Gammaridean Amphipoda of Australia, Part III: The Phoxocephalidae

J. LAURENS BARNARD

and

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J. Laurens Barnard and Margaret M. Drummond



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ABSTRACT

Barnard, J. Laurens, and Margaret M. Drummond. Gammaridean Amphipoda of Australia, Part III: The Phoxocephalidae. Smithsonian Contributions to Zoology, number 245, 551 pages, 269 figures, 1978.—Phoxocephalidae are found to be the most diverse family of benthic marine amphipods in southern Australia. This study reports on 88 species in 26 genera. Most of the taxa are described as new. The Phoxocephalidae of the world are reorganized by the describtion of 8 new subfamilies and the removal of all but 2 species from Paraphoxus either to new genera or by indication that new genera must be described. Some taxa of Australian phoxocephalids are shown to be the most primitive known to exist, especially Pontharpinia and a new subfamily Tipimeginae. Lines of evolutionary deployment radiate outward from Australia to South America and then northward into the northern hemisphere. The expected close relationship to urothoids and pontoporeids is briefly discussed; in addition, an affinity to Ponto-Caspian gammaroids is also explored. Extraordinarily dense populations of phoxocephalids are found in embayments of Australia, especially Western Port and Port Phillip Bay.

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Gammaridean Amphipoda of Australia, Part III: The Phoxocephalidae

J. Laurens Barnard and Margaret M. Drummond

Introduction

The Phoxocephalidae in Austrialian marine shallows constitute the largest familial element of Amphipoda discovered so far on that continent. Most of the taxa are newly described. This study reports on 88 species in 26 genera, comprising about 40 percent of the known taxa worldwide. Both Australia and the world in general remain poorly explored for this group.

Australia appears to have the most primitive known assemblage of phoxocephalids as represented by: the endemic Pontharpiniinae; its satellite the Tipimeginae, composed of several genera from both Australia and New Zealand; the Brolginae, composed of five genera with more advanced members being found in South America and the northern hemisphere; and the Birubiinae and Parharpiniinae, with lines of dispersal towards the American continents.

Almost all of the phoxocephalid characters or generic attributes have been found, at least in rudimentary form, in the Australian fauna. The only other major center of distinctive attributes in the The Phoxocephalidae appear to have their closest morphological counterparts not only in the pontoporeid-urothoid-haustoriid family groups but also in the primitive pontogammarid groups of the Ponto-Caspian basin. The latter relationship, however, is strongly disjunct both morphologically and geographically in the present time. There may have been a closer relationship geographically in times of Pangaea.

The immense diversity of amphipodan species in the bays of Victoria, especially that of Western Port (= Westernport), deserves special mention in the context of this study.

Acknowledgments.—In Australia our study has been helped in many ways by a number of individuals and organizations. In particular, we acknowledge the debt to Mr. A. Dunbavin Butcher, Deputy Director of Conservation in Victoria, who, as Director of Fisheries and Wildlife, was in large part

family is found in the subantarctic islands or the cold-temperate part of South America where the *Proharpinia-Pseudharpinia-Heterophoxus* (Harpininae) center of distribution is located. Phoxocephalids in other parts of the world, though known only sketchily, appear to be advancements from or descendents out of these two centers, Australia and Subantarctica. Although these two foci may have been primary centers of evolution in the group, they might simply be relict areas in which certain primitive taxa have been preserved.

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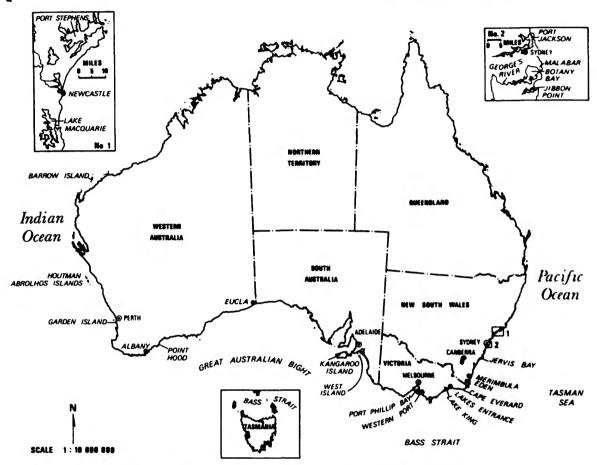


FIGURE 1.-Map of Australia showing major collecting localities.

responsible for initiating the vital surveys in Western Port and Port Phillip Bay. We have appreciated his continued interest in our study. The Ministry of Conservation of Victoria has listed this present monograph as Publication Number 6 of their Environmental Studies Series.

These surveys were supported by subventions from the Government of Victoria and from industry. The Crib Point Benthic Survey, confined to a small area around the newly-constructed refinery and productive of an enormous amphipod collection, was financed entirely by British Petroleum Australia Ltd. Four firms, British Petroleum Australia Ltd., The Broken Hill Proprietary Co. Ltd., Esso Australia, Ltd., and John Lysaght (Australia) Ltd. (all now represented at Western Port) spon-

sored, jointly with the Victorian Government, the more extensive Western Port survey of 1973-74. The Port Phillip Environmental Study was a joint project of the Melbourne and Metropolitan Board of Works and of the Victoria Department of Fisheries and Wildlife.

Within the Division of Fisheries and Wildlife, appreciation is due: Dr. Alistair J. Gilmour, Assistant Director of Marine Pollution Studies, who has given us much practical help and advice; Dr. Gary C. B. Poore of the Marine Pollution Studies Group, who placed at our disposal Phoxocephalidae from the Port Phillip Bay Environmental Study and supplied all station data for that large collection; Mrs. Danuta Karpow, who, in addition to assisting ably in the laboratory, has collated the

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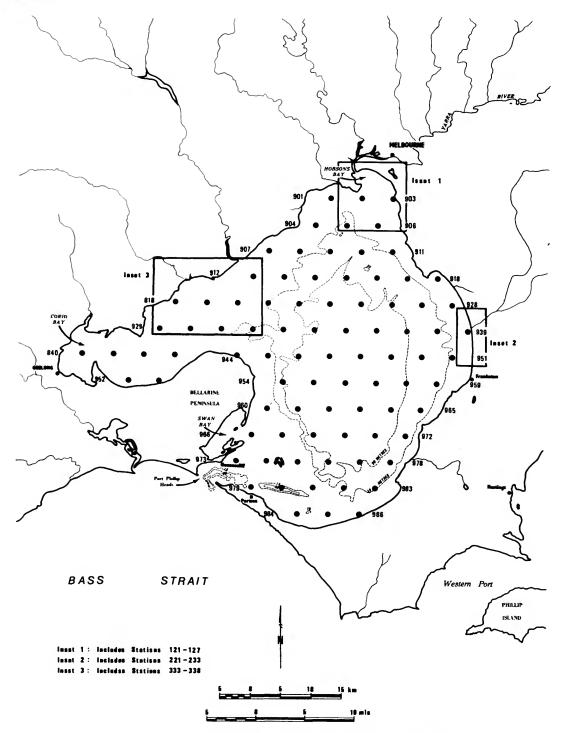


FIGURE 2.—Map of Port Phillip Bay, Victoria, showing collecting localities.

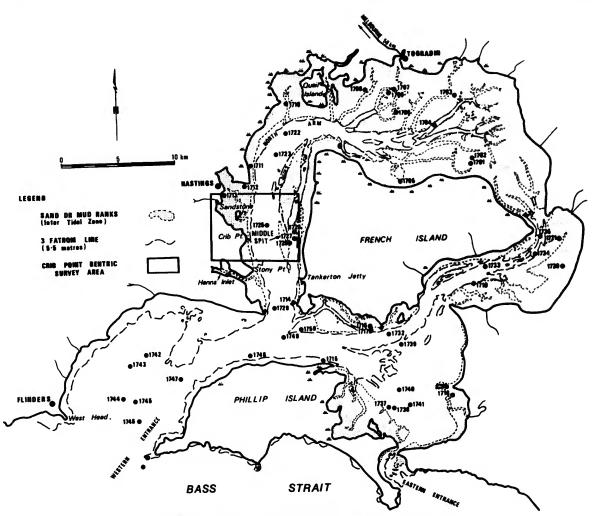


FIGURE 3.—Map of Western Port, Victoria, showing collecting localities.

species list; and the skippers and technical crews of the Division's Research vessels, whose care in the taking and initial treatment of samples resulted in the assembling of a first rate collection for us to study.

We wish to thank Mr. John McNally, Director of the National Museum of Victoria, Dr. D.J.G. Griffin of the Australian Museum, Dr. R. W. George of the Western Australia Museum, and Dr. David C. Lee of the South Australian Museum for providing facilities for examining their collections, and for loan of material; Dr. L. Collett of the New South Wales State Fisheries for loan of material; and Dr. D.J.G. Griffin, Dr. Roger Lincoln, British Museum (Natural History), Dr. Torben Wolff, Universitetets Zoologiske Museum, Copenhagen, and Dr. Charles Pettit of the Manchester University Museum, United Kingdom, for help in the search for material. We are also indebted to Dr. A. A. Fincham, British Museum (Natural History), for an advance copy of his study (1977) on Waitangi.

We are grateful to Miss Helen Fisher of The Australian Museum and Miss Cathy Drummond of the Fisheries Branch of the Department of Lands NUMBER 245

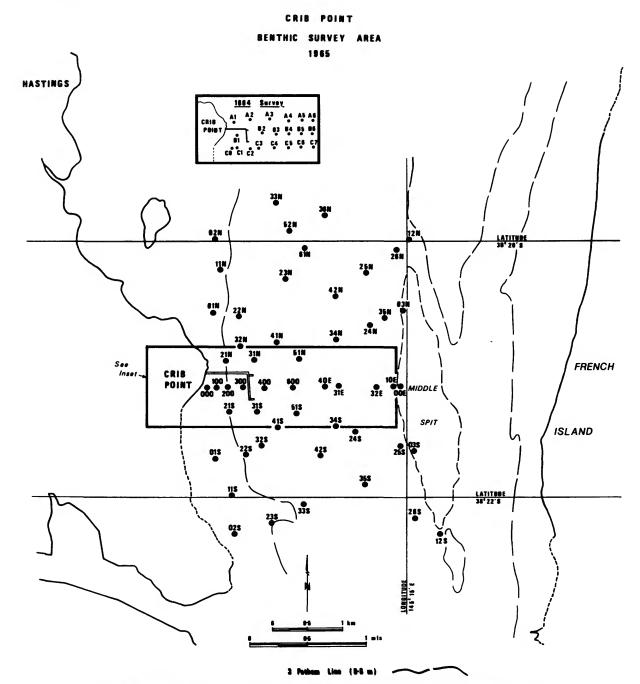


FIGURE 4.—Map of Western Port, Victoria, showing Crib Point Benthic Survey collecting localities.

and Forests, New South Wales, for the opportunity to examine phoxocephalid collections and relevant data from, respectively, the Shelf Benthic Survey and the New South Wales State Fisheries Estuarine Benthic Survey.

The Australian maps were prepared by the Central Draughting Section of the Ministry for Conservation in Victoria, under the direction of Mr. D. J. Lloyd. The Draughting Section of the Melbourne and Metropolitan Board of Works kindly loaned, for copying, the original map of Benthic Sampling Stations in the Port Phillip Bay Environmental Study.

The Smithsonian Institution fund for support of the study of taxomony in Indian Ocean biota financed the work of Wilma A. Findley, Carolyn I.. Cox, and Biruta Akerbergs, who inked our drawings and readied them for publication. Charline M. Barnard and Anne B. Cohen prepared the bibliography and collated the manuscript. We thank Dr. E. L. Bousfield, National Museum of Canada, for offering valuable suggestions and support during the five years consumed in this study. On behalf of the Smithsonian Institution the senior author gratefully acknowledges the generous gift of duplicate specimens tendered by the various sources. Our editor, Barbara T. Spann, contributed many improvements to our work.

Organization of the Study.—Because a large percentage of the world taxa in Phoxocephalidae are newly described in this treatise, the opportunity is taken to present a revision of the family by creating new keys and diagnoses for all genera and by discussing the important elements of morphological diversification and the major evolutionary events that have occurred. This synthesis replaces and revises the phoxocephalid compilation given by J. L. Barnard (1960). Because few studies on elements of the Phoxocephalidae have appeared since 1960, the replication of keys to species in several non-Australian genera such as Harpinia, Harpiniopsis, and Heterophoxus is unnecessary. Keys and diagnoses of all genera, lists of all known species in heavily revised genera, and updated lists in unmodified genera are given, however, so that a broad perspective to generic level can be presented.

The main contributions to phoxocephalid taxonomy since 1960 include the description of *Limnoporeia* by Fearn-Wannan (1968), *Coxophoxus* by J. L. Barnard (1966a), *Metaphoxoides* by Ledoyer

(1968), a new species of *Metaphoxus* by J. L. Barnard (1967) (here relegated to a new genus), a new species of *Paraphoxus* by J. L. Barnard (1972b) (here relegated to a new genus), new species of *Metaphoxus* by Ledoyer (1973) (here relegated to new genera), other new species described by J. L. Barnard (1962, 1964a, 1972), a review of Mediterranean phoxocephalids by Karaman (1973) and a review of western Atlantic species by Bousfield (1973).

MATERIALS.—The bulk of our material comes from three Victorian surveys, conducted in Western Port and Port Phillip Bay between 1964 and 1974 by the Department of Fisheries and Wildlife (since 1973 a Division of the Ministry for Conservation in Victoria). These are: the Crib Point Survey (CPBS), carried out in Western Port in 1965, preceded by a small preliminary survey in 1964 and followed up with seasonal samplings at five selected stations until 1970; the Port Phillip Bay Environmental Study (PPBES), 1968–72; and the Westernport Bay Environmental Study (WPBES), 1973–74.

In addition to this material we also had at our disposal, through the good offices of The Australian Museum and the New South Wales State Fisheries respectively, phoxocephalid collections from two surveys recently undertaken in New South Wales: Shelf Benthic Survey (SBS), in waters off Sydney; and New South Wales State Fisheries Estuarine Benthic Survey (EBS) in the Georges River, Jervis Bay, Botany Bay, and Lake Macquarie.

We have gleaned all available material from the Australian Museum, Sydney; the Western Australian Museum, Perth; the South Australian Museum, Adelaide; and the National Museum of Victoria, Melbourne.

Ralph H. Miller (RHM), of the University of Melbourne, loaned us a large private collection of plankton samples taken over the period 1967–70 in the Crib Point area of Western Port. Some of our personal collections from the Western Australian intertidal (JLB AUS), and from New South Wales (MMD), also have contained phoxocephalids included in this report.

Through examination of the more than 5300 phoxocephalids in warm-temperate Australia provided from these sources, we have identified a large number of species, but this is probably a very small proportion of those still to be discovered in Australian waters. When one considers that 90 percent

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of our material has come from sampling programs confined mainly to a few protected embayments, and that from the one third million square miles of open-sea coastal shelf around Australia we have seen fewer than two score samples, it may be anticipated that, as different areas are explored, substantial additions will be made to the phoxocephalid taxa.

A condensed list of samples comprises the Appendix; station localities in Western Port and Port Phillip Bay are presented in Figures 2, 3, and 4; and other localities from which material has come are shown in Figure 1. The position of West Island, near Kangaroo Island, is shown to correct the erroneous arrow in J. L. Barnard (1972a:3, fig. 1).

METHODS.—In the quantitative surveys of Western Port (WPBES) and Port Phillip Bay (PPBES) most of the bottom samples were collected with a 0.1 m² Smith-McIntyre benthic grab, operated from one of the Division's research vessels. Intertidal flats had to be sampled at high tide from a flat-bottomed barge. Additional dredgings were carried out at some of the Western Port stations for qualitative appraisal.

Immediate gross sorting of each sample was effected on board the vessels by washing the contents of the grab through a graded series of sieves (the minimum mesh aperture being 1.0 mm), and preserving the residues in a 5 percent neutral solution of formaldehyde in seawater for storage. Subsequent separation of organisms from sediment and the final sorting of organisms into higher taxa was done in the laboratory, by hand, with the aid of magnifying lamp and stereomicroscope. Sorted material was stored in 70 percent ethyl alcohol.

Samples collected in Port Phillip Bay (Figure 2) were obtained on intersections of a simple grid system (PPBES). The 52 stations of the Western Port Survey of 1965 (CPBS) were disposed along a number of radii centering on Crib Point, and concentrated within an area of 915 hectares (Figure 4). The WPBES (1973–74) samples were obtained from stations more widely spread, and randomly selected from within three habitats: intertidal flats, shallow sublittoral areas to a depth of 5.5 m, and deeper sublittoral areas (Figure 3). Each sample was obtained from a station at which numerous environmental conditions were also recorded, but these data and the ecology of the phoxocephalids will be reported in other media.

Mechanics of Presentation

The format of this study is designed to include an overview of world Phoxocephalidae to generic level. A phyletic system is proposed (page 37) and the text is presented in the order of that system (with the exception of the genera Rikkarus, Japara, Kondoleus, and Limnoporeia, which, for ease of discussion are presented in a different order). Non-Australian taxa are intermingled with Australian taxa to facilitate discussion of the interrelationships of higher taxa. Within diverse genera the Australian (and New Zealand) species are presented first in phyletic order, followed by an alphabetical arrangement of exotic species. Presentation of the latter is limited to their synonymy and distribution. At the present time the knowledge of minute morphology of the exotic species necessary to incorporate them into a world phyletic system is unavailable.

By arranging the species of large genera such as Birubius (37 species) into clustered phyletic systems, the discussion of interrelationships has been condensed. In each cluster one species is selected as the model to which the following species are compared (Figure 82). Later clusters are compared to antecedent clusters by groups. Convergence and replication of evolutionary trends occur in numerous clusters otherwise remotely related to each other. This occurrence is so common that we have appended an exposition of unusual replications in Birubius as an example ("Aids to Identification in Birubius"). This follows the system designed for Paradexamine by J. L. Barnard (1972b) and might aid future students of evolution in this group to detect possible pathways of descent by early recognition of convergences.

All world genera are rediagnosed and described so as to match the new diversity of detail necessary to the elaboration of Australian taxa. Generic diagnoses and descriptions are produced according to a model suitable to the Australian group. The programming lists a set range of alternatives for each character. If data relative to this character are not available, the alternatives are listed in brackets. Keys to all subfamilial groups, genera, and their species are newly constructed, but new keys are not provided for groups not studied since 1960.

Several new genera comprising species groups heretofore assigned to *Paraphoxus* will be*described

in a later paper.

Each species presentation begins with "Description," based on females where possible, a condensed description of the male and juvenile when known, and usually paragraphs with the headings "Observations" (concerning characters not included in the description and minor anomalies exhibited by the specimens described) and "Variations" (noting, in most cases, normal deviations evidenced by any of the specimens associated with the taxon). Often a section under the heading "Illustrations" is included to explain anomalies, omissions, and comparisons pertaining to the figures. Designations under the headings "Holotype," "Type-Locality," and "Voucher Material" follow. Paragraphs under "Relationship," (and occasionally "Remarks," having reference to problems not concerned with relationship) and condensed terminal sections under "Material" and "Distribution" complete the presentation. Further explanation of this format is contained under "Presentation of Species Data."

TERMS.—To save space and cut printing costs, various grammatical and syntactical devices have been used. For example, we have often used substitute terms such as "long" for "elongate," and terms with "ad" endings such as "laterad" or "ventrad," refering to the flow or direction of a character, e.g., setae "extending ventrad," meaning setae extending in a ventral direction.

The term "ordinary" is used frequently to condense what would otherwise be laborious and often replicated descriptions of certain characteristics better visualized than described. Whenever the term is used the reader is advised to turn to illustrations to see the average condition implied and to cross check diagnoses of other genera to see alternatives. For example, the alternatives to "article 2 of antenna 1 ordinary" are: "especially shortened" and "especially elongate." The only alternative to "pereopod 5 ordinary" is "pereopod 5 especially small," and the only alternative to "pereopod 5 article 3 ordinary" is "article 3 greatly enlarged." The alternative to "dactyl normal" is "dactyl vestigial." The terms "normal" and "ordinary" are used in the context of our present knowledge of phoxocephalids; they may require modification after future discoveries.

The word "medium" is used to denote a condition halfway between extremes; thus a medium spine is neither "elongate" nor "shortened." The

terms are employed only where alternatives are distinctive and mostly self-explanatory. The phrase "continuously spinose" is applied to rami of uropods 1-2 to denote the presence of spines more or less evenly distributed on the apical third of each ramus.

The term "Mark" (M.) followed by a number 0–100 refers to a point on an appendage, article, or ramus, the distance from which point to the base of the structure is expressed as the percentage of the total length of that structure. For example, a spine at Mark 70 (or M. 70) on the outer ramus of uropod 3 lies 0.70 (or 70 percent) of the distance from base to apex of the stated ramus.

TEXT ABBREVIATIONS

AM	The Australian Museum, Sydney
CPBS	Crib Point Benthic Survey, Western Port
EBS	New South Wales State Fisheries Estuarine Ben- thic Survey
JLB AUS	collected by J. L. Barnard
M.	Mark, see definition herein on page 8.
MMD	collected by Margaret M. Drummond
NMV	National Museum of Victoria, Melbourne
NSW	New South Wales
PPBES	Port Phillip Bay Environmental Study
RHM	samples from the plankton collection of Ralph H. Miller, University of Melbourne
SAM	South Australian Museum, Adelaide
SBS	Australian Museum Shelf Benthic Survey
T	iotal
WAM	Western Australian Museum, Perth
WPBES	Westernport Bay Environmental Study

FIGURE ABBREVIATIONS

(used in specimen drawings)

A	antenna	S	maxilliped
В	prebuccal from lateral	T	telson
C	head	\boldsymbol{U}	upper lip from anterior
D	dactyl of pereopod	V	palp
E	coxa	W	pleon (pleonites 1-3
F	accessory flagellum		bearing epimera;
G	gnathopod		pleonites 4-6, also
H	peduncle		referred to as
I	inner plate or ramus		urosomites 1-3,
J	right lacinia mobilis		comprising urosome;
K	spine, seta, or denticle		often shown with
\boldsymbol{L}	lower lip		attached structures:
M	mandible		telson and uropods
N	molar		1-3)
0	outer plate or ramus	X	maxilla
P	pereopod	Y	see legend under
Q	cuticle		illustration
R	uropod	Z	calceolus

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Lower case letters on the left side of labels denote specimens cited in the legends and voucher material in the text; lower case letters on the right side of labels (or affixed to the drawings as is often the case with "e" and "s") indicate the following:

a	alternative view	n	obliq ue
с	eyes omitted	o	opposite
d	dorsal	þ	in situ
e	broken	r	reduced
f	flat	5	setae removed
h	half	t	right
i	medial	u	part
j	uncularged	v	ventral
l	lateral	y	enlarged
m	abnormal	•	•

For other lower case letters see definition in legend. Where space does not allow a horizontal alinement of the label, the resulting vertical arrangement has the same order of elements top to bottom as found in the horizontal from left to right.

Counts and Measurements (Figure 5).—Body length of amphipods in this study is computed from a lateral parabolic line drawn from the apex of the rostrum through the middle of the head, along the dorsal gut margin to the posterior limit of pleonite 6 at its posteroventral corner. Measurements are made generally in tenths of millimeters, but in species where numerous specimens of very similar sizes are compared, the level is extended to hundredths of millimeters.

Length of head is measured from apex of rostrum through the midaxis to a posterior point precisely tangential to the posterior limit of the dorsoposterior corner of the head as seen in lateral aspect. This length is quoted herein as a percentage of the total body length and includes that part of the head telescoped into body segment 1. The observation of total body length is not highly satisfactory because of segmental telescoping after death. Body size, length, or other precise measurements are not highly reliable and are not used in amphipod taxonomy as extensively as in other fields of study.

Ocular pigmentation is included in the description of each species as a weak but potentially valuable characteristic. Most of our materials were preserved originally in formaldehyde and then transferred to alcohol and held one or more years before examination. Most of the CPBS specimens were held up to four years in formaldehyde before being transferred to alcohol. The eyes are generally

reddish brown. PPBES and WPBES specimens, on the other hand, were held only a few weeks in formaldehyde before being transferred to alcohol. The eye pigment is dark purplish-black in these specimens. Occasional species retain ocular pigment for many years, others do not. Eyes termed as "stained" are evenly but translucently pigmented. A standard cycle of preservation and examination as described by J. L. Barnard (1970) might reveal good descriptive differences in ocular pigment in the Australian phoxocephalids.

Spine formulas on articles 4 and 5 of antenna 2 concern the facial spines, quoted from distal to proximal. On article 4 in certain species, the first spine group, often restricted to one spine, occurs at the dorsodistal corner and is often attached medially; in other species this spine is absent or is joined laterally by other spines forming the first group. The ventral counts of setae on article 4 do not include the basal plusetules which in most phoxocephalids occur medially but which in our illustrations are heavily inked for clarity rather than being reduced to dots to denote their medial position.

On article 5 the dorsal margin is termed naked if no armaments other than one dorsodistal setule group are present. Facial spines near the dorsal margin are usually easy to distinguish but the apicalmost facial spine is often shifted so close to a pair of ventrodistal spines that the three appear to be in one group. In *Birubius*, if three of those ventrodistal spines are present, one is removed to the facial formula, usually quoted, for example, 1–2–2.

Aesthetascs are usually present on the primary flagellum of antenna 1, though not on all articles. Commonly they are borne on all except proximal articles 1-3 and the terminal article (Birubius mayamayi, Brolgus tattersalli, Parharpinia villosa, etc.). In other species they are confined to the distal articles, or may be absent altogether; and in one species they are present on all articles. The descriptions mainly differentiate between gross abundance or size of aesthetascs, without further elaboration of detail.

In descriptions of calceoli on antenna 2 of males, a condensed flagellar formula, e.g., "28, 2, 3, 5, 7 . . . 27," includes the total number of flagellar articles first, followed by the sequence of segments having attached calceoli, beginning with article 2 and observing the progression 2, 3, 5, 7, up through article

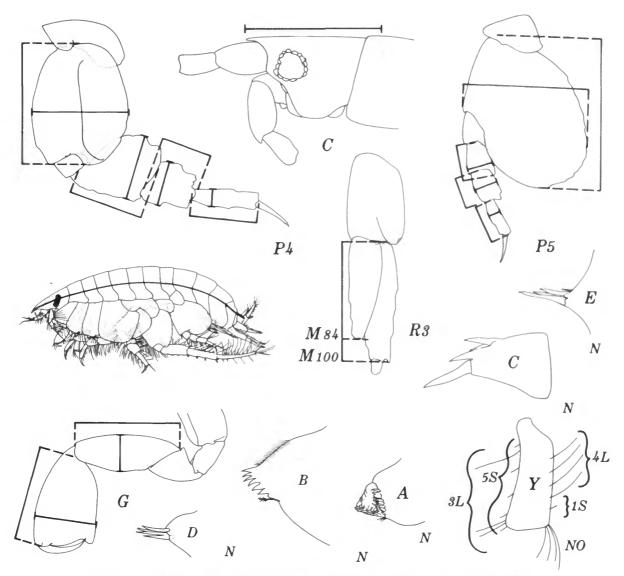


FIGURE 5.—Location of measurements for body and separate parts (see "Figure Abbreviations" for key to symbols not defined in this legend); use of term "Mark" (on R3 the point marking end of article 1 of inner ramus designated M 100; length of outer ramus expressed as a percentage of the line that measures the length of inner ramus article 1; in this case M 84); five kinds of molars (designations A-E correspond to developmental stages described on page 19); setal count on article 2 of gnathopods 1-2 and pereopods 1-2 (Y = article just described, left side of Y = anterior, L = long, S = short, NO = not counted in formulae).

27. When a variation in this formula is added, the first term (total number of articles) and/or the final term (last article bearing a calceolus) are omitted if they are identical to their counterparts in the original statement of the formula. Usually the basal

attachments can be recognized if the calceoli are

On maxilla 2 medial setae on the inner plate obviously belonging to the distal fan are discounted as medial.

An apicoventral seta or setule on the inner plate of the maxilliped is discounted in the descriptions except in the Brolginae where it comes to taxonomic prominence.

Location of measurements for length and width of articles 5-6 of gnathopods 1-2 and articles 2, 4, 5, 6 of percopods 3-5 are shown in Figure 5. Such measurements were taken in mm from the expanded drawings which for this publication were reduced to the 44-15 percent level. These measurements are expressed in species descriptions as unreduced ratios. The basic measurements in mm are taken primarily from the holotype but considerable variation occurs in these dimensions from specimen to specimen; these data are therefore to be used only as gross approximations of conditions typical for the species. Precision in establishing exact ranges and frequencies of these ratios is left to the student of population structure.

Counts of setae on article 2 of gnathopods 1-2 and pereopods 1-2 include on the posterior margin all setae except those in the clump at the posterodistal corner, but on the anterior margin include all setae at the anterodistal corner and on both of the anterior edges where two such edges are present. Other counts of setae and spines on pereopods 1-2 refer to facial setae on articles 4 and 5, posterior spines on article 6 and the presence or absence of thick posteroproximal spines on article 5. The statement "facial setae on article 4 of pereopods 1-2 = 5and 6" refers to the presence of 5 setae on article 4 of pereopod 1, and 6 setae on article 4 of pereopod 2. If a single number is quoted, each pereopod bears the stated number. Counts of spines on article 6 refer to the lateral row first and the medial row second. In the example, "posterior spines of article 6 on pereopods 1-2 = 5 + 6 and 5 + 7 plus middistal seta," each pereopod has 5 lateral spines but pereopod 1 has 6 medial and pereopod 2 has 7 medial spines. The middistal seta is set between the rows and occurs on both sets of pereopods.

Facial ridge formulas on article 2 of pereopods 3-5 occasionally have the letter "s" included to denote a shortened ridge, for example, the formulas might read 1 + 1, 1 + 0, and 1s + 0 for pereopods 3, 4, 5.

Counts of posterior setae on epimera disregard the dorsalmost setule or seta, if disjunct; in such case that setule is described in a subsequent phrase.

The length of article 2 on the outer ramus of

uropod 3, is cited in the descriptions as a decimal, being the calculation of the length of article 2 as a fraction of the length of article 1.

Nomenclature.—Except where noted, all new names derive from the aboriginal languages of Australia. All new generic names, regardless of ending, are masculine in gender. Those Australian species names not agreeing in ending with their genera are nouns in apposition. Names are derived from appropriate adjectives or legendary descriptives of gods, star clusters, biological analogues, or natural phenomena.

PRESENTATION OF SPECIES DATA.—The description of a species generally follows a standardized form established for this study, although occasional deviations occur in order to accommodate unusual morphological conditions.

"Description of Female" (or "Male" if the female is unknown, poorly known, or included in our collections in subadult condition only) is based on the holotype and other adults, usually restricted to 10 or fewer individuals. Such specimens, supplementary to the holotype, are listed under "Voucher Material." As nearly as possible, descriptions of species within any genus consider the same set of characters and use the same terminology and order to facilitate congruency. From genus to genus, however, slight to great differences do occur in species descriptions owing to different taxonomic states.

A female has been selected as holotype wherever possible. Females of Phoxocephalidae provide a better taxonomic standard than males because males have not been uniformly collected and because males undergo numerous transformations of characters in adulthood. Small juveniles of several species, except those from the 1965 (February-April) survey, are largely uncollected. The smallest of these are lost through 1 mm sieves. Most nonadult material in many species is composed of large juveniles or specimens called "subadults," within one or two instars of reaching sexual maturity. These subadults take the form of females.

Little attention has been accorded to variation in spine and setae counts on gnathopods, pereopods, and most mouthparts, but antennae, epimera, uropods, and telson of all voucher specimens have been examined for spine and setae counts or other gross variables. Details of minor characters are confined to statements about either the holotype or a similar adult. For example, setation count on article 2 of

the first four legs is usually restricted to observations made on one specimen. Such constraint to a narrow typological limit is not intended to be definitive, but should be sufficient to give some indication of interspecific distinctions that may, in the future, be worth statistical study.

In addition to noting minor variations within the voucher material, the section "Observations" contains miscellaneous information and notes on special or uncommon features not included in the description, any of which may be of potential concern to the validity of the taxonomic appraisals. Unless otherwise specified, comments in this section refer to the species as a whole, not just to individual specimens.

Unusual deviations found in voucher and non-voucher materials are discussed under "Variations."

Where females are used as the basis of a specific description, the attendant "Description of Male" is variable in form and content. Males undergo several instars of transformation from the femalelike morphology of the subadult to the terminal male stage. Male distinctions are therefore more or less strong depending on the degree of this transformation. Fully terminal males of several species have not been found. Details of transformation are reserved for a more intensive project studying life histories of amphipods.

In previous studies such as that of J. L. Barnard (1960) in the eastern Pacific Ocean, males were rarely found in bottom grabs but frequently were caught in neritic tows or near night lights strung from ships in shallow water. In contrast, males have been caught abundantly in the bottom grabs from southern Australia. However, a few neritic tows have produced males of certain species not found in benthic samples.

A "Standard Description of Male Phoxocephalids," applicable especially to Birubius, the dominant Australian genus, is presented on page 26. The details of this standard description are omitted from the specific descriptions of males unless warranted by deviations from the pattern. Occasional setal counts on various appendages are cited to demonstrate similarities to or distinctions from the female, especially in cases where good male material is available. Because the description of the male is included for the purpose of providing a contrast with the female and because significant distinction between the sexes may vary from species

to species, male attributes lacking distinction from the females are omitted and the format is adjusted to accomodate specific needs.

Where necessary, a section under the heading "Illustrations" is included to explain anomalies in the graphic presentation. If an illustration of any particular part is omitted, reference may be made to a comparable illustration for another species; or, if such illustration is inadequate to portray special variations or peculiarities, these are described under "Observations" or "Variations." Sample localities for illustrated specimens have not been listed in the figure legends since this information may be derived by correlating the locality designations found under "Type-Locality" and "Voucher Material" with the data included in the "Appendix," supplemented by Figures 2-4. Details of "Illustration Technique" are presented below.

Under "Voucher Material" will be found a list of the specimens, in addition to the holotype, used for illustration and for confirmatory observations, e.g., occasionally an array of variously sized adults is used to check variation in spine and setae counts. These specimens, designated in illustrations by lower case letter, usually have been dissected completely. The parts are preserved in small vials and deposited in the National Museum of Victoria or in the museum from which they were borrowed.

Affinities of the species are discussed in "Relationship." The discussions are far from exhaustive. The strongest information concerning one or a few closely similar species is presented but replications from species to species are omitted. In the most complicated section (the 37 species of Birubius), keys, discussions, and an evolutionary chart assist in the comparisons; the members of that genus are arranged loosely in a phyletic order. Many aspects of growth are poorly understood and in each comparison between species the differences have been limited to those of highest possible qualitative value. To the reader is left the task of comparing illustrations and descriptions to find distinctions that have been ignored for reasons of possible variability but which in the future may be useful to the student of populations and thereby ultimately to the alpha taxonomist.

The section under "Material" contains a synopsis of identified material using the abbreviations defined above under "Text Abbreviations."

ILLUSTRATION TECHNIQUE.—The following ma-

nipulations have been undertaken to present reasonably consistent views of morphology. Generally, unless otherwise specified in the following paragraphs or in the labels appearing on drawings, illustrations herein present a left lateral view.

Head: The lateral aspect is composed with the eyes and rostral edges in line side to side. Generally, the anteroventral part of the head is in full view with the basal article of antenna 2 shown flush to the side. The dorsal view is presented with the rostrum fully extended and flush dorsally. Setae and spines are omitted from antennae attached to the head. Antenna 1 is viewed with the so-called ventral margin projecting laterally. Antenna 2 normally extends outward towards the observer but it is bent downward in the cephalic view to show the full width of the articular faces.

Antennae: Antenna 1 is so attached to the head that the margin termed "ventral" projects more or less laterally, the dorsal margin turned medially. In the view of the excised antenna the appendage is rolled into a position so that the broadest lateral faces of articles 1-3 are shown to the viewer. On the excised antenna 2 the same manipulation is performed but without crushing articles 1-2 before they are illustrated. Occasionally articles 1-2 are omitted from the illustrations. Later pressing of the cover slip presents the full face of articles 4-5.

Prebuccal Complex: The upper lip and epistome are the most unsatisfactory parts for illustration. Fully facial anterior views are obtained without distortion by frontally orienting the head with attached prebuccal complex; but the complex is soft and distortable and the ventral margin of the upper lip changes appearance with the slightest change in orientation. A frontal view may show a slight ventral concavity, an oblique dorsal view may show a strong concavity, whereas various other oblique views show truncation or convexity and may bring into focus a small midhump. Certain species lack humps and bear concavities in any view so that we have abandoned reliance on prebuccal anterior views for important specific distinctions. Although no Australian taxa, except Booranus, have the produced epistomal cusp so common to species in the eastern Pacific Ocean, the prebuccal complex is illustrated for holotypes of most species to show subtle differences in conformation.

Mandible: The palpar hump is described as absent, small, medium, or large in many species

without specifying its precise dimensions. Such measurements can be learned by examining the variations depicted in several species. The degree of bulbosity in mandibular molars may vary according to preservational techniques; thus extensive shadow illustration of this feature is deemphasized. Mandibular spines are shown in the illustrations as pressed flat in unnatural orientation; this flattening may cause the spines to fall in a variety of planes, thus resulting in their orientation being different from drawing to drawing.

Lower Lip: This is another appendage that is difficult to illustrate because it often preserves poorly, is difficult to orient, and requires the most tedious of manipulations. The lower lip is difficult to excise in phoxocephalids without breaking connections closely appressed to the first maxillae and mandibles. The bundle of parts containing the lower lip and the pair of first maxillae is excised and mounted on a slide with the coverslip initially elevated by sand grains and then lowered so as to flatten the mandibular lobes of the lower lip without crushing other parts. The oral view of the lower lip is outlined first, deep focusing is employed to obtain aboral structures, then the maxillae are teased away from the base of the lower lip, the latter turned over, and additional configuration at the base of the inner lobes is added to the illustration. the entire view being converted to an aboral aspect.

Maxilla 1: The appendage is first flattened sufficiently to give a view of the flattest face of the inner plate, which is illustrated aborally. Later the coverslip is pressed first to flatten the outer plate and again to press the palp as flat as possible; however, the palp is rarely flattened to its full width and thus is drawn in oblique view to avoid crushing of its base and apex. The inner plate often overlaps the outer plate so greatly that in the illustration the inner plate is moved medially so as to prevent confusion from overlapping lines.

Maxilliped: A coverslip is mounted lightly over the appendage to flatten the inner plate first and, after that is illustrated orally, subsequent pressings of the coverslip are used to flatten the outer plate and then progressively the segments of the palp. Only half of the appendage complex is shown.

Gnathopods (legs 1-2): The medial view of the right members is drawn preferentially but lateral views of left members are illustrated if opposite sides are in poor condition; minor variations in

setation on the lateral and medial sides of these appendages have been ignored. Article 2 of these appendages is not illustrated, although setal counts on anterior and posterior margins are given in the descriptions.

Pereopods 1-2 (legs 3-4): The main taxonomic features are found on the outer or lateral surfaces of these appendages. Article 2 is not illustrated although setal counts are cited in the text. Setal and spine counts of articles 4-6 are compared in the descriptions. Pereopod 2 is usually similar to pereopod 1 though often very slightly stouter.

Pereopods 3-5 (legs 5-7): Although the main taxonomic features are found on the lateral surfaces, the medial apex of article 6 on pereopod 5 merits description because of specific variables in the degree of terminal digitation or in the development of fringe and combs.

Epimera: The carcass of the amphipod is rolled so that the epimera are shown as flush laterally as possible, although epimera 1-2 roll inward slightly along the ventral margin. In identifying phoxocephalids one must scan the epimera under high power microscopy to detect any missing setae by finding the sockets retained in the cuticle.

Uropods and Telson: Uropods 1-2 are illustrated as attached to the animal with supporting views of medial margins in many species where spine sizes and counts on medial margins have comparative value interspecifically. In preserved phoxocephalids uropod 3 is usually thrust anterodorsad against the telson; this is the relationship shown in the lateral view of the pleon and attached structures. Uropod 3 and the telson are better viewed from the dorsal aspect after dissection. In making the drawing of the exised uropod 3 the appendage is rotated so that the widest flattening of the rami occurs consistent with avoiding any crushing of the peduncle. Either right or left uropod 3 may be illustrated. The telson is especially difficult to mount and flatten in phoxocephalids. Direct excision from pleonite 6 is almost impossible because the telson is usually cleft more than 90 percent to the base. Therefore, pleonite 6 is removed to a slide, the tubular pleonite broken ventrally, the sides spread outward fan-wise, and then teased away from the telson, especially at the basolateral corners; unless this is done the telson will not flatten basally.

Cuticle: The elements of the cuticle are so small

that oil-immersion microscopy scarcely resolves their structure. Sufficient items of taxonomic interest have been found nevertheless, to present a brief analysis of cuticle for each species. Perhaps the most favorable locality for viewing is the posterior lobe of coxa 5 (the coxa of pereopod 3, leg 5). This part is superior to epimera which are difficult to flatten without destructive excision and superior to large flat coxae such as coxa 4 because coxa 5 generally has all of the gross variables one might encounter. In many species the epimera lack bulbar setules and in many other species coxae 1-4 lack variants of bulbar setules such as pipes and may also lack striations or have polygonal structures atypically formed. Environmental abrasion is reduced on coxa 5 posteriorly.

Reconstructions have sometimes been necessary because of faulty material; the most frequent of these involves the edges of coxae and second articles of pereopods 3-5 which in death and preservation often shrivel microscopically to the extent that corners have sharp points, or develop notches in specimens that were about to molt before death and in which the cuticle has pulled away slightly from the subcuticular flesh. These extensions and invaginations have been smoothed over in the illustrations. Setae and spines often have been altered to present a clear picture of their relationship; their directions of pointing have been moved, not their origins or insertions. Armaments missing on appendages or epimera have occasionally been reconstructed on the illustration by observation of conditions on opposite side of the specimen. Rare specimens, especially natatory males, in which the dorsal part of the eyes is depressed by preservational defect (dissolution of fatty supportive tissue by alcohol), have been reconstructed in the lateral view so as to inflate or move dorsally the mass of ommatidia into what we believe is a natural position; this defect does not show from the dorsal view because lateral shrinkage evidently does not accompany the dorsal collapse.

Enlargements: As normally practiced in amphipodan taxonomy illustrations are given without scales of enlargements. Terminal adults do not necessarily have a fixed size and may vary with season and environmental conditions. The uniformity of natatory males suggests to us that they may have a fixed size but this would be exceptional in Amphipoda.

Drawings of specific parts are magnified in proportion to other parts as follows: pereopods 3-5 are drawn at the same magnification; gnathopods 1-2 are enlarged to a common but unique degree; pereopods 1-2 are drawn at a common magnification, one which is greater than that for pereopods 3-5, in order to show details of articles 5 and 6: coxae 1-4 are drawn to a scale common to their group but distinct from those of the various appendage groups; maxilla 1 is more highly magnified than is maxilla 2; antenna 2 is usually enlarged to a greater degree than is antenna 1; mandibular bodies are drawn at larger or smaller magnifications than are palps depending on details to be shown; telsons are enlarged more than is uropod 3; head and pleon are drawn at distinct magnifications; when separate from the urosome, uropod 2 is enlarged more than is uropod 1; cuticle is enlarged to the maximum degree with oilimmersion lens (× 1200) and then reduced in the figures herein presented to a level of 45 percent of the magnified image. All other parts are enlarged sufficiently to portray taxonomic details.

Ink Renderings: All structures on the views of cuticle have been inked in solid lines despite the fact that the bulbs and pipes are below the chitin; the chitin, however, is so clear that these structures appear suspended in space as in the ink rendering. The bases of many spines and setae are inked solid even though they are inserted into appendages as shown by their extended bases. Dashed or dotted lines indicate structures lying behind or below the main appendage.

In the figure(s) illustrating each species, the chief specimen depicted is identified first in the figure legend. Any illustrated subsidiary specimens are assigned lower case letters that (1) are identified with the proper specimen in the legend and (2) appear as components on the left side of the labels on the drawings of the part reproduced from such specimens.

Taxonomic Characters of Phoxocephalidae

Phoxocephalidae are among the most richly diverse of amphipod groups in taxonomic characters. Almost all external parts of the body, including head, mouthparts, gnathopods, pereopods uropods, telson, epimera, and coxae, bear characters of both specific and generic value. The only fully stable

conditions in the family are: the relationship between the general form and relative sizes of pereopods 4 and 5; the subchelateness or chelateness of the gnathopods; and the maintenance of the following parts (often lost in other families): inner ramus of uropod 3, strong cleft on the telson, dactyl on the maxilliped, palps on the maxilliped, multiarticulate accessory flagellum, inner lobes and mandibular lobes on the lower lip, and rami on uropods 1-2 (although inner rami occasionally are reduced or fused to the peduncle).

The following characters typical of conceptually primitive phoxocephalids may be obscured by reduction or loss: rostrum, flagellum of antenna 2, thickness of articles and degree of fossorial setation on pereopods, setation or spination of epimera and uropods 1–2, presence of article 2 on outer ramus of uropod 3, size of uropod 3, and elongation of the flagellum on male antenna 2 (sexual character).

Numerous valuable characters in Phoxocephalidae have previously been ignored or underemphasized. Until this study the primary character alternatives in phoxocephalidan taxonomy were: (1) triturativeness or simplicity of mandibular molar; (2) presence or absence of a large palpar hump on the mandible; (3) presence or absence of an ensiform process on article 2 of antenna 2; (4) presence or absence of eyes; (5) bi- or uniarticulation of palp on maxilla 1; (6) presence of a process on article 3 of maxillipedal palp; (7) proportions of the maxillipedal dactyl and its apical nail; (8) enlargement and eusirid (predatorial) adaptation of gnathopod 1; (9) thickness of article 2 on pereopod 3; and (10) presence or absence of apicodorsal spines on various rami of uropods 1-2 (J. L. Barnard, 1960, 1969a).

In earlier days the size of article 4 on pereopod 4 and the similarity or dissimilarity of gnathopods were characters also used in phoxocephalid taxonomy (Stebbing, 1906). Size of article 4 on pereopod 4 as a useful character was deemphasized (J. L. Barnard, 1960) and we have found that this remains true. Such a character alternative signals a potential generic distinction between two species but better characters are available to rectify the generic diagnoses. The dorsal shape of the rostrum has occasionally been used as a generic character (Bousfield, 1973) but our studies indicate that the usefulness is vagarious.

Barnard and Drummond (1976) presented a list of characters newly utilized in the study of Australian phoxocephalids. At least 250 characters in each species have been examined and assessed in the Australian study and many of these are highly useful at specific and generic levels of classification. Many are characters not heretofore widely used even in many other families, for example: fine structure of mandibular molars, setation patterns on mandibular palps, proportions of the setal distribution on article 2 of antenna 1 and article 5 of antenna 2, facial spine and setal distributions on articles 3-4 of antenna 2, presence or absence of cones on the lower lip, setation counts on the inner plate of maxilla 1, degree of cleft between inner lobes of the maxillipeds, linear or nonlinear arrangement of facial setae on article 3 of the maxillipedal palp, presence or absence of posteroproximal setae on article 5 of pereopods 1-2, presence and size of the midapical subdactylar spine on article 6 of percopods 1-2, apical ornamentation of dactyls on percopods 1-2, size and shape of article 3 on percopod 5, presence or absence of facial setae on article 2 of pereopod 5, presence or absence of combs in various places on pereopods and uropods including medial surfaces and rami, presence or absence of long flexible setae on epimera and uropods (at generic level), numbers of and shape of apical setae on article 2 of the outer ramus on uropod 3, presence and degree of development of thick spines on uropods and urosomal surfaces, lengths of rami on uropods 1-2 with special attention to inner ramus of uropod 2, size and position of glandular tissue in urosome, and the presence and number of apical, dorsal, and lateral spines on the telson.

The shape of prebuccal parts was used at specific level by J. L. Barnard (1960); subsequently, generic characters have been discovered in those parts. We continue to find great value in the shape and ornaments of the maxillipedal dactyl, the size of the palpar hump on the mandible, and general aspects of gnathopods, but we have also found classificatory value in the finer structure of gnathopods in terms of anterior setation on article 6, degree of posterior concealment of article 5 on gnathopod 2, and minute difference in size between the pairs of gnathopods. One subfamily, Tipimeginae, is characterized by minuteness of pereopod 5 and within this subfamily, shape and ornamentation of epimeron 3 have generic value.

Convergence in phoxocephalids is rampant. This has led to a very unsatisfactory state of classification

in phoxocephalids of the northern hemisphere (1. L. Barnard, 1960) where convergence has occurred in what are primarily highly advanced phoxocephalids with apparent origins from the more primitive stock in the southern hemisphere. An overview of those from Australia has revealed what appears to be a more satisfactory solution to the interrelationships of world phoxocephalids, a solution that relies on the importance of what were considered, heretofore, to be minor characteristics. For example, generic value is found in anterior setation on the hands of gnathopods, the presence or absence of an enlarged inner peduncular spine on uropod 1, and the presence or absence of supernumerary setation or spination on the telson. Even more importantly, the ancestry of Paraphoxus oculatus, the type species of a genus whose name has been used to enibrace a host of phoxocephalids now seen to be misclassified, now can be traced.

The classificatory difficulty is well illustrated by demonstrating the convergence between Paraphoxus oculatus and a sympatric species, "P." spinosus from the northern hemisphere. No valuable characters to distinguish them generically were found by J. L. Barnard (1960) but study of Australian phoxocephalids demonstrates that Paraphoxus oculatus is the highly evolved product of the Brolginae so abundant in the southern hemisphere, "Paraphoxus" spinosus must be transferred to a new genus which will be distinguished on the following slim characters: presence of more than 3 spines on the molars, presence of 3 (not 2) setae on the inner plate of maxilla 1, presence of 3 setae on epimeron 3, presence of two full rows of spines on article 4 of antenna 2, full enlargement of the apicomedial spine on the peduncle of uropod 1, poor development of the apical nail on the maxillipedal dactyl, and the ordinary elongation of article 5 on gnathopod 2. Restudy of "P." spinosus has not been completed but it would appear to be a very advanced product of the Parharpiniinae on which telsonic and molarial setation has decreased but which is distinguished from the Brolginae in having more than 3 molarial spines and more than 2 setae on the inner plate of maxilla 1.

Other examples of convergence and classificatory difficulties will be reserved for a later paper on reevaluation of northern phoxocephalids.

EVALUATION OF FEMALES.—An evaluation of taxonomic characters in Phoxocephalidae, as based on

the Australian fauna and on a survey of the taxonomic literature, is presented below in morphological order from head to telson. The same order is employed under "Description of Females" found in the presentation of individual species.

Head: The rostrum is elongate, untapered, and flattened dorsally to form a visor in primitive phoxocephalids. Overall, the head is more elongate than in most nonphoxocephalid amphipods but this is not necessarily a condition correlated with fossorial behavior because, on the one hand, nonfossorial amphipods such as ampeliscids have an elongate head and, on the other hand, in many genera of other fossorial amphipods in the Gammaridae (sensu lato), Oedicerotidae, and Synopiidae the head is not necessarily elongate. Despite these exceptions noted, the rostrum may have a fossorial function in many species.

In subfamilies such as Brolginae, Phoxocephalinae, and Harpiniinae the head is maintained in unaltered degree; but in several subfamilies such as Birubiinae and Joubinellinae the rostrum becomes narrowed from side to side, often becomes shortened, and occasionally becomes obsolescent. To some extent the most grossly reduced rostra are associated with other adaptations suggesting commensalistic behavior or functions apart from burrowing (Kondoleus). These adaptations include nonskid cuticle, reduced flagela of antennae, predatorial gnathopods, pygidization (reduction in complexity or increase in rigidification of urosomal structure), development of raptorial spines on pereopods 1-2, or marked change in structure of spines on antennae and uropods. Such modifications may be found in Kotla, Yammacoona, and Japara. But in a single genus, Birubius, the rostrum progresses from the fully developed condition through a series of evolutionary lines to a condition in B. wulgaru in which it scarcely exists.

The rostrum alone is not necessarily a good generic character because of these vargarious evolutionary sequences. The narrowed rostrum was at one time believed to mark the trichophoxin kind of evolutionary stock in the old umbrella Paraphoxus-Pontharpinia-Parharpinia classification but we now recognize that Trichophoxus itself belongs in a group entirely distinct from other phoxocephalids and that the species formerly included in that umbrellar designation belong to several distinctive subfamilies and many genera.

Eyes: Ocular structures are ommatidial in phoxocephalids. Little is known of taxonomic significance in eyes at generic level except that Pseudharpinia is maintained apart from Heterophoxus mainly on the absence of eyes even though J. L. Barnard (1966a) found the normally oculate Heterophoxus oculatus to be blind in depths below 200 m off California. Eyes are degenerate in Phoxocephalus holbolli but present and well developed in many other members of the genus.

Color of ocular pigment in life is poorly known in phoxocephalids although we have seen several species in life with deeply black eyes. In preservative these eyes remain black from distant perspective but usually appear deep purple under high magnification. Most species of the subfamily Phoxocephalinae have almost perfectly clear eyes in preservative, thereby suggesting that they have red pigments in life, as red pigments disappear quickly after preservation. We presume that a modicum of taxonomic information would be available in freshly preserved collections (J. L. Barnard, 1970).

Eyes in oculate males become greatly enlarged. These males often swarm in neritic waters and are attracted to night lights (Fage, 1932, 1933). We know of no anoculate and benthic deep-sea species whose males have been caught in epibenthic fishing and we presume that anoculate males have reduced swarming behavior.

Antenna 1: Article I is elongate and stout and article 3 is much shortened and narrow in phoxocephalids. Article 2 varies in length but usually falls into one of two groups, long or short (see evolutionary scheme of Figure 6). The entire antenna is generally rotated slightly outwards so that the hypothetically primitive lateral surface faces somewhat dorsally; this becomes more pronounced in those species with very broad bodies and heads and small rostra and is similar to the condition in the broad-bodied haustoriids. Penicillate setules are well developed on the ventral margin of article 1 and become very dense in adult males. The dorsodistal apex of article 1 is often slightly produced but has no value in taxonomy in the present scheme because the degree of extension would have to be measured by micrometrical means. The ventral setae on article 2 are of great generic value. They occur in two gross variations, either widely spread in a crescent ventrally or confined apically. In most cases the apical confinement is restricted to genera with shortened article 2. Occasional specific differentiation is made between setae that are widely spread and those confined to the proximal third of the article. In a few taxa the setae are closely continuous or severely reduced in number.

The primary and accessory flagella are multiarticulate. The articles may be elongate or very short but little use has been made of this feature taxonomically (for an exception see Birubius maamus herein). Aesthetascs of several sizes may be found on the distal articles, rarely as far proximally as article 1, and usually restricted to one aesthetasc per article. Occasional aberrations in the flagella of antenna 1 occur. The males of Elpeddo kaikai and Wildus? fuegiensis have unusual first antennae resembling those of lysianassids in which article 1 of the primary flagellum has become swollen and richly furnished with aesthetascs.

Antenna 2: Article 1 is either simple or bears a weak to greatly enlarged process. When the process is present, it and the antenna are termed "ensiform." The largest ensiform processes are confined to a few genera in the subfamily Harpiniinae but these processes are weakly developed in several genera of other subfamilies and in undescribed subfamilies from the eastern Pacific Ocean.

Article 2 is very short, largely hidden from lateral view. It bears a gland cone medioventrally.

Article 3 is relatively stout in phoxocephalids. In primitive phoxocephalids such as *Pontharpinia* and *Tipimegus*, as in the Ponto-Caspian gammarids, it bears abundant facial setae, but these are reduced to 2 in almost all others, and may be absent in several species recorded in the literature. In *Birubius* the 2 setae are small but the more proximal member is usually much the smaller.

Article 4 bears facial spines organized into one or more rows in all phoxocephalids as far as known, except Joubinella. In some of the genera of Birubiinae and Harpiniinae the spines are mainly confined to a subapical position so that they almost appear to be marginal rather than facial. The ventral margin of articles 4–5 is often richly furnished with setae of one or more size groups. In the more primitive taxa, such as Pontharpinia, the long setae are intermingled with a group of short penicillate setules but in more advanced taxa the penicillate setules become reduced to a few proximal members. The apicoventral face may bear one or more thick spines. The antennal spines become jewel-like

spheres in Kondoleus.

Article 5 is generally shorter and thinner than article 4 and in most taxa of such groups as Harpiniinae and Brolginae article 5 is especially small. Both articles 4 and 5 become enlarged in males but in groups in which article 5 is small in the female, the male article 5 does not enlarge as much as in groups such as the Birubiinae, in which article 5 is large in the female. Thick apicofacial spines often occur in females but are reduced to setules in males of many species. Midfacial spines may be present or absent infragenerically in *Birubius* but in such groups as the Tipimeginae the absence of facial spines is marked as a generic character.

The flagellum in females is usually shorter than twice the combined length of articles 4-5 of the peduncle but it becomes elongate and proliferate in all male phoxocephalids except those of the genus *Harpinia*. This may also be true in some taxa of Pontharpiniinae and Tipimeginae but we have not confirmed this at present.

Prebuccal Complex: The presence or absence of sharp, anteriorly projecting tooth on the epistome has been a useful character in specific identification of phoxocephalids (J. L. Barnard, 1960). In the most commonly encountered prebuccal condition the upper lip and epistome are mostly fused together with the weakly distinct upper lip dominating the epistome. In several genera, however, such as Japara, Kondoleus, and Tipimegus, the two parts are fully articulate and one must presume that the variables encountered are relatively uniform at generic level. Tipimegus and Booranus are well distinguished by differences in prebuccal parts.

Mandible: The body of the mandible is large but never as heavily modified as in certain haustoriids. A few genera, such as Mandibulophoxus, and Yammacoona, have that part of the mandible to which the palp is attached strongly extended; this is known as the palpar hump.

Right and left incisors are generally dissimilar. The most commonly encountered right incisor is a flat cutting edge bounded on each end with a blunt tooth and with a third inner and subapical tooth partly hidden by the lacinia mobilis. Occasionally in certain taxa the cutting edge is divided into four or more teeth (Kondoleus, Tipimegus). The left incisor commonly is composed of two weakly divided branches each of which has one or more additional subdivisions, rarely with a more evenly

distributed series of teeth.

The right lacinia mobilis has proved to be invaluable for specific identifications in this study. This structure has been ignored in earlier literature and often depicted so poorly that its character cannot be determined. The evolutionary deployment (Figure 82) of Birubius is based on the progressive simplification of the right lacinia mobilis. The presumed line of development commences with a broad, flabellate, and denticulate piece which becomes clearly divided into two pieces, the distalmost of which remains flabellate, whereas the proximal branch assumes the appearance of a conical raker spine. In the next stage the distal branch is also reduced to a simple conical form, then decreasing in size until, with its loss, the right lacinia mobilis almost fully resembles an ordinary raker spine. There may be instances in which the right lacinia mobilis is actually lost (Birubius eleebanus and B. wulgaru).

An equally logical supposition would be that the right lacinia mobilis becomes more complex by the fusion of one raker spine to a primordial lacinia mobilis so as to form the intermediate condition but the decaying progress found in Birubius fits the advancement of other characters, such as general loss of setation and reduction in rostrum. The right lacinia mobilis of Pontharpinia, the primitive phoxocephalid, appears to be composed of just the distal flabellate piece, so we hypothesize that the ancestral Birubius was characterized by the joining of a raker spine to the lacinia mobilis but that this new adaptation rapidly was reversed through the progression we have outlined in Figure 82. In any event the right lacinia mobilis is highly variable in other phoxocephalids, sometimes appearing to be a simple broad flake and in other places appearing to have a proximal branch that resembles a raker

The left lacinia mobilis is more stable than the right in phoxocephalids. It generally consists of a palmate piece with 4-6 apical teeth, rarely with the teeth blunted or reduced (Kotla), but often in Birubius with the middle teeth shortened.

Raker spines are well developed, numerous, and not generally diverse in phoxocephalids except that a few proximal rakers are sometimes smaller than the others, suggesting that rakers are proliferated basally as growth of the animal proceeds. Between raker spines there are frequently accessory plusetules, alternating with rakers, but these are lost in such aberrant clusters as the *Birubius babaneekus* group where the rakers themselves become very short and broad.

In earlier literature only two kinds of molar were recognized, triturative and non-triturative, but we now find at least five basic kinds of molars in phoxocephalids (Figure 5) and one may see from inspection of our illustrations that further subdivisions may be necessary in the future. Stage one, the primitive molar (Figure 5: A), we presume to be the fully triturative form typical of Pontharpinia and Phoxocephalus and a few other genera. This molar is not precisely like that found in gammaroid amphipods but is a subcylindrical acetabulum-like projection with a weakly hollowed apex surrounded by a crown of teeth. The second stage (Figure 5: B) is represented by Leongathus in which the molar appears as if only one side of the cylinder and its teeth have remained. Stage three (Figure 5: C) appears in the Tipimeginae in which the remaining half of the molar becomes more conical and retains only three or four of the teeth, apparently semiarticulate. This form might be hypothesized to have developed from either stage two or stage four as the apparent articulation of the teeth suggests that they could be enlarged articulate spines. Stage four (Figure 5: D) is found in most phoxocephalids and comprises a small conical or pillow shaped protrusion on the apex of which occur 4 or more splayed and small semiarticulate spines. One may see from the illustrations that this kind might be subdivided into several subgroups based on size, number and plumosity of the spines and the particular shape of the molarial body itself. We see major categories of classification in Birubius alone as "elongate plaques," "short bulbs," "soft cones," and "molar absent but position marked by spines alone." The final stage (Figure 5: E) is typical of Brolginae in which only three or fewer semiarticulate spines remain. These often become enlarged, or become joined basally, and occasionally arise from a distinct basal plate.

We do not suggest that these stages normally occur in the sequence proposed in every evolutionary line. They have been arranged simply in an order of decreasing complexity. Nevertheless we do suggest that the missing links between the fully triturative and the weakly spinose nontriturative molars might be represented by stages two and three and which might well be called "semitriturative" and "pseudotriturative" to reflect their distinctions and possible functions.

The presence of a 3-articulate mandibular palp is a stable feature of Phoxocephalidae. Article 1 is rarely elongate or armed with setae. Article 2 is elongate, usually bears at least 2 setae, and occasionally, bears facial setae in more primitive taxa. Article 3 is well developed, setose facially, usually truncate obliquely, bears stiff apical spine-setae but only in occasional males are setae developed on the inner margin (Tipimegus). In primitive phoxocephalids the outer margin bears a notch armed with one or more setae, but in the more advanced phoxocephalids these setae have shifted onto the face of article 3 or are lost entirely. They may occur in units or pairs (or greater counts) on one or both faces of article 3. The trend appears to be towards total loss in the more advanced taxa.

Lower Lip: Phoxocephalids have well developed mandibular lobes and fleshy inner lobes. The inner lobes are tightly appressed or partially fused together, with the apices almost truncate or weakly bulbous. The widely separated outer lobes have moderately extended mandibular lobes apically rounded or weakly attenuate. In all but primitive phoxocephalids each outer lobe has one or a few salivary cones (extensions of meatal ducts). Thickened setae may also occur in the vicinity of the cones and some of these may prove to be additional cones. Inner and outer plates are often minutely setulose (pubescent) along apical margins.

Maxilla 1: In comparison to primitive gammaroids the inner plate in phoxocephalids becomes enlarged relative to the outer plate but has lost most of its setae. The apex is usually rounded broadly and carries either 4 or 2 setae in the majority of phoxocephalids. The primitive Pontharpinia carries more than 4 shortened setae but Phoxocephalinae have lost all setae on the inner plate and the surface area is expanded. In Birubius the usual setation pattern consists of one large inner facial pluseta, a second often somewhat smaller and more terminal pluseta, and 2 much smaller apicolateral setae. In many Brolginae the 2 apicolateral setae apparently have been lost.

The outer plate bears 5, 7, 9, or 11 spines; in rare cases an even number of spines occurs (*Japara*). The spines are often divided into 2 sets of 5 and 4 or 6 and 5, the smaller set comprising small forked

spines, the larger set comprising large spines, the medialmost of which are serrate medially, the lateralmost of which are very stout and poorly serrate. In many genera one of the large lateral spines, usually spine 2, is especially thickened. In the genus Japara, the innermost spine is diverted to the medial margin and points medially. Many of the Brolginae have an additional medial cusp forming a false spine lying almost flush, and therefore hidden, along the normal medialmost serrate spine. Variations in fineness of serrations, as in Kuritus, have specific usefulness in taxonomy.

The palp of maxilla 1 is either uni- or biarticulate but it is rarely reduced to any degree. A basolateral wing usually occurs on the acclivity of the outer plate below the juncture of the palp. Article 2 is much longer than article 1 and is apically and often facially armed with spines and setae. Facial setae are especially well developed in Tipimeginae. There is little difference between the palps of right and left sides.

Maxilla 2: The pair of plates forming this structure is relatively uniform. Unlike many members of Gammaridae, the inner plate lacks an oblique facial row of setae. In Brolginae and especially in Phoxocephalinae the plates are shortened and apically rounded and the setation is heavily reduced.

Maxilliped: This is well developed, with only an occasional taxon showing some reduction in the size of the plates (Phoxocephalinae, Yammacoona). The apical armament on the inner plate of the primitive phoxocephalid appears to consist of evenly extending elongate setae but in the majority of phoxocephalids one or more (usually not more than 3) short and very stout apical spines have appeared and the setation density has decreased. The trend in the more advanced evolutionary lines such as Brolginae and Phoxocephalinae is towards a decrease in setation and/or narrowing of the inner and outer plates. In several of the Phoxocephalinae the broad and heavily spinose and setose outer plate typical of the primitive phoxocephalid becomes very thin and the armament is reduced to 4 or fewer spines. This is associated with other losses of fossorial adaptation in those taxa. The richly setose palp of the primitive phoxocephalid follows this same pattern of reduced setosity, but the palp with the most abundant and scattered facial setae on article 3 occurs in the Tipimeginae. This article becomes strongly produced apically in the Leptophoxus group but is more weakly produced in a variety of other unrelated taxa. The inner plates of Kondoleus bear remarkable basal salivary spouts.

The primitive dactyl appears to be long, unguiform, and armed with a poorly developed apical nail which in more advanced taxa becomes much more elongate while the article itself may become shorter and stubbier. Supernumerary setules decrease in number in the advanced taxa though exceptions do occur in *Microphoxus* and several of the harpiniins, where accessory apical setules become almost as elongate as the nail.

Coxae: In amphipods the coxae are a specialization of the body form to be discussed apart from their respective legs. Conformation of the coxae in phoxocephalids is very stable and basic compared with the extremes of diversity found in many other families of amphipods. Coxa 1 is generally adzshaped and unreduced in size, coxae 2-3 are elongate rectangles, and coxa 4 forms a broad shield with a posteroclorsal excavation bounded by a posterior tooth.

Only in the rarest cases do these first 4 coxae become heavily modified (Kotla, Kondoleus), though in a few taxa, such as Birubius booleus and Tickalerus birubi, coxa 1 is rectangular and elongate. Coxa 4 is more often variable in size and form, being either large or extremely large (Basuto). The ordinary coxa 4 has distinct anterior, ventral and posterior margins below the posterior tooth but in many cases the posterior and ventral margins merge, so that the resultant posterior margin becomes divergent from the tangent of the anterior margin; and rarely the ventral margin becomes so short that the coxa appears subacuminate (Birubius nammuldus). Anterodorsal humps are especially prominent in the Tipimeginae. The presence or absence of ventral setae on coxa 4 is a very useful taxonomic character in Birubius and in other genera.

Apparently all phoxocephalid coxae 1-4 bear a small anteroventral setule usually surrounded by a clear bulbar halo, though occasionally this halo is reduced or absent as in the *Birubius taldeus* group. Coxa 4 almost always bears a second example of this setule at the posteroventral corner, this occasionally becoming weakly elongate. Only a few genera, such as *Booranus*, have additional ventral setules of extremely small size.

All phoxocephalids have elongate setae on coxae 1-3. These are severely reduced in number in many

of the advanced taxa such as the Phoxocephalinae but the greatest reduction has been found in the Birubius taldeus group where coxae 1-3 each have only 2 long setae. The occurrence of setae on the posterior margin of coxa 4 beyond the hypothetical posteroventral corner occurs mainly in the Tipimeginae and in Pontharpinia, the most primitive taxa of the group.

Coxal gills are generally found on pereonites 2-7 but they are absent or reduced on pereonite 7 in *Tipimegus* and *Limnoporeia*. In *Limnoporeia* they are absent on pereonite 2. Hence the formulas 2-7, 2-6, or 3-6 may prevail. The gill of coxa 7 is usually the smallest. Brood plates occur on pereonites 2-5 in all genera except *Limnoporeia* and *Uldanamia* where the plate of pereonite 2 is absent and the formula is 3-5 only.

Gnathopods: The primitive gnathopodal state in phoxocephalids is presumed to be that reflected in large degree by Pontharpinia, in which gnathopod 2 strongly dominates gnathopod 1. Unlike the condition prevailing in gammaroids, article 5 of gnathopod 2 in primitive phoxocephalids is so short that the posterior margin is hidden from contact with the environment by the abutment of articles 4 and 6. This condition is termed "cryptic article 5." If this is an obligatory characteristic of primitive phoxocephalids and if phoxocephalids indeed are descendants of gammaroids then the majority of phoxocephalids have undergone a reversal in the sense that article 5 becomes more elongate in many of the more advanced lines of phoxocephalids, especially in the Birubiinae and unnamed subfamilies of the eastern Pacific Ocean. A close approximation of the cryptic condition is, however, maintained in the advanced Phoxocephalinae and Harpiniinae although one may see that the most advanced brolgin, Paraphoxus, has lost some of the degree of masking found in several of the more primitive Australian brolgins.

The functional morphology of gnathopods, even in the well studied gammaroids, is very poorly known. Gnathopodal function is clearly for grasping, cleaning other appendages, lowering the top-heavy center of gravity of the body at appropriate times, and manipulating objects by means other than grasping. Such a prehensile member is useful in grasping objects of the inert environment, grasping other biota in a predatorial mode, grasping the opposite sex during copulatory amplexus, and pos-

sibly assisting in the transfer of spermatophores from male to female. Among numerous other more finely characterized functions, shoving capabilities could be envisioned that include defense or moving eggs about in the brood pouch.

We hold to the belief that the first true amphipod had gnathopod 2 fully developed as a grasping device but that the general trend in many evolutionary lines is the reduction in size and prehensility of that appendage with comcomitant loss or readaptation of many of the grasping functions found in the more primitive amphipods. We theorize that the most primitive amphipods had both gnathopods 1-2 of equal size and prehensile capability but that the usefulness of gnathopod I in tandem with gnathopod 2 was quickly lost by natural selection in favor of new functions, particularly that of cleaning anterior appendages and manipulating small environmental particles. This follows the logic of accepted peracaridan theory that the maxillipeds, once fully thoracic, are now mostly cephalic and that the result of such a trend would be that any order of crustacean succeeding amphipods would be one with gnathopod 1 also assuming cephalic functions. The tendency for free thoracic segment 3 now occasionally to develop a prehensile appendage is confirmed in such gammarideans as Endevoura (Lysianassidae), Parandeniexis (Stegocephalidae), and Falklandella (Gammaridae, sensu lato).

There are many examples, of course, where enlargement of gnathopod 1 to a condition dominant over gnathopod 2 has occurred, but we consider these as "derived" evolutionary rather than as examples of primitive conditions in which gnathopod 2 is undergoing an evolutionary enlargement to catch up with gnathopod 1. The aorid examples are obviously instances in which an enlarged gnathopod I has selective advantage to the tube dwellers. The pelagic predatorial examples of Joubinella and Trischizostoma are clearly cases where the predatorial mode is well served by extensible and raptorial first gnathopods. In the cases with which we are most concerned, such as certain species of Gammarus and Anisogammarus in which gnathopod 1 is only subtly larger than gnathopod 2, we suggest that the distinctions in function are also very subtle and that gnathopod 2 is not simply adapting slowly to match gnathopod 1. Most of these gammarid taxa have gnathopods complexly

ornamented and spined to such a degree as to be incomparable to the more simplified and probably more primitive predatorial kind of gnathopod seen in the Baikalian acanthogammarids (Dybowsky, 1874). The selective adaptability of gnathopods would appear to be rapid and extensive in an evolutionary sense as noted by J. L. Barnard (1970), for example, the axial reversal of gnathopods in certain corophiid amphipods.

If one therefore assumes that Joubinella is simply a predatorially adapted case, then one may state that phoxocephalids are well advanced over their probable gammaroid ancestors in respect to gnathopods. Guathopod 1 is fully modified in shape and structure to match the ordinary kind of gnathopod seen in the very advanced gammaridean families and genera such as the non-aorid corophiids, talitroideans, and dexaminids. The enlarged and highly prehensile gnathopod 2 is retained in phoxocephalids in subfamilies otherwise noted for their highly advanced adaptations such as thin-membered pereopod 3 of Harpiniinae and reduced complexity of mouthparts in Phoxocephalinae. Gnathopod 2 of the otherwise ordinary Birubiinae has reached the most advanced or reduced state, where in many taxa it has article 5 elongate and in overall form almost precisely matches gnathopod 1. The severe initial reduction in article 5 of gnathopod 2 has been partially reversed in the advanced Phoxocephalinae and Harpiniinae and fully reversed in the Birubiinae and Tipimeginae. In the latter group and in unnamed subfamilies of the eastern Pacific Ocean a further adaptation has been added to the gnathopods in the form of an apicoanterior brush of setae and spines on the hand. The palms have become shorter and more transverse than in other phoxocephalids. A somewhat similar situation occurs in the limnoporeiin group of Phoxocephalinae where the thin probe-like gnathopods have become strongly chelate.

Pereopods 1-2: These appear to be universally fossorial in the Phoxocephalidae. Article 4 of both pairs is elongate and often greatly broadened. In the best adapted fossorial species it is heavily setose posteriorly but a reduction in setosity does occur, most notably in advanced species of Birubius where pereopod 2 may have as few as 5 posterior setae on article 4

Article 5 occurs in two main forms in Phoxocephalidae. In the Tipimeginae it is elongate and

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bears only terminal posterior setae whereas in most other phoxocephalids article 5 is swollen and bears posterior setae well proximal towards article 4. In most phoxocephalids one or more of the apicoposterior setae on article 5 are heavily thickened as spines and in several species of *Birubius* (especially species 22–28) one or more of the proximal setae are likewise thickened. Article 5 bears apicomedial combs in the Tipimeginae.

Article 6 is elongate and thin but the posterior margin is furnished with two rows, lateral and medial, of spines or setae (or mixtures of both, especially in the Brolginae and Phoxocephalinae). In many advanced taxa, especially those which may live on extremely fine sediments, these spines are reduced in prominence, either by a lesser number or a greater flexibility. Many phoxocephalids also bear an apical seta or spine near the base of the dactyl, situated between the two posterior rows. This seta is severely reduced in such genera as Birubius and occasionally may be absent, whereas in the Tipimeginae it is large and often superenlarged as a thick spine longer than the dactyl.

The primitive dactyl of phoxocephalids is complex in the sense that it bears (1) an apical nail mostly immersed in all taxa, (2) an inner tooth forming a crotch in which is inserted a stiff but sinuous setule, and (3) a medial or outer basal plusetule. In certain taxa of Tipimeginae the medial setule is lost and in the most advanced brolgins the inner tooth is lost but the raphe marking the insertion of the setule is retained.

Pereopods 3-5: All are fossorial and pereopods 4-5 maintain their special relative sizes and shapes throughout the family although numerous modifications occur that have taxonomic value. The primitive phoxocephalid apparently was characterized by extensive fossorial adaptations in breadth and setosity of pereopods 3-5 but advanced taxa have many of these severely reduced. Article 2 of the basic pereopod 3 is broad and of even dimensions axially, but the Harpiniinae are characterized by a very thin article 2 scarcely matching the width of article 3. Article 2 tapers in the Parharpiniinae and Mandibulophoxus. Posterior and, to some extent, facial, setosity is well developed on article 2 of primitive phoxocephalids and is maintained to some extent in the Parharpiniinae but most other groups have lost these features. Article 4 and, more or less, article 5 of pereopods 3-4 is very broad in

primitive groups but in the more advanced Brolginae, Parharpiniinae, Phoxocephalinae, and Harpiniinae the stoutness and spinosity of pereopods 3-4 are greatly diminished. In many cases one might presume this to be an adaptation to fineness of sediments especially in the deep-sea Phoxocephalinae and Harpiniinae. But, as diminution also occurs in the Birubiinae from the shallows of Australia it may have other adaptive significance.

The hatchet shield of article 2 on pereopod 5 is consistent throughout Phoxocephalidae and resembles that seen in pontoporeid amphipods. All shallow water Australian phoxocephalids have a relatively uniform article 2 in terms of the posterior teeth, which are very small, actually the size of serrations, whereas in several northern groups and deep-sea groups some of these teeth become greatly enlarged or fully developed as spikecusps. The ventral margin of article 2 apparently was heavily setose in primitive phoxocephalids (Pontharpinia, Tipimegus) but these setae are lost or reduced to the level of microscopic setules in the majority of phoxocephalids. Weak ventral serrations on the primitive members become greatly enlarged in certain advanced harpiniins (Heterophoxus) but are obliterated in the Phoxocephalinae and are obsolescent in the majority of phoxocephalids only to crop up in several evolutionary lines of Birubius, possibly an indication of diverse origins of the several species groups. Facial setae on article 2 occur rarely, primarily in Pontharpinia and Tipimegus as a mark of their primitiveness. In Pontharpinia the setae occur in bundles as they do in Ponto-Caspian gammaroids, but in Tipimegus they are solitary.

Pereopod 5 of the Tipimeginae is dwarfed, a condition unique to that subfamily. Also, article 3 is greatly enlarged in contrast to all other phoxocephalids except to some extent in the Harpiniinae and perhaps a few other non-Australian taxa. Articles 4-5 are somewhat thin in Tipimeginae but in the other phoxocephalids are more ovate or trapezoidal. Apical combs on articles 5-6 have taxonomic value in several groups (Tipimeginae for example), and many species of *Birubius* have digitate processes apically on article 6. Several males of *Birubius* and males of *Japara* bear enlarged and oddly shaped spines on article 5. The dactyl of pereopod 5 is usually well developed and in *Pontharpinia* has supernumerary marginal setae, but in *Yan* and

Kulgaphoxus the dactyl becomes vestigial.

Epimera: The shapes and armaments of the plates on the sides of pleonites 1-3 are so important to classification in this group of Australian species that we believe almost any adult can be identified to species by reference to epimera and a few other supporting characters. The epimera of primitive phoxocephalids might be envisioned as having marginal setae not only anteriorly, ventrally, and posteriorly but facially as well, if *Tipimegus* and *Pontharpinia* together can be considered to represent the ancestral condition.

Epimera 1-2 of the ordinary phoxocephalid each bears a facial ridge near the ventral margin but only in a few phoxocephalids do facial setae appear dorsal to that ridge line. They are barely dorsal on epimeron 2 of Pontharpinia but fully so in many Tipimeginae. Facial setae are rare on epimeron 3 in species outside of the Australia-New Zealand area where they occur prevalantly in Pontharpiniinae, Tipimeginae. and Birubiinae. In the Birubiinae the evolutionary trend is towards loss of both facial and marginal setae on epimera and this trend is characteristic of all other world Phoxocephalidae even in the Brolginae of Australia, a group characterized by the loss of all long setae on epimeron 3. Posterior marginal setae on epimera 1-2 are lost rapidly in most evolutionary sequences although they occur as far east as North America and may prove useful in tracing the ancestry of the American fauna. The crowding forward of facial setae below the lateral ridge in various species of Birubius is a useful taxonomic character. In Birubius special attention is devoted to the presence, absence, and size of a posterodorsal seta or setule on epimeron 3 in tracing phyletic descent.

Pontharpinia bears a large posteroventral tooth on epimeron 3. This characteristic has been used by us as one of the starting points in delineating the evolution of the species groups in *Birubius*. This tooth is reduced or obliterated in most phoxocephalids though it crops up in various harpiniins and in the *Waitangi* group of the Tipimeginae.

Urosome: Dorsal cuspidation of the body in phoxocephalids is rare and confined to the urosome. Kulgaphoxus and Tickalerus have a sharp dorsal hook on urosomite 3, which occurs also in Metharpinia cornuta Schellenberg. The odd "Paraphoxus" vigitegus J. L. Barnard (1971) bears a dorsal hook on the urosome in a position presumed to be on

urosomite 2. In that species and in many species of *Birubius* urosomites 1-2 are partially to fully fused together, a condition not otherwise common in the family.

Lateral spination on the urosome appears to be of rare occurrence, having been found only in Birubius lorus and Trichophoxus capillatus. Ventral and ventrolateral setal brushes are common in Tipimeginae and a few other taxa and spines or setules are often found on urosomite 1 near the base of uropod 1. Conspicuous urosomial glands are seen in Kondoleus and Kulgaphoxus and in the former genus cause the urosome to bulge dorsally; meatal spouts also occur in Kondoleus.

Uropods 1-2: These are very important in the generic classification of Phoxocephalidae. Basic uropods 1-2 have an elongate peduncle with widely spread dorsal spinosetation on both lateral and medial margins. The rami extend almost equally and are spinose continuously to the apex.

There is a general trend in advanced phoxocephalids to lose most of the medial and lateral spination or the peduncles so that the remnants are confined apically. Spines or setae generally become shorter and thicker. A subapical gap in dorsal spination of the rami on uropods 1-2 appears early in the evolutionary scheme but in almost every subfamily there is found a genus retaining almost continuous dorsal spination on one or more of the rami. Some of the Tipimeginae have 2 rows of dorsal spines on the inner ramus of uropod 1. In Birubius the remnants of continuous spination are marked in a few species by the presence of an accessory apical nail on one or more rami; and in the B. taldeus group this becomes vestigial and is termed an accessory setule. Apical nails are retained in many genera but in the most advanced Phoxocephalinae, for example, the apical nails are resorbed or so deeply immersed that they become almost indiscernible.

The presence of basofacial setae on the peduncle of uropod 1 is primarily a valuable taxonomic feature of *Birubius*. The Tipimeginae are characterized by a ventral spike on the peduncle of uropod 1.

In Pontharpiniinae, Tipimeginae, Brolginae, Parharpiniinae, and occasionally elsewhere, one of the apicomedial spines on the peduncle of uropod 1 becomes greatly enlarged and is shifted onto the apical margin disjunctly from the true inner mar-

gin. We call this a "special enlarged spine." It is one of the main characters distinguishing Parharpiniinae from Birubiinae. It has generic value in the former subfamily because in *Protophoxus* it occurs not medially but laterally.

The peduncle of uropod 1 is shortened in *Tipimegus* and the outer ramus of uropod 1 occasionally is shortened in the Phoxocephalinae. The inner ramus of uropod 2 becomes shortened and ultimately fused to the peduncle in *Kotla*, *Kondoleus*, and *Matong*. The spines on that uropod become very jewel-like in *Kotla*, but jewel-like spines are also seen in several of the undescribed genera in the eastern Pacific fauna.

Combs on the rami of uropods 1-2 are an important specific character in the Tipimeginae. In Brolginae and Phoxocephalinae apical combs on the peduncles of uropods 1-2 are important features but not universally distributed in those subfamilies.

Uropod 3: This is generally of the variramus type (Stock, 1974) in which the inner ramus of the female is shorter than the outer but is not fixed to a specific size ("feminine" form) and in the male the inner ramus elongates to match the outer ramus equally or subequally ("masculine" form). The inner ramus is poorly setose in juveniles and in adult females of many species though in other species it may be strongly setose. In males it becomes heavily setose. The outer ramus usually bears a second article and in the female has sets of lateral spines in acclivities. In the male setae are present in addition to these spines. In primitive phoxocephalids article 2 of the outer ramus is of the elongate form, about 25 to 35 percent as long as article 1. This is generally similar to that of presumed ancestral gammaroids. In advanced phoxocephalids such as Brolginae and Phoxocephalinae, setae and spines of uropod 3 become reduced but article 2 of the outer ramus is maintained in elongate form, whereas in other groups such as Birubiinae the setae are maintained but article 2 of the outer ramus becomes reduced in size. In genera such as Japara and male Matong, the second article is lost and in Kondoleus, Kotla, and Kulgaphoxus both rami of uropod 3 are also reduced to a size approximating the length of the peduncle. Apical setae on the outer ramus are reduced from the normal two to one in Brolgus but are increased to three in the Tipimeginae.

Telson: The general shape, size, and degree of cleavage on the telson remain fairly stable in Phoxocephalidae though in some of the more advanced groups such as Phoxocephalinae the telson becomes elongate. The spination patterns, however, have taxonomic significance at generic level. The ordinary phoxocephalid telson bears very few apical spines and setules and a pair of dorsolateral setules on each side, but the primitive phoxocephalid telson as represented by Pontharpiniinae, Tipimeginae, and Parharpiniinae and unnamed subfamilies of the eastern Pacific, has supernumerary dorsal and lateral spines or setae as are found in many of the presumed taxa of the ancestral gammaroid stock. Pontharpinia bears a large brush of dorsobasal setae on each side of the telson and the Parharpiniinae have extra dorsal setae or spines distinguishing them from the Birubiinae. The ordinary male phoxocephalid often has a single longitudinal row of tiny dorsal denticles on each lobe of the telson but primitive phoxocephalids in the Tipimeginae have these in broad patches. Some taxa have the dorsolateral setules shifted apically (Japara).

Cuticle: The cuticle of ordinary phoxocephalids usually bears bulbar setules with moderately emergent bristles, often plumose, divided, or of ragged form. The actual surface is often faintly striate in the form of human fingerprint patterns (but not whorled); these striations have been examined with SEM and found to be the edges of long rows of overlapping scales. In various species of Birubius, Matong, and Kotla the cuticle becomes more complex by development of plaques around the bulbar setules. Parharpinia villosa has narrow pyramidal irruptions of the cuticle visible at low magnification. The ultimate non-skid cuticle is reached in such genera as Kondoleus where polygons are formed by an increasing density of overlapping scales to such an extent that they can be seen under low power microscopy and can be palpated by human touch.

Well developed non-skid cuticle is associated both with species of clear fossorial mode (*Parharpinia villosa*) and with taxa bearing other morphological advancements suggesting adaptation to an inquilinous mode (*Kondoleus*).

Undoubtedly, electron microscopy will reveal a host of taxonomically significant structures in cuticles of amphipods and we trust that this will become a routine procedure in the near future. In the views of cuticles we have taken, sufficient variation occurs, between the sexes of a species and between individuals of a species, to suggest that problems of age and elapsed time within an instar may be factors to be considered in establishing the precise cuticular configuration. Proliferation of rudimentary bulbar setules may occur at or near sexual maturity, and at, near, or immediately after ecdysis; cuticular striations may be lost owing to edema just before ecdysis; scales may be best developed just prior to ecdysis; and ultimate body size may be positively associated with numbers of bulbar setules.

The ordinary bulbar setule has an emergent plumose blade of length about equal to or slightly greater than the double follicular bulb from which

Standard Description of Male Phoxocephalid (Mainly Birubius)

Body slighter or smaller than in female; eyes greatly enlarged; article 1 of antenna 1 with medial patch of fuzz, ventral margin with additional setules; articles 3-4 of antenna 2 with dorsomedial fuzz, facial setae on article 3 shortened, ventral setae of articles 4-5 shorter and fewer than in female, article 5 and flagellum of antenna 2 elongate, furnished with calceoli; article 3 of mandibular palp with increased number of basofacial setae; setae on gnathopods and pereopods shorter and fewer than in female; article 2 of pereopod 5 and usually of pereopods 3-4 narrower than in female; epimera 1-3 usually broadened, posterior margins of epimera 1-2 protruding, posterior margin of epimeron 3 shortened, setae often fewer; spines of uropods 1-2 smaller than in female, usually more numerous on peduncle of uropod 2, rami of uropod 3 "masculine," inner ramus elongate and setose on both margins, outer ramus with setae in addition to lateral spinosity of female; telson elongate, apical spines shortened, each lobe frequently with dorsal row of denticles; urosome smaller than in female; pleopods enlarged, peduncles powerful, peduncle of pleopod 3 conspicuously shortened.

it grows, but length of the setule varies from species to species and from bulb to bulb on the same specimen. Several species have anomalous setules, branched or extremely short and scarcely emergent.

MALE PHOXOCEPHALIDS.—Terminal male phoxocephalids differ from females in numerous secondary sexual characteristics. In many cases primary taxonomic characters also are modified so that the proper recognition of the two sexes of a species by taxonomists is occasionally obfuscated. Fully terminal males of several species are undescribed because samples of phoxocephalids obtained in bottom grabs often lack associated males of advanced age. Males apparently swim into the nekton of neritic waters, or become epibenthic, or are such powerful swimmers that they can escape grab devices descending towards the bottom. Neritic net hauls at night often contain male phoxocephalids but rarely females.

Subadult males and "juvenile males" are commonly found in the benthos. "Juvenile males" show the first external signs of sexual differentiation in a slight lengthening, due to proliferation of proximal articles, of the flagellum of the second antenna, and a slight increase in the size of the eyes. Apart from this, young males resemble the female, but the subadult males of some species are noticeably heavier bodied and rather larger than adult females of the same species from the same sample. Body conformation also changes greatly in the later instars, resulting, as a rule, in adult males of slighter build than the females. Details of transformation should be reserved for a more intensive project on the life histories of amphipods.

The following morphological changes occur in males, but not all in any one taxon. Among those listed below are some believed to occur so consistently in male phoxocephalids that they have been incorporated into a standard male description (above) and then omitted from the specific descriptions of the males in this study:

- 1. Eyes enlarged, often so much so as to distend the head dorsally and laterally.
- 2. Modification of the rostrum, either thinner or shorter, occasionally more elongate.
- 3. Fuzz or pubescence, often composed clearly of aesthetascs, occurs medially on article 1 of antenna 1 and dorsomedially on articles 3-4 of antenna 2.
- 4. The ventral penicillate setules on article 1 of antenna 1 greatly increase in number.

- 5. Aesthetascs occasionally become enlarged.
- 6. Calceoli develop on the primary flagellum of antenna 1 and on the flagellum of antenna 2 and often dorsally on article 5 of the peduncle on antenna 2. Usually one calceolus occurs on each of the first few articles of the primary flagellum of antenna l and upwards to 7 occur dorsally on article 5 of antenna 2. Clusters of male setae accompany the calceoli of article 5, often more clusters than calceoli. Calceoli of antenna 2 are stated for at least one male of each species where known but these appear to be nondiagnostic at species level in the form we quote because right and left antennae may be in different phases of development; apparently male flagellar articles proliferate from article 1 and alternate in presence and absence of a calceolus so that the formulas are variable within a species. Calceoli occur alternately to the penultimate article of the flagellum in fully terminal males but are rudimentary towards the apex in younger males.
- 7. The flagellar articles of antenna 2 proliferate and increase in length, thereby increasing the overall length of antenna 2, often exceeding the body length.
- 8. Occasionally the upper lip becomes heavily cornified with the ventral margin becoming either less or more excavate than in the female.
- 9. Mandibular palp article 3 occasionally bears supernumerary setae on the inner margin, and the basofacial setae may become altered in number or length.
- 10. Minor changes in other mouthparts infrequently occur, such as modification of the right lacinia mobilis and parts of maxilla 1 and the maxilliped.
- 11. Minor modifications in gnathopods and pereopods 1-2 often occur, such as reduction in numbers and lengths of setae.
- 12. Pereopods 3-5 are often modified to a small degree, article 2 of pereopod 5 usually becoming much narrower than in the female, less frequently so on pereopods 3-4; article 6 of pereopod 3, and especially of pereopod 4, becoming more elongate than in the female but other articles rarely modified in proportion.
- 13. Males develop one penial process on each side of the seventh thoracic sternite just medial to the coxal articulation.
 - 14. The pleopods become very powerful, with

- stout peduncles and enlarged rami bearing highly elongate setae; the peduncle of pleopod 3 in males usually is significantly shorter than that of pleopods 1-2.
- 15. While the pleosome becomes more powerful in male phoxocephalids the urosome usually diminishes in size, becomes thinner dorsoventrally and often more elongate. Uropods 1-2 diminish in in size concordantly.
- 16. Epimera 1-3 are usually broadened anteroposteriorly and epimeron 3 occasionally is shortened posteriorly. The posterior margins of epimera 1-2 often are grossly protuberant and smoother than in the female, with setae on epimera 1-3 often decreasing in length and number.
- 17. Uropods 1-2 usually undergo changes in the number and lengths of setae and spines, the most conspicuous modification being the proliferation and increase in length of spines on the peduncle of uropod 2. The spines on the inner ramus of uropod 2 are occasionally reduced or lost completely.
- 18. Uropod 3 of female phoxocephalids outside of Australia usually has the inner ramus quite short and poorly setose. In most Australian species the female inner ramus is elongate more or less as in the male, but males usually have the inner ramus even more elongate, well exceeding article 1 of the outer ramus and usually far more setose; the outer ramus is either more setose or actually bears setae as well as spines (noting that some females also have setae).
- 19. The telson is usually more elongate and occasionally broader than in females, the apical spines are shortened and a long irregular row or linear patch of denticles develops dorsally and basally near the midline of each lobe.

MINOR ATTRIBUTES.—The following characteristics are relegated to a low level of importance. Though most of them are illustrated for many species they are often consistent from species to species in a genus and unless variability occurs they are omitted from discussion in the sections "Observations" and "Illustrations" when they have not been illustrated for a particular taxon. Because most cases of illustrative and descriptive omission occur in the diverse genus *Birubius* the following list of characters and comments primarily concerns that genus.

Size or shape of cephalic protrusions adjacent to

eye and depth or shape of anteroventral corner of head are mostly illustrated but, because of head deformation after preservation and difficulty in replication of precise angles of observation, these characters have low taxonomic value. Minute marginal setae on the dorsal view of the rostrum are omitted. Medial views of antennae are omitted except in the case of an occasional article 1 of antenna 1 of a male to show the medial patch of fuzz. Article 1 of antenna 1 in the female bears a midapical facial (lateral) setule; midapical setules of articles 2-3 are few in number (3-4 each). The distalmost seta on the lateral face of article 3 on antenna 2 is usually much longer than the proximal seta. Proximal spine groups on the lateral face of article 4 on antenna 2 are accompanied by an accessory setule that is always illustrated but not counted in the spine formulas and otherwise accorded no great taxonomic value. Ventral setal groups usually have the subbasal pair of plusetules omitted or reduced in prominence in the illustrations, or are often hidden medially. Foreshortening of facial spines is ignored. The apex on the flagellum of male antenna 2 bears one elongate seta and a short setule. The gland cone is hidden between the juncture of articles 2 and 3. The prebuccal complex is usually illustrated but described if not illustrated: the lateral view is generally uniform in Australian species, any exceptions are noted, the anterior view is variable from species to species (see p. 13). The full body of the mandible with attached palp is omitted, the palpar hump either being illustrated or described. Setules between mandibular raker spines are deemphasized and the texture of mandibular molars (extremely weak in any event), is ignored. Numerous views of the right lacinia mobilis (usually drawn from an aspect attained when the raker spines are fully extended), have been eliminated. Poor preservation and fleshiness of lower lips reduces their value in distinguishing taxa except for the presence or absence of meatal cones. Except where mentioned the outer plate of maxilla 1 is furnished with 11 spines in 2 groups of 6 and 5, the smaller group with outer bifid apices, and spine 2 of 6-group (second from lateral margin) thickened. Departures from normal include reduction to 9 or 7 spines. Right and left palps of maxilla 1 are approximately similar. Fuzz striations or seriate ranks on maxillipedal palp article 4 are ommitted. "Ordinary" gnathopods denote gnathopod 1 slightly longer and thinner in apical parts than gnathopod 2, and radical departure is so described, often in the main body of the description. The precise shape of crenulations on the palms of gnathopods has not been depicted. Coxae are taller than broad, coxae 1-4 with a small anteroventral bulbar setule, coxa 4 with additional small posteroventral bulbar setule. Departures occur mainly in those few species with the setule not clearly bulbar or in the presence of supernumerary setules on coxa 4. Article 5 of pereopods 1-2 is furnished with a short spine contiguous to the main apical spine. Pereopod 2 is usually not illustrated but in the main description setal formulas on articles 4-5 of percopods 1-2 are quoted. Except where severaly altered, dactyls of pereopods 3-5 have been ignored, although they have setules and protrusions similar to those found on pereopods 1-2 but in a degree of miniaturization. The ventral and posterior margins of article 2 on percopods 3-5 are termed naked unless some of the setules have become elongate setae. Pleopods have been omitted entirely.

Our assessment of certain characters may have been defective. Plumes and disjunct spines on mandibular molars or cuticular setules and ornaments are so small as to be at the limits of light microscopy. Ventral setules on article 1 of antenna 1 are often damaged and subject to interpretation as to how far ventrally a setule must be placed to be included. Denticles on male telsons have not been studied with oil-immersion microscopy as the denticles are so small that superior results probably will be obtained with scanning electron microscopy.

Long descriptive essays on spine and setal lengths and subtleties in shapes and sizes of other parts are generally omitted, although these subtleties are occasionally invoked to make comparisons between species. Setal plumosities are omitted in the vast majority of the illustrations. Discernible by refracted light in microscopic views they are too fine for accurate rendition. The presence or absence of plumes on certain setal groups on various appendages may someday be useful in studies of cryptic or sibling speciation but this aspect has not been pursued except in the Tipimeginae. Considerable success in detecting distinct but closely similar species has been possible with other characters.

An understanding of "microspeciation" must come from studies utilizing vast materials from wide geographic ranges.

SENILITY.—Amphipods apparently are subject to the exigencies of senility, surviving beyond useful reproductive stages and undergoing terminal displacements of morphology, perhaps in a final ecdysis. Several specimens in the collections supply weak evidence that these terminal anomalies may occur in reproductive adults as well as postparturative individuals.

Extremely large adults are called "superfemales" or "superadults" and those with aberrancies, especially the loss of brood plates, are termed "seniles." Superadults are most easily recognized because of gigantism; they may be 20-50 percent greater in body length than ordinary adults and, of course, are much more massive. In the literature they have often been called "intersexes," but that term is restricted herein to those individuals bearing both penes and brood plates. No special search for intersexes has been conducted in this study although 2 specimens of *Birubius* with both sexual characteristics have been found.

Superadults often provide taxonomic difficulties because of character displacement or character convergence towards the typologically separated ordinary individuals of similar species. Occasional museum collections are dominated by such individuals in certain species because they are large, easily seen with the naked eye and have been handpicked from massive samples while the less conspicuous adults of ordinary size have been discarded. Massive samples screened through wide meshes often contain mostly superadults of amphipods. Because of fineness of screening, the survey samples of Western Port and Port Phillip Bay contain only a few superadults in proportion to normal adults thereby indicating that they are an insignificant part of the populations of phoxocephalids in those bays. These superadults have usually been avoided herein as typological models for taxonomic exposition but frequently the complications of their morphological anomalies to the orderly identification of species are mentioned. For this reason they appear to occur more prominently in this study than they actually do in nature.

SUMMARY OF TAXONOMIC EVALUATIONS.—The evolutionary trend within the Phoxocephalidae matches that of other groups of amphipods and

that of the order as a whole. Hypothetically, phoxocephalids commence in primitive state as fully developed fossorial organisms of large size with stout body, heavily spinose and thickened antennae and pereopods, and heavily spinose uropods. Then they undergo the following modifications in various evolutionary lines: reduction in fossorial mechanisms through decrease in body size, streamlining of pereopods, and reduction in spinosity. Primitive gnathopods are a fully diverse pair with gnathopod 2 enlarged and its article 5 shortened, but the most advanced members of most subfamilies have gnathopod 2 reduced in size and beginning to assume the appearance of gnathopod 1. In some groups pygidization is occurring, to wit, the loss of complexity and articulation in the urosome through fusion of urosomites or the inner ramus of uropod 2 to the peduncle. One genus, Joubinella, has become fully nektonic and other joubinellins may be in the process of adapting to the inquilinous or commensalistic mode in benthic habitats.

Phoxocephalid Environment

Phoxocephalidae in Australia.—Phoxocephalidae are a dominantly fossorial group of Amphipoda with limited neritic phases. Both females and immature males are mainly benthic burrowers on coastal shelf sediments that have size ranges in median diameters of 0.12 to 0.93 μm. Phoxocephalids appear to be highly sensitive to any conditions outside of the open sea and therefore are rarely reported from embayments regardless of salinities. Their primary evolutionary habitat has been on the fine grained sediments of fully marine coastal shelves (distributional data, J. L. Barnard, 1960).

Secondarily, Phoxocephalidae have been found on intertidal sediments (for example, *Microphoxus minimus* in Panama, J. L. Barnard, 1960) and occasionally occur in intertidal samples of dominant epiflora where they probably burrow into tiny patches of trapped sediment (J. L. Barnard, 1969b).

The discovery of 16 genera and 54 species of phoxocephalids in two embayments of Victoria is of considerable interest in light of previous knowledge about phoxocephalid ecology. In the sparse records (Reish and Barnard, 1967, Barnard and Reish, 1959, J. L. Barnard, 1964a, Bousfield, 1973) no such similar embayment has ever been reported to contain more than two or three species of phoxo-

cephalids. No other part of the world has such an abundance of phoxocephalids in the shallow open sea as does Australia, the next highest number being the 21 species of California.

No unusual features have been discovered about the environment of Port Phillip Bay and Western Port to explain the high diversity of phoxocephalids in those confined waters. By the standards known for other world embayments one might describe the Australian bays as "species packed." Not only do these embayments contain many phoxocephalids but they contain many other amphipods as well. More than 150 species have already been identified (only partly published as yet, see also J. L. Barnard, 1972a, 1974; M. M. Drummond in preparation). This number approximates the total number of shallow-water amphipod species in the entire warmtemperate province of western North America and far exceeds the 45 species found in Bahía de San Quintín, Mexico, by J. L. Barnard (1964a), an embayment somewhat similar to Western Port.

The two bays of Victoria lie in the cool-temperate (but not cold-temperate) Maugean province that includes Tasmania (Bennett and Pope, 1953, 1960, Knox, 1963). Thermal levels taken by the WPBES investigation in upper waters of adjacent Bass Strait varied between 13.0° (winter) and 19.6°C (summer) over the seasons. In Western Port water temperatures varied between 10° and 21° but in shallower waters they were 9.6° and 22.4° and on mudflats 7.8° and 29°. In Port Phillip Bay between 1947 and 1952 the means ranged between 7°-8° (winter) and 20° (summer) (Rochford, 1966). These values suggest a cool but appropriately categorized warmtemperate regime if the definition is limited to thermal 10°-20°C for 9 months of the year. This is the definition used in amphipod biogeography by J. L. Barnard (1962, 1969a, 1972b).

Port Phillip Bay is a large, ovate bay of about 1950 km², produced into a long western arm, and with a narrow entrance 3.22 km wide. Its maximum depth, occurring in a small area just inside the entrance, is about 91 m, but average depth is very much less, and more than one-half of the total area is less than 14 m deep. The bottom is generally without major relief, sloping fairly evenly towards a large central area with depths in the vicinity of 22 m.

Sediments are mainly clay and silty clay in the central area, sand in the east and south, with sedi-

ments intermediate between these in the northwest. Macroscopic vegetation is fairly sparse except around the periphery of the bay on submerged rocky outcrops (PPBES Report on Phase 1, 1968–71, Melbourne). Cell concentrations of phytoplankton are not extraordinary. Water circulation in the bay is slow, and total flushing takes five months. Salinity levels are very close to those of the open sea.

Despite this wholly unextraordinary environment, there is sufficient environmental diversity to enable at least 12 genera and 32 species of phoxocephalids to occupy this small body of water.

Western Port is a much smaller, complex, tidal embayment, about 1500 km² in area, which includes two large islands, the southernmost of which is so placed that it divides the wide entrance into two channels—the narrow Eastern, and the wider Western, Entrance. The freshwater and sediment input from the hinterland is very small. The water area covers 680 km², of which intertidal flats and sand and mud banks account for 35 percent. The coastline, including the islands, is 263 km long. Sediment is predominantly medium and fine sand, mixed with varying proportions of clay (Marsden and Mallett, 1975).

Compared with Port Phillip Bay, the bottom is in much sharper relief; complex water movements result in more varied sediment in the larger channels. Geologically, too, the areas are dissimilar (Marsden and Mallett, 1975).

Dense beds of seagrasses cover about 38 percent (260 km²) of the total area of the bottom of Western Port. Zostera muelleri and Heterozostera tasmanica extend over most of the intertidal flats; Amphibolus antarctica is confined to a comparatively small area in the main channel. Mangroves (Avicennia marina), with salt marsh swamps, line 40 percent of the 263 km of coastline and occupy an area of 12.1 km². It is suggested (WPBES Report, 1975) that the great extent of these two communities, seagrass and mangrove, could significantly influence nutrient cycling and productivity in the bay.

In light of the significant proportion of biotic dominance by seagrasses, marshes, and mangroves, and our knowledge of similar embayments such as Morro Bay, California (Reish and Barnard, 1967), Newport Bay, California (Barnard and Reish, 1959), and Bahía de San Quintín (J. L. Barnard, 1964a), the Amphipoda should be heavily dominated (80 percent) by epifaunal rather than in-

faunal kinds. When contrasted with this expectation, the percent of infauna in the Australian embayments appears strikingly high: we record 49 species and 15 genera of phoxocephalids from Western Port but have found only 70 species of 35 epifaunal or nestling genera. At least 17 other species in 15 genera of infaunal or free living, nondomicolous amphipods have also been collected in Western Port.

Amphipoda generally appear to be more diverse in southern Australia than in any other well studied marine area (J. L. Barnard, 1969a). More than 300 species (including those presented herein) have been reported from this area (Sheard, 1937, J. L. Barnard, 1972a, 1974) and yet only a few families such as the Dexaminidae and Phoxocephalidae have been studied extensively in a modern context. At least 50 family groups remain poorly studied and will undoubtedly be found to contain hundreds more of unknown species.

The high diversity of amphipods in southern Australia suggests that the overall aspect of the time-stability hypothesis (Sanders, 1969) is operable in southern Australia but also that a factor of incremental allopatric evolution must be integrated into the system. The warm- and cool-temperate Australian environment remains sufficiently steady over long periods of time and is adequately diverse to accumulate and preserve numerous species; but those species must evolve and be naturally selected. Such events producing new species require increments of instability sufficient to isolate populations without damaging the general biotic stability necessary to maintain the species already in existence.

Four kinds of isolation can be suggested. The wide water distance between eastern Australia and the predominantly warm-temperate fauna of New Zealand is a possible divisory pathway. The enormous distance between western and eastern Australia separated by the environmentally undiverse Australian Bight represents another isolating mechanism. If Lake Dieri flooded southern and middle Australia during Pliocene times, its runoff to the sea could have further deteriorated an already poorly diverse environment. The amphipod fauna of southwestern Australia (J. L. Barnard, 1972a, 1974) has many insular characteristics. It resembles the fauna of New Zealand more than that of southeastern Australia, thereby suggesting that it is functionally isolated to some degree and may provide a place, especially during elevated sealevels, where division of pan-Australian populations may occur.

Finally, southeastern Australia has, or has had in the past, numerous anchialine salt lakes such as Lake King, almost fully disjunct from the sea but providing environments in which amphipods, such as Limnoporeia kingi, can survive and perhaps be isolated for time sufficient to permit speciation. Fluctuating sealevels would allow for isolation and rejoining of these lakes to the sea.

BIOGEOGRAPHY OF PHOXOCEPHALIDAE (Figure 6).— The compilation of genera and species in Figure 6 elucidates the dispersal of Phoxocephalidae from an evolutionary center in Australia to other parts of the world by disregarding early continental aggregation. Data enclosed in boxes represent deepsea species for major ocean areas. Other data refer to shallow-water phoxocephalids. The Magellanic region and Falkland Islands represent one area, the remainder of Antarctica, including the South Georgia Islands (not included in Figure 6 but indicated by an arrowhead on lower left margin), represents a second area in the south. Other areas are self evident. Paraphoxus oculatus is considered to be a deep-water form.

Shallow-water Phoxocephalidae appear to be more abundant and more diverse in Australia than in any other part of the world. This broad statement must be tempered strongly by the fact that many areas of the world have either never been explored adequately, or at all, for phoxocephalids. Two areas, the northeastern Atlantic and southern California, have been explored minutely but phoxocephalids in the eastern Atlantic are about one eighth as diverse as in Australia and in the southern California area about one third as diverse as in Australia.

The Okhotsk Sea has been studied extensively with the conclusion that phoxocephalids are sparse there. Only two species occur in South Africa, another area now minutely explored. The numerous publications on Indian and Ceylonese amphipods report only one species from those tropical shores.

Antarctic and Magellanic regions have been widely studied but the number of reported phoxocephalids is fairly low; there is the possibility that survey techniques there failed to recover soft bottom amphipods in proportions equal to those from other habitats. The Magellanic region ap-

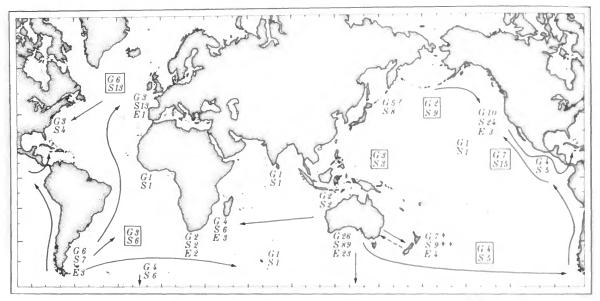


FIGURE 6.—World dispersal of Phoxocephalidae from Australian center (G = genera, S = species, E = endemic species (where pertinent to text), numerals indicate number of genera or species).

pears to be a major stopover on the long dispersal journey from Australia to the Californias and would be expected to have at least as many genera and species as does California (see Figure 6). Nevertheless, there is no evidence, other than in Magellanic South America, that phoxocephalids will be found elsewhere in terms of the vast abundance now known in Australia.

Phoxocephalidae in the tropical shallows of the Indo-Pacific region are sparse and apparently dominated by the subfamily Phoxocephalinae as is the case in Madagascar or by Mandibulophoxus in India. The muddy east tropical Pacific shallows have representatives mainly of Birubiinae such as "Paraphoxus" floridanus or Microphoxus but the Galapagos Islands have a shallow-water species of Proharpinia, the northernmost oculate shallow-water member of Harpiniinae except for Heterophoxus oculatus which penetrates North American waters as far as Oregon.

The California warm-temperate province and its neighbors to the north and south support a rich phoxocephalid fauna dominated by Birubiinae and by species such as "Paraphoxus" fatigans and "P." daboius (which probably should be removed to a new subfamily once the several new genera containing these species are described). None is a

member of Birubius. Many of the eastern Pacific species in the undescribed subfamily bear weakly ensiform antenna 2 and one group carries trichophoxin gnathopods and has weakly enlarged article 3 on pereopod 5 but otherwise is distinct from trichophoxins. These groups are furnished with the elongate article 2 of antenna 1 suggesting relationship to birubiins rather than to brolgins but several species have reduced spination on the mandibular molars as in brolgins "Paraphoxus" cognatus appears to belong to a new genus probably allied to paraphoxins. California is therefore dominated by Birubiinae and a second new subfamily allied to Birubiinae, but, unlike Australia, it has few shallow-water paraphoxins and only one shallow-water harpiniin (Heterophoxus oculatus).

The Magellanic and Antarctic sectors appear to have four brolgins (Wildus? fuegiensis, Parharpinia obliqua, P. rotundifrons, Pontharpinia uncinata [the last three of indeterminant generic placement]); two birubiins (Metharpinia longirostris and M.? cornuta [probably distinct generically]); one parharpiniin (Parharpinia sinuata); two species of Heterophoxus; two species of Proharpinia; and one species of Coxophoxus. The influence of brolgins from Australia is evident and the only parharpiniin to be recorded outside of Australia

occurs in the Magellanic sector. Shallow-water harpiniins are also a predominant group here, the only place outside of the Galapagos Islands, New Zealand, northern Atlantic, or northwestern America where this group lives on coastal shelves.

New Zealand probably has a rich phoxocephalid element. Nine species in eight genera, (of which only five are established) have already been described. The fauna of New Zealand is strongly related to that of Australia as shown by the occurrence of Trichophoxus, a sibling genus of Tipimegus; Protophoxus, a partner of Parharpinia; two genera represented by Waitangi rakiura, Paraphoxus chelatus, and P. spinibasus, again representing trichophoxins; a brolgin, Wildus waipiro; Paraphoxus pyripes, which appears to belong to a new genus of unknown affinity perhaps related to parharpiniins or brolgins; and one species each of Phoxocephalus and Proharpinia. The latter harpiniin reflects the subantarctic, non-Australian element in New Zealand.

The northwestern Pacific shallows, including Japan and the Okhotsk Sea, have eight species primarily of birubiins in several new genera, plus one brolgin. The relationship to the northeastern Pacific is strong. The origins of this group, either across tropical shallows from Australia or against the prevailing southeastward oceanic drift from America, are obscure.

Western Atlantic shallows are poorly explored except in the New England area. The cold north has the predominantly north Atlantic *Phoxocephalus holbolli* and, apart from seven species of *Harpinia*, the other two known species ("*Paraphoxus*" epistomus and "P." spinosus) have siblings found in the eastern Pacific Ocean, suggesting that they passed through the mid-American isthmus in an eastward and northward direction.

The northeastern Atlantic Ocean and Mediterranean Sea are well studied but generically impoverished. Only Metaphoxus, Phoxocephalus, and Harpinia live in those seas. Harpinia is the dominant genus and is probably endemic to the area or, at most, has escaped by a polar route to high latitudes of the north Pacific. Harpinia is one of the most advanced and specialized genera of phoxocephalids; apparently its origins lie in the subantarctic harpiniin stock and its migration occurred via a bathyal pathway (as indicated by its blindness).

The deep seas are dominated by blind harpiniins and a few other genera mainly of the subfamily Phoxocephalinae. *Joubinella* is found in bathypelagic waters but net tows through upper bathypelagic and neritic waters often capture nektonic males of various brolgin and phoxocephalin genera.

In summary, the great diversity of phoxocephalids in Australia, the limited generic diversity and great morphological advancement of phoxocephalids in the northeastern Atlantic, and the dominance of the deep sea by harpiniins whose shallowwater representatives today live mainly in Subantarctica, suggest that Phoxocephalidae underwent their major subfamilial elaboration in the southern hemisphere and are in the process of invading favorable environments of the northern hemisphere. They may be meeting stiff competition from other fossorial families such as urothoids, pontoporeiids, and oedicerotids and may have withdrawn to some extent against an outward flow of those groups; but this appears unlikely in view of the fact that a subantarctic group of blind harpiniins has populated deep sublittoral waters of the northeastern Atlantic. This odd occurrence suggests that the pathway for this immigration may have been the deep sea. Few oculate phoxocephalids have managed to overcome whatever barriers exist to keep them out of the northeastern Atlantic via a shallow-water route from the south. One of those has defective eyes (Phoxocephalus holbolli) and therefore may have moved along a bathyal route.

One assumes that the Magellanic fauna is a descendant of the Australian fauna through the West Wind Drift or from original Gondwana connections. From South America, phoxocephalids could have moved into the Antarctic and northward through the constricted east Pacific tropics characterized by muddy shores and upwelling.

The west coast of the Americas therefore appears to have been a favorable pathway for phoxocephalids to move northward and to populate the Californias richly. Some of those species have close relationships with the Japan-Okhotsk sector and may have immigrated from that region; but the opposite migratory path is more plausible than a path from Australia through east Asian seas. Several species passed into the western Atlantic during the opening of isthmian waterways.

Phoxocephalids have not succeeded in the tropics except in Madagascar and in the muds of the east-

ern Pacific. South Africa has been strongly isolated from phoxocephalids. The west coast of Africa and lower latitudes of South America are poorly known.

In so many distribution patterns of this kind where fossil evidence is lacking one may hypothesize two striking alternatives: (1) the Phoxocephalidae are now being constrained into a relict position and are surviving best in the deep sea, in the otherwise impoverished areas (for amphipods) such as the northeastern Pacific, or in highly isolated regions such as warm-temperate Australia and coldtemperate South America; or (2) the Phoxocephalidae are a relatively youthful group blossoming in the southern hemisphere, and are in the process of immigrating into the northern hemisphere and invading the relatively youthful and very cold deep seas. Morphologically, phoxocephalids appear to be very advanced and efficient organisms, of late origin. Though fossorial, they, unlike any haustoriids or few pontoporeiids and urothoids, have both invaded the deep sea and developed numerous species of reduced fossorial appearance which may be adapted to a semifossorial role in their habitats. Not only the severe reduction of rostra but especially the development of non-skid cuticle in several of the Australian taxa suggest that the family is beginning to move out of its primarily fossorial role into an ecological position broadly known as inquilinous.

Phoxocephalid Evolution

ORIGIN OF PHOXOCEPHALIDAE.—Phoxocephalidae appear to have their closest direct morphological resemblance to Ponto-Caspian genera of the Gammaridae (sensu lato) and somewhat more remote resemblance to the haustoriid-urothoid-pontoporeiid group of families.

A cluster of genera to be called Pontogammarids and comprising genera such as Niphargoides Sars, Niphargogammarus Birstein, Uroniphargoides Stock, Compactogammarus Stock, Obesogammarus Stock, Paraniphargoides Stock, and Pontogammarus Sowinsky represent the focus of this discussion. Other genera belong to this group but lie outside the needs of the discussion. The group has been revised taxonomically by Stock (1974).

The Pontogammarids appear to contain the following attributes suggesting an evolutionary descent towards phoxocephalids: (1) fossorial pereopods 1-5; (2) shortened article 2 of antenna 1 with

apicoventral setation; (3) rich development of penicillate setules ventrally on article 1 of antenna 1; (4) elongate accessory flagellum; (5) reduction in size of article 3 of antenna 2; (6) dominance of antenna 2 by articles 4-5 of the peduncle but with a weakly expressed phoxocephalid tendency for reduction in article 5; (7) expansion of article 1 on antenna 2; (8) retention of the enlarged gnathopod 2 with shortness of article 5; (9) shape and setation of pereopods 1-2; (10) expansion of article 2 on pereopod 5 with facial setation, often in the form of discrete setular bundles; (11) presence of facial setae on epimera; (12) continuous dorsal spination or at least the presence of accessory apical nails on the rami of uropods 1-2; (13) dominance of the outer ramus on uropod 3, with a distinct second article and somewhat to greatly shortened and subsidiary inner ramus, the rami elongate and lanceolate; (14) deeply cleft telson; (15) well developed inner lobes of the lower lip; (16) reduction of setae on the inner plate of maxilla 1 (infrequent).

Not all of these are characteristic of all Ponto-Caspian genera cited. In Niphargogammarus, for example, a protophoxocephalid morphology is reflected in the shortened article 3 of antenna 2, the well expanded article 2 of pereopod 5, and the shape of antenna 1. In Compactogammarus, antennae 1–2, mandibles (in the loss of C and D setae, see Stock 1974), and pereopod 5 are significant in this context, gnathopod 2 only weakly.

All Phoxocephalidae differ from Ponto-Caspian gammaroids in the development of a rostrum, though this has become reduced in highly derived genera or species which can be linked hypothetically to fully rostrate ancestors. All phoxocephalids have shortened articles 4-6 of pereopod 5 and article 2 extends even more distally and posteriorly than in Ponto-Caspian gammaroids. The phoxocephalid mandibular palp lacks an expanded apex on article 3. In no phoxocephalid is article 5 lobed on gnathopod 2 whereas all pontogammarids have a medium to strong lobe. Most phoxocephalids carry gills on pereonite 7 but one subfamily, Tipimeginae, and the genus Limnoporeia, often lack these gills. No phoxocephalid bears a submarginal oblique row of setae on the inner plate of maxilla 1 but some of the more advanced pontogammarids have also lost these setae. The inner plate of maxilla l in phoxocephalids always lacks medial setae and

rarely has more than 4 apical setae. All phoxocephalids bear facial spines on article 4 of antenna 2, though in the more advanced members these often become highly distal and scarcely facial. Only one pontogammarid, a species of *Niphargogammarus*, is known to have facial spines on article 4 of antenna 2.

We hypothesize that a model ancestor of phoxocephalids would bear a fully triturative molar and enlarged gnathopod 2, similar to primitive gammaroids, many pontogammarids, and to primitive living phoxocephalids, which we have identified as *Pontharpinia*. The enlarged gnathopod 2, however, is rapidly reduced in most phoxocephalid lines of evolution and even in several pontogammarids.

Only five genera of phoxocephalids have a fully triturative molar: Pontharpinia, Phoxocephalus, Leptophoxoides, Joubinella, and Jerilderia and each of these also has an enlarged gnathopod 2; but in all of them article 5 is especially short, unlobed and essentially cryptic, unlike that of any pontogammarid. Neither Phoxocephalus nor Jerilderia can be considered close to the ancestral type because of the loss of segmentation in the palp of maxilla 1. Joubinella is a highly adapted nektonic genus, and Leptophoxoides is an apomorphic abyssal genus with heavily modified maxilla 2 and maxilliped.

Pontharpinia comes closer to the ancestral grade than do the other extant genera because of the biarticulate palp on maxilla 1, the supernumerary setae on the inner plate of maxilla 1, the fully setose maxilla 2 (but lacking oblique facial row), the fully developed maxilliped, the rich setosity of the mandibular palp (but C and D setae absent), the presence of more than 2 setae or spines on article 3 of antenna 2, the absence of cones on the lower lip, the presence of facial setae in bundles on pereopod 5, the somewhat elongate articles 4-6 of pereopod 5, the presence of setosity on article 2 of pereopods 3-4, the presence of facial setae on epimeron 3, the apically spinose rami of uropods 1-2, and like many other primitive Australian phoxocephalids but not necessarily like pontogammarids, the fully magniramus uropod 3 with elongate and setose inner ramus in the female. The telson of Pontharpinia is heavily specialized and divergent from pontogammarids and other phoxocephalids.

As has been noted above, in those genera of

phoxocephalids with enlarged gnathopod 2, article 5 is nonlobate, and as in *Pontharpinia*, is usually cryptic, unlike any pontogammarids. If phoxocephalids with enlarged gnathopod 2 are considered to be those genera with strongest ancestral links, then the more advanced phoxocephalids generally have undergone a reversion to the elongate condition of article 5 concomitant with reduction in size of gnathopod 2. This condition is similar to many gammaroids and those few pontogammarids with reduced gnathopod 2.

Phoxocephalids have many characters in common with one or more genera of haustoriids, pontoporeiids, and urothoids (the term "haustorioid" is used hereafter for this group of families). All haustorioids are characterized by reduced, almost mitten-shaped gnathopods; none bears the enlarged gnathopod 2 seen in various primitive phoxocephalids. Most phoxocephalids bear somewhat broadened hands with well developed dactyls fitting the palms, except for the Tipimeginae and a new genus typified by "Paraphoxus" variatus. Few haustorioids (except Zobracho) have a rostrum as well developed as that found in Phoxocephalidae. Haustorioids and phoxocephalids share similar fossorial pereopods, antennae, and uropods but no haustorioid is admitted to the Phoxocephalidae because of the specific combination of the following characters in Phoxocephalidae: visor-like rostrum with expanded, deltoid article 2 of pereopod 5, and shortened stenopodous articles 4-6. No haustorioid bears precisely the kind of triturative mandibular molar found in primitive phoxocephalids (no pontogammarid bears this kind either), whereas a few haustorioids bear the enlarged kind found in pontogammarids or have an immensely enlarged and fuzzy molar. Many haustorioids have variously modified coxae whereas the coxae of Phoxocephalidae fit a consistent, almost invariable basic pattern. Many haustorioids have fully setose inner plates of maxilla 1 and have the oblique facial row of setae on the inner plate of maxilla 2. A few haustorioids carry facial spines on article 4 of antenna 2. Several have poorly cleft or greatly shortened telsons and pontogammarid-like mandibular palps or shortened accessory flagella.

Although phoxocephalids, pontoporeiids, haustoriids, and urothoids may have a common ancestry and this ancestral line may have proceeded outward from a gammarid precursor similar to the

pontogammarid form, the direct linkages between phoxocephalids and haustorioids (sensu lato) have not been preserved in the modern fauna (as known at this time). Phoxocephalids generally retain plesiomorphic gnathopods, whereas haustorioids retain plesiomorphic maxillae on which numerous specializations have been superimposed. Despite the vast degree of convergence among the various groups, almost every genus of both phoxocephalids and haustorioids can be compared minutely and found to have characters which prevent a simple, parsimonious, incremental evolutionary system to be erected between the groups. For example, Urothoe is furnished with a rostral area and pereopod 5 of incipient phoxocephalid character but the mandibular incisors are highly apomorphic, whereas phoxocephalids invariably possess plesiomorphic incisors.

A model ancestor can be hypothesized to diverge into both phoxocephalids and urothoids, or into pontoporeiids and phoxocephalids; but this ancestor remains as close morphologically to pontogammarids as it does to pontoporeiids, urothoids, or phoxocephalids. The conclusion is reached that erection of a model ancestor for phoxocephalids within those groups, or extrapolation from Phoxocephalidae of an ancestor for haustorioids is fruitless in light of present knowledge. Ancestry in organisms like pontogammarids for at least pontoporeiids and phoxocephalids remains the most parsimonious solution in light of known morphology.

The relationship of Phoxocephalidae to Ponto-Caspian gammarids is tenuous geographically. The nearby Mediterranean Sea and eastern Atlantic Ocean are greatly impoverished of Phoxocephalidae: apparently all eastern Atlantic phoxocephalids are highly advanced members of the family. If phoxocephalids did descend from early pontogammarids the thesis must be proposed that a pontogammarid escaped eastward through a Tethyan seaway to an Australian-like environment highly remote from the Ponto-Caspian basin and Mediterranean Sea. Many increments of evolution then took place, but the ensuing barrier between the Ponto-Caspian Basin and the phoxocephalid center has prevented more than a token return of phoxcephalids into the adjoining modern sea basins. This barrier was probably a complex of thermal, competitive, and geographic elements. Perhaps drying of the Mediterranean basin in the Pliocene extinguished any surviving links between pontogammarids and phoxocephalids, although other groups such as sarothrogammarids survived in the trans-Gibraltar eastern Atlantic (J. L. Barnard, in prep.).

The modern position of continents and thermal regimes stretches credibility that phoxocephalids, which appear primarily adapted to nontropical environments, could pass easily from the south warm-temperate through the tropical regime to northern cool waters. One might therefore suppose that the protophoxocephalids would have had an equally difficult time passing from Ponto-Caspian regions into the southern hemisphere, and therefore one might suggest that the events required positions of continents and mild (not torrid) thermal regimes conducive to a continuous environmental pathway from the Ponto-Caspian basins to the Australian regime.

Modern environments do not appear favorable to widespread dispersal of phoxocephalids away from Australia, suggesting that the attenuated faunas of many areas are the result of a coincidence between the major events in phoxocephalid evolution in Australia and environmental conditions more or less similar to those now prevailing. Phoxocephalids are burrowers. Shallow-water species might be expected to have more difficulties in dispersing by rafted materials than nestling or domicolous amphipods. Although the West Wind Drift is a good transporting mechanism and may have brought about a connection between Australia and South America, the physical difficulties encountered by a fossorial amphipod in such a migration must be enormous. Dispersal of shallowwater phoxocephalids is probably hampered by long sea distances and torrid tropical waters which suggest that Australia moved into its present position and marine environmental regime after the protophoxocephalid reached those shores but before much outward dispersal of the group had occurred. The poor return of phoxocephalids from Australia to the northern hemisphere suggests that the Australia-South America connection through Africa in the time of Gondwanaland persisted long after the arrival of phoxocephalids.

The very impoverished situation in South Africa today and the sparse fauna of South America, however, suggest either that Australia was already isolated before the phoxocephalid arrival and that modern distributions reflect dispersal across wide water gaps, or that once split away from Australia, South African and South American sublittoral zones deteriorated environmentally.

EVOLUTIONARY DESCENT IN PHOXOCEPHALIDAE (Figure 7).—If Pontharpinia is taken as a model approaching the primitive phoxocephalid, the lines of descent to various more advanced subfamilies are marked by the following trends.

Tipimeginae: Reduction in overall size of pereopod 5, with increase in size of article 3, loss of posteroproximal setae on article 5 of pereopods 1-2, elongation of article 2 on antenna 1, loss of trituration on molar, resulting in a pseudotriturative form, reduction in size of both gnathopods, almost mitten-shaped with thin hands bearing heavy anterior setation, and development on uropod 1 of a large ventral spike. The Tipimeginae retain facial setae on pereopod 5, dispersed facial setae on palp article 3 of the maxilliped, numerous ornaments on article 3 of antenna 2, extra apical setation on article 2 of the outer ramus on uropod 3, facial and posterior setae on the epimera, broadly fossorial pereopods 3-4 and a relatively enlarged molar bearing 3-4 enlarged spines and having the appearance of being derived from the cusps of a triturative molar. Tipimegins also have an enlarged midapical spine on article 6 of pereopods 1-2, and a medial comb on article 5 of those pereopods. Antenna 2 is weakly ensiform and coxa 4 is heavily setose posteriorly.

Brolginae: Reduction of mandibular molar to a small hump bearing 3 or fewer elongate spines more or less congealed basally, often with a basal plate, reduction of gnathopod 2 in advanced members with elongation of article 5, reduction in breadth of articles 4-5 on pereopods 4-5, simplification of epimeron 3, with loss of all but a few setae or setules, smooth rounding of the posterior margin, and occasional retention of a special peduncular spine on uropod 1.

Leongathinae: Reduction in mandibular molar to a semitriturative condition in which one edge of the discoid molar is toothed much as one side of a triturative molar is toothed.

Joubinellinae: Weak to strong elongation of article 2 on antenna 1, reduction of molar in advanced members to a nontriturative hump with articulate spines.

Parharpiniinae: Reduction of mandibular molar

and gnathopod 2, elongation of article 5 on gnathopod 2, development of supernumerary dorsal spination on telson, retention of special spine on peduncle of uropod 1, and distal tapering of article 2 on pereopod 3.

Birubiinae: Weak to strong elongation of article 2 on antenna 1, reduction of mandibular molar to a nontriturative hump with articulate spines, reduction in size of gnathopod 2 with elongation of article 5.

Phoxocephalinae: Loss of segmentation in palp of maxilla 1, simplification of epimeron 3 and reduction in setation on maxilla 2.

Harpiniinae: Reduction in width of article 2 on pereopod 3, and, in advanced members, the development of an ensiform process on antenna 2.

The general trends in phoxocephalid evolution therefore appear to be reduction in complexities of setation or spination on most parts of the body thought to have fossorial importance, such as the antennae, pereopods 1-5, uropods 1-2, mandibular palp and epimera, the reduction of molarial complexities, loss of palpar segmentation on maxilla 1, loss of setae on inner plate of maxilla 1 and the face of maxillipedal palp article 3, on the mandible and maxilla 2, reduction in numbers of spines on the outer plate of maxilla 1, development of salivary cusps (cones) on the lower lip, reduction in thickness of mandibular palp, reduction in size of gnathopod 2 with reversional elongation of article 5, loss of thickness on articles 4-5 of pereopods 3-4 and on article 2 of pereopod 3, loss of the special spine on the peduncle of uropod 1, and reduction in body size.

Within certain evolutionary clusters such as Birubiinae a trend occurs towards the reduction of the rostrum and loss of segmentation on the urosome. In the Phoxocephalinae there appears to be a trend towards elongation of the telson. In the Harpininae a significant number of species has developed macrocuspidation on article 2 of pereopod 5 and the ensiform process on antenna 2 reaches its maximum development and is retained even in the most advanced taxa such as *Harpinia*.

The deep-sea benthos has been invaded almost exclusively by the Phoxocephalinae and Harpiniinae. Genera of the latter subfamily are found in the deep sea or in cold north Atlantic middepths. The loss of eyes apparently is universal in species inhabiting depths in excess of 600 m; body size is re-

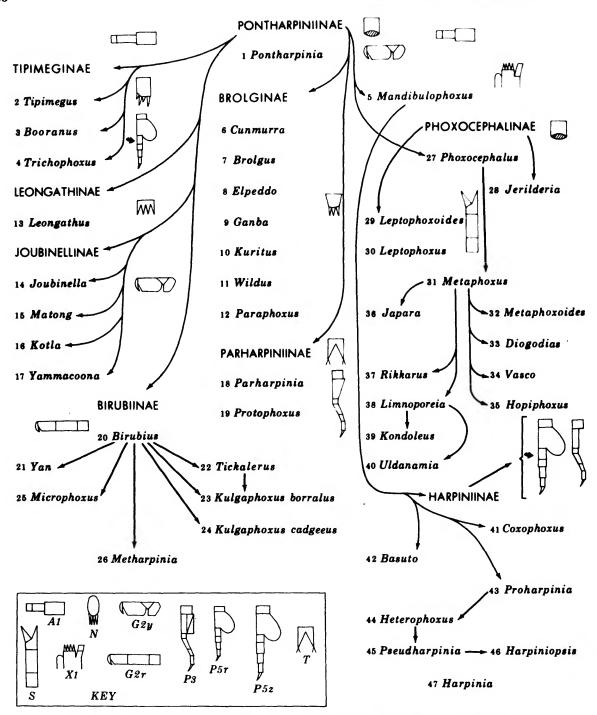


FIGURE 7.—Evolutionary pattern of subfamilies and genera (except Waitangi) of Phoxocephalidae (z = unreduced; short thick arrow points to long or short article 3 of pereopod 5; for identification of other symbol labels in key see "Figure Abbreviations").

duced and almost all the supposed fossorial mechanisms are weakened, apparently as an adaptation to fineness of sediments.

In one of the new Californian genera typified by "Paraphoxus" bicuspidatus epimeron 3 becomes shortened posteriorly in females as well as males; this trend occurs in Australian males of Birubius.

Australian phoxocephalids exhibit all of the evolutionary trends seen in exotic genera except for the full development of an ensiform process on antenna 2 and enlarged cusps of pereopod 5. These latter developments are confined to subantarctic shallow water Harpiniinae and their deep-sea descendants.

PHOXOCEPHALIDAE

DIAGNOSIS.—Head elongate or shortened (specialized) but flat dorsoventrally and usually bearing a flat, sagitally arched, visor-like rostrum, this occasionally obsolescent, lacking ventral retrorse protrusion. Eyes when present ommatidial. Article 1 of antenna 1 elongate, accessory flagellum multiarticulate. Mandibular molar small, either fully triturative or nontriturative and bearing spines, palp present, 3-articulate. Lower lip with strong inner and mandibular lobes. Palp of maxilla 1 well developed. Maxilliped with 4-articulate palp. Anterior coxae of normal length or coxae 1-3 never significantly and individually reduced in size; basic gill formula, 2-7 but occasionally 3-7 or 2-6. Gnathopods either subchelate or chelate, wrists poorly lobate or not lobate, gnathopods never mitten shaped. Pereopods fossorial, heavily spinose and/or setose; only pereopod 4 (rarely 3) elongate, pereopod 5 much shorter than pereopod 4, article 2 enlarged, shield-like, articles 4-6 thin relative to article 2; pereopod 5 strongly distinct in size and shape from pereopod 4. Uropod 3 biramous. Telson laminar, cleft.

DESCRIPTION.—Body stout to medium in thickness, anterior pereonites not strongly compressed forward; body never carinate or processiferous anterior to urosomite 3. Peduncle of antenna 2 with

facial spines (except Joubinella). Mouthpart field quadratiform. Inner plate of maxilla 1 poorly setose, usually with 4 or fewer apical setae (primitive forms with 6 small setae also mostly apical). Inner plate of maxilla 2 rarely with fully medial setae, never with oblique submarginal row of setae. Outer plate of maxilliped always developed and spinose. Urosomites free or fused together in varying degree.

SEXUAL DIMORPHISM.—Major distinctions confined to elongation of flagellum on male antenna 2, increase in size of peduncle on antenna 2, development of calceoli, development of male setular bundles on antenna 2 (rarely on antenna 1), occasional increase in size of aesthetascs or rarely change in sizes of articles on antenna 1; increase in size of eyes; uropod 3 of female usually with short, poorly setose inner ramus, elongate in male, both rami more setose in male; pleopods becoming more powerful with peduncle of pleopod 3 somewhat shortened; body somewhat smaller but more streamlined than in female; urosome reduced and pleosome increased in size relative to female. Minor differences including increased setation on important swimming appendages but reduction of setae where streamline flow impeded (epimera for example); gnathopodal distinctions virtually absent.

Type Genus.—Phoxocephalus Stebbing.

COMPOSITION.—The following new subfamilies: Birubiinae, Brolginae, Harpiniinae, Joubinellinae, Leongathinae, Parharpiniinae, Phoxocephalinae, Pontharpiniinae, Tipimeginae.

REMARKS.—In all but a few genera or species this family is easily recognized by the large dorsally compressed rostrum, the characteristic shape and small size of pereopod 5 relative to pereopod 4 and in the presence of facial spines on the peduncle of antenna 2. One genus, Joubinella, lacks facial spines on antenna 2 but retains a large rostrum, while several genera and species have reduced rostrum but retain the characteristic pereopods 4–5 and facial spines on antenna 2. The combination of any two of these characters serves to distinguish phoxocephalids from similar genera in the gammaroid-haustorioid-platyischnopid family clusters.

Key to the Subfamilies of Phoxocephalidae

ı.	Article 2 of pereopod 3 of thin form	Harpiniinae
	Article 2 of pereopod 3 of broad form	2
2.	Palp of maxilla 1 uniarticulate	PHOXOCEPHALINA

	Palp of maxilla 1 biarticulate
3 .	Article 3 of percopod 5 enlarged, mandibular molar pseudotriturative, of form C (Figures
	5: C, 16)
	Article 3 of pereopod 5 not enlarged, mandibular molar not pseudotriturative 4
4.	Mandibular molar semitriturative, of form B (Figures 5: B, 58)LEONGATHINAE
	Mandibular molar not semitriturate 5
5.	Article 2 of antenna 1 especially shortened
	Article 2 of antenna 1 elongate
6.	Mandibular molar triturative, of form A (Figures 5: A, 8)Pontharpininal
	Mandibular molar not triturative
7.	Mandibular molar of special form E (Figures 5: E, S7) bearing S or fewer spines usually with common base, article 2 of pereopod S not tapering distally, telson lacking supernumerary dorsal spination
	Mandibular molar of form D (Figures 5: D, 105) bearing articulate spines not all organized into common base, usually 4 or more widely spread spines, article 2 percopod 3 tapering distally, telson bearing supernumerary dorsal spination
8.	Gnathopods 1 or 2 or both enlargedJournelland
	Gnathopods 1 and 2 both small

PONTHARPINIINAE

Diagnosis.—Article 2 of antenna 1 shortened. Mandibular molar fully triturative. Palp of maxilla 1 biarticulate. Setation on maxilla 2 ordinary. Gnathopod 2 significantly enlarged. Article 2 of pereopod 3 of broad form; pereopod 5 with slightly enlarged article 3.

SPECIAL CHARACTER.—Telson with large setal brushes.

DESCRIPTION.—Article 5 of antenna 2 reduced. Epimeron 3 of nonrounded classification. Apices of peduncles on uropods 1-2 not combed.

Type Genus.—Pontharpinia Stebbing. Composition.—Unique.

Pontharpinia Stebbing

Pontharpinia Stebbing, 1897:32-33.

DIAGNOSIS.—Eyes present. Flagella of antennae 1-2 unreduced in female; article 2 of antenna 1 especially shortened, ventral setae widely spread; article 1 of antenna 2 weakly ensiform, article 3 with numerous setae and setules, facial spines on article 4 in 2 or more rows plus special apical long spines and short posterior spines, article 5 especially thin. Right mandibular incisor with 3 teeth, molar strongly triturative, medium, usually bearing fuzz, palpar hump medium. Palp of maxilla 1 biarticulate, inner plate with 5+ setae. Setation of maxilla 2 ordinary. Inner plate of maxillipeds ordinary, apex of palp article 3 weakly protuberant, dactyl elongate, apical nail distinct, mostly immersed,

short. Gnathopods dissimilar; gnathopod 2 strongly enlarged; article 5 of gnathopod 1 of ordinary length, free, on gnathopod 2, cryptic, with weak eusirid attachment, palms oblique, hand of gnathopod 2 broadened; hands of both gnathopods poorly setose anteriorly. Article 5 of pereopods 1-2 not setose posteroproximally. Article 2 of pereopod 3 of broad form; articles 4-5 of pereopods 3-4 broad to medium, article 2 of pereopods 3-4 setose posteriorly; pereopod 5 ordinary, article 2 strongly setose ventrally, article 3 slightly enlarged, dactyl normal but with supernumerary setae. Epimera 1-2 lacking long posterior setae, without midfacial setae above ventral facial ridge except weakly on epimeron 2; epimeron 3 ordinary. Peduncle of uropod 1 normally elongate, without apicoventral spike, with special enlarged apicomedial spine, peduncular apices of uropods 1-2 not combed, inner ramus of uropod 1 with 2 rows of marginal spines, all rami continuously spinose to apex, inner ramus of uropod 2 ordinary. Uropod 3 ordinary, article 2 of outer ramus carrying 3 short, apical setae. Telson with only one apicolateral spine on each lobe plus setules, with special brush of dorsal and lateral setae. Urosomite 1 bearing one or more midventral crescents or bundles of setae and sparse apicoventral setae near base of uropod 1; urosomite 3 without dorsal hook or special process.

DESCRIPTION.—Rostrum fully developed, unconstricted. Fuzz on article 1 of antenna 1 in male absent, calceoli on male primary flagellum of antenna 1 present. Calceoli on male antenna 2 unknown. Prebuccal parts ordinary, extended forward,

poorly separated from each other, upper lip dominant. Right lacinia mobilis simple, flabellate; article l of mandibular palp short, palp thick, apex of article 3 oblique, article 2 with outer setae. Lower lip lacking cones. Outer plate of maxilla 1 with 11 spines (one spine especially thickened). Inner plates of maxilliped thick, ordinarily setose. Gills present on coxae 2-7. Coxae 2-4 without special anterodorsal humps. All posterior spines on article 6 of pereopods 1-2 thin and stiff, midapical spine present. Article 2 of pereopod 5 with facial setae in bundles. Peduncle of uropod 1 with dorsolateral spines widely spread, medial spines widely spread; peduncle of uropod 2 with medial spines widely spread. Peduncle of uropod 3 bearing extra subapical setae or spines. Telson with midlateral setules on each side highly proximal, reduced to one member on each side.

Type-Species.—Urothoe pinguis Haswell, 1880a [monotypy].

Composition.—Unique.

RELATIONSHIP.—Pontharpinia is considered to be the most primitive known phoxocephalid even though it possesses many advanced attributes. Like Phoxocephalus and Leptophoxoides it bears fully triturative molars and enlarged gnathopod 2, two characteristics assumed to be primitive, but unlike the more advanced Phoxocephalus and Leptophoxoides it has more setae on the inner plate of maxilla 1, continuously spinose rami on uropods 1–2, and facial setae on article 2 of pereopod 5, all characters which might be marks of relationship to gammaroid-haustorioid ancestors.

Other characters not necessarily confined to Pontharpinia but assumed to be primitive or basic to the phoxocephalid stock are: dispersed and numerous apical setae on the inner plate of the maxilliped (none of these formed into short stubby spines); dispersed facial setae on article 3 of the maxillipedal palp; fully developed rostrum; presence of posterior setae on article 2 of pereopods 3-4 and on coxa 4; setose dactyl of pereopod 5; broad articles of pereopods 3-4; fully setose maxilla 2; setal brushes on the telson; widely spread ventral setae on article 2 of antenna 1; short article 2 of antenna 1; widely spread ventral setae on epimera 1-2; ventral setation on urosomite 1; subapical setae on peduncle of uropod 3; outer setosity on palp article 2 of mandible; widely spread medial spinosity on peduncles of uropods 1-2; more than 2 apical setae on article 2 of outer ramus on uropod 3; absence of posteroproximal setae or spines on article 5 of pereopods 1-2; presence of an inner tooth on the dactyls of pereopods 1-2; and finally, but very importantly, the fully flabellate right lacinia mobilis lacking a proximally fused raker spine.

Plesiomorphic characters in *Pontharpinia* are considered to be: short and almost cryptic article 5 on gnathopod 2; weakly ensiform antenna 2; anterior setae on coxa 1; obsolete basofacial setae on uropod 1; basal setules of telson reduced to one on each lobe.

Characters of unknown evolutionary position are: special peduncular spine on uropod 1; absence of posterior seta on epimera 1-2; absence of double spine rows on the inner ramus of uropod 1; absence of lateral spination on the urosome; short and immersed apical nail on the maxillipedal dactyl; unequal flagella of antenna 1; lack of anterodorsal humps on coxae 1-4; absence of facial setae on coxae 6-7; absence of cones on the lower lip; almost fully amalgamated upper lip and epistome with upper lip dominant; and diverse sets of facial spines on article 4 of antenna 2.

Pontharpinia pinguis (Haswell)

FIGURES 8-10

Urothoë pinguis Haswell, 1880:325-326, pl. 19: fig. 2; 1882: 240-241.

Pontharpinia pinguis.—Stebbing, 1906:146 [in part]. Paraphoxus pinguis.—J. L. Barnard, 1960:274-277, pl. 44. Not Pontharpinia pinguis.—Stebbing, 1897:33-34, pl. 9B; 1910:635 [= Tipimegus stebbing].

Description of Female.—Head about 24 percent of total body length, greatest width about 55 percent of length, rostrum unconstricted, narrow, elongate, strongly exceeding apex of article 3 on antenna 1. Eyes small, either stained or clear of pigment. Article 1 of peduncle on antenna 1 about 1.7 times as long as wide, about twice as wide as article 2, ventral margin with about 11 setules, produced dorsal apex with one setule, article 2 about 0.4 times as long as article 1, with apicoventral cycle of 14-15 setae, primary flagellum with 12 articles, about 0.85 times as long as peduncle, first article elongate, bearing sparse short aesthetascs, accessory flagellum with 11-12 articles. Spine formula on article 4 of antenna 2 = 0-15-10-1 or 0-11-9-5 and 6 special apical spines (Figure 8: fA2), dorsal margin

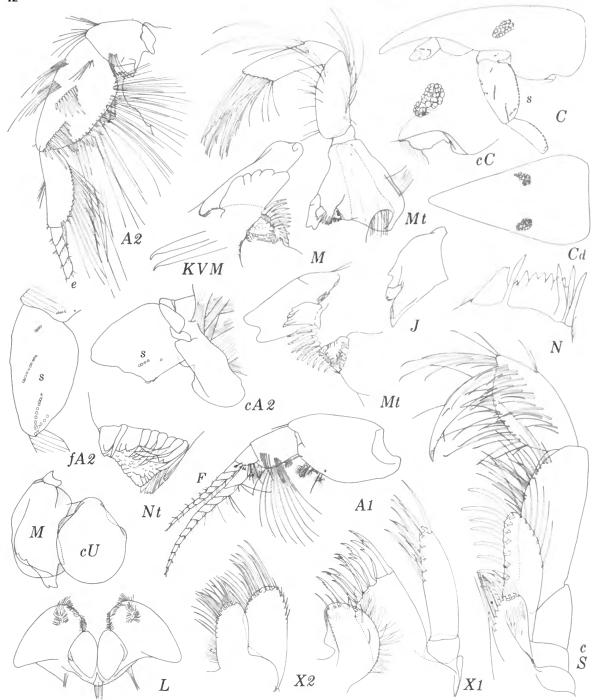


FIGURE 8.—Pontharpinia pinguis (Haswell), female "a," 12.2 mm (c = female "c," 13.2 mm; f = female "f," 12.6 mm).

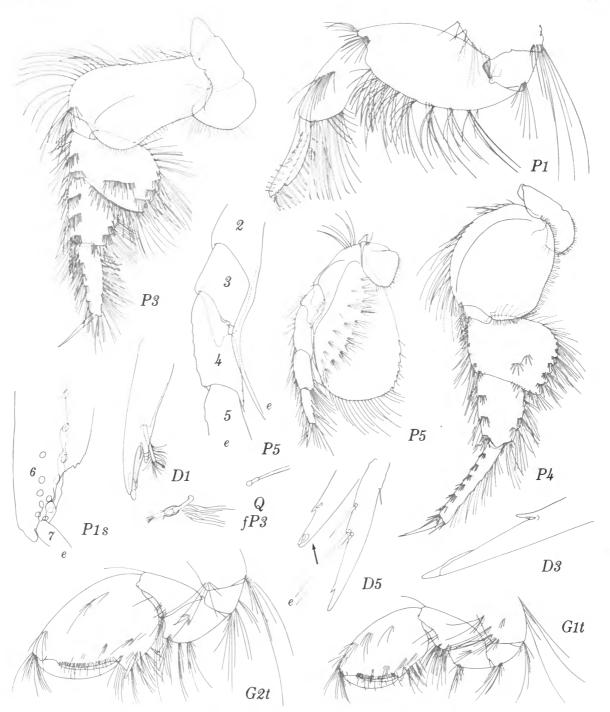


FIGURE 9.—Pontharpinia pinguis (Haswell), female "a," 12.2 mm (f = female "f," 12.60 mm).

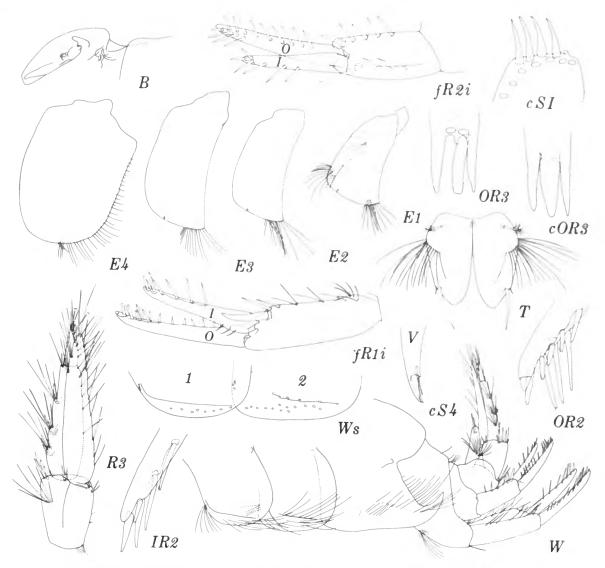


FIGURE 10.—Pontharpinia pinguis (Haswell), female "a," 12.2 mm (c = female "c," 13.2 mm; f = female "f," 12.6 mm).

with notches each bearing 4-5 setae and one spine, ventral margin with numerous long setae and groups of short to medium spines, no ventrodistal spine, article 5 about 0.65 times as long as article 4, facial spine formula = 0, dorsal margin bearing group of short setae, ventral margin with numerous setae, 2-3 ventrodistal short to medium spines, flagellum about 0.7 times as long as articles 4-5 of peduncle combined, with 13 articles. Mandibles

with medium palpar hump; right incisor with 3 teeth; left incisor with 3 humps in one branch; right lacinia mobilis flabellate, denticulate; left lacinia mobilis with 5 teeth; right and left rakers 10; molars subcylindrical, triturative; palp article 1 short, article 2 with one long inner apical seta and 14 other long and short inner setae, and 13 outer setae, article 3 about 1.1 times as long as article 2, oblique apex with 19 spine-setae, basofacial form-

ula = 0-5. Inner plate of maxilla 1 especially large, broad, bearing 3 apical and 3 lateral and facial short setae, palp article 2 with 10 apical-lateralmedial marginal spines and submarginal setae. Inner plate of maxilla 2 narrower and shorter than outer, outer with 7 apicolateral setae, inner with 5-6 medial setae. Inner plate of maxilliped with 4 large thick apical spines, 5 apicofacial setae, 4 medial setae; outer plate with 9 medial and apical spines, 7 apicolateral setae; palp articles 1-2 lacking apicolateral seta, medial margin of article 2 strongly setose, article 3 with about 20 facial setae, pair of lateral setae, nail of article 4 short, almost immersed, with 2 accessory setules. Coxa 1 expanded distally, anterior margin weakly convex, main ventral setae of coxae 1-4 = 11-14-14-37, coxa 1 with extra set of 5 medial setae, with brush of anteroventral setae, posteriormost seta of coxae 1-3 slightly shortened or as long as others, anterior and posterior margins of coxa 4 almost parallel, posterior margin almost straight, posterodorsal corner rounded, posterodorsal margin short, undulant, width-length ratio of $\cos 4 = 2:3$. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 14-22-21-15, short anteriors = 5-54(+10)facial)-5-4, long anterior = 24(+19 facial)-5-25-7; gnathopods enlarged, especially gnathopod 2, width ratios of articles 5-6 on gnathopods 1-2 = 23:38and 26:59, length ratios = 46:62 and 44:80, palmar humps small and large respectively, palms strongly oblique, article 5 of gnathopod 1 ovate, posterior margin rounded, article 5 of gnathopod 2 short, cryptic, triangular, almost lobate. Pereopods 1-2 similar, lacking combs medially, facial setae formula on article 4 = 6 and 6, on article 5 = 10-11 and 11, main spine of article 5 extending to M. 55 on article 6, article 5 lacking proximoposterior armament with dense distal brush of setal-spines, spine formula of article 6 = 12+14 or 12+13 plus large middistal spine, spines especially thin, acclivity on inner margin of dactyls of pereopods 1-2 sharp, produced as tooth, emergent setule short, midfacial pluseta short, highly distad. Coxae 5-7 posteroventral seta formula = 22-(26+)-20. Only article 4 of pereopods 3-4 broad, facial spine rows dense, facial ridge formula on article 2 of pereopods 3-5 = 1-1-2, width ratios of articles 2, 4, 5, 6 of pereopod 3 = 57:60:30:14, of pereopod 4 = 65:60:32:10, of pereopod 5 = 72:13:12:6, length ratios of pereopod 3 =92:54:45:47, of pereopod 4 = 76:48:45:64, of pereo-

pod 5 = 103:34:26:23, article 2 of pereopod 5 exceeding middle of article 5, heavily setose ventrally and facially, article 2 of pereopod 3 tapering proximally, posterior margins of article 2 on pereopods 3-4 densely setose, setae short, dactyls elongate, dactyl of pereopod 5 with stiff inner setae, medial apex of article 6 finely combed, bearing 3 short digital processes. Posteroventral corner of epimeron l rounded, posterior margin convex, anteroventral margin with brush of 6 medium setae, ventral face and margin with 8 medium to long setae; posteroventral corner of epimeron 2 rounded, posterior margin convex, facial setae = 19, above and below 2 ridges; posteroventral corner of epimeron 3 with large tooth, posterior margin straight, setose, ventral margin naked, face with 2-3 oblique rows of 1-6-13 or 2-3-2-12 (etc.) setae from posterior margin to middle. Urosomite 1 with 2 ventral setae at base of uropod 1, 3 brushes of midventral setae from proximal to distal = 10-11, 4-7, and 10-11, articulation line complete; urosomite 3 protuberant dorsally, with 8 basal setae on each side. Rami of uropods 1-2 with articulate small apical nails and accessory nails; continuously spinose outer ramus of uropod 1 with 13-18 dorsal spines (counts here including accessory nails), in rows of 12 and 6 or 13 and 5, inner ramus with 7; outer ramus of uropod 2 with 10-16 dorsal spines, inner with 6, some spines on outer rami paired; peduncle of uropod 1 with 6-8 apicolateral spines and setae, no basofacials, medially with 11-12 marginal setae and spines, some in groups, plus apical enlarged special spine; peduncle of uropod 2 with 5-6 dorsal spines, medially with 5 spines widely spread; apicolateral corner of peduncle on uropods 1-2 lacking comb. Peduncle of uropod 3 with 5 ventrolateral spines, dorsally with lateral spine and setule, medial spine and setule, rami masculine, inner extending to M. 100+ on article 1 of outer ramus, apex with 2 setae, medial and lateral margins setose, article 2 of outer ramus elongate, 0.37, bearing 3 short to medium setae and one spine, medial margin of article 1 setose, lateral margin with 3 acclivities, spine formula = 4-4-3-2, setal formula = 4-4-4-1. Telson unusual, length-width ratio = 1:1, almost fully cleft, each apex narrow, almost sharp, lateral acclivity weak, bearing short lateral setule, spine next medial greatly longer than setule, each lobe with proximolateral arcuate brush of 15-16 long setae plus one basodorsal plusetule. Cuticle with ordinary bulbar

setules of varying sizes mixed with pipes, surface bearing fine striations in form of linear fingerprint pattern, emergent setules branched.

OBSERVATIONS (female).—Ventral crescent and lateral brush of setae on article 2 of antenna 1 separated by gap filled with penicillate setules (not shown on illustration); some long setae on article 2 of gnathopods and pereopods 1–2 paired, especially posteriorly on gnathopods 1–2 and pereopod 1, and anteriorly on gnathopod 1; inner ramus of uropod 1 with 3 basomedial spines (all other phoxocephalids observed have only one basofacial spine, seta, or setule); coxae 5–6 with or without smooth gaps between setae on posterior margin; coxa 1 bearing anteromedial facial setal groups, also with or without supernumerary posteroventral setal group on medial face; apical notch on article 2 of outer ramus on uropod 3 filled with 1–2 scales.

DESCRIPTION OF MALE.—No advanced males in collections. Males at hand marked by penial processes and one large calceolus each on articles 1-3 of primary flagellum on antenna 1, medial margin of article 1 on antenna 1 lacking fuzz, no other differentiation on antenna 2 or uropod 3, dactyl of pereopod 5 flattened, blade-like.

ILLUSTRATIONS.—Pereopod 4 magnified only 84 percent as much as pereopods 3 and 5; black space on illustration of pereopod 1 at juncture between articles 3 and 4 representing open space; six special spines of article 4 on antenna 2 shown only as circles on Figure 8: fA2.

LECTOTYPE (here examined and designated).—AM G.5406, 2 slides with 3 cover slips total, bearing one each of pereopod 4, pereopod 5, uropod 1, uropod 2, epimera 1-3, and some pleopods, sufficient to recognize as *Pontharpinia pinguis*; labeled as "Holotype" but probably not selected by Haswell.

Type-Locality.—As published, not on slides, Bondi, New South Wales, Australia, cast on a beach during a storm.

VOUCHER MATERIAL.—CPBS 35S/5: female "a," 12:2 mm (illus.). CPBS 35S/4: female "c," 13.2 mm (illus.); female "f," 12.60 mm (illus.); male "m," 10.76 mm.

MATERIAL.—CPBS, 36 samples from 13 stations (118); PPBES, 5 samples from 2 stations (7); SBS, 3 samples (5); WAM, one sample (1).

DISTRIBUTION.—Victoria: Western Port and Port Phillip Bay, 2-16.5 m, sand, muddy sand, shell. New South Wales: Bondi Beach (type-locality); off Jibbon Point, 40 m; and off Port Stephens, near Newcastle, 18-22 m, sand.

TIPIMEGINAE

DIAGNOSIS.—Article 2 of antenna 1 ordinary to elongate. Mandibular molar enlarged but pseudotriturative, bearing a special pattern of 3-4 mostly fused spines. Palp of maxilla 1 biarticulate. Setation on maxilla 2 ordinary. Gnathopod 2 as small as gnathopod 1. Article 2 of pereopod 3 of broad form, not tapering distally; pereopod 5 with enlarged article 3.

SPECIAL CHARACTERS.—Gnathopods of special trichophoxid form, article 5 elongate, article 6 thin, mitellid, heavily setose anteriorly; uropod 1 with ventral spike.

DESCRIPTION.—Article 5 of antenna 2 usually reduced in size. Epimeron 3 of nonrounded classification. Apices of peduncles on uropods 1-2 combed.

Type Genus.—Tipimegus, new genus.

Composition—Booranus, new genus; Trichophoxus K. H. Barnard; Waitangi Fincham.

Key to the Genera of Tipimeginae

Tipimegus, new genus

Diagnosis.—Eyes present. Flagella of antennae 1-2 unreduced in female; article 2 of antenna 1 especially elongate, ventral setae widely spread. Article 1 of antenna 2 weakly ensiform; article 3 with 3 or more setae, setules, and spines; facial spines on article 4 in 2 or more rows, plus special apical spines; article 5 especially thin and short. Right mandibular incisor with 4 teeth; molar not triturative, large, elongate, conical, then subtruncate and bearing 3-4 special large spines, not bearing fuzz; palpar hump small. Palp of maxilla 1 biarticulate, inner plate with 3-5 setae. Setation of maxilla 2 ordinary. Inner plate of maxillipeds ordinary, apex of palp article 3 not or weakly protuberant, dactyl elongate, apical nail absent. Gills present on coxae 2-6 only. Gnathopods small, similar, article 5 elongate, free, without eusirid attachment, palms transverse to chelate, hands elongate, heavily setose anteriorly, trichophoxid in shape. Article 5 of pereopods 1-2 lacking setae posteroproximally. Article 2 of pereopod 3 of broad form; articles 4-5 of pereopods 8-4 broad; article 2 of pereopod 3 weakly or strongly setose posteriorly; pereopod 5 especially small, article 2 strongly setose ventrally, article 3 greatly enlarged, dactyl normal. Epimera 1-2 bearing numerous long posterior setae, with or without midfacial setae above ventral facial ridge; epimeron 3 ordinary, lacking facial spines. Urosomite I naked laterally, bearing one or more midventral crescents or bundles of setae, urosomite 3 lacking dorsal hook or special process. Peduncle of uropod 1 weakly to strongly shortened, with large apicoventral spike, without special enlarged dorsolateral-medial spine, only peduncular apices of uropod 2 combed, inner ramus of uropod 1 with 2 rows of marginal spines, rami often continuously spinose to apex, inner ramus of uropod 2 ordinary. Uropod 3 ordinary, article 2 of outer ramus carrying 3 medium to long apical setae. Telson ordinary, with 2-4 apical spines, rarely one spine slightly

DESCRIPTION.—Rostrum fully developed, constricted. Fuzz on article 1 of male antenna 1 absent, calceoli on male primary flagellum of antenna 1 present, but developing late. Calceoli on article 5 of male antenna 2 present, facial spines absent in female, flagellum in male with calceoli. Prebuccal parts strongly extended forward, massive, epistome

and upper lip distinct, epistome dominant, lacking process. Right lacinia mobilis bifid, thin; article 1 of mandibular palp short, palp medium to thick; apex of article 3 oblique, article 2 with outer setae. Lower lip lacking cones. Outer plate of maxilla 1 with 11 spines, one spine especially thickened. Inner plates of maxilliped thick, ordinarily setose. Coxae 2-4 with anterodorsal humps. All posterior spines on article 6 of pereopods 1-2 thick and stiff, midapical spine especially enlarged. Article 2 of pereopod 5 with facial setae. Peduncle of uropod 1 with dorsolateral spines confined apically, or weakly spread, medial spines confined apically; peduncle of uropod 2 with only 1-3 medial spines confined apically. Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with ordinary pair of midlateral or dorsal setules on each side.

OBSERVATIONS.—Some or all of basofacial setae on article 3 of mandibular palp thick, all confined to basodorsal notch; palp of maxilla 1 with fully facial setae; article 2 of pereopod 5 with anterodorsal bulge; uropod 1 lacking basofacial setae in late instars; male developing facial spines on article 5 of antenna 2, absent in female. Occasional specimens identified as T. kangulun and T. thalerus have the elements of the comb on the outer ramus of uropod 2 fine but elongate, rigid, and even, thereby suggesting that the usual ragged appearance is a result of damage.

Type-Species.—Tipimegus thalerus, new species. Composition.—T. dinjerrus, new species; T. kangulun, new species; T. kalkro, new species; Paraphoxus stebbingi J. L. Barnard, 1958; T. species 4N; T. species 5N.

RELATIONSHIP.—Tipimegus, its companion Booranus, plus Trichophoxus and Waitangi comprise a group of genera characterized by the unusual molar representing an intergrade between the fully triturative molar of Pontharpinia and the reduced, spinose molar typical of most phoxocephalids. The molar in this group of genera, however, appears to lie on a blind evolutionary end since no genus with a simpler molar can be related to this Tipimegus group of genera because of the unusual pereopod 5 in the group. Pereopod 5 is miniaturized, its article 3 is enlarged and somewhat similar in shape to the apparently ancestral situation in Pontharpinia. Article 2 of pereopod 5 bulges anteriorly (except in the genus Booranus) and has facial setae. Gnathopods

1-2, with elongate and free wrists bearing mitellid hands heavily setose anteriorly, could be designated "trichophoxid" after one of the genera in the group. The trichophoxid gnathopod is found in American phoxocephalids also but not in conjunction with the unusal pereopod 5 so that it has apparently evolved at least twice in different evolutionary clusters.

The tipimegin group also has more than 2 setules on article 3 of antenna 2, reminiscent of Pontharpinia. Tipimegin genera are also coordinate in most of the following characters: a ventral spike on uropod 1, posteriorly setose epimera 1-2, almost or fully obsolete nail on dactyl of maxilliped; anterodorsal humps on coxae 2-4, elongate to ordinary article 2 of antenna 1 and short article 5 of antenna 2, with loss of facial spines in female only, elongation of article 5 on pereopods 1-2 with proximoposterior margin naked, manifold sets of dorsal setae on article 4 of antenna 2 in female, posterior setation on coxa 4, extra apical spine or seta on article 2 of outer ramus on uropod 3, slightly ensiform antenna 2, scattered facial setae on palp article 3 of maxilliped, basofacial setae on article 3 of mandibular palp confined to a dorsal notch, presence of outer or facial setae on article 2 of mandibular palp, presence of posterior setae on article 2 of pereopods 3-4, conspicuous middistal spine on article 6 of pereopods 1-2, and presence of supernumerary apical spines on article 4 of antenna

Tipimegin characters shared with *Pontharpinia* are: presence of a basodorsal notch on article 3 of the mandibular palp, presence of more than 2 setules on article 3 of antenna 2, absence of facial spines on article 5 of antenna 2 in the female, absence of posteroproximal setae on article 5 of pereopods 1–2, presence of more than 2 apical setae on article 2 of the outer ramus on uropod 3, presence of ventral bundles of setae on the urosome, absence of basofacial setae on uropod 1, a thin resemblance in setosity on article 2 of pereopods 3–4, and the weakly ensiform antenna 2.

Tipimegus shares with Pontharpinia but not with other tipimegins the presence of 2 individual rows of spines on the inner ramus of uropod 1.

Tipimegus and its allies differ from Pontharpinia in the presence (usually) of 4 teeth on the right lacinia mobilis, the special molar, the unusual gnathopods, hereafter called "trichophoxid," on which

the hand is thin, mitelloid, the palms transverse, the hands heavily armed anteriorly with setae and elongate saber spines, the reduction in size of pereopod 5 with enlargement of article 3 and reduction of article 4, the loss of or complete fusion of the apical nail on the maxillipedal palp, the loss of a special dorsomedial spine on the peduncle of uropod 1 and the comcomitant development of a special ventral, almost interramal spine, usually attached to a process and called a "spike," the usually nonflabellate (except Waitangi) and bifid right lacinia mobilis, the elongation of article 2 on antenna 1, the elongation of one or more setae on the inner plate of maxilla 1, the greater breadth, wider truncation, and more apically confined armament on the palp of maxilla 1, and the reduction in number of thick apical spines on the apex of the inner plates of the maxilliped, generally from 4 down to 2 or fewer. The midapical spine on article 6 of pereopods 1-2 usually becomes highly enlarged in the tipimegin group, and the rostrum is strongly narrowed. All tipimegins appear to share massive prebuccal parts.

Tipimegus differs from Trichophoxus K. H. Barnard in the absence of lateral spines on the telson, in the absence of spines on the inner ramus of uropod 2, in the presence of 2 rows of spines on the inner ramus of uropod 1, in the apical confinement of medial spines on the peduncle of uropod 2, in the somewhat narrow spread of the dorsolateral spines on the peduncle of uropod 1 and the slight to great shortness of that peduncle. Tipimegus also has a much larger spike on uropod 1 than does Trichophoxus, but the latter genus has a much more greatly enlarged midapical spine on article 6 of pereopods 1-2 than does Tipimegus. Trichophoxus also bears facial setae on article 2 of pereopod 4.

Tipimegus and Booranus are composed of two groups of closely related tipimegins. Tipimegus differs from Booranus in the following characters: absence of a strong oblique row of spines on epimeron 3, presence of midfacial setae on epimeron 1, strong posterior setation on article 2 of pereopod 3, presence of only 3 setae on the inner plate of maxilla 1 (as against 4-5), presence of only one apicomedial spine on the peduncle of uropod 2 (as against 2-3), apical confinement of the dorso-lateral spines on peduncle of uropod 1, narrow spread of medial spines on that same peduncle, and the shortness of that peduncle.

Booranus forms a weak bridge between Tigimegus and Trichophoxus in the characters of uropod 1.

The form of spination in tipimegins on article 4 of antenna 2 differs from other phoxocephalids in that an extra fully apical, often widespread row of spines occurs; this is quoted first and usually comprises 2 to 5 spines. The second row, highly oblique, is often composed of 2 subgroups, especially noticeable in *Booranus*. When the citation 4-2-8-7-6 (example) is cited, the second row has been noted as being divided into a set of 2 and 8. In subsidiary

descriptions this division of row 2 is often ignored and the first marginal row is not quoted at all.

In the descriptions the apical nails and accessory apical nails are included in the dorsal spine counts on rami of uropods 1-2 in *Booranus* but not in the other tipimegin genera. We are uncertain as to the homology of apical nails in the tipimegin genera; they are so erect and free that their arrangement is quite distinct from the situation in the birubiin group but somewhat similar to conditions in the harpiniin subfamily.

Key to the Species of Tipimegus (Adults)

(Species 5N cited twice, T. stebbingi not included)

1.	Comb on outer ramus of uropod 2 conspicuous at × 40 magnification (Figure 23: OR2c), grossly uneven
	or comb abraded or absent
2.	Hands of gnathopods narrow apically (Figure 13: GI)
	Hands of gnathopods broad apically (Figure 15: GI)
3.	Palm of guathopod 1 s-shaped, dactyl aud article 6 of pereopod 3 elongate, article 6 very
	thin
	Palm of gnathopod 1 straight, dactyl and article 6 of pereopod 3 not elongate, article 6
	stout
4.	Setae on coxa l spread over more than half of ventral margin, outer ramus of uropod l
	with dorsal spination not continuous evenly to apex
	Setae on coxa 1 spread over less than one-fourth of ventral margin, outer ramus of uropod
	1 with dorsal spination almost fully continuous to apex
5.	Palm of gnathopod 1 s-shaped
	Palm of gnathopod 1 even
6.	Epimeron 2 with setae fully in middle of plate, dactyl of pereopod 3 much longer than half
	of article 6, outer ramus of uropod 1 with large accessory spines contiguous with nail
	Tipimegus sp. 4N
	Epimeron 2 lacking setae in middle of plate, dactyl of pereopod 3 much less than half as
	long as article 6, outer ramus of uropod 1 with large accessory spines contiguous with
	nail

Tipimegus thalerus, new species

FIGURES 11-14

DESCRIPTION OF FEMALE.—Head about 23 percent of total body length, greatest width about 70 percent of length, rostrum constricted, elongate, reaching middle of article 2 on antenna 1. Eyes small, largely occluded with pigment, ommatidia especially small. Article 1 on peduncle of antenna 1 about 1.3 times as long as wide, about 2.3 times as wide as article 2, apicoventral margin with about 10 setules, weakly produced dorsal apex with 2 setules; article 2 about 1.1 times as long as article 1, with ventral cycle of 11–12 setae; primary flagellum with

10-13 articles, basal elongate, about 0.65 times as long as peduncle, bearing several aesthetascs; accessory flagellum almost as long as primary flagellum, with 10-11 articles. Spine formula on article 4 of antenna 2 = 2-2-7-8-6 or 2-11-12-8, with one supernumerary spine, dorsal margin with 4 notches bearing 4-6 setae each, ventral margin with 6 groups of 1-6 long to medium setae, dense ventro-distal brush of setae; article 5 about 0.45 times as long as article 4, facial spine formula = 0, dorsal margin bearing weak clumps of setae, ventral margin with 9 unpaired setae and clump of 4-5 long to medium spine-setae, this row set subfacially; flagellum about 0.85 times as long as articles 4-5 of

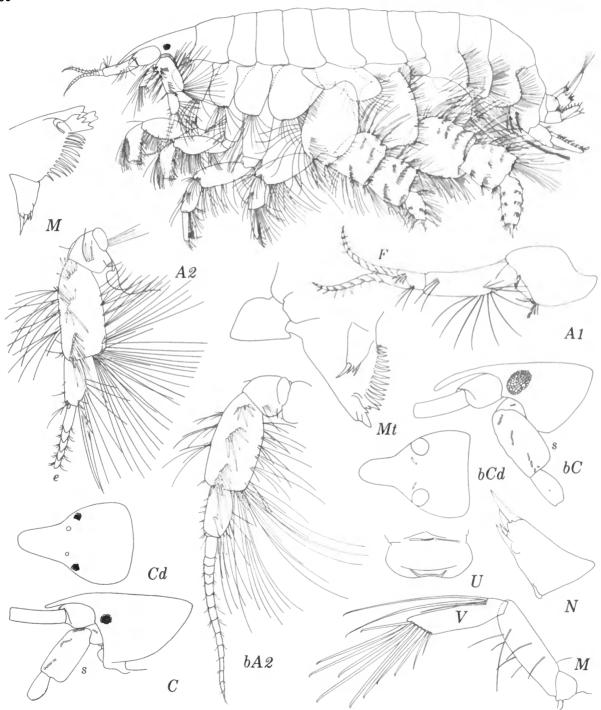


FIGURE 11.—Tipimegus thalerus, new species, holotype, female "a," 7.7 mm (b = male "b," 6.20 mm).

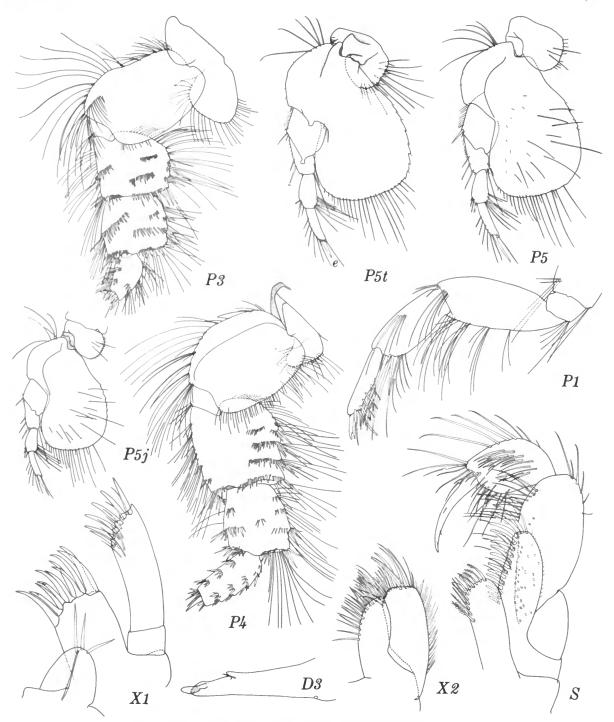


FIGURE 12.—Tipimegus thalerus, new species, holotype, female "a," 7.7 mm.

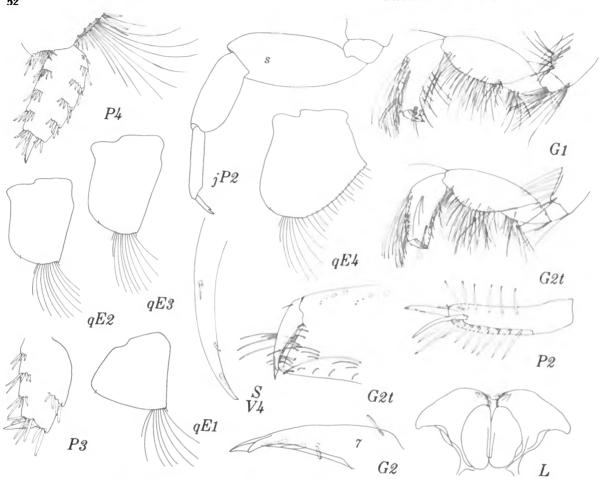


FIGURE 13.—Tipimegus thalerus, new species, holotype, female "a," 7.7 mm (j = juvenile "j," 6.58 mm; q = female "q," 8.46 mm).

peduncle combined, with 12 articles. Epistome large but unproduced anteriorly; upper lip with weak ventral sinus. Mandibles with weak palpar hump; right incisor with 4 teeth; left incisor with 4 humps in 2 branches; right lacinia mobilis bifid, distal branch much shorter than proximal, subbifid, proximal branch simple, pointed; left lacinia mobilis with 4 teeth; right rakers 11, left rakers 12; molars elongate, conical or columnar, each with 4 long to short spines, none disjunct (as in T. kangulun); palp article 1 short, article 2 with 2 long inner apical setae and 5 other shorter inner and facial setae, article 3 about as long as article 2, oblique apex with 11 spine-setae, basodorsal formula = 3. Inner plate of maxilla 1 short, broad, bearing 3

long apical setae, one scarcely more elongate than others, plumose or not; palp article 2 with 6-8 apicalmedial marginal spines and 7 submarginal and facial setae. Inner plate of maxilla 2 shorter and narrower than outer, outer lacking apicolateral setae, inner with 10 medial setae. Inner plate of maxilliped with 2 large, thick apical spines, 5 apicofacial setae, 5-6 medial setae; outer plate with 15 medial and apical spines, one apicolateral seta; palp article 1 lacking apicolateral seta, article 2 with 5 groups of 1-2 apicolateral setae, medial margin of article 2 moderately setose, article 3 with nearly 20 facial setae, 7 lateral setae, article 4 with 2 accessory setules, nail absent. Coxa 1 strongly expanded apically, anterior margin almost straight,

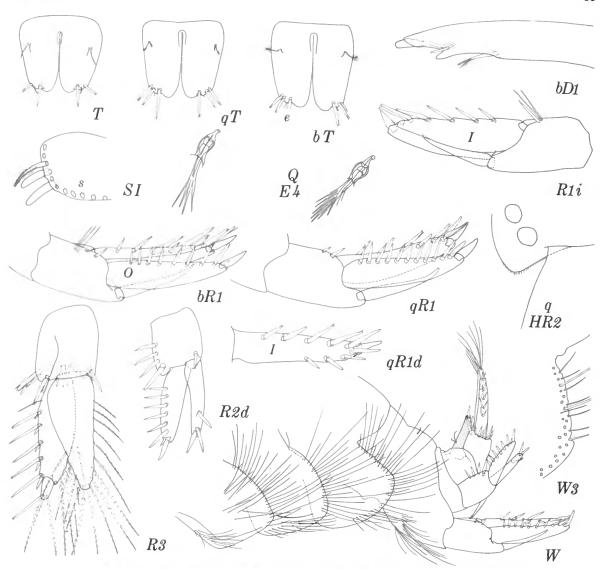


FIGURE 14.—Tipimegus thalerus, new species, holotype, female "a," 7.7 mm (b = male "b," 6.20 mm; q = female "q," 8.46 mm).

main ventral setae of coxae 1-4 = (7-8)-(8-11)-(10-11)-(25-26), posteriormost seta of coxae 1-3 shortest, anterior and posterior margins of coxae 4 strongly divergent, posterior margin oblique, almost straight, posterodorsal corner sharp, posterdorsal margin short, ordinary, undulant, width-length ratio of coxa 4 = 1:1. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 7-6-9-6 and 4 facial on gnathopod 1, long anteriors = 14-14-22-3, short anteriors = 4-2-3-4, no others. Gnathopods

with thin hands narrowed apically; width ratios of articles 5-6 on gnathopods 1-2=27:23 and 25:21, length ratios = 63:50 and 62:44; palmar humps very small, palms transverse; article 5 of gnathopods 1-2 elongate, ovate, posterior margin rounded. Pereopods 1-2 similar; facial setae formula on article 4=5 and 7, on article 5=4-5 and 5-7; main spine of article 5 very thin, extending to M. 55 on article 6, article 5 with one extra long distoposterior spine and numerous setae, proximal margin naked, spine

formula of article 6 = 7 + 9 and 8 + 9 or 7 + 10and 8 + 10 plus huge middistal spine, several spines elongate; acclivity on inner margin of dactyls of pereopods 1-2 sharp, produced as tooth, emergent setule short, marginal pluseta short, coxae 5-7 posteroventral seta formula = 28-29-25, composed of marginal and submarginal groups. Articles 4-5 of pereopods 3-4 broad, facial spine rows dense, facial ridge formula on article 2 of pereopods 3-5 = 0-1-1, width ratios of articles 2, 4, 5, 6 of pereopod 3 =52:48:43:17, of pereopod 4 = 59:59:42:21, of pereopod 5 = 56:9:8:3; length ratios of pereopod 3 =71:45:38:32, of pereopod 4 = 68:60:49:45, of pereopod 5 = 73:18:15:17; article 2 of pereopod 5 almost reaching apex of article 5, ventrally setose; medial apex of article 6 finely combed only on pereopod 5; dactyls of pereopods 3-4 short. Posteroventral corner of epimeron 1 rounded-quadrate, posterior margin weakly convex, setose, anteroventral face with 12+ short to medium setae, midface with 11 medium setae; posteroventral corner of epimeron 2 rounded, posterior margin weakly convex, setose, facial setae = 11, posterior pairs and triads set vertically; posteroventral corner of epimeron 3, weakly protuberant, posterior margin straight, weakly serrate, setose, ventral margin with 16 setae mainly in posterior half, face naked. Urosomite 1 with 3 paired sets of setae, each side with sets of 10-11, ventrally with sets of 3-4 and 3, articulation line complete; urosomite 3 protuberant dorsally. Rami of uropods 1-2 with articulate enlarged sharp apical nails, outer and inner rami of uropods 1-2 with accessory nails, continuously spinose; outer ramus of uropod 1 with 9-10 dorsal spines, inner with 4-5 dorsal and 4 medial; outer ramus of uropod 2 with 6 dorsal spines, inner with 2 dorsal spines; peduncle of uropod 1 with 2-3 apicolateral spines, no basofacial setae, medially with 3 marginal setae and spines in apical clump; peduncle of uropod 2 with 4 dorsal spines, medially with one small apical spine, apicolateral corner on peduncle of uropod 2 with weak comb, rami naked. Peduncle of uropod 3 with 12-13 ventral spines, dorsally with one lateral spine, one medial spine and setule; rami masculine, inner extending to M. 100+ on article 1 of outer ramus, apex with 2 setae, medial and lateral margins setose; article 2 of outer ramus ordinary, 0.21 as long as article 1, bearing 2 medium setae and one spine; apicomedial margin of article 1 setose, lateral margin with 5 acclivities, spine formula = 0-2-2-2-2-2 or 2-2-2-2-2, setal formula = 1-0-0-0-0, or none. Telson ordinary, length-width ratio = 50:53, not fully cleft, each apex wide, rounded, middle acclivity shallow, lateral acclivity tiny, bearing 1-2 ordinary lateral spines, spine next medial longer, with 1-2 lateral and one medial spines separated by setule, midlateral setules diverse. Cuticle with enlarged but sparse bulbar setules, surface bearing fine denticles, emergent setules especially long, branched.

DESCRIPTION OF MALE (subadult, male "b," 6.20 mm).—Eyes enlarged, clear of occluding pigment. Article 1 of antenna 1 with 13 ventrodistal setules, article 2 with 12 setae in ventral spray, primary flagellum with 10 articles, long aesthetases on articles 4-9, accessory flagellum with 9 articles. Spine formula on article 4 of antenna 2 = 2-9-6-6, on article 5 = 1, flagellum only weakly elongate, with 14 articles, not proliferate, calceoli absent. Setal formula on coxae 1-4 = 7-8-8-14. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 3-3-3-4, long anteriors = 12 (plus 2 facial)-9-9-1, short anteriors = 1-4-3-4, no others; hands of gnathopods even thinner than in adult female. Setal and spine formulas on pereopods 1-2, article 4 = 5 and 5, article 5 = 5 and 5, article 6 = 6 + 7plus huge middistal spine, articles 4-5 thinner than in female. Coxa of pereopod 5 with gills besides penial processes(!). Setal formula on epimera: epimeron 1 facial = 8, anteroventral = 6, epimeron 2 anteroventral = row of 6 only, epimeron 3 ventral = 10. Spine formulas on uropods: peduncle of uropod 1 = 2 dorsolateral, 3 medial, of uropod 2 =4 dorsal, one medial; outer ramus of uropod 1 = 9dorsal, of uropod 2 = 6, inner ramus of uropod 1 = 5 dorsomedial, 4 lateral, of uropod 2 = 2. Uropod 3 peduncle ventral = 12, article 1 of outer ramus lateral spines = 1-1-1-2-2-2, setae = 0-0-1-0-0-0, apicolateral spine on article 2 as in female but slightly more elongate, as in juveniles. Telson weakly elongate, each lobe with 3 spines, no denticles. Cuticular setules enlarged as in female.

OBSERVATIONS.—Head of holotype as illustrated showing only weak pointed lobe, this lobe usually larger and more pointed in other specimens. Article 3 of antenna 2 with 6 facial spines and/or setae plus one disjunct setule.

Variations.—Female "t," 13.7 mm: Possibly gerontic but brood plates fully developed; proximal

spine formula on article 4 of antenna 2 = 14-11-9, flagellum with 13 articles; spike on uropod 1 short, scarcely exceeding M. 50 on outer ramus, peduncle of uropod 1 with 3 dorsolateral spines, outer ramus with 15 spines plus accessory spinule at base of nail, inner ramus with 8 medial and 5 lateral spines, outer ramus of uropod 2 with 9 dorsal spines.

Juvenile "j," 6.58 mm: Pereopods 1-2 drawn from this specimen, these pereopods of shape identical to adult female, setal, and spine counts on pereopods 1-2 article 4=5 and 5, article 5=4 and 4, article 6=6+8 and 7+8 plus huge middistal spine; uropod 1 with 3 dorsolateral peduncular spines; article 2 on outer ramus of uropod 3 with apicolateral spine as in adult.

ILLUSTRATIONS.—Most of pereopod 5 hidden from lateral view by pereopod 4 in body illustration; antenna 2 projecting fully lateral but flattened in body illustration; in enlarged views of uropods 1-2 latter enlarged more than former; female pereopod 5 shown in 3 views, small view at same magnification as pereopods 3-4, enlarged views from lateral and medial, note aberrancy of lateral view article 2.

HOLOTYPE.—NMV, female "a," 7.7 mm.

Type-Locality.—CPBS 35S, 3 Aug 1972, Western Port, Victoria, Australia, 14 m, sand.

VOUCHER MATERIAL.—CPBS 25N/1: male "b," 6.20 mm (illus.); female "r," 13.0 mm. CPBS 26N/4: female "q," 8.46 mm (illus.); juvenile "j," 6.58 mm (illus.). CPBS 32E/1171: gerontic female "t," 13.7 mm.

RELATIONSHIP.—As the type-species of *Tipimegus* this forms the model to which following species are compared. The main taxonomic characters of *T. thalerus* are as follows: continuous spination on the outer ramus of uropod 1, short dactyls of pereopods 3—4, highly enlarged cuticular setules, absence of combs on rami of uropods 1—2, apically narrow hands of gnathopods, narrow spread of ventral setae on coxae 1—3, and the transformation of the lateral (number 3) seta on article 2 of the outer ramus on uropod 3 into a stiff spine.

MATERIAL.—CPBS, 10 samples from 7 stations (14); PPBES, 5 samples from one station (6); AM, one sample (1); SBS, one sample (1).

DISTRIBUTION.—Victoria: Western Port and Port Phillip Bay, 9–14 m, sand. New South Wales: off Manly Beach, Sydney, 6 m, sand; off Malabar, 31 m, sand and shell.

Tipimegus dinjerrus, new species

FIGURE 15

Description of Female.—Head about 22 percent of total body length, greatest width about 75 percent of length, rostrum constricted, narrow, exceeding middle of article 2 on antenna 1. Eyes medium, clear of pigment, ommatidia sparse and scattered. Article 1 on peduncle of antenna 1 about 1.2 times as long as wide, about 2.3 times as wide as article 2, ventral margin with about 8 setules, weakly unproduced dorsal apex with 3 setules, article 2 about 1.05 times as long as article 1, with apicoventral crescent of 11 setae; primary flagellum with 11 articles, about 0.6 times as long as peduncle, bearing several long aesthetascs (articles 3-10), accessory flagellum about as long as primary flagellum, with 10 articles. Spine formula on article 4 of antenna 2 = 2-2-9-12-7, with 2 supernumerary spines, dorsal margin setose, ventral margin with 8 groups of 2-4 long to medium setae, dense ventrodistal brush of setae; article 5 about 0.55 times as long as article 4, facial spine formula = 0, dorsal margin naked, ventral margin with 5 sets of one seta each, 5 ventrodistal long to medium spine-setae, this row set facially; flagellum about 0.9 times as long as articles 4-5 of peduncle combined, with 12 articles. Mandibles with weak to medium palpar hump; right incisor with 4 teeth, left incisor with 5 humps in 2 branches; right lacinia mobilis bifid, distal branch shorter than proximal, subbifid, proximal branch simple, pointed, lacking marginal denticles; left lacinia mobilis with 4 teeth; right rakers 10 plus one rudimentary, left rakers 11; molars elongate, conical or columnar, each with one long apical spine, one short apical spine, one medium spine on side with strong nonarticulate partner; palp article 1 short, article 2 with 2 long to medium inner apical setae and 3 other shorter inner setae, and 2 outer setae, article 3 about 0.9 times as long as article 2, oblique apex with 12 spine-setae, basodorsal formula = 2. Inner plate of maxilla 1 ordinary, bearing one long subapical pluseta, 2 apicolateral shorter setae; palp article 2 with 6 apical spines and 7 submarginal and facial setae. Inner plate of maxilla 2 shorter and much narrower than outer, outer lacking apicolateral setae, inner with 9 medial setae. Inner plate of maxilliped with 2 large, thick apical spines, 7 apicofacial setae, 4 medial setae;

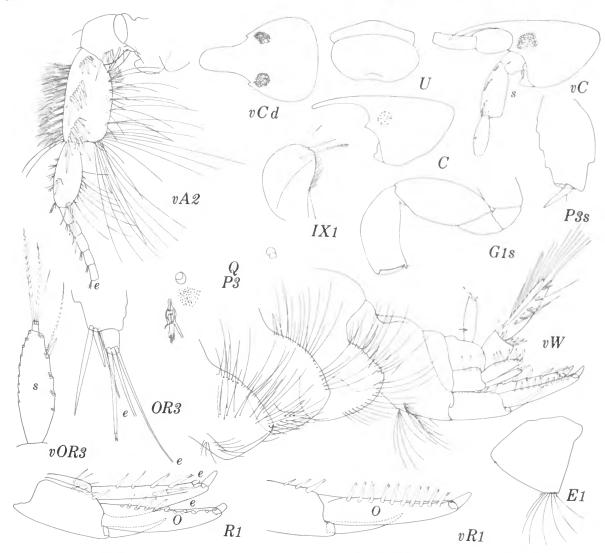


FIGURE 15.—Tipimegus dinjerrus, new species, holotype, female "w," 8.13 mm (v = male "v," 7.85 mm).

outer plate with 14 medial and apical spines, one apicolateral seta; palp article 1 lacking apicolateral seta, article 2 with 4 groups of one each apicolateral setae, medial margin of article 2 moderately setose, article 3 with 14–16 facial setae, 6 lateral setae, nail of article 4 absent, with 3 accessory setules. Coxa 1 strongly expanded distally, anterior margin almost straight; main ventral setae of coxae 1–4 = 9–11–10–25, posteriormost seta of coxae 1–3 shortest; anterior and posterior margins of coxa 4 strongly divergent, posterior margin oblique, almost straight,

posterodorsal corner sharp, posterodorsal margin ordinary, almost straight, width-length ratio of coxa 4 = 11:13. Long posterior setae of article 2 on gnathopods 1-2 and pereopods 1-2 = 6-6-7-6, long anteriors = 15(+6 facial)-11-20-2, short anteriors = 2-4-7-5, no others; gnathopods with thin hands broad apically, width ratios of articles 5-6 on gnathopods 1-2 = 29:26 and 27:25, length ratios = 65:52 and 65:45, palmar humps very small, palms transverse, article 5 of gnathopods 1-2 elongate, ovate, posterior margins rounded-flat.

Pereopod 2 stouter than pereopod 1, especially article 4; facial setae formula on article 4 = 6 and 6. on article 5 = 5 and 6, main spine of article 5 extending to M. 75 on article 6, spine formula of article 6 = 8 + 11 and 8 + 11 plus huge middistal spine; acclivity on inner margin of dactyls of pereopods 1-2 sharp, produced as tooth, emergent setule short, midposterior pluseta short. Coxae 5-7 posteroventral seta formula = 28-26-30, composed of marginal and facial groups. Articles 4-5 of pereopods 3-4 broad, facial spine rows dense; facial ridge formula on article 2 of pereopods 3-5 = 0-1-1; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 52:48:45:17. of pereopod 4 = 62:57:37:19, of pereopod 5 =64:10:9:5; length ratios of pereopod 3 = 74:42: 44:30, of pereopod 4 = 70:60:46:48, of pereopod 5 = 75:20:16:20; article 2 of pereopod 5 exceeding middle of article 5, ventrally setose, with 7 facial setae (long) and several short setae; medial apex of article 6 only on pereopod 5 finely combed; dactyls of pereopods 3-4 short. Posteroventral corner of epimeron 1 rounded, posterior margin weakly convex, setose, anteroventral face with 8 short to medium setae, midface with 5 medium setae; posteroventral corner of epimeron 2 rounded, posterior margin weakly convex, setose, facial setae = 10, in rows of 7 and 3; posteroventral corner of epimeron 3 weakly protuberant, posterior margin straight, weakly serrate, setose, ventral margin with 11 setae mainly in posterior half, 4 of these setae in 2 pairs, face with occasional submarginal seta. Urosomite 1 with 4 paired sets of setae, each side with sets of 5, ventrally with sets of 4, 3, and (2-4), articulation line complete, urosomite 1 protuberant dorsally. Rami of uropods 1-2 with articulate enlarged sharp apical nails; outer and inner rami of uropod 2 with accessory nails, continuously spinose; outer ramus of uropod 1 with 9 dorsal spines, almost continuously spinose, with small asymmetricity, inner with 6 dorsal and 3 lateral spines; outer ramus of uropod 2 with 7 dorsal spines, inner with one spine (= accessory); peduncle of uropod 1 with 3-4 apicolateral spines, medially with 3 marginal spines, peduncle of uropod 2 with 5 dorsal spines, medially with one small apical spine, apicolateral corners of peduncles on uropods 1-2 and rami lacking comb. Peduncle of uropod 3 with 17 ventral spines, dorsally lacking lateral spine (merged with ventral spines), one medial spine and setule; rami submasculine, inner extending to M. 100 on article 1 of outer ramus, apex with 3 setae, medial and lateral margins setose; article 2 of outer ramus short, 0.14, bearing 3 medium to long setae, lateralmost being medium unplumose spine, apicomedial margin of article 1 setose, lateral margin with 3 acclivities, spine formula = 2-2-2-2, setal formula = 0-0-0-1 or 0. Telson ordinary, lengthwidth ratio = 25:28, not fully cleft, each apex of medium width, rounded, undulant, lateral acclivity shallow, weak, with lateral and medial spines separated by setule; midlateral setules diverse. Cuticle with ordinary bulbar setules mixed with pipes, surface bearing fine denticles, emergent setules branched.

OBSERVATION (female).—Article 3 of antenna 2 with 6 facial spines and setae plus one disjunct setule; rostrum much narrower than in T. thalerus.

DESCRIPTION OF MALE (subadult).—Eyes scarely enlarged; primary flagellum of antenna 1 with 10 articles, bearing long aesthetascs on articles 2-9; dorsal margin of article 4 on antenna 2 with male fuzz, spine formula = 2-10-9-5, of article 5=2, article 5 with 5 sets of dorsal male setae, flagellum weakly elongate, with 15 articles, calceoli absent; basofacial setal formula on article 3 of mandibular palp = 3, inner margin with 2 medium sized accessory setae; article 4 of pereopods 1-2 much thinner than in female; pereopods 3-5 and epimera similar to those of female; see illustrations for spines on uropods 1-2; spine formula on article 1 of outer ramus on uropod 3 = 1-2-2-2, setae = 1-1-1-11, setae otherwise scarcely more dense than in female, peduncle with 12 ventral spines, one dorsolateral spine; telson as in female but with sparse mediobasal denticles on each lobe.

ILLUSTRATIONS.—All parts, except those few illustrated and except for proportions and spine counts mentioned in description, like those of *Tipimegus thalerus*, especially epistome, mouth parts, pereopods 1–5, dactyls of pereopods 3–4, uropod 3, telson, especially article 5 of pereopod 5 and setal distribution on coxae 2–3.

HOLOTYPE.—WAM, female "w," 8.13 mm.

Type-Locality.—WAM 416-73, 24 Jul 1943, off Jibbon Point, New South Wales, Australia, 40 m. Voucher Material.—The type-locality: male "v," 7.85 mm (illus.) and 2 similar males.

RELATIONSHIP.—This species appears closest to T. thalerus mainly because so many minor proportions, such as those of pereopods 3-5, and the general large

size of and setation densities on epimera and coxae 1-3, resemble that species rather than T. kangulun. Nevertheless T. dinjerrus differs from T. thalerus in characters it shares with T. kangulun, such as the small cuticular setules, almost continuous spination on the outer ramus of uropod 1, and the broad apices on the hand of the gnathopods. From T. kangulun, T. dinjerrus differs mainly in the short dactyls of pereopods 3-4 and the distinctiveness of the lateral spine on article 2 of the outer ramus on uropod 3. Only one female and 4 subadult males of T. dinjerrus are known; thus a wider variety of material is required to determine whether or not this species is valid.

MATERIAL.—WAM, one sample (5).
DISTRIBUTION.—New South Wales, off Jibbon Point, 40 m.

Tipimegus kangulun, new species

FIGURES 16-19

Description of Female.—Head about 20 percent of total length, greatest width about 77 percent of length, rostrum constricted, narrow, exceeding middle of article 2 on antenna 1. Eyes small, clear of pigment or darkly stained. Article 1 of peduncle of antenna 1 about 0.8 times as long as wide, about 2.8 times as wide as article 2, ventral margin with about 7 setules, weakly produced dorsal apex with 3 setules, article 2 about 0.9 times as long as article 1, with ventral crescent of 13-14 setae; primary flagellum with 9 articles, about 0.55 times as long as peduncle, bearing several long aesthetascs; accessory flagellum almost as long as primary flagellum, with 8-9 articles. Spine formula on article 4 of antenna 2 = (2-3)-2-11-10-7 + 2-3 supernumerary spines, dorsal margin setose, ventral margin with 8-9 groups of 2-5 long to short setae, dense ventrodistal brush of setae; article 5 about 0.5 times as long as article 4, facial spine formula = 0, dorsal margin naked, ventral margin with 6 unpaired setae, 6 ventrodistal long to medium spine-setae, this row set facially; flagellum about 0.75 times as long as articles 4-5 of peduncle combined, with 10 articles. Mandibles with weak to medium palpar hump; right incisor with 4 teeth; left incisor with 5 humps in 2 branches; right lacinia mobilis bifid, distal branch shorter than proximal, subbifid proximal branch simple, pointed, with marginal denticles; left lacinia mobilis with 4 teeth; right rakers 10 plus one rudimentary; left rakers 11; molars elongate, conical or columnar, each with one long apical spine, one short apical spine, one medium spine on side with vestigial nonarticulate partner; palp article 1 short, article 2 with 4-5 medium inner apical setae, 3 other shorter inner setae and 2-3 outer setae, article 3 about 0.9 times as long as article 2, oblique apex with 14 spine-setae, basodorsal formula = 3. Inner plate of maxilla 1 ordinary, bearing one long subapical pluseta, 2 apicolateral shorter setae; palp article 2 with 6-7 apical spines and 9 submarginal and facial setae. Inner plate of maxilla 2 shorter and much narrower than outer, outer lacking apicolateral setae, inner with 9-10 medial setae. Inner plate of maxilliped with 2 large, thick apical spines, 6 apicofacial setae, 7 medial setae, outer plate with 14 medial and apical spines, no apicolateral setae; palp article 1 lacking apicolateral seta, article 2 with 3 groups of 1-2 apicolateral setae, medial margin of article 2 moderately setose, article 3 with 11 facial setae, 4 lateral setae, article 4 with 3 apical accessory setules, nail absent. Coxa 1 strongly expanded distally, anterior margin almost straight; main ventral setae of coxae 1-4=14-16-15-32, posterior-most seta of coxae 1-3 shortest; anterior and posterior margins of coxa 4 strongly divergent, posterior margin oblique, almost straight, posterodorsal corner sharp, posterodorsal margin ordinary, almost straight, width-length ratio of coxa 4 = 27:29. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 9-7-8-5, long anteriors = 20(+6) facial)-19-(15-20)-5, short anteriors = 2-3-2-5, no others. Gnathopods with thin hands broad apically, width ratios of articles 5-6 on gnathopods 1-2 = 30:26 and 27:25, length ratios = 63:50 and 63:45; palmar humps very small, palms transverse; article 5 of gnathopods 1-2 elongate, ovate, posterior margins rounded-flat. Pereopod 2 stouter than pereopod 1, especially article 4; facial setae formula on article 4 = 10-11 and 10, on article 5 = 5 and 5, main spine of article 5 extending to M. 75 on article 6, spine formula of article 6 = 6 + 9 or 7 + 9 plus huge middistal spine; acclivity on inner margin of dactyls of pereopods 1-2 sharp, produced as tooth, emergent setule short, midposterior pluseta short. Coxae 5-7 posteroventral seta formula = 32-32-20, composed of marginal and facial groups. Articles 4-5 of pereopods 3-4 broad, facial spine rows dense; facial ridge formula on article 2 of pereopods 3-5 =

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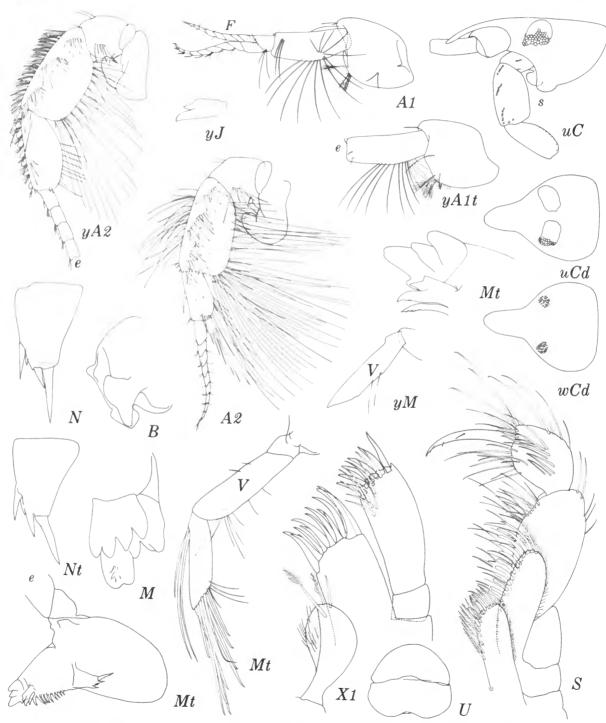


FIGURE 16.—Tipimegus kangulun, new species, holotype, female "n," 7.60 mm (u = male "u," 6.72 mm; w = female "w," 7.20 mm; y = male "y," 7.10 mm).

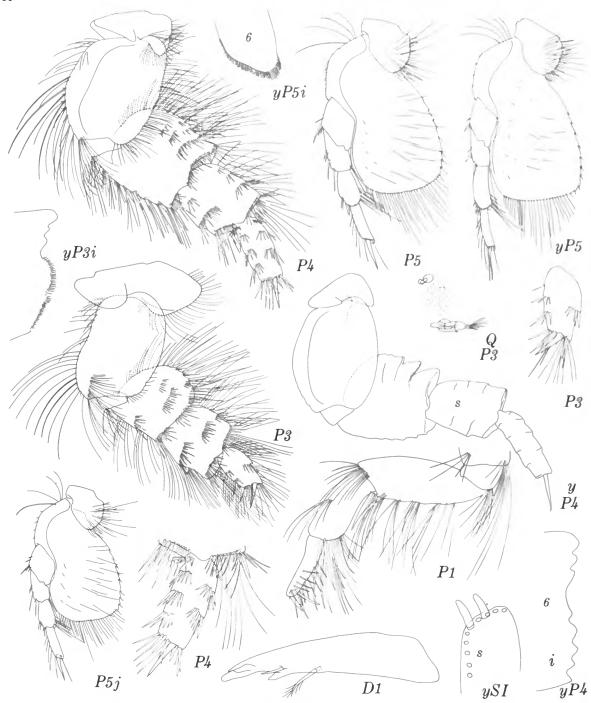


Figure 17.—Tipimegus kangulun, new species, holotype, female "n," 7.60 mm (y = male "y," 7.10 mm).

NUMBER 245 61 G1tE3E4yE40000 IR1dR1iG2tzR1iuOR1S uR1iG2t E_1 0 zR1iR1

FIGURE 18.—Tipimegus kangulun, new species, holotype, female "n," 7.60 mm (j = juvenile "j," 4.37 mm; u = male "u," 6.72 mm; y = male "y," 7.10 mm; z = female "z," 11.25 mm).

0-1-1; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 53:48:42:18, of pereopod 4 = 63:59:44:20, of pereopod 5 = 55:11:10:5; length ratios of pereopod 3 = 72:44:44:34, of pereopod 4 = 75:62:47:45, of pereopod 5 = 80:23:19:22; article 2 of pereopod 5 reaching middle of article 5, ventrally setose; medial apex on article 6 of pereopods 3 and 5 finely combed; dactyls of pereopods 3-4 elongate. Posteroventral corner of epimeron 1 rounded, posterior margin convex, setose, anteroventral face with 15 short to medium setae, midface with 11 medium setae; posteroventral corner of epimeron 2 rounded, weakly protuberant, posterior margin convex, setose, facial setae = 15 + 2 midfacial, pairs and

triads set vertically; posteroventral corner of epimeron 3 weakly protuberant, posterior margin straight, weakly serrate, setose, ventral margin with 16 setae mainly in posterior half, face with occasional sub marginal seta. Urosomite 1 with 4 paired sets of setae, each side with sets of 8 and 2, ventrally with sets of 3 and 2, articulation line complete; urosomite 3 protuberant dorsally. Rami of uropods 1-2 with articulate enlarged sharp apical nails, rami of uropod 2 with accessory nails, continuously spinose; outer ramus of uropod 1 with 9 dorsal spines, irregularly gapped apically, inner with 4 dorsal and 3 lateral (actually medial and lateral) spines; outer ramus of uropod 2 with 6-7

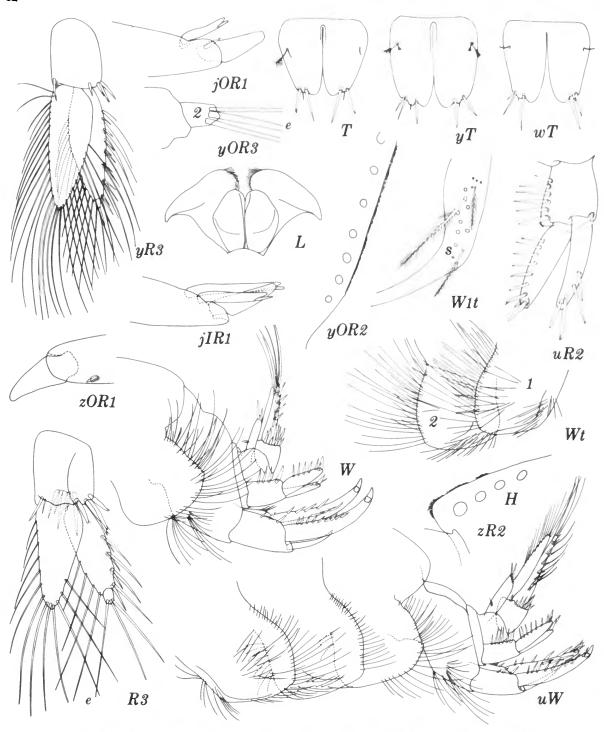


FIGURE 19.—Tipimegus kangulun, new species, holotype, female "n," 7.60 mm (j = juvenile "j," 4.37 mm; u = male "u," 6.72 mm; w = female "w," 7.20 mm; y = male "y," 7.10 mm; z = female "z," 11.25 mm).

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dorsal spines, inner with 2-3 dorsal spines; peduncle of uropod 1 with 3 apicolateral spines, medially with 4 spines; peduncle of uropod 2 with 4-5 dorsal spines, medially with one small apical spine; outer rami of uropods 1-2 and apicolateral corner of peduncle on uropod 2 with weak even comb. Peduncle of uropod 3 with 13-14 ventral spines, dorsally with one lateral spine, one medial spine and setule; rami submasculine, inner extending to M. 100+ on article 1 of outer ramus, apex with 2 setae, medial and lateral margins setose, article 2 of outer ramus short, 0.16, bearing 3 medium to long setae, medial margin of article 1 setose, lateral margin with 3-4 acclivities, spine formula = 2-2-2-(+2), or 1-2-2-2-2, setal formula = 0. Telson ordinary, length-width ratio = 25: 29 or 26:27, not fully cleft, each apex of medium width, rounded, undulant, lateral acclivity shallow, weak, with lateral and medial spines separated by setule, occasionally lateral spine position paired, midlateral setules diverse. Cuticle with ordinary bulbar setules, surface punctate or bearing fine striations in form of linear fingerprint pattern, emergent setules branched.

OBSERVATIONS (female).—Unspined subapex of outer ramus of uropod 1 often with spine vestige subapically, juveniles as small as 3.7 mm also lacking spines apically or juvenile "j," 4.37 mm, with subapical spine and second spinule on face of nail, this spinule also present in superfemale; inner ramus of uropod 1 in juvenile with pair of accessory apical spines; protuberant base of spike on peduncle of uropod 1 becoming elongate in terminal adults.

Variations (female).—Female "w," 7.20 mm: Article 5 of pereopod 3 with 2 rows of posterior facial spines, article 6 of pereopod 4 with 4 rows of posterior facial spines; spine formula on outer ramus of uropod 3 = 2-3-2-2-2.

Superfemale "2," 11.25 mm: Comb on apex of article 6 on pereopod 3 absent, article 2 of pereopod 5 with only 6 facial setae; inner ramus of uropod 1 so cylindrical that dorsal (medial) spines rotated out of sight medially (see illustration), peduncle of uropod 2 with 6 dorsal spines, outer ramus with 8, inner with 4.

DESCRIPTION OF MALE.—Eyes enlarged. Article 1 of antenna 1 with increased numbers of ventral setules, no medial fuzz; primary flagellum with 9 articles, one calceolus each on articles 1-4, aesthetascs well developed; accessory flagellum with 8 articles. Facial

spine formula on article 4 of antenna 2 = 2-12-11-7, dorsomedial margin fuzzy, other setae shortened; article 5 with 8 dorsal sets of male setae and 7 calceoli, ventrodistal apex with 2 setules; flagellar formula = 45, 2-4, 6, 8 ... 40 or 44, 2-5, 7, 9 ... 39. Distal member of right lacinia mobilis poorly subbifid, inner margin of article 3 on mandibular palp with 2 accessory setae not in female. Inner plate of maxilliped with 2 main apical spines spread slightly more than in female, 4 medial setae; outer plate with 12 spines; palp article 2 with 3 lateral setae, article 3 with 6 lateral setae. Coxae 3-4 slightly to much longer than in female; ventral setal formula of coxae 1-4 = 10-13-13-27. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-26-6-6-3, long anteriors = 6-9-14-7, short anteriors = 1-2-4-3, no others. Setal and spine formulas of pereopods 1-2 on article 4 = 5 + 5 (separated by gap from other distal setae), on article 5 = 5 and 5, on article 6 = 9 + 10 plus middistal spine, setae on posterodistal margin of article 4 shorter than in female. Article 2 of pereopods 3 and 5 slightly narrower than in female. Epimera 1-2 with numerous short posterodorsal setae, epimera 1-3 slightly broadened, posterior margin of epimeron 3 not shortened. Urosome ventrally with 3 paired sets of setae, lateral set = 7, ventral sets = 3 and 4. Spine formula of uropods: uropod 1 peduncle apicolateral = 3; uropod 2 peduncle dorsal = 6; dorsal spines on outer ramus of uropod 1 = 9, continuous to apex, but with slightly excessive gap between spines 1-2, of uropod 2 = 8; inner ramus of uropod 1 = 6-7 plus 3, of uropod 2 = 3. Ventral spines on peduncle of uropod 3 = 14-15; spine formula on 2-2-2-2, setal formula = 3-1-1-1-1-1 or 2-1-2-1-11-1-1. Telson weakly elongate, broadened apically, distal spines scarcely shortened, midbase of each lobe with numerous acute denticles.

VARIATIONS.—Aberrant male, 8.0 mm, PPBES 960/3: Eyes scarcely enlarged but penial processes well developed; antenna 2 like that of female; uropod 3 almost fully masculine but antenna 1 and epimera like those of female.

ILLUSTRATIONS.—Female maxilla 2 as in *Tipimegus thalerus*; several spines on ventral side of peduncle on uropod 3 omitted.

HOLOTYPE.—AM, female "n," 7.60 mm.

TYPE-LOCALITY.—SBS C4S4, 17 May 1972, off Malabar, New South Wales, Australia, 69 m, sand.

VOUCHER MATERIAL.—SBS E2S4: female "w," 7.20 mm (illus.); male "y," 7.10 mm (illus.); male "u," 6.72 mm (illus.); juvenile "j," 4.37 mm (illus). CPBS 24N: female "z," 11.25 mm (illus.).

RELATIONSHIP.—This species differs from Tipimegus thalerus in the elongate dactyls of pereopods 3-4, the small size of the cuticular setules, the broad apices of the hands on the gnathopods, the widely spread setae on coxae 1-3, and the elongation of the lateral seta on article 2 of uropod 3 which in T. thalerus forms a shorter and distinctive spine. Tipimegus kangulun is characterized by the noncontinuous dorsal spination on uropod 1, particularly well developed in females and juveniles but becoming obscured in males. Male uropod 1 usually has some weak degree of asymmetry in the placement of apical spines and lacks any definite apical spine fully contiguous with the nail. In all but superfemales article 6 of pereopod 3 bears a distal comb which is absent in T. thalerus. Generally the spine forming part of the spike on the peduncle of uropod 1 is shorter in T. kangulun than in T. thalerus.

REMARKS.—A single male with stunted antenna 2 from JLB AUS 11, Western Australia, is provisionally identified with *T. kangulun* but the setae on coxae 1-3 are few and narrowly spread; this may be a new species and will be reserved until more material from Western Australia can be collected.

MATERIAL.—CPBS, 3 samples from 2 stations (3); WPBES, 2 samples from 2 stations (5); PPBES, 14 samples from 10 stations (26) [5 doubtful from 2 samples]; AM, one sample (1); SBS, 6 samples from 4 stations (17).

DISTRIBUTION.—Victoria: Western Port and Port Phillip Bay, 2-13 m, sand. New South Wales: off Sydney, 53-150 m, sand.

Tipimegus kalkro, new species

FIGURES 20-23

Description of Female.—Head about 22 percent of total body length, greatest width about 70 percent of length, rostrum constricted, narrow, reaching apex of article 2 on antenna 1. Eyes medium, partly occluded with pigment. Article 1 on peduncle of antenna 1 about 1.2 times as long as wide, about twice as wide as article 2, ventral margin with about 11 setules, weakly produced dorsal apex with 2 setules; article 2 about 1.1 times as long as article

1, with ventral crescent of 12-13 setae; primary flagellum with 8-9 articles, about 0.65 times as long as peduncle, bearing long aesthetascs; accessory flagellum with 8 articles. Spine formula on article 4 of antenna 2 = 11-8-5 or 11-8-4+3-4 supernumerary spines, dorsal margin setose, ventral margin with 7-8 groups of 2-5 long to medium setae, dense ventrodistal brush of setae; article 5 about 0.45 times as long as article 4, facial spine formula = 0, dorsal margin sparsely setulose, ventral margin with 9 unpaired setae, 5 ventrodistal medium spines, this row set facially; flagellum about 0.9 times as long as articles 4-5 of peduncle combined, with 11-12 articles. Mandibles with weak palpar hump; right incisor with 4 teeth; left incisor with 4 teeth in 2 humps; right lacinia mobilis bifid, distal branch much shorter than proximal, broad, subbifid, proximal branch simple, pointed; left lacinia mobilis with 4 teeth; right rakers 10-12 plus 0-1 rudimentary; left rakers 13-14 plus one rudimentary; molars elongate, conical or columnar, each with one long apical spine, one short apical spine, one medium spine on side with vestigial nonarticulate partner; palp article 1 short, article 2 with 1-2 medium inner apical setae, plus 3-5 other shorter apical setae in clump and one other short inner seta, and 3 outer facial setae, article 3 about 0.95 times as long as article 2, oblique apex with 16 spine-setae, basodorsal formula = 3 (or 2 on left occasionally). Inner plate of maxilla 1 large, bearing one long subapical pluseta, 2 apicolateral shorter setae; palp article 2 with 7-8 apical spines and 12 submarginal and facial setae. Inner plate of maxilla 2 shorter and narrower than outer, outer lacking apicolateral setae, inner with 6 medial setae. Inner plate of maxilliped with 2 large, thick apical spines, 6 apicofacial setae, 4 medial setae, outer plate with 14 medial and apical spines, no apicolateral setae; palp article 1 lacking apicolateral seta, article 2 with one group of 2 apicolateral setae, medial margin of article 2 strongly setose, article 3 with 29 facial setae, 5 lateral setae, article 4 with 3 apical setules, nail absent. Coxa 1 strongly expanded distally, anterior margin straight; main ventral setae of coxae 1-4 = (6-7)-(9-11)-(9-11)-(16-22), posteriormost seta of coxae 1-3 shortest; anterior and posterior margins of coxa 4 strongly divergent, posterior margin oblique, almost straight, posterodorsal corner sharp, posterodorsal margin ordinary, almost straight; width-length ratio of $\cos 4 = 17:18$. Long posterior

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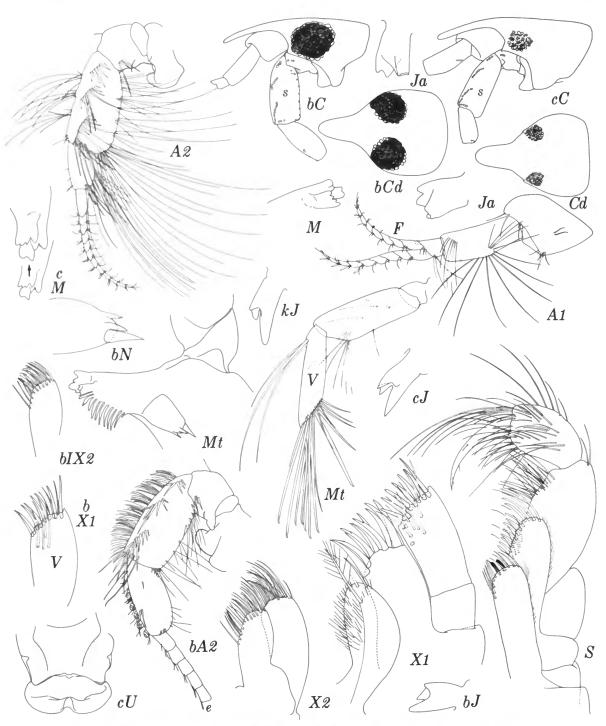


FIGURE 20.—Tipimegus kalkro, new species, holotype, female "d," 5.66 mm (b = male "b," 5.00 mm; c = female "c," 5.43 mm; k = female "k," 5.67 mm).

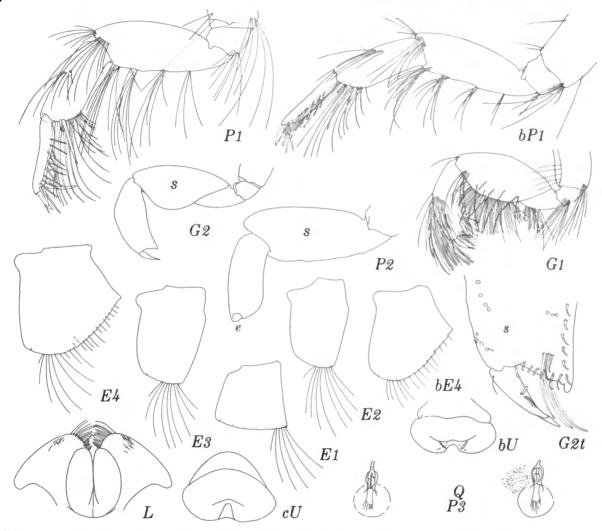


FIGURE 21.—Tipimegus kalkro, new species, holotype, female "d," 5.66 mm (b = male "b," 5.00 mm; c = female "c," 5.43 mm).

setae on article 2 of gnathopods 1-2 and pereopods 1-2=6-8-9-7, long anteriors = 17(+3 facial)-14-15-1, short anteriors = 2-3-4-4, no others. Gnathopods with thin hands narrow apically; width ratios of articles 5-6 on gnathopods 1-2=30:21 and 29:21, length ratios = 65:50 and 63:47, palmar humps small, palms transverse; article 5 of gnathopods 1-2 elongate, ovate, posterior margins rounded. Pereopod 2 stouter than pereopod 1, especially article 4; facial setae formula on article 4=7 or 8 and 8 or 8, on article 5=6 and 6 or 6 and 7; main spine of article 5 extending to M. 85 on article 6,

spine formula of article 6 = 9 + 9 and 9 + 9 or 8 + 9 plus huge middistal spine; acclivity on inner margin of dactyls of pereopods 1-2 sharp, produced as tooth, emergent setule short, midposterior pluseta short. Coxae 5-7 posteroventral seta formula = 22-35-30 composed of marginal and facial groups. Articles 4-5 of pereopods 3-4 broad, facial spine rows dense; facial ridge formula on article 2 of pereopods 3-5 = 0-1-1; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 53:47:48:22, of pereopod 4 = 57:55:43:19, of pereopod 5 = 55:9:8:4; length ratios of pereopod 3 = 72:42:41:31, of pereopod 4 = 64:57:48:27

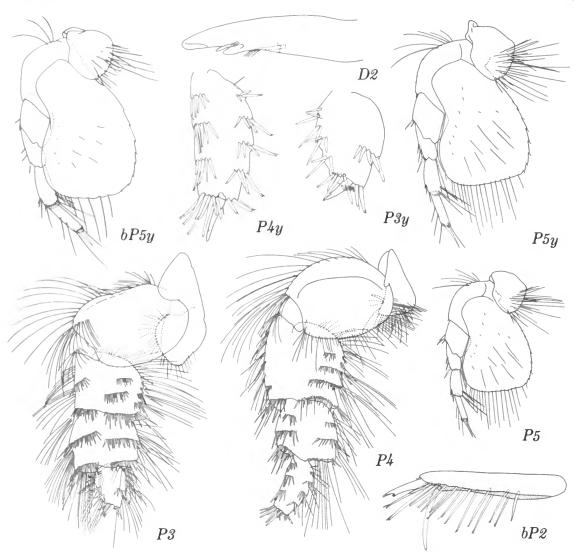


FIGURE 22.—Tipimegus kalkro, new species, holotype, female "d," 5.66 mm (b = male "b," 5.00 mm).

42:40, of pereopod 5 = 75:20:19:20; article 2 of pereopod 5 reaching middle of article 5, ventrally setose; medial apex on article 6 of pereopods 3 and 5 finely combed; dactyls of pereopods 3-4 short. Posteroventral corner of epimeron 1 weakly protrusive, posterior margin weakly convex, setose, anteroventral face with 7-8 short to medium setae, midface with 11 medium setae; posteroventral corner of epimeron 2 rounded, weakly protuberant, posterior margin convex, setose, facial setae = 8-9 plus one midfacial, some pairs set vertically (rows of 7 + 2 or

6 + 2); posteroventral corner of epimeron 3 weakly protuberant, posterior margin almost straight, weakly serrate, setose, ventral margin with 8-10 setae mainly in posterior half, face with several submarginal setae. Urosomite 1 with 4 paired sets of setae, each side with sets of 5-7, ventrally with sets of 2-4, 2-4, and 2, articulation line complete; urosomite 3 protuberant dorsally. Rami of uropods 1-2 with articulate enlarged sharp apical nails, rami of uropods 1-2 with 1-2 accessory nails, continuously spinose; outer ramus of uropod 1 with 7 dorsal

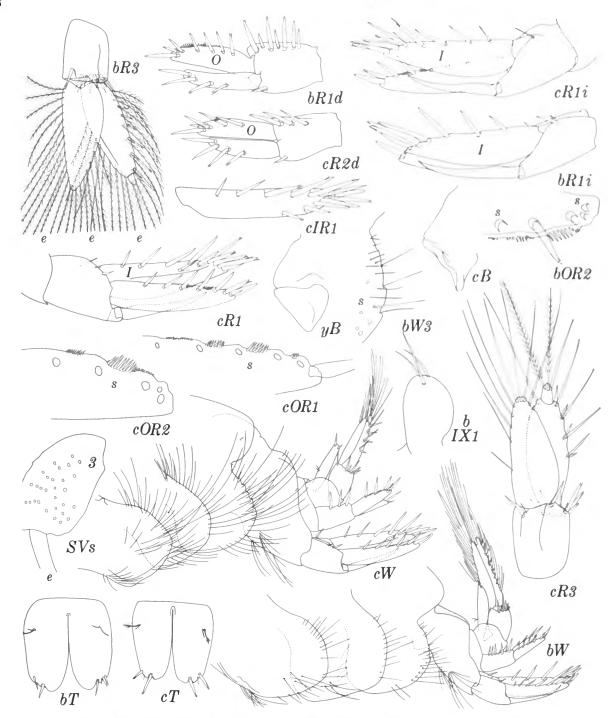


FIGURE 23.—Tipimegus kalkro, new species, holotype, female "d," 5.66 mm (b = male "b," 5.00 mm; c = female "c," 5.43 mm; y = male "y," 5.30 mm).

spines, inner with 5-8 dorsal plus 3-5 lateral; outer ramus of uropod 2 with 4-5 dorsal spines, inner with 3 dorsal spines; peduncle of uropod 1 with 2 apicolateral spines, medially with 1-2 marginal spines; peduncle of uropod 2 with 3 dorsal spines, medially with one small apical spine; outer rami of uropods 1-2 and apex of peduncle on uropod 2 with large comb (or comb absent on peduncle of uropod 2). Peduncle of uropod 3 with 9-12 ventral spines, dorsally with one lateral spine, medial spine and setule or 2 spines only; rami submasculine, inner extending to M. 100+ on article 1 of outer ramus, apex with 3 setae, medial margin setose, lateral margin with one apical seta; article 2 of outer ramus ordinary, 0.20, bearing 3 medium to long setae, lateralmost shortest, thin, nonplumose, spinelike; apicomedial margin of article 1 with 3 setae, lateral margin with 4 acclivities, spine formula = 2-2-2-2, setal formula = 0. Telson ordinary, length-width ratio = 1:1, not fully cleft, each apex of medium width, rounded, undulant, lateral acclivity shallow, weak, with lateral and medial spines separated by setule, midlateral setules diverse. Cuticle with ordinary bulbar setules, surface with dense fuzz of denticles, emergent setules branched.

OBSERVATIONS (female).—Article 2 on percopod 5 of female "c" with 11 long facial setae, 9 setules but only 3 anterodorsal setae; article 5 of percopod 1 in adults with strong medial comb on distal bevel, with one medioproximal spinule; female "d" holotype with aberrant right lacinia mobilis, proximal branch stubby, perhaps broken and regenerate.

DESCRIPTION OF MALE.—Less robust than female. Eyes enlarged. Article 1 of antenna 1 lacking medial fuzz, bearing 16 or more ventral setules; article 2 with 11 ventral setae; one calceolus each on articles 1-3 of primary flagellum. Spine formula on article 3 of antenna 2 = 3 plus disjunct setule, on article 4 = 3-9-7-6 or 3-11-7-5, (or, rarely, variations thereof), plus 3 supernumerary spines, on article 5 = 2, article 4 with dorsomedial fuzz, ventral setae shortened and fewer than in female; article 5 with 5 distoventral setules, dorsal margin with 5-6 calceoli and 7-8 sets of male setae; flagellum with approximately 42 articles (often broken), flagellar formula = 42, 3, 4, 6, 8 ... 40 (calceoli on segments 3-12 rudimentary), or 2-7, 9 ... (calceoli on 5, 6, 7, 11 rudimentary), or 2-5, 7, 9 ... (calceoli on 3 and 7 rudimentary), or, rarely, other variations. Upper lip more deeply incised than in female. Mandibular molars bearing only 3 spines; right rakers 10 plus one rudimentary, left 13 plus one rudimentary; basofacial setal formula on palp article 3=2, inner margin with 5 setae (absent in female). Coxa 4 narrower than in female but of similar length relative to coxa 1. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 1-4-5-4, long anteriors = 10-11-12-1, short anteriors = 1-3-5-3. Pereopods 1-2 thinner than in female; facial and spine formulas on article 4 = 7 and 6, on article 5 = 5 and 5, on article 6 = 8 + 8 plus huge middistal spine. Article 2 of pereopod 5 narrower than in female; articles 5 and 6 of pereopod 4 greatly to slightly narrower. Epimera 1-3 broadened; posterior margin of epimeron 3 shortened; facial ridge on epimeron 2 weak or absent; setal formulas, epimeron 1 anteroventral = 5-6, facial = 14 decreasing to 5, epimeron 2 facial = 5-6, epimeron 3 ventral = 8-9. Spine formulas of uropods, uropod 1 peduncle apicolateral = 2, medial = 1, uropod 2 peduncle dorsal = 6-7, dorsal spines on outer ramus of uropod 1 = 8, of uropod 2 = 6-7, inner ramus of uropod 1 = 5 + 5, of uropod 2 = 3. Ventral spines on peduncle of uropod 3 = 12-13, spine formula on article 1 of outer ramus = 0-0-0-1-1-2-2-3-3, or 0-0-0-2-2-2, or, rarely, other variations thereof, setal formula = 1×9 , or 2-1-1-1-1-0-0, or other variations. Telson weakly elongate, broadened, 2-3 distal spines on each lobe shortened, each lobe with patch of midbasal denticles.

ILLUSTRATIONS.—Lateral head of female "c" illustrated but outline of antenna 1 added to drawing from holotype female "d" by adjusting heads to same proportions; palp of maxilla 1 heavily flattened, 2 setae omitted; palp article 3 of maxilliped with several setae omitted from face on whole view but enlargement with setae marked by their pits showing all 29 facial setae; article 2 on outer ramus of male uropod 3 lacking mid seta, often broken off, lateralmost spine-seta plumose or not (variable on single individual); denticles of male telson too small to show on illustration.

HOLOTYPE.—NMV, female "d," 5.66 mm.

Type-Locality.—PPBES 912/4, 19 Nov 1971, Port Phillip Bay, Victoria, Australia, 7 m, sand.

VOUCHER MATERIAL.—Type-locality: female "c," 5.43 mm (illus.); young male "a," 5.72 mm. PPBES 912/1: male "b," 5.00 mm (illus.); male "y," 5.30

mm (illus.). PPBES 920/5: female "k," 5.67 mm (illus.); male "m," 5.61 mm.

Relationship.—This species differs from T. thalerus, T. dinjerrus, and T. kangulun in the presence of grossly enlarged combs on the outer rami of uropods 1-2. It further differs from T. thalerus in the smallness of the cuticular setules, in the greater elongation or thinness of the special lateral spine-seta on article 2 of the outer ramus on uropod 3, in the fewer spines on the outer ramus of uropod 2, the greater number of spines on the inner ramus of uropod 2, the fewer spines medially on the peduncle of uropod 1, and in the longer spines on uropods 1-2. From T. dinjerrus, T. kalkro further differs in the narrow apices of the gnathopods. From T. kangulun, T. kalkro further differs in the evenly spread spination on the outer ramus of uropod 1, in the shortened dactyls of pereopods 3-4, and in the narrow apices of the gnathopods.

MATERIAL.—PPBES, 23 samples from 13 stations (54).

DISTRIBUTION.—Victoria, Port Phillip Bay, 4-8 m, sand.

Tipimegus stebbingi (J. L. Barnard), new combination

Pontharpinia pinguis.—Stebbing, 1897:33-34, pl. 9B [not Haswell, 1880]; 1910:635
 Paraphoxus stebbingi J. L. Barnard, 1958:148; 1960:282.

Type.—Female 3/10 inch.

Type-Locality.—Jervis Bay, New South Wales, Australia.

Notes.—The female identified by Stebbing as Pontharpinia pinguis (Haswell) does not belong to that species, nor, indeed to the genus Pontharpinia. Stebbing used this female to erect the genus Pontharpinia to contain Pontharpinia pinguis as the type-species in monotypy. Pontharpinia is therefore a confounded genus but we prefer to maintain Pontharpinia as a valid genus for the purposes of nomenclatural stability. J. L. Barnard (1958) renamed Stebbing's specimen but according to Dr. Roger J. Lincoln of the British Museum (Natural History), Dr. D.J.G. Griffin of the Australian Museum and Dr. Torben Wolff of the Universitetets Zoologiske Museum, this specimen is lost. Those are the three museums in which it might have been deposited.

We cannot identify T. stebbingi from Stebbing's description; extensive exploration of Jervis Bay will be necessary to sort out the probable identity. Tipimegus stebbingi is apparently not in the genus Booranus because article 2 of percopod 5 is poorly inflated anteriorly in that genus. The short dactyl of percopod 3 and the apically narrowed hands of the gnathopods suggest that T. stebbingi may be identical to T. thalerus or T. kalkro but the widely spread setae of coxa 2 suggest affinity with T. kangulun. Tipimegus stebbingi may therefore be fully distinct from any of the new species described herein.

Tipimegus species 4N

Notes.—This probable new species is represented in the collections only by an immature male; its full description is reserved until additional materials become available. Setae on coxa 1 poorly spread; hands of gnathopods broad apically, palms straight; dactyl of pereopod 3 short, article 6 stout, dactyl of pereopod 4 longer than half of article 6, latter elongate, thin; outer ramus of uropod 1 with continuous and apically dense dorsal spination; outer ramus of uropod 2 with dense and even but fine dorsal comb; epimeron 2 bearing setae in middle of lateral surface; cuticular setules composed of very small bulbs, emergent setule at most asymmetrically bifid or bearing very few side plumes.

It differs from *T. thalerus* in the very elongate article 6 and dactyl of pereopod 4, the presence of midsetae on epimeron 2, and the dense clumping of apical spines on the outer ramus of uropod 1.

It also differs from T. dinjerrus in the presence of midsetae on epimeron 2, the shorter dactyl of pereopod 4 and the dense clumping of apical spines on the outer ramus of uropod 1.

MATERIAL.—SBS E253, male, 3.84 mm, New South Wales, off Malabar, 52 m, sand.

Tipimegus species 5N

Notes.—This apparently distinct species is represented in the collections by subadult males and juveniles; its full description is reserved until adult females become available. Setae on coxa 1 poorly spread; hands of gnathopods narrow apically (but slightly broader than in T. thalerus), palm of gnathopod 1 S-shaped; dactyls of pereopods 3-4 longer than in T. thalerus but less than half as

long as article 6, latter elongate and thin in both pereopods 3-4; outer ramus of uropod 1 with continuous spination but with weak and excessive gap between spines 1 and 2 (spine 1 closely adjacent to nail); outer ramus of uropod 2 lacking conspicuous dorsal comb but with ultrafine ragged combfuzz; epimeron 2 lacking setae in middle of lateral surface; cuticular setules composed of small bulbs of size similar to those of T. dinjerrus, emergent setules branched.

It differs from T. thalerus in the weakly S-shaped curve on the palm of gnathopod 1, in the greater elongation of the dactyl and article 6 of pereopods 3-4, and in the greater gap between spines 1 and 2 on the outer ramus of uropod 1.

It differs from T. species 4N in the S-shaped but slightly shorter palm of gnathopod 1, the absence of middle setae on epimeron 2, the sparser apical spination on the outer ramus of uropod 1, and the somewhat shorter dactyls of pereopods 3-4.

It further differs from *T. dinjerrus* in the S-shaped palm of gnathopod 1 and the slightly more elongate articles 6-7 of pereopods 3-4.

MATERIAL.—PPBES, 7 samples from 3 stations (18).

DISTRIBUTION.—Victoria, Port Phillip Bay, 4-8 m, sand.

Booranus, new genus

DIAGNOSIS.—Eyes present. Flagella of antennae 1-2 unreduced in female. Article 2 of antenna 1 ordinary, ventral setae widely spread. Article 1 of antenna 2 weakly ensiform; article 3 with numerous setae, setules and spines; facial spines on article 4 in 2 or more rows, plus special apical spines; article 5 especially thin and short. Right mandibular incisor with 4 teeth; molar not triturative, large, elongate conical, then subtruncate and bearing 3-4 special large spines, not bearing fuzz; palpar hump small. Palp of maxilla 1 biarticulate; inner plate with 4-5 setae. Setation of maxilla 2 ordinary. Inner plate of maxillipeds ordinary; apex of palp article 3 not protuberant, dactyl elongate, apical nail absent. Gnathopods small, similar; article 5 of gnathopods 1-2 elongate, free, without eusirid attachment; palms transverse to chelate, hands elongate, heavily setose anteriorly, trichophoxid in shape. Article 5 of pereopods 1-2 lacking setae posteroproximally. Article 2 of pereopod 3 of broad form, articles 4-5 of pereopods 3-4 broad, article 2 of pereopods 3-4 setose posteriorly; pereopod 5 especially small, article 2 strongly setose ventrally, article 3 greatly enlarged, dactyl normal, pereopod 5 with gills. Epimera 1-2 bearing numerous long posterior setae, rarely with midfacial setae above ventral facial ridge; epimeron 3 ordinary, bearing row of facial spines. Urosomite 1 naked laterally, bearing one or more midventral crescents or bundles of setae; urosomite 3 lacking dorsal hook or special process. Peduncle of uropod 1 normally elongate to weakly shortened, with apicoventral spike, without special enlarged apicolateral or medial spine, only pedunclar apices of uropod 2 combed; inner ramus of uropod 1 with 2 rows of marginal spines, some rami continuously spinose to apex; inner ramus of uropod 2 especially shortened. Uropod 3 ordinary, article 2 of outer ramus carrying 3 short to long apical setae. Telson ordinary, with 2-3 apical spines or setae on each lobe plus setules.

DESCRIPTION.—Rostrum fully developed, constricted. Fuzz on article 1 of antenna 1 in male absent; calceoli on male primary flagellum of antenna 1 present. Calceoli on article 5 of male antenna 2 present, facial spines absent in female, flagellum in male with calceoli. Prebuccal parts strongly extended forward, especially massive, strongly distinct, epistome with large tooth, neither epistome nor upper lip dominant. Right lacinia mobilis bifid, thin; article 1 of mandibular palp short, palp medium, apex of article 3 oblique, article 2 with outer setae. Lower lip lacking cones. Outer plate of maxilla 1 with 11 spines, one spine especially thickened. Inner plates of maxilliped thick, ordinarily setose. Coxae 2-4 with special anterodorsal humps. All posterior spines on article 6 of pereopods 1-2 thick and stiff, midapical spine present, especially enlarged. Article 2 of pereopod 5 with facial setae. Peduncle of uropod 1 with dorsolateral spines widely spread, medial spines partially spread; peduncle of uropod 2 with medial spines confined apically. Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with ordinary pair of midlateral or dorsal setules on each side.

Type-Species.—Booranus weemus, new species. Composition.—Booranus tikeri, new species; B. wangoorus, new species.

RELATIONSHIP.—This genus is extremely close to

Tipimegus but is believed to qualify as a full and separate genus because each forms a tight cluster of 3 to 5 species without intergradations. The main distinctions of *Booranus* are the massively produced epistome and the presence of gills on pereopod 5.

The two clusters also differ in the presence (Booranus) or absence (Tipimegus) of a grossly developed lateral spine row on epimeron 3.

See "Relationship" under *Tipimegus* for other common characteristics.

Key to the Species of Booranus

Booranus weemus, new species

FIGURES 24-26

Description of Female.—Head about 22 percent of total body length, greatest width about 60 percent of length, rostrum constricted, narrow, elongate, exceeding middle of article 2 on antenna 1. Eyes large, clear of pigment, ommatidia ordinary. Article 1 on peduncle of antenna 1 about 1.25 times as long as wide, about twice as wide as article 2, ventral margin with about 4 setules, weakly produced dorsal apex with 1-3 setules; article 2 about as long as article 1, with ventral cycle of 12-13 setae; primary flagellum with 10-11 articles, about 0.85 times as long as peduncle, bearing medium aesthetascs; accessory flagellum with 11 articles. Article 3 of antenna 2 with 5 setae-spines and one setule; spine formula of article 4 = 4-10-9-9 or 3-9-10-8, dorsal margin with 4 notches each bearing 3-5 setae, ventral margin with 7 groups of 1-5 long to short setae, 2-3 distal long spines and brush of 11+ setae; article 5 about half as long as article 4, facial spine formula = 0, dorsal margin bearing 2 setae, ventral margin with 7-9 unpaired setae, clump of 5-6 ventrodistal long to short spines, no subdistal facial spines; flagellum about as long as articles 4-5 of peduncle combined, with 14 articles. epistome with sharp anterior protrusion; upper lip with ventral sinus. Mandibles with weak palpar hump; right incisor with 4 teeth; left incisor with 4 humps in 2 branches; right lacinia mobilis bifid, distal branch shorter than proximal, subbifid, proximal branch simple, pointed, with marginal denticles, humps; left lacinia mobilis with 4 teeth; right rakers 11 plus or minus one rudimentary; left rakers 12-13; molars elongate, conical, each molar with 4 long to short spines, none disjunct; palp article 1 short, article 2 with one long and one short inner apical setae and 6 other shorter inner and facial setae, article 3 about 1.1 times as long as article 2, oblique apex with 12 spine-setae, basodorsal formula = 0-2. Inner plate of maxilla 1 large, bearing one long apicofacial pluseta, 3 shorter apical setae; palp article 2 with 9-10 apical marginal spines and 9-10 submarginal setae. Inner plate of maxilla 2 shorter and narrower than outer, outer lacking apicolateral setae, inner with 10-11 medial setae. Inner plate of maxilliped with 2 large thick apical spines, 5-6 apicofacial setae, 4-5 medial setae; outer plate with 15-18 medial and apical spines, one apicolateral seta; palp articles 1-2 lacking apicolateral setae; medial margin of article 2 moderately setose; article 3 with about 30 facial setae, 7-9 lateral setae in 5 groups; article 4 with 5 accessory setules, mostly on face, nail absent. Coxa 1 strongly expanded distally, anterior margin almost straight; main ventral setae of coxae 1-4 = (7-8)-(9-10)-(9-10)-17, posteriormost seta of coxae 1-3 shortest; anterior and posterior margins of coxa 4 divergent, posterior margin oblique, almost straight, posterodorsal corner rounded, posterodorsal margin short, undulant, width-length ratio of coxa 4 = 13:16; gills present on coxae 2-7. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 4-3-7-6, long anteriors = 20(+3 facial)-7-8-(2-3), short anteriors = 3-5-4-(4-5), no others. Gnathopods thin, hands thin, parachelate, mitellid (occasionally

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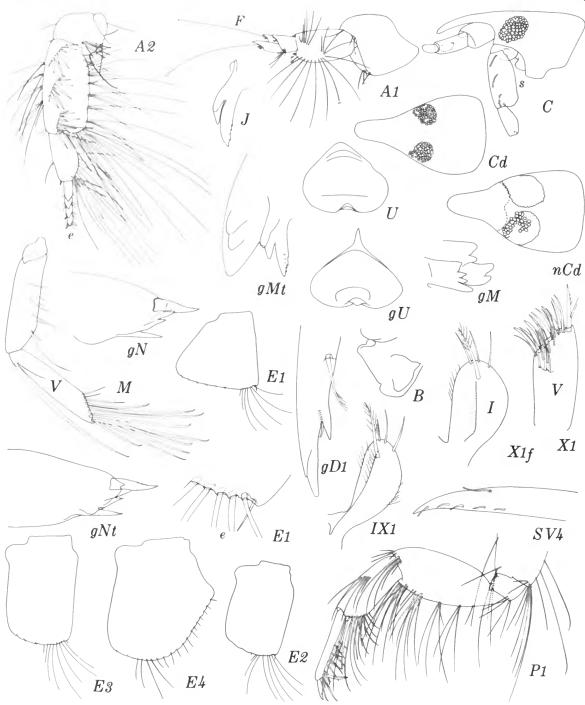


FIGURE 24.—Booranus weemus, new species, female "a," 6.1 mm (g = holotype female "g," 5.63 mm; n = male "n," 5.58 mm).

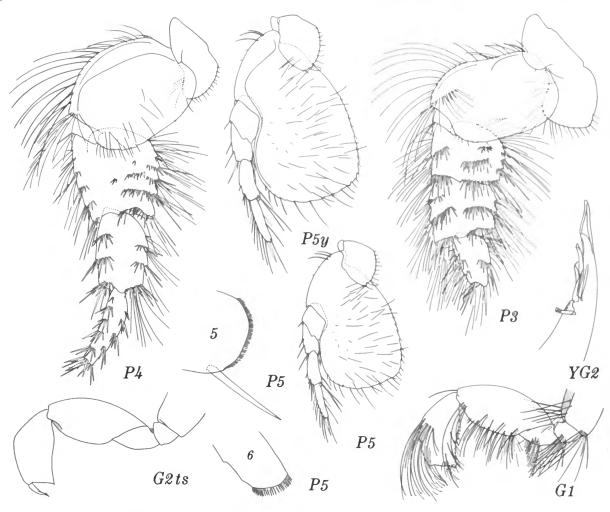


FIGURE 25.—Booranus weemus, new species, female "a," 6.1 mm (Y = dactyl).

gnathopod 2 slightly smaller than gnathopod 1); width ratios of articles 5-6 on gnathopods 1-2=29:24 and 28:25, length ratios = 63:46 and 65:46; palmar humps very small, palms transverse; article 5 of gnathopods 1-2 elongate, ovate, posterior margins rounded-flat. Pereopods 1-2 similar; article 4 of pereopods 1-2 similar but much stouter on pereopod 2; article 5 with apicomedial comb on pereopods 1-2; facial setae formula on article 4=5 and 5 or 5 and 4, on article 5=5 and 6 or 6 and 6; main spine of article 5 extending to 6. 6 on article 6, article 6 with one extra long distoposterior spine and numerous setae, proximal margin naked; spine formula of article 6=6+8 and 7+8

or 7 + 9 and 8 + 9 plus huge middistal spine, some spines especially long; acclivity on inner margin of dactyls of pereopods 1-2 sharp, produced as tooth, emergent setule short, marginal pluseta highly proximal. Coxae 5-7 posteroventral seta formula = 18-18-11, none facial. Articles 4-5 of pereopods 3-4 broad, facial spine rows dense; facial ridge formula on article 2 of pereopods 3-5 = 0-1-1; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 52:48:44:22, of pereopod 4 = 65:55:34:14, of pereopod 5 = 60:10:8:4; length ratios of pereopod 3 = 71:39:38:35, of pereopod 4 = 77:59:51:52, of pereopod 5 = 89:20:21:22; article 2 of pereopod 5 almost reaching apex of article 5, ventrally setose, anterior margin weakly

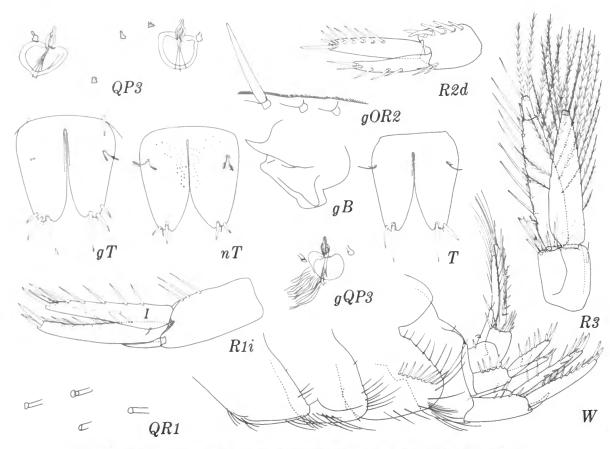


FIGURE 26.—Booranus weemus, new species, female "a," 6.1 mm (g = holotype female "g," 5.63 mm; n = male "n," 5.58 mm).

bulging, pereopod 5 small and mostly hidden by pereopod 4, lateral apex of article 5 and medial apex of article 6 finely combed. Posteroventral corner of epimeron 1 rounded-quadrate, posterior margin straight, weakly setose (4), anteroventral margin and face with 6-7 short setae, posteroventral margin with 2-3 short setae, no fully facial setae; posteroventral corner of epimeron 2 rounded, posterior margin straight, weakly serrate, setose, facial setae = 5-7, none set vertically; posteroventral corner of epimeron 3 rounded, weakly protuberant, posterior margin almost straight, serrate, setose, ventral margin with 6-7 setae mainly in posterior half, face with oblique row of 7-8 spines in middle; epimera 1-2 with setule on posterodorsal margin set in weak notch. Rami of uropods 1-2 with articulate enlarged sharp apical nails and accessory nails, spike on uropod 1 reaching to M. 30-35 on

outer ramus, outer ramus of uropod 1 with 8-10 dorsal spines, inner with 5-6 and facial row of 3-4 spines; outer ramus of uropod 2 with 5-6 dorsal spines, inner with 3-4 dorsomedial spines including accessory nail; peduncle of uropod 1 with 4 apicolateral spines, no basofacial setae, medially with 3 marginal spines, apicalmost ordinary; peduncle of uropod 2 with 4-5 dorsal spines, medially with pair of apical spines; apicolateral corners of peduncles on uropods 1-2 with weak comb. Peduncle of uropod 3 with 11-12 ventral spines, dorsally with 4-5 lateral spines, one medial spine; rami masculine, inner extending to M. 100 on article 1 of outer ramus, apex with 3 setae, medial and lateral margins setose; article 2 of outer ramus ordinary, 0.17, bearing 2 medium setae and one spine, apicomedial margin of article I setose, lateral margin with 7-8 acclivities, spine formula =

(1)-2-2-2-2-2-2-2, one spine of each set elongate, setal formula = 0. Urosomite 1 with midlateral group of 8-9 setae, one ventral seta on each side, articulation line incomplete; urosomite 3 protuberant dorsally, with middorsal spine on each side. Telson long, length-width ratio = 31:28, not fully cleft, each apex narrow to medium, rounded, with middle acclivity, lateral acclivity narrow, weak, bearing ordinary lateral spine, spine next medial longer, with lateral and medial spines separated by setule, often with third spine fully lateral, midlateral setules diverse. Cuticle with bulbar setules closely packed with pipes and spicules or studs, setules surrounded by cordate plaques, surface bearing fine striations in form of linear fingerprint pattern, emergent setules branched.

OBSERVATIONS (female).—Description based on holotype female "g" and female "a." Female "a" with aberrant, narrowed telson bearing only 2 (normal) apical spines on each lobe; spike of uropod 1 about 15 percent shorter than in female "g"; facial ridges on article 2 of pereopod 3 probably artifacts.

DESCRIPTION OF MALE.—Eyes hugely enlarged. Article I of antenna I lacking medial fuzz, bearing numerous ventral setules; article 2 with 11 ventral setae; primary flagellum with 11 articles, one calceolus each on articles 1-5, aesthetascs on primary flagellum as in female; accessory flagellum with 9 articles. Facial spine formula on article 4 of antenna 2 = 4-10-9-7; article 5 with 5 ventral setae, one subapical facial spine, one setule, proximal face with one setule, dorsal margin with 4 sets of male setae and 3 calceoli, ventrodistal apex with 5 setules in row; flagellar formula = 28, 2, 4, 6 ... 14. Mandibular palp article 3 as in female, lacking setae on inner margin. Coxa 4 similar to but smaller in relation to coxa 1 than in female; ventral setal formula of coxae 1-4 = 8-9-9-15. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 2-3-3-3. Pereopods 1-2 much thinner than in female; facial and setal spine formulas of pereopods 1-2 on article 4 = 4 and 4, on article 5 = 5 and 6, on article 6 = 6 + 8 and 7 + 8 plus middistal spine. Article 2 of pereopods 3, 4, 5 slightly narrower than in female. Epimera 1-3 broadened; posterior margin of epimeron 3 not shortened; setal formulas, epimeron 1 anteroventral = 4, ventral = 7 widely spread, posterior = 8, epimeron 2 facial = 5, posterior = 8, epimeron 3 posterior = 8, facial = 9, ventral = 5. Spine formulas of uropods, uropod 1 peduncle apicolateral = 4, uropod 2 peduncle dorsal = 6, dorsal spines on outer ramus of uropod 1 = 10 including nails, of uropod 2 = 9 including nails, inner ramus of uropod 1 = 6 and 5 including nails, of uropod 2 = 5 including nails, spine formula on article 1 of outer ramus = $0-0-0-2 \times 8$, spines shorter than in female, setal formula = 1×11 . Telson broadened, distal spines shortened, each lobe with broad patches of dorsal denticles.

OBSERVATIONS (male).—Male "n" dimensions of pereopods 3-5, widths of articles 2, 4, 5, 6 of pereopod 3 = 50:44:42:20, of pereopod 4 = 60:50:30:13, of pereopod 5 = 54:10:8:5, lengths of articles on pereopod 3 = 77:40:35:36, of pereopod 4 = 62:65:50:52, of pereopod 5 = 90:21:23:23; alternative spine formula on outer ramus of uropod 3 = 0-1-2-2-2... n.

ILLUSTRATIONS.—Generally as in Booranus tikeri except in specific characters mentioned for female or for notes in male description. Following female parts like Tipimegus thalerus except as specified in description: maxilla 2 and maxilliped. Following parts like B. tikeri except as specified in description: lower lip and maxilla 1 except for more elongate inner plate as figured for B. weemus.

HOLOTYPE.—NMV, female "g," 5.63 mm.

TYPE-LOCALITY.—CPBS 12S/1, 16 Mar 1965, Western Port, Victoria, Australia, 2.4 m, fine sand, mud.

VOUCHER MATERIAL.—Type-locality: female "a," 6.1 mm (illus.); male "n," 5.58 mm (illus.); smallest juvenile examined, 3.5 mm.

MATERIAL.—CPBS, 5 samples from one station (38); WPBES, one sample (2).

Distribution.—Victoria, Western Port, 0.3-2.0 m, sand, sand with mud, seagrass.

Booranus tikeri, new species

FIGURES 27, 28

Description of Female.—Head about 20 percent of total body length, greatest width about 65 percent of length, rostrum constricted, narrow, elongate, exceeding middle of article 2 on antenna 1. Eyes large, clear of pigment or deeply stained, ommatidia ordinary. Article 1 on peduncle of antenna 1 about as long as wide, about 1.8 times as wide as article 2, ventral margin with about 9 setules, weakly produced dorsal apex with 3 setules; article

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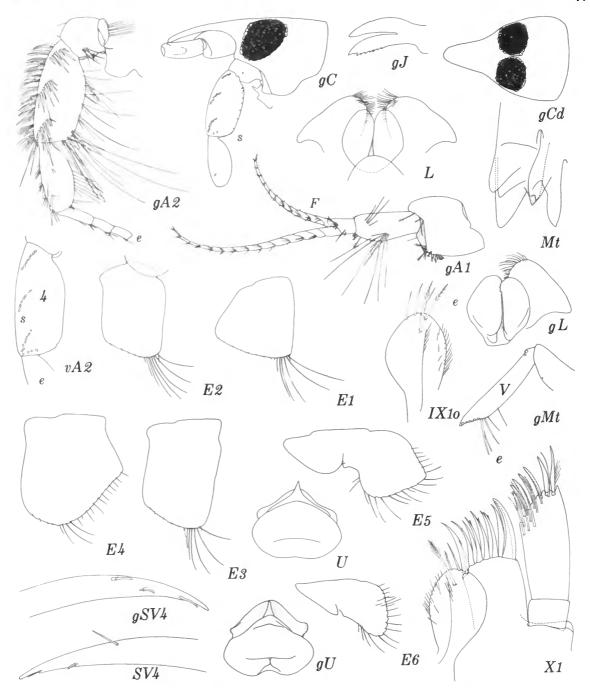


FIGURE 27.—Booranus tikeri, new species, holotype, female "f," 6.92 mm; (g = male "gg," 7.4 mm; v = male "v," size unknown).

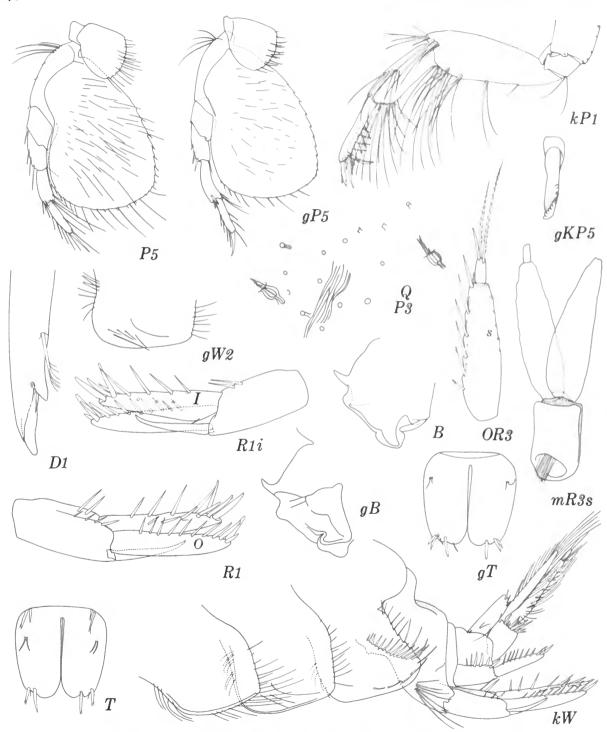


FIGURE 28.—Booranus tikeri, new species, holotype, female "f," 6.92 mm (g = male "gg," 7.4 mm; k = male "k," 6.60 mm; m = male "m," 7.0 mm).

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2 about as long as article 1, with ventral cycle of 12 setae; primary flagellum with 13 articles, about 1.1 times as long as peduncle, bearing medium aesthetascs; accessory flagellum with 13 articles. Article 3 of antenna 2 with 4 setae-spines and one setule; spine formula of article 4 = 4-3-9-9-8, dorsal margin with 4 notches each bearing 3-5 setae, ventral margin with 6-7 groups of 1-6 long to medium setae, 2-3 distal long spines, and clump of 11+ setae; article 5 about 0.57 times as long as article 4, facial spine formula = 0, dorsal margin naked or bearing 2 setae, ventral margin with 7 unpaired setae, clump of 5 ventrodistal long to medium spines, no subdistal facial spines; flagellum about 1.1 times as long as articles 4-5 of peduncle combined, with 16 articles. Epistome with sharp anterior protrusion; upper lip with weak ventral sinus. Mandibles with weak palpar hump; right incisor with 4 teeth; left incisor with 4 teeth in 2 branches; right lacinia mobilis bifid, distal branch much shorter than proximal, subbifid, proximal branch simple, pointed; left lacinia mobilis with 4 teeth; right rakers 11 plus one rudimentary; left rakers 12 plus one rudimentary; molars elongate, conical, each molar with 4 long to short spines, none disjunct; palp article 1 short, article 2 with one long, one short inner apical setae and 6 other long and short inner and facial setae; article 3 about 1.1 times as long as article 2, oblique apex with 12 spine-setae, basodorsal formula = 2 (one short). Inner plate of maxilla 1 large, bearing one long apicofacial pluseta, 3-4 shorter similar apical setae; palp article 2 with 7 apical marginal spines and 10 submarginal setae. Inner plate of maxilla 2 shorter and narrower than outer, outer without apicolateral seta, inner with 9 medial setae. Inner plate of maxilliped with 2 large thick apical spines, 5 apicofacial setae, 5 medial setae; outer plate with 16 medial and apical spines, one apicolateral seta; palp articles 1-2 lacking lateral setae, medial margin of article 2 moderately setose, article 3 with 36 facial setae, 8 lateral setae in 3 sets, article 4 with 2 accessory setules, nail absent, Coxa 1 strongly expanded distally, anterior margin almost straight; main ventral setae of coxae 1-4 = 8-9-(9-8)-15, posteriormost seta of coxae 1-3 shortest; coxa 2 beveled anteroventrally; anterior and posterior margins of coxa 4 divergent, posterior margin oblique, almost straight, posterodorsal corner sharp-rounded, posterodorsal margin short, ordinary, width-length ratio of coxa 4 = 34:39; gills present on coxae 2-7. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 6-5-5-6, long anteriors = 14 (+4 facial)-6-8-1, short anteriors = 3-5-7-5, no others. Gnathopods thin, hands thin, parachelate, mitellid, gnathopod 2 slightly smaller than gnathopod 1; width ratios of articles 5-6 of gnathopods 1-2 = 29:24 and 28:24, length ratios = 67:48 and 65:48; palmar humps very small, palms transverse; article 5 of gnathopods 1-2 elongate, ovate, posterior margins rounded-flat. Pereopods 1-2 similar; article 4 of pereopod 2 much stouter than article 4 of pereopod 1; article 5 with apicomedial comb on pereopods 1-2; facial setae formula on article 4 = 5and 4, on article 5 = 5 and 6; main spine of article 5 extending to M. 75-80 on article 6, spine formula of article 6 = 6 + 10 and 7 + 10 plus huge middistal spine, some spines especially long; acclivity on inner margin of dactyls of pereopods 1-2 sharp, produced as tooth, emergent setule short, marginal pluseta ordinary. Coxae 5-7 posteroventral setae formula = 19-19-16, some facial. Articles 4-5 of pereopods 3-4 broad, facial spine rows dense; facial ridge formula on article 2 of pereopods 3-5 = 0-1-1, width ratios of articles 2, 4, 5, 6 of pereopod 3 = 50:46:41:20, of pereopod 4 = 70:55:33:14, of pereopod 5 = 60:9:7:4, length ratios of pereopod 3 = 73:40:37:34, of pereopod 4 = 75:70:47:54, of pereopod 5 = 88:20:17:20; article 2 of pereopod 5 almost reaching apex of article 5, ventrally setose, anterior margin weakly bulging, pereopod 5 small and mostly hidden by pereopod 4, lateral apex of article 5 not combed; medial apex of article 6 finely combed. Posteroventral corner of epimeron 1 roundedquadrate, posterior margin straight, weakly setose (14), anteroventral margin and face with 6-8 short setae, posteroventral margin with 1-2 short setae, no facial setae, posterior margin with 13 setae; posteroventral corner of epimeron 2 rounded, posterior margin straight, weakly serrate, setose (12-13), facial setae = 7, none set vertically; posteroventral corner of epimeron 3 rounded, weakly protuberant, posterior margin almost straight, weakly serrate, setose (10-11), ventral margin with 6 setae mainly in posterior half, face with oblique row of 9-11 spines in middle; epimera 1-2 with setule on posterodorsal margin set in weak notch. Urosomite 1 with midlateral group of 9-10 setae, one ventral seta on each side, articulation line complete; urosomite 3 protuberant dorsally, with 2 middorsal spines on each side. Rami of uropods 1-2 with articulate enlarged

sharp apical nails, outer and inner rami of uropods 1-2 with accessory nails; spike on uropod 1 reaching to M. 55-65 on outer ramus, outer ramus of uropod I with 11 dorsal spines including apicals, inner with 5 and facial row of 4, not including one apical nail; outer ramus of uropod 2 with 7 dorsal spines, including apicals, inner with 3 dorsomedial spines including accessory nails; peduncle of uropod 1 with 4 apicolateral spines, no basofacial setae, medially with 2 apical spines; peduncle of uropod 2 with 6 dorsal spines, medially with 2 apical spines, apicolateral corners on peduncles of uropods 1-2 with weak comb, outer rami also weakly combed. Peduncle of uropod 3 with 11+ ventral spines, dorsally with 4-5 lateral spines, one medial spine and setule; rami masculine, inner extending to M. 100 on article 1 of outer ramus, apex with 3 setae, medial and lateral margins setose, article 2 of outer ramus ordinary, 0.17, bearing 2 long setae and one medium spine, apicomedial margin of article 1 setose, lateral margin with 5 acclivities, spine formula = 1-2-2-2-2, setal formula = 0. Telson ordinary, length-width ratio = 1:1, not fully cleft, each apex wide, rounded, with or without middle acclivity, lateral acclivity narrow, weak, bearing ordinary lateral spine, spine next medial longer, with lateral and medial spines separated by setule, no lateral spine, midlateral setules alike. Cuticle with bulbar setules closely packed with pipes and spicules, setules not surrounded by cordate plaques, surface bearing fine striations in form of linear fingerprint pattern, emergent setules branched.

DESCRIPTION OF MALE.—Eyes enlarged. Article 1 of antenna 1 with 15 ventral setules, no medial fuzz; article 2 with 15 ventral setae; primary flagellum with 14 articles, one calceolus each on articles 1-5 or 1-6 or 2-6, aesthetascs on primary flagellum as in females; accessory flagellum with 11 articles. Article 3 of antenna 2 with facial seta-spine and setule formula of 4 + 1; on article 4 = 4-(2+7)-9-9or 4-(2+7)-9-8 or 4-(2+7)-9-7, ventral margin with 6 sets of shortened setae; article 5 with 4-5 sets of dorsal male setae and 3 calceoli, ventrally with 8+ setae and 2-4 apicoventral setules, flagellar formula = 28, 2, 4, 6, ... 26, or 36, 2, 4, 6 ... 26, often apical calceoli rudimentary from article 22 onwards. Palp article 3 of mandible with inner seta near apex. Coxa 4 similar to that of female but smaller in relation to coxa 1. Hands of gnathopods slightly thinner than in female. Article 4 of pereopods 1-2 thinner than in female. Article 2 of pereopods 3-4 much thinner than in female. Other highly slender articles = article 4 of pereopods 3-4; slightly thinner = article 5 of pereopods 3-4 and article 2 of pereopod 5; coxae 5-7 smaller relative to their legs than in female. Epimera 1-2 broadened, posterior margin of epimeron 3 not shortened; setal and spine formulas = epimeron 1 anteroventral = 4-6, posterior = 9, ventral = 7-9widely spread, epimeron 2 facial = 2-5, posterior = 9-12, epimeron 3 posterior = 8-9, facial = 9-15, ventral = 5-6. Spine formulas of uropods, uropod 1 peduncle apicolateral = 3-4, uropod 2 dorsal = 6; following notations not including apical nail and accessory nail, dorsal spines on outer ramus of uropod 1 = 8-9, of uropod 2 = 7-9, inner ramus of uropod 1 = 5-6 + 3-4, of uropod 2 = 3, ventral and lateral spines on peduncle of uropod 3 = 17, spine formula on article 1 of outer ramus (maximum observed), spines = 0-0-0-2-2-2-2-2-2, setae = 1-1-1-2-1-1-1-1-1-1, spines short. Telson scarcely elongate, each lobe with widely scattered patch of dorsal denticles, distal spines shortened. Cuticular setules sparse.

OBSERVATIONS.—Male: Eyes becoming as large as shown for male B. weemus; terminal males with anterior spines on article 5 of percopod 5 absent.

Juveniles: Juvenile "j," 3.95 mm, each molar with 4 spines. Juvenile "p," 3.45 mm, left molar with 3 teeth, right with 3 and incipient fourth.

ILLUSTRATIONS.—Maxilla 2 and maxilliped generally as shown for *Tipimegus thalerus*; all other parts similar to those shown for *B. weemus* except as specified in the description and attendant figures.

HOLOTYPE.—NMV, female "f," 6.92 mm.

Type-Locality.—CPBS B6/4, 12 Oct 1964, Western Port, Victoria, Australia, depth and sediment unknown.

VOUCHER MATERIAL.—CPBS 26N/1171: male "k," 6.60 mm (illus.); male "m," 7.0 mm (illus.). CPBS 25N/1171: male "gg," 7.4 mm (illus.). CPBS B4/4: male "v," (illus.). CPBS 34N/4: juvenile "j," 3.95 mm; juvenile "p," 3.45 mm.

RELATIONSHIP.—This species differs from the type-species of *Booranus*, *B. weemus*, in the longer spike on uropod l, the broader apices of the telsonic lobes, the fewer accessory setules on the dactyl of the maxilliped, the presence of facial setae on coxae 6–7, the shorter spines on the outer ramus

of uropod 3, the presence of 2 (not 1) spines on each side of urosomite 3 at the base of the telson, the absence of a lateral comb on article 5 of pereopod 5, the shorter article 6 of pereopod 5, the absence of plaques around the cuticular setules, and in the presence of an extra set of spines on article 4 of antenna 2.

MATERIAL.—CPBS, 20 samples from 12 stations (155); WPBES, 5 samples from 3 stations (10); PPBES, 2 samples from 2 stations (2).

DISTRIBUTION.—Victoria: Western Port and Port Phillip Bay, 3-18 in, sand, sand and shell, sand and mud, seagrass.

Booranus wangoorus, new species

FIGURE 29

DESCRIPTION OF FEMALE.—Head about 23 percent of total body length, greatest width about 63 percent of length, rostrum constricted, narrow elongate, exceeding middle of article 2 on antenna 1. Eyes medium, largely occluded with pigment.

Article 1 on peduncle of antenna 1 about 1.2 times as long as wide, about 1.8 times as wide as article 2. ventral margin with about 7 setules, weakly produced dorsal apex with 3 setules; article 2 about 0.85 times as long as article 1, with ventral crescent of 9 setae; primary flagellum with 8 articles, about 0.85 times as long as peduncle, bearing long aesthetascs; accessory flagellum with 8 articles Spine formula of article 4 on antenna 2 = 2-2-6-6-6, dorsal margin with 2 notches each bearing one long and 1-2 short setae, ventral margin with 5 groups of 1-3 long to medium setae, dense ventrodistal brush of 11+setae; article 5 about 0.56 times as long as article 4, facial spine formula = 0, dorsal margin bearing 2 setae, ventral margin with 5 sets of one long seta each, 4 ventrodistal short to medium spine-setae; flagellum about 1.1 times as long as articles 4-5 of peduncle combined, with 11 articles. Epistome with sharp anterior protrusion; upper lip with weak ventral sinus. Mandibles with weak palpar hump; right incisor with 4 teeth; left incisor with 4 teeth in 2 branches; right lacinia mobilis bifid, distal branch little shorter than proxi-

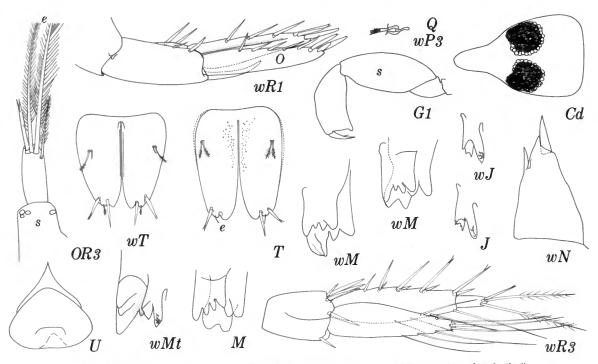


FIGURE 29.—Booranus wangoorus, new species, holotype, male "y," 4.30 mm (w = female "w," 3.81 mm).

mal, subbifid, proximal branch simple, pointed, with marginal denticles or facial humps; left lacinia mobilis with 4 teeth, middle teeth shortened; right rakers 8; left rakers 10; molars elongate, conical, each molar with 3 (rarely 4) long to short spines, one disjunct, middle one completely fused to molar; palp article 1 short, article 2 with one long inner apical seta and one other short inner seta and 2 tiny facial setae, article 3 about as long as article 2, oblique apex with 9 spine-setae, basodorsal formula = one long. Inner plate of maxilla 1 large, thin, bearing one long apicofacial pluseta, 3 shorter apical setae; palp article 2 with 7 apical marginal spines and 8 submarginal setae (4 of these facial). Inner plate of maxilla 2 shorter and narrower than outer, outer with one apicolateral seta, inner with 3 medial setae. Inner plate of maxilliped with 2 large thick apical spines, 5 apicofacial setae, 3 medial setae; outer plate with 11 medial and apical spines, one apicolateral seta; palp articles 1-2 without apicolateral setae, medial margin of article 2 strongly setose, article 3 with 14 facial setae, 4 lateral setae in 4 groups, article 4 with 2 accessory setules, one on face, nail absent. Coxa l strongly expanded distally, anterior margin almost straight; main ventral setae of coxae 1-4 = 6-7-6-11, posteriormost seta of coxae 1-3 shortest; anterior and posterior margins of coxa 4 divergent, posterior margin oblique, almost straight, posterodorsal corner sharp, posterodorsal margin of medium length, concave, width-length ratio of $\cos 4 = 7.8$; gills present on coxae 2-7. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 4-3-3-4, short posteriors = 0-0-0-1, long anteriors = 13(+4)facial)-8-6-0, short anteriors = 1-1-3-2, no others. Gnathopods thin, hands thin, parachelate, mitellid, gnathopod 2 slightly smaller than gnathopod 1; width ratios of articles 5-6 on gnathopods 1-2 =26:22 and 25:21, length ratios = 64:42 and 61:42; palmar humps very small, palms transverse; article 5 of gnathopods 1-2 elongate, ovate, posterior margin rounded-flat. Pereopods 1-2 similar, article 4 of pereopod 2 stouter than article 4 of pereopod 1; article 5 with apicomedial comb on pereopods 1-2; facial setae formula on article 4 = 3 and 2, on article 5 = 3 and 4, main spine of article 5 extending to M. 80 on article 6, article 5 with one extra long distoposterior spine and numerous setae, proximal margin naked, spine formula of article 6 = 4+6 and 5+6 plus huge middistal spine, some spines especially long; acclivity on inner margin of dactyls of pereopods 1-2 sharp, produced as tooth, emergent setule short, marginal pluseta ordinary. Coxae 5-7 posteroventral seta formula = 11-12-10 (only 1-2 facial on coxa 7). Articles 4-5 of pereopods 3-4 broad, facial spine rows dense; facial ridge formula on article 2 of pereopods 3-5 = 0-1-1, width ratios of articles 2, 4, 5, 6 of pereopod 3 = 46:44:37:19, of pereopod 4 = 65:52:35.14, of pereopod 5 = 70:11:9:6, length ratios of pereopod 3 = 75:39:40:33, of pereopod 4 = 80:66:50:55, of pereopod 5 = 88:24:23:25; article 2 of pereopod 5 reaching middle of article 5, ventrally setose, anterior margin scarcely bulging, pereopod 5 small and mostly hidden by pereopod 4, lateral apex of article 5 and medial apex of article 6 finely combed. Posteroventral corner of epimeron 1 roundedquadrate, posterior margin straight, strongly setose (11-14), anteroventral margin and face with 5 short setae, posteroventral margin with 2 short setae, face with 2-3 setae near posterior margin; posteroventral corner of epimeron 2 rounded, posterior margin straight, weakly serrate, setose (6-9), facial setae = 3, none set vertically; posteroventral corner of epimeron 3 rounded, weakly protuberant, posterior margin almost straight, serrate, setose (6), ventral margin with 5 setae mainly in posterior half, face with oblique row of 7 spines in middle, epimera 1-2 with setule on posterodorsal margin set in weak notch. Urosomite I with midlateral group of 6 setae, one ventral seta on each side, articulation line complete; urosomite 3 protuberant dorsally, with middorsal spine on each side. Rami of uropods 1-2 with articulate enlarged sharp apical nails, outer and inner rami of uropods 1-2 with accessory nails; spike on uropod I reaching to M. 50 on outer ramus, outer ramus of uropod 1 with 8 dorsal spines including nails, inner with 5 including nails and facial row of one spine; outer ramus of uropod 2 with 6 dorsal spines including nails, inner with 3 dorsomedial spines including nails; outer rami of uropods 1-2 very weakly combed; peduncle of uropod 1 with 2 apicolateral spines, no basofacial setae, medially with 2 marginal spines, apicalmost ordinary; peduncle of uropod 2 with 2-8 dorsal spines, medially with pair of apical spines; apicolateral corners on peduncles of uropods 1-2 with comb. Peduncle of uropod 3 with 9 ventral spines, well segregated from one dorsal and lateral spine, one medial spine; rami submasculine, inner extending to M. 100 on article 1 of outer ramus, apex with 3 setae, medial and lateral margins setose; article 2 of outer ramus ordinary, 0.26, bearing 2 long setae and one spine, apicomedial margin of article 1 setose, lateral margin with 3-4 acclivities, spine formula = 2-2-2-2or 1-2-2-2=2; setal formula = 0. Telson ordinary, length-width ratio = 1:1, not fully cleft, each apex narrow, rounded, with middle acclivity, lateral acclivity narrow, weak, bearing ordinary lateral spine, spine next medial subequal, lateral and medial spines separated by setule, midlateral setules diverse. Cuticle with bulbar setules mixed with pipes and spicules, setules not surrounded by cordate plaques, surface bearing fine striations in form of linear fingerprint pattern, emergent setules branched.

OBSERVATIONS (female).—Description based on female "w"; male "y" fully described below owing to remote possibility these two specimens not conspecific. Article 3 on peduncle of antenna 2 with groups of 3 setae and one setule. Spines on outer ramus of uropod 3 almost as long as in Booranus weemus; coxae 1-3 slightly larger relative to coxa 4 than in B. weemus; eyes slightly smaller than B. weemus; inner plate of maxilla 1 thinner than in B. weemus; article 4 of pereopods 1-2 about 15 percent thinner and article 6 about 10 percent shorter than in B. weemus.

Description of Male.—Head about 21 percent of total body length, greatest width about 66 percent of length, rostrum constricted, narrow, elongate, exceeding middle of article 2 on antenna 1. Eyes large, largely occluded with pigment. Article 1 on peduncle of antenna 1 about 1.1 times as long as wide, about twice as wide as article 2, ventral margin with about 13 setules, weakly produced apex with 3 setules; article 2 about as long as article 1, with ventral crescent of 9 setae; primary flagellum with 8 articles, about 0.85 times as long as peduncle, bearing long aesthetascs; accessory flagellum with 8 articles. Spine formula on article 4 of antenna 2 = 2-2-6-7-5, dorsomedial margins of articles 3-4 fuzzy, ventral margin with 6 groups of 1-3 long to medium setae, ventrodistal brush of 7-12 either all long or all short setae; article 5 about 0.77 times as long as article 4, facial spine formula = 2 dorsodistal, dorsal margin bearing 4 groups of male setae and 3 calceoli, ventral margin with 5 sets of one short seta each, 3 ventrodistal setules set facially; flagellar formula = 27, 2, 3, 5, 7 ... 19. Epistome with sharp anterior protrusion; upper lip with weak ventral sinus. Mandibles with weak palpar hump; right incisor with 4 teeth; left incisor with 4 teeth in 2 branches; right lacinia mobilis bifid, distal branch shorter than proximal, subbifid, denticulate, with 2 facial humps, proximal branch simple blunt, with marginal denticles or facial humps; left lacinia mobilis with 4 teeth, middle teeth shortened; right rakers 7 plus one rudimentary; left rakers 9 plus one rudimentary; molars elongate, conical, each molar with 3 long to short spines, one disjunct, mildle one completely fused to molar; palp article 1 short, article 2 with one long inner apical seta and 2 other short inner setae and one medium facial seta, article 3 about as long as article 2, oblique apex with 10 spine-setae, basofacial formula = 2 (one long, one very short). Inner plate of maxilla 1 large, thin, bearing one long apicofacial pluseta, 3 shorter apical setae; palp article 2 with 8-9 apical marginal spines and 8-10 submarginal setae (4-6 facial). Inner plate of maxilla 2 slightly shorter and narrower than outer, outer with one apicolateral seta, inner with 5 medial setae. Inner plate of maxilliped with 2 large thick apical spines, 5 apicofacial setae, 3 medial setae; outer plate with 13 medial and apical spines, one apicolateral seta; palp articles 1-2 without apicolateral seta, medial margin of article 2 strongly setose, article 3 with 17 facial setae, 5 lateral setae in 4 groups, article 4 with 2 accessory setules, nail absent. Coxa l strongly expanded apically, anterior margin almost straight; main ventral setae of coxae 1-4 = 6-8-7-13, posteriormost seta of coxae 1-3 shortest; anterior and posterior margins of coxa 4 divergent, posterior margin oblique, almost straight, posterodorsal corner sharp, posterodorsal margin concave, undulant, widthlength ratio of coxa 4 = 33:38; gills present on coxae 2-7. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 3-3-4-4, short posteriors = 0, long anteriors = 17(+3 facial)-98-1, short anteriors = 1-2-2-2, no others. Gnathopods thin, hands thin, parachelate, mitellid, gnathopod 2 slightly smaller than gnathopod 1; width ratios of articles 5-6 on gnathopods 1-2 = 25:21and 27:20, length ratios = 64:42 and 62:41; palmar humps small, palms transverse; article 5 of gnathopods 1-2 elongate, ovate, posterior margin roundedflat. Pereopods 1-2 similar, article 4 even thinner than in female, but stouter on pereopod 2 than on

pereopod 1; article 5 with apicomedial comb, facial setae formula on article 4 = 4 and 2, on article 5 = 4 and 4, main spine of article 5 extending to M. 77 on article 6; article 5 with one extra long distoposterior spine and numerous setae, proximal margin naked; spine formula of article 6 = 5 + 6and 5 + 6 plus huge middistal spine, some spines especially long; acclivity on inner margin of dactyls of pereopods 1-2 sharp, produced as tooth, emergent setule short, marginal pluseta ordinary. Coxae 5-7 posteroventral seta formula = 13-13-11 (only one facial on coxa 7). Articles 4-5 of pereopods 3-4 broad, facial spine rows dense, facial ridge formula on article 2 of pereopods 3-5 = 0-1-1, width ratios of articles 2, 4, 5, 6 of pereopod 3 = 43:40:38:18, of pereopod 4 = 58:47:28:11, of pereopod 5 = 65: 10:9:4, length ratios of pereopod 3 = 68:37:38:30, of pereopod 4 = 75:65:44:50, of pereopod 5 =90:21:22:23; article 2 of pereopod 5 exceeding middle of article 5, ventrally setose, anterior margin scarcely bulging, pereopod 5 small and mostly hidden by pereopod 4, lateral apex of article 5 and medial apex of article 6 finely combed. Epimera 1-3 broadened; posteroventral corner of epimeron 1 rounded-quadrate, posterior margin almost straight, strongly setose (14), anteroventral margin with 6-7 short setae, posteroventral margin with 5 medium setae, one fully facial short seta; posteroventral corner of epimeron 2 rounded, weakly protuberant, with seta notch, posterior margin straight, setose (10), facial setae = 3, none set vertically; posteroventral corner of epimeron 3 rounded, weakly protuberant, posterior margin straight to weakly convex, not shortened, weakly serrate, setose (7), ventral margin with 5 setae mainly in posterior half, face with oblique row of 7 spines in middle; epimera 1-2 with setule on posterodorsal margin set in weak notch. Urosomite 1 with midlateral group of 7 setae, one ventral seta on each side, articulation line incomplete, short; urosomite 3 protuberant dorsally, with middorsal spine on each side. Rami of uropods 1-2 with articulate enlarged sharp apical nails, spike on uropod 1 reaching to M. 50 on outer ramus, outer and inner rami of uropods 1-2 with accessory nails, outer ramus of uropod 1 with 10 dorsal spines including nails, inner with 6 including nails plus one in facial row, outer ramus of uropod 2 with 9 dorsal spines including nails, inner with 6 dorsomedial spines including nails, outer rami of uropods 1-2 very weakly combed; peduncle of uropod 1 with 2 apicolateral spines, no basofacial setae, medially with 3 marginal spines, apicalmost ordinary; peduncle of uropod 2 with 5 dorsal spines, medially with 2 spines, apicolateral corners on peduncles of uropods 1-2 with comb. Peduncle of uropod 3 with 13 ventral spines, dorsally with one lateral spine, one medial spine and setule; rami masculine, inner extending to M. 120+ on article 1 of outer ramus, apex with 3 setae, medial and lateral margins setose, article 2 of outer ramus short, 0.21, bearing 2 long setae, one spine, occasionally one setule, medial margin of article 1 setose, lateral margin with 6 acclivities, spine formula = 0-0-2-2-2-2-2, spines medium, setal formula = 1-2-1-1-1-1. Telson long, length-width ratio = 15:11, not fully cleft, each apex narrow, rounded, with middle acclivity, lateral acclivity narrow, weak, bearing ordinary lateral spine, spine next medial longer, with lateral and medial spines separated by setule, midlateral setules equal to each other. Cuticle with bulbar setules mixed with pipes and spicules, setules not surrounded by cordate plaques, surface bearing fine striations in form of linear fingerprint pattern, emergent setules branched.

OBSERVATIONS (male).—Description based on male "y." Article 5 of gnathopod 1 slightly thinner than in female, article 6 slightly shorter, palmar hump slightly larger; article 3 on peduncle of antenna 2 with groups of 3 setae and one setule; antenna 2 more strongly ensiform than in female or in Booranus weemus; article 5 of pereopod 5 with 4 anterior spines and setae; pereopods 3-4 smaller relative to pereopod 5 than in female of B. weemus; coxa 4 about as shown for female of B. weemus; coxa 1 not differentially enlarged relative to ratios of coxae 1 and 4 in female of B. weemus.

Variations.—Females "k," "m," and "n" with 5 setae on inner plate of maxilla 1; female "n" with poorly developed fourth tooth on molar, specimen otherwise not senile; female "k" with only 7 rakers on each mandible, bearing incipient fourth molarial tooth; female "m," though small, bearing full 12 apical setae on article 3 of mandibular palp, right rakers 10 plus one rudimentary, left rakers 11 plus one rudimentary; largest ovigerous female in collections, 5.85 mm, and parts mentioned for female "m" identical; one subadult male from CPBS 01N with incipient fourth tooth on molar; juve-

nile, 3.75 mm, with 5 teeth on left lacinia mobilis, only 3 molarial teeth, 9 apical spines on palp article 3 of mandible and 8 raker spines (left side only observed).

ILLUSTRATIONS.—Parts conforming to those of *Booranus weemus* except as noted in description and observations.

HOLOTYPE.—NMV, male "y," 4.30 mm.

TYPE-LOCALITY.—PPBES 904/5, 7 Jun 1971, Port Phillip Bay, Victoria, Australia, 9 m, silty sand.

VOUCHER MATERIAL.—Type-locality, female "w," 3.81 mm (illus.); CPBS 10E/2, female "k," 5.05 mm; CPBS 25S/3, female "m," 4.42 mm; CPBS 01N/3, female "n," 5.00 mm.

RELATIONSHIP.—This species is extremely difficult to separate from the other two species of Booranus. It is a dwarf species recognized by its small size at maturity, about 4.0 mm in body length. Specimens of the other species in that size range are juveniles with greatly reduced setation on epimera compared with 4.0 mm adults of B. wangoorus. It is easily differentiated from B. weemus in the longer spike on uropod 1 that reaches M. 50 on the outer ramus. The terminal males are easily recognized because they bear 2 facial spines on article 5 of antenna 2 in contrast to one spine in the other species. The mandibular molar almost never bears more than 3 tooth-cusps in specimens of 4.0 mm body length whereas juveniles of the other species bear 4 tooth-cusps, although specimens of those other species 3.5 mm long have only 3 teeth or 3 plus one rudimentary. In some respects the species is closer to B. weemus than to B. tikeri: article 5 of pereopod 5 is combed apicolaterally and urosomite 3 bears only one dorsal spine on each side in contrast to the two spines on each side in B. tikeri. The broadened telson of B. tikeri is usually distinctive though not easy to estimate in undissected view. Article 2 on the outer ramus of uropod 3 is somewhat more elongate in B. wangoorus than in the other two species, and unlike B. tikeri, coxa 3 is not beveled anteroventrally. The apical spines on each lobe of the telson are somewhat more widely spread in B. wangoorus than in the other two species. Unlike B. tikeri, coxa 7 has one facial seta in B. wangoorus.

MATERIAL.—PPBES, 21 samples from 8 stations (77); CPBS, 21 samples from 12 stations (31); WPBES, 4 samples, from 3 stations (24); AM, 2

samples (5).

DISTRIBUTION.—Victoria: Western Port and Port Phillip Bay, 0–14 m, sand, silty sand, silty clay, sand and shell, seagrass. South Australia: Kangaroo Island, neritic. Bass Strait: 70 miles south of Lakes Entrance, 95 m.

Trichophoxus K. H. Barnard

Trichophoxus K. H. Barnard, 1930:336.—Barnard and Drummond, 1976:534.

DIAGNOSIS OF MALE.—Eyes present. Flagella of antennae 1-2 unreduced in male. Article 2 of antenna l elongate, ventral setae widely spread. Article 1 of antenna 2 weakly ensiform, article 3 with numerous setae and setules, facial spines on article 4 in 2 or more rows plus special apical spines, article 5 short. Right mandibular incisor with 4 teeth; molar not triturative, large, elongate-conical, then subtruncate and bearing 4 special large spines, not bearing fuzz; palpar hump small. Palp of maxilla l biarticulate, inner plate with 4 setae. Setation of maxilla 2 ordinary. Inner plate of maxillipeds ordinary; apex of palp article 3 not protuberant, dactyl elongate, apical nail short, mostly immersed. Gills present only on coxae 2-6. Gnathopods small, similar, article 5 of gnathopods 1-2 free, elongate, without eusirid attachment; palms transverse, almost chelate, hands of gnathopods 1-2 elongate, heavily setose anteriorly, trichophoxid in shape. Article 5 of pereopods 1-2 lacking posteroproximal setae. Article 2 of pereopod 3 of broad form, articles 4-5 of pereopods 3-4 broad, article 2 of pereopods 3-4 weakly setose posteriorly, pereopod 5 especially small, article 2 strongly setose ventrally, article 3 greatly enlarged, dactyl normal. Epimera 1-2 bearing numerous long posterior setae, with midfacial setae above ventral facial ridge, epimeron 3 ordinary; urosomite I with large lateral facial spines, bearing one or more midventral crescents or bundles of setae, urosomite 3 without dorsal hook or special process. Peduncle of uropod 1 normally elongate, with apicoventral small spike, without special enlarged apicolateral-medial spine, peduncular apices of uropods 1-2 combed, inner ramus of uropod 1 with one row of marginal spines, only one ramus continuously spinose to apex, inner ramus of uropod 2 ordinary but naked. Uropod 3 ordinary, article 2 of outer ramus carrying 2-3 long apical setae. Telson with

2 apical spines on each lobe plus setules, with special lateral spines.

DESCRIPTION OF MALE.—Rostrum constricted, small. Fuzz on article 1 of antenna 1 in male absent; calceoli on male primary flagellum of antenna l present. Calceoli on article 5 of male antenna 2 present, flagellum in male with calceoli. Prebuccal parts extended forward, especially massive, strongly distinct, upper lip dominant. Right lacinia mobilis bifid, thin; article 1 of mandibular palp short, palp thin, apex of article 3 oblique, article 2 with outer setae. Lower lip lacking cones. Outer plate of maxilla 1 with 11 spines, one spine especially thickened. Inner plates of maxilliped thick, ordinarily setose. Coxae 2-4 with special anterodorsal humps. All posterior spines on article 6 of pereopods 1-2 thick and stiff, midapical spine or seta present, especially enlarged. Article 2 of pereopod 5 with facial setae. Peduncle of uropod 1 with dorsolateral spines widely spread, of uropods 1-2 with medial spines widely spread. Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with midlateral setules highly apical, reduced to one member on each side.

Type-Species.—Trichophoxus capillatus K. H. Barnard, 1930 (monotypy).

Composition.—Unique.

RELATIONSHIP.—Trichophoxus is distinguished from Tipimegus in numerous attributes, among them: (1) lateral spination on urosome; (2) lateral spination on telson; (3) far more numerous setae on article 4 of antenna 2; (4) presence of 4 setae (not 3) on inner plate of maxilla 1; (5) immensity of apical midspine on article 6 of pereopods 1-2; (6) elongation and bareness of inner ramus on uropod 2; (7) normally elongate peduncle of uropod 1; (8) proximal spination on peduncle of uropod 1; (9) presence of only one row of spines on inner ramus of uropod 1; (10) presence of only one ventral crescent of setae on urosomite 1; (11) strong distal shift of and reduction in number of dorsal setules on telson; (12) absence of any combs on pereopods 3-5; (13) presence of facial humps on right lacinia mobilis; (14) distad shift in primary tooth on dactyls of pereopods 1-2; (15) presence of more than one medial spine on peduncle of uropod 2.

Trichophoxus is more primitive than Tipimegus in such characters as peduncles of uropods 1-2 and lack of pereopodal combs but is far more special-

ized than the Australian genus in telsonic and urosomal ornamentation.

Trichophoxus capillatus K. H. Barnard

Trichophoxus capillatus K. H. Barnard, 1930:336-337, fig. 13.—Barnard and Drummond, 1976:536-543, figs. 1-3, 4 [part].

Distribution.—New Zealand, North Cape, 3 m, neritic.

Waitangi Fincham

Waitangi Fincham, 1977:286.

Diagnosis (based on literature prior to Fincham, 1977) .- Eyes present. Flagella of antennae 1-2 unreduced in female. Article 2 of antenna 1 ordinary, ventral setae widely spread. Article 1 of antenna 2 weakly ensiform; article 3 with numerous setae and setules; facial spines on article 4 in 2 or more rows [?plus special apical spines]; article 5 thin and short. [Right mandibular incisor with ?4 teeth]; molar not triturative, large, elongate-conical, then subtruncate and bearing 4 special large spines, not bearing fuzz; palpar hump small. Palp of maxilla 1 biarticulate; [inner plate with ? 2 3 4 5 + setae. Setation of maxilla 2 ordinary, ?weak. Inner plate of maxilliped ?ordinary, ?mostly fused together; ?apex of palp article 3 not or weakly strongly protuberant, ?dactyl elongate, short, stubby, ?apical nail distinct, mostly immersed, short, medium, elongate, obsolescent, absent]. Gnathopods similar; article 5 of gnathopods 1-2 free, elongate, without eusirid attachment; palms transverse to chelate; hands of gnathopods 1-2 ordinary, elongate, heavily setose anteriorly, trichophoxid in shape. Article 5 of pereopods 1-2 lacking posteroproximal setae. Article 2 of pereopod 3 of broad form; articles 4-5 of pereopods 3-4 broad; article 2 of pereopods 3-4 setose posteriorly; pereopod 5 especially small, article 2 strongly setose ventrally, article 3 greatly enlarged, dactyl normal. Epimera 1-2 bearing long posterior setae, with midfacial setae above ventral facial ridge; epimeron 3 ordinary, with large tooth. Urosomite 1 [with ?large lateral facial spines], bearing one or more midventral crescents or bundles of setae; urosomite 3 without dorsal hook or special process. Peduncle of uropod 1 normally elongate, with apicoventral small spike, without special enlarged apicolateral-medial spine; peduncular apices of uropods 1-2 not combed, but peduncles and rami with long setae, inner ramus of uropod 1 with one row of marginal spines, all rami continuously spinose to apex, inner ramus of uropod 2 ordinary. Uropod 3 ordinary, article 2 of outer ramus [carrying ?one, 2, 3 long vestigial apical setae]. Telson ordinary, with 2-4 apical spines or setae on each lobe plus setules.

DESCRIPTION.—Rostrum constricted, small. [Fuzz on article I of antenna I in male unknown, calceoli on male primary flagellum of antenna 1 unknown, calceoli on male antenna 2 unknown]. Prebuccal parts strongly extended forward, especially massive, strongly distinct, both epistome and upper lip dominant. [Right lacinia mobilis ?bifid, ?flabellate]; article 1 of mandibular palp short, palp thin, apex of article 3 oblique, article 2 with outer setae; [?Lower lip bearing, lacking cones. ?Outer plate of maxilla 1 with 7, 9, 11 spines, no or one spine especially thickened. ?Inner plates of maxilliped especially thin, poorly armed, thick, ordinarily setose]. Coxae 2-4 with special anterodorsal humps. All posterior spines on article 6 of pereopods 1-2 thin and stiff, midapical spine or seta present, especially enlarged. Article 2 of pereopod 5 with facial setae. Peduncle of uropod 1 with dorsolateral spines confined apically, medial spines confined apically; peduncle of uropod 2 with medial spines widely spread. Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with midlateral or dorsal setules on each side highly apical, reduced to one member on each side.

Type-Species.—Paraphoxus rakiura Cooper and Fincham, 1974.

Composition.—Unique.

RELATIONSHIP.—Waitangi resembles Trichophoxus more than it does Tipimegus or Booranus in the elongate peduncle of uropod 1, elongate midapical spine on article 6 of pereopods 1-2, smallness of spike on uropod 1, and presence of facial setae on article 2 of pereopod 4, but resembles Tipimegus more in the presence of spine-setae on the inner ramus of uropod 2, the narrow spread of apicolateral spines on the peduncle of uropod 1, in the absence of lateral spines on the telson, and the lack of lateral spines on urosomite 1.

Waitangi differs from both Trichophoxus and Tipimegus in the presence of long setae on the peduncles and rami of uropods 1-2 and in the

huge tooth of epimeron 3, a radical development in the tipimegin group.

Waitangi rakiura (Cooper and Fincham)

Paraphoxus rakiura Cooper and Fincham, 1974:168-173, figs. 7b, 8-10.

Waitangi rakiura.—Fincham, 1977:286.

DISTRIBUTION.—New Zealand, Stewart Island, intertidal sand.

BROLGINAE

DIAGNOSIS.—Article 2 of antenna 1 shortened; mandibular molar nontriturative, bearing 3 or fewer tightly clumped spines; palp of maxilla 1 biarticulate; setation on maxilla 2 ordinary to reduced; gnathopod 2 either enlarged or not; article 2 of pereopod 3 of broad form, pereopod 5 with ordinary article 3.

Description.—Article 5 of antenna 2 reduced; epimeron 3 of rounded classification; apices of peduncles on uropods 1–2 usually combed.

Type Genus.—Brolgus, new genus.

Composition.—Cunmurra, new genus (placed here provisionally, technically assignable to Joubinellinae), Elpeddo, new genus, Ganba, new genus, Kuritus, new genus, Mandibulophoxus J. L. Barnard (satellite genus), Paraphoxus Sars, and Wildus, new genus.

THE BROLGIN GROUP OF GENERA

Brolgus tattersalli (J. L. Barnard) and nine other new species from Australia constitute the brolgin group of genera, divided into Brolgus, Elpeddo, Ganba, Kuritus, and Wildus. A sixth genus, Paraphoxus, now restricted to one or two species, forms the ultimate evolute confined to north boreal waters. A seventh genus, Cunmurra, forms an intergradation between the brolgin group and the Birubius mayamayi group of species. Cunmurra has the gnathopods and epimera of a brolgin but has one too many spines (4) on the mandibular molar and far too elongate an article 2 of antenna 1 to qualify as a fully fledged brolgin. Mandibulophoxus is a satellite genus perhaps deserving a subfamily of its own.

One main feature of the brolgin group in its primitive state is the diversity between gnathopods

1 and 2 and the enlargement of gnathopod 2. This state is fully expressed in *Brolgus*, where gnathopod 2 is very large, the wrist is short, and the strongly oblique palm is almost as long as or longer than the posterior margin of the hand. The hand of gnathopod 1 is generally thinner than in typical Australian species of *Birubius* and this becomes even thinner in other genera of the *Brolgus* group. In *Kuritus*, gnathopod 2 assumes the thin handed form also.

Because of variability in gnathopods other characters serve better to identify the Brolgus group. All known genera of the Brolgus group have the following characters in common: molars with only 3 or fewer tightly clumped large spines, molar otherwise weak; article 2 of antenna 1 very short; third and fourth facial rows of spines on article 4 of antenna 2 amalgamated; setae on inner plate of maxilla 1 reduced, generally to 2 members; pereopods 4-5 with only one main facial ridge on article 2, occasionally with weak second ridge; inner plate of maxilliped with only one main distal spine, this spine long and thin, weakly feathered or not; epimeron 3 of rounded classification, lacking any elongate setae, protruding posteriorly and bearing at most 3 setule notches. The thinness of spines on article 4 of antenna 2 creates confusion between those spines and the plumose accessory setules easily distinguished in Birubius. Proximal groups of spines in members of the brolgin group have been counted by subtracting the accessory setules identified by their plumosities.

The following characters also are of use in recognizing members of the Brolgus group but are not present in all genera: apical combs on peduncles of uropods 1-2 (except in Ganba); articles 4-5 of pereopods 3-5 very thin except in Ganba where pereopod 3 is slightly thickened; article 5 of antenna 2 shortened in females (unknown in Kuritus because the female is yet unknown); article 6 of pereopods 1-2 with very thin posterior spines (except in Ganba and Elpeddo). Brolgus and Ganba have lost one of the two apical setae on article 2 of the outer ramus on uropod 3 typical of birubiins. All species have an unprotuberant article 3 on the maxilliped, normal nail on the dactyl of the maxilliped, lack accessory apical spines or continuous spination on the rami of uropods 1-2 but generally, in other respects, conform to the birubiin morphology.

Cunmurra, the satellite genus, possibly primitive, has weakly enlarged gnathopod 2 but the wrist is not fully shortened, and, in addition, Cunmurra lacks the following features of the Brolginae: sparse molarial spination, sparse setation on inner plate of maxilla 1, thin single apical spine on inner plate of maxilliped, short article 2 of antenna 1 and article 5 of antenna 2, amalgamated spine rows on article 4 of antenna 2, thin spines on pereopods 1-2, thin distal articles on pereopods 3-5, and presence of combs on uropods 1-2. Cunmurra also bears 2 ventral setae on epimeron 3, a condition not typical of brolgins. Cunmurra thus demonstrates the close convergence between the Birubius mayamayi group of species and the brolgin genera but is also a broadly transitional genus because it could be assigned to the Joubinellinae owing to its mandibular molar, elongate article 2 of antenna 1, and enlarged gnathopod 2.

After Cunmurra, Ganba is the next weakest member of the Brolgus group because of the absence of uropodal combs and thicker articles 4-5 of pereopod 3 but Ganba does not form a good intergrade between Cunmurra and the other brolgin genera because of specializations in gnathopods and maxillipeds. The gnathopods are thin and the inner plates of the maxilliped have become partially fused, truncate, and bear all their setae distally. This condition is, however, signaled in Wildus, which has partially fused plates with mostly terminal setae, but with the apices not fully truncate. Ganba also has thickened spines on pereopods 1-2, a primitive condition in this context.

Kuritus is a poor intergrade between Cunmurra and any other brolgin, although it maintains in primitive condition the pair of apical setae on the outer ramus of uropod 3, strong basofacial setae on uropod 1, and has the more advanced spination of pereopods 1-2. Gnathopods of Kuritus, being thin and similar, have departed widely from the brolgin concept.

No even-handed line of descent occurs in the known taxa because of the mixture of characters. One ultimate brolgin, *Brolgus*, has enlarged gnathopod 2 and only one seta on uropod 3, whereas another, *Ganba*, in addition to these characters, retains mostly short posterior spines on article 6 of pereopods 1–2 and has more specialized inner plates on the maxillipeds. *Wildus* does not form a good step towards *Ganba* because it combines fully

specialized spines on the pereopods with primitive maxillipeds. Wildus would be considered a good ancestral type for Brolgus except for the weak specialization in maxillipeds.

Elpeddo also retains 2 apical setae on the outer ramus of uropod 3 but these are very short, almost vestigial. The gnathopods are scarcely enlarged. The male of Elpeddo, perhaps aberrantly, has developed a swollen article 1 on the primary flagellum; this article bears rows of elongate aesthetascs in the form of an enormous antennal brush. None of the posterior spines on article 6 of pereopods 1-2 is elongate and thin.

The tropical Mandibulophoxus J. L. Barnard is considered to be an advanced satellite of the Brolginae in which the palpar hump of the mandible is huge, the molar is reduced or absent, and on the rami of uropods 1-2 dorsal spination is continuous to the apex. Article 5 of antenna 2 is not shortened relative to article 4 but the latter itself is shortened, suggesting that article 5 is indeed in the shortened configuration. Article 2 of pereopod 5 is extended posteroventrally. Epimeron 3 has a few ventral setae. Article 6 of the gnathopods is not truly brolgin because it is expanded distally but gnathopod 2 otherwise meets brolgin requirements in that it is larger than gnathopod I and has a cryptic wrist. Mandibulophoxus may therefore branch away from a hypothetical brolgin precursor rather than stand directly in the mainstream of this group. The continuous dorsal spination on uropodal rami is one primitive mark suggesting this early branching.

RELATIONSHIPS OF THE BROLGIN GROUP TO Metaphoxus and Phoxocephalus

The Brolgus group of genera is easily confounded

with species in Metaphoxus and Phoxocephalus because of external resemblances. Both groups have a poorly setose epimeron 3 with bulging posterior margin and both have apical combs on the peduncle of uropods 1-2. The palp of maxilla 1 is uniarticulate in Metaphoxus and Phoxocephalus but biarticulate in Brolgus. Phoxocephalus, unlike Brolgus and Metaphoxus, has a fully triturative molar. The molar of Brolgus bears 3 heavy spines and that of Metaphoxus is armed with numerous thin setules. In addition, Brolgus has 1-2 long apical setae on the outer ramus of uropod 3 which are not present in Metaphoxus and Phoxocephalus. If the outer ramus of uropod 1 is slightly shortened then one is not dealing with a member of the Brolgus group, though only a few species of the other genera have that ramus shortened. Several brolgins retain well setose second maxillae in contrast to the Metaphoxus group.

The close resemblance of the Brolgus group to Metaphoxus and Phoxocephalus suggests a possible direct evolutionary relationship. If one holds the thesis that triturative molars are more primitive, then Phoxocephalus might be ancestral to the Brolgus group, but this would require an evolutionary reversal in segmentation on the palp of maxilla 1. Phoxocephalus could be, however, ancestral to Metaphoxus, without this reversal. The Brolgus group could be ancestral to Metaphoxus but not to Phoxocephalus without reversal in evolution of the molar. Metaphoxus and Phoxocephalus are so close in many features, including the uniarticulate first maxillary palp, that their independent evolutionary development is not logically held. One must therefore conclude, provisionally, that the Brolgus group is simply convergent, sharing the Metaphoxus and Phoxocephalus similarities in epimera and uropods.

Key to the Genera of Brolginae

ı.	Article 2 of peduncle on antenna 1 elongate, mandible with 4 or more spines on molar
	(not fully typical of brolgins)
	Article 2 of peduncle on antenna 1 shortened, mandible with 3 or fewer spines on molar
2.	Apex of outer ramus on uropod 3 with 2-3 setae
	Apex of outer ramus on uropod 3 with one seta
3.	Rami of uropods 1-2 continuously spinose to apex
	Rami of uropods 1-2 not continuously spinose to apex
4.	Uropod 1 lacking special apicomedial spine on peduncle
	Uropod 1 bearing special apicomedial spine on peduncle

Mandibulophoxus J. L. Barnard

Mandibulophoxus J. L. Barnard, 1957:432.

Diagnosis.—Eyes absent. Flagella of antennae 1-2 unreduced in female. Article 2 of antenna 1 especially shortened, ventral setae widely spread towards apex. Article 1 of antenna 2 not ensiform; article 3 with 2 setules; facial spines on article 4 in 2 or more rows highly apicad; article 5 thin. Right mandibular incisor with 5 teeth; molar not triturative, small, bearing 3 spines, not bearing fuzz; palpar hump large. Palp of maxilla 1 biarticulate; inner plate with 4 setae. Setation of maxilla 2 ordinary. Inner plate of maxillipeds ordinary, apex of palp article 3 not protuberant, dactyl elongate, apical nail distinct, medium. Gnathopods dissimilar; gnathopod 2 weakly enlarged; article 5 of gnathopod 1 of ordinary length, free, but cryptic and short on gnathopod 2, with weak eusirid attachment; palms oblique, hands of gnathopods 1-2 ordinary, ovatorectangular, elongate, poorly setose anteriorly. Article 6 of pereopods 1-2 weakly setose posteroproximally. Article 2 of pereopod 3 of broad form; articles 4-5 of pereopods 3-4 broad; article 2 of pereopod 3 weakly setose posteriorly. Pereopod 5 ordinary, article 2 setose ventrally, article 3 ordinary, dactyl normal. Epimera 1-2 lacking long posterior setae, without midfacial setae above ventral facial ridge; epimeron 3 ordinary. Urosomite I generally naked except for sparse ventral setae; urosomite 3 without dorsal hook or special process. Peduncle of uropod 1 normally elongate, without apicoventral spike, with special enlarged apicolateral spine; peduncular apices of uropods 1-2 not combed; inner ramus of uropod 1 with one row of marginal spines, some rami continuously spinose to apex, inner ramus of uropod 2 ordinary. Uropod 3 ordinary, elongate article 2 of outer ramus carrying 3 long apical setae. Telson ordinary, with 2-4 apical spines on each lobe plus setules.

DESCRIPTION.—Rostrum fully developed. [Fuzz and calceoli on male antennae unknown.] Prebuccal parts ordinary, poorly separated from each other, upper lip dominant. Right lacinia mobilis simple; article 1 of mandibular palp slightly elongate, palp medium to thick, apex of article 3 oblique, article 2 without outer setae. Lower lip bearing cones. Outer plate of maxilla 1 with 9 spines, one spine especially thickened. Inner plates of maxilliped thick, ordinarily setose. Coxae 2-4 without special anterodorsal humps. All posterior spines on article 6 of percopods 1-2 thin but stiff, midapical spine present, enlarged. Article 2 of pereopod 5 without facial setae. Peduncle of uropod l with dorsolateral spines widely spread, medial spines widely spread; peduncle of uropod 2 with medial spines widely spread. Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with midlateral or dorsal setules reduced to one member on each side.

Type-Species.—Mandibulophoxus gilesi J. L. Barnard, 1957 (monotypy.)

COMPOSITION.—Phoxus uncirostratus Giles, 1890. RELATIONSHIP. — Mandibulophoxus resembles Pontharpinia in the shape of pereopods 3-4, noting especially the apically expanded article 2 of pereopod 3, in the presence of only one midlateral telsonic setule, in the simple right lacinia mobilis (but flabellate in Pontharpinia), generally in the mandible and palp, in the short article 2 of antenna 1, the thin article 5 of antenna 2, in the extra row of ventral spines on article 4 of antenna 2, the elongate article 2 on the outer ramus of uropod 3, in the special peduncular spine on uropod 1, and the wide spread in medial spination on the peduncles of uropods 1-2.

Mandibulophoxus differs from Pontharpinia in the simple molar bearing only 2-3 spines, the more numerous apical spines and absence of a setal brush on the telson, the reduction in setae on article 2 of antenna 2, the apical confinement of facial spines on article 4 of antenna, 2, the absence of facial setae on article 2 of pereopod 5, the weakly developed posteroproximal setation on article 5 of pereopods 1-2, the reduction of setae on the inner plate of maxilla 1, the absence of posterior setae on article 2 of pereopod 4 and outer setae on article 2 of the mandibular palp, in the longer nail of the maxillipedal dactyl, in the smaller gnathopod 2, and in apical details of the second article on the outer ramus of uropod 3.

REMARKS.—Pontharpinia stimpsoni Stebbing is removed from this genus to form the type of a new genus, Basuto, leaving Mandibulophoxus with two very closely similar species, M. uncirostratus (Giles) and M. gilesi J. L. Barnard (see Gray and McCain, 1969, for distinctions). The species of Mandibulophoxus are highly advanced tropical and warm-

temperate evolutes, probably with ancestors remotely near Pontharpinia. The single species of the new genus Basuto, from South Africa, forms a reasonably good intergrade between Pontharpinia and Mandibulophoxus but we do not imply that the relationship is precise. Basuto has an intermediate mandibular molar and weak eyes. The cephalic elongation is approximate to that of Pontharpinia but the difference between Pontharpinia and Mandibulophoxus is not great and Basuto bears the smoothly rounded posterior lobation on coxa 4 of Mandibulophoxus, distinct from the situation in Pontharpinia. Basuto cannot stand on a direct line to Mandibulophoxus because article 2 of pereopod 3 is narrowed, the outer ramus of uropod 1 is shortened, and the dorsal spines are absent. It is therefore removed to the Harpiniinae.

Key to the Species of Mandibulophoxus

Mandibulophoxus uncirostratus (Giles)

Phoxus uncirostratus Giles, 1890:65-66, pl. 2: fig. 2.
Leptophoxus uncirostratus.—Walker, 1904:249.—Nayar, 1959:
14-15, pl. 4: figs. 1-16.
Pontharpinia uncirostrata.—Stebbing, 1906:147.
Mandibulophoxus uncirostratus.—J. L. Barnard, 1957:435-436.

Pontharpinia uncirostratus.—Pillai, 1957:39-41, fig. 5. Paraphoxus uncirostrata.—Nayar, 1967:140.

DISTRIBUTION.—Madras coast and Ceylon.

Mandibulophoxus gilesi J. L. Barnard

Mandibulophoxus gilesi J. L. Barnard, 1957:433-435, figs. 1, 2.—Gray and McCain, 1969:189-191, fig. 1.

Mandibulophoxus uncirostratus.—J. L. Barnard, 1960:359 [in part, not Giles]; 1969c:196 [not Giles].

REMARKS.—Gray and McCain (1969) have demonstrated numerous minute distinctions between M. gilesi and M. uncirostratus. To those might be added the distribution of setae on article 2 of the mandibular palp. In M. uncirostratus according to

Pillai (1957) the article bears 2 setae in tandem, whereas according to Barnard (1957) and Gray and McCain (1969) a pair of contiguous apical setae occurs on article 2 of the mandibular palp. From our study of phoxocephalids in Australia we have learned that this kind of difference has specific value.

New Description.—Facial spine formula on article 4 of antenna 2 = 2-2-2 or 1-3-2, spines highly apicad, ventral margin of article 4 with long blade-like spines in addition to row of long setae; article 3 of antenna 2 with 2 setae, apicalmost elongate, proximalmost very small. Right mandibular incisor with 5 teeth, left with 8 sharp teeth in 2 branches; right lacinia mobilis simple, conical, weakly trifid or irregularly dentate, thin, smaller than raker spines; left lacinia mobilis flabellate, with 6-8 teeth; right rakers 8, left 9; each molar a weak hump, right bearing 3 spines, left 2, spines not on basal plaque but individually inserted. Pereopods 1-2 with midapical spine on article 6 large, as long as dactyl or other spines. Apices of uropods 1-2 not combed.

DISTRIBUTION.—Eastern Pacific Ocean from Yaquina Bay, Oregon, to southern California, 0-18 m.

Cunmurra, new genus

DIAGNOSIS OF MALE.—Eyes present. [Flagella of antennae 1-2 probably unreduced in female.] Article 2 of antenna 1 elongate, ventral setae widely spread. Article 1 of antenna 2 not ensiform; article 3 with 2 setules; facial spines on article 4 in 2 or more rows; article 5 ordinary in size. Right mandibular incisor with 3 teeth; molar not triturative, ordinary to small, pillow-shaped, bearing 4 or more splayed, semiarticulate spines, usually bearing fuzz; palpar hump medium. Palp of maxilla 1 biarticulate; inner plate with 4 setae. Setation of maxilla 2 ordinary. Inner plate of maxillipeds ordinary; apex of palp article 3 not protuberant, dactyl elongate, apical nail distinct, short to medium. Gnathopods dissimilar, gnathopod 2 moderately enlarged; article 5 of gnathopod 2 of ordinary length, free, elongate on gnathopod 1, with weak eusirid attachment; palms oblique, hands of gnathopods 1-2 elongate and broadened respectively, poorly setose anteriorly. Article 6 of pereopods 1-2 with posteroproximal setae. Article 2 of pereopod 3 of broad form, articles 4-5 of pereopods 3-4 broad to medium, article 2 of pereopods 3-4 not setose posteriorly; pereopod 5 ordinary, article 2 naked ventrally, article 3 ordinary, dactyl normal. Epimera 1-2 lacking long posterior setae, without midfacial setae above ventral facial ridge; epimeron 3 ordinary but almost of rounded classification and bearing 2 medium setae. Urosomite 1 generally naked except for sparse apicoventral setae or spines near base of uropod 1; urosomite 3 without dorsal hook or special process. Peduncle of uropod 1 normally elongate, without apicoventral spike, without special enlarged apicolateral-medial spine; peduncular apices of uropods 1-2 not combed; spines if present on inner ramus of uropod 1 in one row, no rami continuously spinose to apex, inner ramus of uropod 2 ordinary. Uropod 3 ordinary, article 2 of outer ramus carrying 2 long apical setae. Telson ordinary, with only one apical spine on each lobe plus setules.

DESCRIPTION OF MALE.—Rostrum fully developed. Fuzz on article 1 of antenna 1 in male present, calceoli on male primary flagellum of antenna 1 present. Calceoli on article 5 of male antenna 2 present, flagellum in male with calceoli. Prebuccal

parts ordinary, poorly separated from each other, upper lip dominant. Right lacinia mobilis bifid, thin; mandibular palp thin, article 1 short, article 2 without outer setae, apex of article 3 oblique. Lower lip bearing cones, outer plate of maxilla 1 with 11 spines, one spine especially thickened. Inner plates of maxilliped thick, ordinarily setose; outer plates especially small. Coxae 2-4 without special anterodorsal humps. All posterior spines on article 6 of pereopods 1-2 thick and stiff, midapical seta present. Article 2 of pereopod 5 without facial setae. Peduncle of uropod 1 with dorsolateral spines confined apically, medial spines widely spread; peduncle of uropod 2 with only one medial setule confined apically. Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with ordinary pair of midlateral or dorsal setules on each side.

Type-Species.—Cunmurra itickerus, new species. Composition.—Unique.

RELATIONSHIP.—This genus appears to stand near the ancestral pool of the Brolgus group of genera in which gnathopod 2 is enlarged and bears a shortened wrist, and in which the apices of the peduncles on uropods 1-2 are combed, and in which epimeron 3 is very simple, poorly setose, protuberant, and rounded posteroventrally. Cunmurra is more primitive than other members of the Brolgus group because of the presence of 4 spines on the mandibular molars, the presence of 2 ventral setae and several posterior setules on epimeron 3, and the absence of uropodal combs. Gnathopod 2 is weakly enlarged but the wrist is not fully shortened. Gnathopod 1 has departed from the hypothetically ideal condition in that it is more slender than in other members of the group so that Cunmurra does not form the perfect ancestral grade visualized for the Brolgus group. Cunmurra retains the normal birubiin or primitive inner plate on maxilla 1, which in the Brolgus group often has reduced numbers and sizes of setae and it also retains the following nonbrolgin features: elongate article 2 of antenna 1, strongly spinose molar, stouter spines on article 6 of pereopods 1-2 and stouter distal articles on pereopods 3-5. Whether or not Cunmurra retains the elongate article 5 of antenna 2 in the female is unknown because that sex is undiscovered in Cunmurra.

Cunmurra appears to be in an ancestral grade of the Birubius mayamyi (11) and B. booleus (15) groups, especially of the latter, itself a close sibling of B. mayamayi. Cunmurra differs from B. booleus mainly in the distinctive primitive gnathopods and in the normalcy of the right lacinia mobilis, which in B. booleus is more complex.

Birubius ularitus (29) is especially close to Cunmurra itickerus. Besides the slight difference in gnathopods, Cunmurra itickerus differs from B. ularitus in the more elongate article 2 of antenna 1, bifid right lacinia mobilis, smaller outer plate of the maxilliped, narrower coxa 4, absence of a posterodorsal setule on epimeron 3, and the absence of basofacial setae on uropod 1.

Cunmurra must surely find its classificatory home eventually in the Joubinellinae because of the enlarged gnathopod 2, elongate article 2 of antenna 1, and the presence of more than 3 spines on the mandibular molar. It would be considered to be the most unspecialized member of that group which is otherwise composed of aberrant phoxocephalids having either pelagic and predatorial adaptations or inquilinous adaptations.

Cunmurra itickerus, new species

FIGURES 30-32

Description of Male.—Head about 21 percent of total body length, greatest width about 63 percent of length; rostrum weakly constricted, broad, reaching middle of article 2 on antenna 1. Eyes medium to large, clear of pigment. Article 1 on peduncle of antenna 1 about 1.2 times as long as wide, about 2.3 times as wide as article 2, with medial patch of fuzz, ventral margin with about 13 setules, weakly produced dorsal apex with 4 setules; article 2 about as long as article 1, with ventral cycle of 7 setae; primary flagellum with 9 articles, about 0.66 times as long as peduncle, bearing several short aesthetascs; accessory flagellum with 7 articles. Spine formula on article 4 of antenna 2 = 3-4-2, dorsal margin bearing fuzz, ventral margin with 4 groups of 1-2 short to medium setae, one ventrodistal long spine; article 5 about as long as article 4, facial spine formula = 2, dorsal margin bearing 2 sets of male setae and one calceolus, ventral margin with 2 sets of one seta plus setule, 2 ventrodistal medium spines; flagellum elongate, flagellar formula = (20-21), 1-4, 6, 8... (18 or 20), Mandibles with medium palpar hump; right incisor with 3 teeth; left incisor with 2 teeth and apical

hump; right lacinia mobilis bifid, distal branch much shorter than proximal, weakly flabellate, narrow, subbifid, proximal branch simple, pointed, with marginal denticles; left lacinia mobilis with 5 teeth; right rakers 7; left rakers 7 plus 2 rudimentaries; molar in form of bulbous hump, right molar with 6 primarily medium spines, one short spine weakly disjunct, left molar with 7 primarily medium spines, one spine weakly disjunct, each molar with plume; palp article 1 short, article 2 with one long inner apical seta and 2 other shorter inner setae, article 3 about 1.1 times as long as article 2, oblique apex with 9 spine-setae, basofacial formula = 0-2. Inner plate of maxilla 1 ordinary, bearing one long apical pluseta, one similar apicomedial seta, 2 apicolateral much shorter setae; palp article 2 with 6 apicalmedial marginal spine-setae. Plates of maxilla 2 extending equally, of similar width, outer with 3 apicolateral setae, inner with 3 medial setae. Inner plate of maxilliped with 2 large thick apical spines, 4 apicofacial setae, one medial seta, outer plate with 6 medial and apical spines, one apicolateral seta; palp article 1 without apicolateral seta, article 2 with one apicolateral seta, medial margin of article 2 weakly setose, article 3 unprotuberant, with 4 facial setae, one lateral seta, nail of article 4 short, with 2 accessory setules. Coxa 1 not expanded distally, anterior margin straight; main ventral setae of coxae 1-4 =5-6-6-3, posteriormost seta of coxae 1-3 shortest; anterior and posterior margins of coxa 4 parallel, posterior margin oblique, almost straight, posterodorsal corner rounded, posterodorsal margin short, weakly excavate, width-length ratio of coxa 4 = 2:3. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 3-4-4, short anteriors = 2-2-1-1, long anteriors = 1-4-0-0, no others. Gnathopod 1 with elongate and thin articles 5-6; gnathopod 2 enlarged, article 5 short, article 6 stout; width ratios of articles 5-6 on gnathopods 1-2 = 23:33 and 25:43, length ratios = 68:73 and 53:70; palmar humps ordinary, palms oblique; article 5 of gnathopod I elongate, posterior margin almost flat; article 5 of gnathopod 2 softly triangular. Pereopod 2 stouter than pereopod 1, especially on article 4, posterior margin of latter more moderately setose, facial setae formula on article 4 = 3-3, on article 5 = 4-5, main spine of article 5 extending to M. 80 on article 6, article 5 lacking proximoposterior spines, spine formula of article 6 on both pairs = 4 + 5 plus middistal seta, some spines long; acclivity

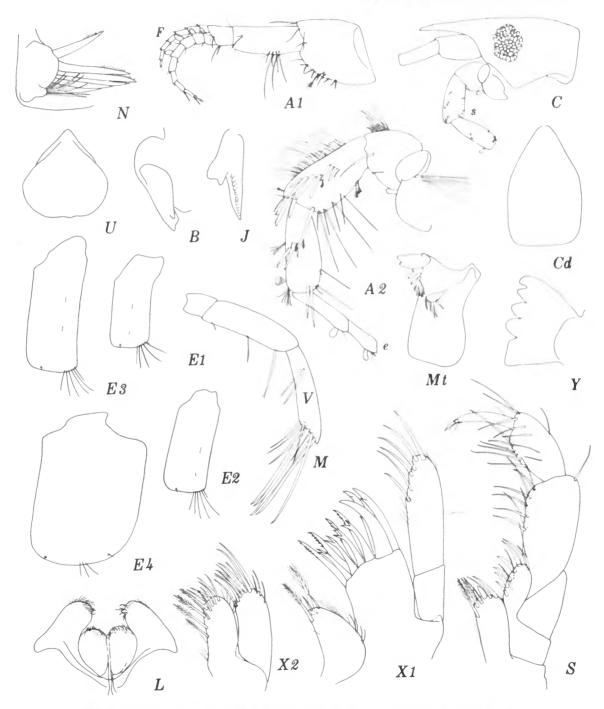


FIGURE 30.—Cunmurra iticherus, new species, holotype, male "a," 4.00 mm (Y = left lacinia mobilis).

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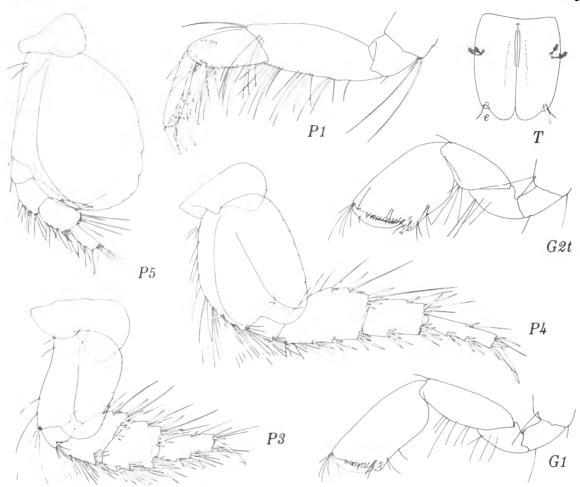


FIGURE 31.—Cunmurra itickerus, new species, holotype, male "a," 4.00 mm.

on inner margin of dactyls of pereopods 1-2 sharp, produced as tooth, emergent setule long, midfacial pluseta short. Coxae 5-7 posteroventral setule formula = 1-2-3. Articles 4-5 of pereopods 3-4 of ordinary width, facial spine rows moderately developed, facial ridge on article 2 of pereopods 3-5=1-2-2, width ratios of articles 2, 4, 5, 6 of pereopod 3=48:40:34:16, of pereopod 4=69:37:26:11, of pereopod 5=88:21:19:8, length ratios of pereopod 3=72:30:35:38, of pereopod 4=91:55:42:50, of pereopod 5=114:26:26:25, article 2 of pereopod 5 reaching apex of article 4, medial apex of article 6 bearing 5 digital processes. Posteroventral corner of epimeron 1 rounded, posterior margin weakly convex, with setule in notch above corner,

anteroventral margin and face with 2 sets of 3 and 2 setae, posteroventral face with one seta; posteroventral corner of epimeron 2 rounded-quadrate, posterior margin almost straight, facial setae = 6 in tandem; posteroventral corner of epimeron 3 rounded but with weakly protuberant setule sinus, posterior margin convex, with 3 setule notches, ventral margin with 2 short setae. Urosomite 1 naked, articulation line complete; urosomites 1-3 unprotuberant. Rami of uropods 1-2 with articulate enlarged apical nails, outer ramus of uropod 1 with 3 dorsal spines, inner with one, outer ramus of uropod 2 with 2 dorsal spines closely appressed, inner with none; peduncle of uropod 1 with 2 apicolateral spines, medially with 4 marginal spines, apicalmost

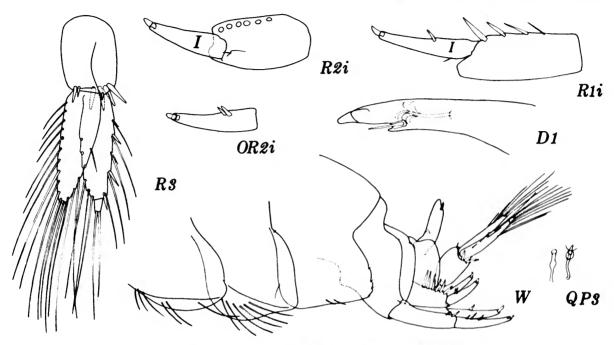


FIGURE 32.—Cunmurra iticherus, new species, holotype, male "a," 4.00 mm.

enlarged; peduncle of uropod 2 with 6-8 dorsal spines, medially with one tiny apical setule; apicolateral corners of peduncles on uropods 1-2 lacking comb. Peduncle of uropod 3 with 4 ventral spines, dorsally with one lateral spine, 2 medial spines; rami masculine, inner extending to M. 100 on article 1 of outer: ramus, apex with 2 setae, medial and lateral margins setose, article 2 of outer ramus short, 0.14, bearing 2 long setae, apicomedial margin of article 1 with 6 setae, lateral margin with 4 acclivities, spine formula = l-l-l-l-1, setal formula = l-l-l-l-1. Telson ordinary, length-width ratio = 35:29, almost fully cleft, each apex broad, rounded, lateral acclivity broad, shallow, bearing ordinary lateral setule, spine next medial longer than setule, midlateral setules ordinary, also bearing rows of male dorsal denticles. Cuticle with ordinary bulbar setules of varying sizes mixed with pipes, surface bearing extremely fine striations in form of linear fingerprint pattern or simply pebbled, setules especially short.

ILLUSTRATIONS.—Head reconstructed dorsally, eyes omitted; lateral view of damaged head partially reconstructed, with antenna 2 added in disconnected position.

HOLOTYPE.—AM, male "a," 4.00 mm. Unique. Type-Locality.—AM P.18125, 12 Dec 1939, Kangaroo Island, South Australia, light in net at night. Distribution.—South Australia, Kangaroo Island, neritic.

Brolgus, new genus

Diagnosis.—Eyes present. Flagella of antennae 1-2 unreduced in female. Article 2 of antenna 1 especially shortened, ventral setae widely spread or confined apically. Article 1 of antenna 2 not ensiform; article 3 with 1-2 setules; facial spines on article 4 in 2 or more rows; article 5 especially thin and short. Right mandibular incisor with 3 teeth; molar not triturative, small, bearing 3 or fewer long clumped spines with common base, usually not bearing fuzz; palpar hump small to medium. Palp of maxilla 1 biarticulate; inner plate with 2 or fewer setae. Setation of maxilla 2 weak. Inner plate of maxillipeds ordinary; apex of palp not protuberant, dactyl elongate, apical nail distinct, medium. Gnathopods dissimilar; hand of gnathopod 2 moderately to strongly enlarged; article 5 of gnathopods NUMBER 245 97

1-2 of ordinary length to very short, cryptic on gnathopod 2, with eusirid attachment; palms oblique, hand of gnathopod I elongate, poorly setose anteriorly. Article 5 of pereopods 1-2 bearing posteroproximal setae. Article 2 of pereopod 3 of broad form; articles 4-5 of pereopods 3-4 narrow, article 2 of pereopods 3-4 not setose posteriorly; pereopod 5 ordinary, article 2 naked or weakly setose ventrally, article 3 ordinary, dactyl normal. Epimera 1-2 lacking long posterior setae, without midfacial setae above ventral facial ridge; epimeron 3 of rounded classification, lacking long setae. Urosomite l generally naked except for sparse apicoventral setae or spines near base of uropod 1; urosomite 3 without dorsal hook or special process. Peduncle of uropod l normally elongate, without apicoventral spike, with special enlarged apicomedial spine; peduncular apices of uropods 1-2 combed; spine(s) on inner ramus of uropod 1 set in one row, no rami continuously spinose to apex; inner ramus of uropod 2 ordinary. Uropod 3 ordinary, article 2 of outer ramus carrying one long apical seta. Telson elongate, with 1-3 apical spines or setae on each lobe plus setules.

DESCRIPTION.—Rostrum fully developed, unconstricted. Fuzz on article 1 of antenna 1 in male present; calceoli on male primary flagellum of antenna 1 present. Calceoli on article 5 of male antenna 2 present; flagellum in male with calceoli. Prebuccal parts ordinary, poorly separated from each other, upper lip dominant. Right lacinia mobilis bifid; mandibular palp thin, article 1 slightly elongate, article 2 without outer setae, apex of article 3 oblique. Lower lip bearing cones. Outer plate of maxilla 1 with 9-11 spines, one spine especially

thickened. Inner plates of maxilliped thin, poorly armed. Coxae 2-4 without special anterodorsal humps. Some posterior spines on article 6 of pereopods 1-2 thin and seta-like, others slightly thicker, midapical spine or seta absent. Article 2 of pereopod 5 without facial setae. Peduncle of uropod 1 with dorsolateral spines confined apically, medial spines widely spread; peduncle of uropod 2 with only one medial spine or setule confined apically. Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with ordinary pair of midlateral or dorsal setules on each side.

Type-Species.—Paraphoxus tattersalli J. L. Barnard, 1958 [here designated].

COMPOSITION.—The following new species: Brolgus koongarrus, B. mahmak, B. millinus, B. tavelus.

RELATIONSHIP.—Brolgus differs from Kuritus and Wildus in the presence of only one apical seta on the outer ramus of uropod 3, and from Ganba in the presence of several elongate and very thin posterior spines on article 6 of pereopods 1-2 (Ganba bearing only one such spine, other spines short and thick), the stouter gnathopod 1, and fully separate inner plates of the maxillipeds.

The most proximal row of spines on the face of article 4 on antenna 2 is becoming obsolete in brolgins. In that set of armaments we distinguish between a true spine which lacks plumes and the plumose setules which approximate the size of the spines. A spine often carries a subapical trigger.

As shown in the following two keys, two sets of character alternatives are used to distinguish the species: the spine and setule formulas on the telson and the presence or absence of scales on the apical nails of the rami on uropods 1–2.

Keys to the Species of Brolgus

KEY A

1.	Each lobe of telson with 2 stout spines plus I-2 setules
	Each lobe of telson with only one stout spine or 1-2 elongate setae plus 1-2 setules 3
2.	Rami of uropods 1-2 with apical scale
	Rami of uropods 1-2 lacking apical scale
	Main element on telson an elongate seta, or exceptionally 2 elongate setal spines, plus 2
	setules medial to seta(e)
	Main element on telson a short, stout spine, plus 1-2 setules either lateral or medial to spine
4.	Rami of uropods 1-2 with apical scale, setules on telsonic lobes lateral to spine
	Rami of uropods 1-2 lacking apical scale, setules on telsonic lobes medial to spine B. mahmak, new species
	• • • • • • • • • • • • • • • • • • • •

KEY B

1.	Rami of uropods 1-2 lacking apical scale, outer plate of maxilla 1 with 11 spines, inner ramus of uropod 2 with dorsal spine
	Rami of uropods 1-2 bearing apical scale, outer plate of maxilla 1 with 9 spines, inner ramus of uropod 2 naked
2.	Each lobe of telson with 2 stout spines
	Each lobe of telson with one stout spine or 1-2 elongate setal spines
3.	Facial ridge on epimeron 2 ordinary, telson with 1-2 elongate setal elements on each lobe
	B. tattersalli
	Facial ridge on epimeron 2 obsolescent, very short, telson with only short elements on each
	lobe
4.	Each lobe of telson with one stout spine and one lateral setule B. tavelus, new species
	Each lobe of telson with 2 stout spines separated by setule (or one stout spine and 2 lateral
	setules)

Brolgus tattersalli (J. L. Barnard), new combination

FIGURES 33-36

Parharpinia villosa.—Tattersall, 1922:4-6, pl. 1: figs. 7-14 [not Haswell, 1879].

Paraphoxus tattersalli J. L. Barnard, 1958:148; 1960:282.

DESCRIPTION OF FEMALE.—Head about 21 percent of total body length, greatest width almost 70 percent of length; rostrum unconstricted, broad, exceeding apex of article 2 on antenna 1. Eyes medium, narrow-reniform, largely occluded with pigment. Article 1 on peduncle of antenna 1 about 1.75 times as long as wide, about 1.9 times as wide as article 2, apicoventral margin with about 7 setules, strongly produced dorsal apex with 3 setules; article 2 about 0.35 times as long as article 1, with apicoventral rows of 8-9 and 4-6 shorter setae; primary flagellum with 9-11 articles, about 0.7 times as long as peduncle, bearing aesthetascs on all but first and last articles; accessory flagellum with 6-9 articles. Spine formula on article 4 of antenna 2 = 2-1-6-1 or 3-6-1, dorsal margin with notch bearing 3 setalspines, ventral margin with 9-10 groups of 1-2 long to short setae, one ventrodistal medium spine; article 5 about 0.65 times as long as article 4, facial spine formula = 0, dorsal margin naked, ventral margin with 5 sets of 1-2 long to short setae, 4 ventrodistal long to short spines, 2 of these set as subdistal facial spines; flagellum about 0.95 times as long as articles 4-5 of peduncle combined, with 8-11 articles. Mandibles with medium palpar hump; right incisor with 3 teeth; left incisor with 3 humps in 2 branches; right lacinia mobilis bifid, distal branch much shorter than proximal, flabellate or simply broad, subbifid or denticulate, proximal branch simple, pointed, with marginal denticles; left lacinia mobilis with 5 teeth; right rakers 7-10, left rakers 8-10, molar in form of short protusion or soft cone demarcated mainly by spines, each molar with 3 long spines; palp article 1 slightly elongate, article 2 with 1-2 medium inner apical setae and 3 other shorter inner setae, article 3 about 1.1 times as long as article 2, oblique apex with 8 spine-setae, basofacial formula = 0-1 or 0-2. Inner plate of maxilla 1 large, broad, bearing one long apical or facial pluseta, one similar apicomedial seta; outer plate with 11 spines; palp article 2 with 6 apicalmedial spines and setae. Inner plate of maxilla 2 shorter and narrower than outer, outer with 4 apicolateral setae, inner with pair of medial setae. Inner plate of maxilliped with one large, thin, feathered apical spine, 2 apicofacial setae, one medial seta; outer plate with 8-9 medial and apical spines, no apicolateral setae; palp articles 1-2 naked laterally, medial margin of article 2 weakly setose, article 3 with 3 facial setae, one lateral seta; nail of article 4 long, with one accessory setule. Coxa 1 expanded distally, anterior margin straight; main ventral setae of coxae 1-4 = 10-9-11-(6-7), posteriormost seta of coxae 1-2 slightly shortened; anterior and posterior margins of coxa 4 almost parallel, posterior margin almost straight, posterodorsal margin ordinary, V-shaped, width-length ratio of coxa 4 = 11:12. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 8-8-7-9, long anteriors = 2-3-0-1, short anteriors = 1-1-1-0. Gnathopod 1 with elongate hand, gnathopod 2 with enlarged hand; width ratios of articles 5-6 on gnathopods 1-2 = 26:36 and 26:55, length ratios = 52:80 and 36:90; palmar humps ordinary, palms strongly oblique; article 5 of gnathopod 1 ovate, posterior margin rounded, article 5 of gnathopod 2

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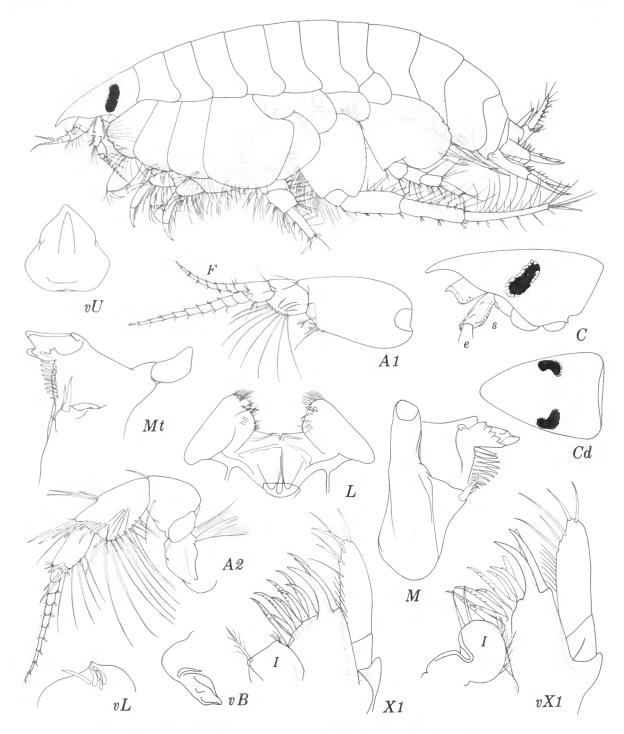


Figure 33.—Brolgus tattersalli (J. L. Barnard), female "w," 6.9 mm (v = male "v," 6.7 mm).

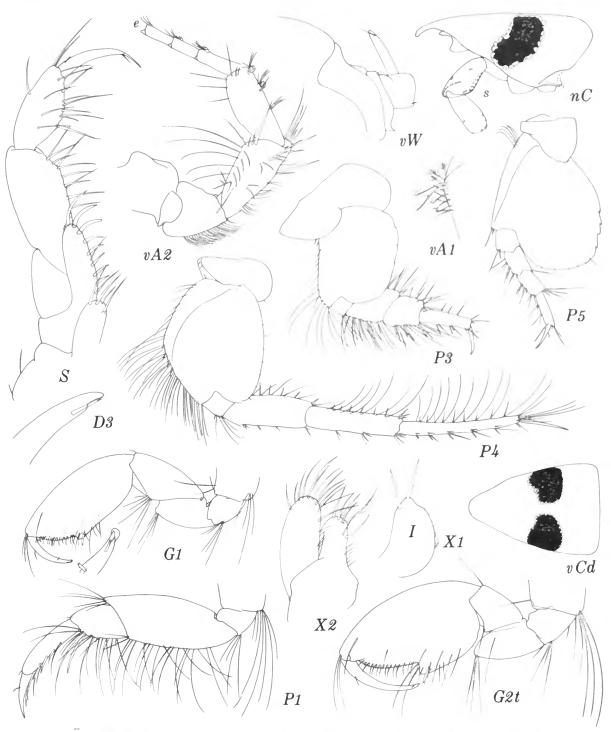


FIGURE 34.—Brolgus tattersalli (J. L. Barnard), female "w," 6.9 mm (n= male "n," 5.7 mm; v= male "v," 6.7 mm).

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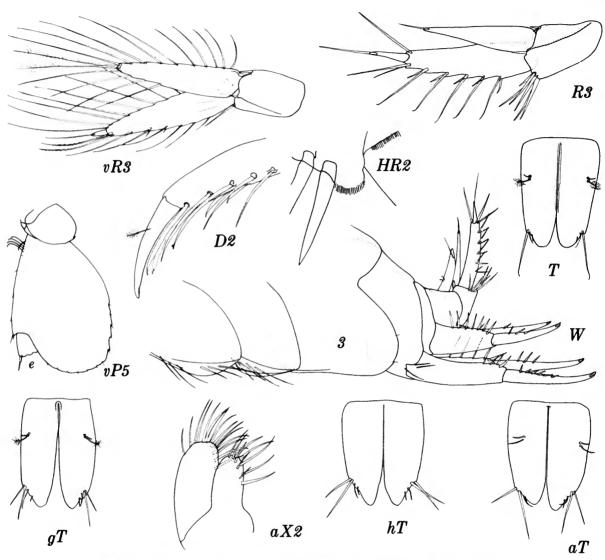


FIGURE 35.—Brolgus tattersalli (J. L. Barnard), female "w," 6.9 mm (v = male "v," 6.7 mm; g = male "g," 6.3 mm; h = female "h," 7.5 mm; a = female "a," 7.2 mm).

short, triangular, cryptic, almost lobate. Pereopods 1–2 similar, facial setae formula on article 4=0 and 0, on article 5=0 and 0; main spine of article 5 slender, extending to M. 68 on article 6, article 5 lacking proximoposterior spines; spine formula of article 6=5+5, no middistal seta, some spines especially thin, acclivity on inner margin of dactyls of pereopods 1–2 obsolescent, emergent setule almost fully immersed, midfacial pluseta ordinary. Coxae 5–7 posteroventral setule formula = 1-(1-3)-

1. Articles 4-5 of pereopods 3-4 narrow, facial spine rows absent, facial ridge formula on article 2 of pereopods 3-5 = 0-1-1, width ratios of articles 2, 4, 5, 6 of pereopod 3 = 51:23:20:9, of pereopod 4 = 65:20:14:9, of pereopod 5 = 70:13:10:6, length ratios of pereopod 3 = 63:29:22:33, of pereopod 4 = 80:53:62:78, of pereopod 5 = 89:19:18:24; article 2 of pereopod 5 exceeding middle of article 4; medial apex of article 6 finely combed, lacking digital processes. Posteroventral corner of epi-

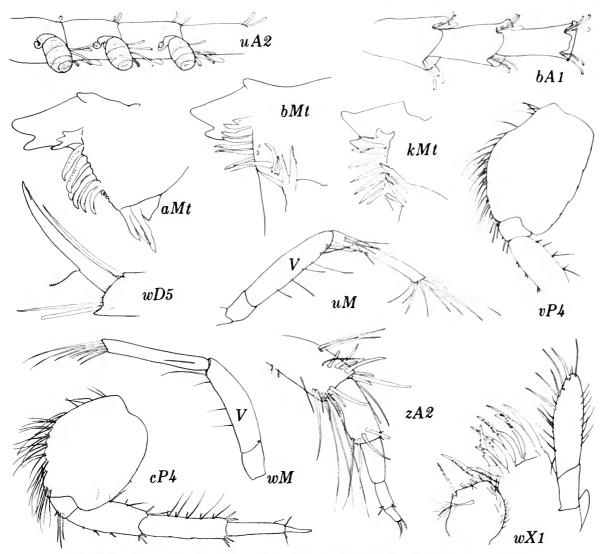


FIGURE 36.—Brolgus tattersalli (J. L. Barnard) (a = female "a," 7.2 mm; b = female "b," 6.6 mm; c = female "c," 6.1 mm; k = female "k," 6.9 mm; u = male "u," 6.6 mm; v = male "v," 6.7 mm; w = female "w," 6.9 mm; z = juvenile "z," 3.6 mm (abnormal antenna 2)).

meron I rounded, posterior margin weakly convex, anteroventral margin with 3 medium setae, posteroventral face with 3-4 medium setae, setule on posterodorsal margin; posteroventral corner of epimeron 2 rounded-quadrate, posterior margin almost straight, facial setae = 4-6; posteroventral corner of epimeron 3 rounded, with setule sinus, posterior margin strongly convex, with one setule notch, ventral margin naked. Urosomite 1 with lateral

setule at base of uropod 1, articulation line complete; urosomite 3 unprotuberant dorsally. Rami of uropods 1-2 with semi-articulate immersed weak apical nails lacking scale, outer ramus of uropod 1 with 4-6 dorsal spines, inner with 2-3, outer ramus of uropod 2 with 3-4 dorsal spines, inner with 1-2 dorsomedial spines; peduncle of uropod 1 with 3-4 apicolateral spines and 2-3 basofacial setae, medially with 4-5 marginal setae and spines plus apical

enlarged special spine; peduncle of uropod 2 with 6-7 dorsal spines, medially with one medium apical spine; apicolateral corners of peduncles on uropods 1-2 with comb. Peduncle of uropod 3 with 6 elongate ventral spines, dorsally with one lateral spine, one medial spine; rami feminine, inner extending to M. 85 on article 1 of outer ramus, apex with one seta, medial and lateral margins naked, article 2 of outer ramus elongate, 0.30, bearing one long seta, apicomedial margin of article 1 with one seta, lateral margin with 5 acclivities, spine formula = 2-2-2-2-2, one of each pair elongate, setal formula = 0. Telson elongate, length-width ratio = 7:5, almost fully cleft, each apex narrow, rounded, lateral acclivity narrow, bearing 1-2 elongate lateral spine-setae, 2 short medial setules, dorsolateral setules diverse. Cuticle smooth, with fine plumose hairs scattered on posterior dorsum of body.

OBSERVATIONS (female).—The facial spine formula on article 4 of female antenna 2 is counted as 1-6-1 but 2 additional long spine-setae occur dorsomedial to the most distal facial spine and could be counted in the first group, to wit, 3-6-1; this is true also in B. millinus and B. mahmak.

DESCRIPTION OF MALE.—Slighter than female, with enlarged eyes, shortened peduncle of pleopod 3, weakly crested urosomite 2, heavily setose rami of uropod 3. Primary flagellum of antenna 1 with 1+ more articles than in female, articles 1-5 or 1-6 with calceoli and elongated aesthetascs, only distal articles with elongate aesthetasc, distoventral corner of article 1 of peduncle with numerous setules. Articles 3-4 of peduncle on antenna 2 with dorsomedial fuzz, ventral setae of articles 4-5 fewer and shorter, dorsal margin of article 5 with 3 sets of male setae, one spine and 2 calceoli, flagella formula = 38, 1-5, 7, $9 \dots 37$. Article 2 of mandibular palp with 6-8 setae, longer and stouter than in female; article 3 with basofacial formula of 3-2 or 2-1. Coxae 1-4, gnathopods and percopods 1-2 with fewer setae. Spines and setae on article 5 of pereopods 1-2 stouter than in female. Article 2 of pereopod 4 narrower, with spines on anterodistal corner, anterior marginal setae sparser and shorter, proximal half of anterior margin concave; pereopod 5 narrower than in female, spines on anterodistal corners of articles 2-3 shortened. Epimeron 3 less produced posteriorly, setules smaller. Peduncle of uropod I usually with one additional basofacial seta, one more medial spine, inner ramus usually

with 2 spines and rudimentary third; peduncle of uropod 2 with 7-9 spines, outer ramus with 3-4, inner with 1-2. Rami of uropod 3 masculine.

OBSERVATIONS (male).—Juveniles resembling females but eyes smaller, becoming sexually differentiated at 5 mm of length. Mature individuals showing variations, regardless of body size, in numbers of posterior setae on article 2 of gnathopods, between 4 and 13, usually 9.

Variations.—Pereopod 4 subject to abnormality in about 4 percent of specimens with this appendage intact, abnormal condition reflected in shortness of article 6, with fewer spines and setae, with occasional shortness of articles 5 and 7, perhaps resulting from imperfect regeneration. Juvenile, 3.9 mm, PPBES 984/1, with right flagellum of antenna 2 composed of only 3 articles, left flagellum with 6 articles.

Variation in telsonic spine patterns is widespread through all samples; total number of adult specimens closely examined = 606; of these, 435 have the normal telson with one spine on each lobe; 45 specimens have one spine on one lobe but 2 spines on the other lobe; 22 specimens have 2 spines on each lobe; 2 specimens have three spines on one lobe and 2 spines on the other lobe; one specimen has 3 spines on each lobe; finally, one specimen has one spine on one lobe and no spine on the other lobe.

Specimens with two spines on each telsonic lobe are not senile though they are generally the largest individuals of the collections (about 7.0 mm long). These are also characterized by having more medial setae on the inner plate of maxilla 1 (Figure 35: aX2) but no other characteristic has been found to be correlated with increased telsonic spination, except that the distal branch of the right lacinia mobilis is more elaborate (Figure 36: aMt).

Juveniles of B. millinus and B. mahmak already have their characteristic telsonic spination in the size range of 2.4-2.6 mm.

VOUCHER MATERIAL (all illustrated).—CPBS 31S/1270: female "w," 6.9 mm; male "v," 6.7 mm. CPBS 31N/1270: male "n," 5.7 mm. PPBES 920/3: female "a," 7.2 mm. PPBES 920/4: female "b," 6.6 mm. PPBES 920/2: female "c," 6.1 mm; male "g," 6.3 mm. PPBES 334: female "k," 6.9 mm. PPBES 984/1: juvenile "z," 3.6 mm. RHM, 22 Oct 1971: male "u," 6.6 mm. CPBS 31N/770: female "h," 7.5 mm.

RELATIONSHIP.—Brolgus tattersalli is the type-

species and model for *Brolgus* and therefore its relationships are stated in discussions of the other species of *Brolgus*.

MATERIAL.—CPBS, 120 samples from 31 stations (546); PPBES, 32 samples from 16 stations (99); WPBES, 10 samples from 8 stations (12); SBS, 3 samples from 3 stations (4); EBS, 2 samples from 2 stations (2); WAM, one sample (21); AM, 2 samples (71); RHM, one sample (3).

DISTRIBUTION.—Victoria: Western Port and Port Phillip Bay, 0-19 m, sand, silty sand, weed, shell; off Cape Everard, 77 m. New South Wales: off Malabar, 49 m, sand, shell; Jervis Bay, 6 m, *Halophila*, *Zostera*. South Australia: Kangaroo Island, neritic. Tasmania: off Tasmanian Coast, 182 m.

Brolgus millinus, new species

FIGURES 37-39

Description of Female.—Head about 20 percent of total body length, greatest width about 63 percent of length; rostrum unconstricted, broad, reaching apex of article 2 on antenna 1. Eyes medium, reniform, clear of pigment. Article I on peduncle of antenna 1 about 1.6 times as long as wide, about twice as wide as article 2, ventral margin with about 4 apical setules, produced dorsal apex with 2 setules; article 2 about 0.43 times as long as article 1, with apicoventral cycle of 6 setae; primary flagellum with 7-10 articles, about as long as peduncle, bearing several short aesthetascs; accessory flagellum with 5-7 articles. Spine formula on article 4 of antenna 2 = 1-(8-10)-1(+1), dorsal margin with notch bearing 4 setal-spines, ventral margin with 5 groups of 1-2 long to medium setae, one ventrodistal long to medium seta; article 5 about 0.67 times as long as article 4, facial spine formula = 0, dorsal margin naked, ventral margin with 3 sets of 2-3 long to short setae, 2 ventrodistal medium spines set subdistally; flagellum about 1.3 times as long as articles 4-5 of peduncle combined, with 8 articles. Mandibles with medium palpar hump; right incisor with 3 teeth and notch; left incisor with 3 humps in 2 branches; right lacinia mobilis bifid, distal branch shorter than proximal, broad, subbifid, proximal branch simple, pointed, with marginal denticles; left lacinia mobilis with 5 teeth; right rakers 9 plus 1+ rudimentaries; left rakers 10 plus 1+ rudimentaries; molar in form of short protrusion demarcated mainly by spines, each molar with 3 long spines, none disjunct; palp article l elongate, article 2 with one medium inner apical seta and one other shorter inner seta, article 3 about 1.1 times as long as article 2, oblique apex with 5-6 spine-setae, basofacial formula = 0. Inner plate of maxilla 1 suborbicular, bearing one long apical pluseta, one similar apicomedial seta; outer plate with 11 spines; palp article 2 with 2 apical-medial marginal spines and 3 apicolateral and submarginal setae. Inner plate of maxilla 2 shorter and narrower than outer, outer with 3 apicolateral setae, inner with one medial seta. Inner plate of maxilliped with one long, thin apical spine, 2 apicofacial setae, one medial seta; outer plate with 9 medial and apical spines, no apicolateral setae; palp articles 1-2 lacking apicolateral seta, medial margin of article 2 moderately to weakly setose, article 3 with 3-4 facial setae, one lateral seta, nail of article 4 medium, with one accessory setule. Coxa l expanded distally, anterior margin straight; main ventral setae of coxac 1-4 = (8-9)-8-8-4, posteriormost seta of coxae 1-3 slightly shortened; anterior and posterior margins of coxa 4 almost parallel, posterior margin convex, posterodorsal corner rounded, posterodorsal margin short, L-shaped, width-length ratio of coxa 4 = 16:17. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = (2-4)-(2-6)-5-5, long anteriors = 0-2-0-0, short anteriors = l-l-l-l, no others. Gnathopods with enlarged hands, slightly elongate on gnathopod 1; gnathopod 2 larger than gnathopod 1, with short and cryptic wrist; width ratios of articles 5-6 on gnathopods 1-2 = 26:38 and 25:47, length ratios = 55:77 and 42:80; palmar humps ordinary, palms strongly oblique; article 5 of gnathopod 1 ovate, posterior margin rounded; article 5 of gnathopod 2 short, triangular, almost lobate, cryptic. Pereopods 1-2 similar, facial setae formula on article 4 = l-1; on article 5 = (0-1) and 1, main spine of article 5 extending to M. 70 on article 6, article 5 lacking proximoposterior spines; spine formula of article 6 = 4 + 4, no middistal seta, some spines especially long and thin; acclivity on inner margin of dactyls of pereopods 1-2 obsolescent, setule almost fully immersed, midmarginal pluseta ordinary. Coxae 5-7 posteroventral setule formula = 1-1-1; articles 4-5 of pereopods 3-4 narrow, facial spine rows sparse, facial ridge formula on article 2 of pereopods 3-5 =0-1-1, width ratios of articles 2, 4, 5, 6 of pereo-

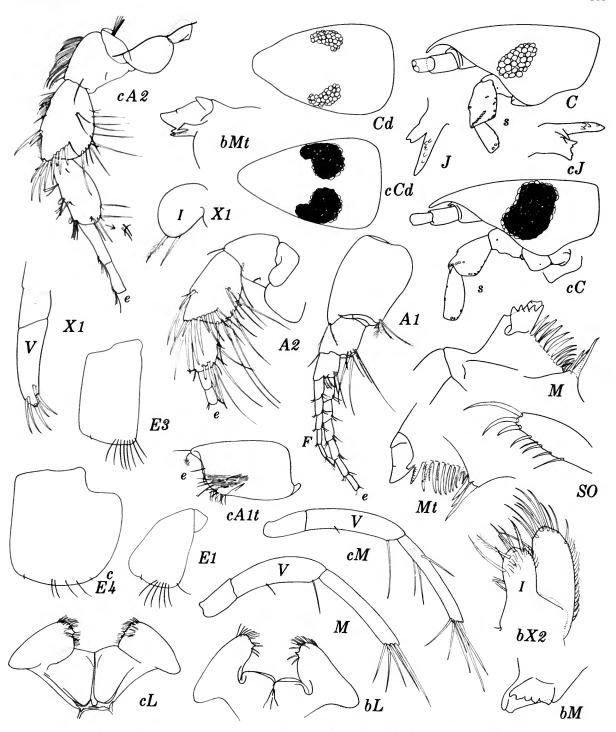


FIGURE 37.—Brolgus millinus, new species, holotype, female "a," 3.9 mm (b = female "b," 4.2 mm; c = male "c," 4.9 mm).

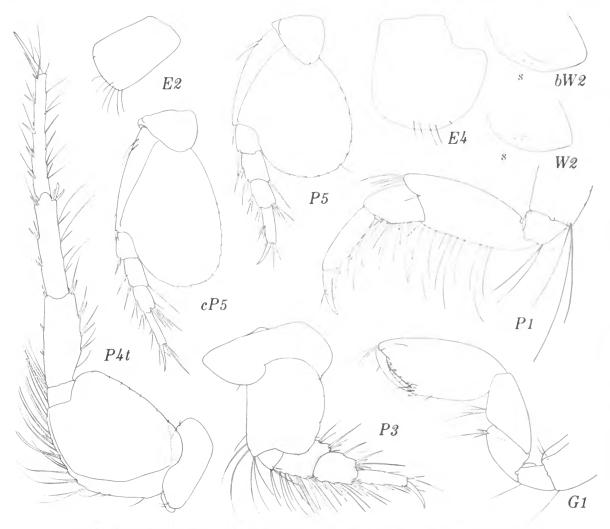


FIGURE 38.—Brolgus millinus, new species, holotype, female "a," 3.9 mm (b = female "b," 4.2 mm; c = male "c," 4.9 mm).

pod 3 = 50:26:21:9, of pereopod 4 = 71:25:15:10, of pereopod 5 = 78:15:13:7, length ratios of pereopod 3 = 63:30:28:34, of pereopod 4 = 86:59: 70:80, of pereopod 5 = 98:21:20:25; article 2 of pereopod 5 exceeding middle of article 4; medial apex of article 6 finely combed, truncate. Posteroventral corner of epimeron 1 narrowly rounded, posterior margin weakly convex, anteroventral margin with one medium seta, posteroventral corner of epimeron 2 rounded-quadrate, posterior margin straight, facial setae = 2, lateral ridge very short to obsolescent; posteroventral corner of epimeron 3

rounded, weakly protuberant, with setule sinus, posterior margin convex, with one setule notch, ventral margin naked. Urosomite 1 with lateral setule at base of uropod 1, articulation line complete; urosomite 3 unprotuberant dorsally. Rami of uropods 1-2 with articulate weak apical nails, lacking scale; outer ramus of uropod 1 with 2-3 dorsal spines, inner with one; outer ramus of uropod 2 with 2 dorsal spines, inner with one dorsomedial spine; peduncle of uropod 1 with 3 apicolateral spines and 2-3 basofacial setae, medially with 4-5 marginal setae and spines plus special apical enlarged spine; peduncle of uropod 2 with

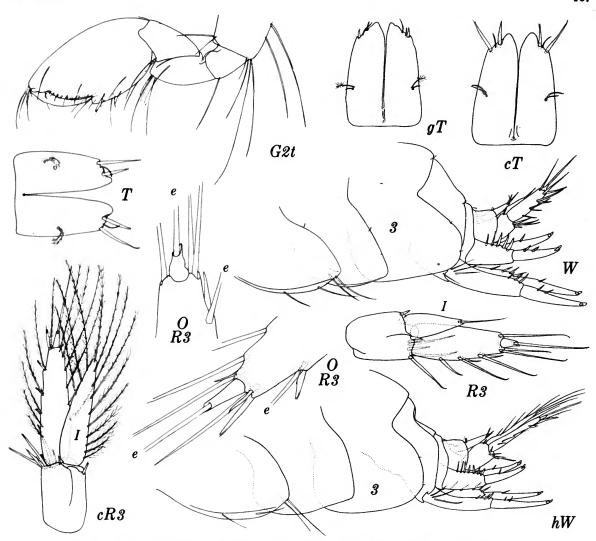


FIGURE 39.—Brolgus millinus, new species, holotype, female "a," 3.9 mm (c = male "c," 4.9 mm; h = male "h," 4.6 mm); Brolgus mahmak, new species (g = female "g," 5.25 mm).

5 dorsal spines, medially with one large apical spine, apicolateral corners of peduncles on uropods 1-2 with comb. Peduncle of uropod 3 with 5-6 ventral spines, some elongate, dorsally with one lateral spine, one medial spine; rami feminine, inner extending to M. 60 on article 1 of outer ramus, apex with one seta, medial and lateral margins naked, article 2 of outer ramus ordinary, 0.19, bearing one long seta, apicomedial margin of article 1 with one seta, lateral margin with 3 acclivities, spine formula = 1-2-2-2, some very elongate. Telson long, length-width ratio = 28:25, not fully

cleft, each apex narrow, rounded, lateral acclivity broad, shallow, with elongate lateral and medial spines separated by ordinary setule, midlateral setules of equal length. Cuticle with ordinary but very sparse bulbar setules.

OBSERVATIONS (female).—Spines of outer plate more elongate than in *B. tattersalli*, maxillipeds otherwise like that species; telsonic lobes usually with 2 (rarely 1 or 3) large spines separated by setule, medial spine smaller than lateral spine. See "Observations" (female) under *B. tattersalli*.

DESCRIPTION OF MALE.—Differing from female in

slightly narrower rostrum, enlarged eyes, elongate flagellum of antenna 2, broader epimera, narrower urosome, shortened peduncle of pleopod 3, longer and more setose rami of uropod 3. Article 1 on peduncle of antenna I with medial patch of fuzz, ventral margin with numerous setules; each flagellum with additional article, primary flagellum bearing calceoli and elongate aesthetascs. Basal support articles below head for attachment of antenna 2 much enlarged; articles 3-4 of antenna 2 with dorsomedial fuzz, article 4 generally with one fewer facial spine in main row; article 5 lacking both distofacial spines on article 5, flagellum with upwards to 31 articles, flagellar formula = (≤ 31) , 1-4, 6, 8 . . . 30. Distal branch of right lacinia mobilis more elaborately sculptured than in female, basofacial setal formula on article 3 of mandibular palp = 1-2. Coxae 1-4, gnathopods and pereopods with fewer setae than in female. Anteroproximal margin of article 2 on pereopod 4 depressed; pereopod 5 with narrower articles, particularly articles 2 and 6, spines on anterodistal apices of articles 2-3 shorter. Epimera 1-2 broader than in female but epimeron 3 less deeply produced posteriorly. Uropod I usually with one fewer basofacial seta than in female and one additional dorsal spine, spination of rami similar to that of female. Telson more elongate, spines shorter than in female.

ILLUSTRATIONS.—Following items similar to B. tattersalli and not illustrated: prebuccal mass, upper lip, outer plate of maxilla 1, maxilliped (but see outer plate illustrated), pereopodal dactyls. Following parts of male similar to those of female and not illustrated: mandible (but see palp and right lacinia mobilis), maxillae, maxillipeds, gnathopods, pereopods 1–4, coxae 1–3. Male and female lower lips drawn from opposite aspects, that for female from dorsal aspect, that for male from ventral aspect.

HOLOTYPE.—NMV, female, 3.9 mm.

Type-Locality.—CPBS 23N, 10 Mar 1965, Western Port Bay, Victoria, Australia, 10 m, gravel, coarse sand, broken shell.

VOUCHER MATERIAL.—CPBS 41N/3: female "b" 4.2 mm (illus). RHM, 22 Oct 1971: male "c," 4.9 mm (illus); male "h," 4.6 mm (illus.). CPBS 32N/1270: female "k," 4.3 mm.

RELATIONSHIP.—Brolgus millinus differs from B. koongarrus and B. tavelus in the absence of apical scales on the rami of uropods 1-2 and in having

11 instead of 9 spines on the outer plate of maxilla 1, and from B. mahmak in the development of 2 full spines on each lobe of the telson and in the obsolescence or absence of a facial ridge on epimeron 2.

Brolgus millinus is a cryptic species very close to B. tattersalli in which maturation occurs at a small size, not longer than 5.0 mm, but in which there is a full development of body armaments even, in the case of telson and basofacial uropod 1, a superdevelopment in relation to conditions typical of B. tattersalli. Brolgus millinus is further distinguished from B. tattersalli in the short to absent facial ridge on epimeron 2, the more rectangular article 1 of antenna 1, the greater height of female coxa 4, the shorter inner ramus of uropod 3 in the female, and the shorter article 2 on the outer ramus of uropod 3.

MATERIAL.—CPBS, 71 samples from 21 stations (159); WPBES, 8 samples from 6 stations (11); SBS, 4 samples from 3 stations (11); RHM, 2 samples (8).

DISTRIBUTION.—Victoria, Western Port, 0.3-19.2 m, fine and coarse sand, muddy sand, sandy gravel, coarse sand on clay; also nektonic. New South Wales, off Malabar, 39-66 m.

Brolgus mahmak, new species

FIGURES 39 (gT), 40-42 (part)

Description of Female.—Head about 18 percent of total body length, greatest width about 70 percent of length; rostrum unconstricted, broad, reaching or exceeding apex of article 2 on antenna 1. Eyes large, fully black or clear of pigment. Article 1 on peduncle of antenna 1 about 1.6-1.7 times as long as wide, about 1.7 times as wide as article 2, ventral margin with 4-6 setules, produced dorsal apex with 1-3 setules; article 2 about 0.35 times as long as article 1, with apicoventral crescent of 5 setae; primary flagellum with 7-8 articles, about 0.8 times as long as peduncle, bearing several short aesthetascs; accessory flagellum with 5-6 articles. Spine formula on article 4 of antenna 2 = 3-6-1, dorsal margin with notch bearing one setule and 3-4 spines, ventral margin with 4-5 groups of 2-3 long to medium setae, 2 ventrodistal long to medium spines; article 5 about 0.7 times as long as article 4, facial spine formula = 0 or 1, dorsal margin naked, ventral margin with 2-3 sets of 1-3 long

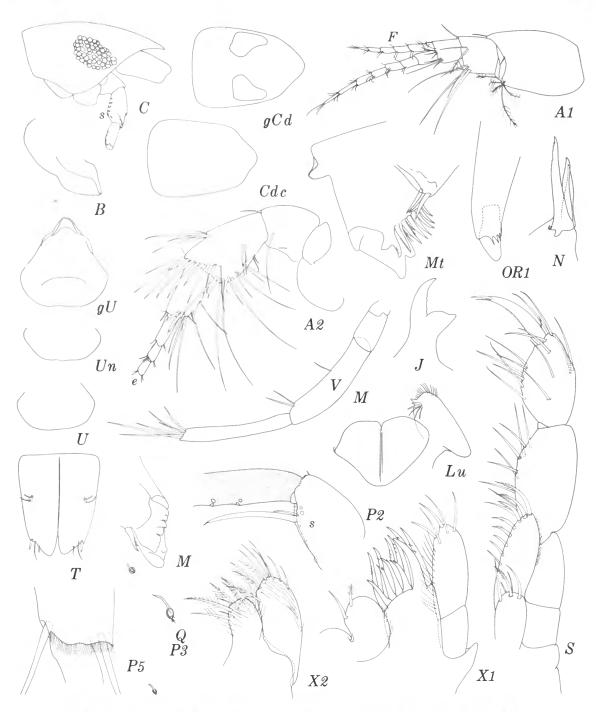


Figure 40.—Brolgus mahmak, new species, holotype, female "a," 4.54 mm (g = female "g," 5.25 mm).

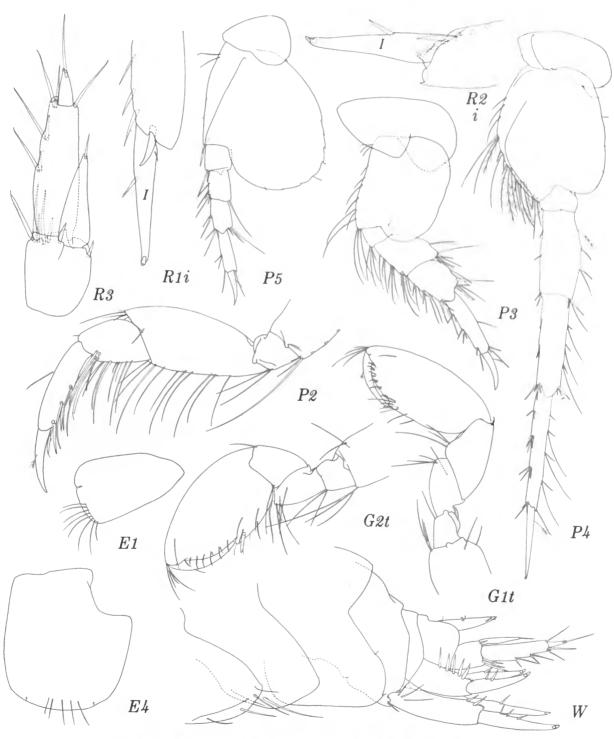


FIGURE 41.—Brolgus mahmak, new species, holotype, female "a," 4.54 mm.

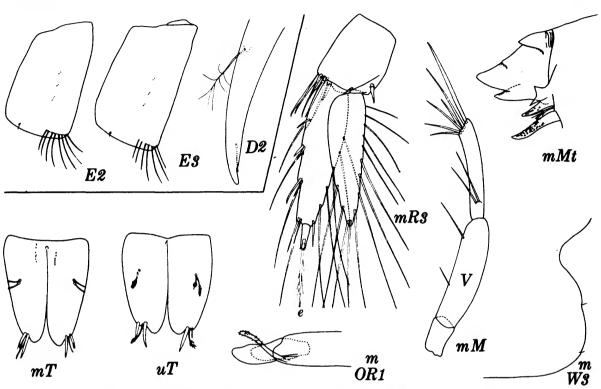


FIGURE 42.—Upper left: Brolgus mahmah, new species, holotype, female "a," 4.54 mm; lower: Brolgus koongarrus, new species, holotype, male "m," 3.06 mm (m = holotype; u = male "u," 3.44 mm).

to short setae, 2 ventrodistal medium spines set somewhat on face; flagellum about 1.0-1.1 times as long as articles 4-5 of peduncle combined, with 7-8 articles. Mandibles with medium palpar hump; right incisor with 3 teeth; left incisor with 4 humps in 2 branches; right lacinia mobilis bifid, distal branch shorter than proximal, broad, simple, proximal branch simple, pointed, curved into hook, with marginal denticles; left lacinia mobilis with 5 teeth plus 3 accessory teeth; right rakers 5-7 plus 0-2 rudimentaries; left rakers 6-8 plus 1-2 rudimentaries; molar in form of soft cone demarcated mainly by spines, each molar with 3 long spines; palp article 1 slightly elongate, article 2 with 1-2 (rarely 2) medium apical setae and 1-2 other short inner setae, article 3 narrow, about 1.1 times as long as article 2, oblique apex with 5-7 spine-setae, basofacial formula = 0. Inner plate of maxilla 1 broad, suborbicular, bearing one medium apical pluseta, one large apicomedial seta; outer plate with 11 spines; palp article 2 with 2 apical-medial margi-

nal spines and 3 submarginal setae. Inner plate of maxilla 2 shorter and narrower than outer, outer with 3 apicolateral setae, inner with one medial seta. Inner plate of maxilliped with small, thin, unfeathered apical spine, additional thin apicomedial spine, 3 apicofacial setae, no medial setae; outer plate with 7-9 medial and apical spines, no apicolateral sétae; palp articles 1-2 naked laterally, medial margin of article 2 weakly setose, article 3 with 3-5 facial setae, 2 lateral setae, nail of article 4 short, with one accessory setule. Coxa 1 scarcely expanded distally, anterior margin straight; main ventral setae of coxae 1-4 = (8-10)-(8-9)-(7-9)-(3-5), posteriormost seta of coxae 1-3 slightly shortened or seta of coxa 2 scarcely so; anterior and posterior margins of coxa 4 almost parallel, posterior margin almost straight, posterodorsal corner narrowly rounded, posterodorsal margin long, almost L-shaped; width-length ratio of $\cos 4 = 8:9$. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = (2-5)-(3-5)-(3-4)-(4-6), short

posteriors = 0, long anteriors = 1(+1 facial)-(1-2)+ l-2 facials)-0-0, short anteriors = l-l-l-1, no others. Gnathopods with enlarged hands, slightly elongate on gnathopod 1, gnathopod 2 larger than gnathopod 1; width ratios of articles 5-6 on gnathopods 1-2 = 28:40 and 25:48, length ratios = 53:85and 37:84; palmar humps small, palms strongly oblique; article 5 of gnathopod 1 ovate, posterior margin rounded, short; article 5 of gnathopod 2 short, cryptic, triangular. Pereopods 1-2 similar, facial setae formula on article 4 = 1 and 1, on article 5 = 1 and 2; main spine of article 5 extending to M. 67 on article 6, article 5 lacking proximoposterior spines; spine formula of article 6 = 3 + 4, no middistal seta; acclivity on inner margin of dactyls of pereopods 1-2 obsolescent, emergent setule short, almost fully immersed, midfacial pluseta ordinary. Coxae 5-7 posteroventral setule formula = (1-2)-(1-2)-1. Articles 4-5 of pereopods 3-4 narrow, facial spine rows sparse; facial ridge formula on article 2 of pereopods 3-5 = 0-1-1; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 53:26:22:10, of pereopod 4 = 67:25:16:10, of pereopod 5 = 78:15:13:8, length ratios of pereopod 3 = 67:31:30:43, of pereopod 4 = 80:54:65:78, of pereopod 5 = 95:20:22:27; article 2 of pereopod 5 reaching middle of article 4; medial apex of article 6 finely combed, undulant. Posteroventral corner of epimeron 1 with small protrusion, posterior margin weakly convex, anteroventral margin with 1-2 medium setae, posteroventral margin with 1-2 long setae; posteroventral corner of epimeron 2 rounded or weakly protuberant, with weak sinus, posterior margin weakly convex, facial setae = 1-2; posteroventral corner of epimeron 3 weakly protuberant, with setule sinus, posterior margin convex, with one setule notch, ventral margin naked; epimera 1-2 lacking seta on posterodorsal margin. Urosomite 1 with lateral setule at base of uropod 1, articulation line complete; urosomite 3 unprotuberant dorsally. Rami of uropods 1-2 with articulate apical nails, lacking scale, each with distinctive jagged flap at base; outer ramus of uropod 1 with 2-3 dorsal spines, inner with 1-2, outer ramus of uropod 2 with 2 dorsal spines, inner with 1-2 dorsomedial spines; peduncle of uropod 1 with 2 apicolateral spines and 2-4 basofacial setae, medially with 3 marginal setal-spines, plus apical enlarged special spine; peduncle of uropod 2 with 4-6 dorsal spines, medially with one large apical

spine; apicolateral corners of peduncles on uropods 1-2 with fine comb. Peduncle of uropod 3 with 5-6 ventral spines, dorsally with one lateral spine, one medial spine; rami feminine, inner extending to M. 70 on article 1 of outer ramus, apex with one seta, medial and lateral margins naked, article 2 of outer ramus ordinary, 0.26, bearing one medium seta, apicomedial margin of article 1 with one seta, lateral margin with 2-3 acclivities, spine formula = long and short 2-2-2 or 2-2-2-2, setal formula = 0. Telson long, length-width ratio = 17:14, almost fully cleft, each apex narrow, rounded subsharply, lateral acclivity shallow, weak, bearing short lateral spine, setule next medial longer than spine, with occasional second shorter setule, midlateral setules weakly diverse. Cuticle with scattered ordinary bulbar setules.

OBSERVATIONS.—See "Observations" under B. tattersalli.

ILLUSTRATIONS.—Dorsal outline of eyes reconstructed by approximation on female "g"; antenna l shown disarticulate on lateral view of head.

HOLOTYPE.—NMV, female "a," 4.54 mm.

Type-Locality.—CPBS 41N/2, Western Port, Victoria, Australia, 30 Mar 1965, 12.8 m, heavy reef, large stones, gravel, mud.

VOUCHER MATERIAL.—CPBS 41N/2, female "g," 5.25 mm (illus.). Male unknown.

RELATIONSHIP.—This species differs from B tattersalli in the presence of a stout and short lateral spine as the main element on the telsonic lobes and not an elongate spine-seta as in B. tattersalli. In B. mahmak the facial ridge on epimeron 2 is shorter, the inner ramus of uropod 3 on the female is shorter, the setae on article 2 of antenna 1 are fewer and more apicad, and the palmar hump on gnathopod 2 is smaller than in B. tattersalli.

Brolgus mahmak differs from B. millinus in the failure of the third and medialmost element on each lobe of the telson to develop fully into a spine. Characters more minor or difficult to observe in B. mahmak include the stouter article 2 of antenna 1, the shape of the right lacinia mobilis, the presence of a short apical spine on the inner plate of the maxilliped, the presence of a distinctive and jagged flap at the base of the nails on uropods 1-2 and in the shorter and stouter article 6 and longer dactyl of pereopod 4, which however are somewhat variable in B. millinus.

MATERIAL.—CPBS, 3 samples from 2 stations (19); WPBES, one sample (30).

DISTRIBUTION.—Victoria, Western Port, 12.8 m, heavy reef bottom.

Brolgus tavelus, new species Figures 43, 44

DESCRIPTION OF MALE.—Head about 23 percent of total body length, greatest width about 70 percent of length; rostrum unconstricted, broad, elongate, evenly tapering, reaching apex of article 2 on antenna 1. Eyes medium, clear of pigment core, reddish brown. Article 1 on peduncle of antenna 1 about 1.5–1.7 times as long as wide, about 2.3 times as wide as article 2, with medial patch of fuzz,

ventral margin with about 10 setules, weakly produced dorsal apex with one long seta, one setule; article 2 about 0.4 times as long as article 1, with apicoventral crescent of 3-4 setae; primary flagellum with 6-8 articles, about 0.8 times as long as peduncle, bearing calceolus on articles 1-4, long aesthetascs on articles 2-(pen)ultimate; accessory flagellum with 4-6 articles. Spine formula on article 4 of antenna 2 = 3-6-1 or 3-5-1, dorsal margin with notch bearing 3-4 spines, ventral margin with 5-6 groups of one medium or pairs of long to medium setae, 2-3 ventrodistal medium spines, articles 3-4 with dorsomedial fuzz; article 5 about as long as article 4, facial spine formula = 0-1, dorsal margin bearing 1-2 calceoli and 3 groups of 3-4 male

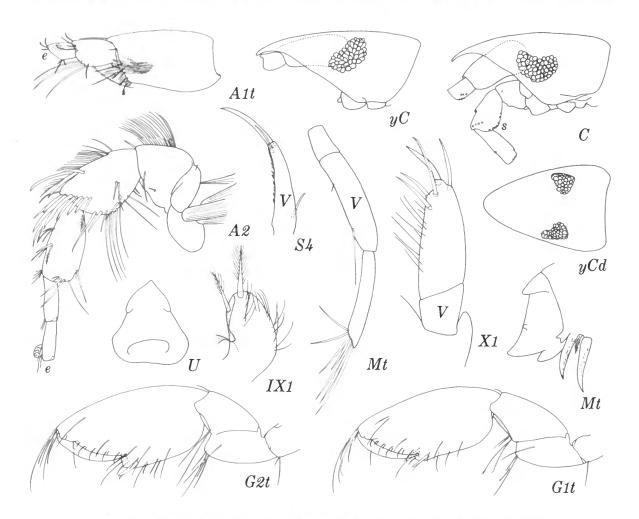


FIGURE 43.—Brolgus tavelus, new species, holotype, male "c," 3.50 mm (y = male "y," 3.63 mm).

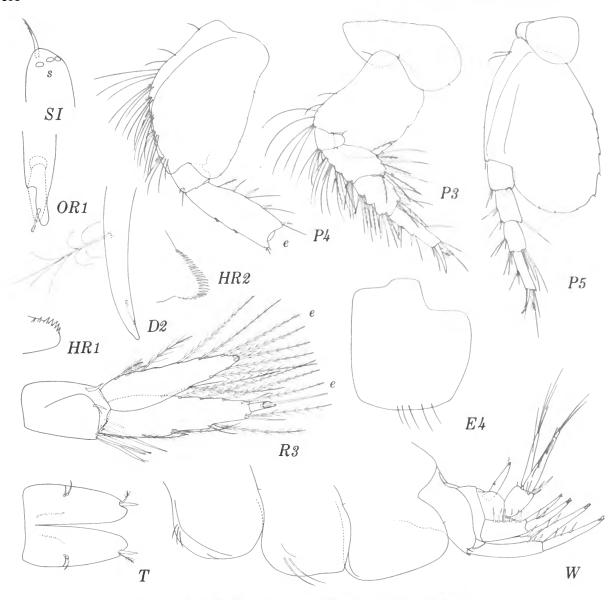


FIGURE 44.—Brolgus tavelus, new species, holotype, male "c," 3.50 mm.

setae, ventral margin with one setal-spine pair, subapical facial crescent of 3 medium spines and 2 short setae; flagellum elongate, flagellar formula = (17-23), (1) 2-4, 6, 8 . . . penultimate. Mandibles with medium palpar hump; right incisor with 3 teeth and notch; left incisor with 5 humps in 2 branches; right lacinia mobilis bifid, distal branch much shorter than proximal, subbifid, proximal branch simple, with marginal denticles; left lacinia mobilis with 5 teeth plus one accessory tooth; right and left rakers 4-5 plus 0-2 rudimentaries; molars demarcated mainly by spines, each molar with 3 long spines; palp article 1 slightly elongate, article 2 with 1-2 long inner apical setae and 1-2 other short inner setae, article 3 about 0.90 times as long as article 2, oblique apex with 7-8 spine-setae, basofacial formula = 0-2. Inner plate of maxilla 1 narrower than in *Brolgus mahmak*, bearing one

long apical pluseta, one shorter similar apicomedial seta; outer plate with only 9 spines; palp article 2 with 2 apical-lateral marginal spines and 3 submarginal setae. Inner plate of maxilla 2 shorter and narrower than outer, outer with 4 apicolateral setae, inner with pair of medial setae. Inner plate of maxilliped with one elongate feathered apical spine, 3 apicofacial setae, no medial setae; outer plate with 7-8 medial and apical spine-setae, no apicolateral setae; palp articles 1-2 naked laterally, medial margin of article 2 weakly setose, article 3 with 2-3 facial setae, one lateral seta, nail of article 4 long, with one accessory setule. Coxa 1 expanded distally, anterior margin almost straight; main ventral setae of coxae 1-4 = (8-11)-(8-10)-9-(5-6), posteriormost seta of coxae 1-3 slightly shortened; anterior and posterior margins of coxa 4 almost parallel, posterior margin slightly convex, posterodorsal corner rounded, posterodorsal margin ordinary, V-shaped, width-length ratio of coxa 4 = 14:15 or 10:11. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 2-(0-2)2-(2-3), short posteriors = (0-1)-0-0-0, long anteriors = (0-1)-(0-1)-0-0, short anteriors = 1-0-1-(0-1), one long facial on gnathopods 1-2. Gnathopod 1 with elongate hand, gnathopod 2 with enlarged hand; width ratios of articles 5-6 on gnathopods 1-2 = 28:43 and 26:50, length ratios = 54:97 and 45:102; palmar humps ordinary to large, palms strongly oblique; article 5 of gnathopod 1 triangular, cryptic, posterior margin short, article 5 of gnathopod 2 short, triangular. Pereopods 1-2 similar; posterior margin of article 4 on latter with longer setae, facial setae formula on article 4 = 0-0 or 1-1, on article 5 = 2-2 and 2-(2-1)3), main spine of article 5 extending to M. 90+ on article 6, article 5 lacking proximoposterior spines, spine formula of article 6 = 4 + 4, no middistal seta, some spines especially long; acclivity on inner margin of dactyls of pereopods 1-2 obsolescent, emergent setule almost fully immersed, midfacial pluseta long. Coxae 5-7 posteroventral setule formula = 1-2-1. Articles 4-5 of pereopods 3-4 narrow, facial spine rows sparse, facial ridge formula on article 2 of pereopods 3-5 = 0-1-1; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 50:25:20:10, of pereopod 4 = 67:23:16:10, of pereopod 5 =75:13:12:6, length ratios of pereopod 3 = 73:35: 30:38, of pereopod 4 = 100:60:85:92, of pereopod 5 = 115:24:22:29; article 2 of pereopod 5

reaching middle of article 4, medial apex of article 6 combed, sigmoid. Posteroventral corner of epimeron 1 rounded, posterior margin convex, anteroventral margin with 1-3 medium setae, posteroventral face with one medium seta; posteroventral corner of epimeron 2 rounded-quadrate, posterior margin weakly convex, facial ridge extremely weak, facial setae = 2 crowded forward; posteroventral corner of epimeron 3 rounded, with setule sinus, rarely absent, posterior margin strongly convex, with 0-1 setules, ventral margin naked; epimera 1-2 with small setule on posterodorsal margin set in weak notch, epimera 2-3 with very short facial ridge or none. Urosomite 1 with lateral setule at base of uropod 1, articulation line complete; urosomite 3 unprotuberant dorsally. Rami of uropods 1-2 with articulate apical nails, bearing scale; outer ramus of uropod 1 with 2-3 dorsal spines, inner with 1-2, outer ramus of uropod 2 with 1-2 dorsal spines, inner naked; peduncle of uropod 1 with 2-3 apicolateral spines and one basofacial seta, medially with 3 marginal spines, plus special apical enlarged spine; peduncle of uropod 2 with 4-6 dorsal spines, medially with one large apical spine; apicolateral corners of peduncles on uropods 1-2 with comb, coarse dorsolaterally on uropod 1. Peduncle of uropod 3 with 6 ventral spines, dorsally with one lateral spine, one medial spine; rami masculine, inner extending to M. 100 on article 1 of outer ramus, apex with 2 setae, medial and lateral margins setose, article 2 of outer ramus ordinary, 0.17, bearing one long seta, apicomedial margin of article 1 with one spine and one seta, lateral margin with 3 acclivities, spine formula = 2-2-2-2or 1-2-2-2, setal formula = 1-1-1-1. Telson elongate, length-width ratio = 16:11, not fully cleft, each apex narrow, rounded, lateral acclivity shallow, narrow, bearing ordinary lateral setule, spine next medial slightly longer or of length equal to setule, each lobe with row of denticles, midlateral setules almost alike. Cuticle with sparse, ordinary bulbar setules.

OBSERVATIONS.—Prebuccal parts moderately extended forward, epistomal region extended as rounded lobe from lateral view, epistome and upper lip fused together but with remnants of articulation line dorsally, anterior face with crescentic rugosity, ventral margin almost truncate, with tiny midhump (visible if rotated properly); lower lip as in *Brolgus mahmak* but mandibular

lobes slightly broader apically; maxilla 1 like that of B. mahmak (but outer plate with only 9 spines), shape of inner plate slightly narrower (see illustration) and palp of different appearance (see illustration), palp with stout apical spine, thinner marginal spine and 3 setae; maxilla 2 like that of B. mahmak; maxilliped generally like that of female B. mahmak but main apical spine on inner plate almost twice as long (see illustration), bearing 3 apicofacial setae, no ventroapical seta (except for one attributed as spine), outer plate with 6 spines, article 3 of palp with 2 facial setae and one lateral seta, nail of dactyl (see illustration) much longer than in B. mahmak; coxae 1-3 as in B. mahmak, coxa 4 broader, width length ratio averaging 11:12; pereopod 4 about 1.2 times as long as in B. mahmak relative to pereopods 3 and 5; apical nails on rami of uropods 1-2 of this species and B. koongarrus with scale extensions borne on chitin of ramal body, each scale bearing free setule.

ILLUSTRATIONS.—Calceoli on dorsal margin of article 5 of antenna 2 not shown; second facial ridge on article 2 of pereopod 5 apparently artificial; head of holotype male "c" with eyes in wrong position owing to preservational defects, male "y" with presumed normal eyes and correct insertion of antenna 1; right mandibular palp of holotype abnormal in having only one long inner apical seta on article 2 and no basofacial setae on article 3; coxa 7 of holotype with setule omitted; posteroventral setule sinus on holotype epimeron 3 omitted.

HOLOTYPE.—AM, male "c," 3.50 mm (with right uropod 3 missing).

TYPE-LOCALITY.—AM P.18125, 12 Dec 1939, Antechamber Bay, Kangaroo Island, South Australia, in net at night.

VOUCHER MATERIAL.—Type-locality, male "y," 3.63 mm (illus.). Female unknown.

RELATIONSHIP.—The male (female unknown) of Brolgus tavelus differs from the females of B. tattersalli, B. millinus, and B. mahmah and the males of B. tattersalli and B. millinus in the telsonic armament formula, to wit, in B. tavelus the main apical spine is medial and the setule is lateral, whereas in the other three species the lateralmost element is always a spine or elongate seta. The male of B. koongarrus also has a spine as the lateral element.

This species and B. koongarrus appear to differ

from the other species in the presence of a scale adjoining the apical nails on the rami of uropods 1-2. They also have only 9 spines on the outer plate of maxilla 1 in contrast to the other 3 species which bear 11 spines.

Together, B. tavelus and B. koongarrus (to follow) differ from B. mahmak in the much narrower rostrum, the bifid and distally unextended right lacinia mobilis, unbroadened distal tooth on left lacinia mobilis, presence in almost all specimens (except holotypes) of 2 long apical setae on article 2 of mandibular palp, presence of basofacial setae on article 3 of mandibular palp, absence of a stout apicomedial spine on inner plate of maxilliped (apart from normal 3 spine-setae and fine apicoventral spine found in all species of Brolgus), much longer main apical spine on article 5 of pereopods 1-2, longer article 2 of mandibular palp (longer than article 3), shape of epimeron 3, coarseness of apicolateral comb on peduncle of uropod 1, the the uropodal scales, differences in telsonic spination, and absence of spines on inner ramus of uropod 2.

MATERIAL.—AM, one sample (8).

DISTRIBUTION.—South Australia, Kangaroo Island, in net at night.

Brolgus koongarrus, new species

FIGURE 42 (part)

Description of Male.—Head about 23 percent of total body length, greatest width about 22 percent of length; rostrum broad, reaching apex of article 2 on antenna 1. Eyes subreniform, fairly large, clear of pigment core, reddish brown. Article 1 on peduncle of antenna 1 about 1.4 times as long as wide, about 2.25 times as wide as article 2, with medial patch of fuzz, ventral margin with about 10 setules, weakly produced dorsal apex with 2 setules; article 2 about 0.3 times as long as article 1, with apicoventral cycle of 6 setae; primary flagellum with 7-8 articles, about 0.7 times as long as peduncle, bearing calceolus on articles 1-4, several medium aesthetascs; accessory flagellum with 5 articles. Spine formula on article 4 of antenna 2 = 3-5-1 or 3-4-1, dorsal margin with 2 notches bearing 4 and 2 spines, ventral margin with 5-6 medium setae rarely paired with shorter seta, 3 ventrodistal long and short spines; article 5 about as long

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as article 4, facial spine formula = 0-1, dorsal margin naked, bearing 3 groups of male setae, occasional calceolus, ventral margin with 2 sets of seta and spine, subapical facial crescent of 2 spines and 2 short setae; flagellum elongate, flagellar for $mula = (22-24), 1-3, 5, 7 \dots (21 \text{ or } 23).$ Mandibles with medium palpar hump; right incisor with 3 teeth and notch; left incisor with 5 humps in 2 branches; right lacinia mobilis bifid, distal branch much shorter than proximal, broad, bifid, branches gaping, proximal branch simple, pointed, with marginal denticles; left lacinia mobilis with 5 teeth, right rakers 4-6 plus 0-1 rudimentary; left rakers 4-5 plus 0-1 rudimentary; molars demarcated mainly by spines; each molar with 3 primarily long spines; palp article 1 slightly elongate, article 2 with 1-3 long inner apical setae and one other short inner seta, article 3 about 0.9 times as long as article 2, oblique apex with 6-7 spine-setae, basofacial formula = 0-2 or 1-2. Inner plate of maxilla 1 narrower than in Brolgus mahmak, bearing one long apical pluseta, one shorter similar apicomedial seta; outer plate with only 9 spines; palp article 2 with 2 apical-lateral marginal spines and 3 submarginal setae. Inner plate of maxilla 2 shorter and narrower than outer, outer with 3 apicolateral setae, inner with one medial seta. Inner plate of maxilliped with one thin apical spine, 3 apicofacial setae, medialmost elongate (contrast B. tavelus), no medial setae; outer plate with 6-8 medial and apical spines, no apicolateral setae; palp articles 1-2 naked laterally, medial margin of article 2 weakly setose, article 3 with 3 facial setae, one lateral seta, nail of article 4 very long (contrast B. tavelus), with one accessory setule. Coxa I expanded distally, anterior margin almost straight; main ventral setae of coxae 1-4 = (8-11)-(8-11)-(8-9)-(5-7), posteriormost seta of coxae 1-3 slightly shortened; anterior and posterior margins of coxa 4 almost parallel, posterior margin slightly convex, posterodorsal corner rounded (but less than B. tavelus), posterodorsal margin ordinary, L-shaped, width-length ratio of coxa 4 = 11:12. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = (1-2)-(1-3)-2-(2-3), short posteriors = 0, long anteriors = 1-1-0-0, short anteriors = 0-(0-1)-1-1, 1-2long facials on gnathopods 1-2. Gnathopod 1 with elongate hand, gnathopod 2 with enlarged hand; width ratios of articles 5-6 on gnathopods 1-2 = 28:40 and 26:54, length ratios = 44:104 and

55:109; palmar humps ordinary to large, palms strongly oblique: article 5 of gnathopod 1 triangular, posterior margin short; article 5 of gnathopod 2 short, cryptic, triangular. Pereopods 1-2 similar; facial setae formula on article 4 = 1 and 1, on article 5 = 2 and 2, main spine of article 5 extending to M. 100+ on article 6, article 5 lacking proximoposterior spines, spine formula of article 6 = 3+ 3, 3 + 4 or 4 + 4, no middistal seta, some spines especially long; acclivity on inner margin of dactyls of pereopods 1-2 obsolescent, emergent setule almost fully immersed, midfacial pluseta long. Coxae 5-7 posteroventral setule formula = 1-2-1. Articles 4-5 of pereopods 3-4 narrow, facial spine rows sparse; facial ridge formula on article 2 of pereopods 3-5 = 0-1-1; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 55:30:23:11, of pereopod 4 = 70:25:16:10, of pereopod 5 = 79:15:12:7, length ratios of pereopod 3 = 74:37:32:41, of pereopod 4 = 111: 70:84:115, of pereopod 5 = 124:27:23:33; article 2 of pereopod 5 almost reaching apex of article 4 or slightly beyond; medial apex of article 6 combed, sigmoid. Posteroventral corner of epimeron 1 rounded, posterior margin convex, anteroventral margin with 1-3 medium setae, posteroventral face with one medium seta; posteroventral corner of epimeron 2 subquadrate, posterior margin weakly convex, facial ridge short, very weak or absent, facial setae = one; posteroventral corner of epimeron 3 rounded, posterior margin weakly convex, with 0-2 setule notches, ventral margin naked; epimera 1-2 with small setule on posterodorsal margin set in weak notch. Urosomite 1 with lateral setule at base of uropod 1, articulation line complete; urosomite 3 unprotuberant dorsally. Rami of uropods 1-2 with articulate apical nails, bearing scale, outer ramus of uropod 1 with 2-3 dorsal spines, inner with 1-2, outer ramus of uropod 2 with 1-2 dorsal spines, inner naked; peduncle of uropod 1 with 2-3 apicolateral spines and one basofacial seta, medially with 2-3 marginal spines, plus special apical enlarged spine; peduncle of uropod 2 with 4-5 dorsal spines, medially with one large apical spine, apicolateral corners of peduncles on uropods 1-2 with comb, coarse dorsolaterally on uropod 1. Peduncle of uropod 3 with 6-7 ventral spines, dorsally with one lateral spine, one medial spine; rami masculine, inner extending to M. 100 on article 1 of outer ramus, apex with 2 setae, medial and lateral margins setose, article 2 of outer ramus ordinary, 0.19,

bearing one long seta, medial apex of article 1 with one spine, one seta, lateral margin with 3 acclivities, spine formula = 1-2-2-2 or 2-2-2-2, setal formula = 1-1-1-1. Telson long, length-width ratio = 5:4, almost fully cleft, each apex narrow, rounded, lateral acclivity shallow, narrow, bearing shorter lateral and longer medial spine separated by setule longer than lateral spine, lateral spine occasionally reduced to proportions of setule; each lobe with row of denticles, midlateral setules almost alike. Cuticle with sparse ordinary bulbar setules.

OBSERVATIONS.—Prebuccal parts moderately extended forward, epistomal region extended as rounded lobe from lateral view, epistome and upper lip fused together but with remnants of articulation dorsally, anterior margin with crescentic rugosity, ventral margin almost truncate, weakly concave, with tiny midhump (visible if rotated properly); lower lip generally like that of B. mahmak but mandibular lobes broader apically; maxilla 1 generally like that of B. mahmak, (but outer plate with only 9 spines), inner plate and palp like those of B. tavelus; maxilla 2 like that of B. mahmak; maxilliped generally like that of B. mahmak but lacking additional apical spine, bearing 3 apicofacial setae, no ventrofacial seta (except for one attributed as spine), outer plate with 6 spines, article 3 of palp with 3 facial and one lateral setae, nail of dactyl much longer than in B. mahmak, like B. tavelus; coxae 1-3 like female of B. mahmak, coxa 4 broader, width-length ratio about 11:12, as in B. tavelus; pereopod 4 about 1.2 times as long as pereopod 4 of B. mahmak in relation to pereopods 3 and 5; setae on epimeron 1 about 50 percent longer than in B. tavelus; uropods 1 and 2 with scales near apical nails as in B. tavelus.

ILLUSTRATIONS.—Mostly omitted because of similarities to *B. tavelus* and to *B. mahmak* as detailed above; seta on medial apex of article 1 of outer ramus of uropod 3 not shown.

HOLOTYPE.—AM, male "m," 3.06 mm (with right uropod 3 missing).

Type-Locality.—AM P.18125, 12 Dec 1939, Antechamber Bay, Kangaroo Island, South Australia, in net at night.

VOUCHER MATERIAL.—Type-locality: male "k," 3.60 mm; male "u," 3.44 mm (illus.). Female unknown.

RELATIONSHIP.—The specimens assigned to this species, like those of *Brolgus tavelus*, cannot repre-

sent the male of *B. mahmak* (known only for the female) because the telson in the majority of these males bears two fully developed spines on each lobe and the apical nails on the rami of uropods 1-2 bear scales. Possibly such scales are characters of males of all these species but until such can be demonstrated, the feature is considered as a good taxonomic character. The telson of *B. koongarrus* resembles that of *B. millinus*, hence the best gross characters of distinction between the species are the uropodal scales and the 9 spines on the outer plate of maxilla 1 in *B. koongarrus*. In *B. koongarrus* the apical spine on article 5 of pereopods 1-2 and the telsonic spines are relatively more elongate than in *B. millinus*.

The majority of specimens of B. koongarrus differs from B. tavelus in the telsonic armament formula. Brolgus koongarrus has 2 thick spines separated by a setule, whereas B. tavelus has one spine plus a lateral setule. Occasional specimens of B. koongarrus have the thick lateral spine transformed into a thin seta-spine and often it is rudimentary, thus approaching the condition in B. tavelus where the telson has simply one medial spine and one lateral setule. The aberrant specimens of B. koongarrus generally have the aberrant condition only on one side of the telson, the other side being normal. Brolgus koongarrus also has a broader distal ramus on the right lacinia mobilis but this feature is so difficult to observe in proper orientation that we have not used it as a taxonomic character nor have we checked it for consistency.

MATERIAL.—AM, one sample (11).

DISTRIBUTION.—South Australia, Kangaroo Island, in net at night.

Elpeddo, new genus

DIAGNOSIS.—Eyes absent. Flagella of antennae 1-2 unreduced in female, article 2 of antenna 1 shortened, ventral setae confined apically. Article 1 of antenna 2 not ensiform; article 3 with 2 setules, facial spines on article 4 in one main row; article 5 ordinary in size. Right mandibular incisor with 3 teeth; molar not triturative, medium, bearing 3 long clumped spines with common base, bearing fuzz; palpar hump small to medium. Palp of maxilla 1 biarticulate, inner plate with 3 setae. Setation of maxilla 2 ordinary. Inner plate of maxillipeds ordinary; apex of palp article 3 weakly

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protuberant, dactyl elongate, apical nail distinct, medium. Gnathopods ordinary, small, similar, gnathopod 2 weakly enlarged; article 5 of gnathopods 1-2 of ordinary length, free, without eusirid attachment; palms oblique, hands of gnathopods 1-2 ordinary, ovatorectangular, poorly setose anteriorly. Article 5 of pereopods 1-2 setose posteroproximally. Article 2 of pereopod 3 of broad form, weakly tapering distally; articles 4-5 of pereopods 3-4 narrow to medium; article 2 of pereopods 3-4 not setose posteriorly; pereopod 5 ordinary, article 2 naked ventrally, article 3 ordinary, dactyls normal. Epimera 1-2 lacking long posterior setae, without midfacial setae above ventral facial ridge; epimeron 3 of rounded classification and lacking long setae. Urosomite I generally naked except for sparse apicolateral setae near base of uropod 1; urosomite 3 without dorsal hook or special process. Peduncle of uropod l normally elongate, without apicoventral spike, with special enlarged apicomedial spine, peduncle apices of uropods 1-2 combed, spine(s) on inner ramus of uropod 1 in one row, no rami continuously spinose to apex, inner ramus of uropod 2 ordinary. Uropod 3 ordinary, elongate article 2 of outer ramus carrying 2 short apical setae. Telson elongate, with 2 apical spines on each lobe plus setules.

Description.—Rostrum fully developed. Article l of primary flagellum on male antenna l elongate, thickened, densely furnished with aesthetascs, fuzz absent, calceoli absent. Calceoli on article 5 of male antenna 2 present; flagellum in male without calceoli. Prebuccal parts ordinary, poorly separated from each other, upper lip dominant. Right lacinia mobilis bifid, flabellate; mandibular palp thin, article 1 slightly elongate, article 2 without outer setae, apex of article 3 oblique. Lower lip bearing cones. Outer plate of maxilla 1 with 11 spines, one spine especially thickened. Inner plates of maxilliped poorly armed, thick. Coxae 2-4 without special anterodorsal humps. All posterior spines on article 6 of pereopods 1-2 thick and stiff, midapical spine present. Article 2 of pereopod 5 without facial setae. Peduncle of uropod 1 with dorsolateral spines confined apically, medial spines widely spread; peduncle of uropod 2 with only one medial spine confined apically. Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with ordinary pair of midlateral or dorsal setules on each side.

Type-Species.—Elpeddo kaikai, new species.

Composition.—Unique.

RELATIONSHIP.—This genus differs from Brolgus and Ganba in the presence of 2 apical setae, albeit short, on article 2 of the outer ramus on uropod 3, and from Kuritus in the stout, weakly diverse gnathopods with short article 5 on gnathopod 2. Elpeddo appears closest to Wildus, from which Elpeddo differs in the shortness of apical setae on the outer ramus of uropod 3, in the fully split inner plates of the maxilliped and in the male by the odd, lysianassid antenna 1 which in itself may be simply an aberrancy. The absence of eyes, also a possible aberrancy, distinguishes Elpeddo from its neighbors

The presence of double spination on each lobe of the telson suggests affinities with Brolgus koongarrus, B. mahmak, and B. millinus. The two former species have unserrate right laciniae mobiles whereas B. millinus has the distal branch serrate as in E. kaikai. Brolgus millinus has an extremely short article 2 on the outer ramus of uropod 3, perhaps one of the best distinguishing characteristics between the two species.

The unique male is extremely unusual and may be aberrant; it has the first antenna of a lysianassid and irregularities in shapes or armaments of uropod 3, urosomite 1, peduncle of uropod 1, antenna 2, and apex of maxillipedal palp, all suggesting that the first antenna may also be an irregularity, unique to this specimen and possibly not typical of the species.

Elpeddo kaikai, new species

FIGURES 45-47

Description of Female.—Head about 19 percent of total body length, greatest width about 63 percent of length; rostrum unconstricted, not reaching middle of article 2 on antenna 1. Eyes absent. Article 1 on peduncle of antenna 1 about 1.6 times as long as wide, about 1.8 times as wide as article 2, ventral margin with about 9 setules, weakly produced dorsal apex with 2 setules; article 2 about 0.5 times as long as article 1, with apicoventral row of 6 setae; primary flagellum with 10 articles, about as long as peduncle, lacking aesthetascs; accessory flagellum with 7 articles. Spine formula on article 4 of antenna 2 = 7 (or possibly 3-4), dorsal margin with notch bearing 3 setae and one spine, ventral

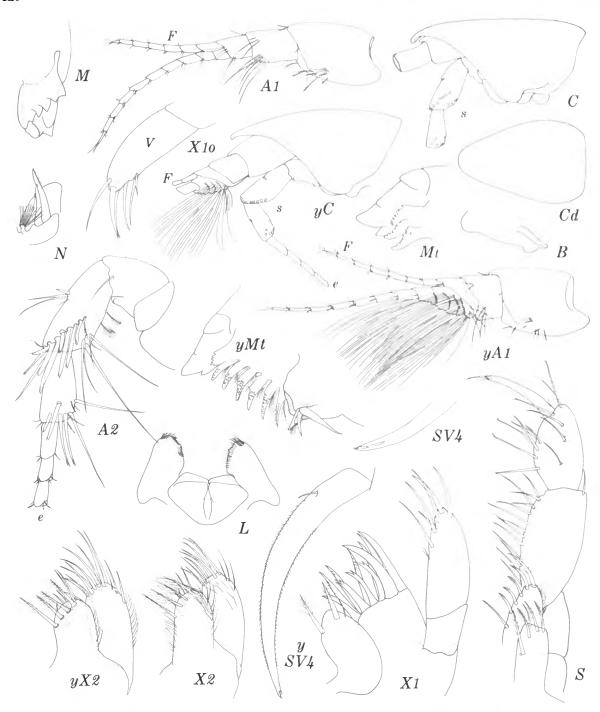


FIGURE 45.—Elpeddo haihai, new species, holotype, female "a," 3.40 mm (y = male "y," 3.08 mm).

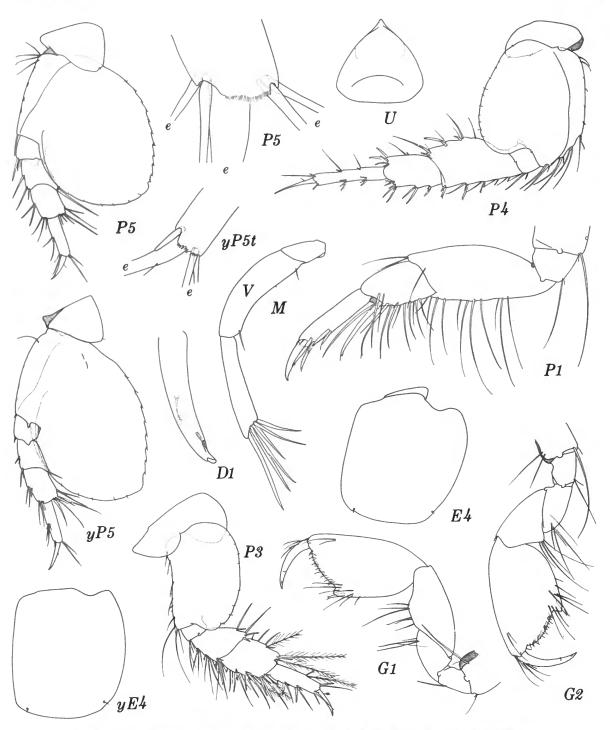


FIGURE 46.—Elpeddo kaikai, new species, holotype, female "a," 3.40 mm (y = male "y," 3.08 mm).

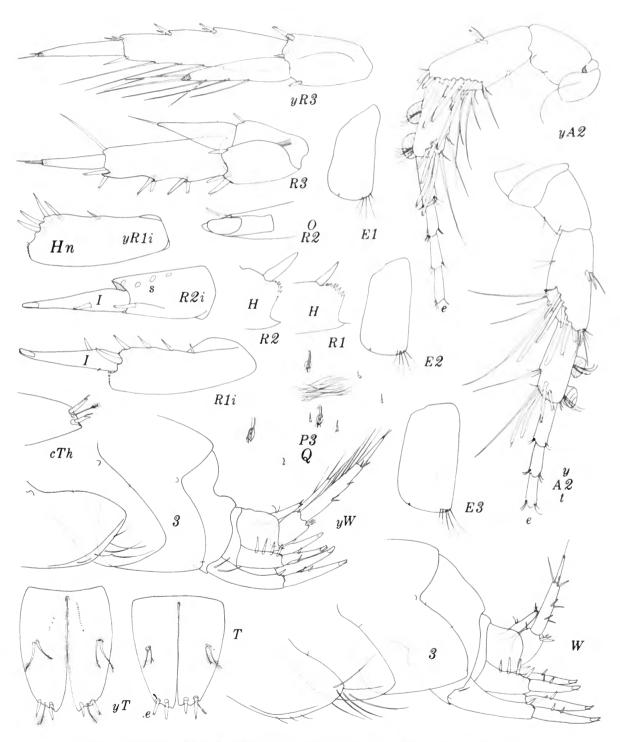


FIGURE 47.—Elpeddo kaikai, mew species, holotype, female "a" 3.40 mm (c = female "c," 3.05 mm; y = male "y," 3.08 mm).

margin with 2 groups of 2-3 long to short setae, one ventrodistal long thin setal-spine; article 5 about 0.7 times as long as article 4, facial spine formula = 0, dorsal margin naked, ventral margin with 2 sets of 2 medium to short setae, 3 ventrodistal short to medium spines, one subdistal facial spine; flagellum about 1.8 times as long as articles 4-5 of peduncle combined, with 10 articles. Mandibles with medium palpar hump; right incisor with 3 teeth and notch; left incisor with 4 humps in 2 branches; right lacinia mobilis bifid, distal branch shorter than proximal, flabellate, denticulate, proximal branch weakly flabellate but pointed, with marginal denticles; left lacinia mobilis with 4 teeth plus 2 accessory teeth; right rakers 6 plus 2 rudimentaries; left rakers 7; molar composed of bulbous hump demarcated mainly by spines, each molar with 3 long spines, none disjunct, each molar with plume; palp article 1 slightly elongate, article 2 with one short inner apical seta and one other shorter inner seta, article 3 about as long as article 2, oblique apex with 6 spine-setae, basofacial formula = 0. Inner plate of maxilla 1 large, bearing one long apical pluseta, one similar apicomedial seta, one apicolateral seta; palp article 2 with 6 apicalmedial-lateral marginal spines and setae. Inner plate of maxilla 2 shorter than outer, outer not broader than inner, outer with 3 apicolateral setae, inner with one medial seta. Inner plate of maxilliped with one thin apical spine, 3 apicofacial setae, one medial seta; outer plate with 6 medial and apical spines, no apicolateral setae; palp article 1 naked, article 2 with one apicolateral seta, medial margin of article 2 moderately setose, article 3 with 3 facial setae, no lateral setae, nail of article 4 medium, with one accessory setule. Coxa 1 scarcely expanded distally, anterior margin weakly concave; main ventral setae of coxae 1-4 = 5-5-5-0, posteriormost seta of coxae 1-2 slightly shortened; anterior and posterior margins of coxa 4 almost parallel, posterior margin convex, posterodorsal corner sharp-rounded, posterodorsal margin short, Vshaped, width-length ratio of $\cos 4 = 38:45$. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = (3-4)-4-4-(3-4), short posteriors = (1-2)-3-(3-5)-4, long anteriors = 1-3-0-0, short anteriors = 4-3-4-3. Gnathopods weakly enlarged; wrist of gnathopod 2 short; width ratios of articles 5-6 on gnathopods 1-2 = 27:40 and 28:44, length ratios = 62:74 and 45:72; palmar humps ordinary,

palms strongly oblique; article 5 of gnathopod 1 ovate, posterior margin flat; article 5 of gnathopod 2 short, triangular, almost lobate. Pereopods 1-2 similar; facial setae formula on article 4 = 1 and 2, on article 5 = 2 and 2, main spine of article 5 extending to M. 75 on article 6, article 5 lacking proximoposterior spines; spine formula of article 6 = 2 and 3, no middistal seta, acclivity on inner margin of dactyls of pereopods 1-2 weak, emergent setule short, midfacial pluseta short. Coxae 5-7 posteroventral setule formula = 1-1-1. Articles 4-5 of pereopods 3-4 narrow, facial spine rows sparse; facial ridge formula on article 2 of pereopods 3-5 = 0-1-2 (posterior short); width ratios of articles 2, 4, 5, 6 of pereopod 3 = 44:27:25:11, of pereopod 4 =68:31:20:9, of pereopod 5 = 90:19:18:8, length ratios of pereopod 3 = 70:22:30:34, of pereopod 4 = 76:58:37:48, of pereopod 5 = 110:25:23:27; article 2 of pereopod 5 almost reaching middle of article 5; medial apex of article 6 finely combed, lacking digital processes. Posteroventral corner of epimeron 1 rounded-quadrate, posterior margin almost straight, anteroventral margin with 1-3 short widely spread setae, posteroventral face with 0-1 long seta; posteroventral corner of epimeron 2 rounded-quadrate, posterior margin almost straight, facial setae = 3; posteroventral corner of epimeron 3 weakly protuberant, with setule sinus, posterior margin convex, with one setule notch, ventral margin naked; epimera 1-3 with setule on posterodorsal margin. Urosomite 1 with lateral setule at base of uropod 1, articulation line complete. Urosomite 3 unprotuberant dorsally. Rami of uropods 1-2 with immersed weak apical nails and accessory scale; outer ramus of uropod 1 with 2 dorsal spines, inner with one; outer ramus of uropod 2 with 1-2 dorsal spines, inner with one dorsomedial spine; peduncle of uropod 1 with one apicolateral spine and one basofacial seta, medially with 4 marginal spines plus apical inner enlarged spine; peduncle of uropod 2 with 3-4 dorsal spines, medially with one apical spine; apicolateral corners of peduncles on uropods 1-2 with comb. Peduncle of uropod 3 with 3 ventral spines, dorsally with one lateral spine, one medial spine; rami feminine, inner extending to M. 60 on article 1 of outer ramus, apex with one seta, medial and lateral margins naked, article 2 of outer ramus elongate, 0.50, bearing 2 short setae, medial apex of article 1 with one seta, lateral margin with 2 acclivities, spine formula = 2-2-2, setal formula = 0.

Telson long, length-width ratio = 6:5, almost fully cleft, each apex narrow, truncate, lateral acclivity weak, bearing ordinary lateral setule, spine next medial of length equal to setule, next spine slightly shorter, midlateral setules subsequal. Cuticle with bulbar setules of varying sizes closely packed on coxae and article 2 of pereopod 5 but rare elsewhere, surface bearing fine striations in form of linear fingerprint pattern, emergent setules especially short.

OBSERVATIONS (female).—One spine on outer plate of maxilla l in holotype aberrantly trifid.

DESCRIPTION OF MALE (male "y," 3.08 mm, only specimen known, possibly aberrant).—Antenna 1 with thickened articles 2-3; basal article of flagellum swollen and bearing rows of long aesthetascs (similar to Lysianassidae). Peduncle of antenna 2 somewhat thinner than in female; anterior triad of spines and setae on article 4 short, spine formula of article 4 = 1-7 or 1-6, one long blunt spine on ventrodistal margin in place of seta found on female; anterior margin of article 5 with 2 giant calceoli; right antenna 2 with female-like flagellum comprising 8 articles about 1.6 times as long as articles 4-5 of peduncle combined, calceoli absent, left flagellum masculine but broken after 4 articles, calceoli absent. Upper lip with small midhump ventrally, otherwise like female. Right mandible with 5 rakers; molar and incisor like female, palps broken and missing, [left mandible lost during dissection]. Maxillipedal palp article 4 with apical nail setule-like and completely immersed, no accessory setules (condition aberrant?). Coxae generally like those of female, setae identical, coxae 2-3 slightly longer than in female, posterodorsal margin of coxa 4 even more dorsad than in female. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = (2-3)-3-2-2, short posterior setae = 0-0-1-(2-3), long anterior setae = 1-2-0-0, short anterior setae = 3-4-4-4, short setae strawlike. Pereopods 1-2, setae and spine formulas of article 4 = 1-1, article 5 = 2-2, article 6 = 2 + 3on both pairs, article 4 thinner than in female, of pereopod 1 with only 2 groups of 4 and 3 setae posteriorly, of pereopod 2 with groups of 4, 3, and 1. Article 2 of pereopod 3 slightly thinner than in female; article 5 of pereopod 5 narrower and more elongate than in female, medial apex of article 6 on pereopod 5 with comb composed of much enlarged elements. Shape of epimera generally similar

to that of female, epimeron 1 with 2 anteroventral setae and one posteroventral seta, none facial [ventral setae probably spread posteriad more than in female, thus 3 of female spread into groups of 2 and 1]; epimeron 2 with 2 facial setae; epimeron 3 lacking dorsal and posterior setules except at corner sinus. Urosomite I with dorsal saddle and invagination similar to that of lysianassids and ampeliscids. Medial margin on peduncle of uropod 1 with spines crowded toward distal margin (see illustration), basofacial setae = 2 elongate; outer ramus of uropod 2 with one dorsal spine. Uropod 3 intermediate between masculine and feminine, inner ramus not elongate but bearing medial setae, outer ramus with medial setae on article 1. Telson slightly elongate, bearing irregular basomedial rows of denticles.

OBSERVATIONS (male).—Possibly aberrant, only one specimen known.

ILLUSTRATIONS.—Inner plate of maxilliped skewed laterally in drawing; coxa of pereopod 4 reconstructed by reference to male "y" and female "c"; illustration of urosome and uropods 1-3 of male "y" partially reconstructed, very slightly shriveled on specimen; head of male dorsally similar to female, not illustrated.

HOLOTYPE—AM, female "a," 3.40 mm.

Type-Locality.—SBS C6S3, 22 May 1972, off Malabar, New South Wales, Australia, 75 m, sandy gravel.

VOUCHER MATERIAL.—SBS CxS4, male "y," 3.08 mm (illus); SBS C6S2, female "c," 3.05 mm (illus.). MATERIAL.—SBS, 3 samples (3).

DISTRIBUTION.—New South Wales, off Malabar, 75-92 m, sandy gravel.

Ganba, new genus

DIAGNOSIS.—Eyes present. Flagella of antenna 1-2 unreduced in female. Article 2 of antenna 1 especially shortened, ventral setae confined apically. Article 1 of antenna 2 not ensiform, article 3 with 2 setules, facial spines on article 4 in one main row, article 5 short. Right mandibular incisor with 3 teeth; molar not triturative, small, bearing 3 long clumped spines with common base, not bearing fuzz; palpar hump medium. Palp of maxilla 1 biarticulate; inner plate with 2 setae. Setation of maxilla 2 weak. Inner plates of maxillipeds mostly

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fused together; apex of palp article 3 not protuberant, dactyl elongate, apical nail distinct, medium. Gnathopods dissimilar; gnathopod 2 weakly to moderately enlarged; article 5 of gnathopod 2 very short, cryptic, ordinary on gnathopod 1, without eusirid attachment; palms oblique, hands of gnathopods 1-2 elongate, basally broadened, poorly setose anteriorly. Article 5 of pereopods 1-2 setose posteroproximally. Article 2 of pereopod 3 of broad form, articles 4-5 of pereopods 3-4 narrow to medium, article 2 of pereopods 3-4 not setose posteriorly; pereopod 5 ordinary, article 2 naked ventrally, article 3 ordinary, dactyl normal. Epimera 1-2 lacking long posterior setae, without midfacial setae above ventral facial ridge; epimeron 3 of rounded classification and lacking long setae. Urosomite 1 generally naked except for sparse apicoventral setae or spines near base of uropod 1; urosomite 3 without dorsal hook or special process. Peduncle of uropod l normally elongate, without apicoventral spike, without special enlarged appriorial-medial spine; peduncular apices of uropods 1-2 not combed; inner ramus of uropod 1 naked, no rami continuously spinose to apex, inner ramus of uropod 2 ordinary. Uropod 3 ordinary, article 2 of outer ramus carrying one long apical seta. Telson ordinary, with only one apical spine on each lobe plus setules.

DESCRIPTION.—Rostrum fully developed. [Fuzz on article 1 of antenna 1 in male unknown, calceoli on male antennae 1-2 unknown.] Prebuccal parts extended forward, poorly separated from each other, upper lip dominant. Right lacinia mobilis bifid, thin; mandibular palp thin, article 1 slightly elongate, article 2 without outer setae, apex of article 3 transverse. Lower lip bearing cones. Outer plate of maxilla 1 with 9 spines, no spine especially thickened. Inner plates of maxilliped poorly armed, thick. Coxae 2-4 with special anterodorsal humps. Some posterior spines on article 6 of pereopods 1-2 thin and seta-like, most thick and stiff, midapical spine or seta absent. Article 2 of pereopod 5 without facial setae. Peduncle of uropod 1 with dorsolateral spines confined apically, medial spines partially spread; peduncle of uropod 2 with only one medial spine confined apically, Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with ordinary pair of midlateral or dorsal setules on each side.

Type-Species.—Ganba pellati, new species. Composition.—Unique.

RELATIONSHIP.—This genus differs from Kuritus and Wildus in the presence of only one seta on the outer ramus of uropod 3 and from Brolgus in the presence of mostly short and stout spines on article 6 of pereopods 1-2, in the much thinner gnathopod 1 and the partially fused inner plates of the maxilliped. Unlike other members of the Brolgus group of genera, Ganba lacks apical combs on the peduncles of uropods 1-2.

Ganba pellati, new species

FIGURES 48, 49

DESCRIPTION OF FEMALE.—Head about 20 percent of total body length, greatest width about 70 percent of length; rostrum unconstricted, broad, exceeding apex of article 1 on antenna 1. Eyes medium, largely occluded with pigment. Article 1 on peduncle of antenna 1 about 1.8 times as long as wide, about 1.5 times as wide as article 2, ventral margin with about 6 apical setules, weakly produced dorsal apex with 2 setules; article 2 about 0.4 times as long as article 1, naked ventrally; primary flagellum with 8 articles, about 0.8 times as long as peduncle, bearing numerous short aesthetascs; accessory flagellum with 5-6 articles. Spine formula on article 4 of antenna 2 = 2-2-3 or 2-2-4, dorsal margin with notch bearing one seta and 2 spines, ventral margin with 3 pairs of long to short setae, 2 ventrodistal medium to short spines; article 5 about 0.67 times as long as article 4, facial spine formula = 0, dorsal margin naked, ventral margin with 3 pairs of 2 long to short setae, 3 ventrodistal short to medium spines, one of these set as subdistal facial spine; flagellum about as long as articles 4-5 of peduncle combined, with 8 articles. Mandibles with medium palpar hump; right incisor with 3 teeth and notch; left incisor with 4 humps in 2 branches; right lacinia mobilis bifid, distal branch much shorter than proximal, forming cusp, proximal branch simple, pointed; left lacinia mobilis with 4 teeth plus 2 accessory teeth; right rakers 6; left rakers 6; molar of short protrusion demarcated mainly by spines, each molar with 3 long spines, none disjunct; palp article 1 slightly elongate, article 2 with one short inner apical seta and one other short inner seta, article 3 about 1.2 times as long as article 2, truncate apex with 5-6 spine-setae, basofacial formula = 0-1. Inner plate of maxilla 1

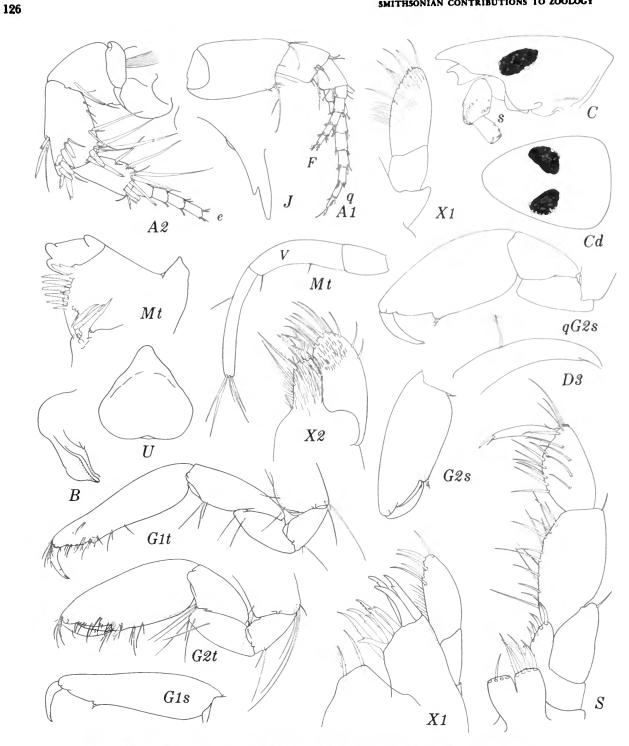


FIGURE 48.—Ganba pellati, new species, holotype, female "a," 5.25 mm (q = female "q," 4.45 mm).

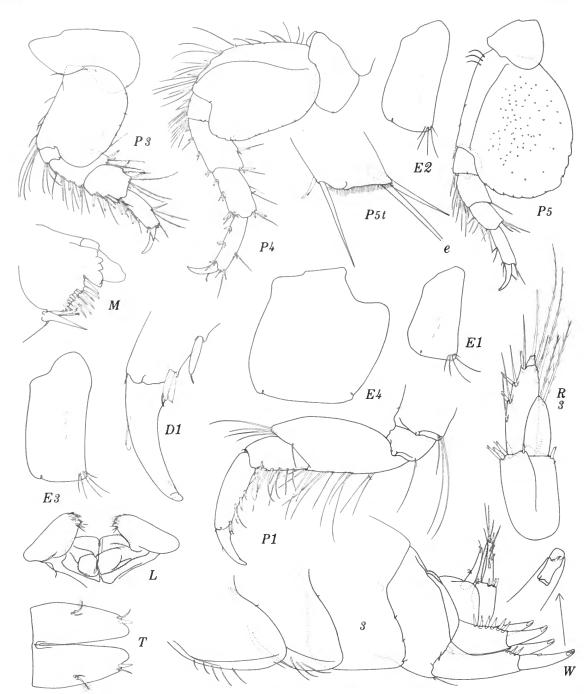


Figure 49.—Ganba pellati, new species, holotype, female "a," 5.25 mm.

especially broad, bearing one long apical pluseta, one shorter similar apicomedial seta, no apicolateral setae; palp article 2 with 2 apical-medial marginal spines and 3-4 submarginal setae. Inner plate of maxilla 2 shorter and much narrower than outer, outer with 4 apicolateral setae, inner with one medial seta. Inner plate of maxilliped with 4 large thin apical spine-setae, no apicofacial setae, no medial setae, inner plates mostly fused together; outer plate with 4 medial and apical spines, no apicolateral setae; palp article 1 with apicolateral seta. article 2 with one apicolateral seta, medial margin of article 2 moderately setose, article 3 with 4 facial setae, no lateral setae, nail of article 4 medium-short, with one accessory setule. Coxa 1 expanded distally, anterior margin weakly concave, main ventral setae of coxae 1-4 = 5-5-5-0, all four with anterodorsal hump, posteriormost seta of coxae 1-8 shortest; anterior and posterior margins of coxa 4 almost parallel, posterior margin almost straight, posterodorsal corner rounded, posterodorsal margin short, concave, V-shaped, width-length ratio of coxa 4 = 1:1. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 2-(1-3)-(4-5)-(4-5), short posteriors = (2-3)-(2-3)-(3-4)-(3-4), long anteriors = 2-3-0-0, short anteriors = 1-2-2-(1-2), no others. Gnathopod 1 thin, elongate; gnathopod 2 enlarged, weakly elongate, hands tapering distally; width ratios of articles 5-6 on gnathopods 1-2 = 23:28 and 26:39, length ratios = 71:100 and 50:88; palmar humps ordinary, palms strongly oblique; article 5 of gnathopod 1 elongate, ovate, posterior margin rounded-truncate; article 5 of gnathopod 2 short, triangular, cryptic. Pereopods 1-2 similar, facial setae formula on article 4 = (1-2) and (2-3)on article 5 = (1-2) and (1-3); main spine of article 5 extending to M. 50 on article 6, article 5 lacking proximoposterior spines; spine formula of article 6 = 2 + 4 plus midposterior seta, spines especially short, acclivity on inner margin of dactyls of pereopods 1-2 absent, setule fully immersed, midfacial pluseta short, highly proximal. Coxae 5-7 posteroventral setule formula = 1-1-1, articles 4-5 of pereopods 3-4 medium narrow, facial spine rows sparse; facial ridge formula on article 2 of pereopods 3-5 = 0-1-1; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 49:29:25:13, of pereopod 4 = 63:25: 19:12, of pereopod 5 = 79:18:14:9, length ratios of pereopod 3 = 68:30:30:32, of pereopod 4 =84:40:38:41, of pereopod 5 = 100:25:22:28; article

2 of pereopod 5 reaching middle of article 4; medial apex of article 6 finely combed, truncate. Posteroventral corner of epimeron 1 rounded, posterior margin weakly convex, anteroventral margin with 4-7 short to medium setae, posteroventral face with one short seta; posteroventral corner of epimeron 2 rounded, weakly protuberant, posterior margin straight, facial setae = 3-4, posteriormost pair set vertically if 4 setae present; posteroventral corner of epimeron 3 weakly protuberant, with setule sinus, posterior margin weakly convex, with 2 setule notches, ventral margin naked; epimera 1-2 with tiny setule on posterodorsal margin. Urosomite 1 with ventral seta and setule at base of uropod 1, articulation line almost complete; urosomite 3 unprotuberant dorsally. Rami of uropods 1-2 with immersed apical nails; outer ramus of uropod 1 with one dorsal spine, inner with none; rami of uropod 2 naked; peduncle of uropod 1 with 3 apicolateral spines and one short basofacial seta, medially with 3 marginal spines, apicalmost enlarged; peduncle of uropod 2 with 6-7 dorsal spines, medially with one large apical spine; apicolateral corners of peduncles on uropods 1-2 lacking comb. Peduncle of uropod 3 with 5 ventral spines (one disjunct), dorsally with one lateral spine, one medial spine; rami feminine, inner extending to M. 66 on article l of outer ramus, apex with one seta, medial margin with one apical seta, article 2 of outer ramus short, 0.14, bearing one long seta, medial margin of article 1 with 3-4 setae, lateral margin with 3 acclivities, spine formula = 0-1-1-1, setal formula = 1-1-1-1. Telson ordinary, length-width ratio = 11:10, almost fully cleft, each apex narrow, rounded, lateral acclivity deep, bearing ordinary lateral setule, spine next medial of length subequal to setule, midlateral setules diverse. Cuticle with ordinary but sparse bulbar setules.

OBSERVATIONS.—Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 with occasional short partners or extra short setae between long members, article 2 of pereopods 1-2 with only one anterior setule; pereopods 1-2 with one posterior seta on article 6 besides spines; facial setae on article 5 of pereopods 1-2 highly posteriad.

Young female: Easily recognizable because of general specific characters on epimera, head and gnathopods but following external observations included: article 6 of pereopods 1-2 with only one posterior spine besides locking spines and one seta; coxae 1-3

with only 3 ventral setae each; uropod 1 with one basofacial seta, 2 apicolateral spines, outer ramus with one long spine; peduncle of uropod 2 with 4 spines; outer ramus of uropod 3 with one lateral acclivity bearing one spine only; epimeron 1 with 3 anteroventral and no posterofacial setae, epimeron 2 with 2 setae, epimeron 3 with only 2 posterior setule notches; article 5 of antenna 2 with only one posterior set of spine-setae, article 4 like adult.

Juveniles: Smallest 1.47 mm, (Slack-Smith 1), generally recognizable because of distinct elongation of article 6 on gnathopod 1; following notes showing reduction in spination on prominent external appendages: spine formula on article 4 of antenna 2 = 1-1-1 (or 2-1 depending on view); coxae 1-3 with one seta each; epimera 1-2 lacking setae; peduncle of uropod 1 with one lateral spine, peduncle of uropod 1 with one lateral spine; rami of uropods 1-2 dorsally naked.

Variations.—Smaller female "q," 4.45 mm, from Shepherd 15 (South Australia) better developed morphologically than holotype female from Western Australia, generally more spinose and setose, upper lip with heavy crescentic rugosity, eyes larger but following parts not compared because of damage to female "q": articles 6–7 of pereopods 1, 2, 4, 5 and uropod 3; holotype with aberrantly vestigial outer plate of maxilla 2.

ILLUSTRATIONS.—Whole views of gnathopods 1-2 with article 6 not fully flattened, this shape shown on setoseless outline views; distinctions between spines and setae on palp of maxilla 1 described mainly by their positions because these armaments highly similar to each other; view of left pereopod 3 reconstructed from right appendage; setule on coxa 7 omitted.

HOLOTYPE.—WAM, female "a," 5.25 mm.

Type-Locality.—Slack-Smith 1, 4 Dec 1968, Cheyne Beach, Albany, Western Australia, on weedy rocks, intertidal.

VOUCHER MATERIAL.—Shepherd 15, female "q," 4.45 mm (illus.); JLB AUS 13, juvenile "c," 3.34 mm; Slack-Smith 1, juveniles, smallest 1.47 mm (6). Male unknown.

MATERIAL.—Slack-Smith 1, one sample (7); JLB AUS, one sample (1); Shepherd 15, one sample (1).

DISTRIBUTION.—Albany, Western Australia to Pearson Island, South Australia, 0-8 m.

Kuritus, new genus

DIAGNOSIS OF MALE.—Eyes present. Flagella of antennae 1-2 unreduced in male. Article 2 of antenna l especially shortened, ventral setae confined apically. Article 1 of antenna 2 not ensiform, article 3 with 2 setules, facial spines on article 4 weakly in 2 rows, article 5 ordinary in size. Right mandibular incisor with 3 teeth; molar not triturative, small, conical, bearing 3 long clumped spines, lacking fuzz; palpar hump small. Palp of maxilla 1 biarticulate; inner plate with 2 setae. Setation of maxilla 2 weak. Inner plates of maxillipeds ordinary; apex of palp article 3 not protuberant, dactyl elongate, apical nail distinct, elongate, Gnathopods small, similar; article 5 of gnathopods 1-2 of ordinary length, free, without eusirid attachment; palms oblique, hands of gnathopods 1-2 ordinary, ovatorectangular, elongate, poorly setose anteriorly. Article 5 of pereopods 1-2 setose posteroproximally. Article 2 of pereopod 3 of broad form, articles 4-5 of pereopods 3-4 narrow to medium, article 2 of pereopods 3-4 not setose posteriorly; pereopod 5 ordinary, article 2 naked ventrally, article 3 ordinary, dactyl normal. Epimera 1-2 lacking long posterior setae, without midfacial setae above ventral facial ridge; epimeron 3 of rounded classification and lacking long setae. Urosomite I generally naked; urosomite 3 without dorsal hook or special process. Peduncle of uropod 1 normally elongate, without apicoventral spike, with special enlarged apicomedial spine; peduncular apices of uropods 1-2 combed; spine(s) on inner ramus in one row, no rami continuously spinose to apex, inner ramus of uropod 2 ordinary. Uropod 3 ordinary, elongate article 2 of outer ramus carrying 2 medium apical setae. Telson elongate, with 2 apical spines on each lobe plus setules, without special dorsal and lateral spines or setae.

DESCRIPTION OF MALE.—Rostrum fully developed. Fuzz on article 1 of antenna 1 in male present; calceoli on male primary flagellum of antenna 1 present. Calceoli on article 5 of male antenna 2 present, flagellum in male with calceoli. Prebuccal parts extended forward, poorly separated from each other, upper lip dominant. Right lacinia mobilis in 2 parts; mandibular palp thin, article 1 short, article 2 without outer setae, apex of article 3 oblique. Lower lip bearing cones. Outer plate of maxilla 1 with 9 spines, one spine especially thick-

ened. Inner plates of maxilliped poorly armed, thick. Coxae 2-4 without special anterodorsal humps. All posterior spines on article 6 of pereopods 1-2 thin and stiff, midapical spine present. Article 2 of pereopod 5 without facial setae. Peduncle of uropod 1 with dorsolateral spines confined apically, medial spines widely spread; peduncle of uropod 2 with only one medial spine confined apically. Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with ordinary pair of midlateral or dorsal setules on each side.

Type-Species.—Kuritus nacoomus, new species. Composition.—Unique.

RELATIONSHIP.—Kuritus differs from Brolgus and Ganba in bearing 2 apical setae on the outer ramus of uropod 3 and from Wildus and Brolgus in the thin gnathopods that are identical to each other and on which the wrists are not cryptic. See Paraphoxus for further relationships.

The type-species has an unusual right lacinia mobilis in which the two main elements are separate, the so-called distal branch being fully articulate and the proximal branch therefore resembling a raker spine. The proximal branch of the right lacinia mobilis in most phoxocephalids resembles a raker spine and may actually be a raker spine fused to the primitive lacinia mobilis. In the case of Kuritus nacoomus the proximal branch is separate but is not counted as a raker spine. In other respects morphological similarities lie with Brolgus, the telsonic spination, coxal setation, and epimeral setation indicating a relationship to B. millinus and B. mahmak.

Kuritus nacoomus, new species

FIGURES 50, 51

DESCRIPTION OF MALE.—Head about 19 percent of total body length, greatest width about 60 percent of length; rostrum unconstricted, broad, reaching apex of article 2 on antenna 1. Eyes large, largely occluded with pigment, ommatidia especially large. Article 1 on peduncle of antenna 1 about 1.8 times as long as wide, about 2.2 times as wide as article 2, ventral margin with about 10 setules, strongly produced dorsal apex with 3 setules; article 2 about 0.37 times as long as article 1, with apicoventral cycle of 5 setae; primary flagellum with 8 articles, about 1.1 times as long as peduncle,

bearing several aesthetascs and calceoli on articles 1-4; accessory flagellum with 4 articles. Spine formula on article 4 of antenna 2 = 2-5-1, spines thin, dorsal margin with 2 notches bearing 3 and 1 spines, ventral margin with 3 groups of 1-3 long to medium setae, 2 ventrodistal medium and short spines; article 5 about 0.9 times as long as article 4, facial spine formula = 1, dorsal margin bearing 2 groups of male setae and 2 calceoli, ventral margin with 2 pairs of medium and short setae, 2 ventrodistal medium spines; flagellum elongate, flagellar formula = 20, 1-3, 5, 7 ... 19 or 1, 3, 5 Mandibles with weak palpar hump; right incisor with 3 teeth, weak notch; left incisor with 2 teeth and hump; right lacinia mobilis bifid, distal branch shorter than proximal and fully articulate, broad, subbifid, proximal branch simple, pointed, with marginal denticles; left lacinia mobilis with 5 teeth plus one accessory tooth; right rakers 3; left rakers 4; molars short, conical, demarcated mainly by spines, each molar with 3 clumped medium spines; palp article 1 short, article 2 with one long inner apical seta and one other shorter inner seta, article 3 about 0.95 times as long as article 2, oblique apex with 7 spine-setae, basofacial formula = 0-3. Inner plate of maxilla 1 ordinary, bearing one short stout apical pluseta, one similar apicomedial seta; denticles on spines of outer plate very thin; palp article 2 with 2 apical spines and one apicomedial spine. Plates of maxilla 2 extending subequally, outer slightly broader than inner, outer with 2 apicolateral setae, inner with one medial seta. Inner plate of maxilliped with one thin short apical spine, 2-3 apicofacial setae; outer plate with 4 medial and apical spines, palp articles 1-2 naked laterally, medial margin of article 2 weakly setose, article 3 unprotuberant, with 2 facial setae, nail of article 4 long, with one accessory setule. Coxa 1 scarcely expanded distally, anterior margin almost straight; main ventral setae of coxae 1-4 = 9-8-8-8, posteriormost seta of coxae 1-3 slightly shortened; anterior and posterior margins of coxa 4 almost parallel, posterior convex, posterodorsal corner rounded, posterodorsal margin long, V-shaped, width-length ratio of coxa 4 = 18:19. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 2-1-1-2, short anteriors = 2-2-1-1, long anteriors = 1-1-0-0, no others. Gnathopods slender. weakly elongate, nearly identical; width ratios of articles 5-6 on gnathopods 1-2 = 22:29 and 22:28,

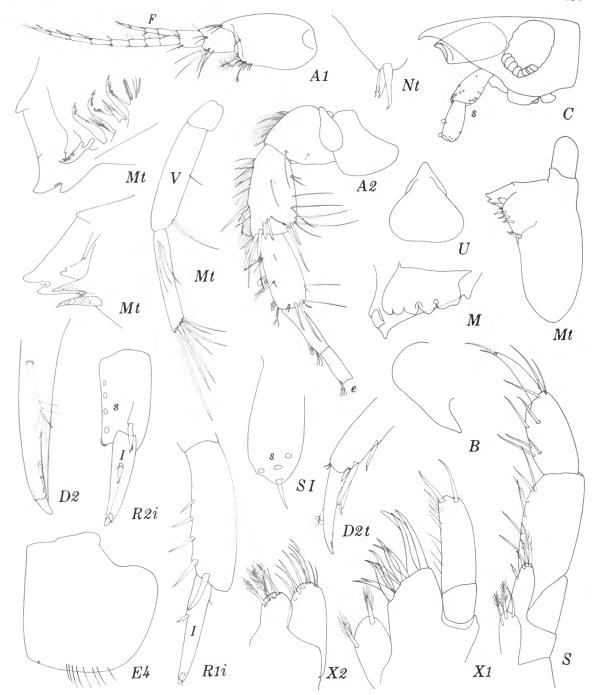


FIGURE 50.—Kuritus nacoomus, new species, holotype, male "a," 4.16 mm.

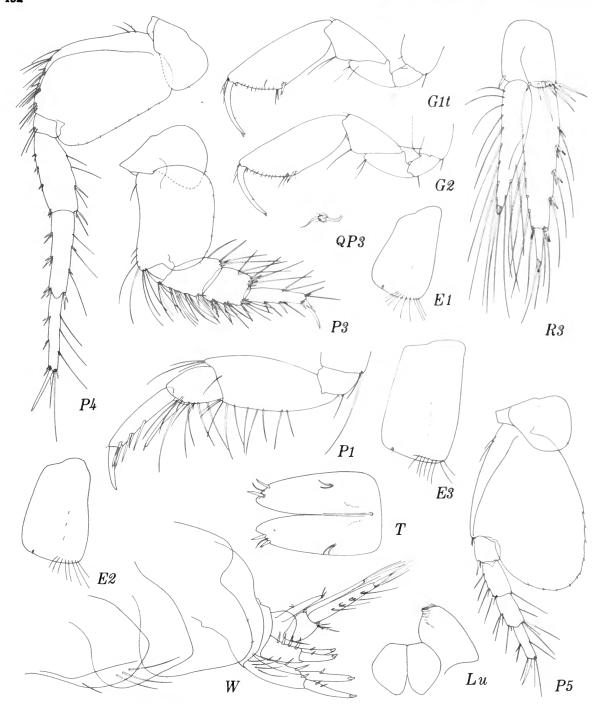


Figure 51.—Kuritus nacoomus, new species, holotype, male "a," 4.16 mm.

length ratios = 46:74 and 45:74; palmar humps absent, palms oblique; article 5 of gnathopod 1 ovate, posterior margin rounded-lobate, article 5 of gnathopod 2 similar. Pereopods 1-2 similar; facial setae formula on article 4 = 1, on article 5 = 1; main spine of article 5 extending to M. 75 on article 6, article 5 lacking proximoposterior spines; spine formula of article 6 = 3 + 2 plus middistal spine; acclivity on inner margin of dactyls of pereopods 1-2 obsolescent, emergent setule short, partly immersed, midfacial pluseta ordinary. Coxae 5-7 posteroventral setule formula = 1-1-1. Articles 4-5 of pereopods 3-4 narrow, facial spine rows sparse, facial ridge formula on article 2 of pereopods 3-5 = 0-1-1; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 50;29:26:10, of pereopod 4 =64:22:15:8, of pereopod 5 = 75:14:13:7, length ratios of pereopod 3 = 71:32:28:40, of pereopod 4 = 90:54:59:53, of pereopod 5 = 110:24:23:25; article 2 of pereopod 5 reaching apex of article 4; medial apex of article 6 finely combed. Posteroventral corner of epimeron 1 rounded, posterior margin straight, anteroventral margin with one medium seta; posteroventral corner of epimeron 2 rounded-quadrate, posterior margin straight, facial setae = 3 in horizontal tandem anteriad, facial ridge absent; posteroventral corner of epimeron 3 rounded, with setule, posterior margin convex, with one setule, ventral margin naked. Urosomite 1 with articulation line complete, urosomite 3 weakly protuberant dorsally. Rami of uropods 1-2 with articulate apical nails, outer ramus of uropod 1 with 2 dorsal spines, inner with one, outer ramus of uropod 2 with one dorsal spine, inner with one dorsomedial spine; peduncle of uropod 1 with one apicolateral spine and 4 basofacial setae, medially with 5 marginal spines, apicalmost enlarged and set medially; peduncle of uropod 2 with 4 dorsal spines, medially with one apical spine; apicolateral corners of peduncles on uropods 1-2 with comb, weak on uropod 1. Peduncle of uropod 3 with 6 ventral spines, dorsally with one lateral spine, one medial spine; rami submasculine, inner extending to M. 85 on article 1 of outer ramus, apex with 2 setae, medial and lateral margins setose, article 2 of outer ramus elongate, 0.30, bearing 2 medium setae, apicomedial margin of article 1 with 2 setules and one seta, lateral margin with 4 acclivities, spine formula = 1-2-2-2-2, setal formula = l-l-l-l-1. Telson long, length-width

ratio = 18:11, not fully cleft, each apex narrow, lateral acclivity weak, with one lateral and one medial spine separated by setule, midlateral setules ordinary. Cuticle with ordinary bulbar setules, emergent setules ordinary, long.

ILLUSTRATIONS.—Lateral view of eyes reconstructed from damaged condition; dorsal view of head omitted, like that of male *Brolgus millinus* but eyes larger; upper lip shown from oblique ventral view; apex of right pereopod 2 showing smallest medial distal spine hidden from lateral view on illustration of pereopod 1, spine next adjacent considered as middistal spine hiding distalmost lateral spine.

HOLOTYPE.—WAM male "a," 4.16 mm. Unique. TYPE-LOCALITY.—WAM 414-73, 2 Sep 1954, Barrow Island, Western Australia, presumably surface. DISTRIBUTION.—Western Australia, Barrow Island, neritic.

Wildus, new genus

Diagnosis.—Eyes present. Flagella of antennae 1-2 unreduced in female. Article 2 of antenna 1 especially shortened, ventral setae confined apically. Article 1 of antenna 2 not ensiform, article 3 with 2 setules, facial spines on article 4 in 2 or more rows, article 5 especially short. Right mandibular incisor with 3 teeth; molar not triturative, small, bearing 3 long clumped spines with common base, not bearing fuzz; palpar hump medium. Palp of maxilla 1 biarticulate, inner plate with 2 setae. Setation of maxilla 2 weak. Inner plates of maxillipeds mostly fused together; apex of palp article 3 not protuberant; dactyl elongate, apical nail distinct, elongate. Gnathopods scarcely dissimilar, gnathopod 2 weakly enlarged; article 5 of gnathopod 2 very short, cryptic, slightly more elongate on gnathopod 1, without eusirid attachment; palms oblique, hands of gnathopods 1-2 rectangular, slightly elongate, poorly setose anteriorly. Article 5 of pereopods 1-2 setose posteroproximally. Article 2 of pereopod 3 of broad form, articles 4-5 of pereopods 3-4 narrow to medium, article 2 of pereopods 3-4 not setose posteriorly; pereopod 5 ordinary, article 2 naked ventrally, article 3 ordinary, dactyl normal. Epimera 1-2 lacking long posterior setae, without midfacial setae above ventral facial ridge; epimeron 3 of rounded classification and lacking long setae. Urosomite 1 generally naked;

urosomite 3 without dorsal hook or special process. Peduncle of uropod 1 normally elongate, without apicoventral spike, with special enlarged apicomedial spine; peduncular apices of uropods 1-2 combed; spine(s) on inner ramus of uropod 1 in one row, no rami continuously spinose to apex, inner ramus of uropod 2 ordinary. Uropod 3 ordinary, article 2 of outer ramus carrying 2 medium to long apical setae. Telson ordinary to elongate, with only one apical spine on each lobe plus setules.

DESCRIPTION.—Rostrum fully developed. Fuzz on article 1 of antenna 1 in male present; calceoli on male primary flagellum of antenna 1 present. Calceoli on article 5 of male antenna 2 present; flagellum in male with calceoli. Prebuccal parts ordinary, poorly separated from each other, upper lip dominant. Right lacinia mobilis bifid, thin; mandibular palp thin, article 1 slightly elongate, article 2 without outer setae, apex of article 3 almost transverse. Lower lip bearing cones. Outer plate of maxilla 1 with 9 spines, no spine especially thick-

ened. Inner plates of maxilliped thin, poorly armed. Coxae 2-4 without distinct anterodorsal humps. Some posterior spines on article 6 of pereopods 1-2 thin and seta-like, others thick and stiff, midapical spine or seta absent. Article 2 of pereopod 5 without facial setae. Peduncle of uropod 1 with dorsolateral spines confined apically, medial spines widely spread, peduncle of uropod 2 with only one medial spine confined apically. Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with ordinary pair of midlateral or dorsal setules on each side.

Type-Species.—Wildus thambaroo, new species. Composition.—Wildus mullokus, new species; Parharpinia fuegiensis Schellenberg, 1931; Paraphoxus waipiro J. L. Barnard, 1972b.

RELATIONSHIP.—Wildus differs from Brolgus and Ganba in bearing 2 setae on the outer ramus of uropod 3 and differs from Kuritus in the stouter and more diverse gnathopods with cryptic article 5 on gnathopod 2. See Elpeddo for further differentiation.

Key to the Species of Wildus

1.	Epimeron 3 with 3 ventral setae
	Epimeron 3 lacking ventral setae
2.	Inner rami of uropods 1-2 dorsally naked, peduncle of uropod 2 with 2 apicolateral spines
	Inner rami of uropods 1-2 with one dorsal spine each, peduncle of uropod 2 with one api- colateral spine
3.	Coxa 4 with long setae, article 6 of pereopods 1-2 with one elongate setal spine
	Coxa 4 lacking long setae, article 6 of percopods 1-2 with three elongate setal spines
	W. thambaroo, new species

Wildus thambaroo, new species

FIGURES 52-54

Description of Female.—Head about 18 percent of total body length, greatest width about 60 percent of length; rostrum unconstricted, broad, short, reaching middle of article 2 on antenna 1. Eyes medium, largely occluded with pigment. Article 1 on peduncle of antenna 1 about 1.4 times as long as wide, about 1.7 times as wide as article 2, ventral margin with about 4 apical setules, weakly produced dorsal apex with one setule; article 2 about 0.5 times as long as article 1, with apicoventral cycle of 4–5 setae; primary flagellum with 6 articles, about 0.75 times as long as peduncle,

bearing aesthetascs; accessory flagellum with 4 articles. Spine formula on article 4 of antenna 2 = 3-3-2-1, dorsal margin with notch bearing seta and 2 spines, ventral margin with 3 groups of 1-2 long to medium setae, one ventrodistal long spine; article 5 about 0.65 times as long as article 4, facial spine formula = 0, dorsal margin naked, ventral margin with 2 pairs of long to short setae, 4 ventrodistal short to medium spines, 2 of these set as subdistal facial spines; flagellum 1.1-1.25 times as long as articles 4-5 of peduncle combined, with 6-7 articles. Mandibles with medium palpar hump; right incisor with 3 teeth and notch; left incisor with notch and 4 humps in 2 branches; right lacinia mobilis bifid, distal branch much shorter than

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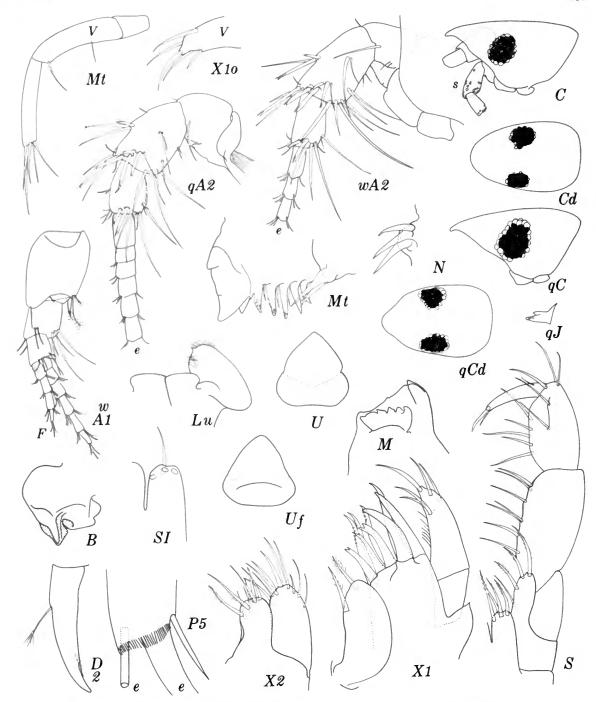


FIGURE 52.—Wildus thambaroo, new species, holotype, female "a," 2.43 mm (q = male "q," 2.36 mm; w = female "w," 2.47 mm).

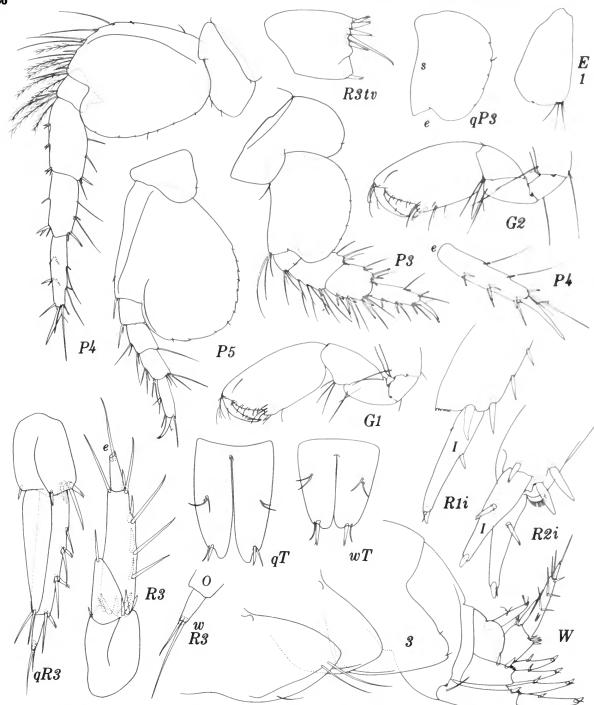


FIGURE 53.—Wildus thambaroo, new species, holotype, female "a," 2.43 mm (q = male "q," 2.36 mm; w = female "w," 2.47 mm).

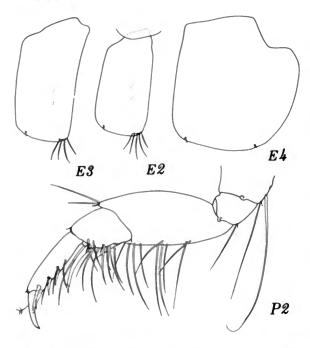


FIGURE. 54.—Wildus thambaroo, new species, holotype, female "a," 2.45 mm.

proximal, narrow, simple, proximal branch simple, pointed, with marginal denticles; left lacinia mobilis with 5 teeth plus accessory hump; right rakers 4; left rakers 4; molar in form of short protrusion demarcated mainly by spines, right molar with 3 long spines, none disjunct; left molar with 3 long spines, none disjunct; palp article 1 slightly elongate, article 2 with one medium inner apical seta and one other shorter inner seta, article 3 about as long as article 2, weakly oblique apex with 5 spine-setae, basofacial formula = 0. Inner plate of maxilla l large, bearing one apical pluseta, one longer apicomedial seta; palp article 2 with 5 apical-lateral-medial marginal spines and setae. Inner plate of maxilla 2 shorter and slightly narrower than outer, outer with 3 apicolateral setae, inner with one medial seta. Inner plates of maxilliped partly fused, each with one large, thin apical spine-seta, 3 apicofacial setae, no medial setae; outer plate with 4 medial and apical spines, no apicolateral setae; palp articles 1-2 laterally naked, medial margin of article 2 weakly setose, article 3 with 2 facial setae, no lateral setae, nail of article 4 medium, with one accessory setule. Coxa 1 expanded distally, anterior margin straight; main

ventral setae of coxae 1-4 = 4-5-4-0, posteriormost seta of coxae 1-3 slightly shortened; anterior and posterior margins of coxa 4 almost parallel, posterior margin convex, posterodorsal corner rounded, posterodorsal margin short, V-shaped, width-length ratio of coxa 4 = 8:9. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 2-(2-3)-(1-3)-(4-5), short posteriors = 1-0-0-0, long anteriors = 1-2-0-0, short anteriors = 2-2-1-1, no others. Gnathopods weakly enlarged, gnathopod 2 larger, wrists very short; width ratios of articles 5-6 on gnathopods 1-2 = 24:36 and 21:40, length ratios = 44:72 and 35:72; palmar humps ordinary, palms strongly oblique; article 5 of gnathopod 1 triangular, posterior margin rounded, lobate; article 5 of gnathopod 2 short, triangular. Pereopods 1-2 similar, facial setae formula on article 4 = 0 and 1, on article 5 = 1 and 2; main spine of article 5 extending to M. 67 on article 6, article 5 lacking proximoposterior spines; spine formula of article 6 = 4 + 3 and no middistal seta, some spines especially thin; acclivity on inner margin of dactyls of pereopods 1-2 obsolescent, emergent setule long, midfacial pluseta ordinary, highly proximal. Coxae 5-7 posteroventral setule formula = 1-2-1; articles 4-5 of pereopods 3-4 narrow, facial spine rows sparse, facial ridge formula on article 2 of pereopods 3-5 = 0-1-1; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 55:27:24:11, of pereopod 4 =76:26:19:11, of pereopod 5 = 82:16:14:9, length ratios of pereopod 3 = 75:25:29:34, of pereopod 4 = 90:48:40:49, of pereopod 5 = 103:20:22:28; article 2 of pereopod 5 reaching middle of article 4; medial apex of article 6 finely combed and truncate. Posteroventral corner of epimeron 1 narrowly rounded, posterior margin weakly convex, anteroventral margin with one short seta, posteroventral face lacking setae; posteroventral corner of epimeron 2 rounded, posterior margin weakly convex, facial setae = 2; posteroventral corner of epimeron 3 weakly protuberant, with setule sinus, posterior margin weakly convex, with one setule notch, ventral margin naked. Urosomite 1 naked, articulation line almost complete; urosomite 3 unprotuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, outer rami of uropods 1-2 and inner of uropod 1 with one accessory setule, outer ramus of uropod 1 with one dorsal spine, inner with one, outer ramus of uropod 2 with one dorsal spine, inner with one dorsomedial spine;

peduncle of uropod I with one apicolateral spine and one basofacial seta, medially with 3 marginal spines, apicalmost enlarged, plus one larger spine at base of inner ramus; peduncle of uropod 2 with 2 dorsal spines, medially with one small apical spine; apicolateral corners of peduncles on uropods 1-2 with comb. Peduncle of uropod 3 with 5 ventral spines, one of these elongate, dorsally with one lateral spine, one medial spine; rami feminine, inner extending to M. 45 on article 1 of outer ramus, apex with one seta, medial and lateral margins naked, article 2 of outer ramus elongate, 0.34, bearing 2 medium and long setae, apicomedial margin of article 1 with one seta, lateral margin with 3 acclivities, spine formula = 2-2-2-2, setal formula = 0. Telson weakly elongate, length-width ratio = 12:11, not fully cleft, each apex narrow, rounded-truncate, lateral acclivity broad, shallow, bearing ordinary lateral setule, spine next medial longer than setule, midlateral setules subequal in size. Cuticle with ordinary but sparse bulbar setules.

DESCRIPTION OF MALE.—Immature, similar to female but eyes larger, rostrum slightly constricted subapicad (dorsal view). Antenna 1 like female, no medial fuzz on article 1. Antenna 2 scarcely elongate, flagellum 9-articulate, spine formula on article 4 = 3-3-2-1, on article 5 = (1 tiny setule). Right mandible with 3 rakers and one rudimentary; molar with 2 spines and one rudimentary; palp with only 4 apical setae on article 3. Inner plate of maxilliped with only 2 dorsofacial setae, palp article 3 with only one facial seta. Coxa 4 larger than in female but of similar shape. Article 2 of gnathopods 1-2 each with 2 long posterior setae; article 6 of these gnathopods slightly thinner than in female. Article 2 of pereopods 1-2 with 2 long posterior setae each, facial setal formulas on article 4 of pereopods 1-2 = 0-0, on article 5 = 2-2 (1) long, 1 short), on article 6 = (3-1) and (3-1), with one seta next to each of 2 proximal spines in the row of 3. Article 2 of pereopod 3 narrower than in female (see illustration); pereopod 5 relatively larger than in female but shape of article 2 generally similar. Uropod 3 with inner ramus elongate, reaching to apex of article 1 on outer ramus, naked except for 2 apical setae. Telson elongate, lengthwidth ratio = 16:11.

DESCRIPTION OF JUVENILE (smallest 1.36-1.40 mm).—Eye very small. Spine formula on article 4 of antenna 2 = 2-3-1. Setae of coxae 1-3 = 3-3-3.

Facial setae on article 5 of pereopods 1-2=1-2; spines on article 6=2+2 and 2+2. Articles 4-6 of pereopod 3 lacking posterior spines and setae. Epimera 1-2 lacking setae. Peduncle of uropod 1 with one apicolateral spine; rami of uropods 1-2 naked or outer ramus with one dorsal spine; peduncle of uropod 2 with 1-2 apicolateral spines. Outer ramus of uropod 3 with 0-1 lateral acclivity and 0-1 lateral spine, article 2 of outer ramus relatively longer than in adult.

ILLUSTRATIONS.—Article 3 of maxillipedal palp not flattened; pereopod 4 illustrated in 2 sections joined together, articles 1-4 from left side, articles 5-7 from right side (medial view on latter portion); uropod 3 of female holotype aberrant (Figure 53: R3), bearing excessive total of 2 dorsolateral spines and no elongate ventral spine, one seta on article 2 of outer ramus missing; see normal peduncle of right uropod 3 in Figure 53: nR3t.

HOLOTYPE.—WAM, female "a," 2.43 mm.

Type-Locality.—JLB AUS 13, 30 Sep 1968, Middleton Beach, Albany, Western Australia, intertidal wash of sandy rocks, coralline algae.

VOUCHER MATERIAL.—Type-locality: male "q," 2.36 mm (illus.); juvenile "c," 1.40 mm; female "w," 2.47 mm (illus.). Slack-Smith 1: juvenile "j," 1.36 mm.

RELATIONSHIP.—See Wildus mullokus.

MATERIAL.—JLB AUS, 3 samples (14); Slack-Smith 1, one sample (7).

DISTRIBUTION.—Western Australia, Albany, intertidal.

Wildus mullokus, new species

FIGURES 55-57

Description of Male.—Head about 19 percent of total body length, greatest width about 60 percent of length; rostrum unconstricted, broad, reaching middle of article 2 on antenna 1. Eyes medium, clear of pigment core, but stained eosin in preservative. Article 1 on peduncle of antenna 1 about 1.4 times as long as wide, about twice as wide as article 2, apicoventral margin with about 9 setules, strongly produced dorsal apex with 3 setules; article 2 about 0.45 times as long as article 1, with apicoventral cycle of 5 setae; primary flagellum with 7 articles, about 0.85 times as long as peduncle, bearing several aesthetascs and one

calceolus each on articles 1-3; accessory flagellum with 5 articles. Spine formula on article 4 of antenna 2 = 1-5-1, dorsal margin with notch bearing 2 spines, and proximally another spine, ventral margin with 3 groups of 1-3 short-medium setae. 2 ventrodistal long to medium spines; article 5 about 0.8 times as long as article 4, facial spine formula = 1, dorsal margin bearing 2 calceoli and 3 groups of male setae, ventral margin with 1-2 sets of 1-2 setae, ventrodistally with 2 medium spines and 2 setules; flagellum elongate, flagellar formula = $21, 1-3, 5, 7 \dots 21$ or $1, 2, 4, 6 \dots 20$. Mandibles with weak palpar hump; right incisor with 3 teeth and midnotch; left incisor with 5 humps in 2 branches; right lacinia mobilis bifid, distal branch little shorter than proximal, distal branch narrow, weakly subbifid, proximal branch simple, weakly pointed; left lacinia mobilis with 5 teeth and 2 accessory teeth; right rakers 5; left rakers 6 plus one rudimentary; molar in form of short protrusion crowned with 3 long spines; palp article 1 slightly elongate, article 2 with one long inner apical seta and one other shorter inner seta, article 3 about as long as article 2, weakly oblique apex with 6 spine-setae, basofacial formula = 0-2. Inner plate of maxilla 1 ordinary, bearing one medium long apical pluseta, one similar apicomedial seta, no apicolateral setae; palp article 2 with one apical spine on protrusion, 2 apicolateral spine-setae, one apicomedial seta and one facial seta. Inner plate of maxilla 2 shorter than outer, outer plates slightly broader than inner, outer with 3 apicolateral setae, inner with one medial seta. Inner plate of maxilliped with 3 large apical spinesetae, one medial seta, one small apicomedial seta, plates fused medially more than normally; outer plate with 5 medial and apical spines, no apicolateral setae; palp articles 1-2 without apicolateral setae, medial margin of article 2 weakly setose, article 3 with 2 facial setae, no lateral setae, nail of article 4 long, with one accessory setule. Coxa l scarcely expanded distally, anterior margin almost straight; main ventral setae of coxae 1-4 = 6-7-6-2, posteriormost seta of coxae 1-3 slightly shortened; anterior and posterior margins of coxa 4 almost parallel, posterior margin convex, posterodorsal corner rounded, posterodorsal margin ordinary, Vshaped, width-length ratio of coxa 4 = 5 : 6. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 1-2-2-3, long anteriors = 0-1-0-0,

short anteriors = 2-2-1-1. Gnathopods generally ordinary, subequal in size; width ratios of articles 5-6 on gnathopods 1-2 = 24:40 and 25:41, length ratios = 55:88 and 47:80; palmar humps ordinary, palms strongly oblique; article 5 of gnathopod 1 with posterior margin rounded; article 5 of gnathopod 2 with posterior margin triangular. Pereopods 1-2 similar, posterior margin of article 4 moderately setose on both pairs, facial seta formula on article 4 = 1 and 1, on article 5 = 1 and 1; main spine of article 5 extending to M. 75 on article 6, article 5 lacking proximoposterior spines; spine formula of article 6 on pereopods 1-2 = 2 + 3 plus middistal seta, some spines long; acclivity on inner margin of dactyls on pereopods 1-2 obsolescent, emergent setule short, midfacial pluseta long. Coxae 5-7 posteroventral setule formula = 1-1-1. Articles 4-5 of pereopods 3-4 narrow, facial spine rows sparsely developed, facial ridge formula on article 2 of pereopods 3-5 = 0-1-1; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 53:28:25:10, of pereopod 4 = 66:24:14:8, of pereopod 5 =75:14:13:7, length ratios of pereopod 3 = 74: 32:29:36, of pereopod 4 = 92:63:58:60, of pereopod 5 = 120:25:25:28; article 2 of pereopod 5 reaching middle of article 4; medial apex of article 6 coarsely combed. Posteroventral corner of epimeron l rounded, posterior margin convex, corner naked, anteroventral margin with one long seta, posteroventral face naked; posteroventral corner of epimeron 2 rounded-quadrate, posterior margin weakly convex, facial ridge absent, facial setae = 2 anteriad in tandem; posteroventral corner of epimeron 3 rounded, posterior margin convex, with one setule notch, ventral margin and face naked; epimera 1-2 with setule on posterodorsal margin set in weak notch. Urosomite 1 with lateral setule at base of uropod I, articulation line complete, protuberant basodorsally and then forming weak posterior saddle. Urosomite 3 weakly protuberant dorsally. Rami of uropods 1-2 with articulate large apical nails, outer ramus of uropod 1 with one dorsal spine, inner with one, outer ramus of uropod 2 with one dorsal spine, inner with one; peduncle of uropod 1 with one apicolateral spine and 3 basofacial setae, medially with 2 ordinary marginal spines plus thick medial spine at base of inner ramus; peduncle of uropod 2 with 3 dorsal spines, medially with one apical spine; apicolateral corners of peduncles on uropods 1-2 with comb.

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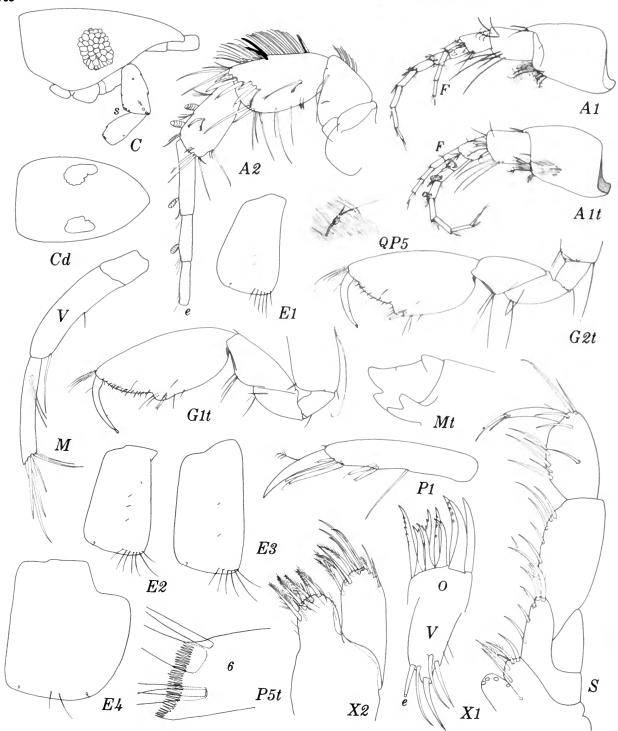


FIGURE 55.-Wildus mullokus, new species, holotype, male "a," 3.19 mm.

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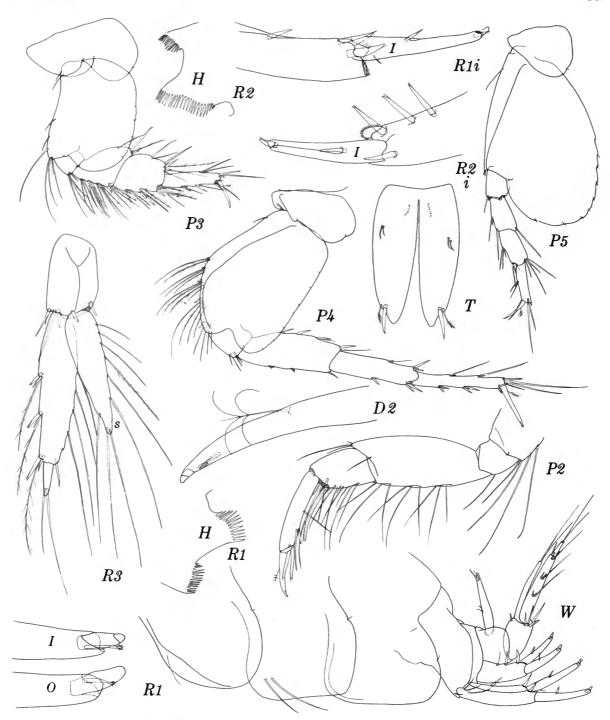


FIGURE 56.—Wildus mullokus, new species, holotype, male "a," 3.19 mm.

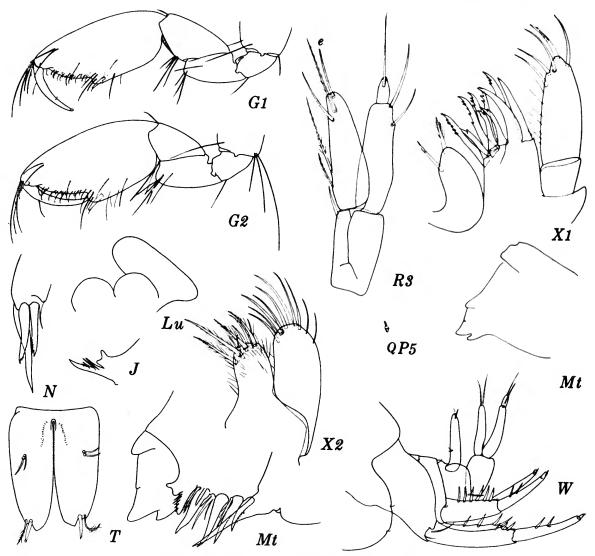


FIGURE 57.-Wildus mullokus, new species, male "v," 3.44 mm.

Peduncle of uropod 3 with 4 ventral spines, one elongate, dorsally with one lateral spine, one medial spine; rami submasculine, inner extending to M. 80 on article 1 of outer ramus, apex with 2 setae, medial margin setose, lateral margin with one subapical seta, article 2 of outer ramus ordinary, 0.22, bearing 2 medium to long setae, apicomedial margin of article 1 with one short spine-seta, lateral margin with 2 acclivities, spine formula = 1-1-2, setal formula = 1-1-1, medial margin setose. Telson elongate, length-width ratio = 19:11, not

fully cleft, each apex narrow, lateral acclivity broad, bearing ordinary lateral setule, spine next medial longer than setule, base bearing short denticle rows, midlateral setule pairs short. Cuticle with ordinary sparse bulbar setules of varying sizes, surface bearing fine striations in form of linear finger-print pattern, emergent setules elongate, branched.

OBSERVATIONS.—Prebuccal parts, left mandible and lower lip missing or damaged on holotype.

VARIATIONS.—Male "c," 4.02 mm: Outer ramus of uropod 1 with 2 dorsal spines, peduncle with 3

basofacial setae, lateral apex of peduncle with one spine. Forming intergrade between holotype and large aberrant male "v."

Large, aberrant male "v," 3.44 mm, from typelocality: Missing parts include: left mandible, prebuccal parts, right uropod 3, inner rami of uropod 1, right pereopod 3, left pereopod 1, and most of both members of pereopod 4. This specimen probably combining features of senility and regeneration; spines and setae more numerous than on holotype except on uropod 1 basofacially, left uropod 3 apparently regenerant. Head similar to that of holotype but eye slightly larger and more elongate. Article 2 of antenna 1 with 7 ventrodistal setae; accessory flagellum 5-articulate; primary flagellum 8-articulate, with 3 calceoli. Facial spine formula on article 4 of antenna 2 = 1-6-1, dorsal notch with 3 setal spines, dorsoproximal group with 3 members; flagellum 25-articulate, bearing calceolus only on article 1 or articles 1-4 (right or left, thus aberrant or senile). Distal branch on right lacinia mobilis broader and more distinctly bifid than on holotype; article 2 of mandibular palp with 3 long apical setae in tandem, article 3 with 8 apical setae. Inner plate of maxilliped lacking medial seta; outer plate with 6 spines; article 3 of palp with one midlateral spine and 2 facial spines. Anteroventral corner of coxa I bulging more than in holotype; long setae on coxae 1-4 =9-9-9-6; coxa 4 broader than in holotype. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 2-2-3, long anteriors = 1-2-0-0, short anteriors = 2-2-1-1. Article 6 of gnathopod I larger relative to articles 4 and 5 than in holotype; gnathopod 2 much better developed (see illustration). Pereopods 1-2 more setose than in holotype; article 5 with 2 and 3 apicolateral setae; article 6 with rows of 3 and 4 spines plus midposterior seta. Article 5 of pereopod 3 slightly thinner than in holotype. Peduncle of uropod I with only one basofacial seta, peduncle with 3 apicolateral spines, 4 mediomarginal spines plus distal medial spine at base of inner ramus; peduncle of uropod 2 with 6 dorsal spines; outer ramus of uropod 1 with 2 spines, inner ramus missing, outer ramus of uropod 2 with 2 dorsal spines, inner naked. Uropod 3 aberrant, probably regenerant (see illustration), noting deep setal sheaths. Telson shorter than in holotype, apicolateral setule on each lobe elongate.

ILLUSTRATIONS.—Holotype: Top of head probably flattened slightly from preservational effects, eyes displaced, drawn in outline only on dorsal view.

Male "v," 3.44 mm: Views of molar and inner plate of maxilla 1 corresponding to those of holotype, not duplicated for latter; minor differences noted in palp of maxilla 1 and much broader distal branch of right lacinia mobilis; part of lower lip reconstructed, noting short mandibular lobe; rudimentary bulbar setule of cuticle more frequently occurring than on holotype.

HOLOTYPE.—AM, male "a," 3.19 mm.

TYPE-LOCALITY.—AM P.18125, 12 Dec 1939, Antechamber Bay, Kangaroo Island, South Australia, with light in net at night.

VOUCHER MATERIAL.—Type-locality, aberrantsenile male "v," 3.44 mm (illus.); EBS 31, male "c," 4.02 mm. Female unknown.

RELATIONSHIP.—This species differs from Wildus thambaroo in the broader spread of the setae on coxae 1-3, in the presence of setae on coxa 4, in the larger distal branch of the right lacinia mobilis, in the spine formula on the posterior margin of article 6 on pereopods 1-2, and the highly elongate pereopod 4. By disregarding the distal spines on article 6 of pereopods 1-2 one counts a long seta and a pair of stout spines, whereas in W. thambaroo the count is 3 long setae and 2 short spines in tandem.

Wildus mullokus has many similarities to Brolgus tavelus and B. tattersalli. Wildus mullokus differs from B. tavelus in the presence of 2 apical setae on article 2 of uropod 3, the absence of a facial ridge on epimeron 2 and the presence of a long seta on article 6 of pereopods 1–2. Male "v" of W. mullokus is attached here rather than to B. tavelus on the characters of epimeron 2 and pereopods 1–2, although uropod 3 is aberrant and has the single apical seta characteristic of B. tavelus.

Wildus mullokus differs from B. tattersalli in the absence of a facial ridge on epimeron 2, the posterior seta of pereopods 1-2, the presence of only one seta on epimeron 1, and the presence of 2 apical setae on article 2 of the outer ramus on uropod 3. In addition, the main setal spine on the telson is short and thick, not elongate and seta-like.

MATERIAL.—AM, one sample (one specimen and aberrant specimen); EBS, one sample (1).

DISTRIBUTION.—South Australia, Kangaroo Island,

neritic; New South Wales, Jervis Bay, Murray's Beach, 6.1 m.

Wildus? fuegiensis (Schellenberg), new combination

Parharpinia fuegiensis Schellenberg, 1931:78-80, fig. 40.— Stephensen, 1949:5-6.

Paraphoxus fuegiensis.-J. L. Barnard, 1960:271, pl. 42.

REMARKS.—This species has the definitive attributes of Wildus but 3 characters might be analyzed further as to their generic value: the presence of 3 ventral setae on epimeron 3, the odd placement of basal setae on uropod 1 and the unusual antenna 1 of the male resembling that of male Elpeddo kaikai. Parharpinia fuegiensis appears to differ more strongly from Elpeddo than from Wildus in the absence of basal spines on article 4 of antenna 2 but if the length of setae on article 2 of the outer ramus on uropod 3 were discounted, P. fuegiensis could be assigned provisionally to Elpeddo. Evaluation of male antenna 1 must be extended further as this is a rarely encountered situation and may be a recurrent aberrancy.

DISTRIBUTION.—Magellanic, 0.91 m; South Georgia, 73-311 m; Tristan da Cunha, surface.

Wildus? waipiro (J. L. Barnard), new combination

Paraphoxus waipiro J. L. Barnard, 1972b:143-145, figs. 79, 80.

REMARKS.—This species is distinguished in the key to Wildus, but several characters must be evaluated with fresh material; the presence of a special apicomedial spine on the peduncle of uropod 1 is not confirmed.

DISTRIBUTION.—New Zealand, intertidal.

Paraphoxus Sars

Paraphoxus Sars, 1895:148-149.—Stebbing, 1906:137.—Barnard and Drummond, 1976:524.

Not Pontharpinia Stebbing, Parharpinia Stebbing, Protophoxus K. H. Barnard, Trichophoxus K. H. Barnard, nor Metharpinia Schellenberg.

Diagnosis.—Eyes present. Flagella of antennae 1-2 unreduced in female. Article 2 of antenna 1 especially shortened, ventral setae confined apically. Article 1 of antenna 2 not ensiform, article 3 with 2 setules, facial spines on article 4 in one main row.

with rudimentary second row, article 5 short. Right mandibular incisor with 3 teeth; molar not triturative, small, conical, bearing 3 long clumped spines with common base, not bearing fuzz; palpar hump small. Palp of maxilla 1 biarticulate, inner plate with 2 setae. Setation of maxilla 2 ordinary. Inner plate of maxillipeds ordinary; apex of palp article 3 weakly protuberant, dactyl elongate, apical nail distinct, elongate. Gnathopods small, similar, gnathopod 2 weakly enlarged; article 5 of gnathopods 1-2 very short, almost cryptic, with eusirid attachment; palms oblique, hands of gnathopods 1-2 weakly enlarged, ovatorectangular, elongate, poorly setose anteriorly. Article 5 of pereopods 1-2 setose posteroproximally. Article 2 of pereopod 3 of broad form, articles 4-5 of pereopods 3-4 narrow, article 2 of pereopods 3-4 not setose posteriorly; pereopod 5 ordinary, article 2 naked ventrally, article 3 ordinary, dactyl normal. Epimera 1-2 lacking long posterior setae, without midfacial setae above ventral facial ridge; epimeron 3 of rounded classification and lacking long setae. Urosomite 1 generally naked; urosomite 3 without dorsal hook or special process. Peduncle of uropod 1 normally elongate, without apicoventral spike, without special enlarged apicolateral-medial spine; peduncular apices of uropods 1-2 combed; spine(s) on inner ramus of uropod 1 in one row, no rami continuously spinose to apex, inner ramus of uropod 2 ordinary. Uropod 3 especially elongate, article 2 of outer ramus carrying 2 short to medium apical setae. Telson ordinary, with only one apical spine on each lobe plus setules.

DESCRIPTION.—Rostrum fully developed. Fuzz on article 1 of antenna 1 in male present; calceoli on male primary flagellum of antenna 1 present. Calceoli on article 5 of male antenna 2 present; flagellum in male with calceoli. Prebuccal parts ordinary, extended forward, massive, poorly separated from each other, upper lip dominant. Right lacinia mobilis bifid, flabellate; mandibular palp thin, article 1 slightly elongate, article 2 without outer setae, apex of article 3 almost transverse. Lower lip bearing cones. Outer plate of maxilla 1 with 11 spines, one spine especially thickened. Inner plates of maxilliped poorly armed, thick. Coxae 2-4 without special anterodorsal humps. All posterior spines on article 6 of pereopods 1-2 thin and stiff, midapical spine or seta absent; dactyls of pereopods 1-2 lacking inner tooth, bearing raphe, apical nail distinct

but immersed. Article 2 of pereopod 5 without facial setae. Peduncle of uropod 1 with dorsolateral spines confined apically, medial spines widely spread; peduncle of uropod 2 with medial spines and setae sparse but widely spread. Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with ordinary pair of midlateral or dorsal setules on each side.

Type-Species.—Phoxus oculatus Sars, 1879 (monotypy).

Composition.—Possibly Parharpinia simplex Gurjanova, 1938.

RELATIONSHIP.—Paraphoxus differs from Brolgus and Ganba in the presence of two apical setae on the outer ramus of uropod 3. It differs from Kuritus, Elpeddo and Wildus in the absence of the special apicomedial spine on the peduncle of uropod 1.

See Barnard and Drummond (1976) for an exposition on the nomenclatural history of *Paraphoxus*, the revival of its synonyms, and notes on the placement of species to be rejected from *Paraphoxus*. Also see "Allocation of Species in *Paraphoxus*" below.

Paraphoxus oculatus (Sars)

Phoxus oculatus Sars, 1879:441; 1885:154-156, pl. 13: figs. 4, 4a-e.

Paraphoxus oculatus.—Stebbing, 1906:137-138 [with references].—Oldevig, 1959:38.—J. L. Barnard, 1960:240-243, pls. 27, 28 [with references]; 1966a:89; 1967:138; 1971: 70.—Nagata, 1965:156.—Karaman, 1973:91-98, figs. 25-28.—Griffiths, 1974b:321.

Phoxus maculatus Chevreux, 1888:2-3.

Paraphoxus maculatus.—Chevreux, 1900:34-36, pl. 5: fig. 5; 1911:187, pl. 10: figs. 12, 13.—Chevreux and Fage, 1925: 103-104, fig. 97.—Ledoyer, 1968:191.

DISTRIBUTION.—Atlantic and North Pacific Oceans, to depths of 860 m.

Paraphoxus? simplex (Gurjanova)

Parharpinia simplex Gurjanova, 1938:272-274, 385-386, fig. 10.

Pararpinia [sic] simplex.—Gurjanova, 1951:392-394, fig. 238. Paraphoxus simplex.—J. L. Barnard, 1960:278.

REMARKS.—Many characters of this species need confirmation for its relegation to *Paraphoxus*; one possible mark of its distinction from *Paraphoxus*

oculatus is the stoutness of spines on article 6 of pereopods 1-2.

Distribution.—Japan Sea.

Allocation of Species in Paraphoxus

Paraphoxus abronius J. L. Barnard, 1960, to a genus to be described.

Protophoxus australis K. H. Barnard, 1930, to Protophoxus. Pontharpinia barnardi Pirlot, 1932, to a genus to be described.

Phoxus batei Haswell, 1879, to Birubius.

Paraphoxus bicuspidatus J. L. Barnard, 1960, to a genus to be described.

Pontharpinia calcarata Gurjanova, 1938, to a genus to be described.

Trichophoxus capillatus K. H. Barnard, 1930, to Trichophoxus.

Pontharpinia centralis Schellenberg, 1938, to a genus to be described.

Paraphoxus chelatus Cooper, 1974, to a genus to be described.

Paraphoxus cognatus J. L. Barnard, 1960, to a genus to be described.

Metharpinia cornuta Schellenberg, 1931, to Metharpinia.

Paraphoxus daboius J. L. Barnard, 1960 to a genus to be described.

Pontharpinia epistoma Shoemaker, 1938, to a genus to be described.

Paraphoxus fatigans J. L. Barnard, 1960, to a genus to be described.

Pontharpinia floridana Shoemaker, 1933, to a genus to be described.

Parharpinia fuegiensis Schellenberg, 1931, to Wildus.

Paraphoxus gemmatus J. L. Barnard, 1964a, to a genus to be described.

Phoxus geniculatus Stimpson, 1856, dubious.

Phoxus grandis Stimpson, 1857, dubious.

Paraphoxus heterocuspidatus J. L. Barnard, 1960, to a genus to be described.

Pontharpinia intermedia Schellenberg, 1925, to Basuto stimpsoni.

Paraphoxus jonesi J. L. Barnard, 1963, to a genus to be described

Metharpinia longirostris Schellenberg, 1931, to Metharpinia. Paraphoxus lucubrans J. L. Barnard, 1960, to a genus to be described.

Phoxus maculatus Chevreux, 1888, to Paraphoxus oculatus. Pontharpinia maxima Stephensen, 1947, possibly to Paraphoxus pyripes.

Pontharpinia milleri Thorsteinson, 1941, to a genus to be described.

Pontarpinia [sic] nasuta Gurjanova, 1936, to a genus to be described.

Parharpinia obliqua K. H. Barnard, 1932, to a genus to be described.

Pontharpinia obtusidens Alderman, 1936, to a genus to be described.

Phoxus obtusus Stimpson, 1855, dubious.

Pararpinia [sic] ochotica Gurjanova, 1953, to a genus to be described.

Urothoe pinguis Haswell, 1880, to Pontharpinia.

Paraphoxus pyripes K. H. Barnard, 1930, to a genus to described.

Paraphoxus rakiura Cooper and Fincham, 1974, to Waitangi. Paraphoxus robustus Holmes, 1908, to a genus to be described.

Urothoe rostratus Dana, 1853, to a genus to be described or Birubius.

Parharpinia rotundifrons K. H. Barnard, 1932, to a genus to be described.

Paraphoxus similis J. L. Barnard, 1960, to a genus to be described.

Parharpinia sinuata K. H. Barnard, 1932, to a genus to be described.

Paraphoxus spinibasus Cooper, 1974, to a genus to be described.

Paraphoxus spinosus Holmes, 1908, to a genus to be described.

Paraphoxus stebbingi J. L. Barnard, 1958, to Tipimegus.

Paraphoxus stenodes J. L. Barnard, 1960, to a genus to be described.

Pontharpinia stimpsoni Stebbing, 1908, to Basuto.

Paraphoxus subuncigerus Kudrjaschov, 1965, to a genus to be described.

Paraphoxus tattersalli J. L. Barnard, 1958, to Brolgus.

Pontharpinia tridentata J. L. Barnard, 1954, to a genus to be described.

Parharpinia uncigera Gurjanova, 1938, to a genus to be described.

Pontharpinia uncinata Chevreux, 1912a,b, to a genus to be described.

Phoxus unicirostratus Giles, 1890, to Mandibulophoxus.

Paraphoxus variatus J. L. Barnard, 1960, to a genus to be described.

Paraphoxus vigitegus J. L. Barnard, 1971, to a genus to be described.

Phoxus villosus Haswell, 1879, to Parharpinia.

Paraphoxus waipiro J. L. Barnard, 1972b, to Wildus.

Paraphoxus sp. Australia, J. L. Barnard, 1960, to Matong matong.

Paraphoxus sp. South Africa, J. L. Barnard, 1960, dubious. Pontharpinia sp., Falkland Islands, (= P. rostratus, Stebbing, 1914), dubious.

Pontharpinia sp., Flores Sea, (= P. rostrata, Pirlot, 1932, fig. 15 only), dubious.

LEONGATHINAE

DIAGNOSIS.—Article 2 of antenna 1 ordinary; mandibular molar semitriturative, bearing one extended and toothed margin; palp of maxilla 1 biarticulate; setation on maxilla 2 ordinary; gnathopod 2 significantly enlarged; article 2 of pereopod 3 of broad form, tapering distally; pereopod 5 ordinary.

DESCRIPTION.—Article 5 of antenna 2 reduced in size; epimeron 3 of nonrounded classification; apices of peduncles on uropods 1-2 not combed.

Type Genus.—Leongathus, new genus.

COMPOSITION.—Unique.

Leongathus, new genus

DIAGNOSIS.—Eyes obsolescent. Flagella of antennae 1-2 unreduced in female. Article 2 of antenna l ordinary, ventral setae confined proximally. Article 1 of antenna 2 weakly ensiform; article 3 with 2 setules; facial spines on article 4 in 2 indistinct rows, plus special apical spines; article 5 short. Right mandibular incisor with 3 teeth; molar partly triturative, medium-broad, conical, bearing 7 or more splayed nonarticulate teeth, bearing fuzz; palpar hump medium. Palp of maxilla 1 biarticulate; inner plate with 4 setae. Setation of maxilla 2 ordinary. Inner plate of maxillipeds ordinary; apex of palp article 3 not or weakly protuberant, dactyl elongate, apical nail mostly immersed, short. Gnathopods highly dissimilar, gnathopod 2 strongly enlarged; article 5 of gnathopod 2 very short, cryptic, ordinary on gnathopod 1, without eusirid attachment; palms oblique, hand of gnathopods 1-2 elongate and broadened respectively, poorly setose anteriorly. Article 5 of pereopods 1-2 with posteroproximal setae. Article 2 of pereopod 3 of broad form but tapering distally, articles 4-5 of pereopods 3-4 narrow to medium, article 2 of pereopod 4 setose posteriorly; pereopod 5 ordinary, article 2 naked ventrally, article 3 ordinary, dactyl normal. Epimera 1-2 bearing numerous posterior setae, without midfacial setae above ventral facial ridge; epimeron 3 ordinary. Urosomite 1 bearing one or more midventral crescents or bundles of setae; urosomite 3 without dorsal hook or special process. Peduncle of uropod 1 normally elongate, without apicoventral spike, without special enlarged apicolateral-medial spine; peduncular apices of uropods 1-2 not combed; uropod 2 with long setae on peduncle, spines if present on inner ramus of uropod 1 in one row, no rami continuously spinose to apex, inner ramus of uropod 2 ordinary. Uropod 3 ordinary, article 2 of outer ramus carrying 2 long apical setae. Telson ordinary, with only one apical spine or seta on each lobe plus setules.

DESCRIPTION.—Rostrum fully developed, unconstricted. [Fuzz on article 1 of antenna 1 in male

unknown, calceoli on male antenna 1 and antenna 2 unknown.] Ventral setules on article 1 of antenna I widely spread. Prebuccal parts ordinary, poorly separated from each other, upper lip dominant. Right lacinia mobilis bifid, distal branch flabellate; mandibular palp medium to thin, article 1 short, article 2 with outer setae, apex of article 3 oblique. Lower lip bearing cones. Outer plate of maxilla 1 with 11 spines, one spine especially thickened. Inner plates of maxilliped thick, ordinarily setose. Only coxa 2 with special anterodorsal hump. Some posterior spines on article 6 of pereopods 1-2 thin and seta-like, midapical spine or seta absent. Article 2 of percopod 5 with facial setae. Peduncle of uropod 1 with dorsolateral spines confined apically, basofacial setae dispersed, medial spines widely spread; peduncle of uropod 2 with only one medial spine confined apically. Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with ordinary pair of midlateral or dorsal setules on each side.

Type-Species.—Leongathus nootoo, new species. Composition.—Unique.

RELATIONSHIP.—The mandibular molar of Leongathus appears to be transitional between the fully triturative form of Pontharpinia and the spinose kind of the Matong and Birubius groups of genera.

Leongathus differs from Pontharpinia in the apomorphic right lacinia mobilis bearing a fully fused proximal branch and in the ordinary kinds of maxilla 1, telson, article 3 of antenna 2, labial cones, dactyl of pereopod 5, article 5 of pereopods 1–2, reduced rows of spines on article 4 of antenna 2, tapering article 2 of pereopod 3, fewer facial setae on article 2 of pereopod 5, these not formed into bundles, apically confined dorsal spines on the peduncle of uropod 1, widely dispersed basofacial setae on uropod 1, and absence of the special peduncular spine, presence of posterior setae on epimera 1–2, and elongation of peduncular spines on uropod 2.

From Matong, Kotla, and Yammacoona, Leongathus differs in the unusual molar, the poor nail of the maxillipedal palp, the much shortened, almost vestigial article 5 of gnathopod 2, the tapering article 2 of pereopod 3, the facial setae on article 2 of pereopod 5, the normal coxae 1-3, the elongate setal-spines on the peduncle of uropod 2, and the numerous and dispersed basofacial setae

on uropod 1. Leongathus furthermore differs from Matong and Kotla in the thick antenna 1 with proximal ventral setae on article 2, the long and free inner ramus of uropod 2, and in the confinement of most spines on article 4 of antenna 2 into one row. Leongathus also differs from Yammacoona in the normal plates of maxilliped, absence of a facial brush on epimeron 3, presence of posterior setae on epimera 1-2 and the wide spread of medial spines on the peduncle of uropod 1.

Leongathus differs from Mandibulophoxus and Basuto in the smaller palpar hump on the mandible, the well developed molar, the absence of a special peduncular spine on uropod 1, the more elongate article 2 of antenna 1 with the ventral setae situated proximally, the weak nail on the maxilliped, and the noncontinuous dorsal spination on the rami of uropods 1-2.

Leongathus nootoo, new species

FIGURES 58-60

Description of Female.—Head about 17 percent of total body length, greatest width about 55-60 percent of length; rostrum unconstricted, elongate, almost reaching apex of article 2 on antenna 1. Eyes small, apparently present, clear of pigment, ommatidia apparently absent. Article 1 on peduncle of antenna 1 about 1.5 times as long as wide, about twice as wide as article 2, ventral margin with about 7 setules, weakly produced dorsal apex with 2 setules; article 2 about 0.5 times as long as article 1, with ventral, proximal cycle of 3-6 setae, primary flagellum with 9-10 articles, about 0.45 times as long as peduncle, bearing short aesthetascs; accessory flagellum with 7-8 articles. Spine formula on article 4 of antenna 2 = 1-4-4or 1-3-6 or 1-3-5, dorsal margin with one proximal seta and notch bearing 2 setae and one spine, ventral margin densely setose distally, with 2 ventrodistal long to medium spines; article 5 about 0.7 times as long as article 4, facial spine formula = 1-1 or 1-1-1, dorsal margin naked, ventral margin densely setose, with 2 ventrodistal long to medium spines, one of these subdistal and facial; flagellum about 0.8 times as long as articles 4-5 of peduncle combined, with 8-9 articles. Mandibles with medium palpar hump; right incisor with 3 weak teeth; left incisor with 3 humps in 2 branches; right la-

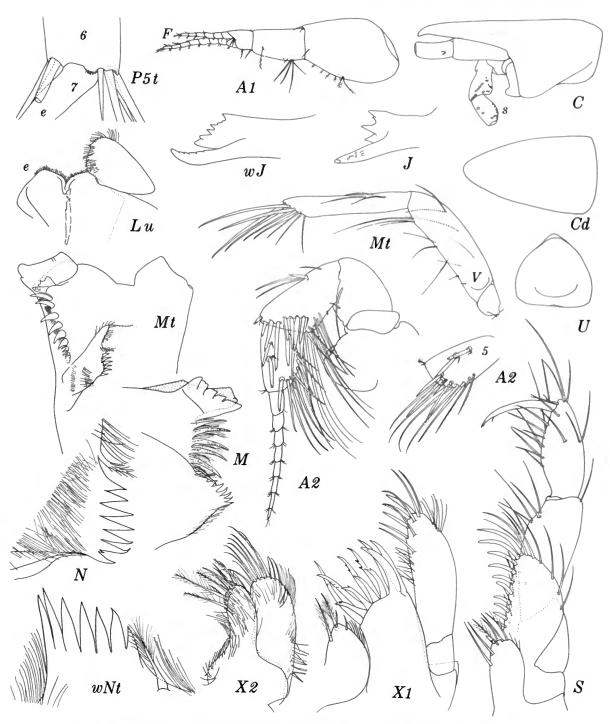


FIGURE 58.—Leongathus nootoo, new species, holotype, female "a," 7.4 mm (w = female "w," 8.6 mm).

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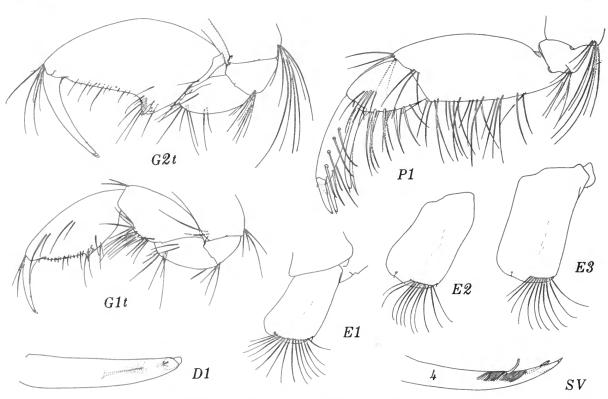


FIGURE 59.—Leongathus nootoo, new species, holotype, female "a," 7.4 mm.

cinia mobilis bifid, distal branch shorter than proximal, flabellate, denticulate, proximal branch simple, pointed, with marginal denticles; left lacinia mobilis with 5 adz-teeth plus accessory denticulations; right rakers 7-9 plus 1-2 rudimentaries; left rakers 8-9 plus 2 + rudimentaries; molars composed of elongate lamina in form of soft cone bearing 6-7 plus rudimentary cusps and one short plusetule weakly disjunct, molars fuzzy; palp article I short, article 2 with 3 long to medium inner apical setae, 5 other long and short inner setae and 3 outer facial and one outer marginal setae, article 3 about 1.1 times as long as article 2, oblique apex with 9 spine-setae, basofacial formula = (1-1)-1. Inner plate of maxilla 1 ordinary, bearing one long apical pluseta, one longer apicomedial seta, 2 apicolateral much shorter setae; palp article 2 with 4-5 apical-medial marginal spines and 5 apicolateral to medial setae. Plates of maxilla 2 extending subequally, outer much broader than inner, outer with 3 apicolateral setae, inner with one medial seta. Inner plate of maxilliped with one large apical spine, 3 apicofacial and one ventrodistal setae, 2 medial setae; outer plate very large, with 10 medial and apical spines, 6 apicolateral setae; palp article I lacking apicolateral setae, article 2 with one apicolateral seta, medial margin of article 2 weakly setose, article 3 unprotuberant, with one facial seta, 2 lateral setae, nail of article 4 obsolescent, mostly immersed, short, with 2 accessory setules. Coxa 1 scarcely expanded distally, anterior margin weakly concave; main ventral setae of coxae 1-4 = (15-18)-(11-15)-(11-14)-18, additional posteriormost setule of coxae 1-3 shortest; anterior and posterior margins of coxa 4 parallel, posterior margin convex to straight, posterodorsal corner rounded, posterodorsal margin short, V-shaped, width-length ratio of coxa 4 = 16:17. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = (1-2)-(3-5)-2-3, long anteriors = (5-6)-8-(4-5)-3, short posteriors = 1-1-0-0, no others. Gnathopod 1 ordinary, gnathopod 2 enlarged; article 5 tiny, cryptic; article 6 very broad and elongate; width ratios of articles 5-6 on gnathopods 1-2 = 30:32 and 28:60,

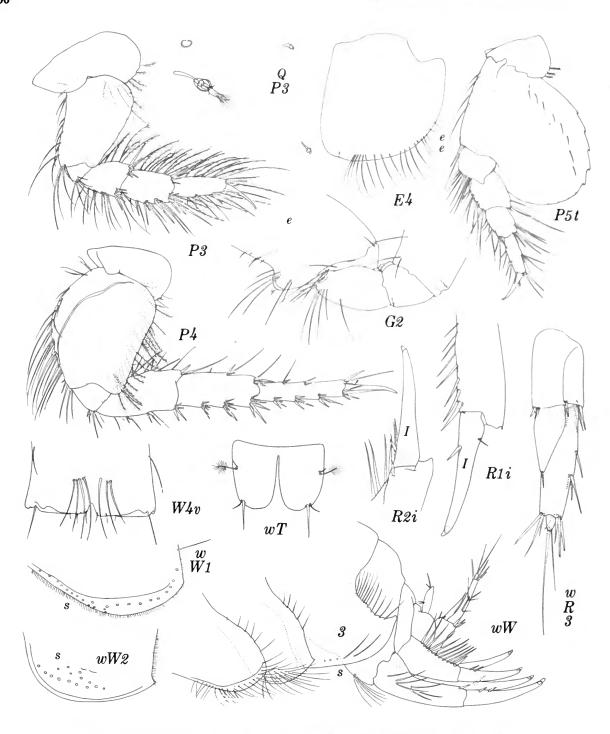


FIGURE 60.—Leongathus nootoo, new species, holotype, female "a," 7.4 mm (w = female "w," 8.6 mm).

length ratios = 56:72 and 14:110; palmar hump of gnathopod 2 very large, palms strongly oblique; article 5 of gnathopod 1 ovate, posterior margin rounded; article 5 of gnathopod 2 short, triangular, lobate. Pereopods 1-2 similar; facial seta formula on article 4 = 3-6 and 3-6, on article 5 = 5-7 and 5-7; main spine of article 5 extending to M. 100 on article 6, article 5 lacking proximoposterior spines; spine formula of article 6 = 4 + 4 or 5 + 5, no middistal seta, most spines especially long and thin; acclivity on inner margin of dactyls of pereopods 1-2 weak, obsolescent, emergent setule short, almost fully immersed, midfacial pluseta ordinary. Coxae 5-7 posteroventral seta formula = (8-11)-(2-3)-(3-5). Articles 4-5 of pereopods 3-4 narrow, facial spine rows sparse, facial ridge formula on article 2 of pereopods 3-5 = 0-1-2, anterior ridge on pereopod 5 short, article 2 of pereopod 3 tapering distally; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 46:23:22:14, of pereopod 4 = 65:30:24:14, of pereopod 5 = 88:23:16:9, length ratios of pereopod 3 = 64:26:34:38, of pereopod 4 = 82:55:58:62, of pereopod 5 = 100:30:22:30; article 2 of pereopod 5 almost reaching apex of article 4, with row of posterofacial setae; medial apex of article 6 with finely combed hump. Posteroventral corner of epimeron 1 rounded, posterior margin straight to weakly convex, setose, postero- and anteroventral margins continuously setose; posteroventral corner of epimeron 2 with small, sharp tooth guarded by sinus, posterior margin weakly convex, serrate, setose, facial setae = dense and scattered, some pairs set vertically; posteroventral corner of epimeron 3 with medium to large tooth, posterior margin almost straight, weakly serrate, setose, ventral margin with 4-5 facial setae mainly in middle. Urosomite 1 with or without lateral setule at base of uropod 1 plus 3-5 ventral setae in group, with or without additional 1-2 setae more anteriorly, articulation line complete; urosomite 3 weakly protuberant dorsally. Rami of uropods 1-2 with articulate apical nails, outer ramus of uropod 1 with 1-2 dorsal spines, inner with one, outer ramus of uropod 2 with 2 dorsal spines, inner lacking dorsomedial spines; peduncle of uropod 1 with one apicolateral spine and sets of 1-3-3 or 1-2 basofacial setae, medially with 8 marginal setae and spines; peduncle of uropod 2 with 7-10 long dorsal setae and one apical spine, medially with one small apical spine; apicolateral

corners of peduncles on uropods 1-2 lacking comb. Peduncle of uropod 3 with 4-5 ventral spines, dorsally with one lateral spine and one setule, one medial spine and 2 setules; rami feminine, inner extending to M. 60 on article 1 of outer ramus, apex with one short seta, medial and lateral margins naked, article 2 of outer ramus short, 0.14, bearing 2 long to medium setae, apicomedial margin of article 1 with 3 spine-setae, lateral margin with 1-2 acclivities, spine formula = 1-3-4 or 0-2-3, setal formula = 0. Telson short, lengthwidth ratio = 2:3, not fully cleft, each apex wide, rounded, lateral acclivity narrow, weak, bearing short lateral setule, spine-seta next medial much longer than setule, midlateral setules diverse. Cuticle with ordinary bulbar setules mixed with pipes, emergent setules especially branched.

OBSERVATIONS.—Eyes composed of weakly visible capsule of irregular tissue (marked in dashed outline in lateral view of head), not visible in dorsal view owing to thickness of cuticle. Description based on both adult females in hand but following parts of female "w" not examined: maxillae 1-2, maxilliped, upper and lower lips, epistome.

Juvenile, 4.1 mm: Generally like adult but armaments fewer, for example: article 2 of antenna 1 with 2 ventral setae, primary flagellum with 6 articles, accessory flagellum with 5 articles; spine formula on article 4 of antenna 2 = 1-2-1, article 5 with one facial spine, flagellum 6-articulate; long setae on coxae 1, 2, 4, = 6, 5, 4; epimeron 1 with only 3 setae, one of these anteroventral, one posteroventral, one ventral; epimeron 2 with 3 lateral setae; epimeron 3 with 4-5 posterior setae and one ventral seta; urosomite 1 with one seta at base of uropod 1, ventral setae present; peduncle of uropod 2 with 3 setae and one spine; basofacial setae of uropod 1 = 1-1; outer ramus of uropod 3 with 0-1 lateral spine.

ILLUSTRATIONS.—One seta on article 2 of antenna 1 missing (6 instead of 5); lower lip drawn from oral side, inner lobes cleft on aboral side; overall view of right mandible showing unflattened version; on overall view of left mandible those raker spines situated behind molar omitted; enlarged views of right mandibular molars from 2 different specimens drawn from opposite sides, thus appearing as mirror images; several spines missing on posteroventral corner of article 4 on pereopod 4; epimera of holotype not illustrated, epimeron 1

with 18 setae, epimeron 2 with 11 setae, epimeron 3 with 12 posterior and 4 ventral setae;

HOLOTYPE.—AM, female "a," 7.4 mm.

Type-Locality.—AM P.18215, 18 Jun 1962, off Sydney, New South Wales, Australia, 33°58.4′ S, 151°29′ E. 150 m.

VOUCHER MATERIAL.—Type-locality: female "w," 8.6 mm (illus.); AM P.18248, juvenile "c," 4.1 mm (only other specimen known). Male unknown.

MATERIAL.—AM, 2 samples (3).

DISTRIBUTION.—New South Wales, Sydney, 150 m.

JOUBINELLINAE

Diagnosis.—Article 2 of antenna 1 ordinary to elongate; mandibular molar fully triturative or reduced to a small hump with articulate spines; palp of maxilla 1 biarticulate; setation on maxilla 2 ordinary to reduced; gnathopod 2 significantly enlarged; article 2 of pereopod 3 of broad form, not tapering distally; pereopod 5 ordinary.

Description.—Article 5 of antenna 2 of normal size or rarely reduced; epimeron 3 of nonrounded classification; apices of peduncles on uropods 1-2

not combed.

Type Genus.—Joubinella Chevreux.

Composition.—Kotla, new genus; Matong, new genus; Yammacoona, new genus, and the "universal" genus Cunmuura, new genus, placed provisionally in the Brolginae.

REMARKS.—The members of this subfamily are highly diverse. Joubinella is a pelagic genus bearing eusirid gnathopods and possible predatorial adaptations, whereas Kotla, Matong, and Yammacoona appear to have benthic inquilinous adaptations in reduced rostra, thickened and oddly spinose antennae, reduction in uropod 3, fusion to the peduncle of the inner ramus of uropod 2 and in some cases nonskid cuticle. Cunmurra is a transitional genus, having affinities mainly to the Brolginae but forming an intergrade towards the Birubius mayamayi group of species and being convergent towards the Phoxocephalinae. Because of the tendency to identify Cunmurra with the brolgins in its overall appearance we have removed it to a position in that subfamily. In its gnathopods, head, epimera and antennae, Cunmurra appears closer to the hypothetical primitive joubinellin than any of the other genera so contained.

Key to the Genera of Joubinellinae

1. Gnathopods of highly eusirid, pelagic, and predatorial form, gnathopod 1 usually much larger than gnathopod 2 but occasionally of equal size, antenna 2 extremely thin, lacking well organized clusters of facial spines, flagellum in female reduced to 2-3 articles, mandi-Gnathopods weakly eusirid, of nonpelagic and nonpredatorial form, gnathopod 2 usually much larger than gnathopod 1 but occasionally of equal size, antenna 2 stout to medium in thickness, bearing well organized clusters of facial spines, flagellum in female exceeding 2. Epimeron 3 reduced to fully rounded classification, lacking all but 2 fully developed setae [head normal, uropod 2 freely articulate, uropods 1-2 lacking accessory apical nails, no epimera with facial brushes of setae above lateral ridges, spines on uropod 2 normal, ventral setae on article 2 of antenna 1 set in middle] 3. Article 4 of antenna 2 bearing only 2 rows of facial and apical spines, head with rostrum obsolete but broadly truncate from lateral view, inner ramus of uropod 2 freely articulate, Article 4 of antenna 2 bearing 3 or more rows of facial and apical spines, head with very short rostrum but anterior margin from lateral view sinuous, inner ramus of uropod 2 partially to fully fused to peduncle, ventral setae on article 2 of antenna 1 set distally.. 4 4. Spines on uropod 2 conical, of normal dimensions, sharp, epimera 1-2 lacking large vertically Spines on uropod 2 of rounded, jewel-like form, blunt, epimera 1-2 bearing large vertically

Ioubinella Chevreux

Joubinella Chevreux, 1908:8-11.-J. L. Barnard, 1960:357-358.

DIAGNOSIS.—Eyes present. Flagella of antennae 1-2 reduced in female. Article 2 of antenna 1 elongate to ordinary, ventral setae absent or confined apically. Article 1 of antenna 2 not ensiform, article 3 with 2 setules; facial spines on article 4 variable, absent (type) or in 2 or more rows; article 5 ordinary in size to especially thin. [?Right mandibular incisor with 2-4 teeth); molar strongly triturative, medium; palpar hump small. Palp of maxilla l biarticulate; inner plate naked. Setation of maxilla 2 ordinary (type) to weak. Inner plate of maxillipeds ordinary; apex of palp article 3 not protuberant, dactyl elongate, apical nail distinct, stout, medium. Gnathopods dissimilar, moderately to strongly enlarged; article 5 of gnathopod 2 of ordinary length, free or almost cryptic, highly elongate on gnathopod l, with eusirid attachment; palms transverse to chelate, hand of gnathopods 1-2 broadened, poorly setose anteriorly. Article 5 of pereopods 1-2 setose posteroproximally. Article 2 of pereopod 3 of broad form but tapering distally; articles 4-5 of pereopods 3-4 narrow to medium, article 2 of pereopods 3-4 not setose posteriorly; pereopod 5 ordinary, article 2 naked ventrally, articles 3-4 especially small, dactyl normal. Epimera 1-2 lacking long posterior setae, without midfacial setae above ventral facial ridge; epimeron 3 of rounded classification and lacking long setae. Urosomite 1 generally naked; urosomite 3 without dorsal hook or special process. Peduncle of uropod I normally elongate to slightly shortened (type), with or without apicoventral spike, without special enlarged apicolateral-medial spine; [?peduncular apices of uropods 1-2 not combed]; inner ramus of uropod l with marginal spines in one row, either none or some rami continuously spinose to apex,

inner ramus of uropod 2 ordinary. Uropod 3 ordinary, article 2 of outer ramus carrying 0-2 long to vestigial apical setae. Telson ordinary, with 2-4 apical spines or setae on each lobe plus setules.

DESCRIPTION.—Rostrum fully developed. [Fuzz on article 1 of antenna 1 in male unknown, calceoli on male antennae 1-2 unknown. Prebuccal parts unknown. ?Right lacinia mobilis bifid]; mandibular palp thin, article I short to slightly elongate, article 2 without outer setae, apex of article 3 oblique. [Lower lip unknown.] Outer plate of maxilla 1 with 9 spines, one or no spine especially thickened. Inner and outer plates of maxilliped poorly armed, thick. Coxae 2-4 without special anterodorsal humps. Some posterior spines on article 6 of pereopods 1-2 thin and seta-like, others thick and stiff, [midapical spine or seta unidentified]. Article 2 of pereopod 5 without facial setae. Peduncle of uropod 1 with dorsolateral spines widely spread, medial spines widely spread; [?peduncle of uropod 2 with only one medial spine or setule confined apically or spines widely spread]. Peduncle of uropod 3 bearing or lacking extra subapical setae or spines. Telson with pair of midlateral or dorsal setules on each side, highly apical.

Type-Species.—Joubinella ciliata Chevreux, 1908 (monotypy).

COMPOSITION.—Joubinella bychovskii Gurjanova, 1952; J. strelkovi Gurjanova, 1952; J. traditor Pirlot, 1932; J. tzvetkovae Kudrjaschov, 1965 (Okhotsk Sea, 88 m). See J. L. Barnard (1960) for other literature and distributions.

REMARKS.—The diversity in antennae and uropods suggests that at least two genera are mixed into this complex. More elaboration of detail is required in several of the species. The diagnosis and description for the genus are drawn from the several species and may be confounded by this combining of facts not limited to the type-species.

Key to the Species of Joubinella

Joubinella species 1

MATERIAL.—AM P.18219, off Sydney, 33°58.4′ S, 115°29′ E, 150 m, juvenile, 2.25 mm.

REMARKS.—A damaged specimen not worthy of specific description but very similar in many respects to the ordinary joubinellas heretofore described in the literature. Article 2 of uropod 3 elongate, bearing 2 short apical setae; uropods 1–2 with long apical spine-nails on rami, with one accessory nail and with subdistal dorsal spine, the degree of apicality indicating youth of the specimen; article 2 of antenna 1 scarcely overriding article 3; article 6 of pereopods 1–2 with spine rows of 1 + 1, spines longer than dactyl; gnathopod 1 definitely much larger than gnathopod 2 and with unusual shape typical of Joubinella.

Joubinella species 2

MATERIAL.—SBS 3 (one shriveled specimen). REMARKS.—This specimen, perhaps in the range of 4-6 mm in length, is clearly a member of *Joubinella* but too poorly preserved for analysis.

Matong, new genus

Diagnosis.—Eyes present. Flagella of antennae 1-2 unreduced in female. Article 2 of antenna 1 elongate, ventral setae mainly apical. Article 1 of antenna 2 weakly ensiform; article 3 with 2 setules; facial spines on article 4 in 2 or more rows; article 5 ordinary in size. Right mandibular incisor with 3 teeth; molar not triturative, ordinary, medium, pillow-shaped, bearing 4 or more splayed, semiarticulate spines, usually bearing fuzz; palpar hump small. Palp of maxilla 1 biarticulate; inner plate with 3-4 setae. Setation of maxilla 2 ordinary. In-

ner plate of maxillipeds ordinary; apex of palp article 3 not protuberant, dactyl elongate, apical nail distinct, medium. Gnathopods enlarged, gnathopod 2 strongly enlarged; article 5 of gnathopods 1-2 of ordinary length but almost cryptic on gnathopod 2, without eusirid attachment; palms transverse, hands of gnathopods 1-2 rectangular, broadened, poorly setose anteriorly. Article 2 of pereopod 3 of broad form, articles 4-5 of pereopods 3-4 broad to medium, article 2 of pereopods 3-4 not setose posteriorly; pereopod 5 ordinary, article 2 naked ventrally, article 3 ordinary, dactyl normal. Epimera 1-2 bearing few short posterior setae, without midfacial setae above ventral facial ridge; epimeron 3 ordinary. Urosomite 1 with small lateral facial spines, lacking midventral bundles of setae, with sparse apicoventral setae or spines near base of uropod 1; urosomite 3 without dorsal hook or special process. Peduncle of uropod I normally elongate, without apicoventral spike, without special enlarged apicolateral-medial spine; peduncular apices of uropods 1-2 not combed; inner ramus of uropod 1 with marginal spines in one row, no rami continuously spinose to apex; inner ramus of uropod 2 shortened, partially fused to peduncle. Uropod 3 small, rami in female not longer than peduncle, article 2 of outer ramus very small, carrying 2 long apical setae. Telson ordinary to short, with only one apical spine on each lobe plus setules.

DESCRIPTION.—Rostrum constricted, small. Antenna l especially thin; fuzz on article 1 of antenna l in male present; calceoli on male primary flagellum of antenna l present. Calceoli on article 5 of male antenna 2 present; flagellum in male with calceoli. Prebuccal parts strongly bulging forward, distinct, neither epistome nor upper lip dominant. Right lacinia mobilis bifid, thin; mandibular palp thin, article 1 slightly elongate, article 2 with outer

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setae, apex of article 3 oblique. Lower lip bearing cones. Outer plate of maxilla 1 with 11 spines, one spine especially thickened. Inner plates of maxilliped thick, ordinarily setose. Coxae 2-3 elongate, coxae 2-4 without special anterodorsal humps, one ventral seta on coxae 1-3 especially thick. All posterior spines on article 6 of pereopods 1-2 thick and stiff, midapical seta present. Article 2 of pereopod 5 without facial setae. Peduncle of uropod 1 with dorsolateral spines confined apically, medial spines widely spread; peduncle of uropod 2 with only one medial spine confined apically. Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with ordinary pair of midlateral or dorsal setules on each side.

TYPE-SPECIES.—Matong matong, new species. Composition.—Unique.

RELATIONSHIP .- Matong differs from Pontharpinia in the elongate article 2 of antenna 1, the presence of cones on the lower lip, the reduction of setules on the face of article 3 on antenna 2 to the normal 2 in number, the normal fully biramous right lacinia mobilis, the nontriturative molar, the presence of posteroproximal setae on article 5 of pereopods 1-2, and the shortened rami of uropod 3. In addition, Matong differs in these secondary characters: absence of dorsal setae on article 4 of antenna 2, enlarged article 5 of antenna 2, thin mandibular palp, reduction of setae to 4 on inner plate of maxilla 1, development of 2 stout spines on the inner plate of the maxilliped, fully discrete nail on dactyl of maxilliped, apical confinement of dorsolateral spines on peduncle of uropod 1, loss of supernumerary setae on dactyl of pereopod 5, on peduncle of uropod 3, on article 2 of pereopods 3-4, on the telson, on urosomite 1, and the normal phoxocephalid telson with apical spines and dorsolateral pairs of setules.

Matong differs from Mandibulophoxus and Basuto in the elongate article 2 of antenna 1, the absence of a special spine on the peduncle of uropod 1, the well developed molars, the elongate wrist of gnathopod 2, and the short rami of uropod 3.

Matong has almost reached the evolutionary grade of Birubius except that it retains enlarged gnathopods. Matong differs from Birubius also in the shortened rami of uropod 3, the rudimentary fusion of the inner ramus of uropod 2 to the peduncle, the more apically placed ventral setae on article 2 of antenna 1, and the slightly developed, but clearly

present, posterior setae on epimera 1-2.

Matong matong, new species

FIGURES 61-64

Paraphoxus sp., Australia, J. L. Barnard, 1960:285-286.

DESCRIPTION OF FEMALE.—Head about 17 percent of total body length, greatest width about 90 percent of length; rostrum almost unconstricted, broad, short, exceeding apex of article 1 on antenna 1. Eyes medium, clear of pigment. Article 1 on peduncle of antenna 1 about 1.4 times as long as wide, about 2.3 times as wide as article 2, ventral margin with about 6 setules and spinule, unproduced dorsal apex with 3 setules; article 2 about 0.95 times as long as article 1, with apicoventral cycle of 4 setae; primary flagellum with 9 articles, about 0.75 times as long as peduncle, aesthetascs poorly developed; accessory flagellum short, with 5 articles. Spine formula on article 4 of antenna 2 = 1-3-4-3 or 1-3-4-4, dorsal margin without notch, bearing one seta, ventral margin with 6 groups of 1-2 long to medium setae, one ventrodistal long spine; article 5 about 0.8 times as long as article 4, facial spine formula = 1-2-2-1, dorsal margin naked, ventral margin with 4 sets of 1-2 long to short setaspines, 3 ventrodistal long spine-setae; flagellum about 0.75 times as long as articles 4-5 of peduncle combined, with 9 articles. Mandibles with weak palpar hump; right incisor with 3 teeth; left incisor with 5 humps in 2 branches; right lacinia mobilis bifid, distal branch much shorter than proximal, distal branch narrow, simplé, pointed, proximal branch simple, pointed, with marginal denticles; left lacinia mobilis with 4 teeth; right rakers 9 plus 2 rudimentaries; left rakers 10; molar in form of elongate plaque, right molar with 6 long to medium spines, two short spines weakly disjunct, left molar with 4 long to short spines, none disjunct, each molar with plume; palp article 1 short, article 2 with one long inner apical seta and 3 other long and short inner setae, plus one outer seta, article 3 almost 0.95 times as long as article 2, oblique apex with 7-8 spine-setae, basofacial formula = 2-2 or 1-2. Inner plate of maxilla 1 enlarged, bearing one long apical pluseta, one shorter similar apicomedial seta, 1-2 apicolateral much shorter setae; palp article 2 with 6 apical-medial marginal spines and setae. Plates of maxilla 2 extending equally, outer

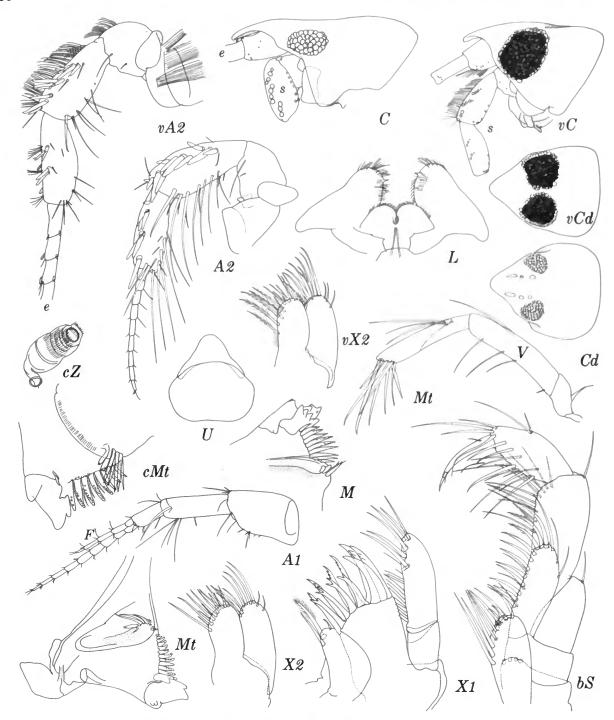


FIGURE 61.—Matong matong, new species, holotype, female "a," 6.50 mm (b = female "b," 6.45 mm; c = male "c," 4.80 mm; v = male "v," 4.70 mm).

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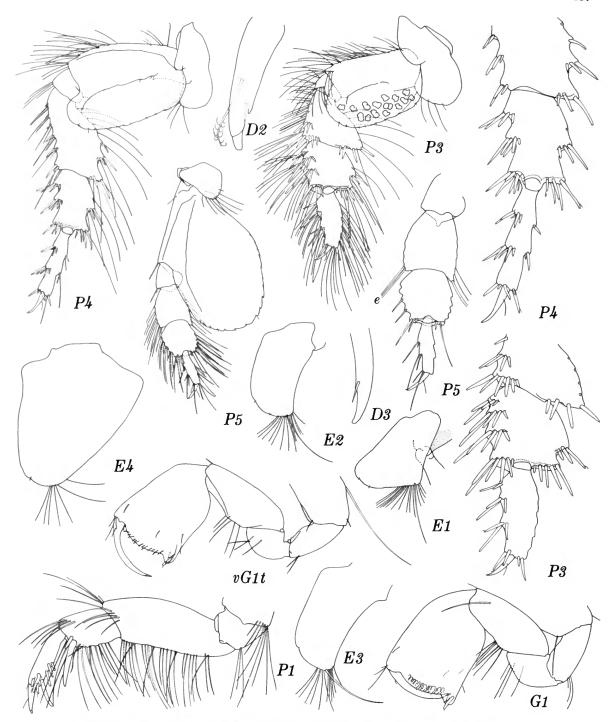


Figure 62.—Matong matong, new species, holotype, female "a," 6.50 mm (v = male "v," 4.70 mm).

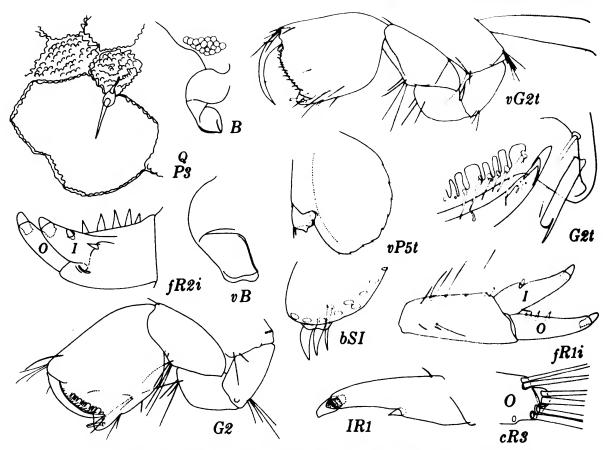


FIGURE 63.—Matong matong, new species, holotype, female "a," 6.50 mm (b = female "b," 6.45 mm; c = male "c" 4.80 mm; f = female "f," 6.80 mm; v = male "v," 4.70 mm).

slightly narrower than inner, with 2 apicolateral setae, inner with one medial seta. Inner plate of maxilliped with 2 large, thick apical spines, 3 apicofacial setae, 5 medial setae; outer plate with 11+ medial and apical spines, 3 apicolateral setal spines; palp article 1 with apicolateral seta, article 2 with one apicolateral seta, medial margin of article 2 moderately setose, article 3 unprotuberant, with 4 facial setae, 2 lateral setae, nail of article 4 medium, with 2 accessory setules. Coxa 1 strongly expanded distally, anterior margin weakly concave; main ventral setae of coxae 1-4 = 15-15-13-7, posteriormost seta of coxae 1-3 shortened, one middle seta especially stout; anterior and posterior margins of coxa 4 strongly divergent, posterior margin very oblique, almost straight, posterodorsal corner rounded, posterodorsal margin short, almost straight, widthlength ratio of $\cos 4 = 16:19$. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 4-5-4-5, long anteriors = 1-6-0-0, short anteriors 4-3-5-2, no others. Gnathopods enlarged, hands quadriform, gnathopod 1 sub-eusirid, article 3 slightly elongate on both pairs; width ratios of articles 5-6 on gnathopods 1-2 = 28:50 and 31:58, length ratios = 62:66 and 61:74, palmar humps very large, palms transverse; article 5 of gnathopod 1 ovate, posterior margin rounded-flat; article 5 of gnathopod 2 ovate, posterior margin rounded, short. Pereopods 1-2 similar, facial setae formula on article 4 = 5-6 and 5, on article 5 = 4 and 6, main spine of article 5 extending to M. 75 on article 6, article 5 lacking proximoposterior spines; spine formula of article 6 = 3 + 4 and 4 + 4 plus middistal seta, acclivity on inner margin of dactyls of pereopods 1-2 sharp, produced as tooth, emergent setule short, midfacial plusetae very long. Coxae 5-7 NUMBER 245

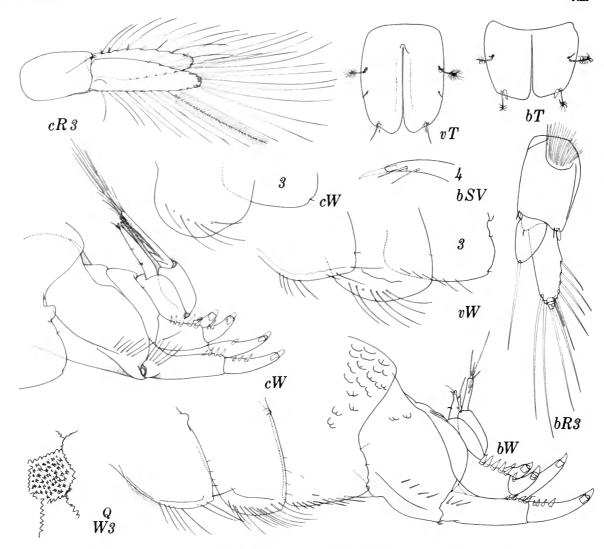


FIGURE 64.—Matong matong, new species, holotype, female "a," 6.50 mm (b = female "b," 6.45 mm; c = male "c," 4.80 mm; v = male "v," 4.70 mm).

posteroventral seta formula = 6-4-8. Articles 4-5 of pereopods 3-4 of ordinary width, facial spine rows moderately developed, facial ridge formula on article 2 of pereopods 3-5=1-2-2, width ratios of articles 2, 4, 5, 6 of pereopod 3=45:40:34:16, of pereopod 4=53:31:27:11, of pereopod 5=70:21:22:7, length ratios of pereopod 3=68:34:33:39, of pereopod 4=80:54:40:47, of pereopod 5=100:26:24:21; article 2 of pereopod 5 reaching apex of article 4, most posterior of ventral setules often slightly elongate; medial apex of article 6 finely combed,

bearing 3 digital processes. Posteroventral corner of epimeron 1 subquadrate, weakly produced, posterior margin weakly convex, setulose, corner with seta, anteroventral margin with 5 long setae, posteroventral margin with 2 long setae; posteroventral corner of epimeron 2 rounded, quadrate, with posterior margin weakly setulose, facial setae = 9-12, fully spread, or occasional 1-2 pairs set vertically; posteroventral corner of epimeron 3 weakly protuberant, with setule sinus and small tooth, posterior margin weakly convex, with 2 setule notches and

posterodistal seta set in weak notch, ventral margin with 8-9 setae evenly spread, face with 1-3 setae near ventral margin in middle. Urosomite 1 with 3 ventral setules at base of uropod 1, row of 4 short facial setae, articulation line complete; urosomite 3 protuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, outer ramus of uropod 1 with 4 dorsal spines, inner with one, outer ramus of uropod 2 with 1-2 dorsal spines, inner with one dorsomedial spine; peduncle of uropod 1 with 4 apicolateral spines and 3-6 basofacial short setae, medially with 4-5 marginal setae plus apical short, stout spine; peduncle of uropod 2 with 4-5 dorsal spines, and 0-1 basofacial seta, medially with one small apical spine. Peduncle of uropod 3 with one ventral setule, dorsally with lateral spine and setule, 2 medial setules; rami feminine, inner extending to M. 55 on article 1 of outer ramus, apex with one seta, medial and lateral margins naked, article 2 of outer ramus short, 0.09, bearing 2 long setae, apicomedial margin of article 1 with 2 setae, lateral margin with 4 acclivities, setal-spine formula = 1-1-1-1-2, setal formula = 0. Telson short, length-width ratio = 25:32, not fully cleft, each apex wide, obliquely truncate, lateral acclivity absent, bearing ordinary lateral setule, spine next medial shorter than setule, midlateral setules diverse. Cuticle with bulbar setules on edges of clear spaces in midst of dense polygonal structure, emergent setules especially long.

OBSERVATIONS (female).—Armament formulas on article 1 of outer ramus on uropod 3, female "g," setae = 1-1-1-1-2 or 1-2-2; female "f," setae = 1-1-3, spines = 0-1-0; uropod 1 with mediobasal setae on peduncle.

DESCRIPTION OF MALE (male "v," 4.70 mm, damaged).—Eyes enlarged, causing extreme lateral protuberance of head. Article 1 of antenna 1 with medial patch of fuzz; primary flagellum with 9 articles, one calceolus each on articles 2–5; accessory flagellum with 5 articles. Spine formula on article 4 of antenna 2 = 3-4-4, on article 5 = 2-2, dorsal margin of article 5 with 3 sets of male setae and 2 calceoli, ventral apex with 2 thin spine-setae; flagellar formula =?, 2-4, 6, $8 \dots 26$ (broken), or?, 2-5, 7, $9 \dots 25$ (broken). Ventral margin of upper lip slightly more excavate than in female. Distal branch of right lacinia mobilis broadened, subbifid; rakers 8 on each side; right molar spines 8, left 7, no plume on left; right basofacial palp arti-

cle 3 = 2-2, left = 2-3. Inner plate of maxilla 2 with 4 setae, 2 large, 2 small. Maxilla 2 with 3 medial setae on inner plate; 3 apicolateral setae on outer plate. Palp article 4 of maxilliped with only one accessory setule. Gnathopods slightly thinner than in female. Article 2 of only pereopod 5 narrower than in female. Epimera 1-3 broadened but not protuberant posteriorly; posterior margin of epimeron 3 not shortened; setal formulas, epimeron 1 anteroventral = 5, posteroventral = 3, epimeron 2 facial = 7-8, epimeron 3 posterior = 2 setules, ventral = 6. Urosomite 1 with 6 faciolateral setae, no ventral setules. Spine formulas of uropods, uropod 1 peduncle apicolateral = 4, basofacial = 5, longer than in female, uropod 2 peduncle dorsal = 5, basofacial = 1, dorsal spines on outer ramus of uropod 1 = 3, of uropod 2 = 2, inner ramus of uropod 1 = 1, of uropod 2 = 1; ventral spines on peduncle of uropod 3 = 0, spine formula on article 1 of outer ramus = 1-1-0-1-0-1-0-0, setal formula = 1-1-1-1-1-1-2, article 2 of outer ramus vestigial. Telson elongate, distal spines scarcely shortened, thin, each lobe with supernumerary lateral setule and row of dorsal denticles.

OBSERVATIONS (male).—Right epimeron 3 of male "v" lacking ventral setae.

DESCRIPTION OF JUVENILE (juvenile female "h," 4.86 mm).—Spine formula on article 4 of antenna 2 = 1-3-4-4, on article 5 = 1-2-2; spine formulas, peduncle of uropod 1 = 3, basofacial = 2, outer ramus = 3, uropod 2 peduncle = 3. outer ramus = 1; setal formulas, epimeron 1 anteroventral = 2, posteroventral = 2, epimeron 2 facial = 5, epimeron 3 ventral = 3, no facial; outer ramus of uropod 1 with setal formula of 1-2 on article 1, inner apex with one seta, apical seta on inner ramus very short, only as long as article 2 of outer ramus (including immersed part of article 2).

ILLUSTRATIONS.—Male "v", on dorsal view of head rostrum not fully extended because of downward curve; right eye damaged; epimeron reconstructed, right epimera 2-3 apparently aberrant, epimeron 2 extending greatly ventrad, epimeron 3 asetose, left epimera apparently normal as illustrated.

HOLOTYPE.—NMV, female "a," 6.50 mm.

TYPE-LOCALITY.—CPBS 32N/866, 25 Aug 1966, Western Port, Victoria, Australia, 13.3 m, sandy gravel.

Voucher Material.—CPBS C3/4: female "b,"

6.45 mm (illus.). CPBS A2/2: subadult male "c," 4.80 mm (illus.). PPBES 126: male "v," 4.70 mm (illus.). PPBES 928/4: female "f," 6.80 mm (illus.); female "g," 7.45 mm; juvenile female "h," 4.86 mm.

MATERIAL.—CPBS, 28 samples from 14 stations (49); PPBES, 6 samples from 4 stations (8); WPBES, one sample from one station (1); AM, one sample ("Type" of *Birubius batei*, type erroneous) (2).

DISTRIBUTION.—Victoria: Port Phillip Bay and Western Port, 8–19.2 m, sand, muddy sand. New South Wales: Port Jackson.

Kotla, new genus

Diagnosis.—Eyes present. Flagella of antennae 1-2 unreduced in female. Article 2 of antenna 1 elongate, ventral setae confined almost apically. Article 1 of antenna 2 not ensiform; article 3 with 2 setules; facial spines on article 4 in 3 or more rows; article 5 ordinary in size. Right mandibular incisor with 3 teeth; molar not triturative, ordinary, medium, pillow-shaped, bearing 4 or more splayed, semiarticulate spines, usually bearing fuzz; palpar hump small. Palp of maxilla 1 biarticulate; inner plate with 4 setae. Setation of maxilla 2 ordinary. Inner plate of maxillipeds ordinary; apex of palp article 3 not strongly protuberant, dactyl elongate, apical nail distinct, elongate. Gnathopods similar, weakly to moderately enlarged; article 5 of gnathopods free, elongate, with weak eusirid attachment; palms almost transverse, hands of gnathopods broadened, poorly setose anteriorly. Article 5 of pereopods 1-2 with posteroproximal setae. Article 2 of pereopod 3 of broad form, artticles 4-5 of pereopods 3-4 broad to medium, article 2 of pereopods 3-4 not setose posteriorly; pereopod 5 ordinary, but articles 4-6 enlarged, article 2 naked ventrally except for one elongate setule, article 3 ordinary, dactyl normal. Epimera 1-2 bearing large vertical facial brushes of setae; epimeron 3 ordinary. Urosomite I generally naked except for sparse apicoventral setae or spines near base of uropod 1; urosomite 3 without dorsal hook or special process. Peduncle of uropod 1 normally elongate, without apicoventral spike, without special enlarged apicolateral-medial spine; peduncular apices of uropods 1-2 not combed; inner ramus of uropod 1 with marginal spines in one row, no rami continuously spinose to apex, inner ramus of uropod 2 fused to peduncle. Uropod 3 small, article 2 of outer ramus vestigial, carrying 2 medium apical setae. Telson ordinary, with only one apical spine plus setule, without special dorsal and lateral spines or setae.

Description.—Rostrum constricted, obsolescent. [Fuzz on article 1 of antenna 1 in male unknown, calceoli on male antenna 1 and antenna 2 unknown.] Prebuccal parts ordinary, distinct, upper lip dominant. Right lacinia mobilis bifid, thin; mandibular palp thin, article 1 slightly elongate, article 2 without outer setae, apex of article 3 oblique. Lower lip bearing cones. Outer plate of maxilla I with 11 spines, one spine especially thickened. Inner plates of maxilliped ordinarily setose. Coxae 1-4 very short, without special anterodorsal humps. All posterior spines on article 6 of pereopods 1-2 thick and stiff, midapical seta present. Article 2 of pereopod 5 without facial setae. Peduncle of uropod 1 with dorsolateral spines widely spread, medial spines confined apically, peduncle of uropod 2 with medial spine or setule absent. Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with ordinary pair of midlateral or dorsal setules on each side.

Type-Species.—Kotla batturi, new species. Composition.—Unique.

RELATIONSHIP.—This genus appears to be descendant from ancestors near *Matong*, new genus. The resemblance is strong in the following characters: thin article 2 of antenna 1 with ventral setae shifted apically, short rami and elongate peduncle of uropod 3, broadened hands of gnathopods, stubby rami of uropod 2, and truncate apices of telson. *Kotla* differs from *Matong* in the fully fused inner ramus of uropod 2, the jewel-like spines on uropod 2, the large vertical brushes of setae on epimera 1–2, the short coxae, the almost fully spread dorsolateral spination on the peduncle of uropod 1, the loss of basomedial setation on the peduncle of uropod 1 and the loss of major teeth on the left lacinia mobilis.

Kotla batturi, new species

FIGURES 65-67

DESCRIPTION OF FEMALE.—Head about 15 percent of total body length, greatest width about 100 percent of length; rostrum obsolescent, scarcely reaching along article 1 on antenna 1. Eyes large, stained ochraceous, clear of occluding pigment. Article 1 on

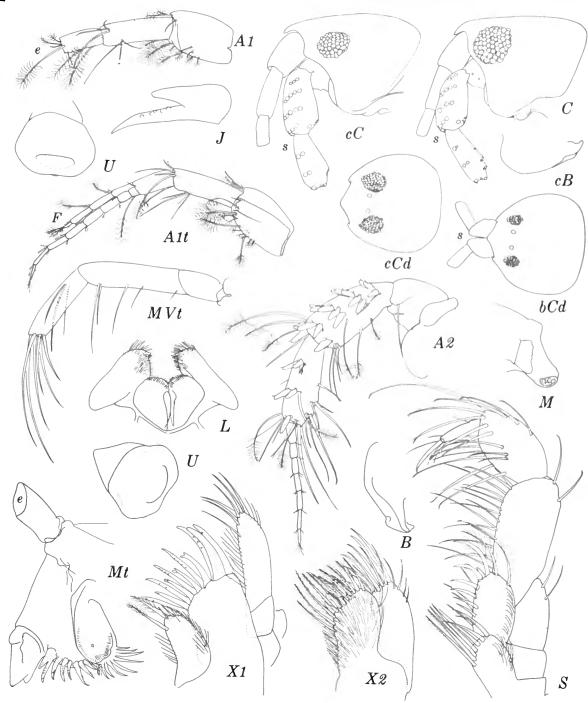


FIGURE 65.—Kotla batturi, new species, holotype, female "a," 5.10 mm (b = female "b," 4.25 mm; c = male "c," 4.33 mm).

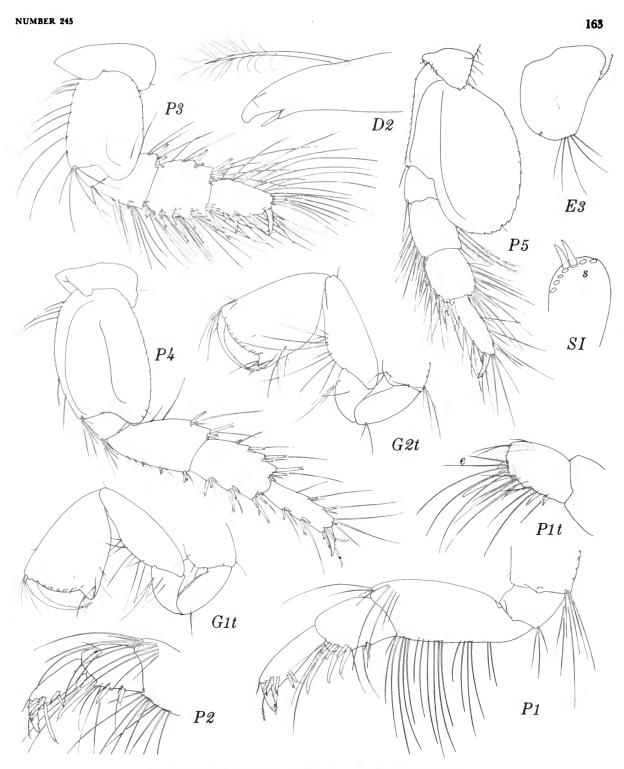


FIGURE 66.—Kotla batturi, new species, holotype, female "a," 5.10 mm.

peduncle of antenna 1 about 1.5 times as long as wide, about twice as wide as article 2, ventral margin with about 9 setules, weakly produced dorsal apex with 3-4 setules; article 2 about 1.1 times as long as article 1, with ventral cycle of 3-4 setae near apex; primary flagellum with 8 articles, about 0.85 times as long as peduncle, bearing aesthetascs; accessory flagellum with 4 articles. Spine formula on article 4 of antenna 2 = 1-3-5-5-4 or 1-3-5-5-3 or 1-4-5-5-3, dorsal margin naked, ventral margin with apical group of 4 medium setae, one ventrodistal short spine and brush of large mediodorsal setules; article 5 about 0.9 times as long as article 4, facial spine formula = 2-2, dorsal margin bearing setule, ventral margin with 3 sets of 1-3 long to medium spines, 3 ventrodistal long setae, one subdistal facial spine; flagellum about 0.65 times as long as articles 4-5 of peduncle combined, with 7 articles. Mandibles with weak palpar hump; right incisor with 3 teeth; left incisor with 3 humps in 2 branches; right lacinia mobilis bifid, distal branch much shorter than proximal, narrow, pointed, denticulate, proximal branch simple, pointed, with marginal denticles; left lacinia mobilis with obsolescent tooth notches; right rakers 6 plus one rudimentary; left rakers 7 plus one rudimentary; molar in form of elongate plaque, bulbous, right molar with 8-9 long to medium spines, none disjunct, left molar with 8 long to medium spines, one of these weakly disjunct, each with plume; palp article 1 elongate, article 2 with pair of long to medium inner apical setae and 3 other long and short inner setae, article 3 about 0.8 times as long as article 2, scarcely oblique apex with 6 spine-setae, basofacial formula = 1-2. Inner plate of maxilla 1 ordinary, bearing one long apical pluseta, one similar apicomedial seta, 2 apicolateral much shorter setae; palp article 2 with 6 apicalmedial setae. Plates of maxilla 2 extending subequally, outer much narrower than inner, outer with 4 apicolateral setae, inner with 3 medial setae. Inner plate of maxilliped with 2 large thick apical spines, 3 apicofacial setae, 4 medial setae; outer plate with 7 medial and apical spines, 2 apicolateral setae, one apical cone; palp article 1 with 2 apicolateral setae, article 2 with 2 apicolateral setae, medial margin of article 2 moderately setose, article 3 with 5 facial setae, 3 lateral setae, nail of article 4 long, with 3 accessory setules. Coxa 1 scarcely expanded distally, anterior margin almost straight; main ventral setae of coxae 1-4 = 3-4-5-3 or 3-34-2, posteriormost seta of coxae 1-3 slightly shortened; anterior and posterior margins of coxa 4 strongly divergent, posterior margin very oblique, straight, posterodorsal corner rounded, posterodorsal margin long, undulant, width-length ratio of coxa 4 = 37:32. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 7-10-(8-9)-(10-11), short anteriors = 1-0-(2-4)-3, long anteriors = 4(+3 facial)-3-0-0, short anteriors = (3-4)-(3-4)-7-(8-9), no others. Gnathopods with stout hands, article 3 elongate, width ratios of articles 5-6 on gnathopods 1-2 = 24:48 and 28:48, length ratios = 75:72 and 75:71; palmar liumps large, palms weakly oblique; article 5 of gnathopods 1-2 elongate, ovate, posterior margin rounded. Percopods 1-2 similar; facial setae formula on article 4 = 4-5 and 5-6, on article 5 = 2-3 and 2-4; main spine of article 5 extending to M. 80 on article 6, article 5 with 2-3 proximoposterior spines; spine formula of article 6 = 4 + 3 or 3 + 3 plus middistal seta, most spines especially short, acclivity on inner margin of dactyls of pereopods 1-2 sharp, produced as tooth, emergent setule long, stout, midfacial pluseta long, dactyls short and stout. Coxae 5-7 posteroventral setule formula = 2-2-7. Articles 4-5of pereopods 3-4 of ordinary width, facial spine rows medium to sparse respectively, facial ridge formula on article 2 of pereopods 3-5 = 1-2-2, that on pereopod 3 very short; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 49:36:38:23, of pereopod 4 = 58:34:32:16, of pereopod 5 = 75:29:28:13, length ratios of pereopod 3 = 70:31:37:43, of pereopod 4 = 90:55:52:50, of pereopod 5 = 108:36:33:43; article 2 pereopod 5 reaching middle of article 4; medial apex of article 6 smooth. Posteroventral corner of epimeron 1 rounded, posterior margin almost straight, with setule, anteroventral margin with 4-9 short setae, posterior face with vertical row of 11-15 long setae, ventralmost weakly disjunct; posteroventral corner of epimeron 2 weakly protuberant, guarded by setule sinus, posterior margin weakly convex, with 2 setule notches, facial setae = 3-5 in horizontal disarray plus upper vertical row of 5-7 long setae, facial ridge absent; posteroventral corner of epimeron 3 rounded, weakly protuberant, with setule sinus, posterior margin convex, with setule notches above and below corner, ventral face with horizontal group of 5-7 setae in disarray near ventral margin in middle. Urosomite 1 with one lateral and 2 ventral setules at base of uropod 1, NUMBER 245 165

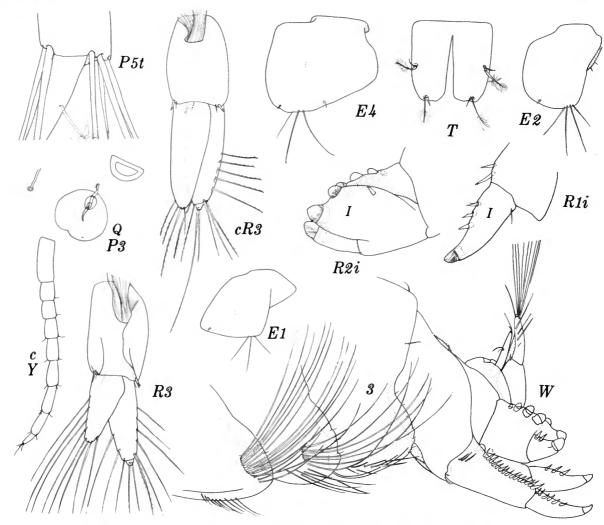


FIGURE 67.—Kotla batturi, new species, holotype, female "a," 5.10 mm (c = male "c," 4.33 mm; Y = flagellum of antenna 2).

articulation line complete; urosomite 3 strongly protuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, outer ramus of uropod 1 with 5-6 dorsal spines, inner with 3, outer ramus of uropod 2 with 2 dorsal spines, inner with 2 dorsal spines, one thin and one jewel like, all other spines of uropod 2 jewel-like, inner ramus fused to peduncle, uropod 2 very thick, peduncle of uropod 1 with 14-15 dorsolateral spines and 3 short basofacial setae, medially with 2 apical spines in tandem, peduncle of uropod 2 with 4 dorsal spines, medially naked (fused). Peduncle of uropod 3 with one ventral setule, dorsally with one lateral spine,

one medial spine; rami not longer than peduncle, submasculine, inner extending to M. 80 on article 1 of outer ramus, apex with 3 setae, medial margin setose, article 2 of outer ramus short, 0.07, bearing 2 medium setae, medial margin of article 1 with 3 setae, lateral margin with 4 acclivities, spine formula = 0, setal formula = 1-1-1-2. Telson ordinary, length-width ratio = 1:1, not fully cleft, each apex wide, truncate, lateral acclivity absent, bearing long lateral setule, spinule or setule next medial shorter, no spines, midlateral setules diverse. Cuticle with bulbar setules mixed with 5-10 times as many pipes, setules surrounded by cordate plaques,

pipes emerging as hemicylinders, setules ordinary.

DESCRIPTION OF MALE (very young male "c," 4.33 mm).-Like female (but because of youth with much smaller eyes). Antenna l similar to female, no medial fuzz. Antenna 2 stouter, flagellum slightly longer, articles thick, articles 4-5 with similar spine formula. Setal formula of coxae 1-4 = 2-3-4-2. Epimeron 1 with 6 anteroventral setae and 12 setae in posterior brush (one seta disjunct); epimeron 2 with 6 setae in brush and 3 horizontal setae in tandem; epimeron 3 slightly elongate anteroposteriorly, with 4 setae in tandem, posteroventral corner with 3 small teeth and 4 setule-notches. Uropod 1 with 3 basofacial setae, 16 peduncular spines, outer ramus with 6 spines, inner ramus with 2; uropod 2 like female holotype. Inner ramus of uropod 3 elongate, as long as outer ramus but poorly setose, 5 lateral setae of outer ramus not plumose but with short scales.

OBSERVATIONS.—Ventral setules on article 4 of antenna 2 large and placed more distally than normal; accessory setules between rakers on mandibles absent; dactyls of gnathopods apically flagellate. The absence of facial setae on article 5 of pereopod 1 and the presence of an extra pair of posterior spines are aberrations in the holotype. The holotype female is almost senilic in light of these aberrations and in the view of the well developed eyes and head; see lateral view of male head also typical of normal females.

ILLUSTRATIONS.—Dorsal view of holotype head not illustrated because of damage; thick apical spines on inner plate of maxilliped shown in Figure 66: SI. HOLOTYPE.—NMV, female "a," 5.10 mm.

Type-Locality.—CPBS 600/5, 29 Mar 1965, Western Port, Victoria, Australia, 18.3 m, sand, silt. Voucher Material.—CPBS 600/3; female "b," 4.25 mm (illus.); male "c," 4.33 mm (illus.); female "d," 4.80 mm.

MATERIAL.—CPBS, 3 samples from 2 stations (10).

DISTRIBUTION.—Victoria, Western Port, 18.3 m, sand. silt.

Yammacoona, new genus

Diagnosis.—Eyes present. Flagella of antennae 1-2 unreduced in female. Article 2 of antenna 1 ordinary to elongate, ventral setae widely spread. Article 1 of antenna 2 not ensiform; article 3 with

2 setules; facial spines on article 4 in 2 rows; article 5 short. Right mandibular incisor with 3 teeth; molar not triturative, ordinary, pillow-shaped, bearing 4 or more splayed, semiarticulate spines, bearing fuzz; palpar hump medium to large. Palp of maxilla I biarticulate; inner plate with 4 setae. Setation of maxilla 2 ordinary. Inner plate of maxillipeds ordinary, apex of palp article 3 moderately protuberant, dactyl elongate, apical nail distinct, medium. Gnathopods dissimilar, gnathopod 2 moderately enlarged; article 5 of gnathopods 1-2 short, but free, without cusirid attachment; palms oblique, hand of gnathopod 2 broadened, poorly setose anteriorly; article 5 of pereopods 1-2 with posteroproximal spines. Article 2 of percopod 3 of broad form, articles 4-5 of pereopods 3-4 broad, article 2 of pereopods 3-4 not setose posteriorly; pereopod 5 ordinary, article 2 naked ventrally, article 3 ordinary, dactyl normal. Epimera 1-2 lacking numerous long posterior setae, without midfacial setae above ventral facial ridge; epimeron 3 ordinary. Urosomite I generally naked except for sparse apicoventral setae or spines near base of uropod 1; urosomite 3 without dorsal look or special process. Peduncle of uropod 1 normally elongate, without apicoventral spike, without special enlarged apicolateral-medial spine; peduncular apices of uropods 1-2 not combed; spine(s) on inner ramus of uropod 1 in one row, some rami with accessory nails, inner ramus of uropod 2 ordinary. Uropod 3 ordinary, article 2 of outer ramus carrying 2-3 medium to long apical setae. Telson ordinary, with only one apical spine plus setae on each lobe plus setules.

DESCRIPTION.—Rostrum constricted, obsolescent. Fuzz on article 1 of antenna 1 in male present; calceoli on male primary flagellum of antenna 1 present. Calceoli on article 5 of male antenna 2 present; flagellum in male with calceoli. Prebuccal parts strongly extended forward, almost horizontal, especially massive, poorly separated from each other, upper lip dominant. Right lacinia mobilis bifid, flabellate; mandibular palp thin, article 1 highly elongate, article 2 without outer setae, apex of article 3 transverse. Lower lip bearing cones. Outer plate of maxilla 1 with 11 spines, one spine especially thickened. Inner plates of maxilliped especially thin, poorly armed; outer plates small. Coxae 2-4 without special anterodorsal humps. All posterior spines on article 6 of pereopods 1-2 thick and stiff, midapical seta absent. Article 2 of pereopod 5

without facial setae. Peduncle of uropod 1 with dorsolateral spines confined apically, medial spines confined apically; peduncle of uropod 2 with only one medial setule confined apically. Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with ordinary pair of midlateral or dorsal setules on each side.

Type-Species.—Yammacoona kunarella, new species.

Composition.—Unique.

RELATIONSHIP.—Yammacoona appears to have its closest relationship to Matong and Kotla but differs from those genera in many significant characters, as follows: stouter antenna 1 with shorter article 3 and with the ventral setae of article 2 placed proximally; reduction in number of spine rows on article 4 of antenna 2, with a longer main row; enlarged palpar hump on the mandible; smaller plates of the maxillipeds and the protuberant article 3 of the palps; free inner ramus of uropod 2; and, to a greater or lesser extent, the shortened article 5 of gnathopod 2. Yammacoona furthermore differs from Kotla in the absence of vertical setal brushes on the faces of epimera 1-2 but does bear such a brush on epimeron 3; and it differs from Kotla in the narrow apical confinement of the dorsolateral spines on the peduncle of uropod 1 and in the enlarged articles 4-5 of pereopod 5. Though bifid, the right lacinia mobilis is far closer to that of Pontharpinia, lacking that proximal part possibly representing a fused raker spine seen in Matong and Kotla.

The enlarged palpar hump on the mandible suggests that Yammacoona belongs to the Pontharpinia-Mandibulophoxus-Basuto group of genera. The closest similarity seems to occur between Basuto and Yammacoona. A conspicuous resemblance between the two genera occurs in epimeron 3, gnathopod 2 and the short article 5 of antenna 2, but Yammacoona differs in the broadness of article 2 on pereopod 3, the unusual head, smaller mandibular palp, small outer plate of maxilliped, unproduced article 3 of the maxillipedal palp, longer article 2 of antenna 1, completely distinctive coxa 4, and the short article 2 on the outer ramus of uropod 3. Yammacoona is even more remote from Mandibulophoxus than from Basuto.

Yammacoona resembles Pontharpinia in the palpar hump of the mandible, thin articles 4-5 of pereopod 5, short article 5 of antenna 2 and in the gnathopods, but differs in many fundamental char-

acters, among them the simple molar, small outer plate of the maxilliped, weaker mandibular palp, shape of epimeron 3 and coxae 1-4, short article 2 on outer ramus of uropod 3, longer article 2 of antenna 1, shape of the head, nonsetose dactyl of pereopod 5, and absence of continuous spination on the rami of uropods 1-2.

Although gnathopod 2 is enlarged, the wrists of the gnathopods are shortened, article 5 of antenna 2 is shortened and the margins of epimeron 3 are relatively simple. Yammacoona otherwise has few similarities to the Brolgus group of genera and is probably not a product of that group. Some of the differences seen in Yammacoona are the short coxae, distinctive article 2 of antenna 1, large palpar hump on the mandible, absence of combs on uropods 1-2, dissimilarities in pereopods 3-5 and inner plate of maxilla 1, small outer plate of the maxilliped, and the presence of accessory apical nails on uropods 1-2.

Among species of Birubiinae, Yammacoona has the closest resemblance to K. cadgeeus in terms of epimera, uropods 1-2, head, right lacinia mobilis, shape of coxa 4, proximal placement of setae on article 2 of antenna 1, thin articles 4-5 of pereopod 5 and protuberant article 3 of the maxilliped. But Yammacoona differs from K. cadgeeus in the shortened and poorly setose coxae, enlarged gnathopod 2 with short wrist, and in the absence of a hook on urosomite 3.

Yammacoona kunarella, new species

FIGURES 68-71

DESCRIPTION OF FEMALE.—Head about 12 percent of total body length, greatest width about 75 percent of length; rostrum unconstricted, broad, short, antenna 1 attached directly to apex of rostrum. Eyes large, mostly occluded with pigment. Article 1 on peduncle of antenna 1 about 1.45 times as long as wide, about 1.4 times as wide as article 2, ventral margin with 3 apical setules, weakly produced dorsal apex with one setule; article 2 about 0.6 times as long as article 1, with ventral cluster of 3–6 setae on hump; primary flagellum with 9–11 articles, about 0.8 times as long as peduncle, bearing aesthetascs; accessory flagellum with 9–11 articles. Spine formula on article 4 of antenna 2 = 1–3–9 or 1–3–8 or 1–2–9, dorsal margin with notch

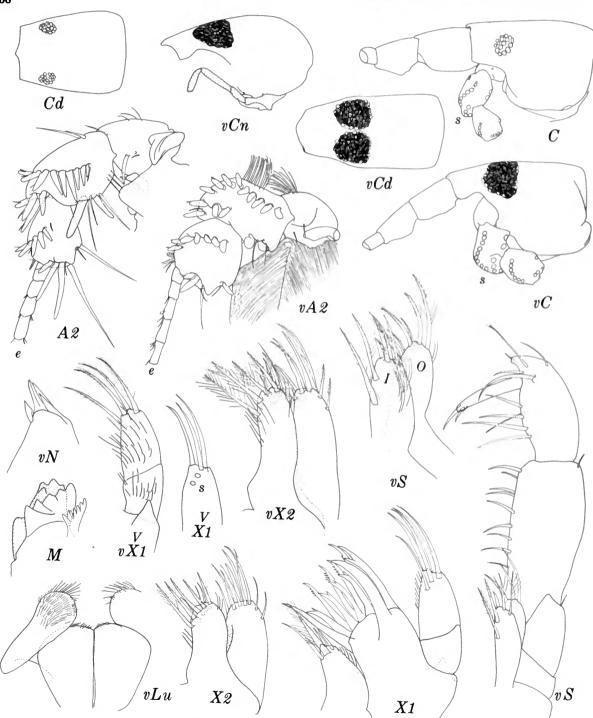


Figure 68.—Yammacoona kunarella, new species, holotype, female "a," 3.46 mm (v = male "v," 3.55 mm; stippled area of vCn = mandible).

bearing 2 spine-setae, ventral marign with 3 medium setae and one spine, one ventrodistal medium spine; article 5 about 0.7 times as long as article 4, facial spine formula = 5 or 4, dorsal margin naked, ventral margin with 2 sets of 2 long and short setae, 3 ventrodistal short to medium spines; flagellum about 1.4 times as long as articles 4-5 of peduncle combined, with 9-11 articles. Mandibles with strong palpar hump; right incisor with 3 teeth; left incisor with 5 humps in 2 branches; right lacinia mobilis bifid, distal branch little shorter than proximal, distal branch flabellate, denticulate, proximal branch flabellate, with marginal denticles and facial humps; left lacinia mobilis with 5 teeth; right rakers 7 plus one rudimentary; left rakers 7 plus 2-3 rudimentaries; molar in form of elongate plaque bearing bulbous fuzzy hump, right molar with 5 medium to short spines plus one short spine strongly disjunct, left molar with 3 medium spines plus one short spine strongly disjunct, each molar with plume; palp article 1 elongate, article 2 with one short inner apical seta and one other shorter inner seta, article 3 about 0.85 times as long as article 2, truncate apex with 6 spine-setae, middorsal formula = 2 spines. Inner plate of maxilla 1 enlarged, bearing one long apical pluseta, one shorter apicomedial seta, 2 much shorter apicolateral setae; palp short and stout, palp article 2 with 5 long apical and subapical setae. Plates of maxilla 2 extending subequally, of equal breadth, outer with 2 apicolateral setae, inner with one medial seta. Inner plate of maxilliped with one apical spine, 2-3 apicofacial setae, 2 medial setae; outer plate very small and almost hidden behind inner plate, with 3-4 medial and apical spines, one apicolateral seta; palp article 1 with apicolateral seta, article 2 elongate, with one apicolateral seta, medial margin of article 2 weakly setose, article 3 strongly protuberant, with one facial seta, one lateral seta, nail of article 4 medium, with 2 accessory setules. Coxae 1-4 short and broad, coxa 1 strongly expanded apically, anterior margin straight; main ventral setae of coxae 1-4 = 1-1-1-0; anterior and posterior margins of coxa 4 strongly divergent, posterior margin very oblique, almost straight, posterodorsal corner rounded, posterodorsal margin short, convex, width-length ratio of $\cos 4 = 1:1$; long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = (2-3)-(2-3)-2-3, short anteriors = (0-1)-(2-3)-(3-6)-(4-5), long anteriors = 0-0-1-0, short an-

teriors = 3-3-5-3, no others. Gnathopod 2 enlarged, hand of gnathopod 1 slightly enlarged; width ratios of articles 5-6 on gnathopods 1-2 = 23:39 and 22:50, length ratios = 47:62 and 34:80; palmar humps very large, palms strongly oblique; article 5 of gnathopod 1 triangular, posterior margin lobate; article 5 of gnathopod 2 short, triangular, lobate, cryptic. Pereopods 1-2 similar; posterior setae on pereopod 1 article 4 mainly apical, on pereopod 2 extending apically to mid mark, in groups 2-2-2-1; facial setae formula on article 4 = 3 and 3, on article 5 = 1 and 2; main spine of article 5 extending to M. 100+ on article 6, article 5 with 3-4 proximoposterior spines; spine formula of article 6 = 3 + 3, no middistal seta, most spines long; acclivity on inner margin of dactyls of pereopods 1-2 sharp, produced as tooth, emergent setule long, midfacial pluseta ordinary. Coxae 5-7 posteroventral setule formula = 3-5-5. Articles 4-5 of pereopods 3-4broad, facial spine rows dense, facial ridge formula on article 2 of pereopods 3-5 = 0-1-2; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 50:50:50:22, of pereopod 4 = 67:58:50:20, of pereopod 5 = 73:18: 17:10, length ratios of pereopod 3 = 78:43:38:45, of pereopod 4 = 85:52:42:48, of pereopod 5 = 105:24: 24:30; article 2 of pereopod 5 exceeding apex of article 5, dactyl weak, medial apex of article 6 smooth, posteroventral corner of epimeron 1 rounded, protuberant, posterior margin weakly sinuous, corner with setule and second setule above, anteroventral margin with 3 medium setae, posteroventral face with 1-2 long setae in vertical pair; posteroventral corner of epimeron 2 rounded, weakly protuberant, guarded by setule sinus, posterior margin weakly convex, facial setae = 5, posteriormost pair or triad set vertically, setae crowded forward; posteroventral corner of epimeron 3 rounded, weakly protuberant, with setule sinus, posterior margin almost straight, face with oblique, almost vertical row of 3-6 setae. Urosomite 1 with ventral setule at base of uropod 1, articulation line complete; urosomite 3 scarcely protuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, inner rami of uropods 1-2 with one accessory nail, outer ramus of uropod 1 with 1-2 dorsal spines, inner with one, outer ramus of uropod 2 with one dorsal spine, inner with no dorsomedial spine; peduncle of uropod 1 with one apicolateral spine and microscopic basofacial setule, medially with marginal setule and apical spine;

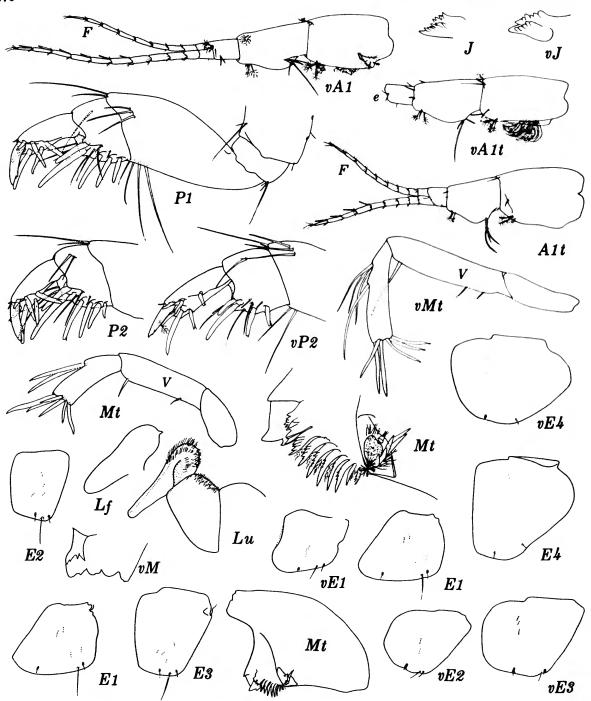


FIGURE 69.—Yammacoona kunarella, new species, holotype, female "a," 3.46 mm (v = male "v," 3.55 mm).

peduncle of uropod 2 with 4-7 dorsal spines, medially with one apical setule; apicolateral corners of peduncles on uropods 1-2 lacking comb. Peduncle of uropod 3 with 2 ventral spines, dorsally with one lateral setule, one medial spine; rami feminine, inner extending to M. 65 or less on article I of outer ramus, apex with one long seta, medial and lateral margins naked, article 2 of outer ramus short, 0.17, bearing 3 long setae, medial margin of article I naked, lateral margin with 3 acclivities, spine formula = 2-2-2-2, setal formula = 0. Telson short and broad, length-width ratio = 7:8, not fully cleft, each apex wide, rounded-truncate, lateral acclivity absent, bearing short lateral setule, spine next medial much longer than setule, set subapically, with adjacent very short medial setule, midlateral setules diverse. Cuticle with ordinary bulbar setules, emergent setules especially short.

OBSERVATIONS (female).—Lateral cephalic lobe thick, anteriorly truncate, strongly extended forward. Apex of each flagellum with short aesthetasc not counted as article. Mouthparts placed highly ventrad, prebuccal complex almost horizontal, strongly extended forward. Molar and spines crowded towards incisor. Article 2 of pereopods 1-2 with additional small posterior straw-shaped setae paired with long members and extending 3-4 in number above long setae. Anterior margin of epimeron 1 with 1-10+ straw-like setules (highly variable), ventral margin with 3-7 straw-like setules; setae on face of epimeron 2 variable, additional variations as follows: 3 vertical and 2 horizontal, or 2 horizontal and 2 vertical, or 4 vertical and one thrust forward horizonally. Basofacial setule on uropod I so small as to be almost invisible.

Description of Male.—Head exceptionally elongate, up to 21 percent of total body length, eyes enlarged, anterior cephalic extension marked off by ventral constriction. Articles 1–2 of antenna 1 of subequal width, article 1 relatively narrower than in female, bearing medioventral patch of long fuzz, article 2 not as strongly humped ventrally as in female, bearing 5 posterior setae in cycle; primary flagellum with 11 articles, terminal members bearing aesthetascs, one calceolus on each of articles 1–7; accessory flagellum 8–9 articulate. Article 3 of antenna 2 with only 2 small facial setules, articles 4–5 greatly broadened, spines short and broad, spine formula of article 4 = 1–3–9, of article 5 = 7, dorsomedial faces of articles 3–4 with

setular fuzz, dorsal margin of article 5 with one calceolus, ventral margin of article 4 with 2 club spines and 2 setules, ventral margin of article 5 with one acclivity bearing spine and setule, ventrodistal margin with 2 spines, seta and setule; flagellum highly elongate, with 30 or 35 articles, one calceolus each on alternate articles, either odd or even, including penultimate article, basally calceoli irregular, for example on articles 3, 4, 6, 8 ... or 3, 6, 8, 10 ... or 3, 5, 7, 9 Raker row of right mandible with 5 spines; left with 4+2rudimentaries; right and left molars with 4 spines + one disjunct; left lacinia mobilis with 4 teeth and supernumeraries; palps with articles 1-3 more elongate than in female, article 1 about 65 percent as long as article 2, latter with 2 small and one large inner setae, article 3 with 2 outer acclivities bearing 1 and 3 spine-setae. Palp of maxilla 1 with 4 apical setae. Plates of maxilla 2 much thinner than in female. Inner plate of maxilliped with only 2 apical setae. Single longer seta on each of coxae 1-3 shorter than in female, coxae much shorter than in female, broader than tall (see illustrations). Long posterior setae of article 2 on gnathopods 1-2 = (2)-(1-2), posterior margin also bearing 6-8 stiff straw-like setae; articles 5-6 of gnathopods of much different proportions from female, both gnathopods with broad article 6 and elongate article 5, length ratios of articles 5-6 of gnathopods 1-2 = 53:68 and 47:68, width ratios = 26:47 and 22:51; article 5 of gnathopod 1 with medium-broad posterior lobe, of gnathopod 2 with narrow protuberant lobe, article 5 almost cryptic on gnathopod 2. Long posterior setae of article 2 on pereopods 1-2=2 and 2 with 10-11 stiff and short straw-like setae lining margin, some of these paired with long setae or occasionally short setae paired together, setal formula of article 4 of pereopods 1-2=3 and 3, of article 5=1 and (0 or rudimentary), article 6 with rows of 3 and 3 spines, anterior margin of article 2 on pereopods 1-2 with up to 18 straw-like setae. Coxa 5 slightly smaller and coxa 6 much smaller than in female; posteroventral setule formula on coxae 5-7 = 1-2-(3-4). Article 6 of pereopods 3-4 more elongate than in female, articles 4-5 narrower, article 2 of pereopod 4 narrower, spine densities much lower; pereopod 5 relatively more elongate and/or thinner than in female, dactyl reduced, anterior margins of article 2 on pereopods 3-5 with dense fuzz composed of stiff,

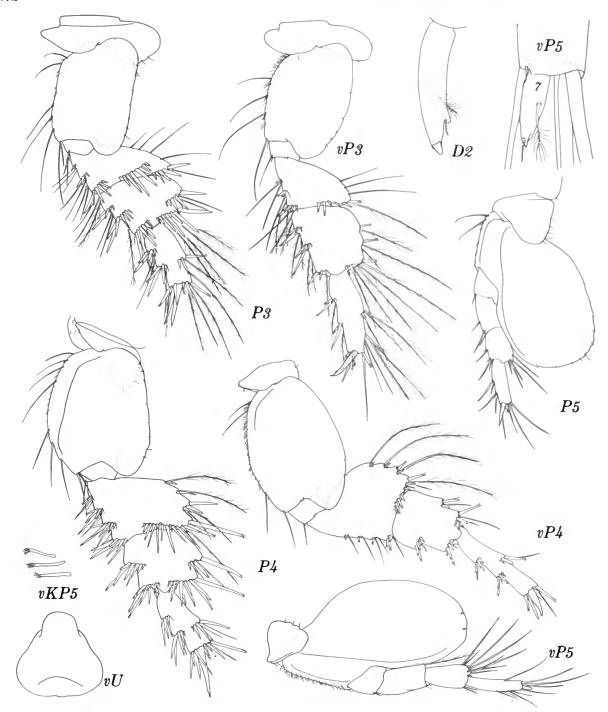


FIGURE 70.—Yammacoona kunarella, new species, holotype, female "a," 3.46 mm (v = male "v," 3.55 mm).

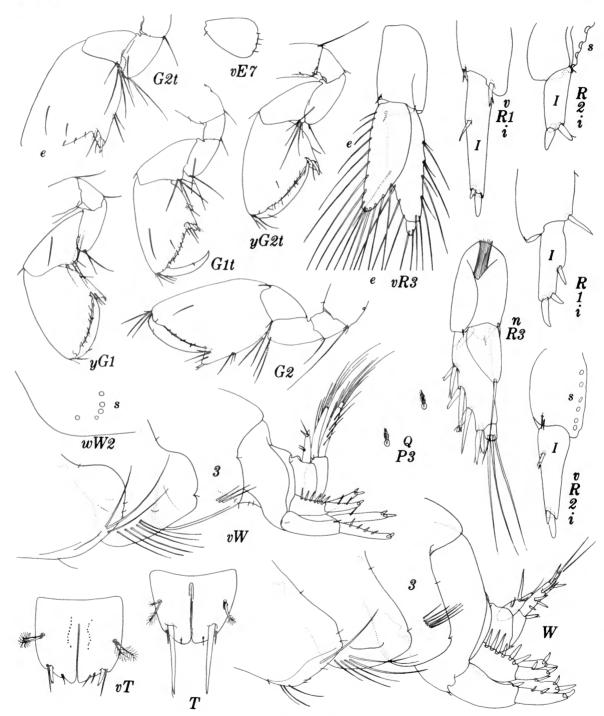


FIGURE 71.—Yammacoona kunarella, new species, holotype, female "a," 3.46 mm (n = female "n," 4.20 mm; v = male "v," 3.55 mm; w = female "w," 4.0 mm; y = male "y," 3.60 mm).

straw-like setules, article 2 of pereopod 4 with only short anterior ridge. Epimera elongate anteroposteriorly, epimeron 1 without distinct ridge (illustration showing 2 artificial folds), with one anteroventral seta and posterior face with vertical row of 2-3 setae, posterior margin strongly bulbous, strawlike setae absent; epimeron 2 with bulbous posterior margin, no lateral ridge, or remnant of ridge, row of 6 setae in weak crescent or 3 horizontal and one highly disjunct seta or in groups of 2-1-1; epimeron 3 with 2 or 3 facial setae set highly ventrad. Basofacial rudimentary setae of uropod 1 somewhat more distinct than in female, outer ramus with 3-4 dorsal spines, inner with one; peduncle of uropod 2 with 3-6 spines, apicomedial corner with only pair of setules, outer ramus with 2 spines, inner ramus of uropod 2 with basomedial spine. Uropod 3 similar to that of terminal female but lacking ventral peduncular spines, dorsally with one lateral, one medial setule; rami of proportions similar to terminal female, inner more strongly setose, spines on acclivities of outer ramus converted to setae, setal formula = 2-2-2-2-2. Telson less cleft than in female, main apical spine on each lobe very short, each lobe with mediodorsal row of denticles.

DESCRIPTION OF JUVENILE (juvenile "u," 2.65 mm).—Generally similar to adult female, but eyes very small; flagella of antenna 1 with 11 primary and 9 accessory articles; spine formula of article 4 on antenna 2 = 1-3-7, article 5 with 4 facial spines; epimeron 1 with one long anteroventral seta, 4 straw-like anterior setules, 2 posterofacial setae (vertical row), epimeron 2 with 3 facial setae (2 horizontal, one thrust), epimeron 3 with 3 setae; uropod 1 peduncle with one spine, outer and inner ramie each with one dorsal spine, peduncle of uropod 2 with 4-5 spines, outer ramus with one, inner lacking dorsal spines; uropod 3 with short inner ramus (as illustrated for large female "n").

Variations.—Female holotype with straw-like setae poorly developed in comparison with other specimens; other females usually of larger body size but female holotype generally with most advanced morphology except in regard to straw-like setae of epimeron 1. Specimens bearing glue-like exudate creating great difficulty in dissecting and mounting parts. Large female "n," 4.20 mm, with juvenoid uropod 3 bearing short inner ramus (see illustration).

ILLUSTRATIONS.—Female: Antenna 1 drawn from medial aspect but description based on observed lateral aspect (as usual); outer lobule of article 2 on antenna 2 not adequately illustrated, poorly preserved or often glued to article 3 by preservational exudate; lower lip of female "n" bearing offset flattened outer lobe; coxae in poor condition, illustrations representing reconstructions; dactyl of maxilliped bearing outer basal short pluseta hidden by other structures; illustration of left pereopod 1 of holotype showing dotted seta on article 5, this seta represented on right pereopod 1 but formed as short spine on left pereopod 1 as shown.

Male: Sketch of head in Figure 68: vCn with antenna 2 removed to show mandible (shaded), remainder of structure being prebuccal complex (note horizontal position of this structure); percopod 3 drawn about 3 percent smaller than percopod 5, percopod 4 drawn about 10 percent smaller than percopod 5; percopods 3-5 larger relative to body than in female.

HOLOTYPE.—NMV, female "a," 3.46 mm.

Type-Locality.—CPBS 32/E2, 19 Feb 1965, Western Port, Victoria, Australia, 12.8 m, sand.

VOUCHER MATERIAL.—Type-locality: female "b," 3.34 mm. RHM: male "v," 3.55 mm (illus.); male "y," 3.60 mm (illus.). CPBS 51N: female "w," 4.0 mm (in 2 pieces, illus). PPBES 979/1: female "n," 4.20 mm (illus.); juvenile "u," 2.65 mm.

MATERIAL.—CPBS, 8 samples from 5 stations (11); RHM, 2 samples from 2 stations (4); PPBES, 3 samples from 2 stations (4); WPBES, 2 samples from 2 stations (3).

DISTRIBUTION.—Victoria: Western Port and Port Phillip Bay, neritic and 12.0–16.5 m, sand, muddy sand.

PARHARPINIINAE

DIAGNOSIS.—Article 2 of antenna 1 ordinary; mandibular molar reduced to a small hump with articulate spines; palp of maxilla 1 biarticulate; setation on maxilla 2 ordinary; gnathopod 2 as small as gnathopod 1; article 2 of pereopod 3 of broad form, tapering distally; pereopod 5 ordinary.

SPECIAL CHARACTERS.—Telson with supernumerary dorsal setae and spines; peduncle of uropod 1 with special apical spine.

DESCRIPTION.—Article 5 of antenna 2 of normal size; epimeron 3 of nonrounded classification;

apices of peduncles on uropods 1-2 combed or not combed.

Type Genus.—Parharpinia Stebbing.
Composition.—Protophoxus K. H. Barnard.

Parharpinia Stebbing

Parharpinia Stebbing, 1899:207; 1906:147.—Barnard and Drummond, 1976:531.

DIAGNOSIS.—Eyes present. Flagella of antennae 1-2 unreduced in female. Article 2 of antenna 1 ordinary, ventral setae widely spread. Article 1 of antenna 2 not or weakly ensiform; article 3 with 2 setules; facial spines on article 4 primarily in one main row; article 5 ordinary in size. Right mandibular incisor with 3 teeth; molar not triturative. small, bearing 4 or more splayed semiarticulate spines, usually bearing fuzz; palpar hump medium. Palp of maxilla 1 biarticulate; inner plate with 4 setae. Setation of maxilla 2 ordinary. Inner plate of maxillipeds ordinary; apex of palp article 3 weakly protuberant, dactyl elongate, apical nail distinct, mostly immersed, short. Gnathopods ordinary, small, similar; article 5 of gnathopods 1-2 of ordinary length, free, without eusirid attachment; palms oblique, hands of gnathopods 1-2 ordinary, ovatorectangular, poorly setose anteriorly. Article 5 of pereopods 1-2 setose posteroproximally; article 2 of pereopod 3 of broad form but tapering distally, articles 4-5 of pereopods 3-4 narrow to medium, article 2 of pereopods 3-4 setose posteriorly; pereopod 5 ordinary, article 2 strongly setose ventrally, article 3 ordinary, dactyl normal. Epimera 1-2 bearing numerous long posterior setae, without midfacial setae above ventral facial ridge; epimeron 3 ordinary. Urosomite 1 generally naked except for sparse apicoventral setae or spines near base of uropod 1; urosomite 3 without dorsal hook or special process. Peduncle of uropod 1 normally elongate, without apicoventral spike, with special enlarged apicomedial spine; peduncular apices of uropods 1-2 not combed; inner ramus of uropod 1 with marginal spines in one row, no rami continuously spinose to apex, inner ramus of uropod 2 ordinary. Uropod 3 ordinary, article 2 of outer ramus carrying 2-4 short to medium apical setae. Telson with 2 or more apical spines or setae on each lobe plus setules, with special dorsal and lateral spines or setae.

Description.—Rostrum fully developed, unconstricted to constricted. Fuzz on article 1 of antenna l in male present; calceoli on male primary flagellum of antenna l absent as far as known. Calceoli of male antenna 2 absent as far as known. Prebuccal parts ordinary, poorly separated from each other, upper lip dominant. Right lacinia mobilis bifid, thin; mandibular palp thin, article 1 short, article 2 without outer setae, apex of article 3 oblique. Lower lip bearing cones. Outer plate of maxilla 1 with 11 spines, one spine especially thickened. Inner plates of maxilliped thick, ordinarily setose. Coxae 2-4 with weak anterodorsal humps. All posterior spines on article 6 of pereopods 1-2 thick and stiff, midapical spine present. Article 2 of pereopod 5 without facial setae, bearing only one ridge. Peduncle of uropod 1 with dorsolateral spines confined apically, medial spines widely spread; peduncle of uropod 2 with only one medial setule confined apically. Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with ordinary pair of midlateral or dorsal setules on each side.

Type-Species.—Phoxus villosus Haswell, 1879 [original designation].

Composition.—Parharpinia warte, new species.

RELATIONSHIP.—Parharpinia bears the special apicomedial spine on the peduncle of uropod 1 and the shortened article 2 of antenna 1 as in Pontharpinia but in almost all other characters (except telson, epimera 1-2 and article 2 of pereopod 3) it resembles Birubius. It differs from Birubius in the special spine on uropod 1, the short article 2 of antenna 1 with especially widespread setation, the posteriorly setose epimera 1-2, the tapering article 2 of pereopod 3, the posteriorly setose article 2 of pereopods 3-4, and the presence of supernumerary dorsal and apical spination and setation on the telson. The facial spines on article 4 of antenna 2 are mostly condensed into one main row in contrast to Pontharpinia and Birubius. The maxillipedal nail is poorly developed in contrast to Biru-

Parharpinia resembles Mandibulophoxus and Basuto in the special spine of uropod 1 and the short article 2 of antenna 1 but differs from those genera in the relatively small palpar hump on the mandible, the better developed molar, the small gnathopod 2, the well setose article 2 of pereopods 3-4, the large article 5 of antenna 2, the dorsal

telsonic spination, the posteriorly setose epimera 1-2, and the poor nail on the maxilliped.

Parharpinia resembles Leongathus in article 2 of pereopod 3, epimeral setation, facial spination on article 4 of antenna 2, the weak nail of the maxilliped, the slightly ensiform antenna 2, and the slightly enlarged articles 4-5 of pereopod 5 but Parharpinia bears a special medial spine on the peduncle of uropod 1, has a small gnathopod 2,

and a reduced and spinose molar.

If any evolutionary flow occurred between Parharpinia and Birubius it might be marked in B. karobrani and B. babaneekus through the ventrally setose article 2 of pereopod 5 or in B. eleebanus through the truncate telsonic lobes and cuticle. Those species of Birubius, however, remain fully distinguished by the several good generic characters stated above.

Key to the Species of Parharpinia

Parharpinia villosa (Haswell)

FIGURES 72-78

Phoxus villosus Haswell, 1879:258-259, pl. 9: fig. 2; 1882: 236-237.

Parharpinia villosa.—Stebbing, 1906:147-148 [in part]; 1910: 635.

Paraphoxus villosus.-J. L. Barnard, 1960: 283-285.

Not Parharpinia villosa.—Tattersall, 1922:4-6, pl. 1: figs. 7-14 [= Brolgus tattersalli].—Schellenberg, 1926:300-301 [= Parharpinia? sp.]: 1931:75-78, fig. 39 [= P. sinuatus].

Not Pontharpinia villosa.—K. H. Barnard, 1940:442-443 [= Pontharpinial sp].

Not Phoxus batei, Thomson, 1882:232-233, pl. 17: fig. 2 [not Haswell, 1880a] [= Protophoxus australis].

Description of Female.—Head about 20 percent of total body length, greatest width about 75 percent of length; rostrum unconstricted, broad, reaching middle of article 2 on antenna 1. Eyes small to medium, stained pink, clear of occluding pigment, ommatidia especially small. Article 1 on peduncle of antenna 1 about 1.8 times as long as wide, about twice as wide as article 2, ventral margin with 2-3 setules, produced dorsal apex with 5 setules; article 2 about half as long as article 1, with two ventral rows of 17 thick and thin setae; primary flagellum with 13-15 articles, about 0.8 times as long as peduncle, bearing aesthetascs; accessory flagellum with 11-13 articles. Spine formula on article 4 of antenna 2 = 1-3-8 or 1-3-10(or other variations), dorsal margin with notch bearing 2-3 setae and 1-2 spines, ventral margin densely setose, with one main ventrodistal short spine and up to 4 other thinner spines; article 5 about 0.95 times as long as article 4, facial spine formula = 2-2-2-1 or 2-2-2-2-2 or 11-12 in tandem alternating long and short (or other variations), dorsal margin naked, ventral margin with 8 sets of 1-2 long to short setae and spines, 4 ventrodistal long to short spines, 2 of these placed as subdistal facial spines; flagellum about 0.85 times as long as articles 4-5 of peduncle combined, with 13-15 articles. Mandibles with weak to medium palpar hump; right incisor with 3 teeth and faint notches; left incisor with 3 humps in 2 branches; right lacinia mobilis bifid, distal branch shorter than proximal, distal branch broad, subbifid, denticulate, proximal branch simple, pointed; left lacinia mobilis with 5 teeth; right rakers 8-11; left rakers 9-11; molar in form of elongate bulbous hump demarcated mainly by spines, each molar with 7-9 primarily medium spines plus one short spine strongly disjunct; palp article 1 short, article 2 with 3 long inner apical setae and 3-8 other long and short inner setae, article 3 about 1.1 times as long as article 2, oblique apex with 12-14 spine-setae, basofacial formula = 0-1 or 1-1. Inner plate of maxilla l large, broad, bearing one long apical pluseta, one similar apicomedial seta, 2 apicolateral much shorter setae; palp article 2 with 8-10 apicalmedial marginal spines and submarginal setae. Inner plate of maxilla 2 shorter and narrower than outer, outer with 3-6 apicolateral setae, inner with 2 medial setae. Inner plate of maxilliped with 2-6 large thin apical spines, 4 apicofacial setae, 2 medial setae; outer plate with 8-12 medial and apical spines, 9-13 apicolateral setae; palp article 1 lacking apicolateral seta, article 2 with 2 apicolateral setae, medial margin of article 2 strongly setose, article 3 weakly

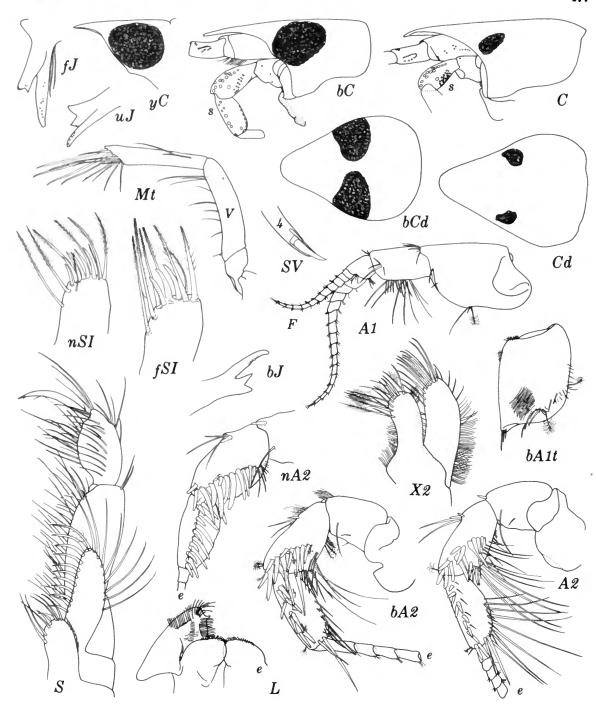


FIGURE 72.—Parharpinia villosa (Haswell), female "a," 16.3 mm (b= male "b," 9.5 mm; f= female "f," 11.9 mm; n= lectotype, female "n," 14.8 mm; u= juvenile "u," 8.8 mm; y= male "y," 10.3 mm).

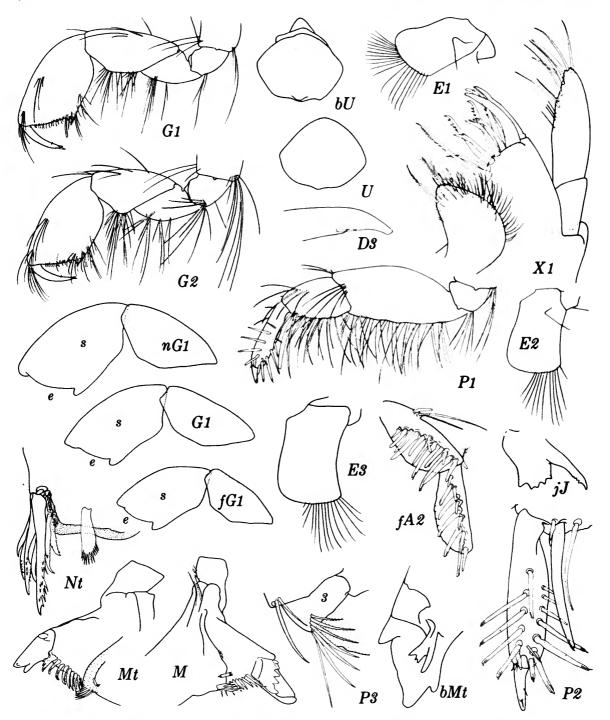


FIGURE 73.—Parharpinia villosa (Haswell), female "a," 16.3 mm (b = male "b," 9.5 mm; f = female "f," 11.9 mm; j = male "j," 9.8 mm; n = lectotype, female "n," 14.8 mm).

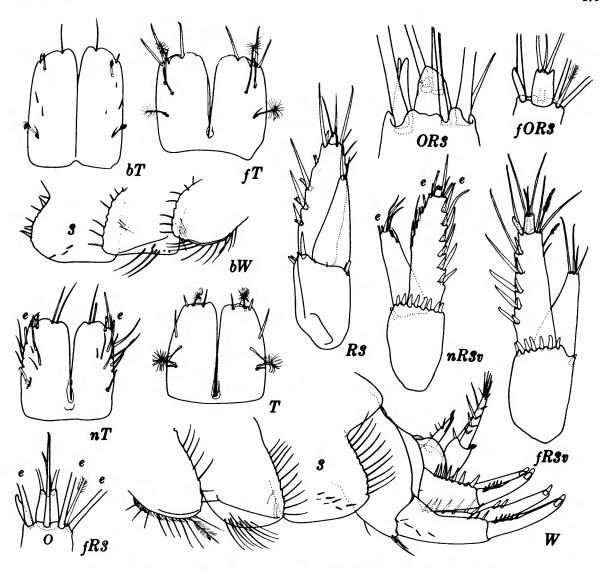


FIGURE 74.—Parharpinia villosa (Haswell), female "a," 16.3 mm (b = male "b," 9.5 mm; f = female "f," 11.9 mm; n = lecototype, female "n," 14.8 mm).

protuberant, with 11 scattered facial setae, 2 groups of 1-4 lateral setae, nail of article 4 short, with one accessory setule. Coxa 1 expanded distally, anterior margin concave; main ventral setae of coxae 1-4 = 20-11-14-35, posteriormost seta of coxae 1-3 shortened; anterior and posterior margins of coxa 4 divergent, posterior margin oblique, almost straight, setose, posterodorsal corner sharp-rounded, posterodorsal margin short, concave, width-length ratio of coxa 4 = 8:7. Long posterior setae on article 2

of gnathopods 1-2 and pereopods 1-2=2-6-5-5, long anteriors = 4-7-0-0, short anteriors = 4-5-2-4, no others. Gnathopods ordinary; width ratios of articles 5-6 on gnathopods 1-2=28:36 and 29:37, length ratios = 62:67 and 56:62; palmar humps ordinary, palms oblique; article 5 of gnathopod 1 weakly elongate, ovate, posterior margin flat; article 5 of gnathopod 2 trapezoidal, posterior margin rounded, almost lobate. Pereopods 1-2 similar, facial setae formula on article 4=(5-8), on article

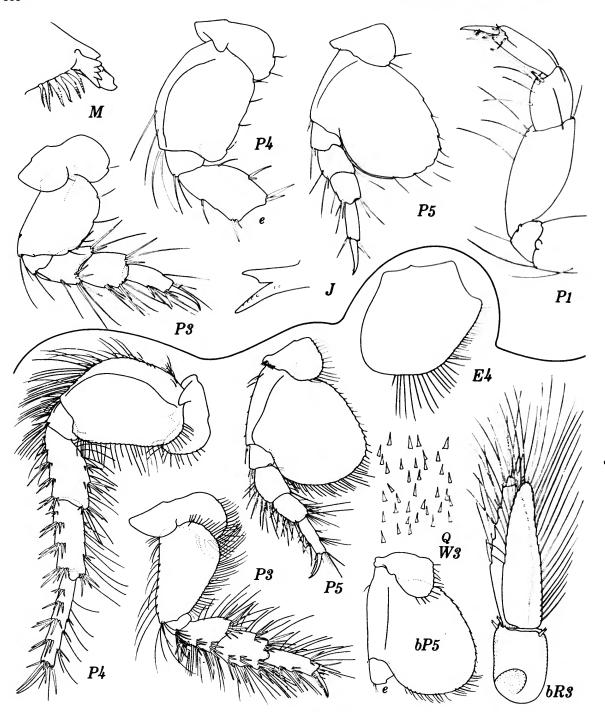


FIGURE 75.—Parharpinia villosa (Haswell), upper: juvenile "m," 3.9 mm; lower: female "a," 16.3 mm (b = male "b," 9.5 mm).

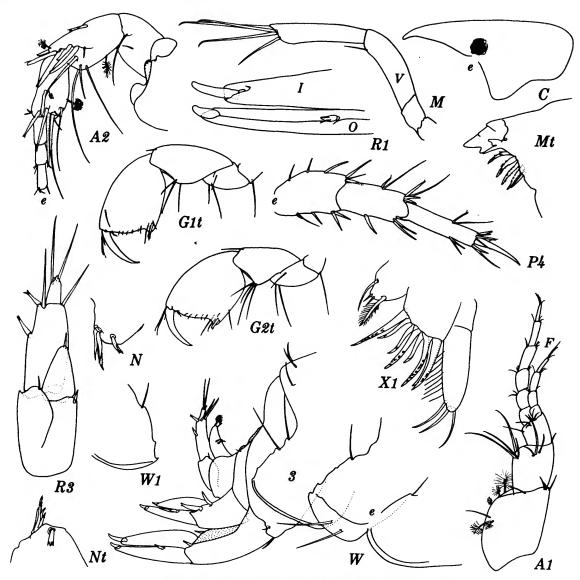


FIGURE 76.—Parharpinia villosa (Haswell), juvenile "m," 3.9 mm.

5 = (5-7); main spine of article 5 extending to M. 90 on article 6, article 5 lacking proximoposterior spines; spine formula of article 6 = 6 + 6 or 7 + 7 plus middistal seta or spinule; acclivity on inner margin of dactyls of pereopods 1-2 weak to obsolescent, emergent setule long to short, midfacial pluseta very short. Coxae 5-7 posteroventral seta formula = 21-13-14. Articles 4-5 of pereopods 3-4 narrow, facial spine rows dense, facial ridge formula on article 2 of pereopods 3-5 = 0-1-1, article

2 of pereopod 3 tapering distally; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 41:25:24:13, of pereopod 4 = 60:26:20:10, of pereopod 5 = 80:20:15:8, length ratios of pereopod 3 = 67:31: 35:36, of pereopod 4 = 76:50:53:66, of pereopod 5 = 84:22:21:27; article 2 of pereopod 5 reaching middle of article 4, posterior and ventral margins of article 2 on pereopods 3-5 setose, medial apex of article 6 finely combed, bearing 4 vestigial digital processes. Posteroventral corner of epimeron

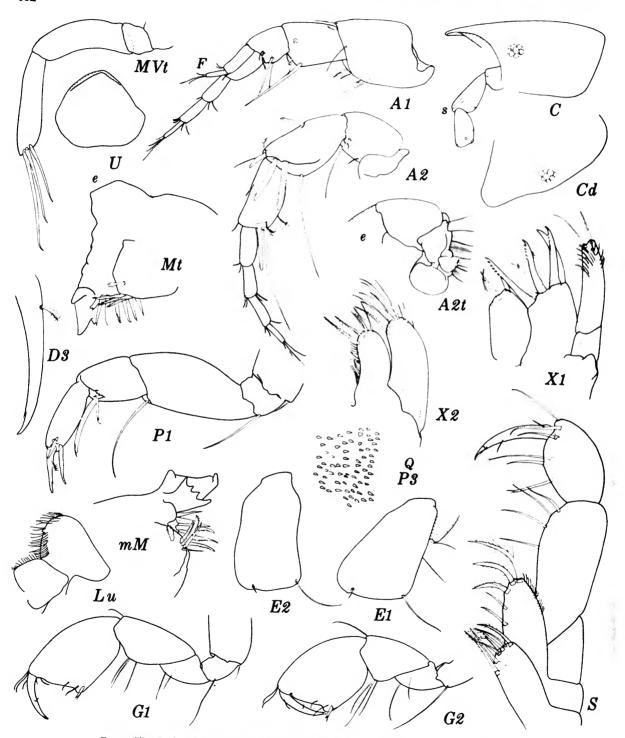


FIGURE 77.—Parharpinia villosa (Haswell), juvenile "h," 3.7 mm (m = juvenile "m," 3.9 mm).

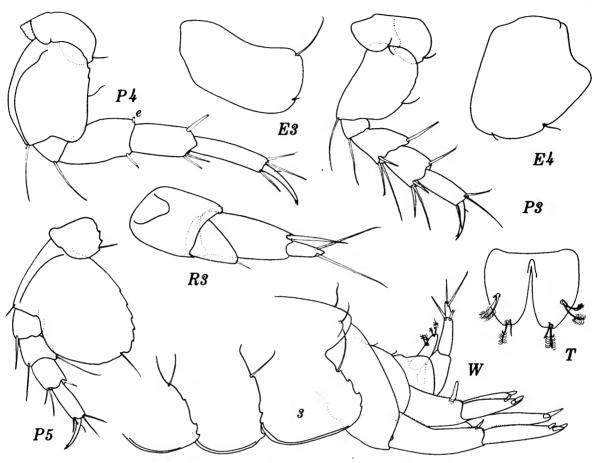


FIGURE 78.—Parharpinia villosa (Haswell), juvenile "h," 3.7 mm.

1 rounded, posterior margin weakly convex, serrate, setose, anterior and ventral margins with 8-10 long to medium setae; posteroventral corner of epimeron 2 rounded, posterior margin almost straight, serrate, setose, facial setae = 9-11, some middle pairs set vertically or irregularly, somewhat crowded forward; posteroventral corner of epimeron 3 rounded, posterior margin weakly convex, serrate, setose, ventral margin naked, face with 3-5 scattered spines and 1-3 setules near ventral margin in middle. Urosomite 1 with 1-3 ventral spines at base of uropod 1, one midventral seta, articulation line complete; urosomite 3 weakly protuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, outer rami of uropods 1-2 with gins naked or with 1-2 setae, article 2 of outer ramus of uropod 1 with 5-10 dorsal spines, inner with 2, outer ramus of uropod 2 with 4-7 dorsal spines, inner with none; peduncle of uropod 1 with 3 apicolateral spines and 3-5 basofacial spinules, medially with 7-9 marginal spines, apicalmost spine set inward on end of peduncle medially, unenlarged; peduncle of uropod 2 with 8-10 dorsal spines, medially with one small apical setule. Peduncle of uropod 3 with 6-8 ventral spines, dorsally with 2 lateral spines, 1-2 medial spines; rami feminine, inner extending to M. 75 on article 1 of outer ramus, apex with 2-6 setae, apicomedial and lateral margins naked or with 1-2 setae, article 2 of outer ramus short, 0.10, bearing 2-4 short to medium setae, medial margin with 2-6 setae, apicomedial margin of article 1 with 3 setae, lateral margin with 4-6 acclivities, spine formula = 2-2-2-2(-2-2) (paired long and short), setal formula = 0 or 0-0-0-0-0-0-3. Telson ordinary, length-width ratio = 1:1 or 13: 12, not fully cleft, each apex wide, rounded to truncate, lateral acclivity broad, shallow, with 1-2 lateral and 1-2 medial spines separated by short setule, spines variable, short to long, dorsodistal surface with 2-4 additional setal spines on each lobe, midlateral setules diverse. Cuticle closely shagreened, villi grouped as ripples, setules sparse.

DESCRIPTION OF MALE.—Eyes often distending head; rostrum shorter than in female. Article 2 of antenna 1 with fewer ventral setae than in female. Facial spine formula on article 4 of antenna 2 = 1-2-8 (= 1-2-3-5) or 1-2-9 or 1-2-10, on article 5 = 2-2-3 or 2-2-2 or 2-1-2-2 or 2-2-2-2; article 5 with 3-4 dorsal sets of male setae (hidden in illustration), no calceoli, ventrodistal apex with 2 thin spines, dorsodistal pair of female absent; flagellum with 27-30 articles, no calceoli. Basofacial setal formula on article 3 of mandibular palp = 1-2 + 1-3 midfacial setae, terminal = 10-12; distal branch of right lacinia mobilis as in female or broader and more deeply bifid. Article 2 of only pereopod 5 narrower than in female. Epimera 1-3 broadened, posterior margin of epimeron 3 shortened; setal formulas, epimeron 1 ventral = 10, epimeron 2 facial = 7, epimeron 3 posterior = 9, facial = 3. Spine formulas of uropods, uropod 1 peduncle apicolateral = 3, basofacial = 3-4, medial = 6, uropod 2 peduncle dorsal = 8, dorsal spines on outer ramus of uropod 1 = 5, of uropod 2 = 4-5, inner ramus of uropod l = 2, of uropod 2 = 0. Spine formula on uropod 3, article 1 of outer ramus = 0-0-1-1-1-1, setal formula = 1-1-1-1-1. Telson elongate, distal spines shortened and fewer.

OBSERVATIONS.—Spine formula on face of article 4 on antenna 2 subject to interpretation, generally quoted here as bearing 3 rows, first row with one apicomedial spine, next row of 2 on face and next row representing agglomeration of 2 weakly distinct rows, sometimes divided weakly into subequal groups, sometimes merging imperceptibly, sometimes with skewed members; one subadult female from WPBES T46-62 with single, heavily thickened midfacial spine on epimeron 3.

Description of Juvenile.—Juvenile "h," 3.7 mm: Highly distinctive. Eyes small. Article 2 of antenna 1 with one long apicoventral spine, primary flagellum with 4 articles, accessory flagellum with 2. Article 4 of antenna 2 with one long ventral spine-seta, facial formula = 1-2; article 5 with

one dorsal spinule, 2 ventral setules, one long apicoventral seta and one spine; flagellum with 4 articles. Right lacinia mobilis bifid, with 2 equally extending branches, distal slightly broadened; left lacinia mobilis with 4 teeth, middle pair shortened; rakers 6 on both sides; molars with 3-4 spines plus one short disjunct spine; palp article 2 naked, article 3 with 3 apical spine-setae, otherwise naked. Outer plate of maxilla 1 with only 6 spines; palp with 2 apical setae. Setation reduced on maxillipeds, gnathopods, pereopods and coxae. Setal formula of coxae 1-4 = 1-1-1-0 (latter with 2 setules as usual). Articles 4-5 of pereopods 1-2 lacking facial and posterior setae except for one apicoposterior seta on article 4; article 5 with 2 distal spines; article 6 with rows of one and one spine. Pereopods 3-5 simplified, article 2 with only one seta each, article 2 of percopod 3 only weakly tapering. Epiniera 1-3 with few large posterior serrations, one large posterodorsal seta each, no other setae. Peduncle of uropool 1 lacking basofacial setae, with one apicolateral spine, uropod 2 similar, outer rami of uropods 1-2 each with one accessory apical nail, otherwise all rami naked except for ordinary apical nails. Uropod 3 with shorter inner ramus and longer article 2 on outer ramus than in adult, setae on article 1 of outer ramus reduced to one, dorsal margins of uropods with pectinations. Telson short, each lobe with narrow apex bearing 2 setules.

Juvenile "m," 3.9 mm: More mature than 3.7 mm juvenile "h," setae and spines more numerous, apical nails on uropods 1-2 absent, these spines apparently migrant to dorsal margins (see illustrations).

Juvenile "k," 3.0 mm: Uropods 1-2 like those of 3.7 mm juvenile "h".

Juvenile "p," 1.7 mm: Uropods 1-2 lacking any but apical nails, no other spines.

ILLUSTRATIONS.—Outline drawings of gnathopods from lectotype and females "a" and "f" given to show variations. Inner plate of maxilliped, uropod 3 and telson of female "f" more highly magnified than views from other specimens. Juvenile "h," 3.7 mm: head damaged, illustration based on partial restoration; left mandible missing; nail of maxillipedal palp article 4 scarcely distinct. Juvenile "m," 3.9 mm: following parts as in 3.7 mm juvenile "h": upper and lower lips, maxilla 2, dactyls of pereopods 1–5, telson, cuticle and maxilliped,

but latter with one lateral seta on outer plate, palp articles 2-3 with several additional setae; molars of mandibles drawn inverted, each body of mandible with ordinary protrusion at base of palp; pereopod 4 illustrated in 2 pieces from right and left members; views of head and pereopods 3-5 partially reconstructed; illustration of urosome slanting away from observer; shapes of coxae 1-4 similar to those of 3.7 mm juvenile "h" but setal formula = 5-4-3-2.

LECTOTYPE.—AM, female "n," 14.8 mm, parts on 5 slides (this specimen, apparently labeled "Type" long after being described by Haswell (see J. L. Barnard, 1974), was presumably dissected by K. Sheard and the various appendages mounted by E. F. Gurjanova; all appendages have now been remounted by us and returned to AM).

Type-Locality.—AM G. 5413, Port Jackson, New South Wales, Australia.

VOUCHER MATERIAL (all illustrated).—CPBS 22N/2, female "a," 16.3 mm; CPBS 52N/1171, male "b," 9.5 mm; CPBS 51S/4, female "f," 11.9 mm; RHM, male "j," 9.8 mm; CPBS 41N/4, juvenile "u," 8.8 mm; AM P.18312, Hood Point, SW Australia, 145 m, male "y," 10.3 mm; CPBS 26S/2, juvenile "h," 3.7 mm; PPBES 985/4: juvenile "k," 3.0 mm; juvenile "m," 3.9 mm, juvenile "p," 1.7 mm.

REMARKS.—The lectotype, an adult female, can no longer be examined in toto, but consists of a series of permanent mounts of the dissected appendages and mouthparts. It has been used extensively in making the fuller description of this species. Upper and lower lips are missing; some appendages are incomplete; many spines and setae are broken or missing altogether. The only brood lamella, remaining more or less intact, is setose. Specimen "a," a female not fully adult, from which the bulk of the illustrations has been drawn, differs essentially from female "f" and the lectotype in quantitative detail only: the number of individual setae, spines and of spine-seta clusters is fewer on some appendages; spines on article 5 of antenna 2 are shorter and on the inner plate of the maxilliped are fewer than in the adult; uropod 3 lacks the full complement of setae on both rami; adult appendages differing in any but most minor details from those of female "a" have been separately illustrated.

Detailed comparison of the size of lectotype ap-

pendages with those of females "a" and "f" (articles 5 and 6 of gnathopod 1 illustrated in outline as an example) indicate that Haswell's specimen must have been larger than female "a." Using the technique adopted in this investigation for measuring length (viz., along a line midway between dorsal and ventral, from tip of rostrum to base of telson), the lectotype would be more than 16.3 mm long, considerably in excess of the 7 lines estimated by Haswell.

MATERIAL.—AM, Lectotype, Port Jackson (1), Hood Point (1); CPBS, 21 samples from 10 stations (29); WPBES, 2 samples from 2 stations (2); RHM, 2 samples from 2 stations (2); PPBES, 2 samples from one station (2); SBS, one sample, dredged (1); Macreadie, 2 samples, plankton (2).

DISTRIBUTION.—New South Wales, Sydney, to Victoria, Port Phillip Bay; Western Australia, Hood Point; depth range, 8–145 m; sediments: sand, shelly sand, sand and gravel, sand and mud.

Parharpinia warte, new species

FIGURES 79-81

Description of Female.—Head about 20 percent of total body length, greatest width about 65 percent of length; rostrum scarcely constricted, somewhat short, reaching apex of article 1 on antenna 1. Eyes small, stained pale eosin, clear of occluding pigment, ommatidia small. Article 1 on peduncle of antenna 1 about 1.7 times as long as wide, about twice as wide as article 2, ventral margin with about 5 setules, weakly produced dorsal apex with one setule; article 2 about 0.5 times as long as article 1, with apicoventral cycles of 10-11 setae; primary flagellum with 11 articles, about as long as peduncle, lacking aesthetascs, [accessory flagellum unknown, broken]. Spine formula on article 4 of antenna 2 = 1-3-4-5 (or 1-3-9), dorsal margin with notch bearing 2 setae and one spine, ventral margin with 3 groups of 1-2 long to medium setae, one ventrodistal long spine; article 5 about 0.85 times as long as article 4, facial spine formula = 2-2-2-2 or 2-2-2-1, dorsal margin naked, ventral margin with 3-4 sets of 1-3 long to medium setae, 2 ventrodistal medium spines, one subdistal facial spine counted in facial formula; flagellum about 1.1 times as long as articles 4-5 of peduncle combined, with 10 articles. Mandibles

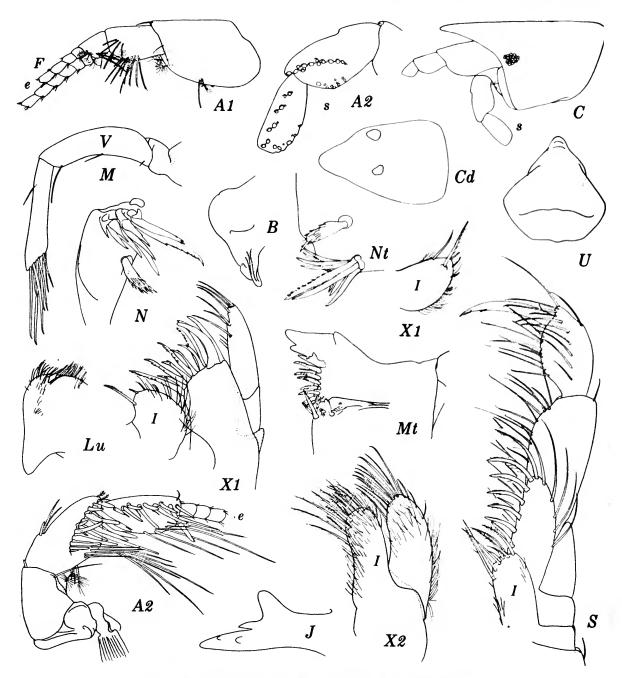


FIGURE 79.—Parharpinia warte, new species, holotype, female "a," 9.6 mm.

with weak palpar hump; right incisor with 3 teeth; left incisor with 3 humps in 2 branches; right lacinia mobilis bifid, distal branch much shorter than proximal, distal branch erect and thorn-like,

narrow, proximal branch simple, pointed, with marginal denticles and facial hump forming cusp in crotch; left lacinia mobilis with 4 teeth plus one accessory tooth, middle teeth lengthened; right and

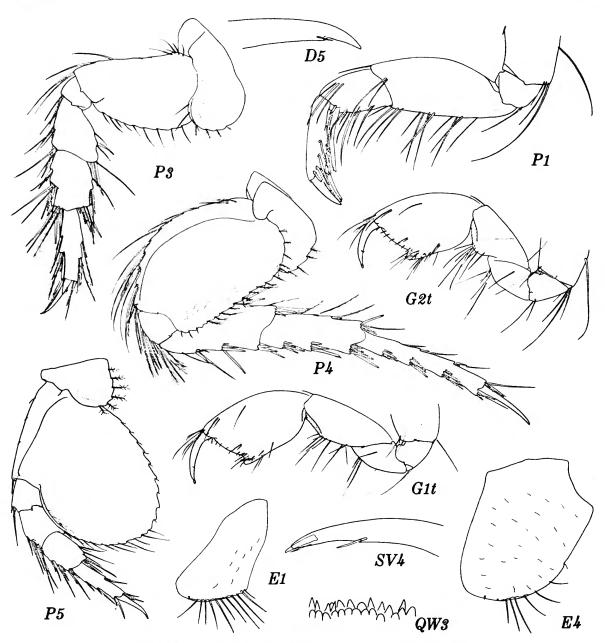


FIGURE 80.—Parharpinia warte, new species, holotype, female "a," 9.6 mm.

left rakers 9; molar in form of elongate bulbous hump demarcated mainly by spines, right molar with 10 primarily medium spines plus 1-2 rudimentaries, plus one spine strongly disjunct, left molar with 9 primarily medium spines plus one spine strongly disjunct, plume absent; palp article

1 short, article 2 with one medium inner apical seta and 2 other shorter inner setae, article 3 about as long as article 2, oblique apex with 8 spine-setae, basofacial formula = 0-1. Inner plate of maxilla 1 large, broad, bearing or lacking one long apical pluseta, one shorter apicomedial seta, 3 apicolateral

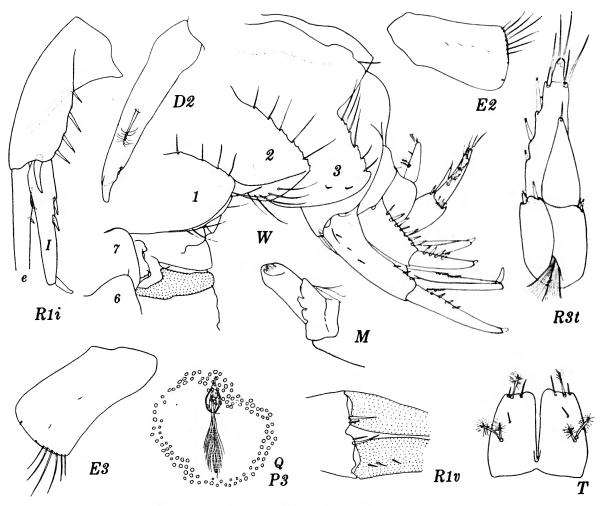


FIGURE 81.—Parharpinia warte, new species, holotype, female "a," 9.6 mm.

much shorter setae; palp article 2 with 6 apical-medial marginal setae. Plates of maxilla 2 extending subequally, outer broader than inner, outer with 4 apicolateral setae, inner with 3 medial setae. Inner plate of maxilliped with 2 large thin apical spines, 4 apicofacial setae, 2 medial setae; outer plate with 8 medial and apical spines, 5 apicolateral setae; palp article 1 lacking apicolateral seta, article 2 with one apicolateral seta, medial margin of article 2 moderately setose, article 3 with 6 facial setae, one lateral seta, article 4 with 2 widely spaced apical accessory setules, nail absent. Coxa 1 strongly expanded distally, anterior margin weakly concave; main ventral setae of coxae 1-4 = 11-7-6-6, poste-

riormost seta of coxae 1-4 shortest; anterior and posterior margins of coxa 4 divergent, posterior margin oblique, straight, posterodorsal corner sharp-rounded, posterodorsal margin short, concave, width-length ratio of coxa 4 = 7:8. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 2-4-(3-4)-(3-4), long anteriors = 6-6-0-0, short anteriors = 3-3-3-2, no others. Gnathopods ordinary; width ratios of articles 5-6 on gnathopods 1-2 = 24:38 and 27:40, length ratios = 62:62 and 52:64; palmar humps ordinary, palms oblique; article 5 of gnathopod 1 ovate, posterior margin rounded-flat, short; article 5 of gnathopod 2 subtriangular, posterior margin rounded, short,

almost lobate. Pereopods 1-2 similar; facial setae formula on article 4 = 2 and 2, on article 5 = 3 and 3; main spine of article 5 extending to M. 85 on article 6, article 5 lacking proximoposterior spines; spine formula of article 6 = 4 + 6 plus middistal seta, one spine especially long; acclivity on inner margin of dactyls of pereopods 1-2 weak, emergent setule short, midfacial pluseta ordinary. Coxae 5-7 posteroventral setule formula = 6-5-6. Articles 4-5 of pereopods 3-4 narrow, facial spine rows sparse, facial ridge formula on article 2 of pereopods 3-5 = 0-1-1, (pereopod 5 with additional short distomarginal ridge); width ratios of articles 2, 4, 5, 6 of pereopod 3 = 49:30:28:16, of pereopod 4 = 70:32: 25:13, of pereopod 5 = 95:22:20:10, length ratios of pereopod 3 = 81:37:39:47, of pereopod 4 = 93:67: 68:88, of pereopod 5 = 110:23:27:36; article 2 of percopod 5 exceeding apex of article 4, ventral margin setose, posterior margins of article 2 on pereopods 3-4 setose, article 2 of pereopod 3 tapering distally; medial apex on article 6 of pereopod 5 finely combed, bearing 3 short digital processes. Posteroventral corner of epimeron 1 rounded, posterior margin straight, serrate, setose, anteroventral margin with 3 medium setae, posteroventral margin with 2 medium setae; posteroventral corner of epimeron 2 rounded to weakly protuberant, with small, sharp tooth, posterior margin straight, serrate, setose, facial setae = 5 crowded anteriorly; posteroventral corner of epimeron 3 weakly protuberant, with sinus, with small tooth, posterior margin straight, weakly serrate, setose, face with horizontal row of 2 short spines; pleonites 1-3 each with 3 dorsal longitudinal rugosities. Urosomite 1 with ventral spine at base of uropod 1, articulation line almost complete; urosomite 3 weakly protuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, outer ramus of uropod 1 with 4 dorsal spines, inner with 2, outer ramus of uropod 2 with 4 dorsal spines, inner lacking dorsomedial spines; peduncle of uropod 1 with 3 apicolateral spines and 4 short dispersed basofacial setae, medially with 5 marginal spines, apicalmost enlarged but set inward; peduncle of uropod 2 with 7 dorsal spines, medially with one tiny apical spine. Peduncle of uropod 3 with 4 ventral spines, dorsally with one lateral spine, one medial spine and setule; rami feminine, inner extending to M. 70 on article 1 of outer ramus, apex with one seta, medial and lateral margins naked, article 2 of outer ramus ordinary,

0.20, bearing 2 medium setae, medial apex of article 1 with 2 setae, lateral margin with 3 acclivities, spine formula = 1-1-2-1, setal formula = 0-0-0-1. Telson ordinary, length-width ratio = 11:13, not fully cleft, each apex wide, truncate, lateral acclivity absent, with lateral short and medial long, thin spine separated by long setule, each lobe dorsally with spinule at M. 70, midlateral setules large, diverse. Cuticle with bulbar setules at edges of clear spaces in midst of dense pebble knobs, dorsally organized on pleon into alternate rows of blunt and sharp knobs, emergent setules especially long, branched.

OBSERVATIONS.—Head damaged but also asymmetrically formed, left side deeper than right; posterior half of sternite 6 heavily calcified and forming half-ring below body; article 3 of antenna 2 with apicodorsal spine.

ILLUSTRATIONS—Some rakers of mandibles omitted from drawings.

HOLOTYPE.—AM, female "a," 9.6 mm. Unique. Type-Locality.—AM P.18276, 5 Jul 1962, Great Australian Bight, south of Eucla, Western Australia, 33°05' S, 128°40' E, 83 m, bottom unknown.

RELATIONSHIP.—This species is very closely similar to Parharpinia villosa and can be readily distinguished only by the cuticular structures. Parharpinia villosa has evenly distributed villi and bulbar setules lacking any marked clear space around them, whereas P. warte has tightly packed villi, apically blunted and forming a ring around spaces in which lie the bulbar setules. The unique holotype of P. warte might be an aberrant specimen of P. villosa in all other respects. Various minor distinctions in setal densities and sizes of gnathopodal articles might be explained on the aberrancy theory but the odd cuticle cannot be so explained.

MATERIAL.—AM, one sample (1).

DISTRIBUTION.—Great Australian Bight, Eucla. 83 m.

Protophoxus K. H. Barnard

Protophoxus K. H. Barnard, 1930:335.—Barnard and Drummond. 1976:532.

DIAGNOSIS OF MALE.—Eyes present. Flagella of antennae 1-2 unreduced in male. Article 2 of antenna 1 especially shortened, ventral setae widely spread. Article 1 of antenna 2 not ensiform, article

3 with 2 setules, facial spines on article 4 primarily in one main row, article 5 ordinary in size. Right mandibular incisor with 3 teeth; molar not triturative, small, pillow-shaped, bearing 4 or more splayed, semiarticulate spines, usually bearing fuzz; palpar hump medium. Palp of maxilla 1 biarticulate; inner plate with 4 setae. Setation of maxilla 2 ordinary. Inner plate of maxillipeds ordinary; apex of palp article 3 not or weakly protuberant, dactyl elongate, apical nail distinct, medium. Gnathopods ordinary, small, similar; article 5 of gnathopods 1-2 of ordinary length, free, without eusirid attachment; palms oblique, hands of gnathopods 1-2 ordinary, ovatorectangular, poorly setose anteriorly. Article 5 of pereopods 1-2 bearing posteroproximal setae. Article 2 of pereopod 3 of broad form but tapering distally, articles 4-5 of pereopods 3-4 broad to medium, article 2 of pereopods 3-4 not setose posteriorly; pereopod 5 ordinary, article 2 naked ventrally, article 3 ordinary; dactyl normal. Epimera 1-2 lacking long posterior setae, without midfacial setae above ventral facial ridge; epimeron 3 ordinary. Urosomite 1 generally naked; urosomite 3 without dorsal hook or special process. Peduncle of uropod 1 normally elongate, without apicoventral spike, with special enlarged apicolateral spine, only peduncular apices of uropod 2 combed; inner ramus of uropod 1 with one row of marginal spines, no rami continuously spinose to apex, inner ramus of uropod 2 ordinary. Uropod 3 highly elongate, article 2 of outer ramus carrying 2 long apical setae. Telson with 2 or more apical spines, with special dorsal spines.

DESCRIPTION.—Rostrum fully developed. Fuzz on article 1 of antenna 1 in male present; calceoli on male primary flagellum of antenna 1 present. Calceoli on article 5 of male antenna 2 present; flagellum in male with calceoli. Prebuccal parts ordinary, poorly separated from each other, upper lip dominant. Right lacinia mobilis bifid, thin; mandibular palp medium to thin, article 1 short, article 2 without outer setae, apex of article 3 oblique. Lower lip bearing cones. Outer plate of maxilla 1 with 11 spines, one spine especially thickened. Inner plates of maxilliped thick, ordinarily setose. Coxae 2-4 without special antero-dorsal humps. All posterior spines on article 6 of pereopods 1-2 thick and stiff, midapical spine present. Article 2 of pereopod 5 without facial setae. Peduncle of uropod 1 with

dorsolateral spines widely spread, medial spines widely spread; peduncle of uropod 2 with only one medial spine confined apically. Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with ordinary pair of midlateral or dorsal setules on each side.

Type-Species.—Protophoxus australis K. H. Barnard, 1930 (monotypy).

Composition.—Unique.

RELATIONSHIP.—Protophoxus shares with Parharpinia the supernumerary dorsal spination on the telson, the presence of a special spine on the peduncle of uropod 1, and the strong taper of article 2 on pereopod 3. Protophoxus differs from Parharpinia in the shift of the special spine on the peduncle of uropod 1 to the lateral side, the absence of posterior setation on epimera 1-2, the absence of strong ventral setation on article 2 of pereopod 5, and the more strongly distinct nail of the maxillipedal dactyl.

Protophoxus and Parharpinia share thin articles 4-5 of pereopods 3-4 but this character is almost as well developed in some of the thin membered species of Birubius.

Protophoxus australis K. H. Barnard

Phoxus batei.—Thomson, 1882:232-233, pl. 17: fig. 2 [not Haswell].

Protophoxus australis K. H. Barnard, 1930:335-336, fig. 12.

—Barnard and Drummond, 1976:534, fig. 4 [part].

Pontharpinia australis.—Hurley, 1954:581-587, figs. 1-28.

DISTRIBUTION.—New Zealand, from Three Kings Islands south to Stewart Island, neritic, 0-3 m, confirmed benthic 13-37 m.

BIRUBIINAE

Diagnosis.—Article 2 of antenna 1 ordinary to elongate; mandibular molar reduced to a small hump with articulate spines; palp of maxilla 1 biarticulate; setation on maxilla 2 ordinary; gnathopod 2 as small as gnathopod 1; article 2 of pereopod 3 of broad form, not tapering distally; pereopod 5 ordinary.

Description.—Article 5 of antenna 2 of normal size; epimeron 3 of nonrounded classification; apices of peduncles on uropods 1–2 not combed.

Type Genus.—Birubius, new genus. (Birubius is

picked as type genus of the subfamily because we are not certain that *Metharpinia*, the oldest name, belongs to the subfamily.)

Composition.—Kulgaphoxus, new genus; Microphoxus J. L. Barnard; Tickalerus, new genus; Yan, new genus; possibly Metharpinia Schellenberg.

Key to the Genera of Birubiinae

1.	Urosomite 3 with large dorsal hook on each side, outer ramus of uropod 3 severely reduced in size, not longer than peduncle
	Urosomite 5 lacking dorsal hooks, outer ramus of uropod 5 usually more than 1.5 times as long as peduncle
2.	Uropods 1-2 lacking accessory apical nails on inner rami, ventral setae on article 2 of antenna 1 placed in middle
	Uropods 1-2 bearing accessory apical nails on inner rami, ventral setae on article 2 of antenna 1 situated proximally
3.	Dactyl of pereopod 5 vestigial
	Dactyl of pereopod 5 fully formed 4
4.	Telson lacking supernumerary lateral spines and setae except for normal pair of midlateral and dorsal setules on each side
	Telson with supernumerary lateral spines and setae besides normal pair of midlateral and dorsal setules on each side
5.	Gnathopod 2 significantly larger than gnathopod 1 Cumusra, new genus (see Brolginae)
	Gnathopods 1-2 subequal in size Birubius
6.	Coxa 4 with posterior setae, see text
	Coxa 4 lacking posterior setae, see text

Birubius Barnard and Drummond

Birubius Barnard and Drummond, 1976:543.

Diagnosis.—Eyes present. Flagella of antennae 1-2 unreduced in female. Article 2 of antenna 1 ordinary to elongate, ventral setae widely spread. Article 1 of antenna 2 not or weakly ensiform; article 3 with 2 setules; facial spines on article 4 in 2 or more rows; article 5 ordinary in size. Right mandibular incisor with 3-4 teeth; molar not triturative, ordinary, pillow-shaped, bearing 4 or more splayed semiarticulate spines, usually bearing fuzz; palpar hump small to medium. Palp of maxilla 1 biarticulate, inner plate with 3-4 setae. Setation of maxilla 2 ordinary. Inner plate of maxillipeds ordinary; apex of palp article 3 not or weakly protuberant, dactyl elongate, apical nail distinct, medium to elongate. Gnathopods ordinary, small, similar; article 5 of gnathopods 1-2 of ordinary length, free on gnathopod 2, often elongate on gnathopod 1, without eusirid attachment; palms oblique, hands of gnathopods 1-2 ordinary, ovatorectangular, poorly setose anteriorly. Article 5 of pereopods 1-2 bearing setae posteroproximally. Article 3 of pereopod 3 of broad form, rarely and scarcely tapering distally, articles 4-5 of pereopods 3-4 broad to narrow, article 2 of pereopods 3-4 not setose posteriorly; pereopod 5 ordinary, article 2 naked or strongly setose and toothed ventrally, article 3 ordinary, dactyl normal. Epimera 1-2 lacking numerous long posterior setae, without midfacial setae above ventral facial ridge; epimeron 3 ordinary. Urosomite 1 generally naked except for sparse apicoventral setae or spines near base of uropod 1, rarely with lateral line of setae; urosomite 3 without dorsal hook or special process. Peduncle of uropod 1 normally elongate, without apicoventral spike, without special enlarged apical spine; peduncular apices of uropods 1-2 not combed; inner ramus of uropod 1 with marginal spines in one row, either no or some rami continuously spinose to apex, or bearing accessory nails, inner ramus of uropod 2 ordinary. Uropod 3 ordinary; article 2 of outer ramus carrying 2 medium to long apical setae. Telson ordinary, with only 1-2 apical spines, or 2 additional setae on each lobe plus setules.

DESCRIPTION.—Rostrum fully developed to obsolescent. Fuzz on article 1 of antenna 1 in male present; calceoli on male primary flagellum of antenna 1 present. Calceoli on article 5 of male antenna 2

present; flagellum in male with calceoli. Prebuccal parts ordinary, poorly separated from each other, upper lip dominant. Right lacinia mobilis bifid or simple, flabellate or thin; mandibular palp medium to thin, article 1 short to slightly elongate, article 2 usually without outer setae, apex of article 3 oblique. Lower lip bearing cones. Outer plate of maxilla 1 with 9-11 spines, one spine especially thickened. Inner plates of maxilliped thick, ordinarily setose. Gills present on coxae 2-7. Coxae 2-4 without special anterodorsal humps. All posterior spines on article 6 of pereopods 1-2 thick and stiff, midapical spine or seta usually present. Article 2 of pereopod 5 without facial setae. Peduncle of uropod 1 with dorsolateral spines confined apically, medial spines widely spread; peduncle of uropod 2 with only one medial spine or setule confined apically or spines widely spread. Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with ordinary pair of midlateral or dorsal setules on each side.

Type-Species.—Birubius panamunus Barnard and Drummond, 1976 [originally designated].

Composition.—36 species (in addition to the type species), all from southern Australia, all described herein.

RELATIONSHIP.—Birubius differs from Pontharpinia Stebbing in the nontriturative molar bearing semiarticulate spines and in the small gnathopod 2, among numerous other characters.

Externally, Birubius is difficult to separate from the generally similar Brolginae but all species have 4 or more spines on the molars whereas the Brolgus group has only 3. Unlike various members of the Brolginae, species of Birubius always lack combs on the peduncles of uropods 1-2, the posterior spines on article 6 of pereopods 1-2 are never thin and seta-like, gnathopod 2 is as small as gnathopod 1, article 5 is free, never cryptic, and the other unusual modifications of gnathopods seen in certain members of the Brolgus group are absent. Birubius usually has 4 (rarely 3) setae on the inner plate of maxilla 1 whereas the Brolginae usually have only 2. The outer plate of maxilla 1 lacks the extra midapical cusp or setule of the Brolgus group. Article 2 of antenna 1 and article 5 of antenna 2 are always fully developed in Birubius whereas they usually are reduced in the Brolginae.

The facial spines on article 4 of antenna 2 always occur in 2 or more fully developed rows whereas the *Brolgus* group has these usually in one main row. The distalmost posterior setule on the dactyl of pereopods 1-2 in the Brolginae is generally more distal and more weakly marked than in *Birubius*. Article 2 of pereopod 5 in *Birubius* always bears 2 facial ridges in contrast to the *Brolgus* group bearing only one. Epimeron 3 of *Birubius* is rarely as simple as that of the *Brolgus* group and articles 4-5 of pereopods 3 and 4 are usually very slightly to much broader than in the *Brolgus* group.

From Parharpinia Stebbing, Birubius differs in the absence of supernumerary dorsal spination or setation on the telson, lacks the special apicomedial spine on the peduncle of uropod l, has a longer apical nail on the dactyl of the maxilliped, usually lacks any indication of an ensiform antenna 2, and never has fully developed posterior setae on epimera 1-2 as seen in certain phases or taxa of Parharpinia. Article 2 of pereopod 3 in species of Birubius usually is untapered though a few species show faint suggestions of this condition, whereas this article in Parharpinia tapers strongly and lacks a posteroventral lobe and furthermore is lieavily setose posteriorly. Article 2 of pereopod 5 in Birubius bears 2 facial ridges whereas Parharpinia bears one.

Birubius differs from Protophoxus in most of the same characters as it does from Parharpinia including those items concerning pereopod 3, telson, uropod 1 (but in Protophoxus the special spine is lateral), antenna 2, and furthermore lacks a comb on the peduncle of uropod 2.

Trichophoxus K. H. Barnard and Tipimegus, new genus, have distinctive molars, mitellid hands on the gnathopods, lack posteroproximal setae on article 5 of pereopods 1-2, and have a miniaturized pereopod 5 with enlarged article 3.

Birubius is most closely similar to the hypothetical immediate ancestor, Cunmurra, new genus, from which Birubius differs only in the small gnathopod 2 and enlarged outer plate of the maxilliped. Cunmurra would not appear to be on a direct line from a primitive ancestor to Birubius because of that small plate on the maxilliped.

In this genus the facial spine formula on article 5 of antenna 2 includes clearly apicofacial spines near or disjunct from the ventrodistal spine group.

The Evolutionary System in Birubius

FIGURE 82

Birubius is the largest known genus of Phoxocephalidae. Many more new species probably will be discovered in Australia. Eventually other genera may be split away from the known 37 species; we indicate some of these places in the discussions of relationship among the many species. In the present context of our knowledge, however, the composition of the genus has been constrained tightly.

The species presented here are arranged in an evolutionary system with progression away from what is considered to be the most primitive state, that represented by B. panamunus in which several characters are reminiscent of the primitive genus Pontharpinia. The characters include fully developed right lacinia mobilis, large tooth and facial setae on epimeron 3, setose coxa 4, unmodified head, broad articles of pereopods 3-4, and the presence, in a reduced state, of continuous dorsal spination on one ramus of uropods 1-2 as marked by the presence of accessory apical nails. Other characters of Pontharpinia, such as strongly developed ventral setae on article 2 of pereopod 5 are not found in B. panamunus but do occur in several species of Birubius in which other more fundamental characters have departed from the panamunus model. Such replications of primitiveness suggest that Birubius may be polyphyletic and that further divisions will become necessary once more species have been found to demonstrate the strength of the various clusters.

The infrageneric evolutionary system in *Birubius* is based on: the successive loss of complexity on epimeron 3, on the right lacinia mobilis, on the apex of the inner ramus on uropod 1; the loss of

setae on coxa 4 and basofacially on uropod 1; the decrease in stoutness of pereopods 3-4; the increasing constriction of the rostrum; and the elongation of the wrists on the gnathopods. Most of the species have only 3 teeth on the right mandibular incisor, few retain long ventral setae on article 2 of pereopod 5, all but one have lost all evidence of an ensiform process on antenna 2, the second article of the outer ramus on uropod 3 decreases in size, the medial and lateral spination on the peduncles of uropods 1-2 becomes more simplified, setation is reduced on the mandibular palp, and spination on article 6 of pereopods 1-2 is reduced by stages in the evolutionary sequence.

The following characters appear to be increasing in complexity in the evolutionary scheme: number of molarial spines, complexity of cuticular ornamentation, apical broadening of coxa 1 with concomitant decrease in setation, broadening or trapezoidal extension of coxa 4, increasing length of article 2 on antenna 1 with concomitant decrease in setation, increase in size and facial spination of article 5 on antenna 2, increasing number of facial ridges on pereopods 3–5, increasing apical digitation on pereopod 5, and loss of articulation on the urosome with increase in development of dorsal processes (very weakly seen).

Key I to Birubius is mainly based on this scheme of evolutionary flow through the genus. The species are arranged generally in the same sequence, although for each cluster of species we pick a good model which may or may not be the most primitive in the cluster and thus may be placed forward out of sequence. The sequence is shown in Figure 82, in which the lines and arrows connecting clusters demonstrate the flow of character modification rather than indicating precise descent.

Keys to the Species of Birubius (Females)

KEY I (Phyletic)

ı.	Right lacinia mobilis bifid		
	Right lacinia mobilis simple	. Key	(
2.	Distal branch of right lacinia mobilis complex, either subbifid or toothed	Key	
	Distal branch of right lacinia mobilis simple, pointed	. Key	1

KEY A

ı.	One or more rami of uropods 1-2, primarily inner ramus of uropod 1, with 1-2 apical acces-
	sory nails, hence ramus continuously spinose to apex

	No ramus of uropods 1-2 bearing apical accessory nails
2.	Coxa 4 with long ventral setae
	Coxa 4 lacking long ventral setae
3.	Tooth of epimeron 3 large, full face with oblique-horizontal row of setae plus ventral
	row 1. B. panamunus
	Tooth of epimeron 3 small, full face with 0-3 irregularly set setae not in even row plus
	ventral row 4
4.	Some ventral setae on epimeron 2 in posterior half of face, posteroventral angle of epimeron
	2 unprotuberant, urosomite 1 with long lateral row of setae 2. B. lorus, new species

FIGURE 82.—Evolutionary pattern in *Birubius* (numbers indicate species as captioned in the text; θ = zero; character symbols are identified at bottom right; arrows indicate general flow of evolution from primitive level in upper left to most advanced level in lower right; seven boxes, A-G, surround species in congruently similar grades of evolution).

Box A bears the most primitive species, with fully flabellate, bifid right lacinia mobilis and accessory apical nails on the rami of uropods 1-2. The head is fully rostrate, and species 1, the most primitive, bears the enlarged posteroventral tooth on epimeron 3. Species 1-3 (left of the dashed vertical subdivisional line) are species with setose coxa 4, while species 4-9 (to the right of the dashed line), lack those setae. Species 2-3 are characterized by loss of facial setae on epimeron 3, reduction of its tooth, and modification in shape of coxa 4. Species 4-5 are characterized by disarray of facial setae on epimeron 3 and reduction in its tooth. Species 6 has epimeron 3 in primitive condition but ventral setae are lost and basofacial setae on uropod 1 are reduced. Species 7-8 have lost facial setae on epimeron 3 but retain the ventral setae. Species 9 is characterized by anterior loss of ventral setae on epimeron 3 and narrowed rostrum.

Box B contains species 10, an offshoot of the Box A group, in which the right lacinia mobilis has become thin and nonflabellate but accessory spines on the rami of uropods 1-2 are maintained; species 10 grades into the Box D group where the accessory spines have also been lost; however the setation on epimeron 3 has become too simplified for species 10 to be considered an intergrade to the species of Box D.

Box C contains species 11-15, generally similar to those of Box A but in which uropods 1-2 have lost the accessory nails on the rami. The model, species 11, has epimeron 3 somewhat similar to species 9 but all species of Box C have setae on coxa 4 and presumably flow directly from species 1. Species 13 is distinguished in the loss of the posterodorsal seta on epimeron 3 and the weakly constricted rostrum. Species 15 is characterized by a partially replicated and complex right lacinia mobilis. Species 14 bears long ventral setae on article 2 of pereopod 5. The rostrum becomes somewhat constricted in the higher numbered species of this group.

Box D contains species 20-27, characterized, like those of Box B, by the nonflabellate but bifid right lacinia mobilis but, unlike the species in Boxes A and B, showing the absence of accessory apical nails on the rami of uropods 1-2. The model, species 20, has scattered facial setae on epimeron 3, but is considered to be primitive because of the absence of posteroproximal spines on article 5 of pereopods 1-2. All other species of Box D bear those spines. Species 22, 23, 24,

26, and 27 have elongate article 5 of gnathopod 1. Species 22-23 have facial setae on epimeron 3 organized into a row. Species 25-27 have reduced basofacial setae on uropod 1. Species 24 has a very special setation pattern on epimeron 3, with deeply submarginal posterior setae. In addition, species 20-23 have short anterior facial ridge on female pereopod 5 (symbolized by a star) and species 22-23 have slightly elongate article 2 on outer ramus of uropod 3 (designated by +). It also should be noted that on epimeron 3 species 20 lacks ventral setae, species 21 and 24 bear several ventral setae, species 22-25 bear only one long ventral seta. species 25-27 bear only tiny posteroventral setules in notclies, and that on epimeron 2 in females, species 22, 25, 26, 27 have facial setae crowded forward.

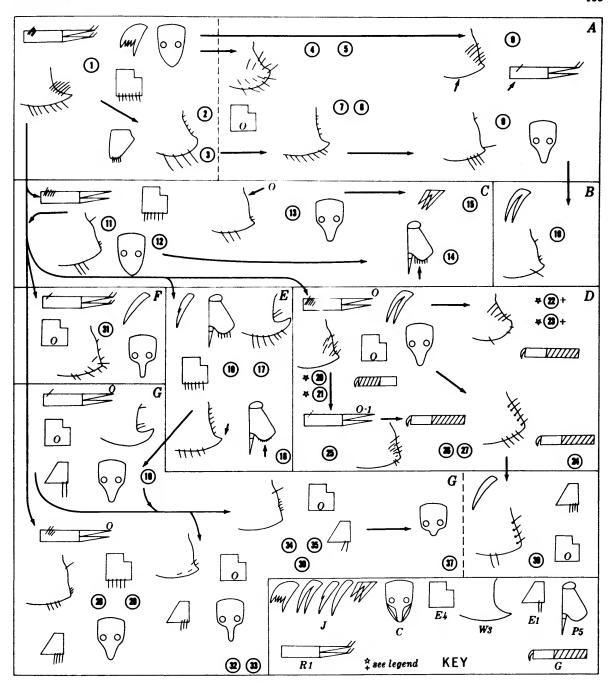
Box E contains species 16-18 with primitive epimeron 3 but with highly advanced mandible bearing an almost simple right lacinia mobilis lacking anything but a cusp to represent the distal branch and with unusual, enlarged, smooth raker spines lacking intercalated plusetules. The epimeral tooth and strong ventral setation on article 2 of pereopod 5 are reduced in species 18.

Box F contains species 31 alone. This species combines a simple right lacinia mobilis with the presence of accessory nails on the rami of uropods 1-2 plus very thin rostrum, lack of setae on coxa 4 and reduced basofacial setation on uropod 1. It forms an excellent bridge between Boxes A plus C and G.

Box G contains all other species, probably of diverse origin as shown by the arrows. All carry the simple right lacinia mobilis and lack accessory apical nails on uropods 1-2, except that species 32-37 bear a setule in place of the accessory apical nail. Species 19 is conceived to flow from Box E where the distinctions between right lacinia mobilis and epimeron 3 are minor but species 19 has lost setae on coxa 4 and the setae on coxa 1 are reduced to 2, like species 34-36.

Species 28-29 have their nearest ancestral grade in species 11 as evidenced by epimeron 3, uropod 1, and coxa 4. Species 30, with its unusual epimeron 3 appears to be descendant from a grade represented by species 24 with similar epimeron 3; but species 30 has the simple right lacinia mobilis.

All other species of Box G, 32-37, have lost setae on coxa 4, have the extremely narrowed rostrum and a reduction of setae on coxae 1-3; on those coxae, species 32-33 have 3 setae, species 34-37 have 2 setae. Species 34-37 retain a posterodorsal setule on epimeron 3 whereas species 32-33 do not. Species 34-35 have long ventral setae on article 2 of pereopod 5. Species 37 is the ultimate evolute in its extremely reduced rostrum.



	and a second sec
	No ventral setae of epimeron 2 in posterior half of face, posteroventral angle of epimeron 2 protuberant, urosomite 1 naked laterally
5.	Epimeron 3 with more than 2 fully facial setae
6.	Epimeron 3 with ventral setae
7.	Epimeron 3 naked ventrally
	minute characters
	Mandibular molars with disjunct spine highly remote from other spines, see description for minute characters
8	Rostrum weakly constricted, main spine on article 5 of pereopods 1-2 reaching apex of
٥.	article 6 in flexed position (male) 6. B. apari, new species
	Rostrum unconstricted, main spine on article 5 of pereopods 1-2 falling well short of apex
	on article 6 in flexed position (female)
9.	Article 5 of gnathopods 1-2 elongate, epimeron 3 with midposterior setules
	Article 5 or gnatnopods 1-2 short, epimeron 5 tacking initiposterior setules
10.	Tooth on epimeron 3 of medium size, cuticular setules surrounded by alate plates
	Tooth on epimeron 3 small, cuticular setules lacking alate plates 8. B. thalmus, new species
11.	Right lacinia mobilis normal, uropod 1 bearing basofacial setae
	Right lacinia mobilis with additional accessory proximal bifid process, uropod 1 lacking basofacal setae
	Right lacinia mobilis normal, uropod 1 lacking basofacial setae (and article 2 of percopod
	5 with one slightly elongate ventral setule, inner ramus of uropod 1 with one cularged
	spine, epimeron 3 with posterodorsal setule, coxa 1 expanded distally, article 5 of pereo-
	pods 1-2 with posteroproximal spines, epimeron 3 with only posterior and facial setae
	[these comments provided so as to follow through couplets 12-15 to check this species])
19	(see KEY B)
	Article 2 of percopod 5 hearing many long ventral setae 14. B. karobrani, new species
13.	Epimeron 3 with posterodorsal setule, spines on inner ramus of uropod 1 of normal size,
	coxa l expanded distally14
	Epimeron 3 lacking posterodorsal setule, spines on inner ramus of uropod 1 enlarged, coxa
14.	1 unexpanded distally
	female
	Article 5 of pereopod 2 lacking posteroproximal spine, epimeron 2 protuberant in
	female
15.	Epimeron 3 bearing ventral setae, lacking facial setae, posterior setae short and sparse
	Epimeron 3 lacking ventral setae, bearing facial setae, posterior setae long and numerous
	(see KEY B)
	•
	Key B
1.	Inner ramus of uropod 1 with 2 apical accessory nails 10. B. gallangus, new species
	Inner ramus of uropod 1 lacking accessory nails
2.	Distal branch of right lacinia mobilis so small as to form only vestigial cusp on main
	branch
3.	Tooth of epimeron 3 small
	Tooth of epimeron 3 large
4.	Article 2 of percopod 3 rounded dorsoposteriorly 16. B. babaneekus, new species
ĸ	Article 2 of percopod 3 with strong dorsoposterior cusp 17. B. gelarus, new species
<i>J</i> ,	Pereopods 1-2 lacking posteroproximal spine(s) on article 5 (see KEY A)
	Pereopods 1-2 bearing posteroproximal spine(s) on article 5
6.	Epimeron 3 with 1-3 long ventral setae
	Epimeron 3 lacking long ventral setae, occasionally with short posteroventral setules10

7.	Article 5 of gnathopods 1-2 short, facial setae on epimeron 3 scattered
	Article 5 of gnathopods 1-2 elongate, facial setae on epimeron 3 either organized into an
8.	even row or absent
9.	Basofacial setae of uropod 1 = 0, urosomite 1 articulation line well developed, inner ramus of uropod 2 with one dorsal spine, and see discussion of these species
	Basofacial setae of uropod 1 = 2, urosomite 1 articulation line weak, inner ramus of uropod 2 with 2 dorsal spines, and see discussion of these species 23. B. kyeemus, new species
	Article 1 of mandibular palp slightly elongate, article 5 of pereopods 1-2 with one postero proximal spine, (article 5 of gnathopod 1 weakly elongate) 27. B. munggai, new species Article 1 of mandibular palp short, article 5 of pereopods 1-2 with 2 posteroproxima spines, (article 5 of gnathopod 1 variable)
	Article 5 of gnathopod 1 elongate, inner ramus of uropod 1 with one dorsal spine (see Key A)
	KEY C
1.	Epimeron 3 with giant posteroventral tooth 19. B. narus, new species
	Epimeron 3 with small or no tooth Coxa 4 with long ventral setae
	Coxa 4 lacking long ventral setae
3.	Head evenly ovate in dorsal view, cuticle relatively simple, see description
	Head with narrowed rostrum and sinuous lateral margins dorsally, cuticle complex, see description
4.	Uropod 1 with 5+ basofacial setae, epimeron 3 with vertical submarginal row of posterior setae, posterior margin unnotched
	Epimeron 3 with facial setae
6.	Rostrum elongate, wrists of gnathopods short, inner ramus of uropod 1 with accessory apical nails
	nails
7.	Coxae 1-3 with more than 2 elongate ventral setae, epimeron 3 lacking fully posterodorsa setule
	Coxae I-3 with only 2 elongate ventral setae, epimeron 3 with fully posterodorsal setule 8
8.	Each lobe of telson with 2 apical spines, rostrum heavily reduced in length
9.	Each lobe of telson with one apical spine, rostrum very narrow but elongate
10.	Article 2 of pereopod 5 heavily setose ventrally, cuticle villose
	of uropod I with 2 apicolateral spines
	Key II (Gradal and Identificatory)
1.	Inner ramus of uropod 1 with apical accessory nail
	Inner ramus of uropod 1 lacking accessory nail

	_
2.	Coxa 4 with long ventral setae
3.	Tooth of enimeron a large face with long even row of setae 1. B. panamunus, new species
	Tooth of enimeron & small face lacking any but 1-2 scattered setae
4.	Urosomite 1 with long row of lateral setae
=	Epimeron 3 with 2 or more ventral setae
Э.	Epimeron 3 with 0-1 ventral seta
6.	Fnimeron 3 with setae fully facial
	Frimeron 3 lacking fully facial setae
7.	Uropod 1 with 0-1 basofacial seta (right lacinia mobilis simple) 31. B. yorlunus, new species
	Uropod 1 with 3+ basofacial setae (right lacinia mobilis bifid)
8.	Mandibular molars with disjunct spine close to other spines, see descriptions for other details
	Mandibular molars with disjunct spine remote from other spines, see descriptions for
	other details
9.	Epimeron 3 with midposterior setules, article 5 of gnathopod 1 elongate
•	Epimeron 3 lacking midposterior setules, article 5 of gnathopod 1 short
	9. B. muldarpus, new species
10.	Tooth on epimeron 3 large, cuticular setules surrounded by alate plaques
	7. B. cartoo, new species
	Tooth on epimeron 3 medium-small, cuticular setules lacking alate plates
	Epimeron 3 with strong oblique row of setae on face
11.	Epimeron 3 with only one facial seta
12.	Rostrum weakly constricted, main spine on article 5 of pereopods 1-2 reaching apex of
	article 6 (male) 6. B. apari, new species
	Rostrum unconstricted, main spine on article 5 of pereopods 1-2 falling well short of apex
	of article 6 (female)
13.	Coxa 4 with long ventral setae
14	Article 2 of percopod 5 with 2 or more clongate ventral setules or setae or with numerous
	ventral setules
	Article 2 of pereopod 5 with ventral setules short, sparse, or absent
15.	Posteroventral tooth on epimeron 3 small, not longer than other posterior teeth (right
	lacinia mobilis fully bifid)
	Posteroventral tooth on epimeron 3 large, much longer than other posterior teeth (if other
16	teeth present at all), tooth large in any event
10.	
	Tooth of epimeron 3 and ventral setae on article 2 of pereopod 5 of elongate variety17
17.	Article 2 of pereopod 3 rounded posterodorsally 16. B. babaneekus, new species
	Article 2 of pereopod 3 with sharp posterodorsal cusp 17. B. gelarus, new species
18.	Coxa 1 with anterior and posterior marginal tangents perfectly parallel
	Coxa 1 with anterior and posterior marginal tangents slightly to strongly divergent15
19.	Right lacinia mobilis bifid
	Right lacinia mobilis simple
20.	Epimeron 3 lacking posterodorsal setule, spine(s) on inner ramus of uropod 1 enlarged
	Epimeron 3 bearing posterodorsal setule, spines on inner ramus of uropod 1 not enlarged
01	Asial- E of annual O 11
41.	Article 5 of percopod 2 with posteroproximal spine(s), epimeron 2 not protuberant postero- ventrally in female
	Article 5 of pereopod 2 lacking posteroproximal spine, epimeron 2 protuberant postero-
	ventrally in female
22.	Head evenly ovate in dorsal view, cuticle relatively simple 28. B. ularitus, new species
	Head with narrowed rostrum and sinuous lateral margins in dorsal view, cuticle complex
00	(Figure 170)
43.	Epimeron 3 with very large tooth (right lacinia mobilis simple, coxa 1 with only 2 long

	setae) 19. B. narus, new species
	Epimeron 3 with small tooth or none
24.	Epimeron 3 with single submarginal posterior vertical row of setae, other facial setae absent
	Epimeron 3 with or without posterior setae but when present, face bearing other setae, or only facial setae present
25.	Right lacinia mobilis bifid
	Right lacinia mobilis simple 30. B. jirrandus, new species
26.	Adult coxa 1 (and usually 2-3) with only 2 long setae
	Adult coxa 1 with 3 or more long setae30
27.	Rostrum vestigial 37. B. wulgaru, new species
	Rostrum thin but elongate
28.	Article 2 of pereopod 5 with few or no long ventral setae, cuticle lacking villi
	Article 2 of percopod 5 heavily setose ventrally, cuticle villose29
29.	Outer ramus of uropod 1 with long gap between apex and apicalmost dorsal spine, peduncle
	of uropod 1 with 2 apicolateral spines
	Outer ramus of uropod 1 with dorsal spination continuous to apex, peduncle of uropod
	1 with only one apicolateral spine
3 0.	Right lacinia mobilis simple
	Right lacinia mobilis bifid
31.	Gap between apices of rami on uropod 1 and apicalmost spines much greater than between base to most proximal spines, epimeron 3 with posteroventral notch obsolescent or absent
	(only males known)
	Gap between apices of rami on uropod 1 and apicalmost spines not greater than between base to most proximal spines, epimeron 3 with posteroventral notch well developed, marked by tooth in both sexes
32 .	Rostrum elongate, wrists of gnathopods short, inner ramus of uropod 1 often with accessory apical nail (but occasionally not)
	Rostrum short, wrists of gnathopods elongate, inner ramus of uropod 1 lacking accessory
••	apical nail
	Article 5 of pereopods 1-2 lacking posteroproximal spines 20. B. gambodeni, new species Article 5 of pereopods 1-2 bearing posteroproximal spine(s)
34.	Epimeron 3 with 1-3 long ventral setae
	Epimeron 3 with 0-3 short posteroventral setules only37
3 5.	Facial setae on epimeron 3 scattered irregularly 21. B. maamus, new species
	Facial setae of epimeron 3 arranged in oblique row
36 .	Basofacial setae of uropod 1 = 0, inner ramus of uropod 2 with one spine, articulation line
	of urosomite 1 well developed and see description 22. B. lowannus, new species
	Basofacial setae of uropod 1 = 2, inner ramus of uropod 2 with 2 spines, articulation line
	of urosomite 1 weak, and see discussion in text 23. B. kyeemus, new species
37.	Article 1 on mandibular palp slightly elongate, article 5 of pereopods 1-2 with one postero-
	proximal spine (article 5 on gnathopod 1 weakly elongate) 27. B. munggai, new species
	Article 1 of mandibular palp short, article 5 of pereopods 1-2 with 2 posteroproximal spines
	(article 5 of gnathopod 1 variable)
38.	Article 5 on gnathopod 1 ordinary, inner ramus of uropod 1 with 2 dorsal spines
	25. B. kokorus, new species
	Article 5 on gnathopod 1 elongate, inner ramus of uropod 1 with one dorsal spine
	26. B. kinkus, new species

Aids to Identification in Birubius

Besides the keys to the species of *Birubius*, which emphasize conditions of the right lacinia mobilis and inner ramus of uropod 1, the following lists of character alternatives may assist the identifier in isolating groups of species in this genus. Each species with the character in positive degree is

listed with its assigned number to assist finding the species in the text.

Kind of epimeron 3 (see Figure 83 for graphic identification of classes)

- 1: 1, panamunus; 3, nammuldus.
- 2a, b. 7, cartoo; 8, thalmus; 16, babaneekus; 17, gelarus; 18, quearus.
- 3: 19, narus.

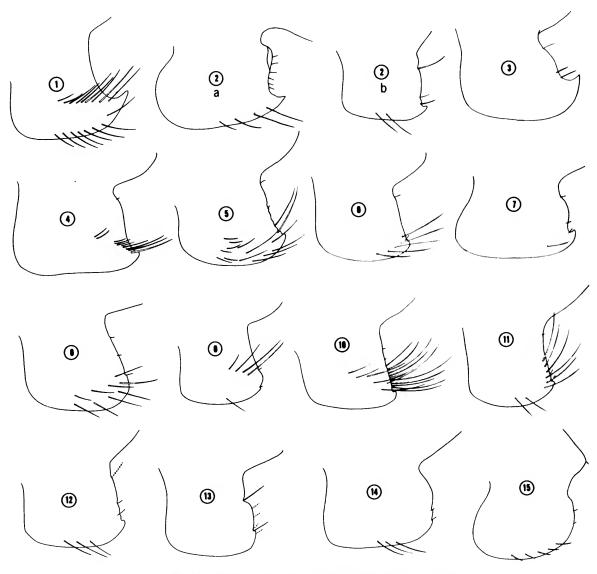


FIGURE 83.—Kinds of epimeron 3 of Birubius (see text, page 199).

- 4: 6, apari.
- 5: 4, myallus; 5, kareus; 21, maamus.
- 6: 9, muldarpus.
- 7: 10, gallangus; 32, eake.
- 8: 31, yorlunus.
- 9: 22, lowannus; 23, kyeemus.
- 10: 20, gambodeni; 25, kokorus; 26, kinkus; 27, munggai.
- 11: 24, batei?; 30, jirrandus.
- 12: 2, lorus; 11, mayamayi; 12, wirakus; 14, karobrani; 15, booleus; 28, ularitus; 29, eleebanus.
- 13: 34, taldeus; 35, yandus; 36, maldus; 37, wulgaru.
- 14: 13, chintoo.

- 15: 33, kabbulinus (male).
- Coxa 4 with long ventral setae: 1, panamunus; 2, lorus; 3, nammuldus; 11, mayamayi; 12, wirakus; 13, chintoo; 14, karobrani; 15, booleus; 16, babaneekus; 17, gelarus; 18, quearus; 28, ularitus; 29, eleebanus.
- Article 2 of pereopod 5 with long ventral setae: 14, karobrani; 18, babaneekus; 17, gelarus; 34, taldeus; 35, yandus; 37, wulgaru.
- Article 5 of percopods 1-2 with posteroproximal spine(s):
 1, panamunus; 2, lorus: 4, myallus; 5, kareus; 9, muldarpus;
 10, gallangus; 12, wirakus; 15, booleus; 19, narus; 20, maamus; 22, lowannus; 23, kyeemus; 24, batei?; 25, kokorus;

26, kinkus; 27, munggai; 30, jirrandus; 31, yorlunus; 32, eake; 33, kabbulinus; 34, taldeus; 35, yandus; 36, maldus; 37, wulgaru.

Article 5 of antenna 2 with more than one set of midfacial spines: 1, panamunus; 3, nammuldus; 4, myallus; 5, kareus; 9, muldarpus; 11, mayamayi; 12, wirakus; 14, karobrani; 15, booleus; 16, babaneekus; 17, gelarus; 18, quearus; 20, gambodeni; 24, batei?; 28, ularitus; 29, eleebanus.

Article 5 of antenna 2 with single set of 3 spines: 7, cartoo; 21, maamus; 23, kyeemus; 25, kokorus (occasionally); 27, munggai; 30, jirrandus (occasionally 4).

Articles 4-5 of pereopod 4 extremely thin: 11, mayamayi; 14, karobrani; 15, booleus; 16, babaneekus; 17, gelarus; 18, quearus; 28, ularitus.

Percopod 3 with facial ridge: 1, panamunus; 2, lorus; 3, nammuldus; 7, cartoo; 8, thalmus; 10, gallangus; 13, chintoo; 29, eleebanus.

Coxa 1 almost or fully rectangular: 2, lorus; 3, nammuldus; 6, apari; 7, cartoo; 12, wirakus; 13, chintoo; 15, booleus.

Setae widely spread on coxa 1: 1, panamunus; 2, lorus; 3, nammuldus; 4, myallus; 7, cartoo; 8, thalmus; 11, mayamayi; 14, karobrani; 16, babaneekus; 17, gelarus; 18, quearus.

Coxa 1 bearing only 2 long ventral setae: 19, narus; 34, taldeus; 35, yandus; 36, maldus; 37, wulgaru.

Setae on article 2 of antenna 1 highly proximal: 2, nammuldus; 4, myallus (weak); 21, maamus; 23, kyeemus; 24, bateit; 30, jirrandus; 31, yorlunus; 34, taldeus; 35, yandus; 36. maldus.

Telson with more than one posterior spine on each lobe: 8, thalmus (extra setule); 20, gambodeni (setae); 37, wulgaru: (16, babaneekus, exceptional specimens).

Urosomite 1 with lateral row of setae: 2, lorus.

Outer ramus of uropod 2 with accessory nail: 31, yorlunus. Rostrum vestigial: 37, wulgaru.

1. Birubius panamunus Barnard and Drummond

FIGURES 84-87

Birubius panamunus Barnard and Drummond, 1976:544-545.

Description of Female.—Head about 21 percent of total body length, greatest width about 73 percent of length; rostrum scarcely constricted, broad, exceeding middle of article 2 on antenna 1. Eyes small to medium, largely occluded with pigment. Article 1 on peduncle of antenna 1 almost 1.5 times as long as wide, about 2.5 times as wide as article 2, ventral margin with about 6 setules, unproduced dorsal apex with 3 setules; article 2 about 0.85 times as long as article 1, with ventral cycle of 6 setae; primary flagellum with 7–8 articles, about half as long as peduncle, bearing short aesthetascs; accessory flagellum with 6–7 articles. Spine formula on article 4 of antenna 2 = 3–4–7 or 1–3–4–6, dorsal margin with notch bearing 4 setae,

ventral margin with 7 groups of 1-2 long to medium setae, one ventrodistal long spine; article 5 about 0.85 times as long as article 4, facial spine formula = 1-2-2-2 or 1-3-2-2, dorsal margin naked, ventral margin with 7 sets of single setae plus occasional short seta, 2 ventrodistal long to medium spines and setae; flagellum about 0.85 times as long as articles 4-5 of peduncle combined, with 11 articles. Mandibles with weak to medium palpar hump; right incisor with 3 teeth and notch; left incisor with 4 humps in 2 branches; right lacinia mobilis bifid, distal branch shorter than proximal, broad, subbifid or denticulate, proximal branch simple, pointed, with marginal denticles; left lacinia mobilis with 4 teeth; right rakers 7-9; left rakers 8-10; molar in form of bulbous hump demarcated mainly by spines, right and left molars with 4-5 primarily long spines, plus one short spine weakly disjunct or not; palp article 1 short, article 2 with one long inner apical seta and 2-4 other shorter inner setae, and 1-4 outer facial setae, article 3 about 1.4 times as long as article 2, oblique apex with 10 spine-setae, basofacial formula = 1-2 or 1-3. Inner plate of maxilla 1 somewhat thin, bearing one medium apical seta, one similar apicomedial seta, 2 apicolateral slightly shorter setae; palp article 2 with 5 apical-medial marginal spines and 4-5 submarginal setae. Plates of maxilla 2 extending subequally, outer slightly broader than inner, outer with 4 apicolateral setae, inner with 2-4 medial setae. Inner plate of maxilliped with 2 large, thick apical spines, 3 apicofacial setae, 4-5 medial setae; outer plate with 7-9 medial and apical spines, 3-4 apicolateral setae; palp article l with apicolateral seta, article 2 with 3 widely spaced apicolateral setae, medial margin of article 2 moderately to weakly setose, article 3 protuberant, with 3-4 facial setae, 2 lateral setae, nail of article 4 medium, with 2 accessory setules. Coxa 1 scarcely expanded distally, anterior margin straight; main ventral setae of coxae 1-4 = 17-15-11-8, posteriormost seta of coxae 1-2 shortened; anterior and posterior margins of coxa 4 weakly divergent, posterior margin oblique, convex, posterodorsal corner sharp, posterodorsal margin long, concave, width-length ratio of $\cos 4 = 14:17$. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = (4-6)-(7-9)-(4-5)-7, long anteriors = (4-7)-(10-18)-7-0, short anteriors = 1-(2-3)-4(1-3), no others. Gnathopods ordinary; width ratios

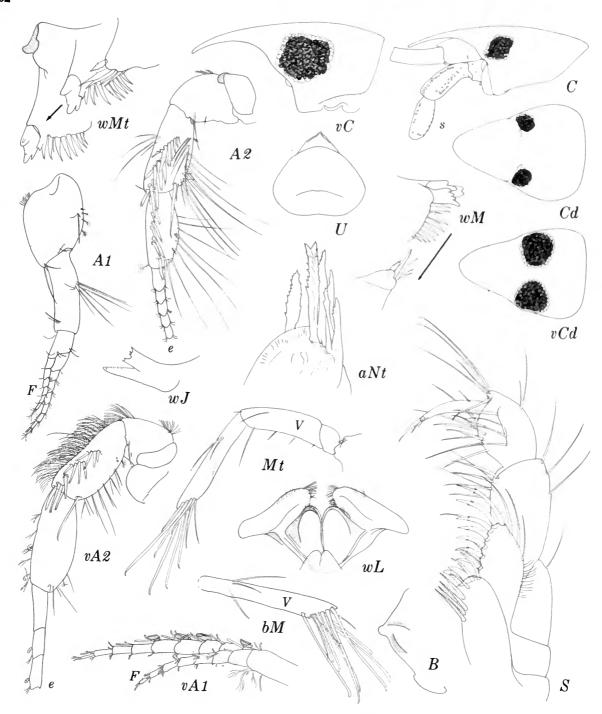


FIGURE 84.—Birubius panamunus, new species, holotype, female "h," 6.5 mm (a= female "a," 4.7 mm; b= female "b," 5.5 mm; v= male "v," 4.6 mm; w= female "w," 5.2 mm).

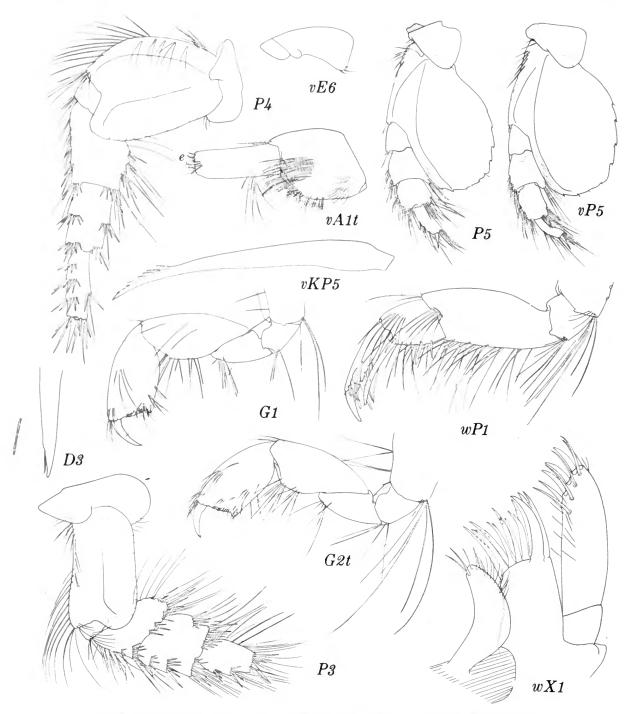


FIGURE 85.—Birubius panamunus, new species, holotype, female "h," 6.5 mm (v = male "v," 4.6 mm; w = female "w," 5.2 mm).

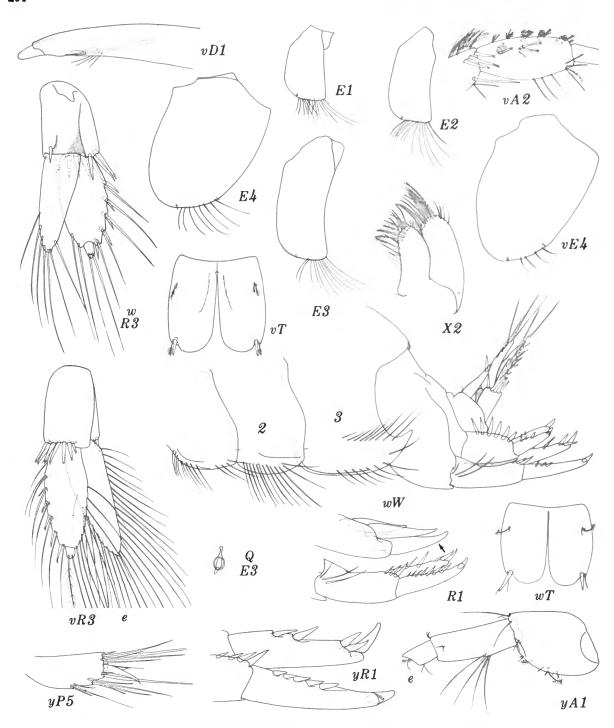


FIGURE 86.—Birubius panamunus, new species, holotype, female "h," 6.5 mm (v = male "v," 4.6 mm; w = female "w," 5.2 mm; y = male "y," 6.1 mm).

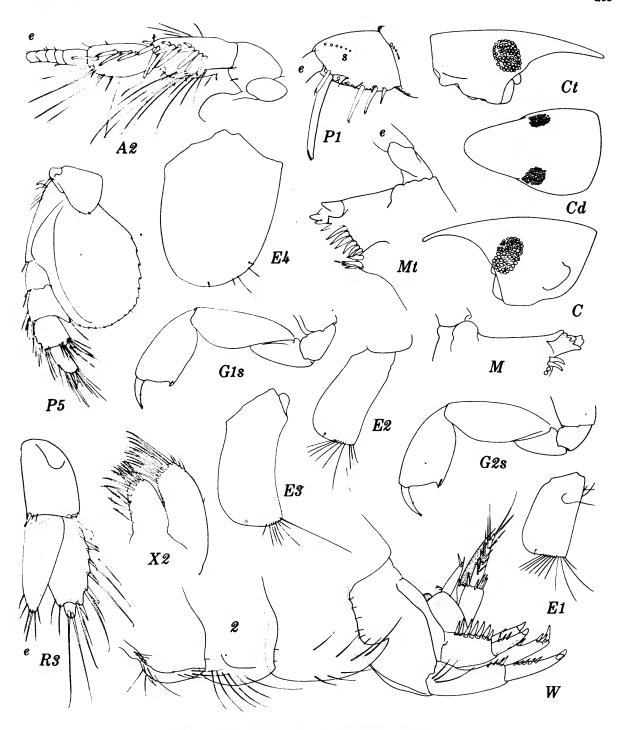


FIGURE 87.—Birubius panamunus, new species, male "y," 6.1 mm.

of articles 5-6 on gnathopods 1-2 = 30:31 and 31:31, length ratios = 71:60 and 71:58; palmar humps small, palms oblique; article 5 of gnathopod 1 elongate, ovate, posterior margin rounded-flat; article 5 of gnathopod 2 elongate, ovate, posterior margin rounded-flat. Pereopods 1-2 similar; facial setae formula on article 4 = 5-8 and 5-8, on article 5 = 6-8 and 6-10; main spine of article 5 extending to M. 100 + on article 6, article 5 with 2-3 proximoposterior spines, spine formula of article 6 = 4 and 6 or 5 and 6 or 5 and 7 plus middistal seta; acclivity on inner margin of dactyls of pereopods 1-2 weak, emergent setule long, midfacial pluseta ordinary. Coxae 5-7 posteroventral setuleseta formula = 9-3-1. Articles 4-5 of pereopods 3-4 broad, facial spine rows moderately developed, facial ridge formula on article 2 of pereopods 3-5 = 1-2-2; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 44:42:40:23, of pereopod 4 = 66:39:27:16, of pereopod 5 = 71:24:19:9, length ratios of pereopod 3 = 81:34:37:35, of pereopod 4 = 90:53:45:49, of pereopod 5 = 98:25:22:21; article 2 of pereopod 5 exceeding apex of article 4; medial apex of article 6 lacking digital processes. Posteroventral corner of epimeron 1 rounded-quadrate, posterior margin weakly convex, setule above corner, anteroventral margin with 6-10 medium setae, posteroventral face with 4 medium setae, posterior pair set vertically; posteroventral corner of epimeron 2 weakly protuberant, guarded by setule sinus, posterior margin convex, facial setae = 12-14, posteriormost pair set vertically; posteroventral corner of epimeron 3 rounded, with large tooth, posterior margin weakly concave, one small setule in crotch, ventral margin with 8-10 setae evenly spread, face with horizontal row of 7-9 setae in middle, epimeron 3 with weak rugosities at posterodorsal invagination. Urosomite 1 naked, articulation line incomplete; urosomite 3 weakly protuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, inner ramus of uropod 1 with two accessory nails, outer ramus of uropod 1 with 5-7 (rarely 3-8) dorsal spines, inner with 2 (rarely 3), outer ramus of uropod 2 with 3-4 dorsal spines, inner with one dorsomedial spine; peduncle of uropod 1 with 3-4 apicolateral spines, and 3-4 basofacial setae, medially with 4-5 marginal setae and spines, apicalmost enlarged; peduncle of uropod 2 with 6-7 dorsal spines, medially with one apical spine. Peduncle of uropod 3 with 8-9 ven-

tral spines, dorsally with one lateral spine, 1-2 medial spines; rami submasculine, inner extending to M. 100+ on article 1 of outer ramus, apex with 2 setae, medial and lateral margins with 1 and 4 setae, article 2 of outer ramus short, 0.18, bearing 2 long setae, apicomedial margin of article 1 with 2 setae in tandem, lateral margin with 4 acclivities, spine formula = 1-1-1-1, setal formula = 1-1-1-1. Telson short, length-width ratio = 13:15, almost fully cleft, each apex wide, rounded, lateral acclivity deep, narrow, bearing ordinary lateral setule, spine next medial of length equal to setule, midlateral setules diverse. Cuticle with ordinary bulbar setules, emergent setules short.

DESCRIPTION OF MALE.—Rostrum slightly narrower than in female. Article 2 of antenna 1 with 6 ventral setae; primary flagellum with 7-9 articles, one calceolus each on articles 1-5, aesthetascs strongly developed. Facial spine formula on article 4 of antenna 2 = 3-4-4 or 3-4-5 or 3-5-5 or 3-1-4-4, on article 5 = 2-2 or 2-1, article 5 with 4-5 dorsal sets of male setae and 4 calceoli, ventrodistal apex with one thin spine and 2 setules, flagellar formula = (28-36), 2-3-4-5, 7, 9 . . . penultimate. Basofacial setal formula on article 3 of mandibular palp = 2-2 or 3-2. Coxa 4 more elongate than in female; ventral setal formula of coxae 1-4 = 15-(12-14)-8-4. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 3-5-3-5, long anteriors = 0-4-7-(4-5). Facial and setal-spine formulas of pereopods 1-2 on article 4 = 6-7 and 6, on article 5 = 4-6 and 7-8, on article 6 = 4 + 5and 5 + 5 plus middistal seta. Article 2 of only pereopods 4-5 narrower than in female, article 6 of pereopods 3 and 5 and articles 5-6 of pereopod 4 thinner and more elongate than in female; spines and setae shortened on articles 2-3 of gnathopods 1-2 and pereopods 1-2 and 5. Coxa 6 with posterior lobe deepened. Article 5 of pereopod 5 with special posterodistal spine. Epimera 1-3 broadened; setal formulas, epimeron 1 anteroventral = 10-14, epimeron 2 facial = 6-11, (anterior = 1-3, absent in female), epimeron 3 facial = 4-7, ventral = 3-7. Urosome elongate, narrowed, declivity of fused urosomites 1-2 sharpened, articulation strongly marked. Spine formulas of uropods, uropod 2 peduncle dorsal = 10-11, dorsal spines on outer ramus of uropod 1 = 5, ventral spines on peduncle of uropod 3 = 7, spine formula on article 1 of outer ramus = 1-0-1-1-1-1-1, setal formula = 1-2-1-1-1

l-l-l or l-l-l-l-l-l. Telson elongate, distal spines shortened.

OBSERVATIONS (male).—Male "y," 6.1 mm: Though unusually large, is immature, lacking penes; eyes relatively small; dorsal pleonal ridge poorly defined; rami of uropod 3 underdeveloped; peduncle of uropod 1 with only 3 basofacial setae, of uropod 2 with only 7 dorsal spines; spine formula on article 4 of antenna 2 = 1-3-3-5, on article 5 = 2-2; basofacial formula of article 3 on mandibular palp = 1-1; inner plate of maxilla 1 with only 2 stout setae, one palp bearing extra apical spine; article 5 of pereopods 1-2 with 3 proximoposterior spines; epimera poorly setose.

Male "v" 4.6 mm: Facial spines on article 4 of left antenna 2 abnormal = 3-1-4-4, erratically arranged; article 5 devoid of facial spines; right antenna 2 normal.

ILLUSTRATIONS.—The inner plate of the maxilliped bears one small, simple, apicolateral and dorsal seta not shown; dorsomedial spine on inner ramus of uropod 2 hidden, not shown; anterior marginal setae on epimeron 3 of male omitted; right and left sides of illustrated male head distinctive owing to bilateral deformation; article 4 of antenna 2 on male "v" not flattened but article 5 fully flattened.

HOLOTYPE.—NMV, female "h," 6.5 mm.

Type-Locality.—PPBES 337, 11 Mar 1971, Port Phillip Bay, Victoria, Australia, 8 m, fine sand.

VOUCHER MATERIAL (all illustrated).—Typelocality, female "w," 5.2 mm; PPBES 919/5, male "v," 4.6 mm; PPBES 919/4, female "b," 5.5 mm; PPBES 901/4, female "a," 4.7 mm; CPBS 31E/1, male "y," 6.1 mm.

RELATIONSHIP.—Birubius panamunus (1) is considered to be the primitive model of Birubius in which numerous characters bear weak resemblance to more primitive phoxocephalids such as Pontharpinia. These characters are the fully broad rostrum, the fully developed right lacinia mobilis, the large tooth on epimeron 3, at least a few facial setae on the epimera, basofacial setae on the peduncle of uropod 1, long setae on coxa 4, the presence of accessory nails, at least on the inner ramus of uropod 1, thus reflecting remnants of continuous dorsal spination seen in all rami of uropods 1–2 in Pontharpinia, and reasonably broad articles 4–5 of pereopods 3–4.

Another possible model is B. mayamayi (11) but

in that species the epimeral tooth and setae are reduced. *Birubius gambodeni* (20) lacks setae on coxa 4, lacks the accessory nails on uropod 1 and has a smaller tooth on epimeron 3.

MATERIAL.—PPBES, 30 samples from 10 stations (139); CPBS, 2 samples from 2 stations (3); SBS, 2 samples from 2 stations (2).

DISTRIBUTION.—Victoria: Western Port and Port Phillip Bay, 6-22 m, sand, silty sand, clay. New South Wales: off Malabar, 66 m.

2. Birubius lorus, new species

FIGURES 88-90

DESCRIPTION OF FEMALE.—Head about 17 percent of total body length, greatest width about 65 percent of length; rostrum constricted, narrow, almost reaching middle of article 2 on antenna 1. Eyes large, mostly occluded with pigment. Article 1 on peduncle of antenna 1 about 1.3 times as long as wide, about 2.2 times as wide as article 2, ventral margin with about 9 setules, unproduced dorsal apex with 3 setules; article 2 about 0.9 times as long as article 1, with ventral cycle of 4-5 setae; primary flagellum with 11 articles, about 1.1 times as long as peduncle, bearing long aesthetascs; accessory flagellum with 7 articles. Spine formula on article 4 of antenna 2 = 1-3-4-4 or 1-3-4-3, dorsal margin with notch bearing 3 setae, ventral margin with 5 groups of 1-2 long to medium setae, one ventrodistal medium spine; article 5 almost 0.85 times as long as article 4, facial spine formula = 1-2, dorsal margin bearing 2 sets of short setae, ventral margin with 4 sets of 1-2 long to short setae, 2 ventrodistal long to medium spines and setae; flagellum about 1.4 times as long as articles 4-5 of peduncle combined, with 12 articles. Mandibles with medium palpar hump; right incisor with 4 teeth; left incisor with 6 teeth; right lacinia mobilis bifid; distal branch shorter than proximal, flabellate, subtrifid, denticulate, with one facial hump, proximal branch simple, pointed, with marginal denticles or facial humps; left lacinia mobilis with 4 teeth, middle teeth shortened; right rakers 5-6; left rakers 5-6; molar in form of bulbous hump, right molar with 5 primarily long spines plus one spine strongly disjunct, left molar with 10 primarily long spines, no spine disjunct; palp article 1 short, article 2 with one short inner apical

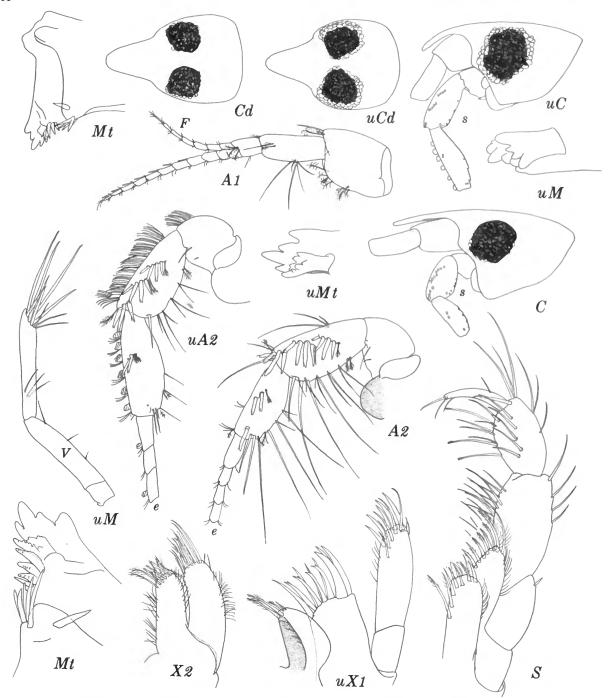


FIGURE 88.—Birubius lorus, new species, holotype, female "a," 4.60 mm (u = male "u," length unknown).

seta and 2 other shorter inner setae, article 3 about 1.2 times as long as article 2, oblique apex with 9-10 spine-setae, basofacial formula = 1-1 or 0-1. Inner plate of maxilla 1 large, bearing one long apical pluseta, one similar apicomedial seta, 2 apicolateral much shorter setae; palp article 2 with 5 apicalmedial marginal spines and 5 submarginal setae. Plates of maxilla 2 extending subequally, outer scarcely broader than inner, outer with 2 apicolateral setae, inner with no medial setae. Inner plate of maxilliped with 3 large, thick apical spines, 3 apicofacial setae, 4 medial setae; outer plate with 7 medial and apical spines, one apicolateral seta; palp article I with apicolateral spine, article 2 with 4 lateral setae, medial margin of article 2 moderately setose (naked apically), article 3 scarcely protuberant, with 5 facial setae, 3 lateral setae, nail of article 4 long, with 2 accessory setules. Coxa 1 not expanded distally, anterior margin almost straight; main ventral setae of coxae 1-4 = (10-13)-10-(4-5)-3, posteriormost seta of coxae 1-3 shortened; anterior and posterior margins of coxa 4 strongly divergent, posterior margin very oblique, convex, posterodorsal corner subsharp, posterodorsal margin short, undulant, width-length ratio of coxa 4 = 9:10. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 3-4-4(5-6), long anteriors = 7-(11-12)-0-0, short anteriors = 1-1-4-1. Gnathopods thin; width ratios of articles 5-6 on gnathopods 1-2 = 28:28 and 29:30, length ratios = 78:61 and 75:58; palmar humps small, palms weakly oblique; article 5 of gnathopods 1-2 elongate, ovate, posterior margin roundedflat, long. Pereopod 2 slightly stouter than pereopod 1, especially article 4; facial setae formula on article 4 = 5 and 6, on article 5 = 4 and 6; main spine of article 5 extending to M. 100 on article 6, article 5 with one proximoposterior spine; spine formula of article 6 = 3 and 5 or 4 and 5 plus middistal seta, some spines especially long; acclivity on inner margin of dactyls of pereopods 1-2 sharp, produced as tooth, emergent setule long, midfacial pluseta long. Coxae 5-7 posteroventral setule formula = 1-1-1. Articles 4-5 of pereopods 3-4 of ordinary width, facial spine rows dense to moderately developed, facial ridge formula on article 2 of pereopods 3-5 = 1-2-2; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 44:42:40:21, of pereopod 4 = 60:38:25:12, of pereopod 5 = 61:23:20:9, length ratios of pereopod 3 = 77:33:42:40, of

pereopod 4 = 82:49:38:46, of pereopod 5 = 87: 21:20:23, article 2 of pereopod 5 almost reaching apex of article 4; medial apex of article 6 deeply combed and bearing 4 digital processes. Posteroventral corner of epimeron 1 rounded-quadrate, posterior margin convex, corner with setule, anteroventral margin with 3-7 medium setae, posteroventral face with 2 long setae; posteroventral corner of epimeron 2 rounded-quadrate, with setule, posterior margin convex, facial setae = 9-10, posteriormost pair set vertically; posteroventral corner of epimeron 3 weakly and broadly protuberant, with setule sinus, posterior margin straight, with 7 setule notches, ventral margin with 3-4 submarginal setae mainly posterior. Urosomite 1 with lateral horizontal row of 5-11 setae, articulation line complete; urosomite 3 unprotuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, inner ramus of uropod 1 with two accessory nails, outer ramus of uropod 1 with 3-4 dorsal spines, inner with one, outer ramus of uropod 2 with 1-2 dorsal spines, inner with one dorsomedial spine; peduncle of uropod 1 with 2 apicolateral spines, and 1-3 basofacial setae, medially with 3 marginal setae and spines, apicalmost an enlarged spine; peduncle of uropod 2 with 4 dorsal spines, medially with one large, apical spine. Peduncle of uropod 3 with 5 ventral spines, dorsally with one lateral spine, one medial spine; rami masculine, inner extending to M. 100 on article 1 of outer ramus, apex with 3 setae, medial and lateral margins setose, article 2 of outer ramus ordinary, 0.17, bearing 2 medium setae, medial margin of article 1 with 4 setae, lateral margin with 4 acclivities, spine formula = 0-1-1-1-1, setal formula = 1-1-1-1-1. Telson long, length-width ratio = 6:5, almost fully cleft, each apex wide, rounded, lateral acclivity shallow, weak, bearing short ordinary lateral setule, spine next medial of length equal to setule, midlateral setules diverse. Cuticle with ordinary bulbar setules of varying sizes closely packed with pipes and horseshoes, surface bearing fine striations in form of linear fingerprint pattern, emergent setules ordinary.

DESCRIPTION OF MALE.—Only known specimen broken, missing urosome and epimeron 3. Rostrum narrower than in female. Eyes very large, forming weak lateral bulges. Article 2 of antenna 1 with 5 ventral setae; primary flagellum with 11 articles, one calceolus each on articles 1–8, one aesthetasc

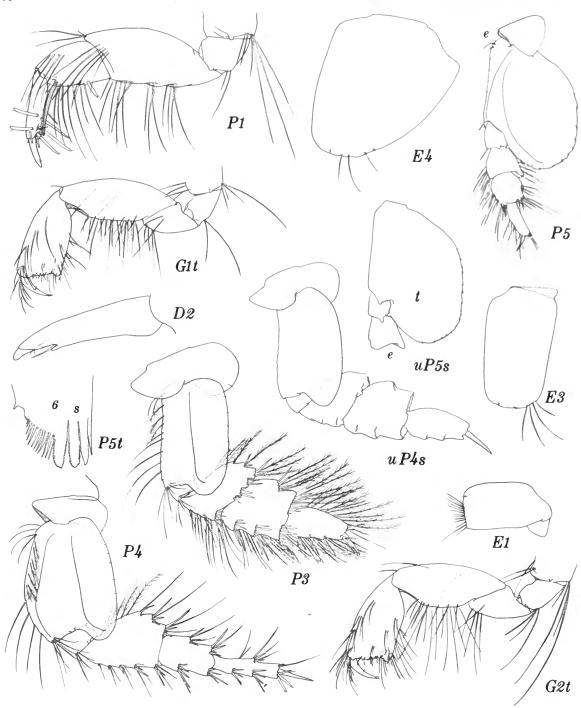


FIGURE 89.—Birubius lorus, new species, holotype, female "a," 4.60 mm (u = male "u," length unknown).

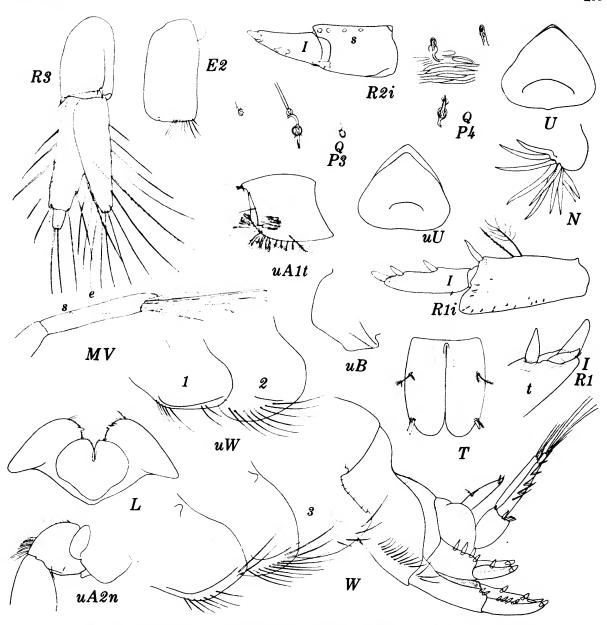


FIGURE 90.—Birubius lorus, new species, holotype, female "a," 4.60 mm (u = male "u," length unknown).

strongly developed on articles 9 and 10; accessory flagellum with 7 articles. Facial spine formula on article 4 of antenna 2=3-4-4, on article 5=2 plus 1-3 accessory setules (varying right and left), article 5 with 6 dorsal sets of male setae and 2-6 calceoli, ventrodistal apex with 2 thin spines and

one setule; flagellar formula = 23 (broken), 1-2-3-4, 6, 8...22. Right rakers 6 plus 1-2 rudimentaries; left rakers 7 plus one rudimentary; right molar with 7 spines plus one weakly disjunct spine; left molar with 6 spines and one rudimentary spine, none disjunct; basofacial setal formula of article 3

on mandibular palp = 1-2. Inner plate of maxilliped with only 2 apical spines. Coxa 4 like that of female but smaller in relation to coxa 1; ventral setal formula of coxae 1-4 = (10-11)-(7-8)-5-3. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 1-(1-3)-3-3, long anteriors = (5-6)-8-0-0, short anteriors = 1-1-3-1, no others. Articles 4-5 of pereopods 1-2 thinner than in female, especially pereopod 1. Article 2 of only pereopod 3 narrower than in female, articles 4-5 of pereopod 3 also narrower, article 4 of pereopod 4 slightly broadened; pereopod 5 larger relative to pereopod 3 than in female. Epimera 1-2 (3 unknown) broadened; setal formulas, epimeron 1 anteroventral = 5, posteroventral = 2, epimeron 2 facial = 8. Cuticle with mainly bulbar setules and their rudiments, pipes and horseshoes obsolescent, striations strong on pereopods 3-5 and epimera.

HOLOTYPE.—Figures herein presented of female "a," 4.60 mm. (The holotype is designated as the figures because during placement of parts of that specimen in its depository vial a few parts of the holotype of *Birubius eleebanus* were mixed into the vial; during attempts to segregate the mixture the telson and one maxilla 2 of *B. lorus* were lost; one maxilla 2 of *B. eleebanus* may be deposited in this vial as this mouthpart in the two species is indistinguishable; the holotype specimen may therefore be confounded but designation of the figures ameliorates the problem. No other specimen is as desirable as this for designation as a holotype.)

Type-Locality.—EBS 363, 10 Jul 1973, Lake Macquarie, Salt's Bay, New South Wales, Australia, 0.3 m, coarse sand.

VOUCHER MATERIAL.—Type-locality: female "b," 4.00 mm; female "c" 3.90 mm; female "d," 3.93 mm; male "u," broken, true length unknown (illus.).

RELATIONSHIP.—The B. lorus-nammuldus (2-3) group of species is very close to B. panamunus (1) but differs in the absence of a fully facial oblique row of setae, in the smaller tooth on epimeron 3, and in the more trapezoidal coxa 4.

Birubius gallangus (10) has a simple distal branch on the right lacinia mobilis, ordinary gnathopodal hands and lacks long setae on coxa 4.

MATERIAL.—EBS, 4 samples (14).

DISTRIBUTION.—New South Wales, Lake Macquarie, Salt's Bay, 0.3 m, coarse sand.

3. Birubius nammuldus, new species

FIGURES 91, 92

DESCRIPTION OF MALE.—Head about 17 percent of total body length, greatest width about 75 percent of length; rostrum slightly constricted, reaching (unbent) middle of article 2 on antenna 1. Eyes large, mostly clear of pigment but stained ochracerus-rose, ommatidia especially large. Article 1 on peduncle of antenna l about l.l times as long as wide, about 2.5 times as wide as article 2, ventral margin with about 17 setules, weakly produced dorsal apex with 3 setules; article 2 about 0.9 times as long as article 1, with ventral cycle of 6 setae; primary flagellum with 8-9 articles, about 0.55 times as long as peduncle, bearing long aesthetases and one calceolus each on articles 1-4; accessory flagellum with 6 articles. Spine formula on article 4 of antenna 2 = 3-4-4, dorsomedial margins of articles 3-4 fuzzy, ventral margin of article 4 with 6 groups of 1-3 short to medium setae, one ventrodistal medium spine, article 5 about 1.25 times as long as article 4, facial spine formula = 2-2, dorsal margin bearing 7 calceoli and 7 sets of male setae, ventral margin with 5 widespread setae, 5 ventrodistal setules, flagellum elongate, flagellar for $mula = (28-30), 1-5, 7, 9 \dots (27 \text{ or } 29).$ Mandibles with weak palpar hump; right incisor with 3 teeth and notch; left incisor with 5 humps in 2 branches; right lacinia mobilis bifid, distal branch much shorter than proximal, broad, subbifid, denticulate, proximal branch simple, pointed, with marginal denticles; left lacinia mobilis with 4 teeth plus one accessory tooth, middle teeth shortened; right rakers 7 plus one rudimentary; left rakers 7; molar in form of short protrusion, demarcated mainly by spines, right and left molars with 3 primarily long spines, plus one short spine weakly disjunct; palp article 1 short, article 2 with 2 long inner apical setae and 3 other shorter to much shorter inner setae, article 3 as long as article 2, oblique apex with 9 spine-setae, basofacial formula = 2-2. Inner plate of maxilla 1 thin, bearing one long apical pluseta, one shorter apicomèdial pluseta, 2 apicolateral similar setae; palp article 2 with 4 apicalmedial marginal spines and 4 submarginal setae. Plates of maxilla 2 extending subequally, outer broader than inner, outer with 3 apicolateral setae, inner with 2 medial setae. Inner plate of maxilli-

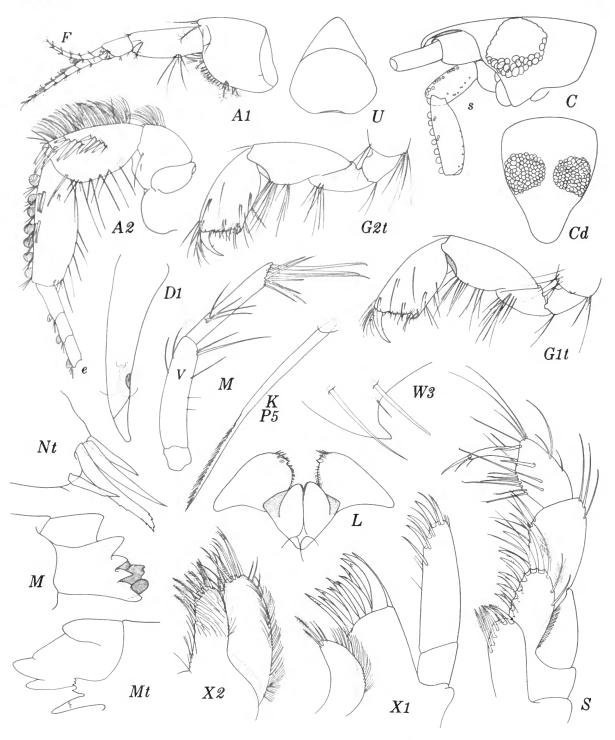


FIGURE 91.—Birubius nammuldus, new species, holotype, male "a," 4.98 mm.

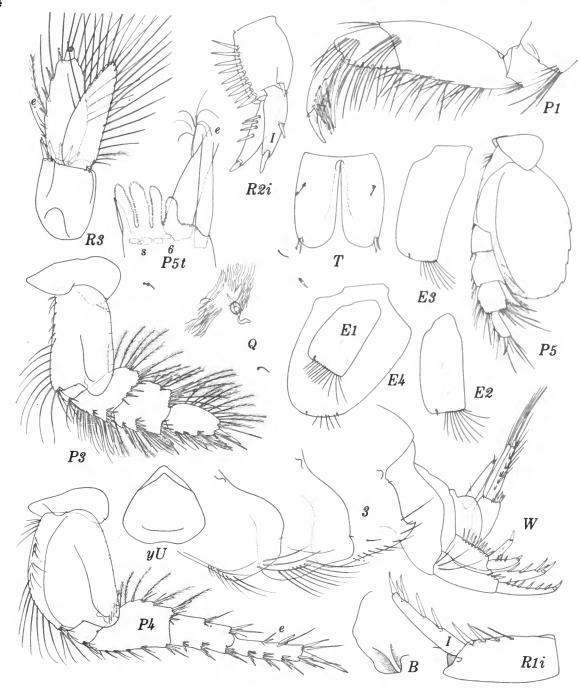


FIGURE 92.—Birubius nammuldus, new species, holotype male "a," 4.98 mm (y = male "y," 5.07 mm).

ped with 2 large, thick apical spines, 2 apicofacial setae, 4 medial setae; outer plate with 7 medial and apical spines, 3 apicolateral setae; palp article 2 with 3 groups of one each apicolateral setae, medial margin of article 2 weakly setose, article 3 weakly protuberant, with 3 facial setae, 3 lateral setae, nail of article 4 long, with 2 accessory setules. Coxa 1 scarcely expanded distally, anterior margin weakly convex; main ventral setae of coxae 1-4 = (12-14)-(8-10)-(7-8)-(4-5), posteriormost seta of coxae 1-2 shortened; anterior and posterior margins of coxa 4 strongly divergent, posterior margin oblique, convex, posterodorsal corner rounded, posterodorsal margin ordinary, width-length ratio of coxa 4 = 3:4; long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = (2-3)-4-3-4, long anteriors = 6-7-(7-8)-(3-4), short anteriors = (1-2)-2-(2-3)-(0-1). Gnathopods somewhat thin; width ratios of articles 5-6 on gnathopods 1-2 = 28:29 and 27:28, length ratios = 69:61 and 67:58; palmar humps ordinary, palms weakly oblique; article 5 of gnathopods 1-2 elongate, ovate, posterior margin rounded. Pereopods 1-2 similar; facial setae formula on article 4 = 6 and 5, on article 5 = 6 and 7; main spine of article 5 extending to M. 100+ on article 6, article 5 lacking proximoposterior spine; spine formula of article 6 = 5 and 5 (or 6 and 5 on pereopod 2) plus middistal seta, some spines especially long; acclivity on inner margin of dactyls of pereopods 1-2 obsolescent, emergent setule short, almost fully immersed, midfacial pluseta very short, highly distad. Coxa 5-7 posteroventral setule formula = 1-2-1. Articles 4-5 of pereopods 3-4 of ordinary width, facial spine rows sparse to moderately developed, facial ridge formula on article 2 of pereopods 3-5 = 1-2-2; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 44:41:36:22, of pereopod 4 = 60: 35:22:12, of pereopod 5 = 66:22:19:8, length ratios of pereopod 3 = 78:36:34:37, of pereopod 4 = 84:52:46:51, of pereopod 5 = 118:25:23:19; article 2 of pereopod 5 reaching middle of article 5, medial apex of article 6 finely combed and bearing 5 digital processes. Posteroventral corner of epimeron I rounded, posterior margin deeply convex, with setule, anteroventral margin with 8 short to medium setae, posteroventral face with 2-3 long setae, one pair set vertically; posteroventral corner of epimeron 2 rounded, weakly protuberant, guarded by dorsal setule sinus, posterior margin

convex, facial setae = 7-12, posteriormost or occasional other pair set vertically; posteroventral corner of epimeron 3 with setule sinus and medium tooth, posterior margin convex, with one long seta, ventral margin with 7 setae evenly spread, face with 1-2 other setae, epimeron 3 with setule on posterodorsal margin set in weak notch. Urosomite 1 naked, articulation line complete; urosomite 3 unprotuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, inner ramus of uropod 1 with two accessory nails, outer ramus of uropod 1 with 6 dorsal spines, extending full margin, inner with 2, outer ramus of uropod 2 with 4 dorsal spines, inner with one dorsomedial spine; peduncle of uropod 1 with 2-3 apicolateral spines, and 3 basofacial setae, medially with 4 marginal setae and spines; peduncle of uropod 2 with 7-9 dorsal spines, medially with one small apical spine. Peduncle of uropod 3 with 6 ventral spines, dorsally with one lateral spinule, one medial spine and setule; rami masculine, inner extending to M. 100 on article 1 of outer ramus, apex with 2 setae, medial and lateral margins setose, article 2 of outer ramus short, 0.14, bearing 2 long setae, medial margin of article 1 setose, lateral margin with 6 acclivities; spine formula = 0-0-1-2-2-2, setal formula = 1s-2-1-1-1-1. Telson elongate, lengthwidth ratio = 33:29, not fully cleft, wide, rounded, lateral acclivity weak, bearing short lateral setule, spine next medial of length subequal to setule, midlateral setules diverse. Cuticle with sparse ordinary bulbar setules of varying sizes mixed with pipes, surface bearing fine striations in form of linear fingerprint pattern, emergent setules short.

ILLUSTRATIONS.—Inner plate of maxilla l not fully flattened in illustration; eyes of all known specimens composed of clear ommatidia but dorsally jumbled, illustration omitting dorsal ommatidia except for outline; holotype with right epimeron 3 bearing only setule at midfacial position of spine.

HOLOTYPE.—WAM, male "a," 4.98 mm.

TYPE-LOCALITY.—WAM 414-73, 2 Sep 1954, Barrow Island, Western Australia, presumably neritic.

VOUCHER MATERIAL.—Type-locality: male "y," 5.07 mm (illus.); male "c," 5.00 mm; male "d," 4.80 mm. WAM 9561: male "m," 4.97 mm; male "k," 5.58 mm; male "v," 4.61 mm; male "z," 4.55 mm. Female unknown.

RELATIONSHIP.—This species differs from B. lorus

(2) in the more crowded setae of epimeron 2, the protuberant posteroventral angle of epimeron 2, the longer spines on the rami of uropods 1-2, the absence of lateral setae on urosomite 1, the presence of a ridge on pereopod 3, a weaker tooth on the dactyls of pereopods 1-2, and in a sharper and larger tooth on epimeron 3.

MATERIAL.—WAM, 2 samples (8).

DISTRIBUTION.—Western Australia, from Barrow Island south of Garden Island, neritic.

4. Birubius myallus, new species

FIGURES 93-97

Description of Female.—Head about 19 percent of total body length, greatest width about 73 percent of length; rostrum weakly constricted, broad, reaching middle of article 2 on antenna 1. Eyes large, clear of pigment. Article 1 on peduncle of antenna 1 almost 1.5 times as long as wide, about 2.3 times as wide as article 2, ventral margin with about 13 setules, weakly produced dorsal apex with 2 setules; article 2 about 0.8 times as long as article 1, with ventral cycle of 9 setae; primary flagellum with 11-14 articles, about 0.63 times as long as peduncle, bearing numerous aesthetascs; accessory flagellum almost as long as primary, with 9-11 articles. Spine formula on article 4 of antenna 2 = 1-3-4-(5-7), dorsal margin with notch bearing 3 setae and setule, ventral margin with 10 groups of 1-2 long to short setae, one ventrodistal long spine; article 5 about 0.8 times as long as article 4, facial spine formula = 2-2-2-2, 1-2-2-2, 1-2-2-1, or 1-2-2-2-1, dorsal margin naked, ventral margin with 8 sets of 1-2 long to short setae, 3 ventrodistal medium spines; flagellum about 0.9-1.1 times as long as articles 4-5 of peduncle combined, with 11-17 articles. Mandibles with weak palpar hump; right incisor with 3 teeth and midcusp; left incisor with 5 humps in 2 branches; right lacinia mobilis bifid, distal branch shorter than proximal, distal branch flabellate, subbifid, broad, denticulate, proximal branch simple, with marginal denticles; left lacinia mobilis with 4 teeth; right rakers 9-14; left rakers 11-14(-17); molar in form of elongate bulbous plaque, right molar with 5-9 primarily long spines, one short spine weakly disjunct, each molar with setule; palp article 1 short, article 2 with one medium inner apical seta and 3-4 other shorter inner setae, and groups of 1 and 3 outer setae, article 3 about 1.2 times as long as article 2, oblique apex with 10-11 spine-setae, basofacial formula = 3-1 or 3-2, occasionally 1-2 outer setae. Inner plate of maxilla 1 ordinary, especially pointed, bearing one long apical pluseta, one similar apicomedial seta, 2 apicolateral much shorter setae; palp article 2 with 5-6 apicalmedial marginal spines and, 5 submarginal setae. Inner plate of maxilla 2 scarcely shorter than outer, of equal breadth, outer with 4-6 apicolateral setae, inner with 2-3 medial setae. Inner plate of maxilliped with 2-3 large, thick apical spines, 2-3 apicofacial setae, 5 medial setae; outer plate with 9-10 medial and apical spines, 5 apicolateral setae; palp article 1 with 1-2 apicolateral setae, article 2 with as many as 6 groups of 1-3 apicolateral setae, medial margin of article 2 strongly setose, article 3 slightly protuberant, with 6 facial setae, 5 lateral setae, nail of article 4 long, with 2 accessory setules. Coxa 1 weakly expanded distally, anterior margin weakly convex; main ventral setae of coxae 1-4 = (10-14)-(10-14)-(10-14)-0, posteriormost seta of coxa 1 slightly shortened; anterior and posterior margins of coxa 4 weakly divergent, posterior margin almost straight, posterodorsal corner subsharp, posterodrosal margin short, undulant, width-length ratio of coxa 4 = 13:16. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = (3-4)-(5-8)-6-(7-8), long anteriors = 8-(9-19)-(5-6)-(3-10), short anteriors = (3-6)-(3-4)-(3-5)-(3-10), no others. Gnathopods generally ordinary but hands somewhat thin; width ratios of articles 5-6 on gnathopods 1-2 = 27:30 and 28:28, length ratios = 74:55 and 70:56; palmar humps small, palms oblique; article 5 of gnathopod 1 elongate, ovate, posterior margin flat, long; article 5 of gnathopod 2 elongate, ovate, posterior margin rounded. Pereopods 1-2 similar; facial setae formula on article 4 = 7 and (5-7), on article 5 = 6-7; main spine of article 5 extending to M. 85 on article 6, article 5 with 2-3 proximoposterior spines; spine formula of article 6 = 5-4 or 6-5 plus middistal seta; acclivity on inner margin of dactyls of pereopods 1-2 weak, emergent setule long, midfacial pluseta ordinary. Coxae 5-7 posteroventral setule-seta formula = (10-12)-(4-7)-(3-6). Articles 4-5 of pereopods 3-4 ordinary, facial spine rows moderately developed, facial ridge formula on article 2 of pereopods 3-5 = 0-2-2, width ratios of articles 2, 4,

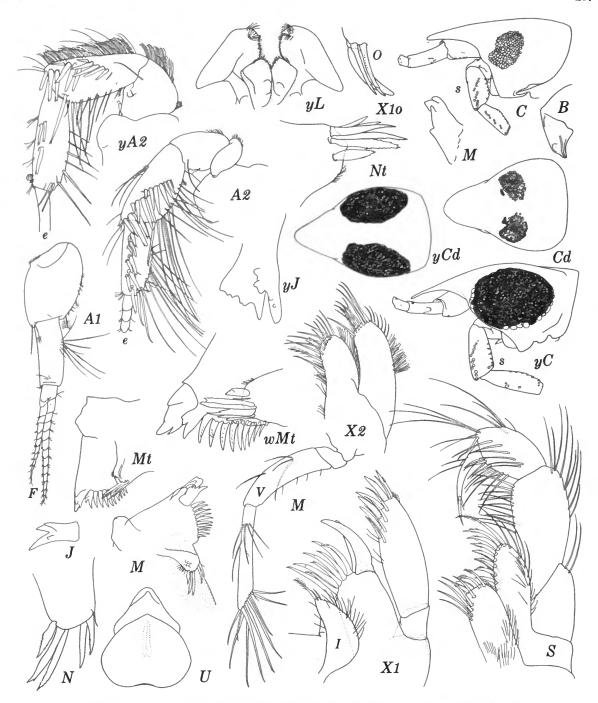


FIGURE 93.—Birubius myallus, new species, holotype, female "a," 9.8 mm (w = female "w," 5.4 mm; y = male "y," 7.6 mm).

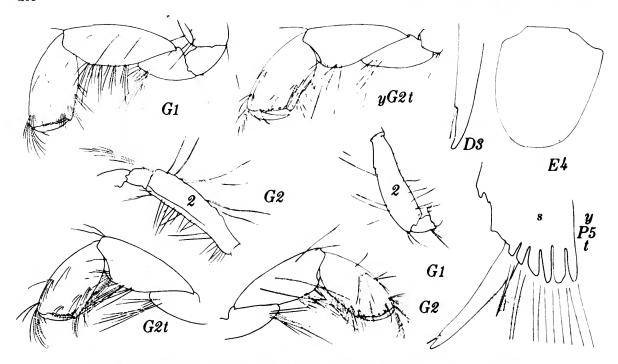


FIGURE 94.—Birubius myallus, new species, holotype, female "a," 9.8 mm (y = male "y," 7.6 mm).

5, 6 of pereopod 3 = 41:40:34:17, of pereopod 4 =63:36:27:12, of pereopod 5 = 72:22:20:7, length ratios of pereopod 3 = 78:33:36:38, of pereopod 4 = 85:53:45:54, of pereopod 5 = 95:23:22:21; article 2 of pereopod 5 reaching apex of article 4 or beyond in subadult females, with longer seta on posteroventral angle (absent in illustration); medial apex of article 6 poorly combed, ragged, bearing 5-6 digital processes. Posteroventral corner of epimeron l rounded or sharply protuberant, margin posterior almost straight, bearing setule, anteroventral margin with 8-11 long setae, posteroventral face with 2-5 medium to long setae, posterior pair or triad set vertically in subterminal female; posteroventral corner of epimeron 2 with small protuberance guarded by sinus (setule present or absent), posterior margin weakly convex, facial setae = 8-16, posteriormost pair set vertically or not; posteroventral corner of epimeron 3 with small to medium tooth, posterior margin straight or undulant, with setule notches and 1-4 setae, face of ventral margin with 5-6 setae pointing posteriorly, evenly spread, face with 2-8 scattered setae; epimeron 3 with small seta on posterodorsal margin

set in weak notch. Urosomite I with midventral setule, articulation line almost complete; urosomite 3 weakly protuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, inner ramus of uropod 1 with two accessory nails, outer ramus of uropod 1 with 8-10 dorsal spines, inner with 2-3, outer ramus of uropod 2 with 3-6 dorsal spines, inner with 0-2 dorsomedial spines; peduncle of uropod 1 with 6-7 apicolateral spines and 3-6 basofacial setae, medially with 6-7 marginal setae and spines, apicalmost an enlarged spine; peduncle of uropod 2 with 7-11 dorsal spines, medially with one apical spine. Peduncle of uropod 3 with 7-10 ventral spines, dorsally with one lateral spine, one medial spine; rami submasculine, inner extending to M. 90-110 on article 1 of outer ramus, apex with 2 setae, medial and lateral margins setose, article 2 of outer ramus short, 0.13-0.20, bearing 2 long to medium setae, medial margin of article 1 setose, lateral margin with 5 acclivities, spine formula = 2-1-1-2 or 0-1-1-1-2. Telson ordinary, lengthwidth ratio = 1:1, not fully cleft, each apex wide, rounded, lateral acclivity shallow, narrow, weak,

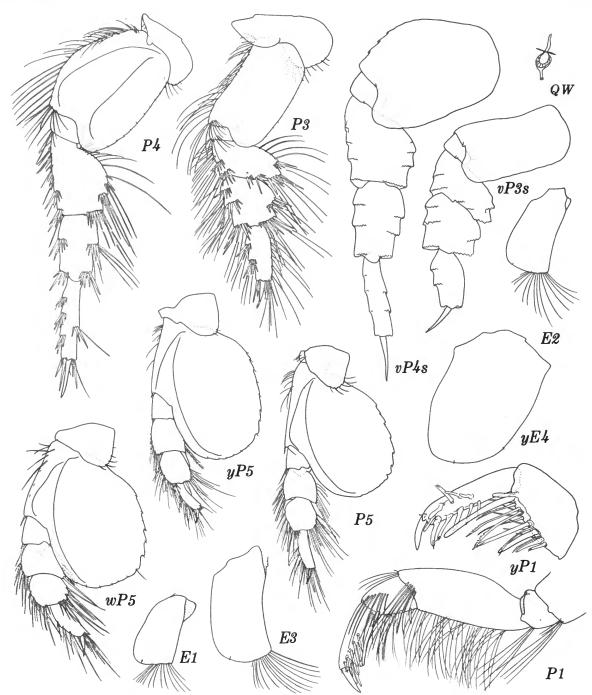


FIGURE 95.—Birubius myallus, new species, holotype, female "a," 9.8 mm (v = male "v," 5.7 mm; w = female "w," 5.4 mm; y = male "y," 7.6 mm).

bearing short lateral setule, spine next medial shorter or of length equal to setule, midlateral setules diverse. Cuticle with ordinary bulbar setules.

DESCRIPTION OF MALE.—Apex of rostrum narrower than in female. Eyes enormous, distending head. Article 2 of antenna 1 with 8 ventral setae; primary flagellum with 10-13 articles, one calceolus each on articles 1-7, aesthetascs strongly developed; accessory flagellum with 8-9 articles. Facial spine formula on article 4 of antenna 2 = 3-4-5, on article 5 = 1-2 or 2-1, article 5 with 4 dorsal sets of male setae and 3 calceoli, ventrodistal apex with 2 thin spines and one setule; flagellar formula = 28+ (broken), (1), 3, 4, 6, 8 . . . 28 (broken). Right lacinia mobilis elaborately sculptured; right rakers 11; left 12 or 13; molars with 6 long and one short spine apically; basofacial setal formula of article 3 on mandibular palp = (3-4) + 2 (right) and (2-3) + 2(left). Palp of maxilla 1 with 6-7 spines and 8-9 setae. Inner plate of maxilla 2 with 2-4 medial setae. Outer plate of maxilliped with only one apicolateral seta; palp article 2 with 2-3 lateral setae. Coxa 4 broadened but smaller in relation to coxa I than in female. Facial and setal-spine formulas of pereopods 1-2 on article 4=7 and 5, on article 5 = 6 and 8, on posteroproximal margin of article 5 = 3-4 and 2-3. Article 2 of pereopods 3-5as in female but article 5 of pereopod 5 with special stout posterodistal spine; article 6 narrowed, medial apex of article 6 on pereopod 5 with (male "y") or without (male "v") apical digits. Epimera 1-2 broadened; posterior margin of epimeron 3 shortened, posteroventral tooth absent in male "y" or with small blunt cusp and indeterminate crenulations in male "v"; setal formulas, epimeron 1 anteroventral = 9, posteroventral = 4-5, posterior pair set vertically, epimeron 2 facial = 10-11, epimeron 3 posterior = 3 plus 2 setules and 2 posterodorsal setules, facial = 3 (or fewer in smaller male), ventral = 4. Articulation line of urosomite 1 distinct. Spine formula of uropods, uropod 1 peduncle apicolateral = 5, basofacial = 3, medial = 5 fine spines and one enlarged spine, uropod 2 peduncle dorsal = 7-8, dorsal spines on outer ramus of uropod 1 = 6-7, of uropod 2 = 3, inner ramus of uropod 1 = 1-2, of uropod 2 = one vestigial; ventral spines on peduncle of uropod 3 = 7-8, spine formula on article 1 of outer ramus = 1-1-1-1-12-2-2-2-2, setal formula = 1-1-2-2-1-1-1-1-1. Telson slightly elongate, distal spines not shortened.

OBSERVATIONS.—Right lacinia mobilis of holotype apparently gerontic, younger females with normal lacinia mobilis composed of bifid, shortened distal branch, and simple, denticulate proximal branch; holotype with aberrant 2 cones on one lobe of lower lip; female "u," 8.6 mm, with 11 apicolateral spines on peduncle of uropod 1 and with accessory apical spine on inner ramus of uropod 2.

DESCRIPTION OF JUVENILE (young females).—Generally similar to holotype as described but following spine and seta counts showing lower densities; if two variations quoted, first based on 5.6 mm female "n," second based on 5.4 mm female "w": antenna 2 article 4 spine formula = 1-3-4-5, spine formula of article 5 = 2-2, article 5 with only 3 posterior setal groups. Right mandible with 7 rakers + one rudimentary or 9 + 1, molar with 6 spines plus one disjunct or 5 + 1; left mandible with 8 rakers + 2 rudimentary, molar with 6 spines + one disjunct, or 5 + 1; article 2 of mandibular palp with 0 or 1 basofacial seta, article 3 of mandibular palp with basofacial setae in formulas of 1 + 1 or 2 + 1. Palp of maxilla 1 with only 4 or 5 of main spines. Outer plate of maxilla 2 with 4 lateral setae, inner setae like holotype. Outer plate of maxilliped with 3 lateral setae; inner plate and palp article 4 like holotype but inner plate with only 2 stout apical spines. Uropod 1 with 4 or 3 basofacial setae, peduncle with 5 or 4 apicolateral spines, outer ramus with 5 or 6 spines, inner with 2; peduncle of uropod 2 with 8 spines, outer ramus with 4, inner with 1. Epimeron 1 on female "n" with 5 posterofacial setae, 3 arranged in vertical row (see illustration), female "w" with 4 setae, 2 arranged vertically; epimeron 2 with 10-11 setae; epimeron 3 with many fewer setae than holotype (see illustrations). Right lacinia mobilis with short distad ramus weakly bifid (flattened in illustration but generally similar to unflattened holotype views). Smaller female therefore advanced in number of spines on outer ramus of uropod 1 and rakers of left mandible and basofacial setae on mandibular palps but less advanced than larger female in other features mentioned above.

ILLUSTRATIONS.—Left mandible shown with molar folded back; one apical seta on article 2 of mandibular palp missing; inner plate of maxilla 1 with one large apical seta absent, other side bearing this seta; upper lip viewed slightly anterodorsally; telson of female "w" shown for aberrant condition of

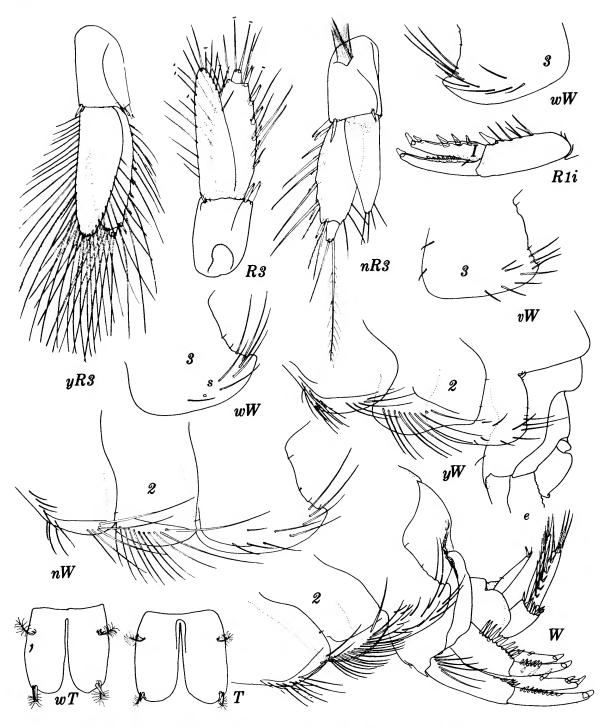


FIGURE 96.—Birubius myallus, new species, holotype, female "a," 9.8 mm (n = female "n," 5.6 mm; v = male "v," 5.7 mm; w = female "w," 5.4 mm; y = male "y," 7.6 mm).

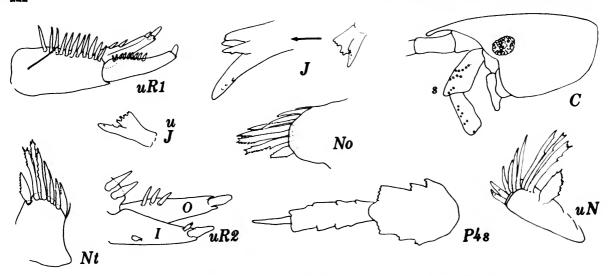


FIGURE 97.—Birubius myallus, new species, female "g," 6.8 mm (u = female "u," 8.6 mm).

setation; pereopod 1 of male "y" with facial setae on article 5 omitted.

HOLOTYPE.—NMV, female "a," 9.8 mm.

TYPE-LOCALITY.—CPBS 10E/2, 5 Apr 1965, Western Port, Victoria, Australia, 3m, fine sand, mud.

VOUCHER MATERIAL (all illustrated).—PPBES 986/5, male "y," 7.6 mm; CPBS 24N/872, male "v," 5.7 mm; CPBS 25S/4, female "n," 5.6 mm; CPBS 25S/2, female "w," 5.4 mm; PPBES 968/2, female "u," 8.6 mm; PPBES 968/5, female "g," 6.8 mm.

REMARKS.—Apparently the holotype of this species is gerontic, as evidenced by the enlarged eyes, submasculine uropod 3, supernumerary facial spines and flagellar articles on antenna 2, supernumerary setae on mandibular palps and other appendages, extra cone on one lobe of lower lip, extra (3 instead of 2) main apical spine on inner plate of maxilliped, presence of 2 spines on inner ramus of uropod 2 and reduction in length of spines on telson, absence of one apical seta on inner plate of maxilla 1 and of the disjunct spine on the right molar, and the smaller number of other molarial spines and mandibular rakers.

RELATIONSHIP.—The greater B. myallus-muldar-pus (4-9) group differs from the B. panamunus-nammuldus (1-3) group in the absence of long ventral setae on coxa 4. This species and that to follow, B. kareus (5), form a subgroup in the greater B. myallus group bearing ventral setae on epimeron 3. They form a pair of species closely similar to the B.

gambodeni (20) and B. jirrandus (30) groups but differ from those species in the presence of an accessory apical nail on the inner ramus of uropod 1, and 2 or more stout apical spines on the inner plate of the maxilliped. In other respects B. myallus and B. kareus differ from the B. gambodeni group in the elongate anterior ridge on pereopod 5 and the elongate wrists of the gnathopods. From B. munggai (27) and the B. lowannus (22) group, these two species differ in the uncrowded setae on epimeron 2 and the well setose basofacial peduncle of uropod 1 and from the B. lowannus group, in addition, by the long anterior ridge on pereopod 5. From the B. batei? (24) group, these two species differ in the poorer development of posterior setae on epimeron 3 and the presence of fully facial setae on epimeron 3.

MATERIAL.—PPBES, 3 samples from 2 stations (4); CPBS, 4 samples from 2 stations (5).

DISTRIBUTION.—Victoria: Port Phillip Bay and Western Port, 4-9 m, sand, muddy sand.

5. Birubius kareus, new species

FIGURES 98-100

Description of Female.—Head about 20 percent of total body length, greatest width about 60 percent of length; rostrum constricted, narrow, reaching middle of article 2 on antenna 1. Eyes

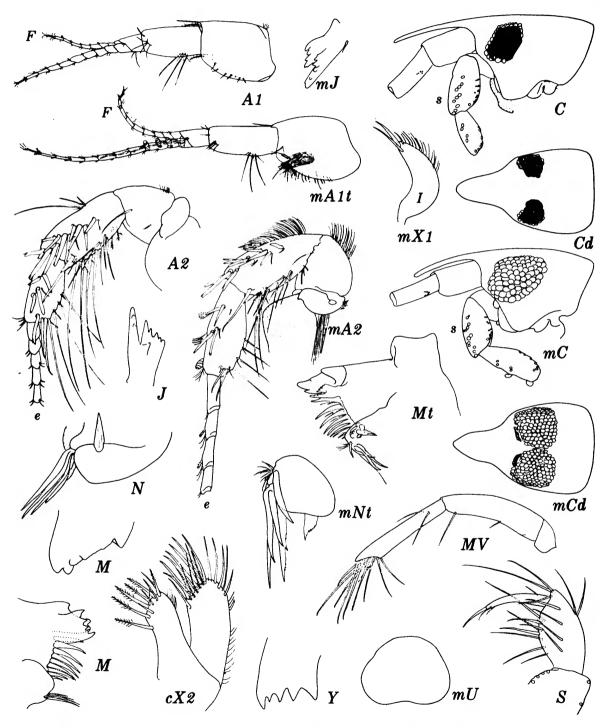


Figure 98.—Birubius kareus, new species, holotype, female "a," 4.6 mm (c = female "c," 4.2 mm; m = male "m," 5.1 mm; Y = left lacinia mobilis).

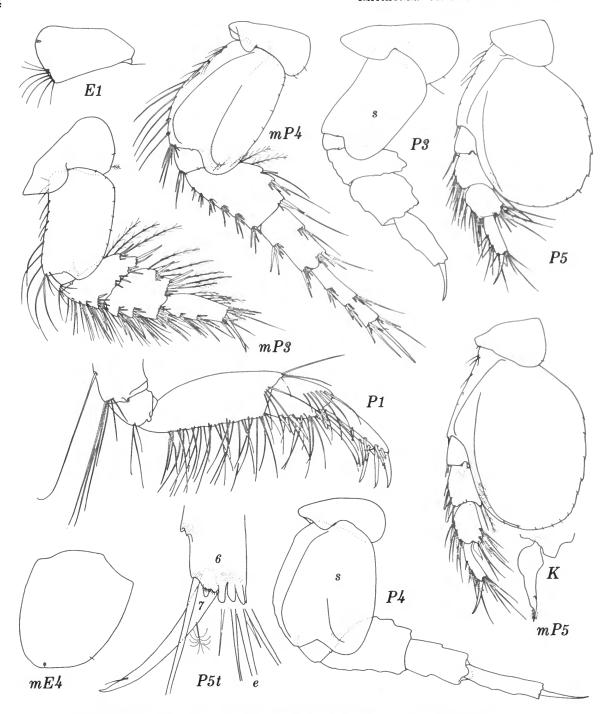


FIGURE 99.—Birubius kareus, new species, holotype, female "a," 4.6 mm (m = male "m," 5.1 mm).

medium, largely occluded with pigment. Article 1 on peduncle of antenna 1 about 1.45 times as long as wide, about twice as wide as article 2, ventral margin with about 9-10 setules, weakly produced dorsal apex with 2 setules; article 2 about 0.8 times as long as article 1, with ventral cycle of 4-6 setae; primary flagellum with 10-11 articles, about 0.75 times as long as peduncle, bearing short aesthetascs; accessory flagellum with 7-9 articles. Spine formula on article 4 of antenna 2 = 1-3-4-3-1 or 1-3-4-3, dorsal margin with notch bearing 4 setae, ventral margin with 5-6 groups of 2 long to short setae, one ventrodistal long spine; article 5 about 0.8 times as long as article 4, facial spine formula = 1-2-2, dorsal margin naked, ventral margin with 4 sets of 2 long to short setae, 2 ventrodistal medium spines, flagellum about 1.0-1.2 times as long as articles 4-5 of peduncle combined, with 10-11 articles. Mandibles with medium palpar hump; right incisor with 3 teeth and accessory cusp; left incisor with 5 humps in 2 branches; right lacinia mobilis bifid, distal branch shorter than proximal, flabellate, broad, denticulate, with one facial hump, proximal branch simple, pointed, with marginal denticles; left lacinia mobilis with 5 teeth, middle teeth shortened; right rakers 8; left rakers 9 plus one rudimentary; molar in form of elongate bulbous hump, right molar with 5 primarily long spines plus one short spine strongly disjunct, left molar with 4 primarily long spines, one short spine strongly disjunct, each molar with plume; palp article 1 short, article 2 with one long inner apical seta and 2 other short inner setae, article 3 about as long as article 2, oblique apex with 8-10 spine-setae, basofacial formula = 1-1 or 2-1. Inner plate of maxilla 1 ordinary, bearing one long apical pluseta, one similar apicomedial seta, 2 apicolateral much shorter setae; palp article 2 with 4-5 apicalmedial marginal spines and 5 submarginal setae. Plates of maxilla 2 extending equally, outer broader than inner, outer with 4-5 apicolateral setae, inner with one medial seta. Inner plate of maxilliped with 2 large, thick apical spines, 3 apicofacial setae, 6-7 medial setae; outer plate with 7-8 medial and apical spines, 1-2 apicolateral setae; palp article 1 with apicolateral seta, article 2 with 2 apicolateral setae, medial margin of article 2 moderately setose, article 3 with 4 facial setae, 2 lateral setae, nail of article 4 medium, with 2 accessory setules. Coxa 1 strongly expanded distally, anterior margin weakly concave; main ventral setae of coxae 1-4 = 7-7-7-0,

posteriormost seta of coxae 1-2 slightly shortened; anterior and posterior margins of coxa 4 weakly divergent, posterior margin almost straight, posterodorsal corner sharply rounded, posterdorsal margin short, concave, width-length ratio of $\cos 4 = 7:8$. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = (0-1)-(2-3)-3-3, long anteriors = 4-5-0-0, short anteriors = 1-4-2-1, no others. Gnathopods ordinary; width ratios of articles 5-6 on gnathopods 1-2 = 31:37 and 31:39, length ratios = 77:73 and 69:70; palmar humps ordinary, palms oblique; article 5 of gnathopods 1-2 elongate, ovate, posterior margin flat-rounded. Pereopods 1-2 similar; facial setae formula on article 4 = 4 and 4, on article 5 = 6 and 6; main spine of article 5 extending to M. 80 on article 6, article 5 with 2 proximoposterior spines; spine formula of article 6 = 4 + 4plus middistal seta, 2 spines especially long; acclivity on inner margin of dactyls of pereopods 1-2 weak, emergent setule long, midfacial pluseta ordinary. Coxae 5-7 posteroventral setule-seta formula = 2-2-1. Articles 4-5 of pereopods 3-4 of ordinary width, facial spine rows moderately developed, facial ridge formula on article 2 of pereopods 3-5 = 0-2-2, posterior ridge on pereopod 4 short; width ratios of articles 2, 4, 5, 6 of pereopod 3 =46:40:34:17, of pereopod 4 = 67:37:23:11, of pereopod 5 = 88:23:21:9, length ratios of pereopod 3 = 76:34:37:43, of pereopod 4 = 89:51:43:51, of pereopod 5 = 110:28:24:30; article 2 of pereopod 5 reaching middle of article 5; medial apex of article 6 finely combed and bearing 6 digital processes. Posteroventral corner of epimeron 1 sharply protrusive, posterior margin straight, with setule, anteroventral margin with 6-7 medium setae, posteroventral face with 2-3 long setae; posteroventral corner of epimeron 2 weakly protuberant, guarded by setule sinus, posterior margin slightly concave, facial setae = 7-8; posteroventral corner of epimeron 3 with small to medium tooth, with setule sinus, posterior margin straight, with 1-2 setule notches, 1-2 long setae distally, ventral margin with 2-3 facial setae pointing posteriorly, evenly spread, face with oblique horizontal row of 4-5 setae and occasionally with another row of 2 setae more ventrally; epimera 1-3 with small seta on posterodorsal margin. Urosomite 1 naked, articulation line incomplete; urosomite 3 weakly protuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, inner ramus of uropod 1 with 2 acces-

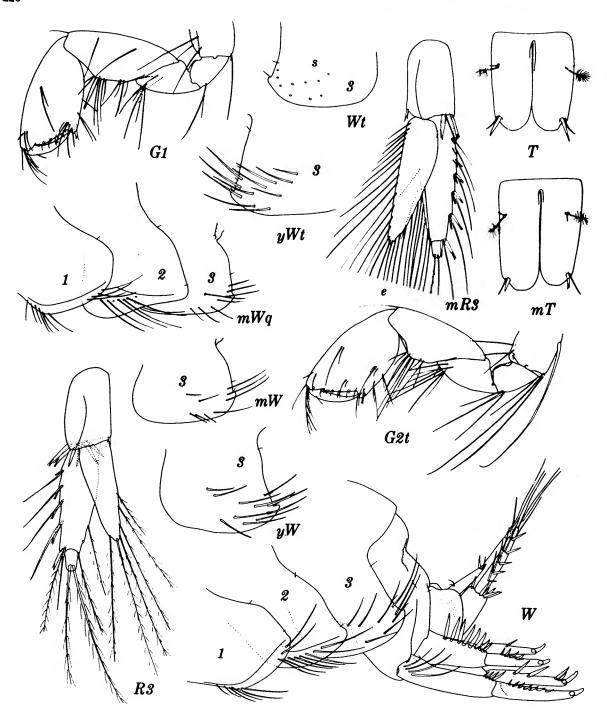


Figure 100.—Birubius kareus, new species, holotype, female "a," 4.6 mm (m = male "m," 5.1 mm; q = right side converted to left view; y = female "y," 5.1 mm).

sory nails, outer ramus of uropod 1 with 6-7 dorsal spines, inner with 2, outer ramus of uropod 2 with 3-5 dorsal spines, inner with 1-2 dorsomedial spines; peduncle of uropod 1 with 3-4 apicolateral spines and 4 basofacial setae, medially with 4-5 marginal setae and spines, apicalmost an enlarged spine; peduncle of uropod 2 with 7-8 (rarely 12) dorsal spines, medially with one apical spine. Peduncle of uropod 3 with 6 ventral spines, dorsally with one lateral spine, one each medial spine and setule; rami submasculine, inner extending to M. 95 on article I of outer ramus, apex with one seta, medial and lateral margins with 2 and 4 setae, article 2 of outer ramus short, 0.21, bearing 2 long setae, medial margin of article 1 with 3 setae, lateral margin with 4 acclivities, spine formula = 1-1-1-1-1, setal formula = 1-1-1-1-2. Telson long, lengthwidth ratio = 13:11, not fully cleft, each apex wide, rounded, lateral acclivity shallow, weak, bearing ordinary lateral setule, spine next medial longer than setule, midlateral setules diverse. Cuticle with ordinary bulbar setules.

DESCRIPTION OF MALE.—Head shorter and broader than in female, distended by greatly enlarged eyes clear of pigment. Article 2 of antenna 1 with 7 ventral setae; primary flagellum with 12 articles, one calceolus each on articles 1-4 or 1-6 (5-6 rudimentary), aesthetascs strongly developed; accessory flagellum with 8 articles. Facial spine formula on article 4 of antenna 2 = 1-3-4-3-1 or 1-2-4-3-1, on article 5 = 2-2; article 5 with 3 dorsal sets of male setae and one calceolus, ventrodistal apex with 2 thin spines and one setule; flagellar formula = 32, 2, 3, 5, 7 . . . 27. Each molar with 5 spines and one small disjunct spine; basofacial setal formula of article 3 on mandibular palp = 1-2. Inner plate of maxilla 1 very thin, with 2 large and one small setae. Article 4 of maxillipedal palp with only one accessory setule. Coxa 4 broadened but smaller in relation to coxa 1 than in female. Long posterior setae on article 2 of gnathopods 1-2 = 1-2. Article 2 of only pereopods 4-5 narrower than in female, articles 4-6 of pereopod 5 narrowed, article 5 with falcate posterodistal spine. Epimera 1-3 broadened; posterior margin of epimeron 3 slightly shortened; setal formulas, epimeron 1 anteroventral = 7, posteroventral = 4, epimeron 2 facial = 7, epimeron 3 posterior = 2 and 1-2 setules, facial = 1-2, ventral = 4-5. Spine formulas of uropods, uropod 1 peduncle apico-

ILLUSTRATIONS.—Female: Upper and lower lips and maxilla 1 as shown for B. myallus (4), inner lobes of lower lip swollen perhaps owing to preservational effect; shape of coxae 2-3 as shown for B. myallus; maxilliped, except for articles 3-4 of palp and notes in description, as shown for B. panamunus (1).

Male: Urosome in poor condition, not illustrated; epimeral view based on partial reconstruction presented as left view of right epimera; one seta on inner plate of maxilla 1 hidden.

HOLOTYPE.—NMV, female "a," 4.6 mm.

Type-Locality.—CPBS 31N/769, 15 Jul 1969, Western Port, Victoria, Australia, 15–19 m, fine sand and mud.

VOUCHER MATERIAL (all illustrated).—CPBS 32S/866, male "m," 5.1 mm; CPBS 21S/4, female "c," 4.2 mm; CPBS 31N/867, female "y," 5.1 mm.

RELATIONSHIP.—This species and Birubius myallus (4) are extremely close morphologically; the best distinction is the wide degree of disjunction of the clear spine on the mandibular molars which in B. myallus is closely approximate to the other spines but which in B. kareus is widely disjunct; the male of B. kareus bears a peculiar falcate spine on article 5 of pereopod 5 which in males of B. myallus is smaller and scarcely modified. Subtle differences in the shape of the head from dorsal view are apparent between the species, B. kareus having a slightly more constricted and streamlined rostrum with the eyes of the male fully contiguous dorsally whereas the eyes of male B. myallus, though extremely large, do not meet dorsally and are extended into nacelles laterodorsally. Birubius kareus has slightly stouter gnathopods than those of B. myallus and the distal branch of the right lacinia mobilis is multifid whereas in B. myallus that ramus is at best bifid or weakly so. All specimens of B. myallus except female "n," 5.6 mm, have at least one basofacial seta on article 2(!) of the mandibular palp whereas these setae are absent in B. kareus. These distinctions are extremely weak and make the routine identification of these two species very difficult. We trust that future collections of these animals may clarify any further distinctions or demonstrate that they are but phenotypes of a single species.

MATERIAL.—CPBS, 35 samples from 13 stations (54); WPBES, 2 samples from 2 stations (2).

DISTRIBUTION.—Victoria, Western Port, 9-19 m, sand, silty sand.

6. Birubius apari, new species

FIGURES 101-104

Description of Female.—Head about 17 percent of total body length, greatest width about 72 percent of length; rostrum unconstricted, broad, reaching middle of article 2 on antenna 1. Eyes medium, largely occluded with pigment. Article 1 of peduncle on antenna 1 about 1.4 times as long as wide, about twice as wide as article 2, ventral margin with about 7 setules, weakly produced dorsal 'apex with 4 setules; article 2 about 0.72 times as long as article 1, with ventral cycle of 4 setae; primary flagellum with 10 articles, about as long as peduncle, bearing long aesthetascs; accessory flagellum with 8 articles. Spine formula of article 4 on antenna 2 = 1-3-4-3, dorsal margin bearing 2 setae, ventral margin with 4 groups of 1-2 long to medium setae, one ventrodistal long spine; article 5 about 0.71 times as long as article 4, facial spine formula = 2, dorsal margin naked, ventral margin with 2 sets of one long seta and one setule, 3 ventrodistal long to medium spines and setae; flagellum about 1.4 times as long as articles 4-5 of peduncle combined, with 11-12 articles. Mandibles with weak palpar hump; right incisor with 3 teeth and notch; left incisor with 4 humps in 2 branches; right lacinia mobilis bifid, distal branch little shorter than proximal, flabellate, broad, subbifid or denticulate, with one facial hump, proximal branch simple, pointed, with marginal denticles; left lacinia mobilis with 4 teeth; right rakers 6 plus one rudimentary; left rakers 7; molars bulbous, each with 5 primarily long spines plus one short spine not disjunct; palp article 1 short, article 2 with one long inner apical seta and 2 other short inner setae, article 3 about 1.1 times as long as article 2, oblique apex with 9 spinesetae, basofacial formula = 0-1. Inner plate of maxilla 1 especially thin, bearing one long apical pluseta, one similar apicomedial seta, 2 apicolateral much shorter setae; palp article 2 with 5 apicalmedial marginal spines and 5 submarginal setae. Plates of maxilla 2 extending equally, outer scarcely broader than inner, outer with 3 apicolateral setae, inner with one medial seta. Inner plate of maxilliped with 3 large, thick apical spines, 4 apicofacial setae, 5 medial setae; outer plate with 8 medial and apical spines, one apicolateral seta; palp article 1 with apicolateral seta, article 2 with 3 groups of one each apicolateral setae, medial margin of article 2 moderately setose, article 3 scarcely protuberant, with 4 facial setae, one lateral seta, nail of article 4 medium, with 2 accessory setules. Coxa 1 scarcely expanded distally, anterior margin weakly convex; main ventral setae of coxae 1-4=4-1-(3-4)-0, posteriormost seta of coxae 1-3 slightly shortened; anterior and posterior margins of coxa 4 slightly divergent, posterior margin almost straight, posterodorsal corner rounded, posterodorsal margin medium, concave, undulant, width-length ratio of coxa 4 = 4:5. Long posterior setae of gnathopods 1-2 and pereopods 1-2 = 1-3-3-4, short anteriors = 1-1-(3-5)-1, long anteriors = (5-6)-7-0-0, short posteriors = 1-0-1-2. Gnathopods ordinary, width ratios on articles 5-6 of gnathopods 1-2 = 25:34 and 28:34, length ratios = 78:58 and 78:59; palmar humps ordinary, palms weakly oblique; article 5 of gnathopod 1 elongate, ovate, posterior margin flat, article 5 of gnathopod 2 elongate, ovate, posterior margin rounded. Pereopod 2 similar but stouter than pereopod 1, especially on article 4, facial setae formula on article 4 = 4 and 3, on article 5 = 4 and 5; main spine of article 5 extending to M. 80 on article 6, article 5 lacking proximoposterior spines; spine formula of article 6 = 3 + 4 and 4 + 4 plus middistal seta, some spines especially long; acclivity on inner margin of dactyls of pereopods 1-2 sharp, produced as tooth, emergent setule long, midfacial pluseta ordinary. Coxae 5-7 posteroventral setule formula = 1-1-1. Articles 4-5 of pereopods 3-4broad to ordinary, facial spine rows sparse to moderately developed, facial ridge formulas of article 2 on pereopods 3-5 = 0-2-2, width ratios of articles 2, 4, 5, 6 of pereopod 3 = 44:47:41:19, of pereopod 4 = 73:42:28:13, of pereopod 5 = 88:20:16:9, length ratios of pereopod 3 = 81:36:36:40, of pereopod 4 = 86:57:40:49, of pereopod 5 = 112:25: 22:20; article 2 of pereopod 5 reaching middle of article 5; medial apex of article 6 bearing 4 digital

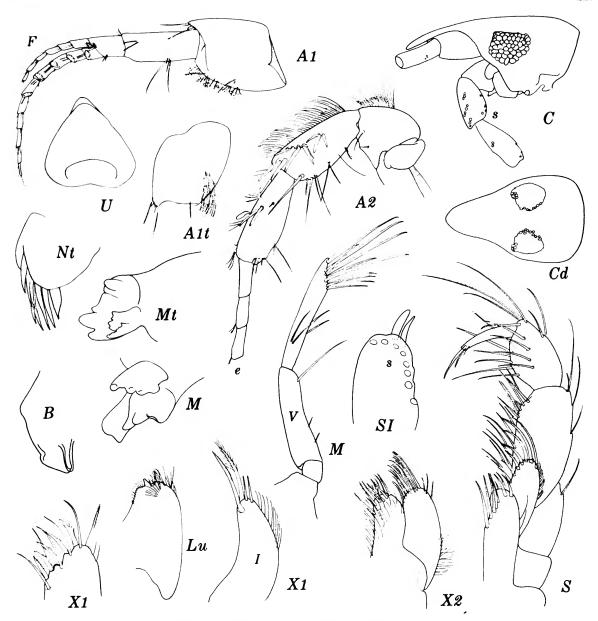


FIGURE 101.—Birubius apari, new species, male "a," 3.9 mm.

processes. Posteroventral corner of epimeron 1 rounded, posterior margin convex, anteroventral margin with 3-4 medium setae, posteroventral face with 3 long setae, posterior pair set vertically; posteroventral corner of epimeron 2 rounded, posterior margin convex, facial setae = 6-7; posteroventral corner of epimeron 3 rounded, with small to

medium tooth, bearing setule, posterior margin straight, ventral margin naked, face with oblique row of 6-8 thick setae commencing on tooth; epimera 1-3 with setule on posterodosal margin. Urosomite 1 with one lateral and one ventral setule at base of uropod 1, articulation line incomplete; urosomite 3 weakly protuberant dorsally. Rami of uropods 1-2

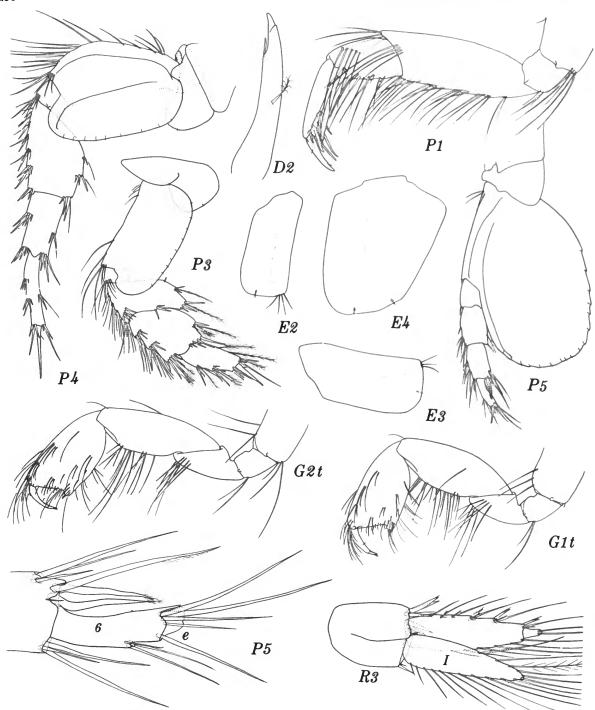


FIGURE 102.—Birubius apari, new species, male "a," 3.9 mm.

with articulate enlarged apical nails, inner ramus of uropod 1 with two accessory nails, outer ramus of uropod 1 with 3-4 dorsal spines, inner with one, outer ramus of uropod 2 with 1-2 dorsal spines, inner with one dorsomedial spine; peduncle of uropod 1 with 2 apicolateral spines, and one tiny basofacial setule, medially with 2 marginal spines, apicalmost enlarged; peduncle of uropod 2 with 4-5 dorsal spines, medially with one small apical spine. Peduncle of uropod 3 with 5 ventral spines, dorsally with one lateral spine, one medial spine; rami feminine, inner extending to M. 85 on article 1 of outer ramus, apex with one seta, medial and lateral margins naked, article 2 of outer ramus ordinary, 0.22, bearing 2 long setae, apicomedial margin of article 1 naked, lateral margin with 2 acclivities, spine formula = l-l-1, setal formula = l-l-1. Telson long, length-width ratio = 9:7, not fully cleft, each apex of medium width, rounded, lateral acclivity broad, shallow, bearing ordinary lateral setule, spine next medial shorter than setule, midlateral setules diverse. Cuticle with ordinary bulbar setules.

OBSERVATIONS (female).—Prebuccal complex convex anteriorly, poorly extended, epistome and upper lip partially fused but weak dorsal articulation line present, anterior face of upper lip with weak rugosity marked as crescent from anterior view, ventral margin weakly excavate. Holotype immature, bearing rudimentary brood plates only on pereonite 4.

ILLUSTRATIONS (female).—Following parts similar to those of male: prebuccal, upper lip and epistome, mandibular palp, left mandible (except basofacial formula), molars, lower lip, maxillae 1–2, maxilliped, gnathopods 1–2, pereopods 3–4.

DESCRIPTION OF MALE.—Head about 20 percent of total body length, greatest width about 65 percent of length; rostrum weakly constricted, broad, reaching middle of article 2 on antenna 1. Eyes medium, clear of occluding pigment, eosin in color. Article 1 of peduncle on antenna 1 about 1.25 times as long as wide, about 3 times as wide as article 2, ventral margin with about 16 setules, produced dorsal apex with 6 setules, medial face with patch of fuzz; article 2 about 0.8 times as long as article 1, with ventral cycle of 4 setae; primary flagellum with 8–10 articles, about 0.85 times as long as peduncle, bearing calceoli on articles 1–5; accessory flagellum with 6–7 articles. Spine formula of article 4 on antenna 2 = 3–4–3, dorsomedial margin of

articles 3-4 bearing fuzz, ventral margin with 4 groups of 1-2 short to medium setae, one ventrodistal long spine; article 5 about as long as article 4, facial spine formula = 2, dorsal margin bearing 3 sets of male setae and 2 calceoli, ventral margin with 2 sets of 1-3 short to medium setae, 3 ventrodistal short setae; flagellum elongate, flagellar formula = 28, 2, 3, 5, 7... 27. Mandibles with medium palpar hump; right incisor with 3 teeth, accessory hump, 2 notches; left incisor with 5 humps in 2 branches; right lacinia mobilis bifid, distal branch little shorter than proximal, flabellate, subbifid, denticulate, proximal branch simple, pointed, with marginal denticles and facial humps; left lacinia mobilis with 4 very low teeth; right and left rakers 6 plus 3 rudimentaries; molars composed of bulbous humps, right molar with 7 primarily medium spines, one short spine weakly disjunct, left molar with 6 primarily medium spines, one short spine weakly disjunct; palp article 1 short, article 2 with one long inner apical seta and 2 other short inner setae, article 3 about 1.15 times as long as article 2, oblique apex with 10 spine-setae, basofacial formula = 2-2. Inner plate of maxilla 1 especially thin, bearing one long apical pluseta, one similar apicomedial seta, 2 apicolateral much shorter setae; palp article 2 with 5 apicalmedial marginal spines and 5 marginal setae. Plates of maxilla 2 extending equally, subequally broad, outer with 3 apicolateral setae, inner with one medial seta. Inner plate of maxilliped with 2 large thick, apical spines, 2 apicofacial setae, 4 medial setae; outer plate with 6 medial and apical spines, one apicolateral seta; palp article 1 with apicolateral seta, article 2 with 3 groups of 1-2 apicolateral setae, medial margin of article 2 strongly setose, article 3 weakly protuberant, with 4 facial setae, 2 lateral setae, nail of article 4 long, with 2 accessory setules. Coxa 1 scarcely expanded distally, anterior margin weakly concave; main ventral setae of coxae 1-4 = 4-(3-4)3-0, posteriormost seta of coxae 1-2 slightly shortened; anterior and posterior margins of coxa 4 almost divergent, posterior margin oblique, almost straight, posterodorsal corner rounded, posterodorsal margin short, ordinary, width-length ratio of coxa 4 = 5:6; long posterior setae of gnathopods 1-2 and pereopods 1-2 = 1-2-2-3, short anteriors = 1-2-2-3, short anteriors = 1-1-4-2, short posteriors = 1-0-1-3. Gnathopods thin, almost identical; width ratios on articles 5-6 of gnathopods 1-2 = 29:32 and

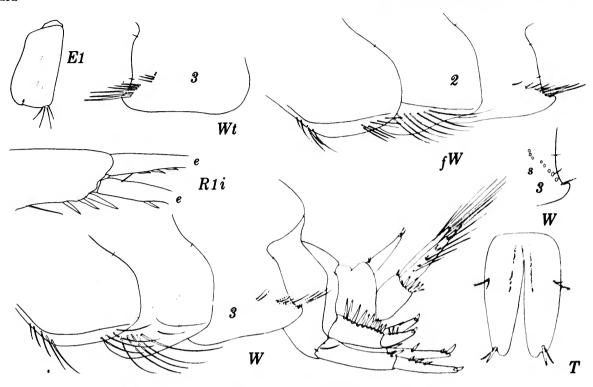


FIGURE 103.—Birubius apari, new species, male "a," 3.9 mm (f = male "f," 3.8 mm).

28:33, length ratios = 80:60 and 84:60; palmar humps ordinary, palms weakly oblique; article 5 of gnathopods 1-2 elongate, ovate, posterior margin flat, long. Pereopods 1-2 similar; facial setae formula on article 4 = 4 and 3, on article 5 = 5 and 5; main spine of article 5 extending to M. 100 on article 6, article 5 lacking proximoposterior spines; spine formula of article 6 = 3 + 4 plus middistal seta, some spines especially long; acclivity on inner margin of dactyls of pereopods 1-2 weak, emergent setule long, midfacial pluseta ordinary. Coxae 5-7 posteroventral setule formula = 1-1-0. Articles 4-5 of pereopods 3-4 of ordinary width, facial spine rows sparse, facial ridge formulas of article 2 on pereopods 3-5 = 0-2-2, width ratios of articles 2, 4, 5, 6 of pereopod 3 = 40:39:33:17, of pereopod 4 = 63:38:22:9, of pereopod 5 = 83:17:14:6, length ratios of pereopod 3 = 78:34:42:35, of pereopod 4 = 89:58:42:50, of pereopod 5 = 123:27:23:20; article 2 of pereopod 5 reaching middle of article 5, latter with 2 special posteroventral spines; medial apex of article 6 weakly scalloped. Posteroventral corner of epimeron 1 rounded, posterior margin convex, corner with setule, anteroventral margin with 4-5 medium setae, posteroventral face with 3-5 medium setae, in tandem or partially paired vertically; posteroventral corner of epimeron 2 rounded, posterior margin convex, facial setae = 5-8 crowded anteriorly in terminal adult; posteroventral corner of epimeron 3 with setule sinus, small to medium tooth, posterior margin weakly convex, face with oblique row of 8-11 setae near posterior margin, setae divided into groups of 5-3-2 or 5-2-1 or 6-5 or 5-2-2 (or other variations); epimera 1-3 with setule on posterodorsal margin. Urosomite 1 naked, articulation line complete; urosomite 3 strongly protuberant dorsally. Rami of uropods 1-2 with articulate, enlarged apical nails, inner ramus of uropod 1 with two accessory nails, outer ramus of uropod 1 with 3 dorsal spines, inner with one, outer ramus of uropod 2 with 3 dorsal spines, inner with one dorsomedial spine; peduncle of uropod 1 with 2 apicolateral spines and one basofacial seta, medially with 4 marginal setae and spines, apicalmost an enlarged spine; peduncle of uropod 2 with

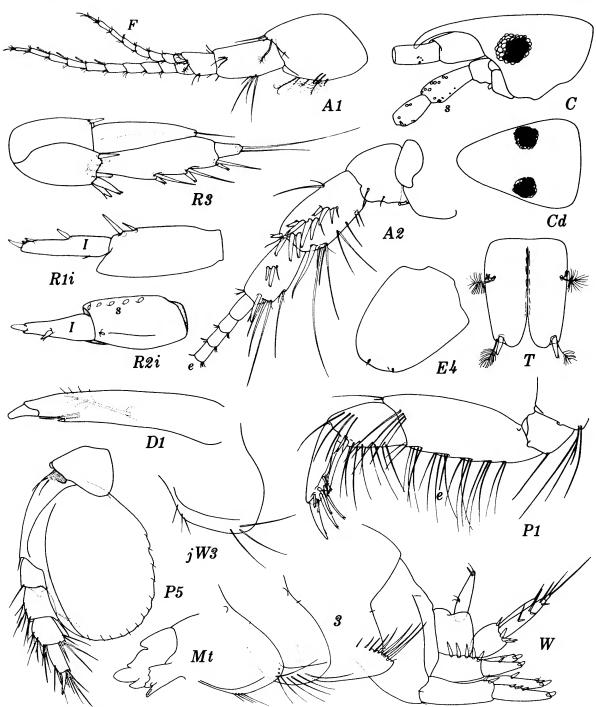


FIGURE 104.—Birubius apari, new species, holotype, female "a," 3.75 mm (j = juvenile "j," 3.46 mm).

10-11 dorsal spines, medially with one small apical setule. Peduncle of uropod 3 with 6 ventral spines, dorsally with one lateral spine, one medial spinule; rami masculine, inner extending to M. 100 on article 1 of outer ramus, apex with 2 setae, medial and lateral margins setose, article 2 of outer ramus ordinary, 0.16, bearing 2 long setae, medial margin of article 1 setose, lateral margin with 5 acclivities, spine formula = 0-1-1-1-1-2, setal formula = 1-1-1-1-1. Telson especially long, length-width ratio = 8:5, not fully cleft, each apex narrow, rounded, lateral acclivity deep, bearing ordinary lateral setule, spine next medial of length equal to setule, midlateral setules diverse, each lobe with dorsal row of denticles. Cuticle with sparse ordinary bulbar setules.

OBSERVATIONS (male).—Male "m" with 8 ventral setae on epimeron 2.

ILLUSTRATIONS (male).—Eyes shrunken ventrad so dorsal margin from lateral view appearing flat; antenna l constructed of flagella from right and left members fitted onto left peduncle; left mandibular molar like right.

Variations.—Calceoli often lost through damage or occasionally absent, for example, absent on right antenna 1 of male "a".

HOLOTYPE.—AM, female "a," 3.75 mm.

Type-Locality.—EBS 31, 25 Apr 1972, Jervis Bay, Murray's Beach, New South Wales, Australia, 6 m, *Halophila*.

VOUCHER MATERIAL.—EBS 20: juvenile "j," 3.46 mm (illus.); juvenile "c," 3.21 mm. EBS 22: juvenile "d," 3.95 mm; juvenile "e," 3.51 mm. AM P.18125: male "a," 3.9 mm (illus.); male "f," 3.8 mm (illus.). PPBES 1834: male "m," 4.45 mm. PPBES 1842: female "n," 4.30 mm. PPBES 1811: subadult male "t," 4.05 mm.

RELATIONSHIP.—This species is distinguished from the *B. myallus* (4) subsection in the absence of ventral setae on epimeron 3 and the reduction of basofacial setae on uropod 1.

Several discrepancies in morphology suggest that the two sexes are distinct species: the unconstricted rostrum of the female, the much narrower coxa 4, the shorter main spine on article 5 of pereopods 1-2, the sharp inner tooth on the dactyls of pereopods 1-2, and the shorter article 2 of antenna 1. Other differences in shapes and spine counts might be attributed to size or sexual differences. However, both sexes have been found together in Victorian

samples after protracted search.

Birubius apari differs from B. panamunus (1) in the absence of long setae on coxa 4, the absence of long basofacial setae on uropod 1 and the absence of a midridge on pereopod 3.

MATERIAL.—EBS, 4 samples from one station (6); AM, one sample (2); PPBES, 3 samples from 3 stations (3).

DISTRIBUTION.—New South Wales: Jervis Bay, Murray's Beach, 6 m, *Halophila* and *Zostera*. Victoria: Port Phillip Bay, 0.5-3.5 m, sand and shelly sand. South Australia: Kangaroo Island, neritic.

7. Birubius cartoo, new species

FIGURES 105-107

Description of Female.—Head about 15 percent of total body length, greatest width about 70 per cent of length; rostrum unconstricted, broad, reaching middle of article 2 on antenna 1. Eyes medium-large, largely occluded with pigment. Article 1 on peduncle of antenna 1 about 1.2 times as long as wide, about 1.4 times as wide as article 2, ventral margin with about 7 setules, weakly produced dorsal apex with 4 setules, article 2 about 0.8 times as long as article 1, with ventral crescent of 9 setae; primary flagellum with 7-8 articles, about 0.65 times as long as peduncle, bearing long aesthetascs; accessory flagellum with 5-7 articles. Spine formula on article 4 of antenna 2 = 1-3-4-4or 1-3-4-3, dorsal margin with notch bearing 3 setae, ventral margin with 5-6 groups of 1-3 long to short setae, one ventrodistal long spine; article 5 about 0.75 times as long as article 4, facial spine formula = 0-2 or 2-1 or 2-2-1, dorsal margin naked, ventral margin with 4 sets of 1-2 long to short setae, 3 ventrodistal long to medium spines and setae; flagellum as long as articles 4-5 of peduncle combined, with 9-11 articles. Mandibles with weak palpar hump; right incisor with 3 teeth, occasional notch; left incisor with 4 humps in 2 branches, right lacinia mobilis bifid, distal branch shorter than proximal, broad, subbifid, proximal branch simple, pointed, with marginal denticles; left lacinia mobilis with 4 teeth plus occasional accessory tooth, middle teeth shortened; right rakers 5-8; left rakers 7-9; molar in form of short protrusion demarcated mainly by spines, right molar with 5-7 primarily long spines, none disjunct,

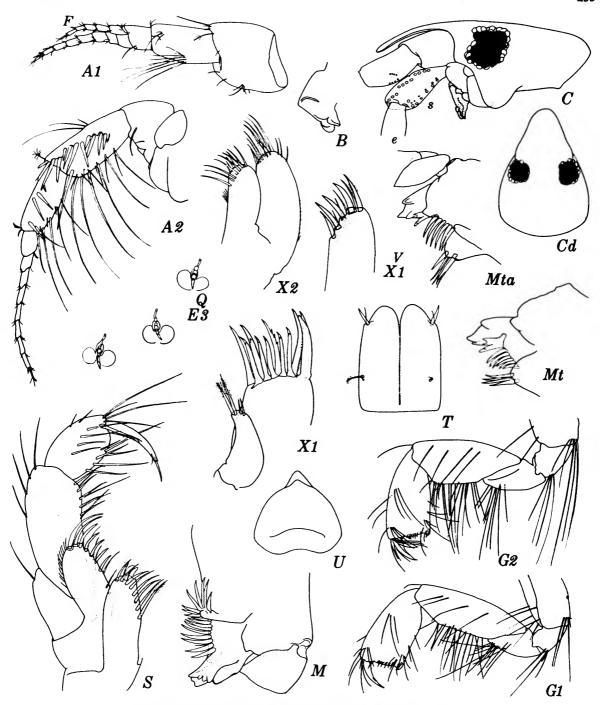


Figure 105.—Birubius cartoo, new species, holotype, female "a," 4.6 mm.

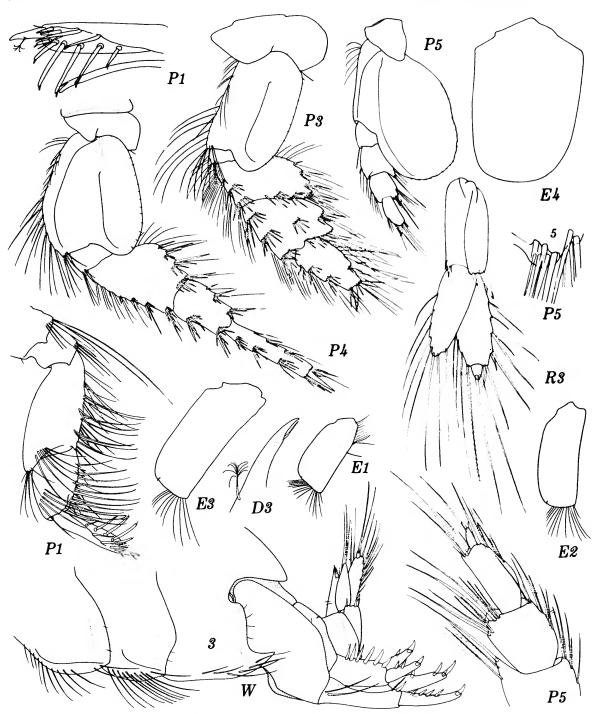


FIGURE 106.—Birubius cartoo, new species, holotype, female "a," 4.6 mm.

left molar with 6-8 primarily long spines, none disjunct; palp article 1 short, article 2 with one long inner apical seta and 2-4 other short inner setae, article 3 about 1.3 times as long as article 2, oblique apex with 9 spine-setae, basofacial formula = 0-1 or 1-1. Inner plate of maxilla 1 thin, bearing 2 long apical plusetae, 2 apicolateral much shorter setae; palp article 2 with 5 apicalmedial marginal spines and 5 submarginal setae. Inner plate of maxilla 2 slightly shorter and much narrower than outer, outer with 3 apicolateral setae, inner with one medial seta. Inner plate of maxilliped with 2 large thick apical spines, one ventral seta, 3 apicofacial setae, 5 medial setae; outer plate with 6-7 medial and apical spines, no apicolateral setae; palp article 1 with apicolateral seta, article 2 with 4 apicolateral setae, medial margin of article 2 moderately setose, article 3 unprotuberant, with 4 facial setae, 1-2 lateral setae, nail of article 4 medium, with 1-2 accessory setules. Coxa 1 not expanded distally, anterior margin weakly convex; main ventral setae of coxae 1-4 = 15-(13-14)-10-0, posteriormost seta of coxae 1-2 shortened; anterior and posterior margins of coxa 4 almost parallel, posterior margin almost straight, posterodorsal corner subsharp, posterodorsal margin ordinary, undulant, width-length ratio of coxa 4 = 7:10. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = (1-3)-(3-4)-5-6, long anteriors = (4-5)-(5-6)-0-0, others not counted. Gnathopods thin; width ratios of articles 5-6 on gnathopods 1-2 = 24:29 and 29:29, length ratios = 77:54and 71:53; palmar humps small, palms almost transverse; article 5 of gnathopods 1-2 elongate, trapezoidal, posterior margin flat, long. Pereopods 1-2 similar; facial setae formula on article 4 = 6-6, on article 5 = 5-5; main spine of article 5 extending to M. 90 on article 6, article 5 lacking proximoposterior spines; spine formula of article 6 = 4 + 6or 4 + 5 or 5 + 6 plus middistal seta, some spines especially long; acclivity on inner margin of dactyls of pereopods 1-2 weak, emergent setule long, midfacial pluseta ordinary. Coxae 5-7 posteroventral setule formula = 2-1-(0-4). Articles 4-5 of pereopods 3-4 broad, facial spine rows dense, facial ridge formula on article 2 of pereopods 3-5 = 1-2-2, width ratios of articles 2, 4, 5, 6, of pereopod 3 = 48:48: 45:24, of pereopod 4 = 65:43:27:11, of pereopod 5 =68:20:16:9, length ratios of pereopod 3 = 82:45: 44:43, of pereopod 4 = 83:55:41:62, of pereo-

pod 5 = 100:24:20:19; article 2 of pereopod 5 almost reaching apex of article 4; medial apex of article 6 finely combed, bearing 6 digital processes. Posteroventral corner of epimeron 1 subquadrate, posterior margin weakly convex, with 2 setules, anteroventral margin with 9-3 long setae, posteroventral face with 2 medium setae; posteroventral corner of epimeron 2 quadrate, posterior margin strongly convex, with 2 setules, facial setae = 9-3, several posterior pairs set obliquely; posteroventral corner of epimeron 3 with large tooth, posterior margin almost straight, with 4-6 setules, ventral margin with 3-6 mainly posterior setae evenly spread; epimeron 3 with rugosities at posterodorsal invagination. Urosomite 1 elongate, naked, articulation line complete, forming lateral ridge running forward to rounded socket fitting invagination of pleonite 3; urosomite 2 largely hidden but elongate and marked by dorsal cleft; urosomite 3 weakly protuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, inner ramus of uropod l with two accessory nails, one of these disjunct, outer ramus of uropod 1 with 3-4 dorsal spines, inner with one, outer ramus of uropod 2 with 1-2 dorsal spines, inner with 0-1 dorsomedial spine; peduncle of uropod 1 with 2 apicolateral spines and 2 basofacial setae, medially with 2-3 marginal setae and spines, apicalmost an enlarged spine; peduncle of uropod 2 with 4-5 (rarely 6) dorsal spines, medially with one apical spine. Peduncle of uropod 3 with 6-7 ventral spines, dorsally with one lateral spine, one medial spine and setule; rami submasculine, inner extending to M. 90+ on article 1 of outer ramus, apex with 2 setae, lateral margin setose, medial margin with one seta, article 2 of outer ramus short, 0.16, bearing 2 long setae, medial margin of article I with 4 setae, lateral margin with 4 acclivities, spine formula = 0-0-0-1-1, setal formula = 2-2-2-1-1. Telson long, length-width ratio = 7:5, no fully cleft, each apex of medium width, rounded, lateral acclivity narrow, weak, bearing ordinary lateral setule, spine next medial longer than setule, midlateral setules highly diverse. Cuticle with closely packed bulbar setules partially surrounded by alate plaques forming clear spaces, emergent setules especially short.

DESCRIPTION OF MALE.—Apex of rostrum narrowed. Eyes enlarged. Primary flagellum of antenna 1 with 8 articles, bearing calceoli and elongate aesthetascs. Spine formula on article 4 of an-

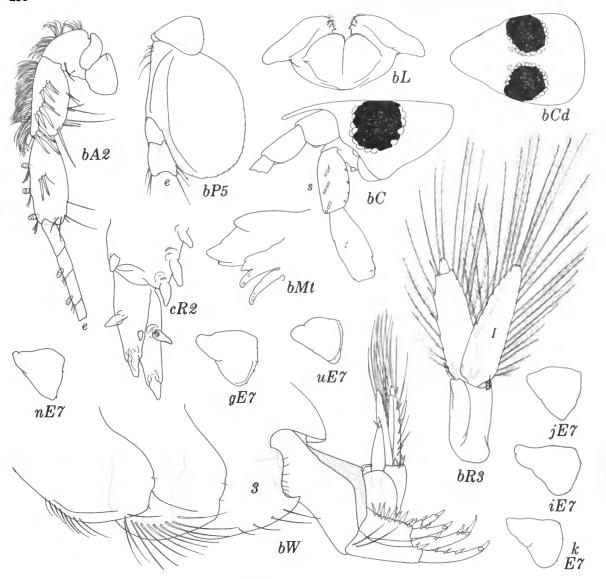


FIGURE 107.—Birubius cartoo, new species, holotype, female "a," 4.6 mm (b = male "b," 4.2 mm; c = female "c," 4.2 mm; g = male "g," 3.9 mm; i = male "i," 3.8 mm; j = male "j," 3.8 mm; k = male "k," 3.9 mm; n = female "n," 4.2 mm; u = juvenile "u," 3.5 mm).

tenna 2=3-4-3 or 3-4-4, of article 5=2, article 5 with up to 4 dorsal calceoli and 4 clusters of male setae; flagellar formula = 28, 1, 2, 4, 5, 7, 9...27 or 1-3, 5, 7... or 2, 3, 5, 7... Distal branch of right lacinia mobilis almost truncate; basofacial setae of article 3 on mandibular palp = 2+1. Article 6 of pereopod 4 more attenuate, length-width ratio = 18:3 (female = 16:3); article 5 also more attenuatenuate.

ate. Article 2 of pereopods 3-5 not narrower than in female. Epimera 1-3 broadened; posterior margin of epimeron 3 not shortened; setal formulas, epimeron 1 anteroventral = 8, posteroventral = 2-3, epimeron 2 facial = 10, epimeron 3 posterior = 6, tooth shorter, ventral = 4; spine formulas of uropods, uropod 1 peduncle apicolateral = 2-3, basofacial = 2, uropod 2 peduncle dorsal = 9, dor-

sal spines on outer ramus of uropod l=3-4, of uropod 2=2, inner ramus of uropod l=1, of uropod 2=1. Ventral spines on peduncle of uropod 3=6; spine formula on article l of outer ramus l-l-l-l-l-l-1, setal formula l-l-l-l-l-1-1. Telson slightly elongate, distal spines scarcely shortened.

OBSERVATIONS.—Shape of coxa 7 variable, not sex-linked, varying from blunt triangle to a more anteriorly produced form, posterior setae varying from 0 to 4; six coxae illustrated to show variations. Inner ramus of uropod 2 in female "c" and juvenile "u" with small additional spine, see illustration.

HOLOTYPE.—NMV, female "a," 4.6 mm.

Type-Locality.—CPBS 22S/4, 9 Mar 1965, Western Port, Victoria, Australia, 10.5 m, sand with mud, shell, stones.

VOUCHER MATERIAI. (all illustrated).—PPBES 906/5: male "b," 4.2 mm; female "c," 4.2 mm. PPBES 986/4: male "g," 3.9 mm. PPBES 919/3: male "i," 3.8 mm. PPBES 902/4: male "j," 3.8 mm. PPBES 127: male "k," 3.9 mm. PPBES 902/3: female "n," 4.2 mm. PPBES 912/4: juvenile "u," 3.3 mm.

RELATIONSHIP.—Birubius cartoo, B. thalmus (8) and B. muldarpus (9) form a group differing from the B. myallus (4) to B. apari (6) group in the absence of fully facial setae on epimeron 3, but epimeron 3 bears ventral setae unlike B. apari (6).

Birubius cartoo and B. thalmus are very close to B. panamunus (1) but differ in the absence of setae on coxa 4 and the absence of fully facial setae on epimeron 3. Birubius cartoo is unusual in bearing a midfacial ridge on pereopod 3.

The broadened rostra of the *B. cartoo* group suggest that it may be near the ancestral stock of *B. muldarpus* (9) and *B. gallangus* (10), both of which, however, have reduced tooth and setae of epimeron 3. See comments written with *B. thalmus* (8).

MATERIAL.—CPBS, one sample from one station (1); PPBES, 46 samples from 18 stations (192).

DISTRIBUTION.—Victoria: Western Port and Port Phillip Bay, 2-18 m, sand, silty sand, sandy silt.

8. Birubius thalmus, new species

FIGURES 108, 109

DESCRIPTION OF FEMALE.—Head about 21 percent

of total body length, greatest width about 70 percent of length; rostrum scarcely constricted, almost reaching middle of article 2 on antenna 1. Eyes mediumlarge, largely occluded with pigment. Article 1 on peduncle of antenna 1 as long as wide, about twice as wide as article 2, ventral margin with about 7 setules, weakly produced dorsal apex with 3 setules; article 2 as long as article 1, with ventral crescent of 8 setae; primary flagellum with 8 articles, about 0.73 times as long as peduncle, bearing long aesthetascs; accessory flagellum with 7 articles. Spine formula on article 4 of antenna 2 = 1-3-4-5. dorsal margin with notch bearing 3 setae, ventral margin with 4 groups of 1-2 long to medium setae, one ventrodistal long spine; article 5 about 0.8 times as long as article 4, facial spine formula = 2, dorsal margin naked, ventral margin with 3 sets of 1-2 long to medium setae, 3 ventrodistal long to medium spines and setae; flagellum about as long as articles 4-5 of peduncle combined, with 11 articles. Mandibles with medium palpar hump; right incisor with 3 teeth and notch; left incisor with 3 humps in 2 branches; right lacinia mobilis bifid, distal branch shorter than proximal, flabellate, denticulate, proximal branch simple, pointed, with marginal denticles; left lacinia mobilis with 4 teeth, middle teeth shortened; right rakers 8; left rakers 9; molar in form of bulbous hump, right molar with 6 primarily long spines, left molar with 7 primarily long spines, none disjunct; palp article 1 short, article 2 with one short inner apical seta and 3 other short inner setae, article 3 about 1.15 times as long as article 2, oblique apex with 8 spine-setae, basofacial formula = 1-1 or 0-1. Inner plate of maxilla 1 somewhat thin, bearing one long apical pluseta, one similar apicomedial seta, 2 apicolateral much shorter setae; palp article 2 with 4 apicalmedial marginal spines and 4 submarginal setae. Inner plate of maxilla 2 slightly shorter and narrower than outer, outer with 3 apicolateral setae, inner without medial setae. Inner plate of maxilliped with 2 large thick apical spines, 2 apicofacial setae, 5 medial setae; outer plate with 7 medial and apical spines, no apicolateral setae; palp article 1 with apicolateral seta, article 2 with 4-5 groups of 1-2 apicolateral setae, medial margin of article 2 strongly to moderately setose, article 3 protuberant, with 5 facial setae, 4 lateral setae, nail of article 4 medium, with 2 accessory setules. Coxa 1 scarcely expanded distally, anterior margin con-

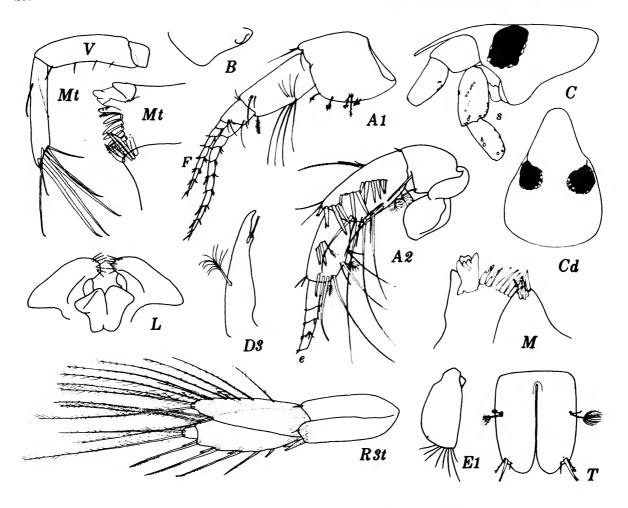


FIGURE 108.—Birubius thalmus, new species, holotype, female "a," 4.3 mm.

vex; main ventral setae of coxae 1-4=8-8-7-0, posteriormost seta of coxae 1-2 shortened; anterior and posterior margins of coxa 4 almost parallel, posterior margin almost straight, posterodorsal corner rounded, posterodorsal margin short, concave, width-length ratio of coxa 4=5:7. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2=4-3-(6-7)-(6-7), short anteriors = (3-4)-1-3-2, long anteriors = 4-4-0-0. Gnathopods moderately thin, almost identical; width ratios of articles 5-6 on gnathopods 1-2=26:31 and 26:31, length ratios = 62:52 and 60:54; palmar humps small, palms almost transverse; article 5 of gnathopods 1-2 elongate, ovate, trapezoidal, posterior

margin rounded-flat, long. Pereopods 1-2 similar; facial setae formula on article 4=5-5, on article 5=5-6; main spine of article 5 extending to M. 100 on article 6, article 5 lacking proximoposterior spines; spine formula of article 6=4+5 plus middistal spine, some spines especially long; acclivity on inner margin of dactyls of pereopods 1-2 weak, emergent setule long, midfacial pluseta ordinary. Coxae 5-7 posteroventral setule formula = 3-2-1. Articles 4-5 of pereopods 3-4 broad, facial spine rows dense, facial ridge formula on article 2 of pereopods 3-5 = 1-2-2; width ratios of articles 2, 4, 5, 6 of pereopod 3=47:49:45:25, of pereopod 4=69:44:25:13, of pereopod 5=68:20:16:8, length

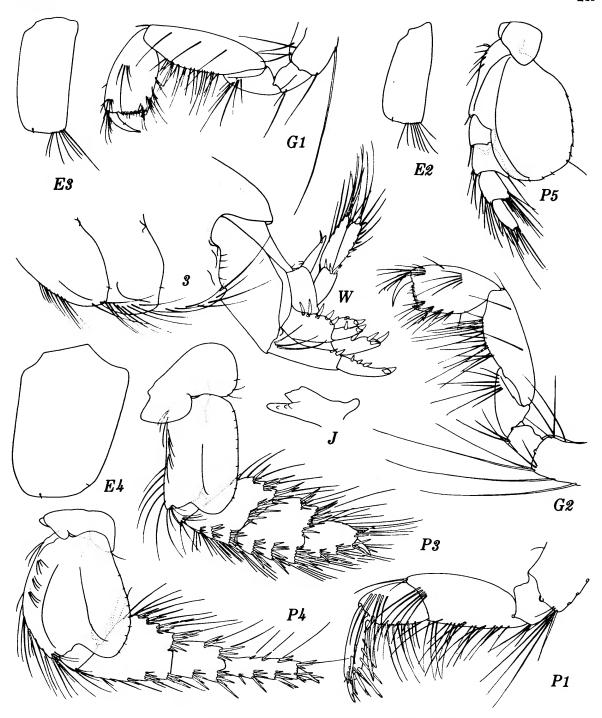


FIGURE 109.—Birubius thalmus, new species, holotype, female "a," 4.3 mm.

ratios of pereopod 3 = 80:42:44:35, of pereopod 4 = 86:54:36:51, of pereopod 5 = 95:24:22:23; article 2 of pereopod 5 reaching apex of article 4; medial apex of article 6 finely combed, bearing 6 digital processes. Posteroventral corner of epimeron 1 subquadrate, posterior margin convex, with setule, anteroventral margin with 9 long to medium setae, posteroventral face with 2 long setae; posteroventral corner of epimeron 2 weakly protuberant, posterior margin convex, with setule, facial setae = 8; posteroventral corner of epimeron 3 with small to medium tooth, posterior margin sinuous, with 4-5 setules, ventral margin with 7 setae evenly spread, pointing posteriorly and dorsally, with rugosities at posterodorsal invagination. Urosomite 1 naked, articulation line complete, forming lateral ridge running foward to rounded socket fitting invagination of pleonite 3; urosomite 2 largely hidden but elongate and marked by dorsal cleft; urosomite 3 protuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, inner ramus of uropod 1 with one accessory nail, outer ramus of uropod 1 with 3 dorsal spines, inner with one, outer ramus of uropod 2 with one dorsal spine, inner with one dorsomedial spine; peduncle of uropod 1 with 2 apicolateral spines and 3 basofacial setae, medially with one marginal seta and apical enlarged spine; peduncle of uropod 2 with 5 dorsal spines, medially with one small apical spine. Peduncle of uropod 3 with 5 ventral spines, dorsally with one lateral spine, one medial spine and setule; rami masculine, inner extending to M. 100 on article 1 of outer ramus, apex with 2 setae, medial and lateral margins setose, article 2 of outer ramus short, 0.15, bearing 2 long setae, medial margin of article I setose, lateral margin with 4 acclivities, spine formula = 1-1-1-1-1, setal formula = 0-1-1-1-1. Telson long, length-width ratio = 17:13, not fully cleft, each apex wide, rounded, lateral acclivity deep, bearing short lateral setule, spine next medial longer than setule, midlateral setules diverse. Cuticle with ordinary bulbar setules.

OBSERVATIONS.—Juvenile differing from adult holotype mainly in smaller eyes and lack of dorsal spine on outer ramus of uropod 2.

ILLUSTRATIONS.—Head heavily restored; upper lip and maxilla 2 damaged during dissection, maxilliped of holotype missing, these appendages taken from juvenile; upper lip and epistome from anterior view similar to illustration shown for B. myallus (4) but epistomal region slightly smaller; maxilla 2 like that of B. myallus but medial setae of inner plate absent; maxilliped as shown for B. myallus but inner plate with only 2 thick apical spines, outer plate lacking lateral setae but palparticle 4 with 2 setules at base of nail; maxilla 1 as shown for B. panamunus (1), inner plate with 2 large and 2 small setae, apex of palp with 4 thick and 4 thin setae (from holotype); peduncle of uropod 3 shriveled and restored in drawing; setule on coxa 7 missing; one spine on outer ramus of uropod 3 missing.

HOLOTYPE.—NMV, female "a," 4.3 nm.

Type-Locality.—PPBES 986/1, 12 Oct 1971, Port Phillip Bay, Victoria, Australia, 4 m, sand.

VOUCHER MATERIAL.—Type-locality, juvenile "b," 4.1 mm. Male unknown.

RELATIONSHIP.—This species, furnished with an excavate posterodorsal margin of pleonite 3 and lateral shield on the urosome, has the appearance of a being a superadult of B. muldarpus (9), but differs markedly in the much longer wrists on the gnathopods, thinner hands and more transversely oriented palms.

Birubius thalmus differs from B. cartoo (7) in the smaller tooth of epimeron 3, simple cuticular setules lacking alate plaques and the longer article 2 of antenna 1.

MATERIAL.—PPBES, one sample from one station (2).

DISTRIBUTION.—Victoria, Port Phillip Bay, 4 m, sand.

9. Birubius muldarpus, new species

FIGURES 110-112

Description of Female.—Head about 21 percent of total body length, greatest width about 60 percent of length; rostrum slightly constricted, narrow, not reaching middle of article 2 on antenna 1. Eyes large, largely occluded with pigment. Article 1 on peduncle of antenna 1 about 1.3 times as long as wide, about twice as wide as article 2, ventral margin with about 11 setules, weakly produced dorsal apex with 3 setules; article 2 about 0.73 times as long as article 1, with ventral cycle of 7 setae; primary flagellum with 9-10 articles, about as long as peduncle, lacking aesthetascs; accessory

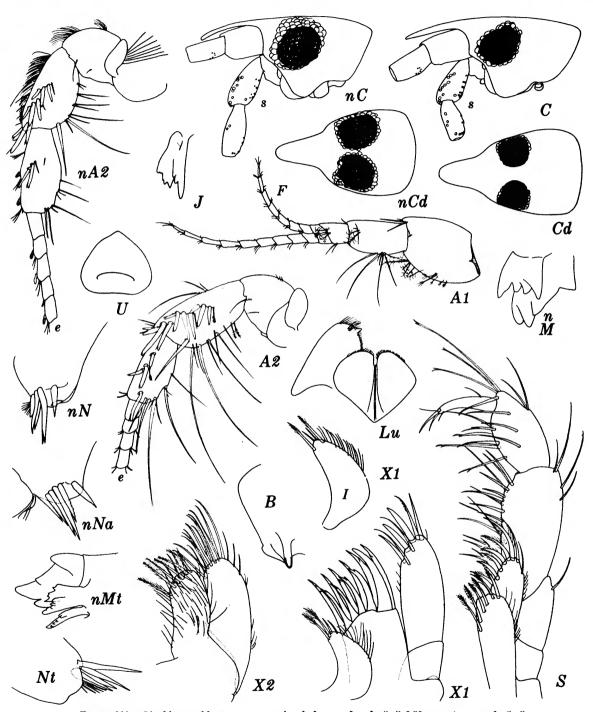


Figure 110.—Birubius muldarpus, new species, holotype, female "a," 3.50 mm (n = male "n," 3.64 mm).

flagellum with 7-8 articles. Spine formula on article 4 of antenna 2 = 1-3-4-3, dorsal margin with notch bearing 3 setae, ventral margin with 4-5 groups of 1-4 long to medium setae, one ventrodistal long spine; article 5 about 0.75 times as long as article 4, facial spine formula = 1-2-1, 1-2-0, or 1-2-2, dorsal margin naked, ventral margin with 3 sets of 1-2 long to short setae, 2 ventrodistal long to medium spines and setae; flagellum about 1.4 times as long as articles 4-5 of peduncle combined, with 11 articles. Mandibles with medium palpar hump; right incisor with 3 teeth and accessory tooth; left incisor with 4 humps in 2 branches; right lacinia mobilis bifid, distal branch little shorter than proximal, distal branch flabellate, denticulate, proximal branch simple, pointed, with 2 facial humps; left lacinia mobilis with 4 teeth, middle teeth shortened; right rakers 9, plus one rudimentary; left rakers 9; molar in form of bulbous hump demarcated mainly by spines, molars with 4-5 primarily long spines, plus one weakly disjunct, each molar with plume; palp article 1 short, article 2 with one short inner apical seta and 2 other shorter inner setae, article 3 about as long as article 2, oblique apex with 9 spine-setae, basofacial formula = 1 + 1. Inner plate of maxilla l ordinary, bearing one long apical pluseta, one similar apicomedial seta, 2 apicolateral much shorter setae; palp article 2 with 4 apicomedial marginal spines and 3 submarginal setae. Plates of maxilla 2 extending equally, outer slightly broader than inner, outer with 3 apicolateral setae, inner with one medial seta. Inner plate of maxilliped with 2 large, thick, apical spines, 3 apicofacial setae, 3 medial setae; outer plate with 6 medial and apical spines, 2 apicolateral setae; palp article 1 with one apicolateral seta, article 2 with 4 apicolateral setae, medial margin of article 2 moderately setose, article 3 weakly protuberant, with 3 facial setae, 2 lateral setae, nail of article 4 long to medium, with 2 accessory setules. Coxa 1 expanded distally, anterior margin weakly concave; main ventral setae of coxae 1-4 = (5-7)-(5-7)-(4-7)-0, posteriormost seta of coxae 1-2 shortest (or aberrantly long on coxa 3); anterior and posterior margins of coxa 4 almost parallel, posterior margin convex, posterodorsal corner sharply rounded, posterodorsal margin short, concave, width-length ratio of coxa 4 = 19:22; long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = (1-2)-3(2-3)-3, short anteriors = (2-3)-(2-3)-(2-3)-(1-2). long anteriors = (2-4)-(5-6)-0-0, no others. Gnathopods ordinary; width ratios of articles 5-6 on gnathopods 1-2 = 26:35 and 26:35, length ratios = 67:63 and 60:58; palmar humps small, palms oblique; article 5 of guathopod I elongate. ovate, posterior margin almost flat; article 5 of gnathopod 2 ovate, posterior margin almost flat. Pereopods 1-2 similar; facial setae formula on article 4 = 3 and 3, on article 5 = 4 and 5; main spine of article 5 extending to M. 80 on article 6, article 5 with 2 proximoposterior spines; spine formula of article 6 = 3-4 and 4-5 plus middistal seta; acclivity on inner margin of dactyls of percopods 1-2 sharp, produced as tooth, emergent setule long, midfacial pluseta short. Coxae 5-7 posteroventral setule formula = 1-1-1. Articles 4-5 of percopods 3-4 medium broad, facial spine rows moderately developed, facial ridge formula on article 2 of pereopods 3-5 = 0-2-2; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 41:40:35:17, of pereopod 4 = 64:37:25:13, of pereopod 5 = 78:24:22:11, length ratios of pereopod 3 = 70:27:36:41, of pereopod 4 = 80:47:37:50, of pereopod 5 = 100: 26:21:27; article 2 of pereopod 5 slightly exceeding apex of article 4; medial apex of article 6 bearing 5 digital processes. Posteroventral corner of epimeron l rounded, posterior margin weakly convex, anteroventral margin with 2-4 medium setae, posteroventral face with 2 long setae; posteroventral corner of epimeron 2 weakly protuberant, posterior margin convex, facial setae = 7-9; posteroventral corner of epimeron 3 weakly protuberant, with setule sinus, posterior margin almost straight, face with crescent of 3-6 setae near ventral posterior margin; epimeron 3 with setule on posterodorsal margin. Urosomite 1 naked, articulation line complete; urosomite 3 weakly protuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, inner ramus of uropod 1 with two accessory nails, outer ramus of uropod 1 with 3-4 dorsal spines, inner with one, outer ramus of uropod 2 with 2 dorsal spines, inner with one circular dorsomedial spine; peduncle of uropod 1 with 2 apicolateral spines and 2 basofacial setae, medially with 3 marginal setae and spines, apicalmost an enlarged spine; peduncle of uropod 2 with 5-7 dorsal spines, medially with one small apical spine. Peduncle of uropod 3 with 6 ventral spines, dorsally with one lateral spine, one medial setule; rami submascu-

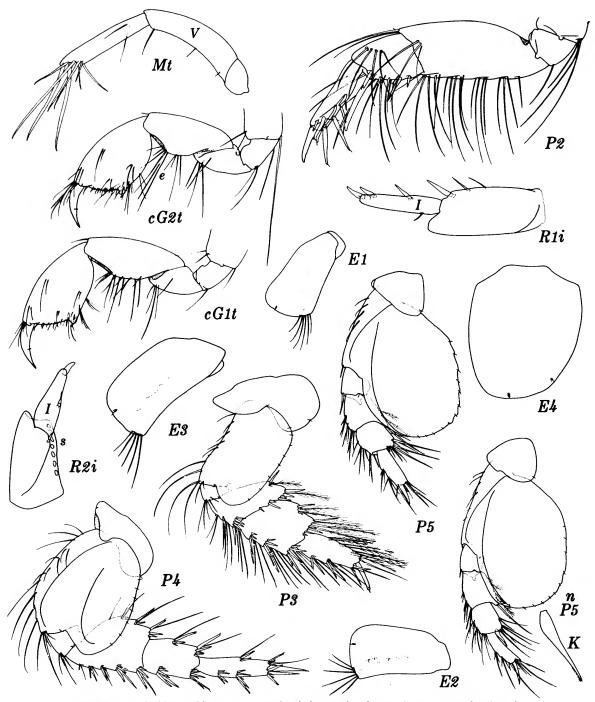


FIGURE 111.—Birubius muldarpus, new species, holotype, female "a," 3.50 mm (c = female "c," 3.39 mm; n = male "n," 3.64 mm).

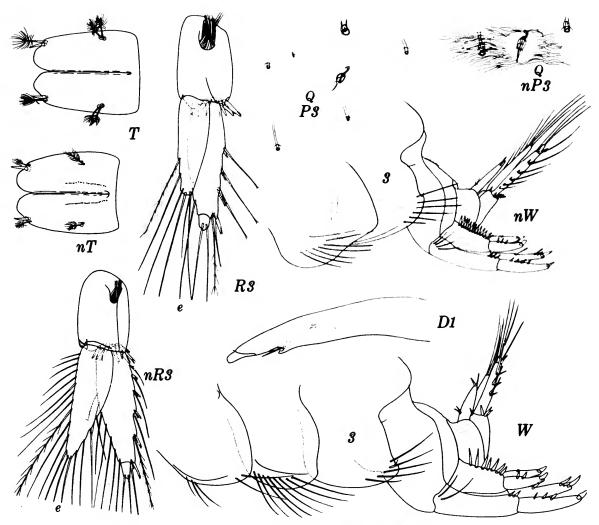


FIGURE 112.—Birubius muldarpus, new species, holotype, female "a," 3.50 mm (n = male "n," 3.64 mm).

line, inner extending to M. 80 on article 1 of outer ramus, apex with 2 setae, medial margin with 3 setae, lateral margin naked, article 2 of outer ramus short, 0.14, bearing 2 long setae, medial margin of article 1 with 2 setae, lateral margin with 3 acclivities, spine formula = 1-1-1-1 or 2-1-1-1, setal formula = 1-1-1-2 or 0-1-1-1. Telson ordinary, length-width ratio = 5:4, not fully cleft, each apex wide, rounded, lateral acclivity shallow, weak, bearing long lateral setule, spine next medial shorter than setule, midlateral setules equal on holotype, diverse in other specimens. Cuticle with ordinary

bulbar setules mixed with pipes, surface lacking fine striations.

Observations (female).—Female "c": Setal formulae of article 4 on pereopods 1-2=3 and 3, of article 4=4 and 5, spine rows of article 6=3 and 5 plus seta; this specimen better developed than holotype except in outer ramus of uropod 3 and peduncle of uropod 2, the high counts of spines and setae on various appendages in the description mainly originating from this specimen.

DESCRIPTION OF MALE.—Rostrum slightly longer and narrower than in female. Article 2 of antenna

1 with 5 ventral setae; primary flagellum with 10 articles, one calceolus each on articles 1-6, aesthetascs poorly developed or absent; accessory flagellum with 7 articles. Facial spine formula on article 4 of antenna 2 = 0-3-3-3, on article 5 = 2, article 5 with 3 dorsal sets of male setae and 2 calceoli, ventrodistal apex with 2 thin spines; flagellar formula = 26, 2, 3, 5, 7 . . . 25. Right rakers 8 plus 1-2 rudimentaries; left rakers 9; molars with 6 spines plus one disjunct spine more strongly separated than in female; basofacial setal formula of article 3 on mandibular palp = 2-1. Palp of maxilla 1 with 5 spines and 4 setae. Palp article 3 of maxilliped with 4 facial setae. Coxa 4 like that of female but smaller in relation to coxa 1; ventral setal formula of coxae 1-4 = (6-7)-6-5-0. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 1-(1-2)-2-2, long anteriors = 4-(5-6)-0-0, short anteriors = 2-2-2-2, no others. Facial and setal spine formulas of pereopods 1-2 on article 4 = 4 and 3, on article 5 = 5 and 5, on article 6 = 3 + 5 plus middistal seta. Article 2 of only pereopod 5 narrower than in female, pereopod 4 slightly larger relative to pereopod 3 than in female, pereopod 5 much larger, pereopod 5 with special spine on article 5. Epimera 1-3 broadened, posterior margin of epimeron 3 shortened; setal formulas, epimeron 1 anteroventral = 3, posteroventral = 2, epimeron 2 facial = 6, epimeron 3 posterior = 2 setules, facial = 6. Spine formulas of uropods, uropod 1 peduncle apicolateral = 3, basofacial = 4, medially = 4 spines and setae, uropod 2 peduncle dorsal = 13; dorsal spines on outer ramus of uropod 1 = 4, of uropod 2 = 3, inner ramus of uropod 1 = 1, of uropod 2 = 1, ventral spines on peduncle of uropod 3 = 7, spine formula on article 1 of outer ramus = 1-1-2-2-2, setal formula = 1-1-1-1-1. Telson not elongate, distal spines not shortened.

ILLUSTRATIONS.—Palp of maxilla 1 fully flattened in illustration; epimeron 1 of male heavily damaged and illustration omitted.

HOLOTYPE.—AM, female "a," 3.50 mm.

Type-Locality.—SBS D1S4, 17 May 1972, off Malabar, New South Wales, Australia, 31 m, coarse sand.

VOUCHER MATERIAL.—Type-Locality: juvenile "b," 2.70 mm. SBS D2S5: female "c," 3.39 mm (illus.). EBS 20: male "n," 3.64 mm (illus.); female "e," 2.97 mm.

RELATIONSHIP.—From the *B. cartoo-thalmus* (7–8) group, *B. muldarpus* differs in the smaller tooth and absence of midposterior setules on epimeron 3, the absence of a midfacial ridge on article 2 of pereopod 3 and the shorter wrists of the gnathopods.

Birubius muldarpus differs from the B. myalluskareus (4-5) group in the absence of fully facial setae on epimeron 3 and from B. myallus in addition by the smaller protrusion on epimeron 3. From B. panamunus (1) and B. apari (6), B. muldarpus differs in the smaller tooth on epimeron 3 and the absence of a midfacial row of setae on epimeron 3.

The absence of long setae on coxa 4 differentiates B. muldarpus from B. lorus (2) and B. nammuldus (3).

Birubius yorlunus (31) has a simple right lacinia mobilis and fully facial setae on epimeron 3.

See comments with *B. thalmus* about the possibility of conspecificity.

MATERIAL.—SBS, 4 samples (4); EBS, one sample (1).

DISTRIBUTION.—New South Wales: off Malabar, 31–49 m, sand and shell frags.; Jervis Bay, Murray's Beach, 6 m, Zostera.

10. Birubius gallangus, new species

FIGURES 113, 114

Description of Male.—Head about 15 percent of total body length, greatest width about 70 percent of length; rostrum constricted, short, apex narrow, reaching almost to middle of article 2 on antenna 1. Eyes medium, clear of opaque pigment, but eosin colored. Article 1 on peduncle of antenna 1 about 0.90 times as long as wide, about 2.5 times as wide as article 2, ventral margin with about 12 setules, weakly produced dorsal apex with 2-3 setules, medial face with patch of fuzz; article 2 about as long as article 1, with ventral cycle of 4 setae; primary flagellum with 9 articles, about 0.85 times as long as peduncle, bearing one calceolus each on articles 1-4, no aesthetascs; accessory flagellum with 6 articles. Spine formula on article 4 of antenna 2 = 3-4-3, dorsomedial margin fuzzy, ventral margin with 3 groups of 2 medium setae, one ventrodistal medium spine; article 5 about 0.9 times as long as article 4, facial spine

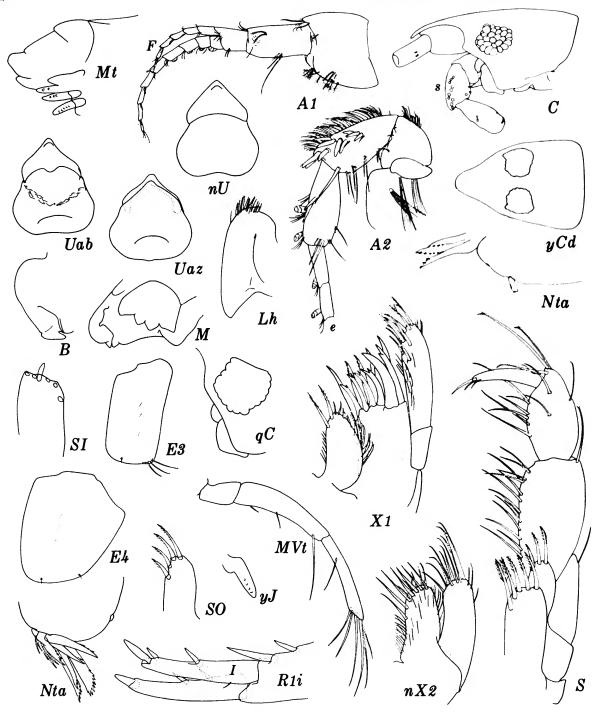


FIGURE 113.—Birubius gallangus, new species, holotype, male "a," 3.26 mm (n = male "n," 3.14 mm; q = male "q," 3.50 mm; y = male "y," 3.11 mm; b = epistome flat, z = upper lip flat).

formula = 2, dorsal margin bearing 3 sets of male setae and 2 calceoli, ventral margin with 2 sets of 1-2 short to medium setae, 2 ventrodistal spines and setule; flagellum elongate, flagellar formula = (23-24), 1-3, 5, 7, ... 23 or 2-4, 6, 8 ... 20. Mandibles with strong palpar hump; right incisor with 3 teeth and accessory notch; left incisor with 4 humps in 2 branches; right lacinia mobilis bifid, distal branch much shorter than proximal, weakly expanded but pointed, proximal branch simple, pointed, with marginal denticles; left lacinia mobilis with 4 teeth; right rakers 5-7, plus rudimentaries; left rakers 6-7 plus 0-1 rudimentary; molar in form of elongate plaque, right and left molars with 5-6 primarily long spines plus one short spine strongly disjunct; palp article 1 slightly elongate, article 2 with one long inner apical seta and 2 other shorter inner setae, article 3 about 0.9 times as long as article 2, oblique apex with 6 spinesetae, basofacial formula = 0-1. Inner plate of maxilla l ordinary, bearing one long apical pluseta, one similar medial seta, 2-3 apicolateral much shorter setae; palp article 2 with 4 apicalmedial marginal spines and 3 submarginal setae. Plates of maxilla 2 extending equally, outer slightly narrower than inner, with 3 apicolateral setae, inner with 2 medial setae. Inner plate of maxilliped with one short apical spine set in middle (unusual), 5 mostly apicofacial setae; outer plate with 4 medial and apical spines, no apicolateral setae; palp articles 1-2 each with apicolateral seta, medial margin of article 2 moderately setose, article 3 protuberant, with 2 facial setae, one lateral seta, nail of article 4 medium, with 2 accessory setules. Coxa 1 expanded distally, anterior margin almost straight; main ventral setae of coxae 1-4=6-6-3-0 and 0-(1-3)-(1-3)-1 rudimentaries, posteriormost seta of coxae 1-2 shortened; anterior and posterior margins of coxa 4 divergent, posterior margin almost straight, posterodorsal corner subsharp, posterodorsal margin long, weakly concave, width-length ratio of coxa 4 = 17:19. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 1-2-3-3, others not noted. Gnathopods ordinary; width ratios of articles 5-6 on gnathopods 1-2 = 28:36 and 28:39, length ratios = 72:75 and 66:65; palmar humps ordinary, palms oblique; article 5 of gnathopod l elongate, ovate, posterior margin rounded-flat; article 5 of gnathopod 2 elongate, ovate, posterior margin rounded. Pereopods

1-2 similar, facial setae formula on article 4 = 4and 4, on article 5 = 4 and 4; main spine of article 5 extending to M. 100 on article 6, article 5 with one proximoposterior spine; spine formula of article 6 = 3 + 3 plus middistal seta; acclivity on inner margin of dactyls of pereopods 1-2 weak, obsolescent, emergent setule long, midfacial pluseta highly distad. Coxae 5-7 posteroventral setule formula = 1-1-1. Articles 4-5 of pereopods 3-4 of ordinary width, facial spine rows sparse, facial ridge formula on article 2 of pereopods 3-5 = 1-2-2, width ratios of articles 2, 4, 5, 6 of pereopod 3 = 47:38:34:16, of pereopod 4 = 61:38:27:11, of pereopod 5 =80:20:17:8, length ratios of pereopod 3 = 72:24: 35:40, of pereopod 4 = 80:42:39:46, of pereopod 5 = 107:27:24:23; article 2 of pereopod 5 almost reaching apex of article 4; medial apex of article 6 bearing digital processes. Posteroventral corner of epimeron l rounded, posterior margin deeply convex, anteroventral margin with 3 long setae, posteroventral face with 3 long setae; posteroventral corner of epimeron 2 rounded-quadrate, posterior margin strongly convex, facial setae = 6-7 crowded anteriorly; posteroventral corner of epimeron 3 with small-medium upturned tooth with setule sinus, posterior margin convex, with 1-2 setule notches, posteroventral face with 1-2 setae; epimera 1-3 with small setule on posterodorsal margin set in weak notch. Urosomite 1 with ventrolateral setule at base of uropod 1, articulation line complete; urosomite 3 weakly protuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, inner ramus of uropod 1 with one accessory nail, outer ramus of uropod 1 with 2-3 dorsal spines, inner with one, outer ramus of uropod 2 with 1-2 dorsal spines, inner with one dorsomedial spine; peduncle of uropod 1 with 3 apicolateral spines, basofacial setae absent, medially with 0-1 marginal enlarged spine; peduncle of uropod 2 with 7-8 dorsal spines, medially with one medium apical spine. Peduncle of uropod 3 with 4 ventral spines, dorsally with one lateral spine, one medial spine; rami masculine, inner extending to M. 110 on article 1 of outer ramus, apex with 2 setae, medial and lateral margins setose, article 2 of outer ramus short, 0.13, bearing 2 long setae, medial margin of article 1 setose, lateral margin with 4 acclivities, spine formula = 1-1-2-2-2, setal formula = 1-1-1-11-1. Telson elongate, length-width ratio = 7:5, fully cleft, each apex protrusive, rounded, lateral

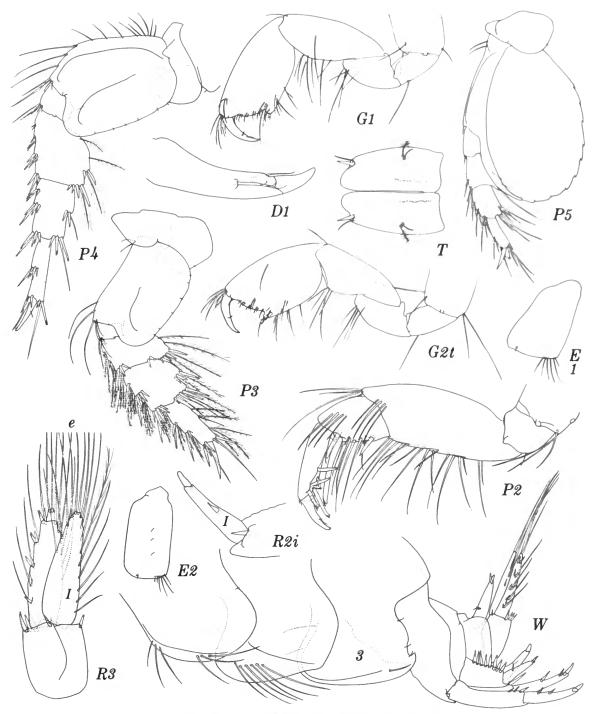


FIGURE 114.—Birubius gallangus, new species, holotype, male "a," 3.26 mm.

acclivity deep, bearing ordinary lateral setule, spine next medial slightly shorter than setule, midlateral setules scarcely diverse, each lobe with dorsal row of denticles. Cuticle with very sparse ordinary bulbar setules.

Variations.—Head of male "q" with almost blunt, poorly protuberant preocular corner (see illustration); male "y" lacking distal branch on right lacinia mobilis (see illustration), left lacinia mobilis only trifid; left lacinia mobilis of male "n" poorly 4-dentate; male "q" with spine formula on article 4 of antenna 2 = 3-5-3 (otherwise males with 3-4-3), 4 apicolateral spines on peduncle of uropod 1, outer ramus of uropod 2 with 2 spines in 3 specimens, facial setae of epimeron 2 arranged in zigzag fashion.

ILLUSTRATIONS.—Dorsal view of head of male "y" bearing only outline of eyes; palp of maxilla 1 as illustrated, not flattened, and normal basal cusp proximal to palp not shown; setule on coxa 6 and epimeron 2 missing.

HOLOTYPE.—AM, male "a," 3.26 mm.

TYPE-LOCALITY.—AM P.18125, 12 Dec 1939, Antechamber Bay, Kangaroo Island, South Australia, with light in net at night.

VOUCHER MATERIAL.—Type-locality: male "n," 3.14 mm (illus.); male "q," 3.50 mm (illus); male "y," 3.11 mm (illus.); male "e," 3.34 mm. Female unknown.

RELATIONSHIP.—Birubius gallangus fits Key B of Birubius in the simplicity of the distal branch on the right lacinia mobilis, but the presence of an accessory apical nail on uropod 1 suggests affinity with species 1-9 in Key A in which the distal branch of the right lacinia mobilis is complex and uropod 1 bears accessory nails. See remarks with B. lorus (2).

This species appears to have more characters in common with *B. muldarpus* (9) than any other species but differs from *B. muldarpus* in the reduced setation on epimeron 3, crowded setae on epimeron 2, different positions and lengths of facial ridges on pereopod 5, presence of a ridge on pereopod 3, shorter rostrum and no true apical spine on the inner plate of the maxilliped.

Birubius gallangus might have a point of origin near B. panamunus (1) and B. cartoo (7) but differs in the small tooth and poor setation of epimeron 3, and the narrower rostrum. Birubius gallangus differs from the greater B. myallus-B. kareus (4-5) group in the reduced setation and sharper tooth of

epimeron 3.

REMARKS.—The apical spine on the inner plate of the maxillipeds is probably not homologous to the spines normally occurring in other species and therefore specific comparisons are made on the basis that the normal apical spine is absent.

MATERIAL.—AM, one sample (40).

Distribution.—South Australia, Kangaroo Island, Antechamber Bay, neritic.

11. Birubius mayamayi, new species

FIGURES 115-118, 119(part)-121

Description of Female.—Head about 19 percent of total body length, greatest width about 58-68 percent of length; rostrum unconstricted, broad, reaching or exceeding middle of article 2 on antenna l. Eyes medium, largely occluded with pigment. Article 1 on peduncle of antenna 1 about 1.3 times as long as wide, about twice as wide as article 2, ventral margin with about 10 setules, weakly produced dorsal apex with one setule; article 2 about 0.8 times as long as article 1, with ventral cycle of 6 setae; primary flagellum with 9-11 articles, about 0.90 times as long as peduncle, bearing several long aesthetascs; accessory flagellum with 6-8 articles. Spine formula on article 4 of antenna 2 = 1-3-4-4, dorsal margin with notch bearing 3 setae, ventral margin with 5-6 groups of 1-2 long and medium setae, one ventrodistal long spine; article 5 about 0.8 times as long as article 4, facial spine formula = 1-2-2-2 or 1-2-3-2 or 1-2-2-1, dorsal margin bearing 2 setules, ventral margin with 5 sets of 1-2 setae, 2 ventrodistal long spines, one subdistal facial spine; flagellum about 1.3 times as long as articles 4-5 of peduncle combined, with 9-13 articles. Mandibles with weak to medium palpar hump; right incisor with 3 teeth and notch; left incisor with 4 teeth on 2 branches; right lacinia mobilis bifid, distal branch much shorter than proximal, distal branch flabellate, broad, variable, subbifid or denticulate, occasionally with facial humps, proximal branch simple, pointed, with marginal denticles; left lacinia mobilis with 4 teeth plus one accessory tooth, middle teeth slightly shortened; right rakers 8-10; left rakers 9-11; molar in form of elongate plaque, right and left molars with 8-9 primarily long spines, each molar with plume; palp article 1 short, article 2 with one long inner apical

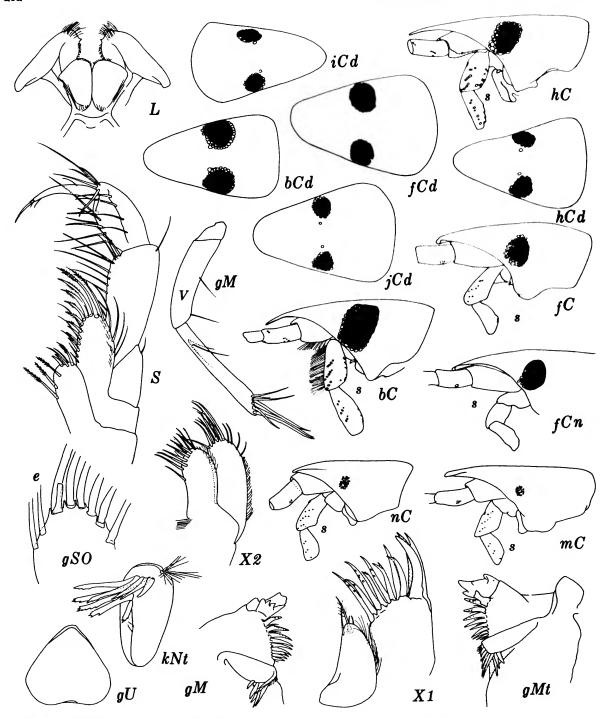


FIGURE 115.—Birubius mayamayi, new species, holotype, female "z," 4.78 mm (key to lower case letters in Figures 115-117: b = male "b," 4.60 mm; c = male "c," 4.61 mm; d = male "d," 4.10 mm; e = male "e," 4.70 mm; f = female "f,"

4.2 mm; g = female "g," 4.72 mm; h = female "h," 4.75 mm; i = female "i," 4.2 mm; j = female "j," 4.40 mm; k = female "k," 4.50 mm; l = female "l," 4.60 mm; m = juvenile "m," 3.50 mm).

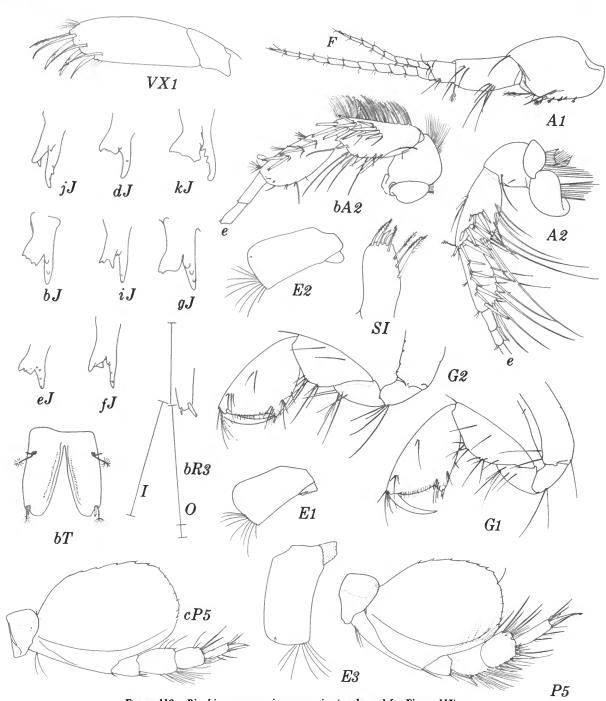


FIGURE 116.—Birubius mayamayi, new species (see legend for Figure 115).

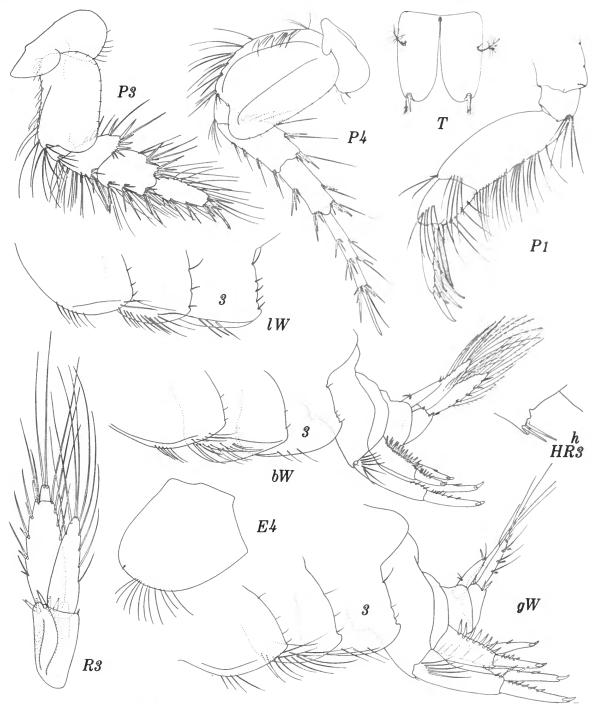


FIGURE 117.—Birubius mayamayi, new species (see legend for Figure 115).

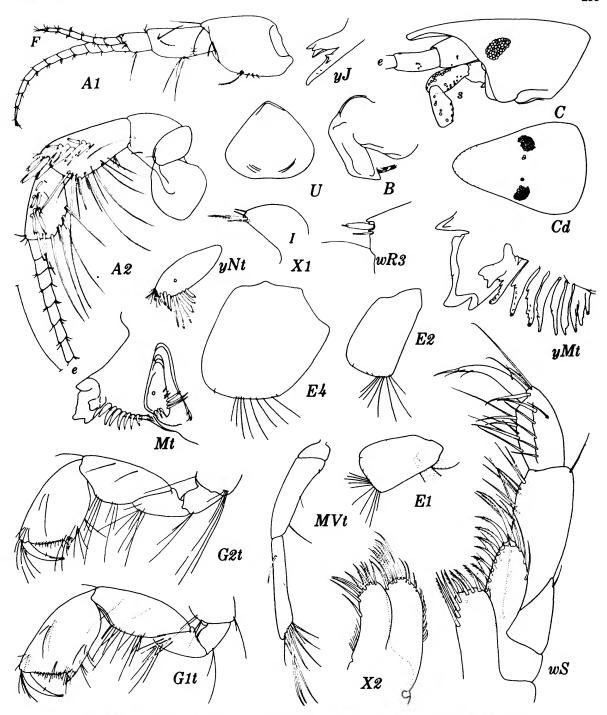


FIGURE 118.—Birubius mayamayi, new species, female "a," 4.9 mm (w = female "w," 4.3 mm; y = female "y," 4.65 mm; line near A2 = length of remaining flagellum).

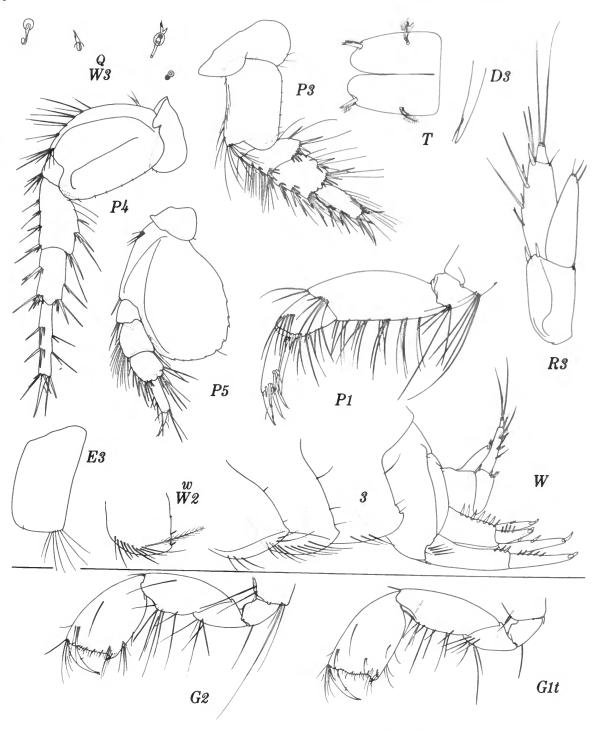


Figure 119.—Upper: Birubius mayamayi, new species, female "a," 4.9 mm (w = female "w," 4.3 mm). Lower: Birubius wirakus, new species, holotype, female "a," 4.3 mm.

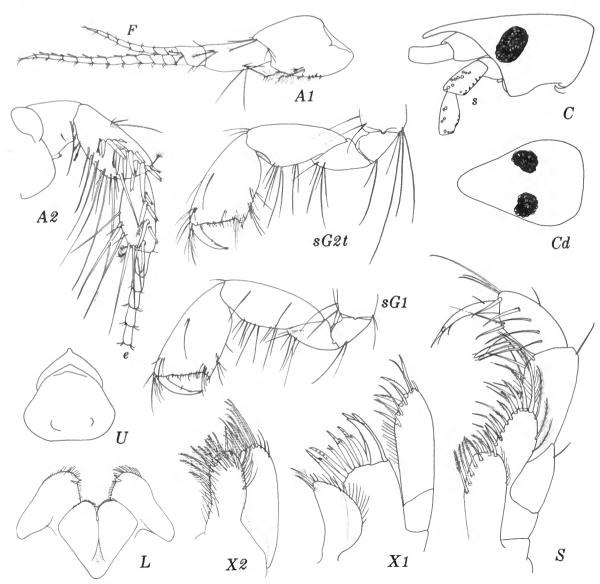


FIGURE 120.—Birubius mayamayi, new species, female "v," 4.92 mm (s = female "s," 4.64 mm).

seta and 1-3 other similar or shorter inner setae, article 3 about 1.3 times as long as article 2, oblique apex with 8-9 spine-setae, basofacial formula = 1-2. Inner plate of maxilla 1 ordinary, bearing one long apical pluseta, one shorter similar apicomedial seta, 2 apicolateral much shorter setae; palp article 2 with 3-4 apicalmedial marginal spines and 3-5 submarginal setae. Plates of maxilla 2 extending subequally, of subequal breadth, outer with 3-4 apicolateral setae, inner with one medial seta. Inner

plate of maxilliped with 2 large thick apical spines, 2-3 apicofacial setae, 3-6 medial setae; outer plate with 10-11 medial and apical spines, 4-6 apicolateral setae; palp article 1 with apicolateral seta, article 2 with one apicolateral seta, medial margin of article 2 moderately setose, article 3 not protuberant, with 4 facial setae, no lateral setae, nail of article 4 long, with 2 accessory setules. Coxa 1 expanded distally, anterior margin straight; main ventral setae of coxae 1-4=9-9-7-11, posteriormost

seta of coxae 1-3 shortest; anterior and posterior margins of coxa 4 strongly divergent, posterior margin very oblique, weakly convex, posterodorsal corner sharp, posterodorsal margin ordinary, weakly V-shaped, width-length ratio of coxa 4 = 15:16. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = (2-3)-3-3-5, plus one long facial on gnathopod 1, long anteriors = 4-(7-9)-0-0, short anteriors = (1-2)-(1-3)-(1-2)-(1-2). Gnathopods generally ordinary, hands slightly broadened; width ratios of articles 5-6 on gnathopods 1-2 =25:36 and 27:38, length ratios = 65:68 and 59:62; palmar humps ordinary to small, palms oblique; article 5 of gnathopod 1 elongate, ovate, posterior margin rounded; article 5 of gnathopod 2 elongate, ovate, posterior margin rounded. Pereopods 1-2 similar, facial setae formula on article 4 = 5 and 5, on article 5 = 6 and 6 or 5 and 5; main spine of article 5 extending to M. 95 on article 6, article 5 lacking proximoposterior spines; spine formula of article 6 = 4 + 5 or 3 + 4 plus middistal seta, some spines especially long; acclivity on inner margin of dactyls of pereopods 1-2 weak, emergent setule short, midfacial pluseta ordinary. Coxae 5-7 posteroventral setule-seta formula = 7-3-1. Articles 4-5 of pereopods 3-4 of ordinary width, facial spine rows sparse, facial ridge formula on article 2 of pereopods 3-5 = 0-2-2; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 40:35:29:15, of pereopod 4 = 57:25:17:8, of pereopod 5 = 80:22:20:7, length ratios of pereopod 3 = 68:28:39:39, of pereopod 4 = 86:45:45:58, of pereopod 5 = 88:25:25:28; article 2 of pereopod 5 almost reaching middle of article 5; medial apex of article 6 finely combed, bearing 5-6 digital processes. Posteroventral corner of epimeron 1 weakly protuberant, posterior margin weakly convex, with 0-3 setules, corner with or without setule, anteroventral margin with 4-5 medium setae, posteroventral margin with 2 long setae; posteroventral corner of epimeron 2 with small rounded or pointed tooth guarded by setule sinus, posterior margin weakly convex, with 2-3 setules, facial setae = 8-11, occasional pair set vertically; posteroventral corner of epimeron 3 rounded, weakly protuberant, with small rounded tooth guarded by setule sinus, posterior margin straight, with 3 setule notches, ventral margin with 2-4 setae evenly spread; epimera 1-3 with large to small seta on posterodorsal margin set in weak notch. Urosomite 1 with ventral setule at base of uropod 1, articulation line complete; urosomite 3 unprotuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, rami of uropods 1-2 lacking accessory nails, outer ramus of uropod 1 with 5-6 dorsal spines, inner with 2-3, outer ramus of uropod 2 with 4 dorsal spines, inner with 1-2 dorsomedial spines; peduncle of uropod 1 with 2 apicolateral spines and 4-5 basofacial setae, medially with 5-6 marginal spines, apicalmost enlarged; peduncle of uropod 2 with 7-9 dorsal spines, medially with one apical spine. Peduncle of uropod 3 with 4-5 ventral spines, dorsally with one lateral spine, 2 medial setules or one spine and one setule; rami submasculine, inner extending to M. 85 on article 1 of outer ramus, apex with 2 setae, medial and lateral margins more or less setose, article 2 of outer ramus short, 0.15-0.22, bearing 2 long setae, medial margin of article 1 with 1-4 setae, lateral margin with 4 acclivities, spine formula = l-l-l-l-1, setal formula = 1-1-1-1-2. Telson long, length-width ratio = 12:11, almost fully cleft, each apex of medium width, rounded, lateral acclivity broad, shallow, weak, bearing ordinary lateral setule, spine next medial of length equal to or shorter than setule, midlateral setules highly diverse. Cuticle with sparse ordinary bulbar setules of varying sizes mixed with pipes, emergent setules ordinary.

DESCRIPTION OF MALE.—Rostrum and head slightly shorter and narrower than in female. Primary flagellum of antenna 1 with 10-12 articles, one calceolus each on articles 1-6; accessory flagellum with 6-7 articles. Facial spine formula on article 4 of antenna 2 = 3-4-4, of article 5 = 2-2-2 or 2-2, article 5 with 2 dorsal sets of male setae and 1-3 calceoli, ventrodistal apex with 3 setules, flagellar formula = 28, 1-3, 5, 7 . . . 27. Article 2 of mandibular palp with 2-3 inner setae, basofacial setal formula on article 3 = 2-2 or 3-2. Article 2 of only pereopod 5 narrower than in female, article 6 and dactyl of pereopod 3 elongate, articles 5-6 narrower than in female, anterior facial ridge of pereopod 5 shortened, article 6 subequal to article 5 in length. Epimera 1-3 broadened; posterior margin of epimeron 3 shortened, posterior setule notches more crowded and sharper than in female; dorsoposterior setule on epimera 1-2 absent, shortened on epimeron 3; setal formulas, epimeron 1 anteroventral = 5, posteroventral = 2, epimeron 2 facial = 9-14, epimeron 3 posterior = 4, ventral = 3-5. Spine formulas of uropods, uropod 1 peduncle apico-

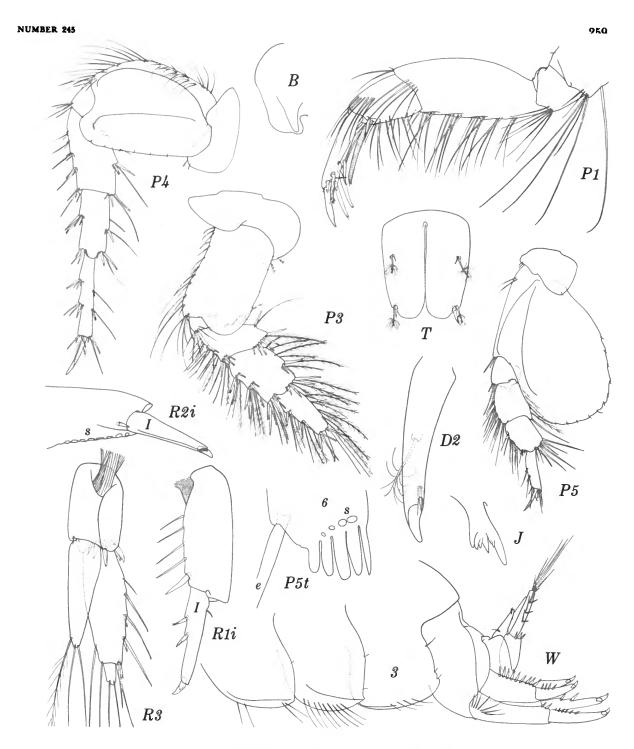


FIGURE 121.—Birubius mayamayi, new species, female "v," 4.92 mm.

lateral = 2-4, basofacial = 6-7, medial = 5, uropod 2 peduncle dorsal = 12-16, dorsal spines on outer ramus of uropod 1 = 6-7, of uropod 2 = 5-6, inner ramus of uropod 1 = 2-3, of uropod 2 = 1-2. Telson slightly elongate, distal spines shortened.

Variations.—The major variant, of subtle distinction, comprises specimens with shorter, apically broader rostrum combined with slightly stouter article 6 of pereopod 4, somewhat narrower hands of gnathopods as illustrated and a spine instead of setules on the apicomedial margin of uropod 3 peduncle. But minor variations occur among other specimens in lengths of spines on article 6 of pereopods 1–2, dorsal outline of head and wide variations in setal and spine counts on epimera and uropods and especially in the form of the right lacinia mobilis (as illustrated). Loss of pigment occurs in the eyes of various specimens, after prolonged exposure to formaldehyde, especially in those of the "major variant" noted above.

Botany Bay Variants: Five out of six specimens from New South Wales in EBS 304 and 311, differ from Victorian material in the absence of a dorsomedial spine on the inner ramus of uropod 2; one specimen, female "p" of EBS 311 bears this spine. Female "v" of that sample is unusual in that the 2 posterofacial setae on epimeron 2 are set horizontally, not vertically. Female "v" is illustrated as voucher material to demonstrate that, despite minor differences, the Botany Bay material belongs with B. mayamayi. Unillustrated parts are described as follows: setal and spine formula of articles 4, 5, 6 of pereopod 2 = (4-5)-6-(4+4); head about 19 percent of total body length; view of upper lip shown from oblique dorsal aspect; coxae and mandibles as in Victorian material; flagellum of antenna 2 with 12 articles, 1.45 times as long as articles 4-5 of peduncle together. The posteroventral tooth on epimeron 2 is smaller and sharper in Botany Bay material than in the majority of Victorian specimens.

Male "u" of EBS 304: Article 4 of antenna 2 with spine formula of 3-4-3, and on article 5=2-2.

HOLOTYPE.—NMV, female "z," 4.78 mm.

Type-Locality.—PPBES 902/5, 21 Sep 1970, Port Phillip Bay, Victoria, Australia, 10 m, sandy silt.

VOUCHER MATERIAL.—Illustrated: PPBES 902/2: male "b," 4.60 mm; female "g," 4.72 mm; female "h," 4.75 mm. PPBES 977/4: male "c," 4.61 mm. PPBES 977/2: female "f," 4.2 mm. PPBES 961/1:

male "d," 4.10 mm. PPBES 964/4: male "e," 4.70 mm. PPBES 983/5: female "i," 4.2 mm; female "j," 4.40 mm. PPBES 951/2: female "k," 4.50 mm. PPBES 959/5: female "1," 4.60 mm. PPBES 938/5: juvenile "m," 3.50 mm; juvenile "n," 3.30 mm. CPBS 03N/2: female "a," 4.9 mm; female "w," 4.3 mm. CPBS C6/3: female "y," 4.65 mm. EBS 304: female "v," 4.92 mm; female "s," 4.64 nim.

Not Illustrated: EBS 311: female "p," 4.48 mm, EBS 304: male "u," 3.94 mm.

RELATIONSHIP.—This species and species 12-15 differ from the *B. panamunus* group (1-10) in the absence of accessory apical nails on uropod 1. *Birubius mayamayi* forms the model to which species 12-15 are compared.

Because B. mayamayi retains an unconstricted rostrum and bears a fully developed posterodorsal setule on epimeron 3 the direct relationship to any of species 1-10 appears to be remote. Only B. panamunus (1) retains the unconstricted rostrum but lacks the epimeral setule. Both B. mayamayi and B. panamunus have setose coxa 4 but epimeron 3 of B. mayamayi is distinct in other ways, such as reduction of tooth, loss of facial setae and development of posteroventral setules.

MATERIAL.—PPBES, 104 samples from 43 stations (169); CPBS, 5 samples from 5 stations (8); EBS, 11 samples from 11 stations (20).

DISTRIBUTION.—Victoria: Port Phillip Bay and Western Port, 2-23 m, sand, clay, silty sand, sandy silt, silty clay, clayey silt. New South Wales, Botany Bay, Towra, 1-3 m, sand, Zostera.

12. Birubius wirakus, new species

Figures 119 (part), 122

DESCRIPTION OF FEMALE.—Head about 21 percent of total body length, greatest width about 66 percent of length; rostrum weakly constricted, broad, not reaching apex of article 2 on antenna 1. Eyes small, weakly occluded with pigment or clear. Article 1 on peduncle of antenna 1 about 1.6 times as long as wide, about 1.7 times as wide as article 2, ventral margin with about 6 setules, weakly produced dorsal apex with two setule-setae; article 2 about 0.9 times as long as article 1, with ventral cycle of 5 setae; primary flagellum with 9 articles, bearing several aesthetascs; accessory flagellum with 7 articles. Spine formula on article 4

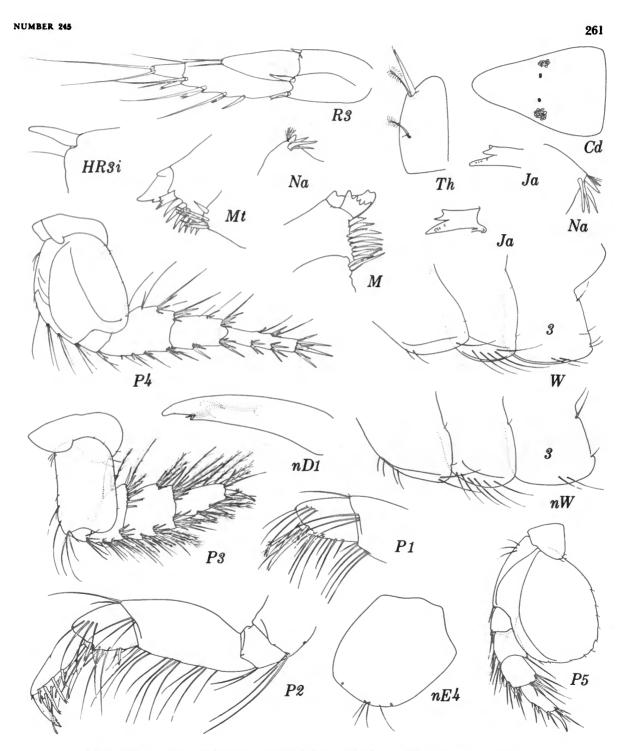


FIGURE 122.—Birubius wirakus, new species, holotype, female "a," 4.3 mm (n = female "n," 3.76 mm).

of antenna 2 = 2-4-4 or 3-4-4, dorsal margin with notch bearing 2 long and short setae, ventral margin with 3 groups of 2-3 mainly long setae, one ventrodistal long spine; article 5 about 0.75 times as long as article 4, facial spine formula = 1-2, dorsal margin naked, ventral margin with one set of setae, ventrodistally with one medium spine, 2 long spines, one long seta, one setule, subdistal facial spine; flagellum about 1.33 times as long as articles 4-5 of peduncle combined, with 10 articles. Mandibles with weak palpar hump; right incisor with 3 teeth; left incisor with 4 humps in 2 branches; right lacinia mobilis bifid, distal branch much shorter than proximal, distal branch broad, subbifid, proximal branch simple, pointed, with marginal denticles, humps; left lacinia mobilis with 4-5 teeth, middle teeth shortened; right rakers 6-8 plus one or more rudimentaries; left rakers 7-9 plus one or more rudimentaries; molar in form of weak hump demarcated mainly by spines, right molar with 5 primarily long spines plus one short spine strongly disjunct, left molar with 4-5 primarily long spines plus one short spine strongly disjunct (except on holotype), each molar with plume; palp article 1 short, article 2 with one long inner apical seta and 1-2 other short inner setae, article 3 about 1.1 times as long as article 2, oblique apex with 6-8 spine-setae, basofacial formula = 0. Inner plate of maxilla 1 large, bearing one long apical pluseta, one shorter similar apicomedial seta, 2 apicolateral much shorter setae; palp article 2 with 3-4 apicalmedial spines and 3 submarginal setae. Plates of maxilla 2 extending equally, outer slightly broader than inner, outer with 3 apicolateral setae. inner with one medial seta. Inner plate of maxilliped with 2 large thick apical spines, 3 apicofacial setae, 3 medial setae; outer plate with 5-7 medial and apical spines, one apicolateral seta; palp articles 1-2 lacking apicolateral setae, medial margin of article 2 strongly setose, article 3 not protuberant, with 3 facial setae, nail of article 4 long, with 2 accessory setules. Coxa 1 scarcely expanded distally, anterior margin weakly convex, main ventral setae of coxae 1-4 = 5-6-(5-6)-(4-5), posteriormost seta of coxae 1-4 elongate; anterior and posterior margins of coxa 4 almost parallel, posterior margin oblique, almost straight, posterodorsal corner rounded, posterodorsal margin weakly concave, width-length ratio of $\cos 4 = 17:20$. Long posterior setae on article 2 of gnathopods 1-2 and pereo-

pods 1-2 = 1-2-(0-2)-4, short anteriors = 1-1-1-0, long anteriors = 0-4-0-0, no others. Gnathopods generally ordinary; width ratios of articles 5-6 on gnathopods 1-2 = 25:34 and 27:36, length ratios = 70:65 and 61:64; palmar humps small, palms weakly oblique; article 5 of gnathopod 1 weakly elongate, ovate, posterior margin rounded-flat; article 5 of gnathopod 2 ovate, posterior margin rounded-flat. Pereopods 1-2 similar, facial setae formula on article 4 = (2-4) and (2-3), on article 5 = 3 and 4; main spine of article 5 almost extending to M. 80 on article 6, article 5 with one proximoposterior spine on pereopod 2 (rarely pereopod 1); spine formula of article 6 = 4 + 4, rarely 4 + 5, plus middistal seta, some spines especially long; acclivity on inner margin of dactyls of pereopods 1-2 sharp, produced as tooth, emergent setule very short, almost fully immersed, midfacial pluseta ordinary. Coxae 5-7 posteroventral setule formula = 3-3-3. Articles 4-5 of pereopods 3-4 of ordinary width, facial spine rows moderately developed, facial ridge formula on article 2 of pereopods 3-5 = 0-2-2; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 39:37:34:17, of pereopod 4 = 58:32: 22:10, of pereopod 5 = 71:20:19:9, length ratios of pereopod 3 = 64:25:34:34, of pereopod 4 =71:43:38:50, of pereopod 5 = 80:22:22:25; article 2 of pereopod 5 reaching apex of article 4; medial apex of article 6 weakly scalloped. Posteroventral corner of epimeron l narrowly rounded, posterior margin weakly convex, with setule, anteroventral margin with 2-4 short setae, posteroventral face with 1-2 long setae vertically paired; posteroventral corner of epimeron 2 subquadrate, with or without setule, posterior margin almost straight, facial setae = 5-6, occasionally posteriormost pair set vertically; posteroventral corner of epimeron 3 weakly protuberant, with setule sinus, posterior margin almost straight, ventral margin with 2 setae; epimera 1-3 with small to large seta on posterodorsal margin set in weak to strong notch. Urosomite 1 with lateral ventral setule at base of uropod 1, articulation line almost complete; urosomite 3 unprotuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, rami of uropods 1-2 lacking accessory nails, outer ramus of uropod 1 with 3 dorsal spines, inner with 2, outer ramus of uropod 2 with 2 dorsal spines, inner with one dorsomedial spine; peduncle of uropod 1 with 2 apicolateral spines and 2 basofacial setae, medially with 3

marginal spines, apicalmost enlarged; peduncle of uropod 2 with 4 dorsal spines. Peduncle of uropod 3 with 4 ventral spines, dorsally with one lateral spine, one medial spine; rami feminine, inner extending to M. 65 on article 1 of outer ramus, apex with 1-2 short setae, article 2 of outer ramus elongate, 0.31, bearing 2 setae, apicomedial margin of article 1 with one long seta, lateral margin with 3 acclivities, spine formula = 1-1-1-1, setal formula = 0-1-1-1. Telson ordinary, length-width ratio = 1:1, almost fully cleft, each apex wide, rounded, lateral acclivity broad, weak, bearing ordinary lateral setule, spine next medial much longer than setule, midlateral setules diverse. Cuticle with ordinary sparse bulbar setules.

OBSERVATIONS.—Female "n," 3.76 mm: Epimeron 2 more densely setose than in holotype (see illustration) but following features of weaker development: spine formula of article 4 on antenna 2 (lesser count stated in description), fewer setae on coxae 3-4, on article 4 of pereopod 1, and on inner ramus of uropod 3, setule count on coxae 5-7 = 4-2-2.

DESCRIPTION OF MALE (subadult, male "nn," 3.93 mm).--Scarcely distinct from female; eyes enlarged, of medium size, darkly pigmented; facial spine formula on article 4 of antenna 2 = 1-3-4-3, on article 5 = 0-2, flagellum with 11 articles, basal article stout and proliferating; disjunct spine on right mandibular molar absent; formula of long setae on coxae 1-4 = 6-6-6-3; length ratios of articles 5-6 on gnathopods 1-2 = 69:72 and 60:69; epimeron 1 with 5 anteroventral setae, posteroventral face with 2 setae in tandem, epimeron 2 with 7 facial setae in tandem, posteriormost pair crowded together; uropod 3 masculine, inner ramus slightly exceeding apex of article 1 on outer ramus, apex with 3 setae, outer ramus with 2 lateral acclivities, setal formula = 1-1-2, spine formula = 1-1-1, medial apex and margin with 2 setae in tandem, peduncle with 5 ventral spines; main spine on each lobe of telson shorter than in female; other characters like female, especially right lacinia mobilis, mandibular palp, antenna 1, dorsal margin of article 4 on antenna 2, pereopods 1-5, epimeron 3, uropods 1-2 except where mentioned, mouthparts other than mandibles not examined.

DESCRIPTION OF JUVENILE (juvenile male "t," 3.32 mm).—Article 4 of antenna 2 with facial spine formula of 1-3-3-1, article 5 with facial spine formula of 0-2; both pereopods 1-2 with postero-

proximal spine on article 5 (unusual); epimeron 1 with 2 anteroventral setae, 2 posterofacial setae in tandem, epimeron 2 with 8 facial setae, epimeron 3 with 2 ventral setae, posterior margin like adult but with 3 setules in tandem just below dorsal seta in crotch; outer ramus of uropod 1 with 2 dorsal spines, of uropod 2 with one dorsal spine, peduncle of uropod 2 with 3 dorsal spines; peduncle of uropod 3 with 4 ventral spines, inner ramus of uropod 3 as long as article 1 of outer ramus, bearing 3 apical setae. Other external features like female; mouthparts not examined.

ILLUSTRATIONS.—Species generally similar to variant-phenotype of Birubius mayamayi (11) (figures 118, 119), and otherwise similar to main phenotype of that species, following illustrations therefore omitted for B. wirakus: lateral head, antennae 1-2, prebuccal mass, upper lip, palpar hump and palp of mandibles, lower lip, maxillae 1-2, maxilliped, urosome, coxae 1-3, cuticle. Following exceptions for B. wirakus noted in description: spine formula on article 5 of antenna 2, basofacial setae of mandibular palp article 3, spines and setae of maxilliped fewer, nail of dactyl of maxilliped more elongate, uropodal spine formulas; view of left mandible heavily flattened, with fourth molar spine and smaller raker spines hidden in view as shown, apex of that molar illustrated separately in 2 views.

Additional specific items not illustrated: midapex on article 1 of antenna 1 with one setule, of article 2 with 3 setules, of article 3 with 4 apical and 2 ventral setules; article 3 of antenna 2 with one long, one short facial setae, proximal facial spine groups on article 4 of antenna 2 with accessory setule, with 2 subbasal penicillate setules on ventral margin, article 5 of antenna 2 much narrower than article 4, dorsodistal apex with several setules; prebuccal complex convex and moderately extended anteriorly, epistome and upper lip amalgamated, anterior margin of upper lip with crescentic rugosity, ventral margin truncate or weakly concave; lower lip with one cone on outer lobe, mandibular lobes rounded apically; outer plate of maxilla 1 with 11 spines, spine 2 broader; outer plate of maxilliped with cusp at base of second apicomedial spine (but absent on one side of holotype); inner ramus of uropod l with normal inner basofacial seta; urosomites 1-2 amalgamated but articulation line complete.

HOLOTYPE.—NMV, female, "a," 4.3 mm.

TYPE-LOCALITY.—CPBS B4/2, 14 Nov 1964, Western Port, Victoria, Australia, 10.7 m, fine sand, mud. VOUCHER MATERIAL.—PPBES 968/1, female "n," 3.76 mm (illus.); EBS 32, male "nn," 3.93 mm; EBS 31, juvenile male "t," 3.32 mm.

Relationship.—This species closely resembles B. mayamayi (11) and is difficult to distinguish except on small characters requiring careful dissection and observation. The main character of easily observable condition is the presence of a stout proximoposterior spine on article 5 of pereopod 2, absent in B. mayamayi. The following characters also distinguish B. wirakus from B. mayamayi: the blunter cornered and squarer coxa 4, more robust pereopod 4, very slightly greater length of article 5 on gnathopod 1 in female, absence of a posterodistal tooth on epimeron 2 in female, longer article 2 on outer ramus of uropod 3, presence of a disjunct spine on molar in female, and proportional differences of articles on pereopods 3 and 5 (see illustrations).

The holotype is a well advanced subadult female, with brood lamellae almost fully grown but naked. Immaturity is marked by poorly developed eyes, paucity of setation, and feeble armament of uropod 3. A small number of subadults and juveniles of B. mayamayi do have a shorter rostrum or a short article 6 of pereopod 4 or both but detailed comparison of B. wirakus with such subadults (of comparable size and development) shows that specimens of B. mayamayi have better developed eyes and more heavily setose appendages. Their mandibles, coxae, gnathopods and pereopods are virtually indistinguishable from those of the terminal adult. They lack a posteroproximal spine on article 5 of pereopod 2, a characteristic of B. wirakus. The inner ramus of uropod 3 is longer and article 2 of the outer ramus is shorter in B. mayamayi.

MATERIAL.—PPBES, 2 samples (2); CPBS, one sample (1); EBS, 2 samples (4).

Distribution.—Victoria: Port Phillip Bay and Western Port, 8–11 m, sand. New South Wales: Jervis Bay, Murray's Beach, 6 m, Halophila.

13. Birubius chintoo, new species

FIGURES 123, 124

DESCRIPTION OF MALE.—Head about 20 percent of total body length, greatest width about 70 per-

cent of length; rostrum weakly constricted, broad, almost reaching middle of article 2 on antenna 1. Eyes medium, clear of pigment, but eosin in color. Article 1 on peduncle of antenna 1 about as long as wide, about 2.6 times as wide as article 2, ventral margin with numerous setules, medially with fuzz, weakly produced dorsal apex with 2 setules; article 2 about as long as article 1, with ventral cycle of 5 setae (one hidden in illustration); primary flagellum with 8 articles, about 0.9 times as long as peduncle, bearing calceolus on articles 1-4; accessory flagellum with 6 articles. Spine formula on article 4 of antenna 2 = 1-2-4-3, dorsomedial margins of articles 3-4 fuzzy, ventral margin with 3-4 groups of 1-2 medium setae, one ventrodistal medium spine; article 5 as long as article 4, facial spine formula = 2, dorsal margin bearing 3 groups of male setae, and 2 calceoli (one hidden in figure), posterior margin with 2 sets of 3 setae and setules, 2 ventrodistal short spines; flagellum elongate, flagellar formula = (25-27), 2-7... 21, 22 (calceolus on article 23 rudimentary) or 2-4, 6, 8 . . . 26. Mandibles with medium palpar hump; right incisor with 3 teeth and weak midhump; left incisor with 5 humps in 2 branches; right lacinia mobilis bifid, distal branch much shorter than proximal, weakly flabellate, subbifid of denticulate, proximal branch simple, pointed, with marginal denticles; left lacinia mobilis with 4-5 teeth, middle teeth scarcely shortened; right and left rakers 8, plus tiny rudimentaries; molar in form of elongate plaque, demarcated mainly by spines, right molar with 4-6 primarily long spines plus one short spine weakly disjunct, left molar with 6 primarily long spines, one of these scarcely disjunct, neither molar with plume; palp article 1 short, article 2 with one long inner apical seta and two other short inner setae, article 3 about 1.1 times as long as article 2, oblique apex with 7 spine-setae, basofacial formula = 0-2 or 0-1. Inner plate of maxilla 1 thin, bearing one long apical pluseta, one similar apicomedial seta, 2 apicolateral much shorter setae; palp article 2 with 4 apicalmedial spines and 3 submarginal setae. Plates of maxilla 2 extending equally, outer slightly narrower than inner, with 2-3 apicolateral setae, inner with one medial seta. Inner plate of maxilliped with 2 large, thick apical spines, 3 apicofacial setae, 4 medial setae; outer plate with 7-8 medial and apical spines, one apicolateral seta; palp article 2 with one apicolateral seta, medial margin of arti-

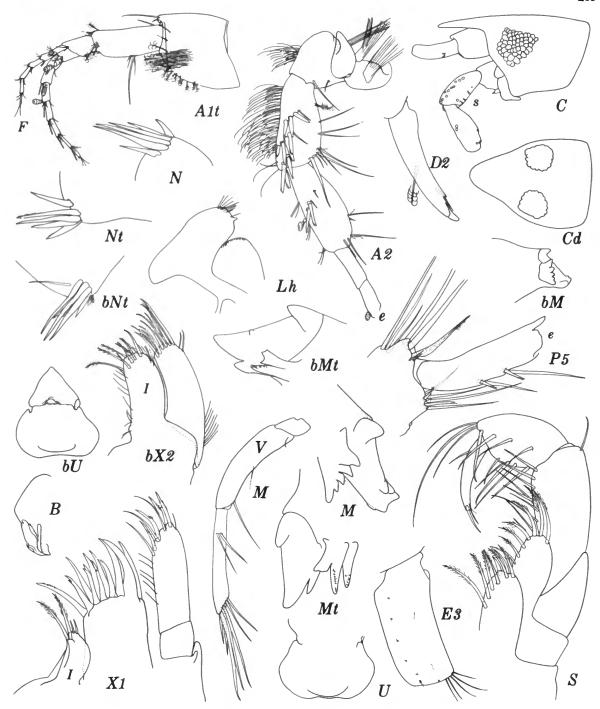


FIGURE 123.—Birubius chintoo, new species, holotype, male "a," 3.53 mm (b = male "b," 3.61 mm).

cle 2 weakly setose, article 3 scarcely protuberant, with 2-3 facial setae, no lateral setae, nail of article 4 medium, with 2 accessory setules. Coxa 1 not expanded distally, anterior margin straight; main ventral setae of coxae 1-4 = 7-6-(5-6)-4, posteriormost seta of coxae 1-3 shortened; anterior and posterior margins of coxa 4 almost parallel, posterior margin almost straight, posterodorsal corner rounded, posterodorsal margin weakly concave, width-length ratio of coxa 4 = 4.5. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 2-2-1-1, others not conspicuous or counted. Gnathopods generally ordinary; width ratios of articles 5-6 on gnathopods 1-2 = 26:34 and 27:35, length ratios = 75:68 and 70:67; palmar humps ordinary, palms oblique; article 5 of gnathopod 1 elongate, ovate, posterior margin flat; article 5 of gnathopod 2 ovate, posterior margin flat. Pereopods 1-2 similar; facial setae formula on article 4 = 3-3, on article 5 = 4-5; main spine of article 5 extending to M. 100 on article 6, article 5 with no proximoposterior spines; spine formula of article 6 = 3-4plus middistal seta, some spines especially long; acclivity on inner margin of dactyls of pereopods 1-2 weak, sharp, emergent setule long, midfacial pluseta ordinary. Coxae 5-7 posteroventral setule formula = (2-3)-2-2. Articles 4-5 of pereopods 3-4 of ordinary width, facial spine rows sparse, facial ridge formula on article 2 of pereopods 3-5 = 1-1-2; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 44:36:37:18, of pereopod 4 = 66:37:23:11, of pereopod 5 = 79:20:20:7, length ratios of pereopod 3 = 77:30:40:40, of pereopod 4 = 88:56: 40:57, of pereopod 5 = 100:24:21:28; article 2 of pereopod 5 reaching middle of article 4, article 5 with inner posterodistal spine of unusual shape, granulate; medial apex of article 6 bearing weak digital processes. Posteroventral corner of epimeron l rounded, posterior margin convex, corner with setule notch, anteroventral margin with 6-7 medium setae, posteroventral face with 2-3 long setae; posteroventral corner of epimeron 2 rounded, guarded by setule sinus, posterior margin convex, facial setae = 8-9; posteroventral corner of epimeron 3 weakly protuberant, with setule sinus, posterior margin convex, with one setule notch, ventral margin with 3 setae; epimera 1-2 with tiny seta on posterodorsal margin set in weak notch. Urosomite 1 with ventral setule at base of uropod 1, articulation line almost complete; urosomite 3 unprotuberant dorsally. Rami of uropods 1-2 with articlulate enlarged apical nails, rami of uropods 1-2 lacking accessory nails, outer ramus of uropod 1 with 3-4 dorsal spines, inner with 2, outer ramus of uropod 2 with 2-3 dorsal spines, inner with one dorsomedial spine; peduncle of propod 1 with 2 apicolateral spines and 2-3 basofacial setae, medially with 2 marginal setae and apicalmost enlarged spine; peduncle of uropod 2 with 7-9 dorsal spines, medially with one tiny apical seta. Peduncle of uropod 3 with 4 ventral spines, dorsally with one lateral spine, one medial spine; rami masculine, inner extending to M. 100 on article 1 of onter ramus, apex with 3 setae, medial and lateral margins setose, article 2 of outer ramus short, 0.18, bearing 2 long setae, apicomedial margin of article 1 setose, lateral margin with 4 acclivities, spine formula = 1-1-2-2-2, setal formula = 1-1-1-1. Telson elongate, length-width ratio = 13:11, not fully cleft, each apex wide, rounded, lateral acclivity weak, bearing ordinary lateral setule, spine next medial shorter than setule, each lobe with dorsal row of denticles, midlateral setules diverse. Cuticle with ordinary sparse bulbar setules.

ILLUSTRATIONS.—In dorsal view the head is outlined slightly broader than reality because of slight squashing; ommatidia from dorsal view not differentiated in the illustration; dorsal margin of eye from lateral view slightly flattened owing to internal shrinkage and eye partially reconstructed by reconsolidating one row of disjunct ommatidia.

HOLOTYPE.—AM, male "a," 3.53 mm.

Type-Locality.—AM P.18125, Antechamber Bay, Kangaroo Island, South Australia, 12 Dec 1939, with light in net at night.

VOUCHER MATERIAL.—Type-locality, male "b," 3.61 mm (illus). Female unknown.

RELATIONSHIP.—This species differs from Birubius mayamayi (11) in the absence of a dorsoposterior seta on epimeron 3, stronger bulge of epimeron 3; many fewer spines and setae on basofacial uropod 1, outer rami of uropods 1–2 and peduncle of uropod 2, all these spines larger; distinctive shape of article 2 on pereopod 5, narrower articles 4–5 of pereopod 5; presence of only one pair of spines on article 5 of antenna 2; larger pair of setae on inner plate of maxilla 1 of equal size; presence of a facial ridge on article 2 of pereopod 3, only one ridge on pereopod 4; unexpanded coxa 1; and stouter articles 4–5 of pereopods 3–4.

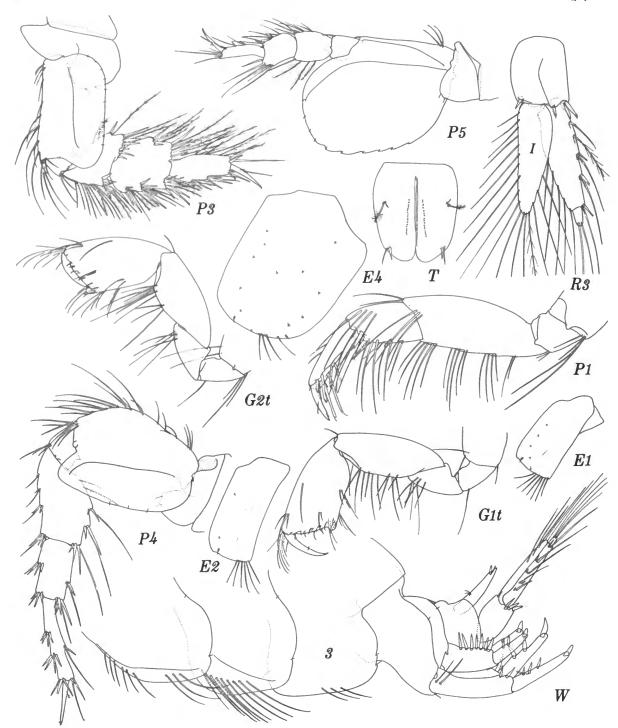


FIGURE 124.—Birubius chintoo, new species, holotype, male "a," 3.53 mm.

Only the slenderest of clues suggests that B. chintoo is not the male of B. wirakus (12): B. chintoo has longer emergent setules on the dactyls of pereopods 1-2, the facial ridge formulas on article 2 of pereopods 3-4 differ strikingly, the breadths of the plates on maxilla 2 are different, the posteriormost seta on coxa 1-3 is shortened, and the distal spine on article 5 of pereopods 1-2 is much longer.

MATERIAL.—AM, one sample (9).

DISTRIBUTION.—South Australia, Kangaroo Island, neritic.

14. Birubius karobrani, new species

FIGURES 125-127

DESCRIPTION OF FEMALE.—Head about 21 percent of total body length, greatest width about 72 percent of length; rostrum scarcely constricted, broad, elongate, reaching middle of article 2 on antenna 1. Eyes small, largely occluded with pigment. Article 1 on peduncle of antenna 1 about 1.4 times as long as wide, about twice as wide as article 2, ventral margin with about 10 setules, weakly produced dorsal apex with 4 setules; article 2 about 0.84 times as long as article 1, with ventral row of 5 setae; primary flagellum with 11 articles, about 0.66 times as long as peduncle, bearing several short aesthetascs; accessory flagellum with 8 articles. Spine formula on article 4 of antenna 2 = 1-3-4-4, dorsal margin with seta and notch bearing 2 setae, ventral margin with 7 groups of 1-2 long and short setae, one ventrodistal long spine; article 5 about 0.84 times as long as article 4, facial spine formula = 1-2-2-2, dorsal margin naked, ventral margin with 4 sets of long to short setae, 2 ventrodistal long to medium spines; flagellum broken, probably exceeding length of articles 4-5 of peduncle combined. Mandibles with weak palpar hump; right incisor with 3 teeth and midnotch; left incisor with 5 teeth and humps on apical branch; right lacinia mobilis bifid, distal branch much shorter than proximal, flabellate, denticulate, proximal branch simple, pointed, with marginal denticles; left lacinia mobilis with 4 teeth plus one accessory tooth, middle teeth shortened; right rakers 8 plus one rudimentary; left rakers 9; molar in form of elongate bulbous plaque, right molar with 9 primarily long spines, one stub, left molar with 10

primarily long spines, each molar with plume; palp article 1 short, article 2 with one short inner apical seta and 2 other shorter inner setae, article 3 about 1.3 times as long as article 2, oblique apex with 9 spine-setae, basofacial formula = 1-1. Inner plate of maxilla 1 thin, bearing one long apical pluseta, one shorter similar apicomedial seta, 2 apicolateral much shorter setae; palp article 2 with 5 apicalmedial marginal spines and 6 submarginal or apical setae. Plates of maxilla 2 extending subequally, outer scarcely broader than inner, outer with 4 apicolateral setae, inner with no medial setae. Inner plate of maxilliped with 2 large thick apical spines, 2 apicofacial setae, 5 medial setae; outer plate with 9 medial and apical spines, 4 apicolateral setae; palp article I with apicolateral seta, article 2 with 2 apicolateral setae, medial margin of article 2 moderately setose, article 3 not protuberant, with 4 facial setae, no lateral setae, nail of article 4 medium, with 2 accessory setules. Coxa 1 scarcely expanded distally, anterior margin convex; main ventral setae of coxae 1-4 = 11-9-9-15, posteriormost seta of coxae 1-4 shortest; anterior and posterior margins of coxa 4 divergent, posterior margin very oblique, convex, posterodorsal corner subsharp, posterodorsal margin short, concave, width-length ratio of $\cos 4 = 9:8$. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 2-3-2-3, long anteriors = (2-3)-9-0-0, short anteriors = 3-3-4-2; no others. Gnathopods generally ordinary; width ratios of articles 5-6 on gnathopods 1-2 = 26:32 and 27:31, length ratios = 64:61 and 57:60, palmar humps ordinary, palms oblique; article 5 of gnathopod 1 elongate, ovate, posterior margin weakly rounded; article 5 of gnathopod 2 not elongate, ovate, posterior margin produced, flat. Pereopods 1-2 similar, facial setae formula on article 4 = 6-6, on article 5 = 6-6; main spine of article 5 extending to M. 100 on article 6, article 5 lacking proximoposterior spines; spine formula of article 6 = 4 + 5 and 5 + 5 plus middistal seta, some spines especially long; acclivity on inner margin of dactyls of pereopods 1-2 weak, emergent setule short, midfacial pluseta ordinary. Coxae 5–7 posteroventral setule formula = 5-2-1. Articles 4-5 of pereopods 3-4 narrow, facial spine rows sparse, facial ridge formula on article 2 of pereopods 3-5 = 0-2-2, width ratios of articles 2, 4, 5, 6 of pereopod 3 = 39:28:26:11, of pereopod 4 =56:28:21:11, of pereopod 5 = 77:21:17:7, length

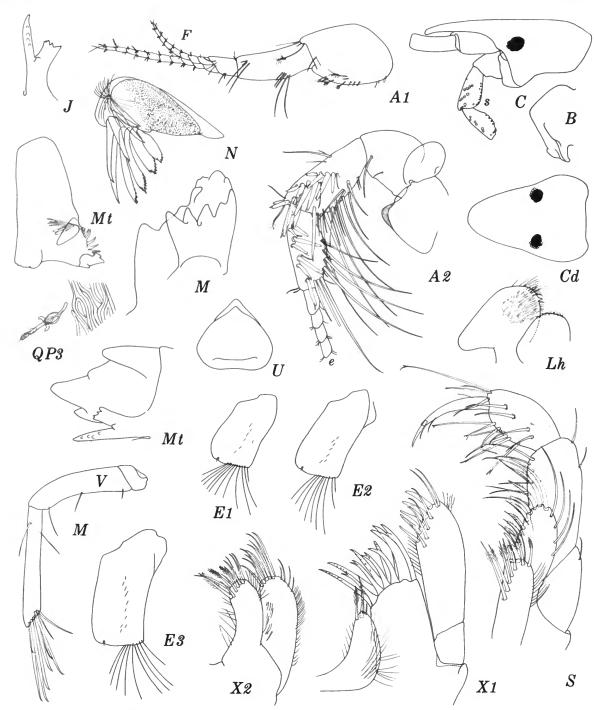


FIGURE 125.—Birubius karobrani, new species, holotype, female "a," 5.88 mm.

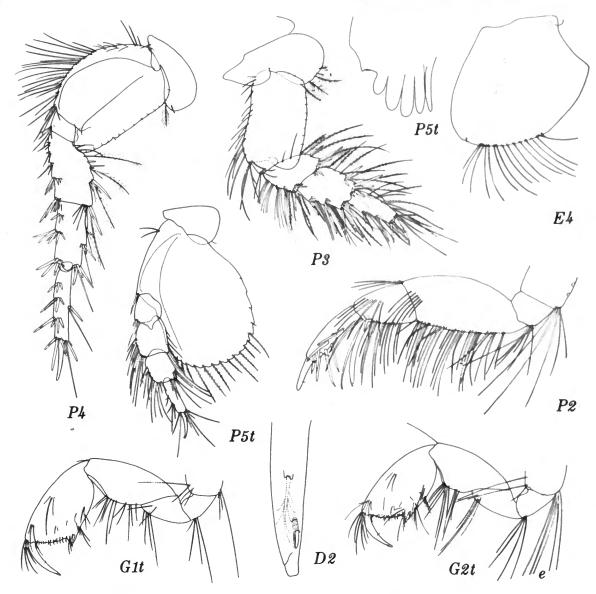


FIGURE 126.—Birubius karobrani, new species, holotype, female "a," 5.88 mm.

ratios of pereopod 3 = 64:29:33:33, of pereopod 4 = 78:45:45:50, of pereopod 5 = 100:23:20:24; article 2 of pereopod 5 reaching middle of article 5, ventral margin deeply scalloped or toothed and bearing long setae; medial apex of article 6 bearing 5 digital processes. Posteroventral corner of epimeron 1 quadrate, posterior margin straight, with 3 setae, anteroventral margin with 4 short setae, posteroventral face with 3 setae, 2 anteriormost in vertical

pairing; posteroventral corner of epimeron 2 with small sharp tooth, posterior margin weakly convex, bearing 5 setae, facial setae = 11, none in pairs set vertically; posteroventral corner of epimeron 3 with small tooth, posterior margin straight, 3 serrate, with setae, ventral margin with 2 setae mainly anteriad; epimeron 3 with 1-2 large setae on posterodorsal margin. Urosomite 1 with articulation line almost complete; urosomite 3 unprotuberant

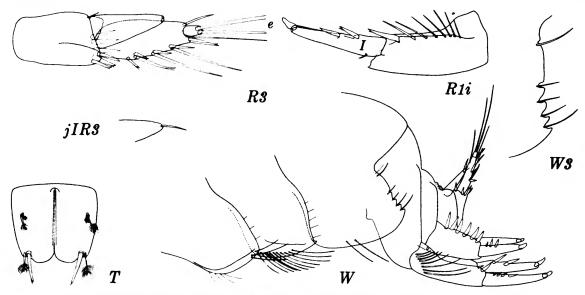


FIGURE 127.—Birubius karobrani, new species, holotype, female "a," 5.88 mm (j = juvenile "j," 4.60 mm).

dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, outer ramus of uropod 1 with 4 dorsal spines, inner with 2, outer ramus of uropod 2 with 3 dorsal spines, inner with none; peduncle of uropod 1 with 2 apicolateral spines and 8 basofacial setae, medially with 8 marginal setae and spines, apicalmost an ordinary enlarged spine; peduncle of uropod 2 with 6 dorsal spines, medially with one medium apical spine. Peduncle of uropod 3 with 5 ventral spines, dorsally with one lateral spine, one medial setule; rami feminine, inner extending to M. 80 on article 1 of outer ramus, apex with one seta, medial and lateral margins naked, article 2 of outer ramus short, 0.22, bearing 2 long setae, apicomedial margin of article l with one spine-seta, lateral margin with 3-4 acclivities, spine formula = 1-1-1-2 or 1-1-1-2, setal formula = 1-1-1-0 or 0-1-1-1. Telson short, length-width ratio = 13:14, not fully cleft, each apex broad, rounded, lateral acclivity broad, shallow, bearing ordinary lateral setule, spine next medial longer than setule, midlateral setules ordinary, diverse. Cuticle with sparse ordinary bulbar setules, surface bearing fine striations in form of linear fingerprint pattern, emergent setules plumose.

OBSERVATIONS.—Juvenile "j," 4.60 mm: Differing from described holotype female in much smaller

eye, presence of only 2 anteroventral setae on epimeron 1, 8 setae on epimeron 2, 3 posterior teeth on epimeron 3, 3 dorsal spines on outer ramus of uropod 1, 6 basofacial setae on peduncle of uropod 1, other external features fitting holotype, mouthparts not examined.

Crushed specimen WPBES 1732/1: Sex unknown, female-like, differing from holotype in presence of 3 anteroventral setae on epimeron 1, 6 setae on epimeron 2, only one ventral seta on epimeron 3, outer ramus of uropod 1 with 3 spines, 6 basofacial setae on peduncle of uropod 1, 5 dorsal spines on peduncle of uropod 2, other external features fitting holotype, mouthparts not examined.

ILLUSTRATIONS.—Pleonal view of epimeron 3 with dotted extra posterodorsal seta present only on right epimeron 3.

HOLOTYPE.—NMV, female "a," 5.88 mm.

Type-Locality.—WPBES 1732/2, 26 Nov 1973, Western Port, Victoria, Australia, 10 m, medium sand.

VOUCHER MATERIAL.—Type-locality, juvenile "j," 4.60 mm (illus.); WPBES 1732/1, 1 poor specimen. Male unknown.

RELATIONSHIP.—This species is very close to but apparently not the female of *Birubius chintoo* (13), which is based only on the male. *Birubius karobrani*

differs from B. chinton markedly in the long ventral setae and teeth on article 2 of pereopod 5.

This species also differs from B. mayamayi (11) and B. wirakus (12) in the teeth and setae of pereopod 5, the elongation of the spine on the telson, the presence of or larger size of the tooth on epimeron 2 and additionally, from B. wirakus, in the less robust pereopod 4 and absence of stout spines posteroproximally on article 5 of pereopods 1-2.

In the broadened coxa 4 and ventral setae on article 2 of pereopod 5, B. karobrani appears to be intermediate between the B. mayamayi group and that centered by Parharpinia villosa and thus demonstrates the convergence between these groups. Birubius karobrani, however, differs from P. villosa in numerous characters, among them: the normal article 2 of pereopod 3 lacking posterior setae, the normal formula of facial ridges on pereopods 3-5, the unspiked cuticle, strong basofacial setal row on uropod 1, absence of posterior setae on coxa 4, simpler telsonic spination, longer article 3 of mandibular palp, distinct and articulate nail on the maxillipedal dactyl, the absence of a disjunct molarial spine, and the generic characters.

Birubius karobrani also has great interest because of its incipient characters of Heterophoxus, such as weakly ensiform antenna 2 and ventrally setose pereopod 5.

MATERIAL.—WPBES, 2 samples from one station (3).

DISTRIBUTION.—Victoria, Western Port, 10 m, sand.

15. Birubius booleus, new species

FIGURES 128-130

DESCRIPTION OF FEMALE.—Head about 19 percent of total body length, greatest width about 65 percent of length; rostrum very weakly constricted, broad, reaching middle of article 2 on antenna 1. Eyes medium, largely occluded with pigment. Article 1 on peduncle of antenna 1 about 1.35 times as long as wide, about twice as wide as article 2, ventral margin with about 10 setules, weakly produced dorsal apex with 4 setules; article 2 about 0.85 times as long as article 1, with ventral cycle of 7 setae; primary flagellum with 13 articles, about 0.9 times as long as peduncle, lacking aesthetascs; accessory flagellum with 10 articles. Spine formula

on article 4 of antenna 2 = 1-3-4-4, dorsal margin with notch bearing one seta and one setule, ventral margin with 5 groups of 2-3 long to medium setae, one ventrodistal medium spine; article 5 about 0.7 times as long as article 4, facial spine formula = 2-2, dorsal margin naked, ventral margin with 3 sets of 1-2 setae and setule, 3 ventrodistal long to medium spines; flagellum about 1.3 times as long as articles 4-5 of peduncle combined, with 13-14 articles. Mandibles with medium palpar hump; right incisor with 3 teeth; left incisor with 2, distal member bifid; right lacinia mobilis bifid, distal branch little shorter than proximal, complex, apparently composed of 2 fused raker spine-remnants (see illustrations); left lacinia mobilis with 5 teeth, middle teeth slightly shortened; right rakers 11 plus one rudimentary; left rakers 18 plus one rudimentary; molar composed of elongate plaque with superimposed setulose bulbous hump, each with 7 long spines plus one shorter spine strongly disjunct, each molar with plume; palp article I short, article 2 with 4 short inner setae and one other longer apical seta, article 3 about as long as article 2, oblique apex with 9 spine-setae, basofacial formula = 0. Inner plate of maxilla 1 ordinary, bearing one long apical pluseta, one similar apicomedial seta, 2 apicolateral much shorter setae; palp article 2 with 4 apicomedial marginal spines and 4 submarginal setae. Plates of maxilla 2 extending subequally, outer broader than inner, with 4 apicolateral setae; inner with 2 medial setae. Inner plate of maxilliped with 2 large thick apical spines, 2 apicofacial setae, 7 medial setae; outer plate with 7 medial and apical spines, 2 apicolateral setae; palp article 2 with 2 apicolateral setae, medial margin of article 2 moderately setose, article 3 protuberant, with 4 facial setae, one lateral seta, nail of article 4 medium, with one accessory setule. Coxa 1 not expanded distally, anterior margin straight; main ventral setae of coxae 1-4 = 6-8-7-5, posteriormost seta of coxae 1-3 shortest, one or two posterior setae especially stout; anterior and posterior margins of coxa 4 almost parallel, posterior margin almost straight, posterodorsal corner rounded, posterodorsal margin short, almost straight, widthlength ratio of $\cos 4 = 17:21$; long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 2-5-5-5, short anteriors = (4-6)-4-7-5, long anteriors = 2-5-0-0, no others. Gnathopods generally ordinary; width ratios of articles 5-6 on

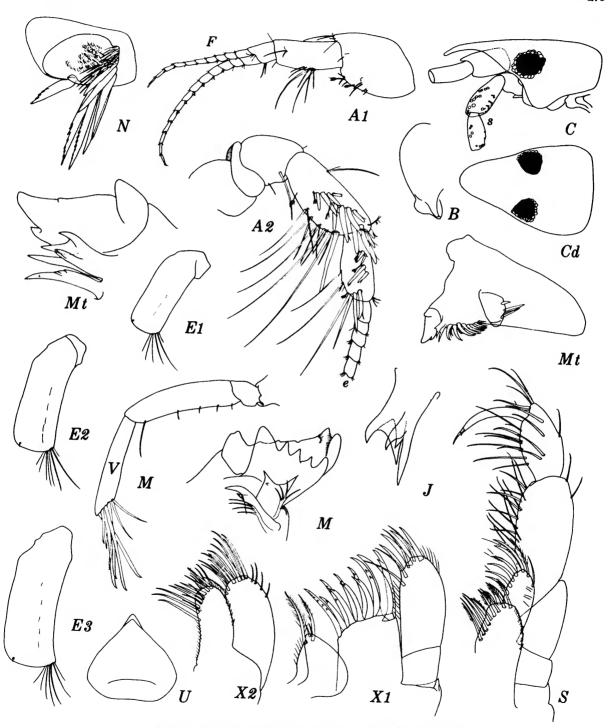


FIGURE 128.—Birubius booleus, new species, holotype, female "a," 6.37 mm.

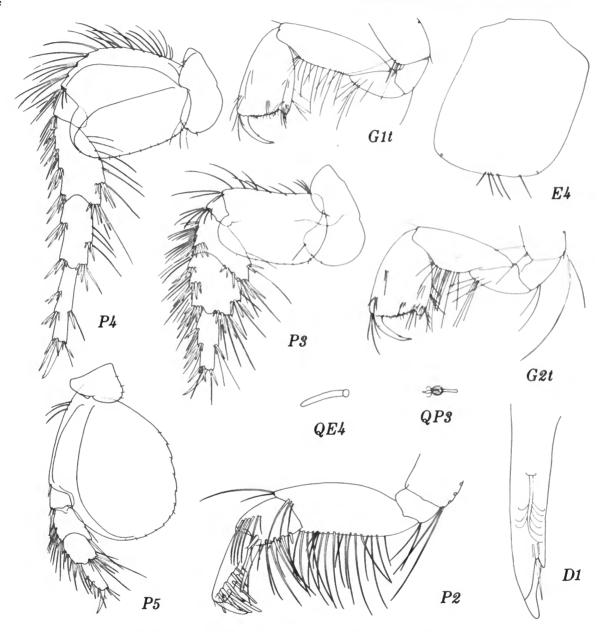


FIGURE 129.—Birubius booleus, new species, holotype, female "a," 6.37 mm.

gnathopods 1-2 = 23:35 and 25:37, length ratios = 78:60 and 67:60; palmar humps ordinary, palms weakly oblique; article 5 of gnathopod 1 elongate, posterior margin flat, long; article 5 of gnathopod 2 weakly elongate, posterior margin rounded-flat. Pereopod 2 stouter than pereopod 1, especially article 4, posterior margin of latter more strongly

setose, facial setae formula on article 4 = 4-3, on article 5 = 5-6; main spine of article 5 extending to M. 75 on article 6, article 5 with one proximoposterior spine only on pereopod 2; spine formula of article 6 = 5 + 6 plus tiny middistal seta, some spines especially long; acclivity on inner margin of dactyls of pereopods 1-2 sharp, produced

as tooth, emergent setule long, midfacial pluseta ordinary. Coxae 5-7 posteroventral setule formula = 3-4-4. Artciles 4-5 of pereopods 3-4 of ordinary width, facial spine rows moderately developed, facial ridge formula on article 2 of pereopods 3-5 = 0-2-2; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 47:40:35:15, of pereopod 4 = 72:30:22:11, of pereopod 5 = 85:20:16:8, length ratios of pereopod 3 = 71:36:40:40, of pereopod 4 = 83:55:49:52, of pereopod 5 = 103:27:22:22; article 2 of pereopod 5 reaching middle of article 4; medial apex of article 6 bearing 3 short digital processes. Posteroventral corner of epimeron 1 rounded, posterior margin weakly convex, corner with setule, anteroventral margin with 11 short setae, posteroventral face with 2 long setae in vertical tandem; posteroventral corner of epimeron 2 rounded or weakly protuberant, guarded by weak setule sinus, posterior margin almost straight, facial setae = 9, posteriormost pair set vertically; posteroventral corner of epimeron 3 weakly protuberant, with setule sinus, posterior margin straight, with 6 setule notches, ventral margin with 2 setae; epimera 1-2 with setule on posterodorsal margin set in weak notch. Urosomite 1 ventrally naked, articulation line almost complete; urosomite 3 unprotuberant. Rami of uropods 1-2 with articulate enlarged apical nails, outer ramus of uropod 1 with 5 dorsal spines, inner with 2, outer ramus of uropod 2 with 3-4 dorsal spines, inner with 2 dorsomedial spines; peduncle of uropod 1 with 3 apicolateral spines and 2 basofacial small setules, medially with 6 marginal setae and spines, apicalmost an ordinary spine; peduncle of uropod 2 with 7 dorsal spines, medially with one apical setule. Peduncle of uropod 3 with 6 ventral spines, dorsally with one lateral spine, 2 medial spines; rami submasculine, inner extending to M. 95 on article 1 of outer ramus, apex with one seta, medial margin with 2, lateral margin with 4 setae, article 2 of outer ramus short, 0.16, bearing 2 long setae, medial margin of article 1 setose, lateral margin with 4 acclivities, spine formula = 1-1-1-1-1, setal formula = 1-1-1-1-1. Telson ordinary, length-width ratio = 1:1, almost fully cleft, each apex wide, rounded, lateral acclivity broad, bearing ordinary lateral setule, spine next medial much longer than setule, midlateral setules diverse, small. Cuticle with ordinary bulbar setules of varying sizes closely packed with numerous large pipes, emergent setules especially short.

OBSERVATIONS.—Lower lip like that of *Birubius chintoo* (13) but extensively setulose; first raker on left mandible peculiar (see illustration); apicalmost facial spine on article 5 of antenna 2 so close to distal spines as to be counted there.

HOLOTYPE.—NMV, female "a," 6.37 mm. Unique. TYPE-LOCALITY.—WPBES 1735/2, 29 Nov 1973, Western Port, Victoria, Australia, 9 m, muddy sand, shell grit.

RELATIONSHIP.—The peculiar right lacinia mobilis, apparently composed of two raker spines fused together might place this species in the group of *Birubius* (Key B) bearing a double-pronged right lacinia mobilis but *B. booleus* bears only weak resemblance to the other species in that group.

A closer resemblance occurs between B. booleus and 3 species in the Birubius group with normal lacinia mobilis but lacking accessory apical nails on uropods 1-2: B. mayamayi (11), B. wirakus (12) and B. chintoo (13). Birubius chintoo is based only on males but is not the male of Cunmurra itickerus because the latter has enlarged gnathopod 2.

Birubius booleus differs from the other 3 species in the absence of basofacial setae on uropod 1 and the distinctive right lacinia mobilis. In addition it differs from B. mayamayi in the absence of a tooth on epimeron 2, the greater spread of setae on epimeron 2, the absence of posterior setae on epimeron 2, and in the vertical pairing of setae on epimeron 1. It differs from B. wirakus, additionally, in the absence of an enlarged posterodorsal seta on epimeron 3. It further differs from B. chintoo in the vertical pairing of setae on epimera 1-2, in the disjunct spine on the molars and in the nonenlarged spines on the inner ramus of uropod 1.

The very narrow anterior coxae suggest strong affinity to Cunmurra so that B. booleus may ultimately be separable generically from Birubius. Birubius booleus could be distinguished from Birubius on coxae 1-3, the right lacinia mobilis and the somewhat reduced article 5 of antenna 2. However, the relationship to B. chintoo in epimeron 3 and coxa 1 is very strong and intergradations towards other species of Birubius such as B. mayamayi suggest prudence in evaluation of the characters until further explorations of Australia reveal additional evidence.

MATERIAL.—WPBES, one sample (1).
DISTRIBUTION.—Victoria, Western Port, 9 m, muddy sand, shell grit.

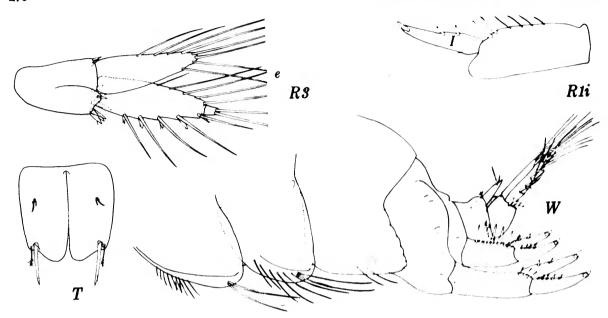


FIGURE 130.—Birubius booleus, new species, holotype, female "a," 6.37 mm.

16. Birubius babaneekus, new species

FIGURES 131-133

DESCRIPTION OF FEMALE.—Head about 17 percent of total body length, greatest width about 63 percent of length; rostrum weakly constricted, narrow, almost reaching middle of article 2 on antenna 1. Eyes small to medium, stained eosin color but clear of occluding pigment. Article 1 on peduncle of antenna 1 about 1.4 times as long as wide, about twice as wide as article 2, ventral margin with about 5 setules, weakly produced dorsal apex with 5 setules; article 2 about 0.7 times as long as article 1, with ventral cycle of 6-8 setae; primary flagellum with 8-10 articles, about 0.75 times as long as peduncle, bearing long aesthetascs; accessory flagellum with 7 articles. Spine formula on article 4 of antenna 2 = 1-3-4-3 or 1-3-4-3-2, dorsal margin with notch bearing 2-3 setae, ventral margin with 4-5 groups of 1-2 long to medium setae, one ventrodistal long spine; article 5 about 0.88 times as long as article 4, facial spine formula = 1-2-2-2 or 1-2-2-2-1, dorsal margin with or without setule, ventral margin with 4-5 sets of 1-2 long to short setae, 2 ventrodistal long spines; flagellum about as long as articles 4-5 of peduncle combined, with 8-10 articles. Mandibles with medium palpar hump; right incisor with 3 teeth and notch; left incisor with 4 humps in 2 branches; right lacinia mobilis bifid, almost simple, distal branch forming cusp on proximal branch, proximal branch simple, pointed; left lacinia mobilis with 4 teeth, middle teeth shortened; right rakers 4-5; left rakers 5-6 plus occasional rudimentary; molar in form of elongate bulbous hump, each molar with 6 primarily medium spines, none disjunct, each with plume; palp article 1 slightly elongate, article 2 with 1-2 long and medium inner apical setae and 2-3 other short inner setae, article 3 about 1.1 times as long as article 2, oblique apex with 8 spine-setae, basofacial formula = 1-2. Inner plate of maxilla 1 ordinary, bearing 4 short, similar setae; palp article 2 with 3-4 apicalmedial marginal spines and 3 submarginal setae. Plates of maxilla 2 extending subequally, outer scarcely broader than inner, outer with 3 apicolateral setae, inner with one medial seta. Inner plate of maxilliped with 2 large thick apical spines, 2 apicofacial setae, 4-5 medial setae; outer plate with 9 medial and apical spines, 4 apicolateral setae; palp articles 1-2 with apicolateral seta, medial margin of article 2 weakly setose, article 3 unprotuberant, with 2-3 facial setae, one lateral seta, nail of article 4 long, with 2 accessory setules. Coxa 1 scarcely expanded distally, anterior

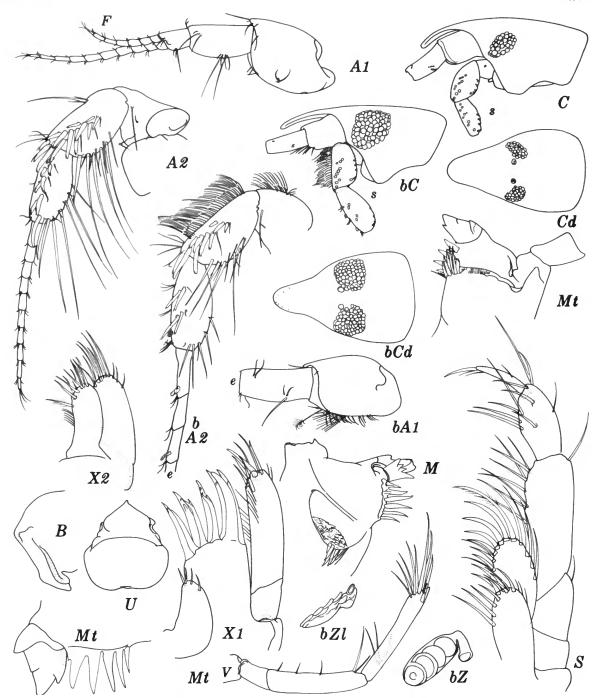


Figure 131.—Birubius babaneekus, new species, female "w," 3.9 mm (b = male "b," 3.8 mm).

margin straight; main ventral setae of coxae 1-4 = (9-11)-(10-11)-(10-13)-(13-17), posteriormost seta of coxae 1-4 shortened; anterior and posterior margins of coxa 4 slightly divergent, posterior margin convex, posterodorsal corner sharp, slightly protrusive, posterodorsal margin ordinary, flat, width-length ratio of coxa 4 = 1:1. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = (3-4)-(4-5)-(5-6)-(7-8), long anteriors = (3-5)-(5-7)-0-0, others not counted. Gnathopods ordinary, width ratios of articles 5-6 on gnathopods 1-2 = 31:37 and 30:37, length ratios = 63:71 and 56:65, palmar humps ordinary, palms oblique; article 5 of gnathopod 1 ovate, posterior margin rounded-flat; article 5 of gnathopod 2 shorter, ovate, posterior margin rounded, short, almost lobate. Pereopods 1-2 similar; facial setae formula on article 4 = 6-8 and 7-8, on article 5 = 8 and 8; main spine of article 5 extending to M. 100+ on article 6, article 5 lacking proximoposterior spines; spine formula of article 6 = 3 + 4 plus middistal seta; acclivity on inner margin of dactyls of pereopods 1-2 weak, emergent setule long, midfacial pluseta ordinary. Coxae 5-7 posteroventral setule formula = (3-4)-(3-4)-(1-2). Articles 4-5 of pereopods 3-4 of ordinary width, facial spine rows sparse, facial ridge formula on article 2 of pereopods 3-5 = 0-2-2; width ratios of articles 2, 4, 5, 6, of pereopod 3 = 42:30:27:16, of pereopod 4 = 54:27: 19:9, of pereopod 5 = 76:19:16:7, length ratios of pereopod 3 = 62:27:33:36, of pereopod 4 =82:46:44:50, of pereopod 5 = 103:22:21:21; article 2 of pereopod 5 reaching middle of article 5, ventral margin with long setae; medial apex of article 6 finely combed, bearing 5 digital processes. Posteroventral corner of epimeron 1 rounded or weakly protuberant, posterior margin convex, setose, anteroventral margin with 3-5 medium setae, posterventral face with one medium seta; posteroventral corner of epimeron 2 protuberant, with small sharp tooth, posterior margin convex, setose, facial setae = 7-11, occasional disjunct grouping anteriorly; posteroventral corner of epimeron 3 with large upturned tooth, posterior margin weakly convex, with 2 setae near crotch, ventral margin with 6-11 setae mainly in middle of margin. Urosomite 1 naked, articulation line complete; urosomite 3 unprotuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, outer ramus of uropod 1 with 5-8 dorsal spines, inner with 2, outer ramus of uropod 2 with 3 dorsal spines, inner lacking dorsomedial spines; peduncle of uropod 1 with 1-2 apicolateral spines and 6-8 basofacial setae, medially with 4-6 marginal setae and spines, plus apical enlarged spine; peduncle of uropod 2 with 6-8 dorsal spines, medially with one apical spine. Peduncle of uropod 3 with 4 ventral spines, dorsally with one lateral spine, 2-3 medial setules; rami feminine, inner extending to M. 70 on article 1 of outer ramus, apex with one seta, medial margin with one seta, article 2 of outer ramus short, 0.18, bearing 2 long setae, apicomedial margin of article I with one seta, lateral margin with 4 acclivities, spines long, formula = 1-1-2-2-1 or 1-2-2-2-2, setal formula = 0-0-0-1. Telson ordinary, length-width ratio = 1:1, almost fully cleft, each apex wide, rounded, lateral acclivity deep, narrow, bearing ordinary lateral setule, spine next medial shorter than or of length equal to setule, occasionally with subapical spine in middle of each lobe, midlateral setules diverse. Cuticle with ordinary bulbar setules, emergent setules short.

DESCRIPTION OF MALE.—Rostrum narrower than in female. Primary flagellum of antenna 1 with 8-10 articles, one calceolus each on articles 1-5, aesthetascs strongly developed; accessory flagellum with 6 articles. Facial spine formula on article 4 of antenna 2 = 1-3-4-3, on article 5 = 2-2, article 5 with 3 dorsal sets of male setae and one calceolus, ventrodistal apex with 2 thin spines and one setule, flagellar formula = (26-31), 1-6, 8, 10, . . . penultimate, or 1-4, 6, 8 . . . or 2-5, 7, 9, . . . or 1, 3, 4, 6, 8 Coxa 4 narrow but smaller in relation to coxa 1 than in female; ventral setal formula of coxae 1-4 = fewer than in female. Facial and setal spine formulas of pereopods 1-2 on article 4=6 and 6, on article 5 = 6 and 6; articles 2 and 6 of pereopod 4 narrower than in female, posterior margin on article 2 of pereopod 5 flattened. Epimeron 2 broadened; posterior margin of epimeron 3 shortened; setal formulas, epimeron 1 anteroventral = 4, posteroventral = 1, epimeron 2 facial = 8 crowded, epimeron 3 posterior = 1-2, tooth shortened, ventral = 7. Spine formulas of uropods, uropod 1 basofacial = 6, medial = 4, uropod 2 peduncle dorsal = 12-14, dorsal spines on outer ramus of uropod 1 = 6, of uropod 2 = 4, inner ramus of uropod 1 = 2, of uropod 2 = 1, ventral spines on peduncle of uropod 3 = 3, spine formula on article 1 of outer ramus = 0-0-1-1-1, setal formula = 2-1-

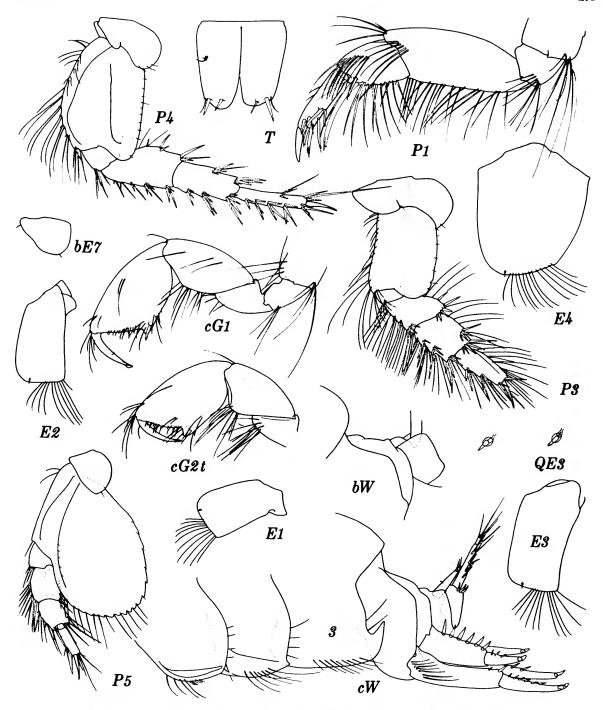


Figure 132.—Birubius babaneekus, new species, female "w," 3.9 mm (b= male "b," 3.8 mm; c= female "c," 4.8 mm).

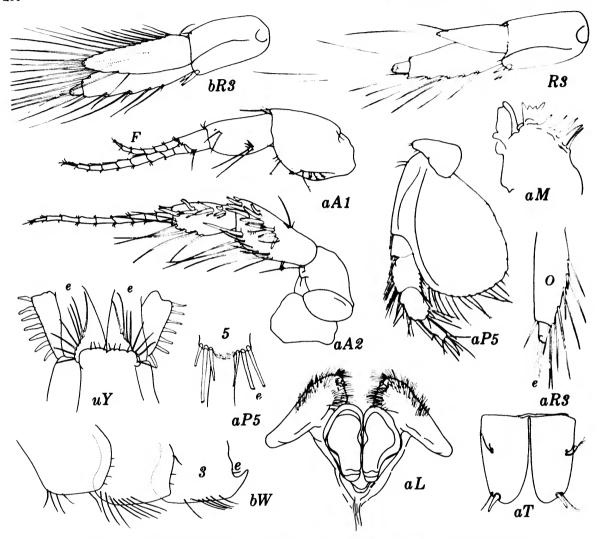


FIGURE 133.—Birubius babaneekus, new species, female "w," 3.9 mm (a = holotype, female "a," 3.9 mm; b = male "b," 3.8 mm; u = female "u," 4.0 mm; Y = venter of urosomite 1).

1-1-1. Telson not elongate, distal spines not shortened.

OBSERVATIONS.—Spine formula on article 5 of female antenna 2 commonly 1-3-4-3 but next most frequently occurring formulas = 1-3-4-3-1 or 1-3-4-3-2, rarely 1-3-5-3 or 1-3-4-2, and one case of 1-3-4-4-3; common spine formula on article 5=2-2-2, most frequent variant = 2-2-2-1 but one abnormally large female, 5.0 mm, from CPBS 31S/468, has a formula of 2-2-2-2 on left antenna 2 and a normal formula of 2-2-2 on the right antenna 2.

Ovigerous female "w," 3.9 mm, has an abnormally shaped coxa 7, partially fused inner lobes on the lower lip, bears one sheathed terminal seta on mandibular palp article 3, and an extra spine on each telsonic lobe; the normal coxa 7 is illustrated for the holotype.

One female, 4.5 mm, CPBS 32S/468, has greatly shortened articles 5-6 on percopod 4.

ILLUSTRATIONS.—Left mandible heavily flattened; pereopodal dactyls as illustrated for *B. cartoo* (7). HOLOTYPE.—NMV, female "a," 3.9 mm.

Type-Locality.—CPBS 32S/4, 12 Mar 1965,

Western Port, Victoria, Australia, 10 m, muddy sand and gravel.

VOUCHER MATERIAL (all illustrated).—CPBS 31S/866, male "b," 3.8 mm; CPBS 200/5, female "c," 4.8 mm; CPBS 35S/5, female "w," 3.9 mm; PPBES 923/1, female "u," 4.0 mm.

RELATIONSHIP.—Three species, B. babaneekus, B. gelarus (17) and B. quearus (18), form a group characterized by: medium to large tooth on epimeron 3, a right lacinia mobilis consisting of a simple spine bearing a distomedial cusp, the absence of accessory nails on uropods 1-2, presence of setae on coxa 4, long to short but conspicuous ventral setae or setules on article 2 of pereopod 5, broad, scarcely constricted rostrum and strong basofacial setae on uropod 1.

The large tooth of epimeron 3 and the setose coxa 4 suggest affinities with B. panamunus (1) but the absence of accessory nails on uropods 1-2 differentiates the B. babaneekus group.

Certain affinity is shown to B. karobrani (14) in the ventrally setose pereopod 5.

Species 20-27 to follow have a better developed distal branch on the right lacinia mobilis but none has the tooth of epimeron 3 as large as or as sharp. The *B. babaneekus* group therefore appears to be an independent cluster with unclear ancestry. The unusual mandibular raker row has not been found in any other group of phoxocephalids.

Birubius eleebanus (29) might be a descendant of the B. babaneekus group but in addition to a somewhat more normal raker row, B. eleebanus has fewer posterior setae and a smaller tooth on epimeron 3.

MATERIAL.—CPBS, 41 samples from 15 stations (60); WPBES, 2 samples from 2 stations (3); PPBES, 133 samples from 47 stations (297).

DISTRIBUTION.—Victoria: Western Port and Port Phillip Bay, 2–25 m, silty clay, sand, clay, silty sand, clayey silt.

17. Birubius gelarus, new species

FIGURES 134, 135

DESCRIPTION OF FEMALE.—Head about 18 percent of total body length, greatest width about 70 percent of length; rostrum scarcely constricted, broad, reaching middle of article 2 on antenna 1. Eyes medium, stained eosin in color but clear of

occluding pigment, ommatidia especially small. Article 1 on peduncle of antenna 1 about 1.3 times as long as wide, about 2.3 times as wide as article 2, ventral margin with about 9 setules, weakly produced dorsal apex with 4 setules; article 2 about 0.67 times as long as article 1, with ventral row of 3 setae; primary flagellum with 9 articles, about 0.73 times as long as peduncle, lacking aesthetascs; accessory flagellum with 7 articles. Spine formula on article 4 of antenna 2 = 1-3-4-3, dorsal margin with notch bearing 2 setae and one spinule, ventral margin with 6 groups of 2 long to short setae, one ventrodistal long spine; article 5 about 0.85 times as long as article 4, facial spine formula = 1-2-2-1or 1-2-2-2 or 1-2-2, dorsal margin naked, ventral margin with 4 sets of 1-2 long to short setae, 2 ventrodistal medium spines; flagellum about as long as articles 4-5 of peduncle combined, with 9-10 articles. Mandibles with weak palpar hump; right incisor with 3 teeth and notch; left incisor with 6 humps in 2 weakly defined branches; right lacinia mobilis weakly bifid, distal branch much shorter than proximal, vestigial, proximal branch simple, pointed, naked; left lacinia mobilis with 4 teeth, middle teeth shortened; right rakers 4-5; left rakers 5-6; molar in form of elongate plaque, right molar with 5-6 primarily medium spines, one spine short and weakly disjunct, left molar with 4-5 primarily long spines, one short spine strongly disjunct, each molar with plume; palp article 1 slightly elongate, article 2 with 1-2 long to medium inner apical setae and 2-4, rarely one, other shorter inner setae, article 3 about 1.1 times as long as article 2, oblique apex with 8 spine-setae, basofacial formula = 1-2 or 0-1. Inner plate of maxilla 1 ordinary to thin, bearing one medium apical pluseta, one similar apicomedial seta; palp article 2 with 4 apicalmedial marginal spines and 4 submarginal setae. Plates of maxilla 2 extending equally, outer scarcely broader than inner, outer with 4 apicolateral setae, inner with 4-6 medial setae fully to base. Inner plate of maxilliped with 2 large thick apical spines, 3 apicofacial setae, 6 medial setae; outer plate with 9 medial and apical spines, 6 apicolateral setae; palp article 1 with one apicolateral seta, article 2 with one apicolateral seta, medial margin of article 2 moderately to weakly setose, article 3 not protuberant, with 3 facial setae, no lateral setae, nail of article 4 long, with 2 accessory setules. Coxa 1

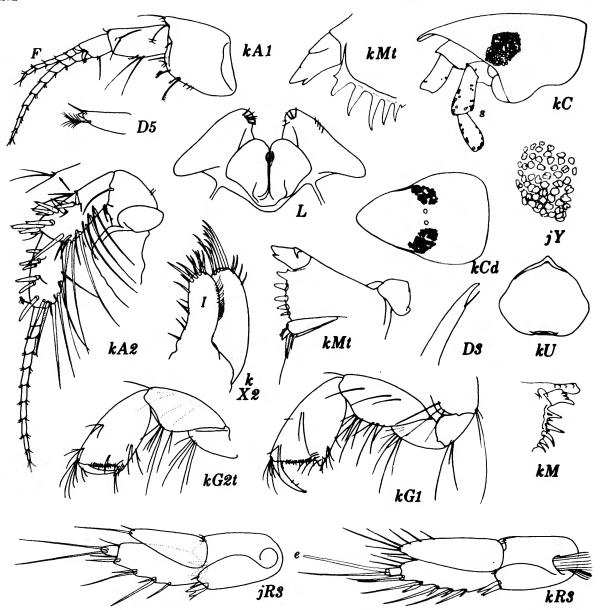


FIGURE 134.—Birubius gelarus, new species, holotype, female "n," 5.3 mm (j = juvenile female"j," 4.7 mm; k = female "k," 6.0 mm; Y = eye).

scarcely expanded distally, anterior margin straight; main ventral setae of coxae 1-4 = (11-13)-9-(8-10)-(9-11), posteriormost seta of coxae 1-3 slightly shortened; anterior and posterior margins of coxa 4 almost parallel, posterior margin convex, posterodorsal corner sharp, posterodorsal margin ordinary, width-length ratio of coxa 4 = 15:16. Long pos-

terior setae on article 2 of gnathopods 1–2 and pereopods 1-2=2-(3-4)-(2-5)-(4-6), long anteriors = (2-4)-(10-11)-0-0, short anteriors = 1-(1-2)-4-(2-3), no others. Gnathopods ordinary; width ratios of articles 5–6 on gnathopods 1-2=29:35 and 27:31, length ratios = 64:67 and 58:60; palmar humps ordinary, palms oblique; article 5 of

gnathopod l elongate, ovate, posterior margin rounded-flat; article 5 of gnathopod 2 ovate, posterior margin rounded. Pereopods 1-2 similar, facial setae formula on article 4 = 6 and 6, on article 5 = 6 and 6; main spine of article 5 extending to M. 100+ on article 6, article 5 lacking proximoposterior spines; spine formula of article 6 = 4 + 4and 3 + 4 plus middistal seta; acclivity on inner margin of dactyls of pereopods 1-2 weak to obsolescent, emergent setule long, midfacial pluseta ordinary. Coxae 5-7 posteroventral setule formula = 3-4-1. Articles 4-5 of pereopods 3-4 of ordinary width, facial spine rows sparse, facial ridge formula on article 2 of pereopods 3-5 = 0-2-2, article 2 of pereopod 3 with posterodorsal tooth; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 41:33:29:18, of pereopod 4 = 52:27:22:9, of pereopod 5 = 76:21:19:7, length ratios of pereopod 3 = 61:27:35:34, of pereopod 4 = 80:43: 45:50, of pereopod 5 = 100:26:21:21; article 2 of pereopod 5 almost reaching middle of article 5, ventral margin with long setae; medial apex of article 6 finely combed, bearing 4 digital processes. Posteroventral corner of epimeron I weakly protuberant sharply, posterior margin convex, with 2 setules, anteroventral margin with 4 medium setae, posteroventral face with 2 medium setae; posteroventral corner of epimeron 2 with small sharp tooth guarded by setule sinus, posterior margin convex, with one additional setule, facial setae = 13, one middle pair set vertically; posteroventral corner of epimeron 3 with large upturned tooth, posterior margin almost straight, setose, with 5 long and short setules mostly near or in tooth crotch, ventral margin with 6 setae mainly in middle of margin. Urosomite 1 with ventral setule at base of uropod 1, articulation line incomplete, short; urosomite 3 weakly protuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, outer ramus of uropod 1 with 5-6 dorsal spines, inner with 2, outer ramus of uropod 2 with 3-4 dorsal spines, inner lacking dorsomedial spine; peduncle of uropod 1 with 2 apicolateral spines and 5 basofacial setae, medially with 4-5 marginal setae and spines, apicalmost an ordinary spine; peduncle of uropod 2 with 6-7 dorsal spines, medially with one small apical spine. Peduncle of uropod 3 with 5 ventral spines, dorsally with one lateral spinule, 2 medial setules; rami submasculine, inner extending to M. 85 on article I of outer ramus,

apex with one medium, one short setae, medial margin with 4 setae, lateral margin with one, article 2 of outer ramus short, 0.18, bearing 2 long setae, medial margin of article 1 with 3 setae, lateral margin with 4 acclivities, spine formula = long and short, 2-2-2-2, setal formula = 0. Telson slightly elongate, length-width ratio = 31:29, almost fully cleft, each apex wide, rounded, lateral acclivity deep, broad, bearing ordinary lateral setule, spine next medial of length equal to setule, midlateral setules subdiverse. Cuticle with ordinary bulbar setules.

DESCRIPTION OF MALE (male "z," 5.16 mm).— Following characters like B. gelarus, female maxilla 2, gnathopods, inner plate of maxilla 1 (long and short setae), length of anterior setae on article 2 of pereopod 4; like B. babaneekus (16), right lacinia mobilis and pereopod 3, with possibility that these parts are modified in males thereby making identification difficult; antenna I with elongate article 2 and primary flagellum, pereopod 5 with short setae on article 2 and bulbars of cuticle with long emergent setules, suggesting possibility that this male is a distinctive species. Eyes hugely enlarged, deeply stained burgundy. Article I on peduncle of antenna 1 about 1.3 times as long as wide, about 2.25 times as wide as article 2, ventral margin with numerous setules, medial margin fuzzy, produced dorsal apex with 4 setules; article 2 about 0.8 times as long as article 1, with ventral cycle of 4 setae; primary flagellum with 10 articles, about as long as peduncle, bearing several long aesthetascs and calceoli on articles 1-6; accessory flagellum with 6 articles, only half as long as primary flagellum. Spine formula of article 4 on antenna 2 = 3-4-3, dorsomedial margins of articles 3-4 densely fuzzy; facial spine formula of article 5 = 2-2, dorsal margin bearing 3 sets of male setae and 2 calceoli, ventrodistal apex with 2 thin spines; flagellum elongate, flagellar formula = (31-32), 2-5, 7, 9 . . . 31 or 1-4, 6, 8 Right lacinia mobilis with distal branch forming weak blunt acclivity as in B. babaneekus; left lacinia mobilis as in female of B. gelarus; right rakers 4; left rakers 5 plus one rudimentary; right molar with 6 spines, left molar with 4 spines and one setule, no molar with plume; palp article 2 with one short inner apical seta and 3 (2 in basal pair) other shorter inner setae, article 3 about 1.25 times as long as article 2, oblique apex with 8 spine-setae, basofacial formula = 1+2-1 or

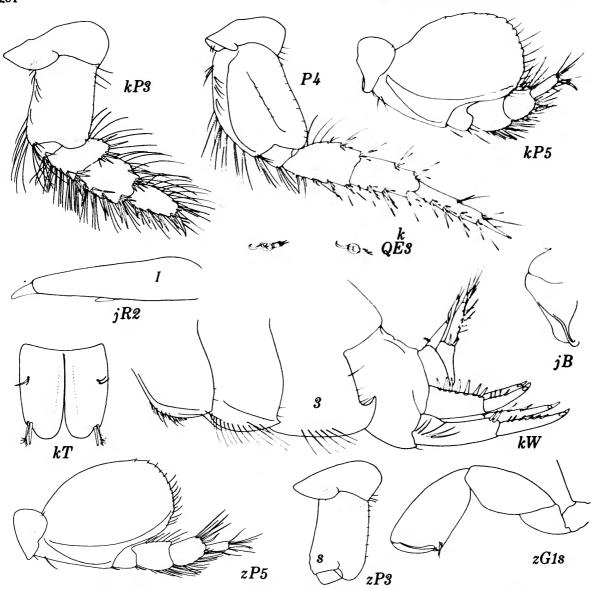


FIGURE 135.—Birubius gelarus, new species, holotype, female "n," 5.3 mm (j = juvenile "j," 4.7 mm; k = female "k," 6.0 mm; z = male "z," 5.16 mm).

1 + 2-0. Inner plate of maxilla 1 bearing one long apical pluseta, one shorter similar apicomedial seta, 2 apicolateral much shorter setae; palp article 2 with 4 apicalmedial marginal spines and 4 submarginal setae. Inner plate of maxilla 2 with medial setae to base. Inner plate of maxilliped with 5 medial setae, otherwise like B. babaneekus; palp missing. Main ventral setae of coxae 1-4 = (11-12)

9-8-10, coxae 1-3 with 1-2 additional anteroventral setules besides normal member; coxa 4 like figure of *B. babaneekus* but posterodorsal corner rounded. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2=2-3-5-5, long anteriors = 4-5(+3) facial)-0-0, short anteriors = 1-1-3-4, no others. Gnathopods almost as thin as female (see illustration). Pereopods 1-2, facial setae

formula on article 4 = 6-7 and 5; on article 5 =5 and 6; spine formula of article 6 = 3 + 4 and 4 + 4 plus middistal seta; acclivity on inner margin of dactyls of pereopods 1-2 weak, emergent setule short, midfacial pluseta ordinary. Article 2 of pereopod 3 subquadrate but not produced (see illustration); pereopod 4 like female; pereopod 5 illustrated, article 2 of pereopod 5 with short ventral setae, article 5 with enlarged posteroventral spine, medial apex of article 6 finely combed, bearing 5 digital processes. Posteroventral corner of epimeron l rounded, weakly protuberant, posterior margin deeply convex, corner with setule, and 3 other posterior setules, anteroventral margin with 6 medium setae, posteroventral face with 2 long setae; posteroventral corner of epimeron 2 rounded, weakly protuberant, with setule sinus above corner, posterior margin weakly convex, with 2 setules, facial setae = 11; posteroventral corner of epimeron 3 with medium tooth, posterior margin straight, with 2 setae in crotch and 2 other posterior setules, ventral margin with 7 setae; epimeron 3 with large seta on posterodorsal margin set in weak notch. Outer ramus of uropod 1 with 5 dorsal spines, inner with 2, outer ramus of uropod 2 with 3 dorsal spines, inner with none; peduncle of uropod 1 with 2 apicolateral spines and 4 basofacial setae, medially with 5 thin marginal setae and spines plus apical enlarged spine; peduncle of uropod 2 with 12 dorsal spines, medially with one apical spine. Peduncle of uropod 3 with 5 ventral spines, dorsally with one lateral spinule, 2 medial setules; rami masculine, inner extending to M. 100+ on article 1 of outer ramus, medial and lateral margins setose, outer ramus lateral margin with 5 acclivities, spine formula = l-l-l-l-l-1, setal formula = l-l-l-l-11-1. Telson especially long, length-width ratio = 21:16, almost fully cleft, each apex bearing very short lateral setule, spine next medial of length equal to setule.

OBSERVATIONS.—Six out of 79 juveniles of this species examined have a dorsomedial spine on the inner ramus of uropod 2 but not necessarily on both sides of the same individual.

ILLUSTRATIONS.—Following parts not illustrated, substantially similar to those figured for *B. babaneekus* (16): right mandibular palp, inner plate of maxilla 1, palp article 4 of maxilliped, coxae 1–4 (but setae fewer), pereopods 1–2; following parts generally similar with exceptions noted in descrip-

tion: left mandibular palp article 2 (only one subbasal seta), outer plate and palp of maxilla 1 (but outer plate with 11 spines), maxilliped. Illustrated pereopod 4 taken from specimen other than that used for illustrations of pereopods 3 and 5 but magnification balanced.

HOLOTYPE.—NMV, female "n," 5.3 mm.

TYPE-LOCALITY.—CPBS B1/1, 4 Aug 1964, Western Port, Victoria, Australia, 7 m.

VOUCHER MATERIAL (all illustrated).—Type-locality, female "k," 6.0 mm; CPBS 10E/3, juvenile female "j," 4.7 mm; PPBES 919/4, male "z," 5.16 mm.

RELATIONSHIP.—This species differs from B. babaneekus (16) conspicuously in the presence of a dorsoposterior cusp on article 2 of pereopod 3 and in many minor characters, including broader head and rostrum, better developed cusp on right lacinia mobilis, smaller plume on molar, larger main setae on inner plate of maxilla 1, presence of medial setae basally on inner plate of maxilla 2, narrower hands of gnathopods and longer setae on article 4 of pereopod 4.

MATERIAL.—CPBS, 32 samples from 14 stations (91); WPBES, 3 samples from 3 stations (4); PPBES, 25 samples from 8 stations (106).

DISTRIBUTION.—Victoria: Western Port and Port Philip Bay, 1–13 m, sand, silty sand, clayey sand, Zostera.

18. Birubius quearus, new species

FIGURE 136

DESCRIPTION OF MALE.—Head about 19 percent of total body length, greatest width about 70 percent of length; rostrum scarcely constricted, broad, short, almost reaching middle of article 2 on antenna 1. Eyes large, clear of pigment. Article 1 on peduncle of antenna 1 about 1.2 times as long as wide, about twice as wide as article 2, ventral margin with about 21 setules, weakly produced dorsal apex with 4 setules; article 2 about 0.9 times as long as article 1, with midventral cycle of 5 setae; primary flagellum with 11 articles, about 0.95 times as long as peduncle, bearing aesthetascs and one calceolus each on articles 1-7; accessory flagellum with 6 articles, only half as long as primary flagellum. Spine formula on article 4 of antenna 2 = 3-4-3, dorsomedial margin of articles 3-4 bearing fuzz, ventral margin with 5 groups of 1-2 long to

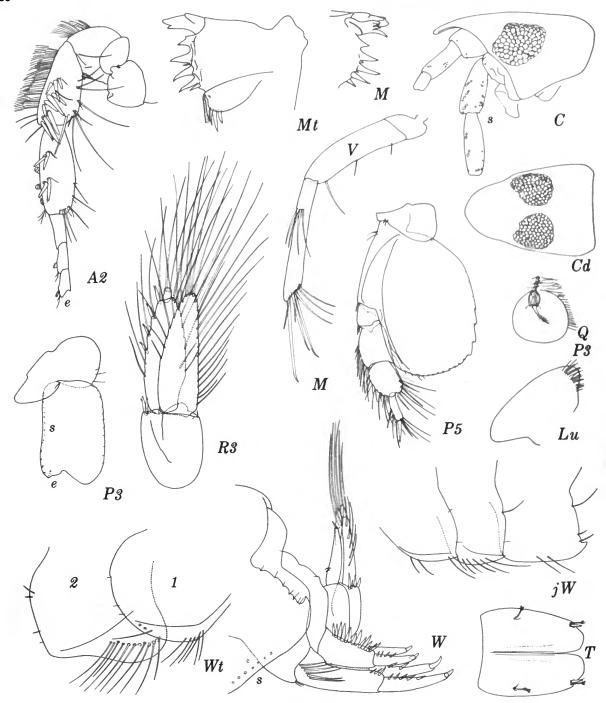


Figure 136.—Birubius quearus, new species, holotype, male "b," 5.0 mm (j = juvenile "j," 3.1 mm).

short setae, one ventrodistal long spine; article 5 about 1.1 times as long as article 4, facial spine formula = 2-2, dorsal margin bearing 4 sets of male setae (not visible in illustration) and 3 calceoli, ventral margin with 3 sets of 1-3 medium to short setae, 2 thin ventrodistal long spines and one setule; flagellum elongate, flagellar formula = (31-32), 1-5, 7, 9 . . . 29 or 1-6, 8, 10 . . . 30. Mandibles with medium palpar hump; right incisor with 3 teeth; left incisor with 4 humps in 2 branches; right lacinia mobilis bifid, very short and broad, distal branch much shorter than proximal, distal branch narrow, gaping, proximal branch simple, pointed; left lacinia mobilis with 4 teeth, middle teeth shortened; right rakers 3 plus one rudimentary; left rakers 4 plus one rudimentary; molar in form of elongate plaque, bulbous, each molar with 4 primarily medium spines, none disjunct, no plume; palp article 1 short, article 2 with one long inner apical seta and 2 other short inner setae, article 3 about 1.25 times as long as article 2, oblique apex with 8 spine-setae, basofacial formula = 2-2. Inner plate of maxilla 1 ordinary, bearing one medium simple pluseta, one similar apicomedial seta, 2 apicolateral slightly shorter setae; palp article 2 with 3 apicalmedial marginal spines and 3 submarginal setae all highly distad, palp elongate. Plates of maxilla 2 extending equally, thin, of equal breadth, outer with 4 apicolateral setae, inner with 4 medial setae to base. Inner plate of maxilliped with 2 large, thick apical spines, 2 apicofacial setae, 3-4 medial setae; outer plate with 9 medial and apical spines, 5 apicolateral setae; palp article I with one apicolateral seta, article 2 with one apicolateral seta, medial margin of article 2 moderately to weakly setose, article 3 unprotuberant, with 2 facial setae, one lateral seta, nail of article 4 medium, with 2 accessory setules. Coxa 1 scarcely expanded distally, anterior margin almost straight; main ventral setae of coxae 1-4 = 9-9-9-11, short, posteriormost seta of coxae 1-4 shortened; anterior and posterior margins of coxa 4 weakly divergent, posterior margin oblique, straight, posterodorsal corner sharp, posterodorsal margin short, straight, width-length ratio of coxa 4 = 32:37. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 3-4-3-6, long anteriors = 4-5-1-0, short anteriors = 1-1-2-2, no others. Gnathopods ordinary; width ratios of articles 5-6 on gnathopods 1-2 =

25:30 and 25:31, length ratios = 62:59 and 54:56; palmar humps ordinary, palms oblique; article 5 of gnathopod 1 weakly elongate, ovate, posterior margin rounded; article 5 of gnathopod 2 ovate, posterior margin rounded, almost lobate. Pereopods 1-2 similar; facial setae formula on article 4 = 7and 6, on article 5 = 5-6 and 6; main spine of article 5 extending to M. 100 on article 6, article 5 lacking proximoposterior spines; spine formula of article 6 = 3 + 4 and 3 + 4 plus middistal seta; acclivity on inner margin of dactyls of pereopods 1-2 weak, emergent setule long, midfacial pluseta ordinary. Coxae 5-7 posteroventral setule formula = 4-5-1. Articles 4-5 of pereopods 3-4 of ordinary width, facial spine rows moderately developed, facial ridge formula on article 2 of pereopods 3-5 = 0-2-2; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 40:30:32:16, of pereopod 4 =56:28:23:9, of pereopod 5 = 78:20:19:5, length ratios of pereopod 3 = 62:25:27:33, of pereopod 4 = 78:45:44:45, of pereopod 5 = 104:27:23:18; article 2 of pereopod 5 exceeding apex of article 4, ventral setules large and numerous; article 5 with enlarged posteroventral spine; medial apex of article 6 smooth, bearing 2 digital processes. Posteroventral corner of epimeron 1 rounded, posterior margin deeply convex, with 2 setules, anteroventral margin with 6-7 medium setae, posteroventral face with 2-3 long setae; posteroventral corner of epimeron 2 rounded-quadrate, posterior margin convex, with 2-3 setules, facial setae = 12-13, occasional pairs set vertically or not; posteroventral corner of epimeron 3 with medium tooth, posterior margin weakly convex, scalloped, with 4 setule notches, ventral margin with 6-7 setae mainly anterior, occasional pair set vertically; epimera 1-3 with setule on posterodorsal margin set in weak notch. Urosomite 1 with 2 ventral setules at base of uropod 1, articulation line complete; urosomite 3 protuberant dorsally. Rami of uropods 1-2 with articulate enlarged long sharp apical nails, outer ramus of uropod 1 with 5-6 dorsal spines, inner with 2, outer ramus of uropod 2 with 4 dorsal spines, inner with none; peduncle of uropod 1 with 3 apicolateral spines and 6 basofacial setae, medially with 5 marginal spines plus apical enlarged spine; peduncle of uropod 2 with 13 dorsal spines, medially with one small apical spine. Peduncle of uropod 3 with 2 ventral spines, dorsally with one lateral spine, one medial setule; rami masculine,

inner extending to M. 100+ on article 1 of outer ramus, apex with 3 setae, medial and lateral margins setose, article 2 of outer ramus short, 0.12, bearing 2 long setae, apicomedial margin of article 1 setose, lateral margin with 5 acclivities, spine formula = 0-0-1-1-1-1, setal formula = 1-1-1-1-1. Telson long, length-width ratio = 7:6, almost fully cleft, each apex wide, rounded, lateral acclivity narrow, weak, bearing short lateral setule, spine next medial of length equal to setule, each lobe with long dorsal row of denticles, midlateral setules diverse. Cuticle with ordinary bulbar setules surrounded by plaques forming clear spaces on surface, bearing fine striations in form of linear fingerprint pattern, emergent setules plumose.

DESCRIPTION OF JUVENILE (juvenile "j," 3.1 mm). -Female facies. Article 2 of antenna 1 shorter than in male, with 4 ventral setae; primary flagellum 7-articulate; accessory flagellum 4-articulate. Article 4 of antenna 2 with facial spine formula of 1-3-4-2, of article 5=2-2, distal apex with 3 long to medium spines, flagellum 7-articulate. Mandibles as in male, basofacial setal formula on article 3 = 0-1, apex with 6 spine-setae. Long setal formula on coxae 1-4 = 6-6-6-7; posterodistal corner of coxa 4 rounded. Article 5 of gnathopod 1 slightly more elongate than in male. Pereopod 5 with 8 elongate ventral setae on article 2, no enlarged spine on article 5. Setal formulas on epimera, anteroventral epimeron 1 = 2, posteroventral = 1, posterior = 1-2 setules, posteroventral corner with small sharp tooth, epimeron 2 facial = 6-7, posteroventral = 1, epimeron 3 ventral = 2, posterior = 2 long setules, epimeron 1 with posterodorsal setule, epimera 2-3 with long posterodorsal seta. Spine formulas on uropods, peduncle of uropod 1 = 2, of uropod 2 = 4, outer rami of uropod 1 = 3, of uropod 2 = 2, inner rami of uropod 1 = 1, of uropod 2 = 0, ventral of uropod 3 peduncle = 4, basofacial setae of uropod 1 = 4, spine formula on outer ramus of uropod 3 = 1-2-2 (elongate), no setae. Apical spines of telson elongate but setules also elongate. Eyes not apparent, probably destroyed in preservative.

OBSERVATIONS.—The juvenile adds only a few points to the probable female morphology: the elongate ventral setae on article 2 of pereopod 5 and the posteroventral points on epimera 1-2; otherwise the female is suspected to have the standard female morphology of eyes, epimera, uropod 3.

ILLUSTRATIONS.—Following unfigured parts like

those of *B. babaneekus* (16): antenna 1 but article 2 more elongate and with more ventral setules on article 1, maxillae 1-2, maxilliped except article 4 as described, coxae, (except setae much shorter), gnathopods, pereopods 1-2, pereopod 3 (except as partially illustrated). Following parts like *B. gelarus* (17): upper lip, pereopod 4. Dorsal male setae on article 5 of antenna 2 not shown (rotated behind); male epimeron 3 showing 7 ventral setal holes, eighth hole set vertically above showing position of seta 7 on right epimeron, latter bearing 6 ventral setae and one disjunct seta; pereopod 3 enlarged 1.1 times over pereopod 5.

HOLOTYPE.—NMV, male "b," 5.0 mm.

TYPE-LOCALITY.—CPBS A4(T)/1, 10 Oct 1964, Western Port, Victoria, Australia, 9 m.

VOUCHER MATERIAL.—CPBS 51N/1, juvenile "j," 3.1 mm (illus.).

RELATIONSHIP.—This species differs from either or both B. babaneekus (16) and B. gelarus (17) in the much smaller tooth of epimeron 3, the large setae on the inner plate of maxilla 1 and the presence of only 4 spines on the molars.

MATERIAL.—CPBS, 2 samples from 2 stations (2). DISTRIBUTION.—Victoria, Western Port, 9-14 m.

19. Birubius narus, new species

FIGURES 137, 138

Description of Female.—Head about 20 percent of total body length, greatest width about 60 percent of length; rostrum strongly constricted, narrow, reaching middle of article 2 on antenna 1. Eyes medium to large, largely occluded with pigment, ommatidia especially large. Article 1 on peduncle of antenna 1 about 1.3 times as long as wide, about 1.75 times as wide as article 2, ventral margin with about 11 setules, weakly produced dorsal apex with one setule; article 2 about 0.73 times as long as article 1, with ventral crescent of 5 setae; primary flagellum with 10 articles, about as long as peduncle, bearing aesthetascs; accessory flagellum with 8 articles. Spine formula on article 4 of antenna 2 = 1-2-4-3, dorsal margin with notch bearing one seta and one spine, ventral margin with 3 groups of 2-4 long to medium setae, one ventrodistal long spine; article 5 about 0.7 times as long as article 4, facial spine formula = 1-2, dorsal margin naked, ventral margin with 2

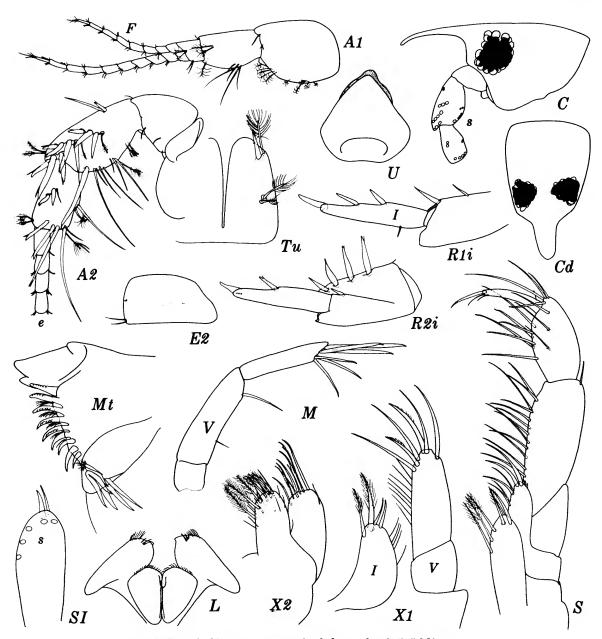


FIGURE 137.—Birubius narus, new species, holotype, female "a," 2.90 mm.

sets of 2-3 long to medium setae, 2 ventrodistal long to medium spines; flagellum about 1.35 times as long as articles 4-5 of peduncle combined, with 10 articles. Mandibles with medium palpar hump; right incisor with 3 teeth; [left incisor and lacinia mobilis damaged, not analyzed]; right lacinia mo-

bilis simple, denticulate; right rakers 8; left rakers 8 plus one rudimentary; molar in form of elongate plaque, right molar with 7 primarily long spines, none disjunct, left molar with 5 primarily long spines, none disjunct, each molar with plume; palp article 1 short, article 2 with one long inner apical

seta and one other shorter inner seta, article 3 about 0.9 times as long as article 2, oblique apex with 6 spine-setae, basofacial formula = 0. Inner plate of maxilla 1 ordinary, bearing one long apical pluseta, one shorter apicomedial seta, 2 apicolateral shorter setae; palp article 2 with 2 apicalmedial marginal spines and 4 marginal setae, one of latter apicolateral. Plates of maxilla 2 extending subequally, of subequal width, outer with one apicolateral seta, inner with one medial seta. Inner plate of maxilliped with one large thick apical spine, 2 apicofacial setae, 3 medial setae; outer plate with 4 medial and apical spines, no apicolateral setae; palp article 2 with one apicolateral seta, medial margin of article 2 moderately setose, article 3 unprotuberant, with 3 facial setae, no lateral setae, nail of article 4 long, with 2 accessory setules. Coxa 1 strongly expanded distally, anterior margin concave; main ventral setae of coxae 1-4 =2-2-2-0, posteriormost seta of coxae 1-3 shortened; anterior and posterior margins of coxa 4 weakly divergent, posterior margin very convex, posterodorsal corner rounded, posterodorsal margin short, concave, width-length ratio of $\cos 4 = 37:41$. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 2-2-1, long anteriors = 3-3-0-1, short anteriors = (1-2)-4-3-2, no others. Gnathopods ordinary, hands stout; width ratios of articles 5-6 on gnathopods 1-2 = 23:40 and 24:41, length ratios = 68:65 and 63:60; palmar humps ordinary, palms weakly oblique; article of 5 of gnathopod 1 elongate, ovate, posterior margin flat; article 5 of gnathopod 2 elongate, ovate, posterior margin rounded. Pereopod 2 slightly stouter than pereopod 1, especially article 4; facial setae formula on article 4 = 2 and 2, on article 5 = 2and 2; main spine of article 5 extending to M. 75 on article 6, article 5 with one proximoposterior spine, spine formula of article 6 = 3 + 4 and 4 + 4plus middistal seta, one spine especially long; acclivity on inner margin of dactyls of pereopods 1-2 blunt, produced as tooth, emergent setule short, midfacial pluseta ordinary. Coxae 5-7 posteroventral setule formula = 1-1-1. Articles 4-5 of pereopods 3-4 broad, facial spine rows moderately developed, facial ridge formula on article 2 of percopods 3-5 = 0-2-2, anterior ridge on pereopod 5 short, width ratios of articles 2, 4, 5, 6 of pereopod 3 = 46:42:36:15, of pereopod 4 = 61:42:29:13, of pereopod 5 = 78:17:16:8, length ratios of pereo-

pod 3 = 70:26:35:37, of pereopod 4 = 78:46: 32:43, of pereopod 5 = 101:23:21:25: article 2 of pereopod 5 reaching middle of article 5; medial apex of article 6 finely combed, bearing obsolescent digital processes. Posteroventral corner of epimeron l rounded-quadrate, posterior margin weakly convex, anteroventral margin with one medium seta, posteroventral face with 2 long to short setae set vertically; posteroventral corner of epimeron 2 rounded-quadrate, weakly protuberant, posterior margin undulant, facial setae = 5, posteriormost pair set vertically; posteroventral corner of epimeron 3 with medium to large tooth, posterior margin weakly convex, with 2 setae in crotch; epimera 1-3 with seta on posterodorsal margin set in weak notch. Urosomite 1 with 2 midventral setules, articulation line incomplete, short; urosomite 3 weakly protuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, outer ramus of uropod 1 with 4 dorsal spines, inner with 2, outer ramus of uropod 2 with 3 dorsal spines, inner with one dorsomedial spine; peduncle of uropod I with one apicolateral spine and one basofacial seta, medially with 2 marginal spines, apicalmost ordinary; peduncle of uropod 2 with 4 dorsal spines, medially with one apical spine. Peduncle of uropod 3 with 3 ventral spines, dorsally with one lateral spine, one medial setule; rami feminine, inner extending to M. 75 on article 1 of outer ramus, apex with one long seta, medial and lateral margins naked, article 2 of outer ramus elongate, 0.28, bearing 2 medium to long setae, medial margin of article 1 with one seta, lateral margin with 3 acclivities, spine formula = 1-2-2-2, setal formul = 0. Telson ordinary, length-width ratio = 1:1, not fully cleft, each apex of medium breadth, rounded, lateral acclivity weak, bearing long lateral setule, spine next medial slightly shorter than setule, midlateral setules diverse. Cuticle with ordinary bulbar setules, surface bearing fine striations in form of linear fingerprint pattern.

ILLUSTRATIONS.—Three lateral spines on article 6 of pereopod 1 blackened so as to distinguish them from medial row; head distorted dorsally; prebuccal lateral view not ascertained, damaged.

HOLOTYPE.—AM, female "a," 2.90 mm. Unique. TYPE-LOCALITY.—EBS 20, 25 Apr 1972, Jervis Bay, Murray's Beach, New South Wales, Australia, 6 m, Zostera.

RELATIONSHIP.—This species bears superficial re-

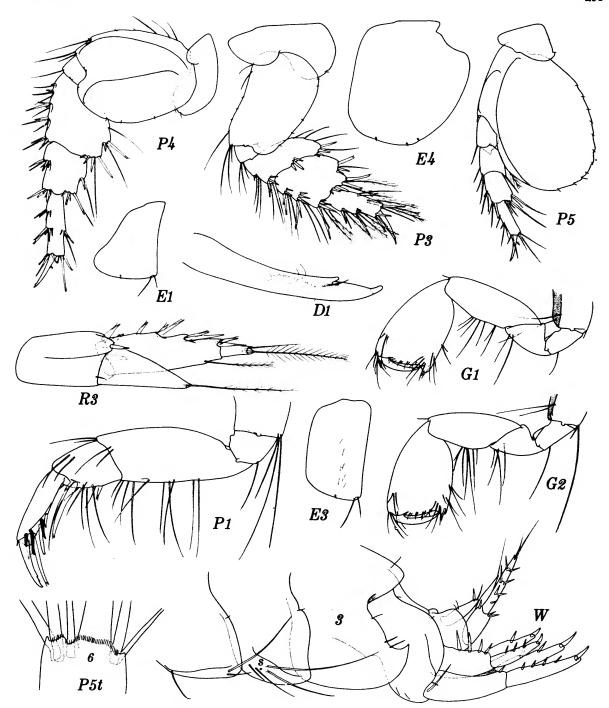


FIGURE 138.—Birubius narus, new species, holotype, female "a," 2.90 mm.

semblance to the B. babaneekus group (16-18) because of the large tooth on epimeron 3, the absence of accessory nails on uropod 1, and the simple right lacinia mobilis but in other respects differs widely from that group and is assumed to have no relationship to it. Some of the characters distinguishing B. narus from the B. babaneekus group are: the denticulations found on the right lacinia mobilis and neighboring raker spines; broad expansion of coxa l and reduction of anterior coxal setae; absence of setae on coxa 4; poorly developed basofacial setae on uropod 1; crowded setae of epimeron 2; narrow rostrum; elongate article 2 on outer ramus of uropod 3; broader articles of pereopods 3-4; small size of the outer plate on the maxillipeds; absence of conspicuous ventral setae on article 2 of pereopod 5; elongate article 5 of gnathopod 2; expanded hands of gnathopods; strong dactylar acclivity on pereopods 1-2; and the shorter main spine on article 5 of pereopods 1-2.

Birubius narus differs from B. panamunus (1) in the absence of facial setae on epimeron 3 and the absence of long setae on coxa 4, but is closer to B. apari (6) in that this latter species also lacks setae on coxa 4.

Birubius narus is a conceivable ancestral type to the B. taldeus (34-37) group because of resemblances in rostrum and coxa 1 among numerous other details, but differs from the B. taldeus group in the large tooth of epimeron 3 and the absence of accessory apical setules on the rami of uropods 1-2. In the latter character B. narus is closer to B. eake (32), a satellite member of the B. taldeus group.

MATERIAL.—EBS, one sample (1).

DISTRIBUTION.—New South Wales, Jervis Bay, Murray's Beach, 6 m, Zostera.

20. Birubius gambodeni, new species

FIGURES 139-143

Description of Female (holotype, female "c," 10.6 mm, from Western Australia).—Head about 16 percent of total body length, greatest width about 70 percent of length; rostrum scarcely constricted, narrow apically, exceeding middle of article 2 on antenna 1. Eyes medium, largely occluded with pigment. Article 1 on peduncle of antenna 1

about 1.4 times as long as wide, about 2.5 times as wide as article 2, ventral margin with numerous setules, unproduced dorsal apex with 2 setules; article 2 about 0.65 times as long as article 1, with ventral cycle of 5 setae; primary flagellum with 13-14 articles, about 0.66 times as long as peduncle, bearing several short aesthetases; accessory flagellum with 12 articles. Spine formula on article 4 of antenna 2 = 1-3-4-7, dorsal margin with 2 notches bearing 9 setae and spines, ventral margin with about 9 groups of 2 long to medium setae, one ventrodistal medium spine; article 5 about 0.75 times as long as article 4, facial spine formula = 3-3, dorsal margin with 2-3 setules, ventral margin with 5 sets of 2 long to short setae, 2 ventrodistal long to medium spines; flagellum as long as articles 4-5 of peduncle combined, with 15 articles. Mandibles with strong palpar liump; right incisor with 3 teeth; left incisor with 3 humps in 2 branches; right lacinia mobilis bifid, distal branch shorter than proximal, broad, subfalcate, proximal branch simple, pointed, with marginal denticles; left lacinia mobilis with 4 teeth; right rakers 9 plus 1-2 rudimentaries; left rakers 10 plus one rudimentary; molar in form of elongate plaque, right molar with 8 primarily long spines plus one short spine strongly disjunct, left molar with 7 primarily long spines, plus one short spine strongly disjunct; palp article 1 short, article 2 with 3 long inner apical setae and 2-3 other shorter inner setae plus 2-3 outer setae, article 3 about 1.1 times as long as article 2, oblique apex with 11 spine-setae, basofacial formula = 2-1or 1-1. Inner plate of maxilla 1 ordinary, bearing one long apical pluseta, one similar apicomedial seta, 2 apicolateral much shorter setae; palp article 2 with 3 apicalmedial marginal spines and 4 submarginal setae. Plates of maxilla 2 extending subequally, of equal width, outer with 6 apicolateral setae, inner with 3 medial setae. Inner plate of maxilliped with one large thick apical spine, 3 apicofacial setae, 4 medial setae; outer plate with 7 medial and apical spines, 2 apicolateral setae; palp articles 1-2 with several lateral setae, medial margin of article 2 strongly setose, article 3 protuberant, with 5 facial setae, group of 4 lateral setae, nail of article 4 medium, with 2 accessory setules. Coxa 1 expanded distally, anterior margin almost straight; main ventral setae of coxae 1-4 =8-10-10-0, posteriormost seta of coxae 1-3 shortened; anterior and posterior margins of coxa 4

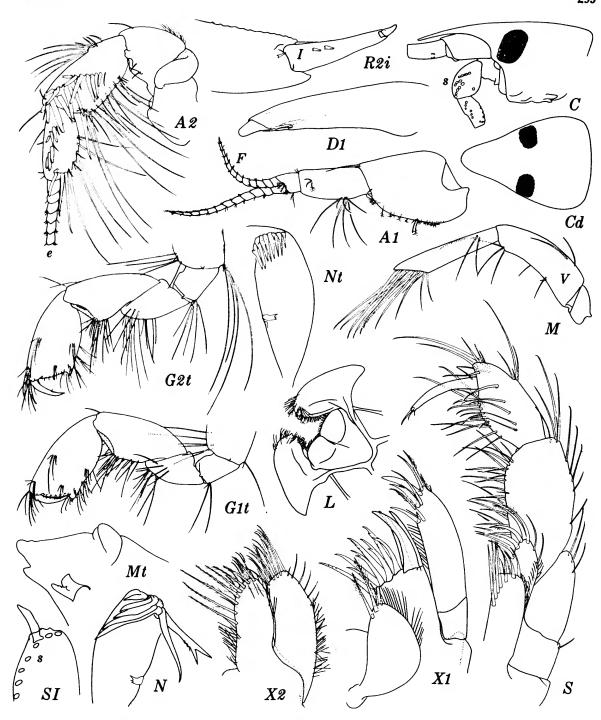


FIGURE 139.—Birubius gambodeni, new species, holotype, female "c," 10.6 mm.

weakly divergent, posterior margin almost straight, posterodorsal corner rounded, posterodorsal margin undulant, width-length ratio of $\cos 4 = 17:20$. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = (5-8)-8-(7-8)-10, long anteriors = 6-18-0-0, short anteriors = 5-10-7-4. Gnathopods ordinary; width ratios of articles 5-6 on gnathopods 1-2 = 29:31 and 29:31, length ratios = 65:65 and 60:65; palmar humps ordinary, palms oblique; article 5 of gnathopod l slightly elongate, ovate, posterior margin flat; article 5 of gnathopod 2 ovate, posterior margin rounded. Pereopods 1-2 similar, facial setae formula on article 4 = 8 and 7, on article 5 = 8 and 8; main spine of article 5 extending to M. 100 on article 6, article 5 lacking proximoposterior spines; spine formula of article 6 = 5 + 6 plus middistal seta; acclivity on inner margin of dactyls of pereopods 1-2 weak, emergent setule short, midfacial pluseta ordinary, highly distad. Coxae 5-7 posteroventral seta formula = (11-12)-5-4. Articles 4-5 of pereopods 3-4 broad to medium, facial spine rows moderately developed, facial ridge formula on article 2 of pereopods 3-5=0-2-2, anterior on pereopod 5 short; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 43:45:35:15, of pereopod 4 =70:39:27:12, of pereopod 5 = 80:25:22:8, length ratios of pereopod 3 = 78:28:37:40, of pereopod 4 = 90:50:43:55, of pereopod 5 = 100:30:25:28; article 2 of pereopod 5 reaching apex of article 4; medial apex of article 6 finely combed, bearing 6-7 digital processes. Posteroventral corner of epimeron 1 subquadrate, posterior margin weakly convex, with 2 setules above corner, anteroventral margin with 9 short to medium setae, posteroventral face with 3 medium setae; posteroventral corner of epimeron 2 weakly protuberant, posterior margin straight, weakly undulant, with setule and 4 setae, facial setae = 11, three pairs set vertically, face dorsally and posterior to ridge with 3 setae; corner of epimeron 3 with small tooth, posterior margin almost straight, strongly setose, ventral margin naked, face with oblique irregular row of 6 setae nearly extending to middle. Urosomite 1 naked, articulation line short; urosomite 3 weakly protuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, outer ramus of uropod 1 with 10 dorsal spines, inner with 3, outer ramus of uropod 2 with 9 dorsal spines, inner with 2 dorsomedial spines; peduncle of uropod 1

with 6 apicolateral spines and 5 basofacial setae, medially with many marginal setae plus apical enlarged spine; peduncle of uropod 2 with 14 dorsal spines, medially with one small apical spine. Peduncle of uropod 3 with 6 ventral spines, dorsally with one lateral spine, one medial spine; rami submasculine, inner extending to M. 87 on article 1 of outer ramus, apex with 2 setae, medial margin setose, article 2 of outer ramus short, 0.12, bearing 2 medium to long setae, apicomedial margin of article 1 setose, lateral margin with 5 acclivities, spine formula = 2-2-2-2-2, setal formula = 0. Telson ordinary, length-width ratio = 15:14, almost fully cleft, each apex wide, rounded, often with 2 midapical setae, lateral acclivity deep, bearing short lateral setule, spine next medial longer than setule, midlateral setules weakly diverse. Cuticle with bulbar setules mixed with pipes bearing apical horsecollar, emergent setules especially short.

OBSERVATIONS.—Pereopods 1-2 of holotype each with 7 and 4 medium to short anterior setae; pre-buccal complex convex anteriorly from lateral view, ventrally truncate or weakly excavate with midhump from anterior view, articulation damaged during dissection.

VARIATIONS.—Female "h," 11.8 mm, PPBES 903/1, from Victoria: Disjunct spine on molars very thin, simple; distal branch of right lacinia mobilis perfectly simple, unexpanded; hands of gnathopods stouter than in Western Australian holotype; apical nail on dactyl of pereopods 1-2 deeply submerged. This specimen is illustrated to show minor differences in other characters, mainly setal and spinal counts. Right mandible with 8 + one rudimentary raker spines, left mandible with 10 + one rudimentary, note accessory teeth on first 2 raker spines of left mandible (illustrated), note fork in large clear spine on both mandibular molars; in illustration of mandibular molars truncate spines broken apically; primary flagellum and accessory flagellum of antenna 1 each with 12 articles, article 2 of peduncle on antenna 1 with 10 ventral setae in main group, article 1 with 19 feathered setules posteriorly; antenna 2 with 14 articles in flagellum; left mandibular palp article 3 with 3+2 facial (basal) setae, right palp with 3+1(illustrated); article 2 of gnathopod 1 with 5 posterior setae (3 at M. 33, 2 at M. 66), gnathopod 2 with 7 or 8 posterior setae; pereopods 1-2 lacking proximoposterior spine on article 5.

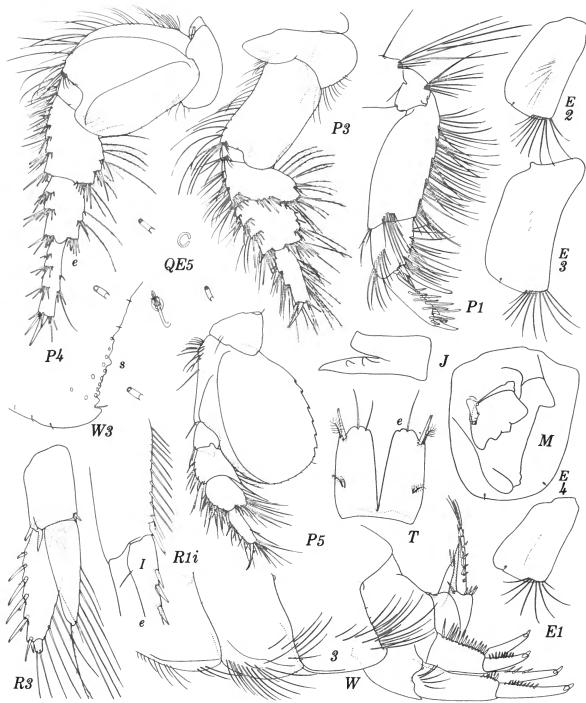


FIGURE 140.—Birubius gambodeni, new species, holotype, female "c," 10.6 mm.

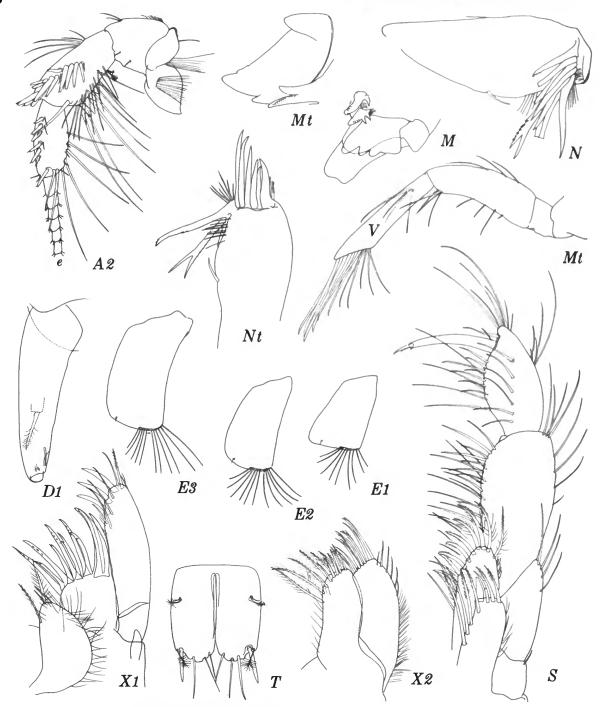


FIGURE 141.—Birubius gambodeni, new species, female "h," 11.8 mm.

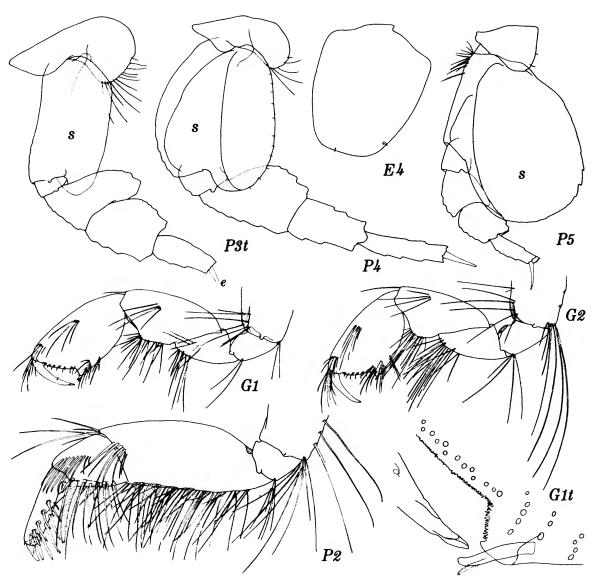


FIGURE 142.—Birubius gambodeni, new species, female "h," 11.8 mm.

Other Victorian specimens with left molarial disjunct spine thin, right spine as in holotype, right lacinia mobilis as in holotype.

ILLUSTRATIONS.—Spines on right mandibular molar of holotype not flattened.

HOLOTYPE.—WAM, female "c," 10.6 mm.

Type-Locality.—JLB AUS 12, 30 Sep 1968, Middleton Beach, Albany, Western Australia, intertidal wash of sandy rocks, coralline algae.

VOUCHER MATERIAL.—PPBES 903/1, female "h," 11.8 mm (illus.). Male unknown.

RELATIONSHIP.—Birubius gambodeni forms the model for a group of species, 20–27, characterized by strongly bifid right lacinia mobilis, each branch of which is simple or nearly so, and by uropods 1–2 lacking accessory nails. All species lack long setae on coxa 4 but species 21–27, in contrast to B. gambodeni, bear one or more posteroproximal spines

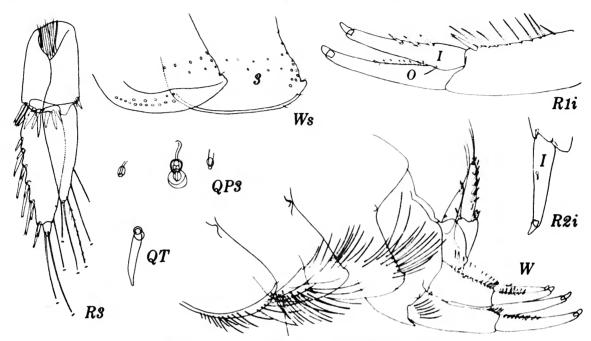


FIGURE 143.-Birubius gambodeni, new species, female "h," 11.8 mm.

on article 5 of pereopods 1-2.

Birubius gambodeni is placed in both keys A and B of Birubius because the distal branch of the right lacinia mobilis is intermediate between simple and complex.

A strong relationship is seen between B. gambodeni and the B. myallus group (4-5) because of correspondence between facial setae of epimeron 3, absence of long setae on coxa 4, slightly constricted rostrum, similar spination and setation patterns on the peduncles of uropods 1-2 and coxae 1-3, and because certain specimens of B. myallus show a reduction in the distal branch of the right lacinia mobilis. Birubius gambodeni differs from the B. myallus group in the absence of accessory nails on uropods 1-2.

In the B. gambodeni group specific distinctions can be made in 4 characters: (1) short or long article 5 of gnathopod 1; (2) long or short anterior facial ridge on article 2 of pereopod 5; (3) dispersed or crowded facial setae on epimeron 2; (4) elongate or shortened article 2 on the outer ramus of uropod 3. The 8 species of the group can be divided into 5 groups on this basis. The first alternative in each category is selected as primitive. No

species has fewer than 2 of the characters in non-primitive condition so that numerous more primitive combinations can be hypothesized than have actually been found, indicating a wide divergence of each group from the hypothetically primitive state. Group 1, composed of B. gambodeni, B. maamus (21), and B. kokorus (25), has characters 2 and 4 in advanced state; group 2, composed of B. munggai (27) has characters 1, 3, 4 in advanced state; group 3, composed of B. lowannus (22) and B. kyeemus (23) has characters 1, 2, and 3 in advanced state; group 4, composed of B. batei (24), has characters 1 and 4 in advanced state, and B. kinkus (26) has all characters in advanced state.

In Figure 82 the 8 species are placed in a slightly different arrangement reflecting a combination of characters concerning epimeron 3, the elongate wrist of the gnathopods and basofacial setation on uropod 1. Three kinds of epimeral setation are considered significant: facially scattered, facially organized, and posteriorly aligned. In this way B. batei is brought into the ancestral position of B. jirrandus (31).

MATERIAL.—PPBES, 5 samples from 4 stations (9); JLB AUS, one sample (1).

DISTRIBUTION.—Victoria, Port Phillip Bay, 5-7 m, sand, sandy silt; Western Australia, Albany, 0 m.

21. Birubius maamus, new species

FIGURES 144-146

Description of Female.—Head about 17 percent of total body length, greatest width about 60 percent of length; rostrum constricted, narrow, elongate, reaching middle of article 2 on antenna 1. Eyes small to medium, largely occluded with pigment. Article 1 of peduncle on antenna 1 almost 1.5 times as long as wide, about twice as wide as article 2, ventral margin with about 10-12 setules, weakly produced dorsal apex with 2 setules; article 2 about 0.7 times as long as article 1, with proximoventral cycle of 4 setae; primary flagellum with 9-11 articles, about 0.7 times as long as peduncle, bearing several long aesthetascs distally; accessory flagellum with 7-9 articles. Spine formula on article 4 of antenna 2 = 1-3-4-3 or 1-3-4-4 or 1-3-5-3, dorsal margin with notch bearing 3 setal-spines, ventral margin with 6 groups of 2 long and medium setae, one ventrodistal long spine; article 5 about 0.7 times as long as article 4, facial spine formula = 1-3, dorsal margin naked, ventral margin with 4 sets of 2 long and short setae, 2 ventrodistal medium spines; flagellum about 0.8-0.9 times as long as articles 4-5 of peduncle combined, with 10-12 articles. Mandibles with medium palpar hump; right incisor with 3 teeth; left incisor with 4 teeth in 2 branches; right lacinia mobilis bifid, distal branch shorter than proximal, distal branch simple, proximal branch simple, pointed, with marginal denticles; left lacinia mobilis with 4 teeth; right rakers 7-9 plus 1-2 rudimentaries, left rakers 9-10 plus 1-2 rudimentaries; molar in form of hump demarcated mainly by spines, right molar with 6-8 primarily long spines, none disjunct, left molar with 7-8 primarily long spines, none disjunct, only left molar with plume, palp article 1 short, article 2 with one short inner apical seta and 1-3 other shorter inner setae, article 3 about 0.9-1.1 times as long as article 2, oblique apex with 10-14 spine-setae, basofacial formula = 0-1. Inner plate of maxilla 1 large, bearing one long apical pluseta, one similar or shorter apicomedial seta, 2 apicolateral much shorter setae (one hidden in illustration); palp article 2 with 3 apicalmedial marginal spines and 4-5 submarginal setae. Plates of maxilla 2 extending equally, outer scarely broader than inner, with 4-5 apicolateral setae, inner with 1-2 medial setae. Inner plate of maxilliped with one large, thick apical spine, 2 apicofacial setae, 4 medial setae; outer plate with 6 medial and apical spines, 2-3 apicolateral setae; palp article 2 with 2 groups of 2-4 apicolateral setae, medial margin of article 2 strongy setose, article 3 protuberant, with 4 facial setae, 1-3 lateral setae, nail of article 4 short, with 2 accessory setules. Coxa 1 weakly expanded distally, anterior margin weakly convex; main ventral setae of coxae 1-4 = 11-9-10-0, posteriormost seta of coxae 1-2(or 3) slightly shortened; anterior and posterior margins of coxa 4 almost parallel, posterior margin convex, posterodorsal corner rounded, posterodorsal margin short, concave, widthlength ratio of coxa 4 = 7:8. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 6-(4-5)-(4-5)-(4-5), long anteriors = 0-(2-6)3)-0-0, others not counted. Gnathopods generally ordinary; width ratios of articles 5-6 on gnathopods 1-2 = 27:32 and 27:35, length ratios = 57:65and 51:62; palmar humps ordinary, palms oblique; article 5 of gnathopod 1 ovate, posterior margin flat; article 5 of gnathopod 2 ovate, posterior margin rounded. Pereopods 1-2 similar, facial setae formula on article 4 = (5-6), on article 5 = (6-7); main spine of article 5 extending to M. 95 on article 6, article 5 with one proximoposterior spine; spine formula of article 6 = 5 + 5 plus middistal seta; acclivity on inner margin of dactyls of pereopods 1-2 weak, emergent setule medium, midfacial pluseta ordinary. Coxae 5-7 posteroventral setule formula = (4-5)-(4-5)-(4-6). Articles 4-5 of pereopods 3-4 broad, facial spine rows moderately to well developed, facial ridge formula on article 2 of pereopods 3-5 = 0-2-2, anterior ridge on pereopod 5 short, width ratios of articles 2, 4, 5, 6 of pereopod 3 = 43:43:36:17, of pereopod 4 = 68:42: 31:13, of pereopod 5 = 85:24:20:8, length ratios of pereopod 3 = 72:31:36:40, of pereopod 4 =80:50:40:50, of pereopod 5 = 107:30:26:27; article 2 of pereopod 5 reaching middle of article 5; medial apex of article 6 finely combed, bearing 5-6 digital processes. Posteroventral corner of epimeron 1 weakly protrusive, posterior margin weakly convex, with 2 setules, anteroventral margin with 6-7 short to medium setae, posteroventral face with 2-3 long setae; posteroventral corner of epimeron 2

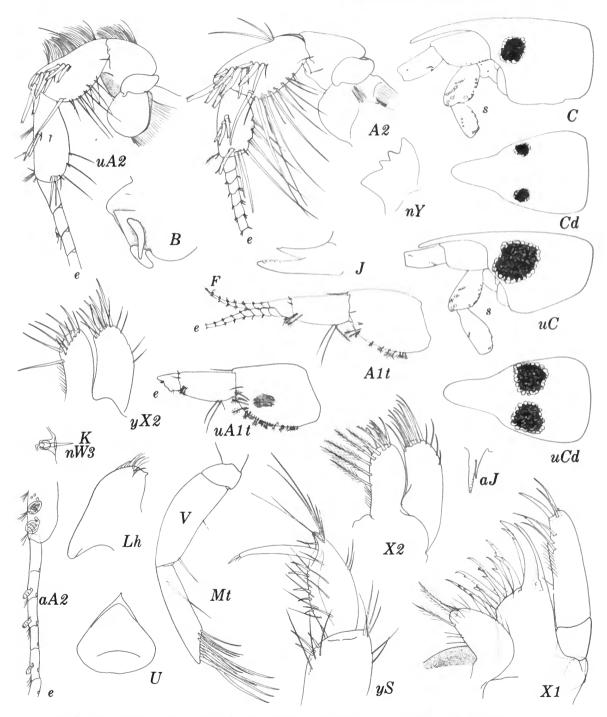


FIGURE 144.—Birubius maamus, new species, holotype, female "w," 6.7 mm (a= male "a," 5.6 mm; n= female "n," 6.6 mm; u= male "u," 6.1 mm; y= female "y," 7.9 mm; Y= left lacinia mobilis).

NUMBER 245 301 E1E2E3nE3aE7uP5G2t yG2E4 uE4P3nE7uG1t

FIGURE 145.—Birubius maamus, new species, holotype, female "w," 6.7 mm (a = male "a," 5.6 mm; n = female "n," 6.6 mm; u = male "u," 6.1 mm; y = female "y," 7.9 mm).

weakly protuberant, guarded by setule sinus, posterior margin weakly undulant, facial setae = 6 in horizontal row and 2-4 irregularly disposed posterior setae; posteroventral corner of epimeron 3 with setule sinus and small tooth, posterior margin straight, with 3-4 setule notches and 2 long setae near tooth, ventral margin with 2 posterior setae near tooth, face with oblique row of 4 setae and 2 others or 6 scattered setae, epimeron 3 with setule on posterodorsal margin set in weak notch. Urosomite 1 with ventral setule at base of uropod 1, articulation line short; urosomite 3 weakly protuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, rami of uropods 1-2 lacking accessory nails, outer ramus of uropod 1 with 6-8 dorsal spines, inner with 2-3, outer ramus of uropod 2 with 5-6 dorsal spines, inner with 1-2 dorsomedial spines; peduncle of uropod 1 with 4 apicolateral spines and 4-5 basofacial setae, medially with 4-7 marginal spines, apicalmost enlarged; peduncle of uropod 2 with 12 dorsal spines, with one small apical spine medially. Peduncle of uropod 3 with 6-7 ventral spines, dorsally with one lateral spine, one medial spine; rami feminine, inner extending to M. 68 on article 1 of outer ramus, apex with one seta, medial and lateral margins naked, article 2 of outer ramus short, 0.17, bearing 2 long setae, apicomedial corner of article 1 naked, medial margin with 2 setae, lateral margin with 4 acclivities, spine formula = 2-2-2-2 setal formula = 0. Telson ordinary, length-width ratio = 12:11, not fully cleft, each apex wide, rounded, lateral acclivity weak, bearing ordinary lateral setule, spine next medial of length subequal to setule, midlateral setules diverse. Cuticle with ordinary bulbar setules, emergent setules ordinary.

Description of Male.—Rostrum slightly longer than in female. Article 2 of antenna 1 with 4 ventral setae; primary flagellum with 9 articles, one calceolus each on articles 1–4; accessory flagellum with 7–8 articles. Facial spine formula on article 4 of antenna 2 = 2–4–3 or 2–4–2, on article 5 = 3 or 2, article 5 with 2–3 dorsal sets of male setae and 2 large calceoli (not visible in illustration), ventrodistal apex with 2 thin spines and one setule, flagellar formula = (29–33), 2, 4, 6 . . . penultimate or 2–4, 6, 8 . . . or 2, 3, 5, 7 . . . Proximal branch of right lacinia mobilis slender; mandibular rakers right = 7–8 plus one rudimentary, left = 6–7 plus one rudimentary; right molars with 5–6 spines, left

with 6-7 plus plume on both; palp article 2 with small proximal and elongate apical inner setae, basofacial formula on article 3 = 2 + 1 or 3 + 1. Coxa 4 not broadened but smaller in relation to coxa l than in female. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 4-5-3-4. Article 2 of only pereopods 4-5 narrower than in female, anterior and apicolateral spines on article 3 of pereopod 5 reduced in length, article 4 of pereopod 3 more produced distoventrally than in female, article 6 narrowed, articles 5-6 of pereopod 4 more elongate than in female. Coxa 7 narrower anteriorly and less sharply protuberant distroventrally than in female. Setal formulas, epimeron 1 anteroventral = 6-7, posteroventral = 2 (omitted in illustration), epimeron 2 facial = 6-7, epimeron 3 posterior = one long, 2 short, facial = 1, ventral = 4. Articulation of mosomites 1-2 complete. Spine formulas of propods, propod 1 peduncle apicolateral = 4-5, basofacial = 5-7, medial = 5-7 plus apical enlarged, uropod 2 peduncle dorsal = 13-18, dorsal spines on outer ramus of uropod 1 = 6-7, of uropod 2 = 4-5, inner ramms of uropod 1 = 2-3, of uropod 2 = 1-2 vestigial. Ventral spines on peduncle of uropod 3 = 7-9, spine formula on article 1 of outer ramus = 1-1-1-1-2, setal formula = 1-1-1-1-1. Telson elongate, distal spines shortened.

ILLUSTRATIONS.—Upper and lower lips, maxillae, maxilliped, and pereopods of the male resembling those of the female and, except for minor differences mentioned in the text, are not illustrated; male gnathopods are figured; normal female gnathopods and the atypical first gnathopod of the holotype are drawn in outline only, that of the holotype a medial view of the right member; drawings of the urosome of both male and female specimens show uropod 1 tilted slightly to reveal medial spinules not seen in normal lateral view; mandibular protrusion at base of palp is as shown for *B. kokorus* (25).

HOLOTYPE.—NMV, female "w," 6.7 mm.

Type-Locality.—PPBES 223, 10 Mar 1971, Port Phillip Bay, Victoria, Australia, 4 m, sand.

VOUCHER MATERIAL.—PPBES 224: male "u," 6.1 mm (illus); female "y," 7.9 mm (illus); male "a," 5.6 mm (illus.). PPBES 230: female "n," 6.6 mm (illus.). PPBES 231: female "f," 6.95 mm. PPBES 225: female "g," 6.95 mm.

Relationship.—This species is very close to B.

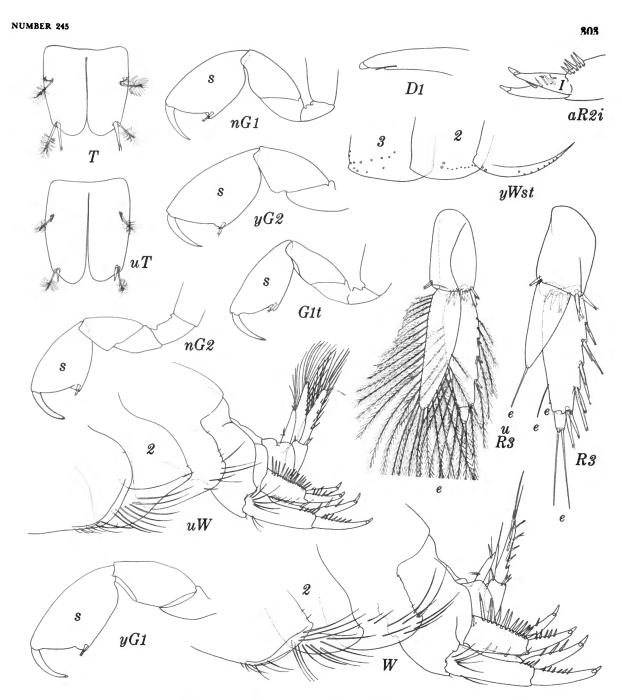


FIGURE 146.—Birubius maamus, new species, holotype, female "w," 6.7 mm (a = male "a," 5.6 mm; n = female "n," 6.6 mm; u = male "u," 6.1 mm; y = female "y," 7.9 mm).

gambodeni (20) but can be distinguished by the presence of one posteroproximal spine on article 5 of pereopods 1-2, by the shorter flagella and more compact articles on antenna 1 and by the more proximal placement of the ventral cycle of setae on article 2 of antenna 1. The basofacial setal formula on article 3 of the mandibular palp is very low compared with B. gambodeni.

MATERIAL.—PPBES, 43 samples from 27 stations (182); WPBES, one sample (1); CPBS, one sample (1 doubtful).

DISTRIBUTION.—Victoria: Port Phillip Bay and Western Port, 4–13 m, sand.

22. Birubius lowannus, new species

FIGURES 147-149

DESCRIPTION OF FEMALE.—Head about 18 percent of total body length, greatest width about 67 percent of length; rostrum constricted, narrow, reaching middle of article 2 on antenna 1. Eyes medium, clear of pigment. Article 1 on peduncle of antenna 1 about 1.5 times as long as wide, about 2.3 times as wide as article 2, ventral margin with 4-5 setules, weakly produced dorsal apex with 2 setules; article 2 about 0.8 times as long as article 1, with ventral cycle of 6 setae; primary flagellum with 12-14 articles, about as long as peduncle, bearing aesthetascs; accessory flagellum with 10-13 articles. Spine formula on article 4 of antenna 2 = 1-3-4-4 or 1-3-5-4, dorsal margin with notch bearing one seta and one spine, ventral margin with 4 groups of 2 long to medium setae, one ventrodistal medium spine; article 5 about 0.7 times as long as article 4, facial spine formula = 2, dorsal margin naked, ventral margin with 2 sets of one seta, one setule, 3 ventrodistal short to medium spines; flagellum about 1.5-1.7 times as long as articles 4-5 of peduncle combined, with 11-15 articles. Mandibles with medium palpar hump; right incisor with 3 teeth; left incisor with 3 teeth in 2 branches; right lacinia mobilis bifid, distal branch simple, shorter than proximal, tightly appressed, proximal branch simple, pointed, with marginal denticles; left lacinia mobilis with 4 teeth and accessories; right rakers 7-8 plus 2-3 rudimentaries; left rakers 8-9 plus 3-4 rudimentaries; molar in form of elongate plaque, right molar with 6-8 primarily long spines plus one tiny disjunct, left molar with 8

primarily long spines plus one tiny spine disjunct, each molar with plume; palp article I slightly elongate, article 2 with one short inner apical seta and 2-3 other shorter inner setae, article 3 about 0.75 times as long as article 2, oblique apex with 6 spinesetae, basofacial formula = 0. Inner plate of maxilla I somewhat thin but large, bearing one long apical pluseta, one thinner apicomedial seta, 2 apicolateral slightly shorter setae; palp article 2 with 6 apicalmedial marginal spines and 6-8 submarginal setae. Plates of maxilla 2 extending subequally, outer slightly narrower than inner, outer with 3-4 apicolateral setae, inner with one medial seta. Inner plate of maxilliped with one large thick apical spine, 3 apicofacial setae, 3-4 medial setae; outer plate with 4 medial and apical spines, one apicolateral seta; palp articles 1-2 with apicolateral seta, medial margin of article 2 moderately setose, article 3 with 3 facial setae, no lateral setae, nail of article 4 medium, with one accessory setule. Coxa 1 strongly expanded distally, anterior margin weakly concave; main ventral setae of coxae 1-4 = 6-6-5-0, posteriormost seta of coxae 1-3 shortened; anterior and posterior margins of coxa 4 weakly divergent, posterior oblique, almost straight, posterodorsal corner rounded, posterodorsal margin short, straight, width-length ratio of coxa 4 = 13:15. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 1-4-4-(5-6), short posteriors = 2-3-3-(2-4), long anteriors 3-(3-5)-0-0, short anteriors = 4-3-7-7. Gnathopods ordinary; width ratios of articles 5-6 on gnathopods 1-2 = 22:33 and 24:36, length ratios = 72:62 and 64:60; palmar humps ordinary, palms oblique; article 5 of gnathopods 1-2 elongate, ovate, posterior margin roundedflat. Pereopods 1-2 similar; facial setae formula on article 4 = 2 and 2, on article 5 = 3 and 3; main spine of article 5 extending to M. 80 on article 6; article 5 with one proximoposterior spine; spine formula of article 6 = 4 + 4 plus middistal seta, 2 spines elongate; acclivity on inner margin of dactyls of pereopods 1-2 weak, emergent setule long, midfacial pluseta ordinary. Coxae 5-7 posteroventral seta formula = 4-10-9. Articles 4-5 of pereopods 3-4 broad, facial spine rows dense, facial ridge formula on article 2 of pereopods 3-5 = 0-2-2, anterior ridge on pereopod 5 slightly shortened; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 44:49: 43:18, of pereopod 4 = 67:52:38:17, of pereopod 5 = 88:23:20:10, length ratios of pereopod

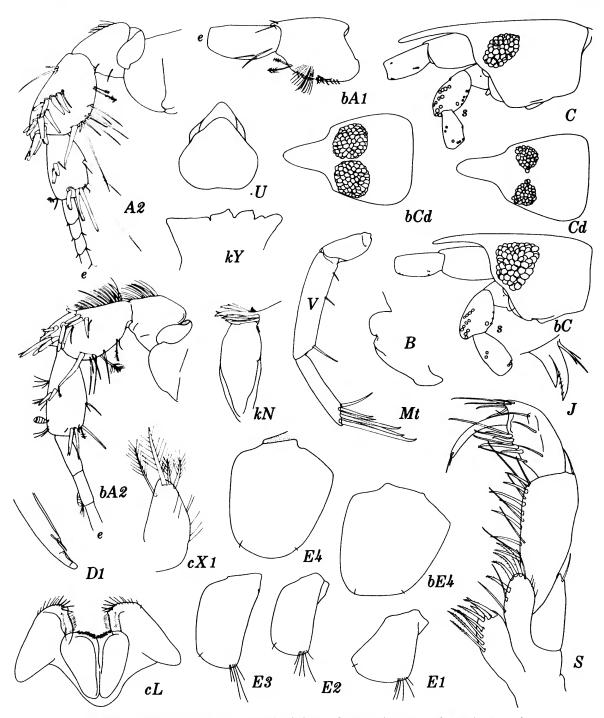


FIGURE 147.—Birubius lowannus, new species, holotype, female "a," 5.80 mm (b = male "b," 5.10 mm; c = female "c," 4.50 mm; k = female "k," 6.55 mm; Y = left lacinia mobilis).

3 = 75:42:44:44, of pereopod 4 = 86:57:39:51, of pereopod 5 = 115:29:25:34; article 2 of pereopod 5 reaching or exceeding middle of article 4: article 2 of pereopod 3 slightly tapered distally; medial apex of article 6 finely combed, bearing 2 small digital processes. Posteroventral corner of epimeron 1 rounded, posterior margin weakly convex, corner with setule (missing in illustration), anteroventral margin with 5-6 short to medium setae, posteroventral face with 2 long to short setae set vertically, ventral seta short (unusual); posteroventral corner of epimeron 2 rounded, weakly protuberant, posterior margin straight, facial setae = 3-4, posteriormost pair set vertically; posteroventral corner of epimeron 3 rounded, weakly and doubly protuberant, with setule sinuses, posterior margin straight, with 2 setule notches, ventral margin with one seta in middle, face with horizontal row of 8 setae, epimeron 3 with setule on posterodorsal margin set in weak notch. Urosomite 1 with ventral setule at base of uropod 1, articulation almost complete; urosomite 3 weakly protuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, outer ramus of uropod 1 with 4-6 dorsal spines, inner with 2, outer ramus of uropod 2 with 3 dorsal spines, inner with one dorsomedial spine; peduncle of uropod 1 with 2-3 apicolateral spines, no basofacial setae, medially with one marginal seta and spinule, apically with pair of ordinary spines; peduncle of uropod 2 with 7-9 dorsal spines, medially with one apical setule. Peduncle of uropod 3 with 8-9 ventral spines, dorsally with one lateral spine, one medial spine and setule; rami submasculine, inner extending to M. 80 on article 1 of outer ramus, apex with 3 setae, medial margin with 2 setae, article 2 of outer ramus ordinary, 0.24, bearing 2 medium setae, medial margin of article 1 with one seta, lateral margin with 4 acclivities, spine formula = 2-2-2-2-2, setal formula = l-l-l-l. Telson ordinary, lengthwidth ratio = 1:1, not fully cleft, each apex wide, rounded, lateral acclivity deep, broad, bearing ordinary lateral setule, spine next medial of length equal to setule, midlateral setules diverse. Cuticle with ordinary but sparse bulbar setules.

OBSERVATIONS (female).—Ommatidia larger than in B. kokorus (25); articles 2-3 of antenna 2 with sparse setular fringe dorsomedially, reminiscent of male phoxocephalids; mandibular palp article 3 unusually short for members of B. gambodeni

group and coxae 1-4 with unusually high density of facial setules.

Female "d," 7.3 mm, superfemale: Brood lamellae normal; externally conforming to ordinary females in head, gnathopods, pereopods, epimera, urosome, and telson but bearing only 9 spines on each outer plate of maxilla 1; bearing 4 setae (instead of one) on apex of palp article 2 on mandible; primary and accessory flagella of antenna 1 with 14 and 13 articles respectively; antenna 2 with 15 flagellar articles; peduncle of uropod 1 with 3 apicolateral spines, of uropod 2 with 9 dorsal spines; each molar with very tiny disjunct spine.

DESCRIPTION OF MALE.—Rostrum more sharply constricted than in female. Article 2 of antenna 1 with 3 short ventral setae; primary flagellum with 11-12 articles, one calceolus each on articles 1-6 or 1-7, aesthetascs strongly developed. Facial spine formula on article 4 of antenna 2 = 1-4-4-4, on article 5 = 2, article 5 with 3 sets of dorsal male setae and one calceolus, ventrodistal apex with 2 thin spines and one setule; flagellar formula = (25-26), 2, 3, 5, 7 . . . 24 or 4, 5, 7, 9 . . . 23. Apical seta on article 2 of mandibular palp longer than in female, basofacial setal formula on article 3 = 1-2 (right only, left lost). Spine 2 on outer plate of maxilla 1 unthickened. Coxa 4 broadened but smaller in relation to coxa 1 than in female; ventral setal formula of coxae 1-4 = 5-5-4-0. Article 2 of only pereopod 5 narrower than in female, articles 5-6 of pereopod 4 and articles 3-5 of pereopod 5 narrowed. Epimera 1-2 broadened, posterior margin of epimeron 3 shortened; setal formulas, epimeron 1 anteroventral = 3, posteroventral = 2, epimeron 2 facial = 4, epimeron 3 posterior = 3 setules, facial = 4. Spine formulas of uropods, uropod 1 peduncle apicolateral = 2, basofacial = 0, uropod 2 peduncle dorsal = 8, dorsal spines on outer ramus of uropod l = 4, of uropod 2 = 3, inner ramus of uropod 1 = 2, of uropod 2 = 1. Ventral spines on peduncle of uropod 3 = 5, spine formula on article 1 of outer ramus = l-l-2-2-2-1, setal formula = 1-1-1-1-1. Telson slightly elongate, distal spines shortened.

ILLUSTRATIONS.—Following parts not figured, resembling those illustrated for species mentioned: antenna 1 similar in proportions to B. kokorus (25) and B. maamus (21); conformation of mandible as in B. jirrandus (30); lower lip similar to that of B. myallus (4); outer plate of female maxilla 1

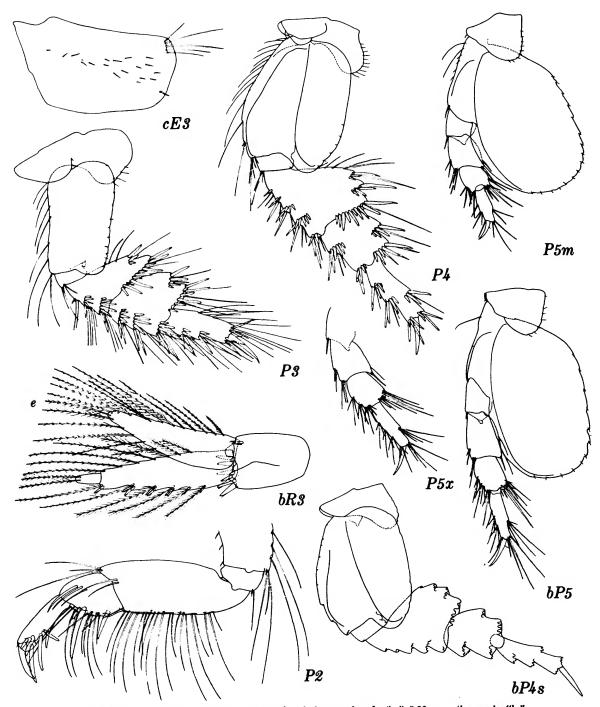


FIGURE 148.—Birubius lowannus, new species, holotype, female "a," 5.80 mm (b = male "b," 5.10 mm; c = female "c," 4.50 mm; x = normal).

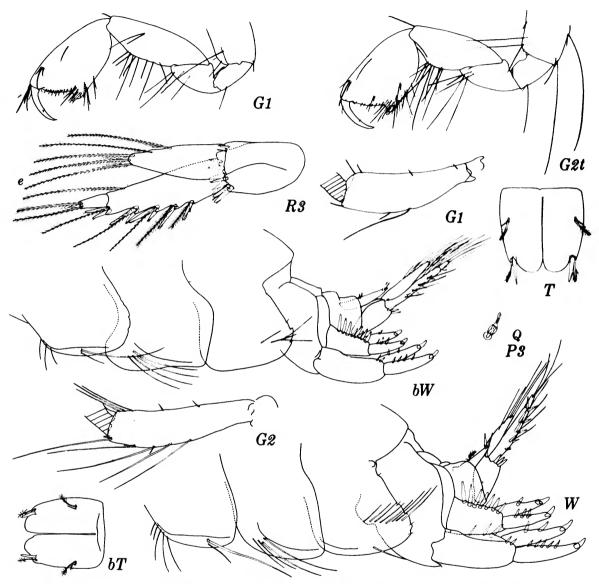


FIGURE 149.—Birubius lowannus, new species, holotype, female "a," 5.80 mm (b = male "b," 5.10 mm).

with one enlarged lateral spine as in *B. myallus*, inner plate of female "c" (like "d") oriented to show 4 setae; inner plate of maxilliped displaced medially to show full length of outer plate; articles 3–7 of right female pereopod 5 illustrated to show normal condition in addition to complete left pereopod with abnormally short articles; pereopod 4 of male "b" represented in outline only for com-

parison with female appendage.

HOLOTYPE.—NMV, female "a," 5.80 mm.

Type-Locality.—CPBS 31E/1, 25 Feb 1965, Western Port, Victoria, Australia, 12 m, medium coarse sand, a little fine mud.

VOUCHER MATERIAL.—CPBS 25N/5, male "b," 5.10 mm (illus.); CPBS 25N/3, female "c," 4.50 mm (illus.); PPBES 980/1, female "d," 7.3 mm; PPBES

980/2, female "k," 6.55 mm (illus.).

RELATIONSHIP.—Birubius lowannus and B. kyeemus (23) form a subgroup within the greater B. gambodeni group characterized by the following combination of characters: organization of facial setae on epimeron 3 into a horizontal row, absence of long posterior setae and presence of one ventral seta on epimeron 3, anteriorly crowded setae on epimeron 2, shortened anterior facial ridge on article 2 of percopod 5, elongate wrists of the gnathopods, and ordinary length of article 2 on the outer ramus of uropod 3.

The B. lowannus group differs from the strict B. gambodeni subgroup in the elongate wrists of the gnathopods, the ordinary article 2 of the outer ramus on uropod 3 and in the organized setation of epimeron 3. From the B. batei group (24-26) the B. lowannus group differs in the absence of long posterior setae and the strong facial row of setae on epimeron 3 and the ordinary article 2 of uropod 3. From the B. munggai group (27) the B. lowannus group differs in the setal organization on epimeron 3, the short anterior ridge on article 2 of pereopod 5, and the ordinary article 2 of uropod 3.

MATERIAL.—CPBS, 12 samples from 6 stations (14); WPBES, 9 samples from 6 stations (20); PPBES, 8 samples from 2 stations (16).

DISTRIBUTION.—Victoria: Port Phillip Bay and Western Port, 7-31 m, sand.

23. Birubius kyeemus, new species

FIGURES 150, 151

Description of Female.—Head about 18 percent of total body length, greatest width about 62 percent of length; rostrum constricted, narrow, elongate, reaching middle of article 2 on antenna 1. Eyes small, largely occluded with pigment. Article 1 on peduncle of antenna 1 about 1.5 times as long as wide, about twice as wide as article 2, ventral margin with about 6 setules, weakly produced dorsal apex with 2 setules; article 2 about 0.60 times as long as article 1, with ventral cycle of 5 setae; primary flagellum with 10–11 articles, about 0.8 times as long as peduncle, bearing several short aesthetascs; accessory flagellum with 8–9 articles. Spine formula on article 4 of antenna 2 = 1–3–4–4, dorsal margin with subproximal spine, ventral

margin with 4 groups of 2 long to medium setae, one ventrodistal medium spine; article 5 about 0.75 times as long as article 4, facial spine formula = 1-3, dorsal margin naked, ventral margin with 2 sets of 3-4 long to medium setae, 2 ventrodistal long to medium spines; flagellum about 1.7 times as long as articles 4-5 of peduncle combined, with 12-14 articles. Mandibles with medium palpar hump; right incisor with 3 teeth; left incisor with 3-4 humps in 2 branches, right lacinia mobilis bifid, distal branch shorter than proximal, both branches simple, pointed, proximal with marginal denticles: left lacinia mobilis with 5 teeth plus one accessory tooth, middle teeth shortened; right rakers 6; left rakers 8; molar in form of elongate plaque, each molar with 5 primarily long spines, none disjunct, each molar with plume; palp article 1 slightly elongate, article 2 with one long inner apical seta and 2 other shorter inner setae, article 3 about 0.75 times as long as article 2, oblique apex with 8 spine-setae, basofacial formula = 0. Inner plate of maxilla 1 elongate, thin, bearing one long apical pluseta, one shorter similar apicomedial seta, 2 apicolateral somewhat enlarged setae; palp article 2 with one apical spine and 4 apicolateralapical-medial setae. Plates of maxilla 2 extending equally, of equal breadth, outer with 3 apicolateral setae, inner with one medial seta. Inner plate of maxilliped with one large thick apical spine, 2 apicofacial setae, 4 medial setae, outer plate with 4-5 medial and apical spines, one apicolateral seta and 2 setules; palp articles 1-2 with apicolateral seta, medial margin of article 2 moderately to weakly setose, article 3 protuberant, with 3 facial setae, no lateral setae, nail of article 4 medium, with 2 accessory setules. Coxa 1 expanded distally, anterior margin weakly concave; main ventral setae of coxae 1-4 = (5-6)-(5-6)-(5-6)-0, posteriormost seta of coxae 1-3 shortened; anterior and posterior margins of coxa 4 divergent, posterior margin oblique, almost straight, posterodorsal corner rounded, posterodorsal margin ordinary, straight, width-length ratio of coxa 4 = 10:11. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 1-3-2-3, short posteriors = 0-0-3(2-3), long anteriors = 0-4-0-0, short anteriors = 2-3-3-4. Gnathopods ordinary; width ratios of articles 5-6 on gnathopods 1-2 = 22:32 and 24:34, length ratios = 66:59 and 59:58; palmar humps ordinary, palms weakly oblique; article 5 of gnath-

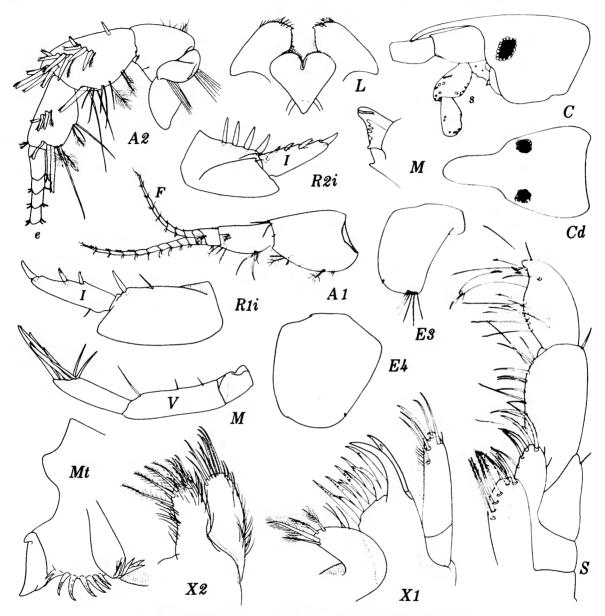


FIGURE 150.—Birubius kyeemus, new species, holotype, female "a," 5.94 mm.

opods 1-2 elongate, ovate, posterior margin flat. Pereopods 1-2 similar, facial setae formula on article 4=3 and 2, on article 5=3 and 4; main spine of article 5 extending to M. 75 on article 6, article 5 with one proximoposterior spine; spine formula on article 6=4+5, some elongate, plus tiny middistal seta (omitted from illustration); acclivity on

inner margin of dactyls of pereopods 1-2 sharp, produced as tooth, emergent setule short, midfacial pluseta ordinary. Coxae 5-7 posteroventral setule formula = 4-5-5. Articles 4-5 of pereopods 3-4 broad, facial spine rows dense, facial ridge formula on article 2 of pereopods 3-5 = 0-2-2, anterior on pereopod 5 short; width ratios of articles 2, 4, 5, 6

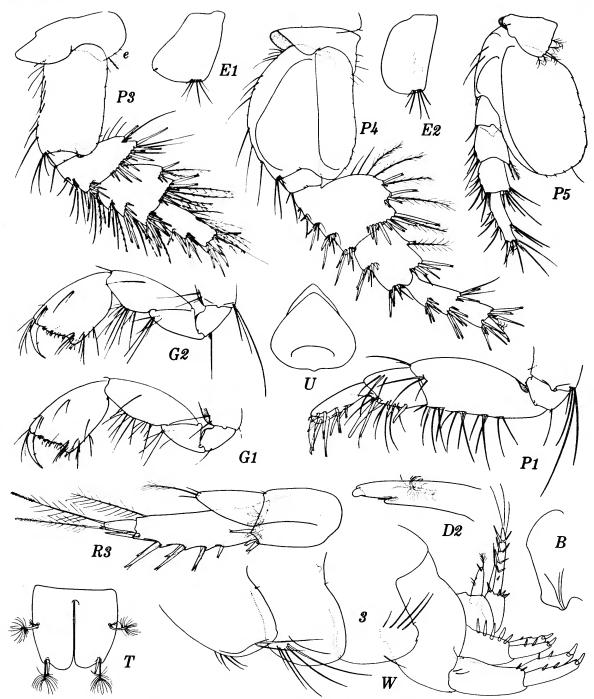


FIGURE 151.—Birubius hyeemus, new species, holotype, female "a," 5.94 mm.

of pereopod 3 = 42:47:41:18, of pereopod 4 =71:51:33:17, of pereopod 5 = 74:22:19:10, length ratios of pereopod 3 = 74:26:39:42, of pereopod 4 = 88:51:42:59, of pereopod 5 = 100:28:24:34; article 2 of pereopod 5 reaching middle of article 5, ventral margin with one medium seta plus setules; medial apex of article 6 scarcely combed, straight. Posteroventral corner of epimeron 1 rounded, weakly protuberant, posterior margin weakly convex, with setule notch, anteroventral margin with 3-4 medium setae, posteroventral face with 2 long setae set vertically; posteroventral corner of epimeron 2 rounded, posterior margin weakly convex, with setule, facial setae = 4-5 crowded anteriorly, posterior pair set vertically; posteroventral corner of epimeron 3 rounded, weakly protuberant, with setule sinus above and below, posterior margin almost straight, naked, ventral margin naked, midface with scarcely oblique row of 3-4 setae plus one seta near ventral margin; epimera 1-2 with weak setule notch posterodorsally. Urosomite 1 with ventral setule at base of uropod 1, articulation line almost absent; urosomite 3 scarcely protuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, outer ramus of uropod 1 with 2-3 dorsal spines, inner with 2, outer ramus of uropod 2 with 2 dorsal spines, inner with 2 dorsomedial spines; peduncle of uropod 1 with 2 apicolateral spines and 2 basofacial setae, medially with one marginal seta and apical enlarged spine; peduncle of uropod 2 with 5 dorsal spines, medially with one setule. Peduncle of uropod 3 with 5 ventral spines, dorsally with one lateral spine, one medial setule; rami feminine, inner extending to M. 57 on article 1 of outer ramus, apex with 3 setae, medial and lateral margins naked, article 2 of outer ramus ordinary to elongate, 0.25, bearing 2 long setae, subapicomedial margin of article 1 with one seta, lateral margin with 3-4 acclivities, spine formula = 1-2-2-2-2 or 1-2-2-2, setal formula = 0. Telson short, length-width ratio = 51:57, not fully cleft, each apex wide, rounded, lateral acclivity broad, shallow, bearing ordinary lateral setule, spine next medial shorter than setule, midlateral setules diverse. Cuticle with ordinary sparse bulbar setules.

HOLOTYPE.—AM, female "a," 5.94 mm.

Type-Locality.—EBS 148, 12 Jan 1973, 500 yards off Towra Point, Botany Bay, New South Wales, Australia, 3 m, sand and shell grit.

VOUCHER MATERIAL.—Type-locality: female "b," 5.42 mm; female "c," 5.36 mm. Male unknown.

RELATIONSHIP.—This species belongs in a group with *Birubius lowannus* (22) and shares with that species all the character differences from other species groups discussed in the "Relationship" section of that species.

Birubius kyeemus differs from B. lowannus in the poor articulation line of urosomite 1, the presence of basofacial setae on uropod 1, shorter spines on the telson, the simultaneous presence of more setae on epimeron 2 and fewer on epimeron 3, the presence of 2 (not 1) dorsal spines on the inner ramus of uropod 2, a much shorter inner ramus of female uropod 3 and the disjunct pairing of 2 facial setae set proximally on palp article 3 of the maxilliped.

MATERIAL.—EBS, one sample (3).
DISTRIBUTION.—New South Wales, Botany Bay,
Towra Point, 3 m, sand and shell grit.

24. Birubius batei? (Haswell), new combination

FIGURES 152-155

Phoxus Batei Haswell, 1879:259-260, pl. 9: fig. 3; 1882:237-238.

Pontharpinia rostrata.—Stebbing, 1906:146-147 [in part]; 1910:635.

NOMENCLATURE.—The so-called type material of this species (AM, P.3438, Port Jackson) is confounded. The specimens in the collection are Matong matong, new species, and clearly not what Haswell described and illustrated (Barnard and Drummond, 1976, erroneously labeled this taxon as "Birubius sp."). There is strong evidence that the material under consideration was labeled as "Type" by a person other than Haswell more than 20 years after his publication (see J. L. Barnard, 1974). We therefore reject that material as being the legitimate type of Birubius batei. On the other hand we hesitate in creating a neotype for this species; instead, we have designated a "Main Voucher." We have material, from Botany Bay, a locality near Port Jackson, that fits Haswell's meager description, but believe that a precise survey of the Port Jackson area should be undertaken to find what lives there today. Another of our species, B. jirrandus (30), also fits the description of B. batei but has not, as yet, been found in the

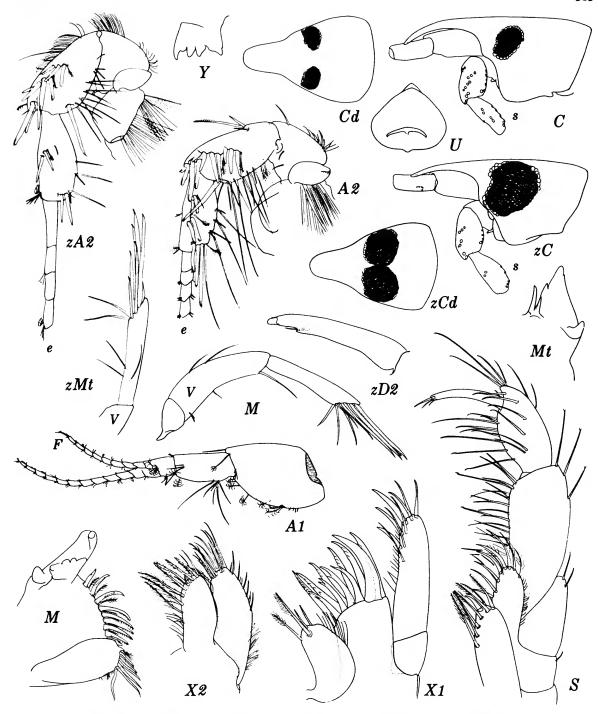


FIGURE 152.—Birubius batei? (Haswell), new combination, main voucher, female "f," 5.39 mm (z = male "z," 5.50 mm; Y = left lacinia mobilis).

vicinity of Port Jackson, New South Wales.

Description of Female.—Head about 25 percent of total body length, greatest width about 65 percent of length; rostrum weakly constricted, narrow, reaching middle of article 2 on antenna 1. Eyes medium, largely occluded with pigment. Article 1 on peduncle of antenna 1 about 1.5 times as long as wide, about 2.4 times as wide as article 2, ventral margin with about 10 setules, weakly produced dorsal apex with 3-4 setules (only 2 showing in illustration); article 2 about 0.55 times as long as article 1, with ventral proximal cycle of 7 setae; primary flagellum with 12 articles, about 0.85 times as long as peduncle, lacking aesthetascs; accessory flagellum with 10 articles. Spine formula on article 4 of antenna 2 = 1-3-4-3, dorsal margin with notch bearing 3 setae and spines, ventral margin with 6 groups of 2 long to short setae, one ventrodistal long spine; article 5 about 0.8 times as long as article 4, facial spine formula = 1-2-2, dorsal margin bearing group of setules, ventral margin with 4 sets of 2-3 long to short setae, 3 ventrodistal long to medium spines; flagellum about 1.3 times as long as articles 4-5 of peduncle combined, with 13 articles. Mandibles with medium palpar hump; right incisor with 3 teeth and notch; left incisor with 3 teeth in 2 branches; right lacinia mobilis bifid, distal branch simple, shorter than proximal, proximal branch simple, pointed; left lacinia mobilis with 4 teeth plus one accessory tooth; right rakers 8; left rakers 9; molar in form of elongate plaque, molars with 8 primarily long spines, no spine disjunct, each molar with plume; palp article 1 short, article 2 with one long inner apical seta and 3 other short inner setae and 2 outer setae, article 3 about as long as article 2, oblique apex with 10 spine-setae, basofacial formula = 0. Inner plate of maxilla 1 large, bearing one long apicofacial pluseta, one shorter similar apicomedial seta. 2 apicolateral much shorter setae; palp article 2 with 2-3 apicalmedial marginal spines and 5-6 submarginal setae. Plates of maxilla 2 extending equally, of equal breadth, outer with 6 apicolateral setae, inner with 3 medial setae. Inner plate of maxilliped with one large thick apical spine, 2 apicofacial setae, 4 medial setae; outer plate with 6 medial and apical spines, 2 apicolateral setae; palp article 1 with 2 apicolateral setae, article 2 with 3 groups of one apicolateral seta each, medial margin of article 2 moderately setose, article 3 pro-

duced, with 4-5 facial setae, 2 lateral setae, nail of article 4 medium, with 2 accessory setules. Coxa 1 scarcely expanded distally, anterior margin almost straight, main ventral setae of coxae 1-4 = (5-6)-7-7-0, posteriormost seta of coxae 1-2 slightly shortened; anterior and posterior margins of coxa 4 divergent, posterior margin oblique, convex, posterodorsal corner rounded, posterodorsal margin short, almost straight, width-length ratio of coxa 4 = 7:8. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 3-(5-6)-1-6, short anteriors = (10-11)-(8-9)-5-3, long anteriors = 3-(13-14)-0-0, gnathopod 1 with 3 long basofacial setae. Gnathopods ordinary; width ratios of articles 5-6 on gnathopods 1-2 = 24:30 and 26:33, length ratios = 65:60 and 58:57; palmar humps ordinary, palms oblique; article 5 of gnathopods 1-2 elongate, ovate, posterior margin flat. Percopods 1-2 similar; pereopod 1 with supernumerary apicofacial setae on article 5, other facial setae formula on article 4 = 4 and 3, on article 5 = 5 and 6; main spine of article 5 extending to M. 75 on article 6, article 5 with 2 proximoposterior spines; spine formula of article 6 = 5 + 6 plus middistal seta; acclivity on inner margin of dactyls of pereopods 1-2 weak, emergent setule long, midfacial pluseta ordinary. Coxae 5-7 posteroventral setule formula = 4-3-4. Articles 4-5 of pereopods 3-4 broad, facial spine rows moderately developed, facial ridge formula on article 2 of pereopods 3-5 = 0-2-2, anterior ridge of pereopod 5 long, posterior ridge abutting; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 41:40:34:16, of pereopod 4 = 67:39:26:14, of pereopod 5 = 77:26:19:9, length ratios of pereopod 3 = 78:34:43:42, of pereopod 4 = 90:52:41: 54, of pereopod 5 = 102:36:28:20; article 2 of pereopod 5 reaching apex of article 4 (discounting special lobe); article 4 of pereopods 3 and 5 with especially elongate posterodistal lobe; medial apex of article 6 truncate, uncombed. Posteroventral corner of epimeron 1 rounded, posterior margin convex, bearing setule, corner with setules, anteroventral margin with 6 short setae, posteroventral margin with 2 long setae; posteroventral corner of epimeron 2 rounded, weakly protuberant, posterior margin undulant, with setule, facial setae = 8-10, posteriormost pair set vertically; posteroventral corner of epimeron 3 with small tooth, posterior margin straight, serrate, 7-8 setose, uppermost seta tiny, ventral margin with 3-4 posterior

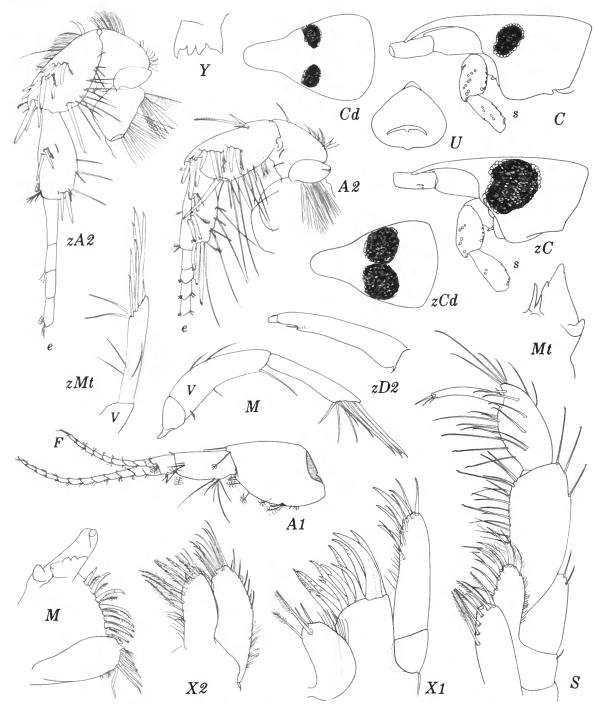


FIGURE 153.—Birubius batei? (Haswell), new combination, main voucher, female "f," 5.39 mm (z = male "z," 5.50 mm).

setae. Urosomite 1 with 2 long ventral spines at base of uropod 1, articulation line broken in middle; urosomite 3 weakly protuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, rami of uropods 1-2 lacking accessory nails, outer ramus of uropod 1 with 6-10 dorsal spines, inner with 2-4, outer ramus of uropod 2 with 4-8 dorsal spines, inner with 1-2 dorsomedial spines; peduncle of uropod 1 with 4-5 apicolateral spines and 4-5 basofacial setae, medially with 6 marginal setae and spines becoming thicker apically; peduncle of uropod 2 with 10-14 dorsal spines, medially with one small apical spinule. Peduncle of uropod 3 with 6 ventral spines, dorsally with one lateral spine, one medial spine; rami feminine, inner extending to M. 75 on article 1 of outer ramus, apex with 3 setae, medial margin with 3 setae, article 2 of outer ramus ordinary, 0.17, bearing 2 long setae, medial margin of article 1 with 2 setae, lateral margin with 5 acclivities, spine formula = 1-2-2-2-2-2, setal formula = 0-1-1-1-1-1. Telson ordinary, length-width ratio = 14:13, not fully cleft, each apex of medium width, rounded, lateral acclivity shallow, bearing ordinary lateral setule, spine next medial of length equal to setule, midlateral setules diverse. Cuticle with ordinary sparse bulbar setules, surface bearing fine striations in form of linear fingerprint pattern.

DESCRIPTION OF MALE.—Rostrum shorter than in female. Antenna 1 with one calceolus each on articles 1-4. Facial spine formula on article 4 of antenna 2 = 1-2-4-3, on article 5 = 2; article 5 with one dorsal set of male setae and one calceolus, ventrodistal apex with 2 thin spines and one setule, flagellar formula = 27, 2, 4, 6 . . . 24. Right and left rakers 8; basofacial setal formula of article 3 on mandibular palp = 1-2. Palp of maxilla 1 with 2 spines and 4 setae. Outer plate of maxilliped with one apicolateral seta. Coxa 4 like that of female but smaller in relation to coxa 1 than in female: ventral setal formula of coxae 1-4 = 4-6-6-0, setae short. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 2-(2-3)-2-3 plus 2 basofacial setae on gnathopod 1, long anteriors = 3-7-0-0. Facial and setal-spine formulas of pereopods 1-2 on article 4 = 3 and 2, on article 5 = 5and 5, on article 6 = 4 and 5 plus middistal seta. Article 2 of only pereopods 3 and 5 narrower than in female, pereopod 5 larger in relation to pereopod 3 than in female. Epimera 1-3 broadened, posterior margin of epimeron 3 shortened; setal formulas, epimeron l anteroventral = 5, posteroventral = 2, epimeron 2 facial = 7, epimeron 3 posterior = 8, facial = 1-2. Articulation lines of urosome strong, ventrolateral spine of urosomite I very small, dorsal base of urosomite 3 with hump. Spine formulas of uropods, uropod 1 peduncle apicolateral = 4-5, basofacial = 6, medial = 4 plus apical enlarged, uropod 2 peduncle dorsal = 11-14, dorsal spines on outer ramus of uropod 1 = 6-7, of uropod 2 = 5-6, inner ramus of uropod 1 = 2-3, of uropod 2 = 2 shortened, fully medial. Ventral spines on peduncle of uropod 3 = 6, spine formula on article 1 of outer ramus = 1-1-2-2-2-2, setal formula = 1-1-1-1-1. Telson slightly elongate, distal spines shortened.

OBSERVATIONS.—Dwarf males from Western Australia, WAM 414-73 (index "273"): Male "a," 3.31 mm, and male "b," 3.50 mm: nail on dactyl of maxilliped elongate, 60 percent as long as article 4; article 6 of gnathopod 2 stouter than in typical plienotype. Other descriptive features of male "a": primary flagellum of antenna 1 with 10 articles, accessory flagellum with 7, primary with one calceolus each on articles 1-4. One aesthetase each on articles 1-8; antenna 2 flagellar formula = 23, 2, 4, 6 . . . 20; article 4 of peduncle with spine formula of 3-4-3, article 5 with 2 facial spines and 2 sets of posterior setal spines; right lacinia mobilis of normal bifid form, mandibular palp article 2 with 3 medial setae and 2 apicomedial setae, article 3 with 7 apical setae, basofacial formula = 2-1; palp of maxilla 1 with 4 spines and 3 setae; setal formula of coxae 1-4 = 4-5-5-0; long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 1-1-2-2, long anteriors = (2-3)-4-0-0, short anteriors = (0-1)-3-3-3, no others, facial setae on articles 4 and 5 of pereopods 1-2=2 and 3, spine formula of article 6 = 3 + 4 plus middistal seta; anterior ridge on article 2 of pereopod 5 of short form seen in Birubius jirrandus (30), pereopod 5 with 6 posterior teeth on article 2; epimeron 1 with 4 anteroventral setae, 2 posteroventral setae, epimeron 2 with 4 horizontal setae and pair set vertically, epimeron 3 with 6 posterior setae and one or no posteroventral seta; peduncle of uropod 1 with 2 basofacial setae, with 4 apicolateral spines, outer ramus with 6 dorsal spines, inner ramus with 2, peduncle of uropod 2 with 9 dorsal spines, outer ramus with 3, inner with one; outer ramus of uro-

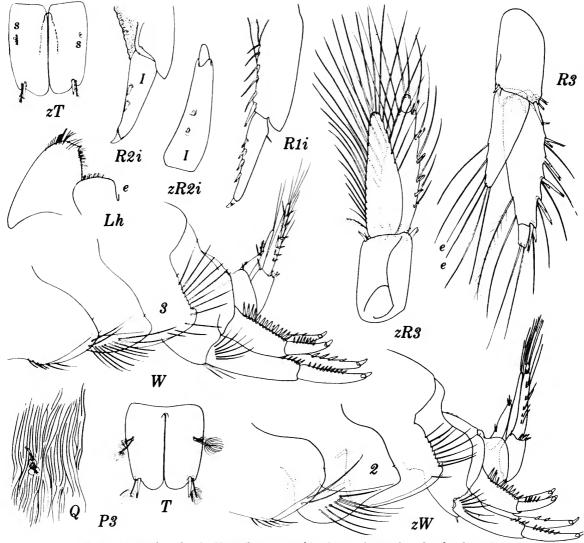


FIGURE 154.—Birubius batei? (Haswell), new combination, main voucher, female "f," 5.39 mm (z = male "z," 5.50 mm).

pod 3 with 4 acclivities, spine formula = 1-1-1-1-2, setal formula = 1-1-1-1-1. Male "b": epimeron 1 with 4 anteroventral and 3 posteroventral setae, epimeron 2 with 5 horizontal setae and pair set vertically, epimeron 3 with 7 posterior and 2 posteroventral setae; peduncle of uropod 1 with 5 basofacial setae, peduncle of uropod 2 with 10 dorsal spines, outer ramus with 4; other counts similar to male "a".

Our southeastern Australian material of Birubius batei? is mostly represented by giant specimens,

whereas the dwarf western Australian males may represent a more average size for this species. Features of subspecific value between the two sets of specimens collected almost 2,000 miles apart include spine counts, the short ridge on pereopod 5, and the broadened hands on the gnathopods.

Males of WAM 414-73 (index "274"): Male "m," 4.80 mm: subbifid apical branch of right lacinia mobilis (see illustration); antenna 2 normal; nail on maxillipedal palp almost 40 percent as long as article 4, thus slightly elongate; hand of gnathopod

1 almost normal, that of gnathopod 2 stout (see illustration); pereopod 5 normal; epimeron 1 with 5 anteroventral setae, 2 posteroventral submarginal setae, epimeron 2 with 5 horizontal and one dorsally thrust setae, epimeron 3 with 6 posterior and no ventral setae; peduncle of uropod 1 with 4-5 basofacial setae, 5 apicolateral spines, outer ramus with 6 spines, inner with 2, peduncle of uropod 2 with 11 spines, outer ramus with 3 dorsal spines and one spine fully inserted (non-emergent) in body of ramus, inner ramus with 2 spines; lateral apex of peduncle on uropod 3 with 2 spines, outer ramus with spine formula of 1-1-2-2-2, setal formula of l-l-l-l-l; abnormalities are maxillipedal nail, gnathopod 2, outer ramus of uropod 2, peduncle of uropod 3. Male "n": right lacinia mobilis normal; both hands of gnathopods stout; outer ramus of uropod 2 with 5 normal spines, inner with one; spine formula on outer ramus of uropod 3 = 2-1-1-1-2, setae = 0-2-1-1-1; abnormalities are gnathopods and outer ramus of uropod 3. Male "p": Only hand of gnathopod 2 stout.

Males of WAM 414-73 (index "275"): Male "q": right lacinia mobilis normal; maxillipedal nail normal; hands of both gnathopods slightly stoutened; anterior ridge of pereopod 5 normal; epimeron 1 with 5 anteroventral setae, with 2 posteroventral setae immediately adjacent to anteroventral set (abnormal), epimeron 2 with 6 horizontal setae and one thrust dorsally, epimeron 3 with 4 posterior setae confined ventrally, one posteroventral seta, one ventral seta-spine; peduncle of uropod 1 with 6 basofacial setae, lateral apex with 6 spines (one of these disjunct towards base), outer ramus with 5 spines, inner with one (abnormal), peduncle of uropod 2 with 11 spines, outer ramus with 4, inner with one; spine formula on outer ramus of uropod 3 = 1-1-1-2-2-2, setae = 0-1-1-1-1-1. Other males: epimeron 1 normal.

Abnormalities in Western Australian Males: Recombinations or gene flow in the direction of Birubius jirrandus (30) are seen in the shortened anterior ridge of pereopod 5 in "273" males, in the spine reduction on the inner ramus of uropod 1 on "275" males; but other abnormalities in maxillipedal nail, setal distribution on epimera 1–2, and right lacinia mobilis of one "274" male, all of which occur inconsistently, suggest that the two main differences listed in the discussion of this species and B. jirrandus are valid.

DESCRIPTION OF JUVENILE (juvenile "k," 2.26 mm). -Head similar to that of adult but somewhat thinner from dorsal view. Antenna 1 with 8 articles in primary flagellum, 5 in accessory flagellum. Spine formula on article 4 of antenna 2 = 1-3-3-3, dorsal margin with 2 setae in notch, article 5 with 2 facial spines and 2 posterior sets of setae; flagellum 7-articulate. Upper lip and epistome lacking articulation. Right lacinia mobilis bifid, both branches conical; right mandible with 5 raker spines; molar with 8 spines, none disjunct (left mandible not examined); palp article 3 lacking basofacial setae. Lower lip and plates of maxilla I not examined; palp of maxilla 1 with 2 spines and 3 setae. Inner plate of maxilla 2 with one medial seta; outer plate with one apicolateral seta. Inner plate of maxilliped with one apical spine and one apicoventral seta, 2 medial and 2 dorsofacial setae; outer plate with 4 spines, no lateral setae; article 3 of palp with 2 facial setae. Setae of coxae 1-4 = 4-3-3-0. Article 2 of gnathopods 1-2 with 0 and 2 long posterior (see illustrations of gnathopods). Setal and spine formulas of pereopods 1-2, article 2, posterior long seta = 1, article 4 facial = 4, article 5 facial = 2, article 6 spines = 3 + 3 plus one seta, article 5 also bearing one proximal spine. Pereopods 3-4 generally similar to those of adult but with fewer spines and setae. Article 2 of pereopod 5 (illustrated) with stronger ventral setae than in adult (generally typical of juveniles in certain species). Epimeron 1 (illustrated) with one anteroventral seta, one posteroventral seta; epimeron 2 with 4 facial setae in tandem; epimeron 3 with 3 posterior setae and 2 setules, no facial setae. Urosomite 1 with one large ventral spine at base of each uropod 1 (not in adult). Uropod 1 with a basofacial seta, 1-2 apicolateral spines, outer ramus with 3 dorsal spines, inner with one dorsal spine; uropod 2 with 4-5 peduncular spines, outer ramus with 2 dorsal spines, inner with one dorsal spine. Uropod 3 and telson as illustrated.

Identification of juvenile with adult is strong but confounded by the relatively great length of the ventral setules on article 2 of pereopod 5. This anomaly can be shown in other species to be characteristic of youthful specimens in contrast to adults.

ILLUSTRATIONS.—The paired basofacial setae on article 3 of the maxillipedal palp in female "f" is an abnormal condition.

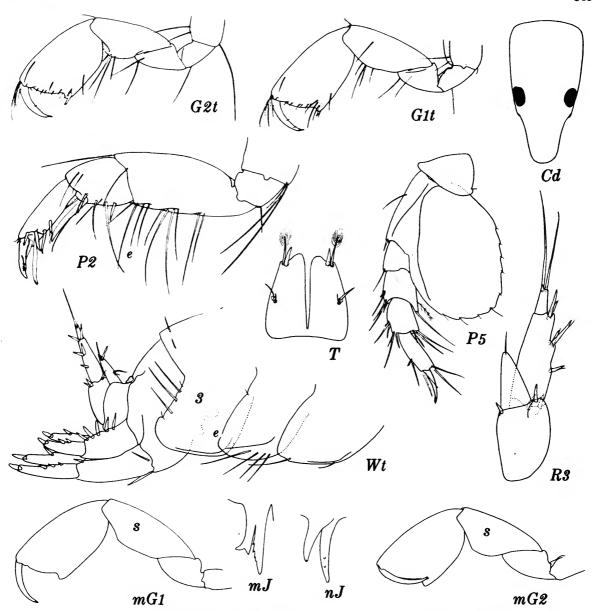


FIGURE 155.—Birubius batei? (Haswell), new combination, juvenile "k," 2.26 mm (m = male "m," 4.80 mm; n = male "n," 4.70 mm).

MAIN VOUCHER.—AM, female "f," ovigerous, 5.39 mm.

LOCALITY.—EBS 200, 11 Apr 1973, off Towra Beach, Botany Bay, New South Wales, Australia, 2.7 m, sand.

VOUCHER MATERIAL.—EBS 362: male "z," 5.50 mm (illus.); female "c," 6.28 mm. EBS 199: female

"d," 6.10 mm. EBS 196: male "e," 5.62 mm. WAM 414-73 (divided into 3 subsamples with indices): "273," male "a," 3.31 mm, male "b," 3.50 mm; "274," male "m," 4.80 mm (illus.), male "n," 4.70 mm (illus.), male "p," 4.20 mm; "275," male "q," 4.36 mm; plus 3 other males. JLB AUS 13: juvenile "k," 2.26 mm (illus.).

RELATIONSHIP.—Because the combination of non-crowded setae on epimeron 2, strong basofacial setae on uropod 1 and elongate wrists on the gnathopods prevents an evolutionary flow from the other 3 subgroups in this division, Birubius batei? and B. jirrandus (30) form a pair distinct from the other members of this division and apparently derive not from any of the other subgroups but directly from their hypothetical ancestor. Birubius batei? and B. jirrandus also differ from the other group in the absence of fully facial setae on epimeron 3 and in the presence of ventral setae, although the latter are almost facial.

In other ways this species appears very close to the B. kokorus group (25-27) but differs in the more numerous basofacial setae on uropod I and/or in the longer telsonic spines. From the B. lowannus group (22-23), B. batei? differs in the longer anterior ridge of pereopod 5, the uncrowded setae of epimeron 2, and the shorter article 2 on the outer ramus of uropod 3. From the B. gambodeni group (20-21) B. batei? differs in the more elongate wrists of the gnathopods and the longer anterior ridge on pereopod 5.

MATERIAL.—EBS, 20 samples (52); WAM, one sample (11); JLB AUS, one sample (1).

DISTRIBUTION.—New South Wales: Botany Bay, Lake Macquarie, and Jervis Bay, 0.3-6.0 m, coarse sand. Western Australia: Barrow Island, presumably surface nekton; and Middleton Beach, near Albany, intertidal.

25. Birubius kokorus, new species

FIGURES 156-158

Description of Female.—Head about 17 percent of total body length, greatest width about 63 percent of length; rostrum constricted, narrow, of medium length, reaching middle of article 2 on antenna 1. Eyes medium, largely occluded with pigment. Article 1 on peduncle of antenna 1 about 1.3 times as long as wide, about 2.2 times as wide as article 2, ventral margin with few setules, unproduced dorsal apex with one setule; article 2 about 0.75 times as long as article 1, with ventral cycle of 4–7 setae; primary flagellum with 11–14 articles, about 0.75–0.87 times as long as peduncle, bearing long aesthetascs distally; accessory flagellum with 9–12 articles. Spine formula on article 4 of

antenna 2 = 1-3-4-5 or 1-3-5-5 or 1-3-6-5 or 1-3-5-4, dorsal margin with notch bearing 3 setae, ventral margin with 4-6 groups of 3-4 long to medium setae, one ventrodistal long spine; article 5 about 0.75 times as long as article 4, facial spine formula = 1-3 or 1-4 or 1-2-2, dorsal margin naked, ventral margin with 4 sets of 2 long and short setae, 2 ventrodistal long to medium spines; flagellum about 1.2 times as long as articles 4-5 of peduncle combined, with 12-14 articles. Mandibles with medium palpar hump; right incisor with 3 teeth; left incisor with 3 teeth in 2 branches; right lacinia mobilis bifid, distal branch simple, shorter than proximal, tightly appressed, proximal branch simple, pointed, with marginal denticles; left lacinia mobilis with 4 teeth; right rakers 8-9 plus 1-2 rudimentaries; left rakers 8-10 plus 1-2 rudimentaries; molar in form of elongate plaque, right and left molars with 7 primarily long spines, no spine disjunct, each molar with plume; palp article 1 short, article 2 with one medium inner apical seta and 3-4 other shorter inner setae, article 3 about as long as article 2, oblique apex with 10 spine-setae, basofacial formula = 0-1 or 0-2. Inner plate of maxilla 1 large, bearing one long apical pluseta, one shorter similar apicomedial seta, 2 apicolateral much shorter setae (one hidden in illustration); palp article 2 with 3-4 apical medial marginal spines and 4-5 submarginal setae. Plates of maxilla 2 extending equally, plates equally broad, outer with 5-6 apicolateral setae, inner with one medial seta. Inner plate of maxilliped with one large thick apical spine, 2 apicofacial setae, 4 medial setae, outer plate with 6-7 medial and apical spines, 2 apicolateral setae; palp article 1 with apicolateral seta, article 2 with 1-2 groups of 1-2 apicolateral setae, medial margin of article 2 strongly setose, article 3 protuberant, with 5 facial setae, no lateral setae, nail of article 4 short, with 1-2 accessory setules. Coxa 1 expanded distally, anterior margin weakly concave; main ventral setae of coxae 1-4 = 10-9-9-0, posteriormost seta of coxae 1-2 slightly shortened; anterior and posterior margins of coxa 4 weakly divergent, posterior margin convex, posterodorsal corner rounded, posterodorsal margin short, concave, width-length ratio of coxa 4 = 14:15. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 3-(5-7)-5-6, long anteriors = +-+-0-0, others not counted. Gnathopods generally ordinary; width ratios of

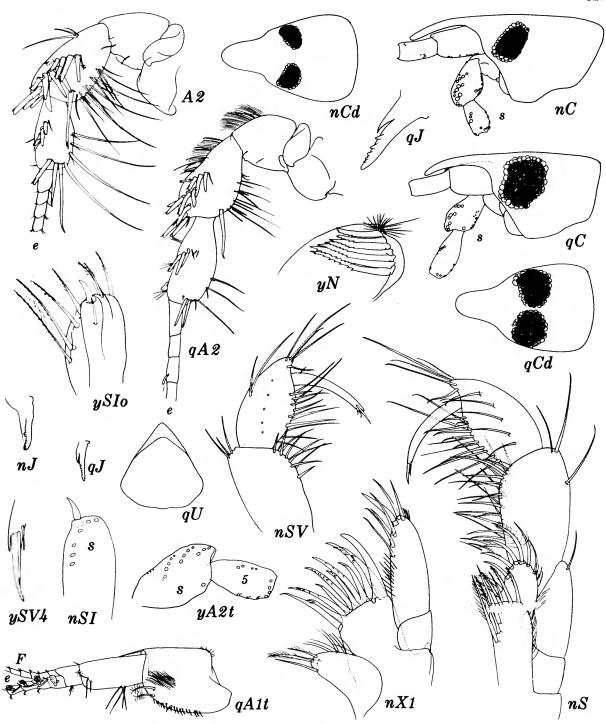


FIGURE 156.—Birubius kokorus, new species, holotype, female "a," 7.7 mm (n= female "n," 8.2 mm; q= male "q," 6.3 mm; y= female "y," 6.3 mm).

articles 5-6 on gnathopods 1-2 = 25:32 and 26:33, length ratios = 54:61 and 49:60; palmar humps ordinary, palms oblique; article 5 of gnathopod 1 ovate, posterior margin flat; article 5 of gnathopod 2 ovate, posterior margin rounded, lobate. Pereopods 1-2 similar; facial setae formula on article 4 = 4-5, on article 5 = 6; main spine of article 5 extending to M. 90 on article 6, article 5 with 2 proximoposterior spines; spine formula of article 6 = 3 + 4 (rarely 4 + 5) plus middistal seta; acclivity on inner margin of dactyls of pereopods 1-2 weak, produced as tooth, emergent setule long, midfacial pluseta ordinary. Coxae 5-7 posteroventral setule formula = 4-4-(3-4). Articles 4-5 of pereopods 3-4 broad, facial spine rows moderately developed, facial ridge formula on article 2 of pereopods 3-5 = 0-2-2, anterior ridge on pereopod 5 slightly shortened; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 45:42:36:17, of pereopod 4 = 71:42:32:14, of pereopod 5 = 87:27:23:10, length ratios of pereopod 3 = 72:33:33:43, of pereopod 4 = 88:53:43:52, of pereopod 5 =115:29:26:30; article 2 of pereopod 5 reaching middle of article 5; medial apex of article 6 finely combed, bearing 4 obsolescent digital processes. Posteroventral corner of epimeron 1 rounded, protuberant, posterior margin convex, corner with setule, anteroventral margin with 8-10 medium setae, posteroventral face with 1-2 long setae; posteroventral corner of epimeron 2 rounded, weakly protuberant, guarded by setule sinus, posterior margin weakly convex, facial setae = 10-14, posteriormost pair or triad of main group set vertically, with additional disjunct seta; posteroventral corner of epimeron 3 weakly protuberant, with setule sinus, with small tooth, posterior margin weakly sinuous, with several setule notches and 3-4 long setae, ventral margin with 2-3 setules mainly posterior, face with 2 oblique horizontal rows of 2-3 setae or variants (see illustrations) near ventral margin in middle; epimeron 3 with setule on posterodorsal margin set in weak notch. Urosomite l with ventral setule at base of uropod 1, (not showing in illustration), articulation line almost complete; urosomite 3 protuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, rami of uropods 1-2 lacking accessory nails, outer ramus of uropod 1 with 7-12 dorsal spines, inner with 1-2, outer ramus of uropod 2 with 4-7 dorsal spines, inner with one dorsomedial spine;

peduncle of uropod 1 with 5-6 apicolateral spines and 0-2 basofacial setae, medially with 6-9 marginal spines, apicalmost or 2 enlarged; peduncle of uropod 2 with 14-18 dorsal spines, medially with one small apical spine. Peduncle of uropod 3 with 6-7 ventral spines, dorsally with one lateral spine, one medial spine; rami submasculine, inner extending to M. 95 on article 1 of outer ramus, apex with 2 setae, medial and lateral margins setose, article 2 of outer ramus short, 0.12, bearing 2 long setae, apicomedial margin of article 1 with setae, lateral margin with 4 acclivities, spine formula = 1-1-1-1-1, setal formula = 1-1-2-2-1. Telson ordinary, length-width ratio = 11:10, not fully cleft, each apex wide, rounded, lateral acclivity shallow, weak, bearing ordinary lateral setule, spine next medial shorter than setule, midlateral setules weakly diverse. Cuticle with sparse ordinary bulbar setules.

OBSERVATION (female).—Female "g," length unknown, damaged, peduncle of uropod 2 with 18 spines.

DESCRIPTION OF MALE.—Rostrum less sharply constricted than in female. Article 2 of antenna 1 with 4 ventral setae; primary flagellum with 12 articles, one calceolus each on articles 1-6, aesthetascs strongly developed. Facial spine formula on article 4 of antenna 2 = 2-1-4-4, on article 5 = 3 or 2-2 or 2-1; article 5 with 3 sets of dorsal male setae and one calceolus, ventrodistal apex with 2 thin spines and one setule, flagellar formula = 35, 2, 3, 5, 7 . . . 34. Right lacinia mobilis with poorly developed distal branch; palp article 2 of mandible with 2 long apical setae, pair of tiny basal setules, intervening setae longer than in female, basofacial setal formula of article 3 = 2 + 3. Palp of maxilla 1 with 12-13 setae and spines. Palp article 3 of maxilliped with 1-2 lateral setae. Coxa 4 not broadened; ventral setal formula of coxae 1-4 = 8-8-7-0. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = (1-2)-(3-5)-3-(3-4). Article 6 of pereopods 3-4 slightly narrowed. Posterior setae of coxae 5-7 shortened. Epimera 2-3 broadened, posterior margin of epimeron 3 not shortened; setal formulas, epimeron 1 anteroventral = 6-8, posteroventral = 2, epimeron 2 facial = 8-9, epimeron 3 posterior = 4, facial = 3, ventral = 2 setules. Articulation of urosomite 1 obscure proximally. Spine formulas of uropods, uropod 1 peduncle apicolateral = 6, basofacial =

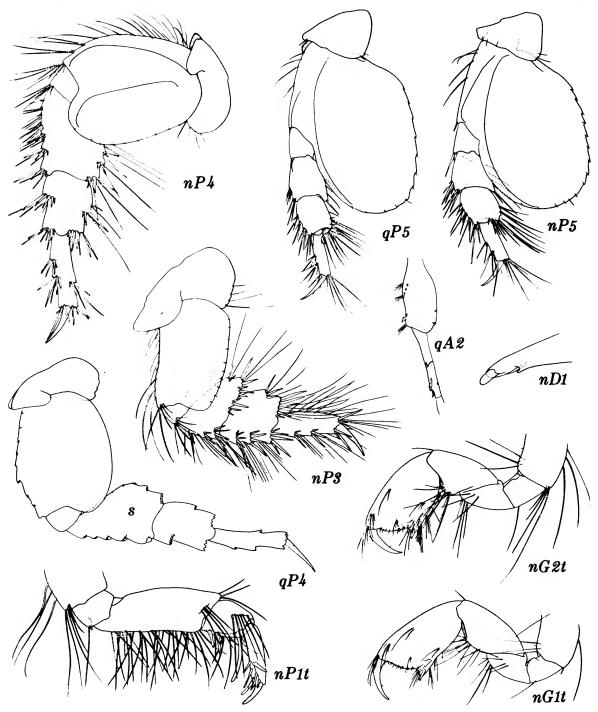


FIGURE 157.—Birubius kokorus, new species, female "n," 8.2 mm (q = male "q," 6.3 mm).

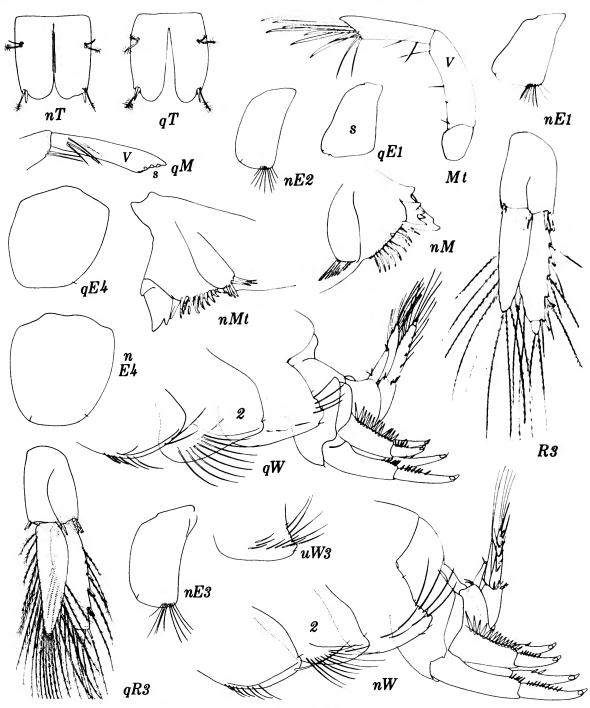


FIGURE 158.—Birubius kokorus, new species, holotype, female "a," 7.7 mm (n= female "n," 8.2 mm; q= male "q," 6.3 mm; u= female "u," 7.5 mm).

1-2, uropod 2 peduncle dorsal = 13-15, dorsal spines on outer ramus of uropod 1 = 7-8, of uropod 2 = 6, inner ramus of uropod 1 = 1-2, of uropod 2 = 1 vestigial, ventral spines on peduncle of uropod 3 = 7, spine formula on article 1 of outer ramus = 0-1-1-2-2-1, setal formula = 1-1-1-1-1-1. Telson not elongate, not broadened, distal spines not shortened.

ILLUSTRATIONS.—Female prebuccal complex and antenna l closely resembling those of male (illustrated); lower lip as shown for B. gelarus (17) and maxilla 2 as shown for female of B. myallus (4). Male prebuccal complex, maxillae, mandible (except for palp and right lacinia mobilis, separately illustrated), maxilliped, coxae 2 and 3, gnathopods and pereopods 1, 2, and 3 resembling those of the female; male pereopod 4 represented in outline only to show proportions of articles for comparison with those of female. Drawing of left molar of female "y" showing apical spines further flattened in plane of their natural inclination, across apex, but plume flattened outwards; left maxillipedal palp of female "n" figured to show those setae normally hidden or obscured in right aspect as illustrated from other side of same specimen; medial peduncular spinules of uropod 1 and proximoventral spinule on inner ramus not visible in normal lateral view of urosome; uropod 1 with 0-1 basofacial seta on holotype, shown as absent on illustration.

HOLOTYPE.—NMV, female "a," 7.7 mm.

TYPE-LOCALITY.—CPBS 32S/870, 12 Aug 1970, Western Port, Victoria, Australia, 13 m, muddy sand, gravel, some shell.

VOUCHER MATERIAL.—Illustrated: Type-locality: female "n," 8.2 mm. CPBS 32S/269: male "q," 6.3 mm; subadult female "u," 7.5 mm. CPBS 41S/5: female "y," 7.8 mm.

Not Illustrated: CPBS 41N/4: male "f," 6.1 mm. CPBS 51N/3: female "g," unmeasured, see observations.

RELATIONSHIP.—This species is difficult to distinguish from the B. gambodeni group (20–21) qualitatively except in the tightly appressed branches of the right lacinia mobilis, and in the presence of spine(s) on posteroproximal article 5 of pereopods 1–2; adults similar in size to those of B. gambodeni have only 0–2, usually 0–1 basofacial setae on uropod 1 and can usually be sorted away from the B. gambodeni group on that basis before the

right mandible must be checked. Full adults of B. gambodeni have accessory posterior setae on the telson.

Spines on the telson are shortened in *B. kokorus*. *Birubius maamus* (21) differs from *B. kokorus* in the more proximally placed ventral cluster of setae on article 2 of antenna 1 and also in the basofacial setae on uropod 1 and the long anterior ridge on pereopod 5 which in *B. maamus* are like those of *B. gambodeni*.

Birubius kokorus and species 26–27 differ from species 21–24 in the absence of long ventral setae on epimeron 3.

MATERIAL.—CPBS, 71 samples from 23 stations (179); WPBES, 5 samples from 4 stations (9); WAM, one sample (1).

DISTRIBUTION.—Victoria, Western Port, 2-19 m, sand, silty sand; New South Wales, off Eden, 30 m, coarse sand.

26. Birubius kinkus, new species

FIGURES 159, 160

Description of Female.—Head about 20 percent of total body length, greatest width about 60 percent of length; rostrum almost unconstricted, broad, reaching apex of article 1 on antenna 1. Eyes medium, largely occluded with pigment. Article 1 on peduncle of antenna 1 about 1.4 times as long as wide, about 2.2 times as wide as article 2, ventral margin with about 10 setules, weakly produced dorsal apex with 4 setules; article 2 about 0.7 times as long as article 1, with apicoventral cycle of 6 setae; primary flagellum with 13-15 articles, about 1.2 times as long as peduncle, bearing several short aesthetascs; accessory flagellum with 10-12 articles. Spine formula on article 4 of antenna 2 = 1-3-4-4, dorsal margin with notch bearing 3 setae, ventral margin with 4 groups of 2 long to medium setae, one ventrodistal long spine; article 5 about 0.7 times as long as article 4, facial spine formula = 1-2, dorsal margin naked, ventral margin with 2 sets of 2-3 long to short setae, 2 ventrodistal long to medium spines; flagellum about 1.8 times as long as articles 4-5 of peduncle combined, with 17 articles. Mandibles with medium palpar hump; right incisor with 3 teeth; left incisor with 3 teeth in 2 branches; right lacinia mobilis bifid, distal branch much shorter than

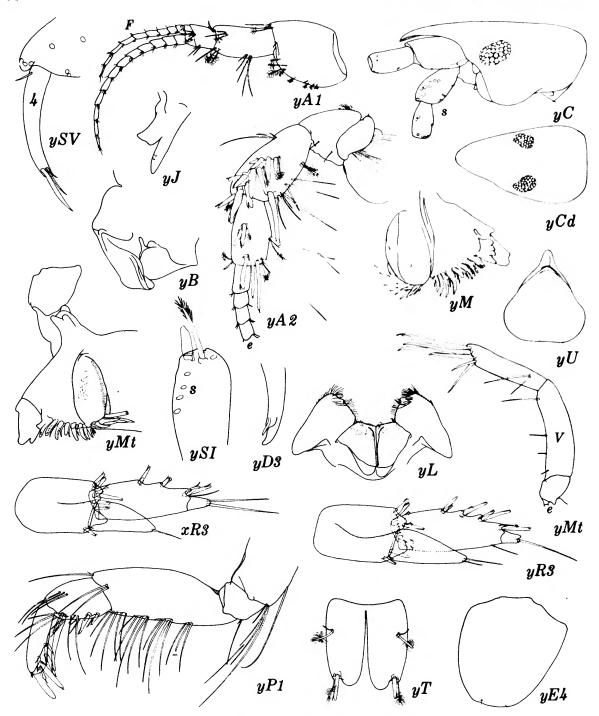


FIGURE 159.—Birubius kinkus, new species (x = juvenile "x," 6.0 mm; y = juvenile "y," 5.8 mm).

proximal, broad, almost subbifid, proximal branch simple, pointed, with marginal denticles; left lacinia mobilis with 4 teeth; right rakers 8; left rakers 8 plus one rudimentary; molar in form of elongate plaque, each molar with 8 primarily long spines, one short very weak spine strongly disjunct, each molar with plume; palp article 1 short, article 2 with one medium inner apical seta and 3 other shorter inner setae, article 3 about 0.9 times as long as article 2, oblique apex with 6 spine-setae, basofacial formula = 1-2 or 1-3. Inner plate of maxilla I ordinary, bearing one long apical pluseta, one shorter similar apicomedial seta, 2 apicolateral much shorter setae; palp article 2 with 4 apical medial marginal spines and 4 submarginal setae. Plates of maxilla 2 extending subequally, outer as broad as inner, outer with 4-5 apicolateral setae, inner with one medial seta. Inner plate of maxilliped with one large thick apical spine, 3 apicofacial setae, 4 medial setae; outer plate with 7 medial and apical spines, 2-3 apicolateral setae; palp article 1 with apicolateral seta, article 2 with 2 groups of 1-2 apicolateral setae, medial margin of article 2 moderately setose, article 3 protuberant, with 5 facial setae, 2 lateral setae, nail of article 4 long-medium, with 2 accessory setules, first of these 0.66 as long as primary nail. Coxa 1 strongly expanded distally, anterior margin almost straight; main ventral setae of coxae 1-4 = (7-8)-(7-8)7-0, posteriormost seta of coxae 1-3 slightly shortened; anterior and posterior margins of coxa 4 strongly divergent, posterior margin oblique, almost straight, posterodorsal corner rounded, posterodorsal margin short, ordinary, width-length ratio of $\cos 4 = 16:17$. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 3-5-5-(5-6), long anteriors = 4-(6-7)-0-0, short anteriors = 4-5-7-6, no others. Gnathopods ordinary; width ratios of articles 5-6 on gnathopods 1-2 = 22:31 and 22:33, length ratios = 73:60and 66:55; palmar humps ordinary, palms oblique; article 5 of gnathopod 1 elongate, ovate, posterior margin rounded-flat; article 5 of gnathopod 2 elongate, ovate, posterior margin rounded. Pereopods 1-2 similar; facial setae formula on article 4 = 3 and 3, on article 5 = 4 and 5; main spine of article 5 extending to M. 80-100 on article 6, article 5 with 3 and 2 proximoposterior spines; spine formula of article 6 = 3 + 5 or 4 + 5 plus middistal seta; acclivity on inner margin of dactyls of

pereopods 1-2 weak but produced, emergent setule short, midfacial pluseta ordinary. Coxae 5-7 posteroventral setule formula = 2-4-3. Articles 4-5 of pereopods 3-4 of ordinary width, facial spine rows moderately developed, facial ridge formula on article 2 of pereopods 3-5=0-2-2; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 45:47:43:18, of pereopod 4 = 73:45:34:15, of pereopod 5 =91:26:20:10, length ratios of pereopod 3 = 78: 33:44:50, of pereopod 4 = 96:58:45:54, of pereopod 5 = 124:33:30:32; article 2 of pereopod 5 reaching middle of article 5, one ventral setule elongate; medial apex of article 6 not combed, bearing 5 vestigial digital processes. Posteroventral corner of epimeron 1 rounded, posterior margin almost straight, corner with setule, anteroventral margin with 5-7 short setae, posteroventral face with 2-3 medium setae; posteroventral corner of epimeron 2 rounded, strongly protuberant, guarded by setule sinus, posterior margin almost straight, undulant, facial setae = 6-8 crowded, posteriormost pair set vertically; posteroventral corner of epimeron 3 weakly protuberant, with setule sinus above and 2 below corner, with small tooth, posterior margin weakly sinuous, with 1-2 setule notches and 2 long setae, ventral margin naked, face with horizontal row of 3-4 setae; epimeron 3 with small setule on posterodorsal margin set in weak notch. Urosomite 1 naked ventrally, articulation line short, almost absent; urosomite 3 protuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, outer ramus of uropod 1 with 5-8 dorsal spines, inner with 1-2, outer ramus of uropod 2 with 3-4 dorsal spines, inner with one dorsomedial spine; peduncle of uropod 1 with 5-6 apicolateral spines and 1-2 basofacial setae; medially with 5 marginal setae and spines, apicalmost an enlarged spine; peduncle of uropod 2 with 7-12 dorsal spines, medially with one small apical spine. Peduncle of uropod 3 with 6-7 ventral spines, dorsally with one lateral spine, one medial spine and setule; rami submasculine, inner extending to M. 85 on article 1 of outer ramus, apex with 2 setae, medial and lateral margins setose, article 2 of outer ramus short, 0.15, bearing 2 medium setae, medial margin of article I setose but not apically, lateral margin with 4 acclivities, spine formula = 2-2-2-2, setal formula = 0-1-1-1-1. Telson long, length-width ratio = 15:13, not fully cleft, each apex of medium width, rounded, lateral acclivity

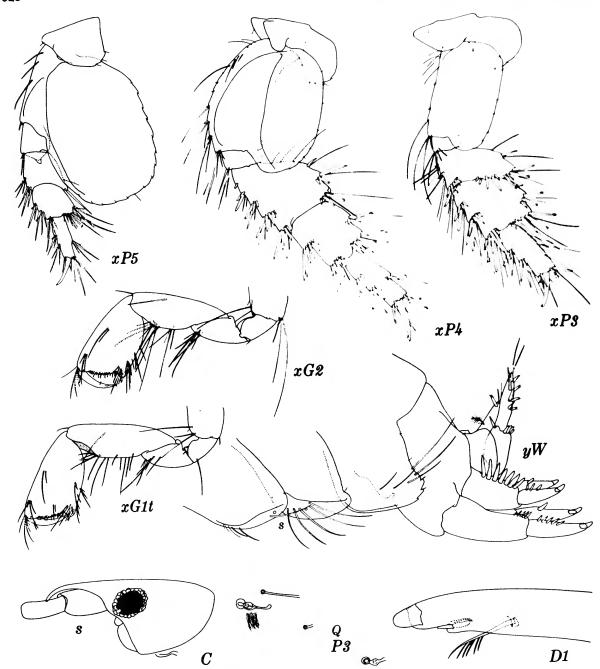


FIGURE 160.—Birubius kinkus, new species, holotype, female "a," 6.84 mm (x = juvenile "x," 6.0 mm; y = juvenile "y," 5.8 mm).

deep, narrow, bearing long lateral setule, spine next medial of length equal to setule, midlateral setules diverse. Cuticle with ordinary bulbar setules of varying sizes closely mixed with pipes, setules bearing apical halo, surface bearing extremely fine striations in form of linear fingerprint pattern, emergent setules especially short.

OBSERVATIONS.—Illustrations mainly taken from juvenile "x," 6.0 mm, noted below; eyes of adult female slightly enlarged as shown in illustration from holotype female "a"; uropod 3 of adults as in B. kokorus (25) but with differences noted in description above.

Juvenile "x," 6.0 mm, WPBES 51S/1: Eyes clear; head shorter than in adult; disjunct spine on left molar broken off (socket present), apparently absent on right molar; article 5 of pereopods 1-2 with 2 or 1 proximoposterior spines; main spine distally longer than in adult; article 5 on pereopod 4 slightly shorter than in adult; uropod 1 with only one basofacial seta (not shown on illustration).

Juvenile "y," 5.8 mm: Uropod 1 lacking basofacial seta.

ILLUSTRATIONS.—Eye on lateral view of head slightly shortened dorsoventrally because of ocular shrinkage (inward pulling of eyes); maxilla 1 like that of B. maamus (21), inner plate with 2 small, one medium, one large seta, outer plate with one thickened spine, palp with 4 spines and 4 setae; maxilla 2 like that of B. jirrandus (30) but lobes slightly broader and inner plate with only one medial seta; maxilliped like that of B. kokorus (25) but main spine on inner plate illustrated, outer plate with 2 lateral setae, face of palp article 3 with 4 setae in tandem, article 3 produced as in B. kokorus, lateral margin of article 3 with one seta, palp article 4 illustrated; coxae 1-3 ordinary, as in B. kokorus.

HOLOTYPE.—NMV, female "a," 6.84 mm.

TYPE-LOCALITY.—CPBS 51 S (resampled), 16 Feb 1972, Western Port, Victoria, Australia, 15.1 m, coarse sand, anchor in clay.

VOUCHER MATERIAL.—CPBS 51 S/1 (sample prior to 16 Feb 1972): juvenile "x," 6.00 mm (illus.); juvenile "y," 5.80 mm (illus.).

RELATIONSHIP.—Birubius kinkus differs from B. gambodeni (20) in the presence of strong posteroproximal spines on article 5 of pereopods 1-2 and in the elongation of article 5 on gnathopods 1-2. From B. maamus (21) to B. kyeemus (23), this species differs in the absence of one or more ventral setae on epimeron 3. From B. kokorus (25) B. kinkus differs in the presence of 2-3 posteroventral setae on epimeron 1 while having fewer setae on epimeron 3, in the more elongate article 5 of the gnathopods, and in the presence of only one spine on the iner ramus of uropod 1.

This species is placed in both keys, A and B. It is placed in Key A because the distal branch of the right lacinia mobilis is like that of B. gambodeni in being slightly thickened if not weakly subbifid.

MATERIAL.—CPBS, 4 samples from one station (9).

DISTRIBUTION.—Victoria, Western Port, 15 m, coarse sand on clay.

27. Birubius munggai, new species

FIGURES 161-163

Description of Female.—Head about 20 percent of total body length, greatest width about 55 percent of length; rostrum constricted, broad, reaching middle of article 2 on antenna 1. Eyes medium, largely occluded with pigment. Article I on peduncle of antenna 1 about 1.5 times as long as wide, about 1.7 times as wide as article 2, ventral margin with about 12 setules, weakly produced dorsal apex with 4 setules; article 2 about 0.7 times as long as article 1, with ventral crescent of 7 setae; primary flagellum, with 13 articles, about 1.15 times as long as peduncle, bearing short aesthetascs; accessory flagellum with 10 articles. Spine formula on article 4 of antenna 2 = 1-3-5-5, dorsal margin with notch bearing 3 setae, ventral margin with 3 groups of 2 long to medium setae, one ventrodistal long spine; article 5 about 0.65 times as long as article 4, facial spine formula = 1-4, dorsal margin bearing several setae, ventral margin with 2 sets of 2-3 long to short setae, one long distal spine next to first main facial spine; flagellum about 1.65 times as long as articles 4-5 of peduncle combined, with 14 articles. Mandibles with medium palpar hump; right incisor with 3 teeth; left incisor with 4 teeth in 2 branches; right lacinia mobilis bifid, distal branch much shorter than proximal, narrow, simple, proximal branch simple, pointed, with marginal denticles; left lacinia mobilis with 4 teeth; right rakers 9; left rakers 8 plus one rudimentary; molar in form of elon-

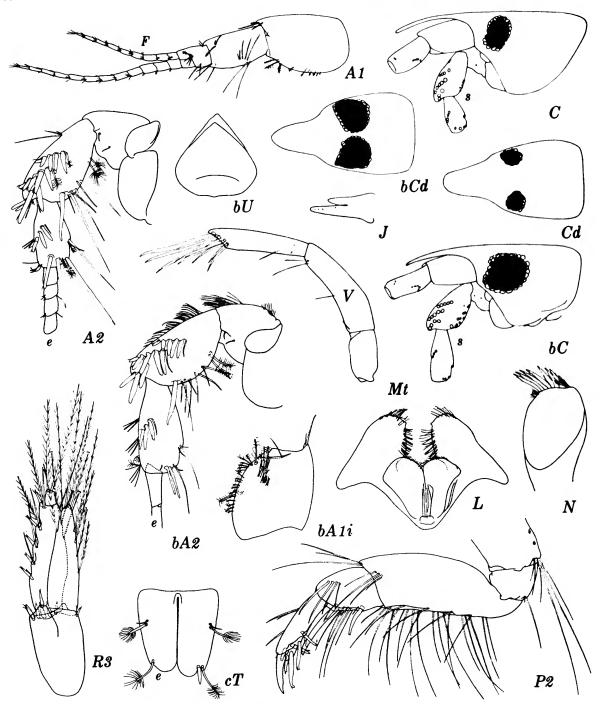


FIGURE 161.—Birubius munggai, new species, holotype, female "a," 6.40 mm (b = male "b," 5.30 mm; c = female "c," 5.40 mm).

gate plaque, each molar with 7 primarily long spines, none disjunct, each molar with plume; palp article 1 slightly elongate, article 2 with 2 medium inner apical setae and 2 other shorter inner setae, article 3 about as long as article 2, oblique apex with 8 spine-setae, basofacial formula = 0-1. Inner plate of maxilla 1 ordinary, bearing one long apical pluseta, one shorter similar apicomedial seta, 2 apicolateral much shorter setae; palp article 2 with 2 apicalmedial marginal spines and 4 submarginal setae. Plates of maxilla 2 extending subequally, outer scarcely broader than inner, outer with 4 apicolateral setae, inner with 2-3 medial setae. Inner plate of maxilliped with one large thick apical spine, 2 apicofacial setae, 5 medial setae, outer plate with 7 medial and apical spines, one apicolateral seta; palp article I with apicolateral seta, article 2 with one apicolateral seta, medial margin of article 2 strongly setose, article 3 protuberant, with 4 facial setae, 2 lateral setae, nail of article 4 long to medium, with 2 accessory setules, one of these 0.75 as long as nail. Coxa 1 strongly expanded distally, anterior margin straight; main ventral setae of coxae 1-4 = 6-6-6-0, posteriormost seta of coxae 1-2 shortest; anterior and posterior margins of coxa 4 divergent, posterior margin oblique, almost straight, posterodorsal corner rounded, posterodorsal margin short, ordinary, width-length ratio of coxa 4 = 15:17. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 3-3-4-5, long anteriors = 4-5-0-0, short anteriors = 7-7-6-9, no others. Gnathopods ordinary; width ratios of articles 5-6 on gnathopods 1-2 = 25:40 and 27:39, length ratios = 66:65 and 61:62; palmar humps ordinary, small, palms oblique; article 5 of gnathopod 1 elongate, ovate, posterior margin rounded-flat; article 5 of gnathopod 2 ovate, posterior margin rounded, weakly lobate. Pereopods 1-2 similar; facial setae formula on article 4 = 4 and 4, on article 5 = 4 and 4; main spine of article 5 extending to M. 80 on article 6, article 5 with one proximoposterior spine; spine formula of article 6 = 3 + 4 and 3 + 4 plus stiff middistal seta; acclivity on inner margin of dactyls of pereopods 1-2 weak, emergent setule short, midfacial pluseta ordinary. Coxae 5-7 posteroventral setule formula = 3-4-4. Articles 4-5 of pereopods 3-4 of ordinary width, facial spine rows moderately developed, facial ridge formula on article 2 of pereopods 3-5 = 0-2-2; width ratios of

articles 2, 4, 5, 6 of pereopod 3 = 47:43:40:17, of pereopod 4 = 74:46:34:14, of pereopod 5 =90:27:23:10, length ratios of pereopod 3 = 80: 37:45:48, of pereopod 4 = 98:56:40:55, of pereopod 5 = 128:33:31:36; article 2 of pereopod 5 reaching middle of article 5; medial apex of article 6 finely combed, bearing 4 vestigial digital processes. Posteroventral corner of epimeron 1 with small tooth, posterior margin weakly convex, corner with setule, anteroventral margin with 6 short setae, posteroventral face with one medium seta; posteroventral corner of epimeron 2 rounded, weakly protuberant, guarded by setule sinus, posterior margin weakly convex, undulant, facial setae = 6 crowded forward, posteriormost pair set vertically; posteroventral corner of epimeron 3 weakly protuberant, with setule sinus above and below small tooth bearing setule, posterior margin straight, with 2 setules on tooth, ventral margin naked, face with horizontal row of 3 setae and offset ventral seta, epimera 2-3 with tiny setule set in weak notch. Urosomite 1 with 2 ventral setules at base of uropod 1, articulation line complete; urosomite 3 protuberant dorsally. Rami of uropods 1-2 with articulate apical nails and weak accessory setule, outer ramus of uropod 1 with 7 dorsal spines, inner with one, outer ramus of uropod 2 with 5 dorsal spines, inner with one dorsomedial spine; peduncle of uropod 1 with 4 apicolateral spines, and one basofacial seta, medially with 6 marginal setae and spines, apicalmost an enlarged spine; peduncle of uropod 2 with 13 dorsal spines, medially with one small apical spine. Peduncle of uropod 3 with 6 ventral spines, dorsally with one lateral spine, one medial spine and setule; rami submasculine, inner extending to M. 100 on article 1 of outer ramus, apex with 3 setae, medial and lateral margins setose, article 2 of outer ramus short, 0.15, bearing 2 long setae, apicomedial margin of article 1 setose, lateral margin with 4 acclivities, spine formula = 2-1-1-1, setal formula = 0-1-1-2-2. Telson weakly elongate, lengthwidth ratio = 29:27, not fully cleft, each apex wide, rounded, lateral acclivity deep, narrow, bearing long lateral setule, spine next medial shorter than setule, midlateral setules diverse. Cuticle with ordinary bulbar setules, surface bearing fine striations in form of linear fingerprint pattern, emergent setules especially short.

DESCRIPTION OF MALE.—Article 2 of antenna 1

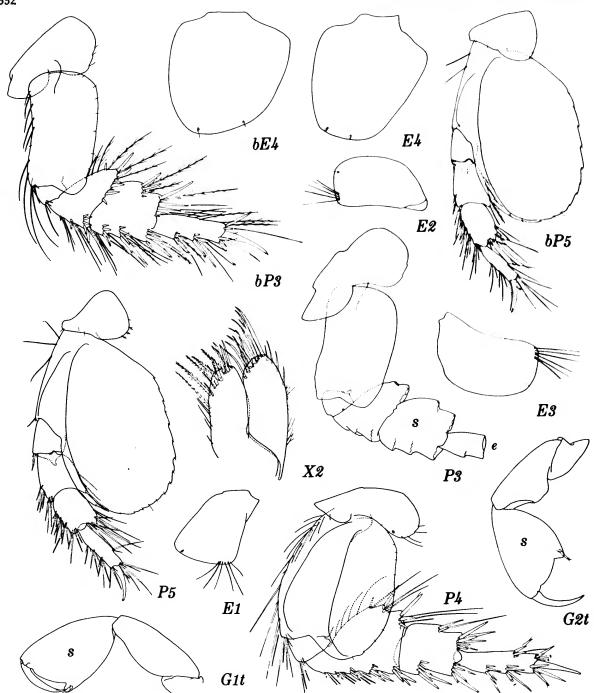


FIGURE 162.—Birubius munggai, new species, holotype, female "a," 6.40 mm (b = male "b," 5.30 mm).

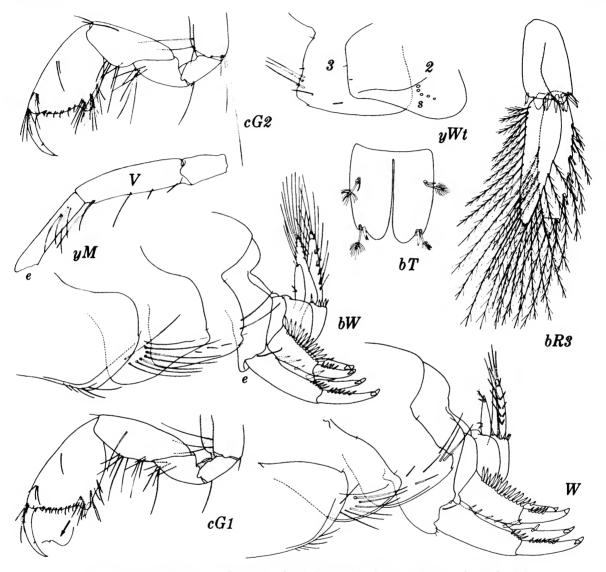


FIGURE 163.—Birubius munggai, new species, holotype, female "a," 6.40 mm (b = male "b," 5.30 mm; c = female "c," 5.40 mm; y = male "y," 5.50 mm).

with numerous ventral setules; primary flagellum with 13 articles, one calceolus each on articles 1-5; accessory flagellum with 11 articles. Facial spine formula on article 4 of antenna 2 = 3-5-5; article 5 with 3 dorsal sets of male setae and one calceolus, ventrodistal apex with 2 thin spines and one setule; flagellar formula = 31, 2, 3, 5, 7 . . . 29. Right lacinia mobilis with distal branch shorter than in female; left rakers 9 plus 1-2 rudimentaries; molars

with 6 spines; basofacial setae on palp article 3 = 2 + 2. Coxa 4 broadened but smaller in relation to coxa 1 than in female. Article 2 of pereopods 3-5 narrower than in female. Epimera 1-3 broadened, posterior margin of epimeron 3 not shortened, convex; setal formulas, epimeron 1 anteroventral = 5, posteroventral = 1, epimeron 2 facial = 6, epimeron 3 posterior = 2 long, facial = 3 setae, ventral = 0. Spine formulas of uropods, uropod 1

peduncle apicolateral = 5, basofacial = 1, uropod 2 peduncle dorsal = 13, dorsal spines on outer ramus of uropod 1 = 6, of uropod 2 = 5, inner ramus of uropod 1 = 1, of uropod 2 = 1, ventral spines on peduncle of uropod 3 = 6, spine formula on article 1 of outer ramus = 0-1-1-1-1-1, setal formula = 1-1-0-1-1-1-1. Telson weakly elongate, distal spines scarcely shortened.

OBSERVATIONS.—Female "c," 5.40 mm, and male "y," 5.50 mm, lacking basofacial seta on uropod 1. Telson of female "c" aberrant, one side lacking spine.

ILLUSTRATIONS.—Following parts resembling Birubius kokorus (25) except as specified in description: prebuccal parts, upper lip, mandibles, maxilla 1, maxilliped, dactyls of pereopods 1–2.

HOLOTYPE.—NMV, female "a," 6.40 mm.

Type-Locality.—PPBES 126, 9 Mar 1971, Port Phillip Bay, Victoria, Australia, 8 m, sand.

VOUCHER MATERIAL (all illustrated).—PPBES 986/5: male "b," 5.30 mm; female "c," 5.40 inm; male "y," 5.50 mm.

RELATIONSHIP.—This species is extremely close to and may be a phenotype of *Birubius kokorus* (25) but differs in the slightly elongate article 1 of the mandibular palp, the presence in adults of only one dorsal spine on the inner ramus of uropod 1 and in the female by the fewer ventral sets of setae on article 5 of antenna 2. *Birubius munggai* bears only one posteroproximal spine on article 5 of pereopods 1–2.

From B. kyeemus (23) and B. lowannus (22) this species differs in the elongate palp article 1 of the mandible and in the absence of the one ventral seta on epimeron 3 known for B. kyeemus and B. lowannus.

Birubius kinkus (26) differs from B. munggai in the shorter article 1 of the mandibular palp, the consistently more elongate wrists of the gnathopods, the more strongly setose epimeron 1, and the presence of more than one posteroproximal spine on article 5 of pereopods 1–2. Again, B. munggai may be a phenotype of either B. kokorus or B. kinkus but the elongation of mandibular palp article 1 occurs well into adulthood and is not found in the other two species.

MATERIAL.—CPBS, one sample (1); PPBES, 2 samples from 2 stations (5).

Distribution.—Victoria: Western Port and Port Phillip Bay, 4-13 m, sand, sandy gravel.

28. Birubius ularitus, new species

FIGURES 164-166

DESCRIPTION OF MALE (subadult).—Head about 21 percent of total body length, greatest width about 67 percent of length; rostrum unconstricted, broad, exceeding middle of article 2 on antenna 1. Eyes medium, clear of pigment core but deeply burgundy. Article 1 on peduncle of antenna 1 about 1.25 times as long as wide, about twice as wide as article 2, ventral margin with about 10 setules, weakly produced dorsal apex with 3 setules; article 2 about 0.7 times as long as article 1, with ventral cycle of 5 setae; primary flagellum with 11 articles, about 0.9 times as long as peduncle, bearing long aesthetascs; accessory flagellum with 8 articles. Spine formula on article 4 of antenna 2 = 1-3-4-4, dorsal margin with notch bearing 4 setae, ventral margin with 7 groups of 1-2 long to short setae, one ventrodistal long spine; article 5 almost 0.75 times as long as article 4, facial spine formula = 1-2-2, dorsal margin bearing one set of male setae, ventral margin with 4 sets of 2 long to short setae, 2 ventrodistal long to medium spines, one set facially; flagellum proliferate as young male. Mandibles with weak palpar hump; right incisor with 3 teeth; left incisor with 4 humps in 2 branches; right lacinia mobilis simple, denticulate; left lacinia mobilis with 4 teeth plus one accessory tooth; right rakers 8; left rakers 9 plus one rudimentary; molar in form of elongate bulbous hump, demarcated mainly by spines, right molar with 7 primarily long spines plus one setule, none disjunct, left molar with 7 primarily long spines, only left molar with plume; palp article 1 short, article 2 with one medium inner apical seta and 2 other shorter inner setae, article 3 about 1.25 times as long as article 2, oblique apex with 8-9 spine-setae, basofacial formula = 1-2 or 1-1. Inner plate of maxilla 1 large, thin, bearing one long apical pluseta, one shorter similar apicomedial seta, 2 apicolateral much shorter setae; palp article 2 with 4 apicalmedial marginal spines and 4 submarginal setae. Plates of maxilla 2 extending equally, of subequal width, outer with 3 apicolateral setae, inner with one medial seta. Inner plate of maxilliped with 2 large, thick apical spines, 2 apicofacial setae, 4 medial setae, outer plate with 10 medial and apical spines, 4 apicolateral setae; palp article I with apicolateral seta, article 2 with one apicolateral seta, medial

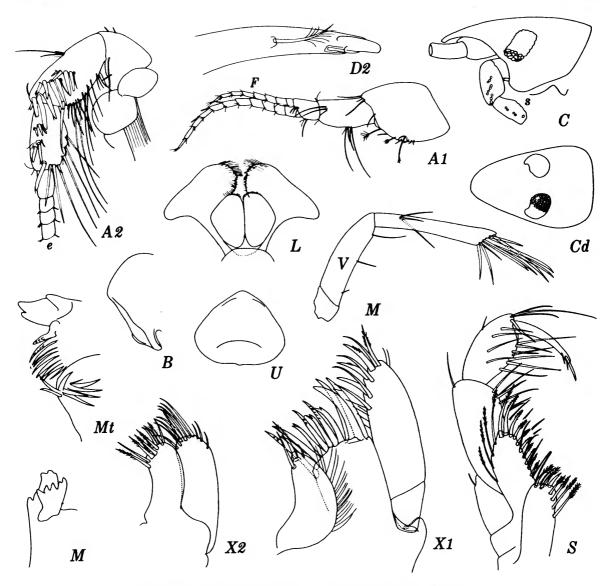


FIGURE 164.—Birubius ularitus, new species, holotype, male "y," 4.2 mm.

margin of article 2 weakly setose, article 3 with 4 facial setae, one lateral seta, nail of article 4 medium, with 2 accessory setules. Coxa 1 scarcely expanded distally, anterior margin almost straight; main ventral setae of coxae 1-4 = 8-7-6-11, posteriormost seta of coxae 1-4 shortened, penultimate seta especially stout on coxae 1-3; anterior and posterior margins of coxa 4 strongly divergent, posterior margin oblique, almost straight, postero-

dorsal corner sharp to rounded, posterodorsal margin short, weakly concave, width length ratio of $\cos 4 = 16:17$. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 2-2-4, long anteriors = 4(+ 1 facial)-6-0-0, short anteriors = 1-1-3-2, no others. Gnathopods ordinary; width ratios of articles 5-6 on gnathopods 1-2 = 24:33 and 26:34, length ratios = 60:60 and 55:57, palmar humps ordinary to large, palms strongly oblique;

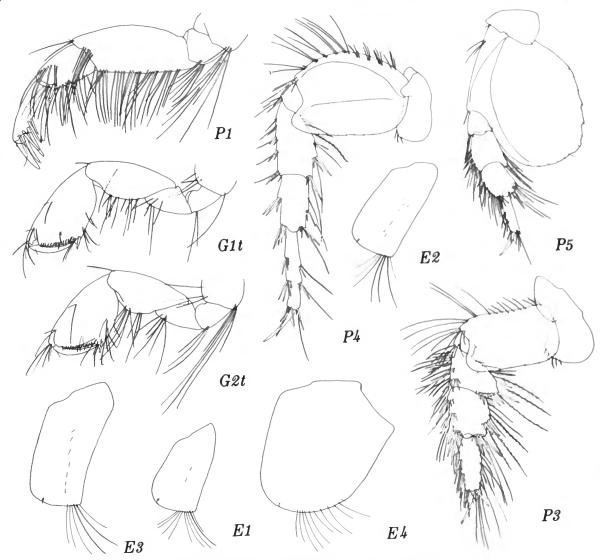


FIGURE 165.—Birubius ularitus, new species, holotype, male "y," 4.2 mm.

article 5 of gnathopod 1 weakly elongate, ovate, posterior margin rounded; article 5 of gnathopod 2 ovate, posterior margin rounded. Pereopods 1-2 similar; facial setae formula on article 4 = 6 and 6, on article 5 = 6 and 6; main spine of article 5 extending to M. 85 on article 6, article 6 lacking proximoposterior spines; spine formula of article 6 = 3 + 4 and 4 + 4 plus middistal seta; acclivity on inner margin of dactyls of pereopods 1-2 weak, emergent setule short, midfacial pluseta ordinary. Coxae 5-7 posteroventral setule formula = 5-3-1.

Articles 4-5 of pereopods 3-4 narrow to ordinary in width, facial spine rows moderately developed, facial ridge formula on article 2 of pereopods 3-5 = 0-2-2; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 37:32:27:14, of pereopod 4 = 55:26:20:10, of pereopod 5 = 76:20:18:6, length ratios of pereopod 3 = 63:30:33:36, of pereopod 4 = 80: 45:38:54, of pereopod 5 = 98:25:24:27; article 2 of pereopod 5 not reaching apex of article 4, with one ventral seta; medial apex of article 6 scarcely combed, bearing 5 digital processes. Postero-

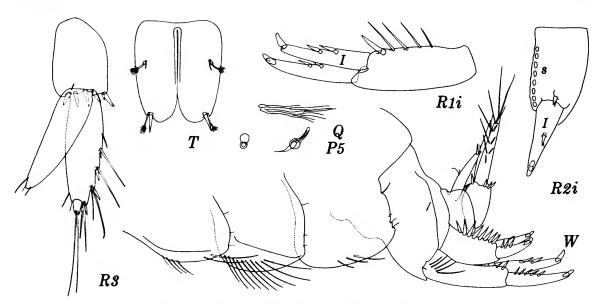


FIGURE 166.—Birubius ularitus, new species, holotype, male "y," 4.2 mm.

ventral corner of epimeron 1 weakly protuberant, posterior margin convex, with one setule, corner with setule, anteroventral margin with 4 medium setae, posteroventral face with 2 long setae; posteroventral corner of epimeron 2 weakly protuberant, with setule sinus, posterior margin convex, with one setule, facial setae = 10, posteriormost pair set vertically; posteroventral corner of epimeron 3 weakly protuberant, with setule sinus, with small tooth, posterior margin weakly convex, with 2 setule notches, mid ventral margin with 3 setae, epimera 1-3 with small seta on posterodorsal margin set in weak to strong notch. Urosomite 1 with lateral setule at base of uropod 1, articulation line almost complete; urosomite 3 weakly protuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, outer ramus of uropod 1 with 5 dorsal spines, inner with 2, outer ramus of uropod 2 with 3 dorsal spines, inner with one dorsomedial spine; peduncle of uropod 1 with 2 apicolateral spines and 5 basofacial setae, medially with 4 thin marginal spines plus apical enlarged spine; peduncle of uropod 2 with 8 dorsal spines, medially with one small apical spine, peduncle of uropod 3 with 4 ventral spines, dorsally with 2 lateral spines or spine and setule, one medial setule; rami submasculine, inner extending to M. 95 on article 1 of outer ramus, apex with 2 short setae, medial margin with one seta,

article 2 of outer ramus short, 0.13, bearing 2 long setae, apicomedial margin of article 1 with 2 setae, lateral margin with 4 acclivities, spine formula = 1-1-1-1-1, setal formula = 0-1-1-2-2. Telson long, length-width ratio = 13:11, not fully cleft, each apex wide, rounded, lateral acclivity broad, shallow, bearing ordinary lateral setule, spine next medial of length equal to setule, midlateral setules diverse. Cuticle with bulbar setules of varying sizes mixed with pipes, surface bearing fine striations in form of linear fingerprint pattern, emergent setules ordinary.

ILLUSTRATION.—Uropod 3 forming composite of right and left members to show maximum number of setae and spines in each position.

HOLOTYPE.—NMV, young male "y," 4.2 mm. Unique.

Type-Locality.—CPBS A2/3, 15 Jul 1964, Western Port, Victoria, Australia, 13.5 m, sediment unknown.

RELATIONSHIP.—This species and B. eleebanus (29) may be distinct generically from Birubius. Pereopod 4 is very thin and the right lacinia mobilis may actually be totally absent so that what appears to be the right lacinia mobilis is really the first raker spine slightly modified; the odd base of the spine suggests this interpretation. This possibility should be studied embryologically. The thin

pereopod 4, however, is matched in other species of Birubius such as B. mayamayi (11).

In other respects this species is almost identical to B. mayamayi but differs in the simple right lacinia mobilis. Pereopod 5 bears one ventral seta on article 2 thereby suggesting relationship to B. karobrani (14) but again the simple right lacinia mobilis distinguishes B. ularitus. The similarities of B. ularitus to Cunmurra itickerus are striking. Birubius ularitus might form the ancestral condition for B. wulgaru (37). The only species with simple right lacinia mobilis to which B. ularitus bears comparison is B. eleebanus; the latter lacks the extra serrations on epimeron 3 and has a more complex cuticle.

MATERIAL.—CPBS, one sample (1). DISTRIBUTION.—Victoria, Western Port, 13.5 m.

29. Birubius eleebanus, new species

FIGURES 167-170

Description of Female.—Head about 19 percent of total body length, greatest width about 75 percent of length; rostrum slightly constricted, short, reaching apex of article 1 on antenna 1. Eyes medium, clear of pigment, ommatidia especially large. Article 1 on peduncle of antenna 1 about 1.3 times as long as wide, about 2.1 times as wide as article 2, ventral margin with about 8 setules, unproduced dorsal apex with 4 setules; article 2 about 0.9 times as long as article 1, with apicoventral cycle of 4-5 setae; primary flagellum with 8 articles, about 0.87 times as long as peduncle, bearing aesthetascs; accessory flagellum with 5-6 articles. Spine formula on article 4 of antenna 2 = 1-3-4-4, dorsal margin bearing 2 setae, ventral margin with 4 groups of 1-2 long to medium setae. one ventrodistal long spine; article 5 about 0.9 times as long as article 4, facial spine formula = 1-2-2, dorsal margin naked, ventral margin with 3 sets of 1-2 long to medium setae, 2 ventrodistal medium spines; flagellum about 1.15 times as long as articles 4-5 of peduncle combined, with 8-9 articles. Mandibles with weak palpar hump; right incisor with 3 teeth and notch; left incisor with 4 humps in 2 branches; right lacinia mobilis simple. denticulate; left lacinia mobilis with 4 teeth, middle teeth shortened; right rakers 8 plus one rudimentary; left rakers 8; molar in form of elongate

plaque, molars with 8-9 primarily long spines, none disjunct, each molar with plume; palp article I slightly elongate, article 2 with one long inner apical seta and 2 other short inner setae, article 3 about 1.1 times as long as article 2, oblique apex with 6 spine-setae, basofacial formula = 1-1. Inner plate of maxilla 1 large, bearing one long apical pluseta, one shorter apicomedial seta, 2 apicolateral much shorter setae; palp article 2 with 2 apicalmedial marginal spines and 4 submarginal setae. Plates of maxilla 2 extending equally, inner slightly broader than outer, outer with 3 apicolateral setae, inner with 2 medial setae. Inner plate of maxilliped with 2 large, thick apical spines, 2 apicofacial setae, 3 medial setae; outer plate with 6 medial and apical spines, 2 apicolateral setae; palp articles 1-2 with apicolateral seta, medial margin of article 2 weakly setose, article 3 unprotuberant with 3 facial setae, no lateral setae, nail of article 4 medium, with 2 accessory setules. Coxa 1 strongly expanded distally, anterior margin weakly convex; main ventral setae of coxae 1-4 = (7-12)-(8-10)-(9-11)-(3-5), posteriormost seta of coxae 1-3 shortened, one middle seta especially stout; anterior and posterior margins of coxa 4 strongly divergent, posterior margin very oblique, almost straight, posterodorsal corner rounded, posterodorsal margin short, undulant, width-length ratio of coxa 4 = 1:1. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 2-3-2-4, long anteriors = 3-6-0-0, short anteriors = 1-1-2-2, no others. Gnathopods with elongate wrists and broad hands; width ratios of articles 5-6 on gnathopods 1-2 = 23:40 and 25:40, length ratios = 74:65 and 65:62; palmar humps large, palms weakly oblique; article 5 of gnathopods 1-2 elongate, ovate, posterior margin rounded. Pereopods 1-2 similar, facial setae formula on article 4 = 4 and 6, on article 5 = 4 and 5; main spine of article 5 extending to M. 85 on article 6, article 5 lacking proximoposterior spines; spine formula of article 6 = 3 + 4 plus middistal seta; acclivity on inner margin of dactyls of pereopods 1-2 weak, sharp, produced as tooth, emergent setule long, midfacial pluseta very long. Coxae 5-7 posteroventral setule formula = 5-3-5. Articles 4-5 of pereopods 3-4 of ordinary width, facial spine rows sparse, facial ridge formula on article 2 of pereopods 3-5 = 1-2-2; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 41:36:36:20, of pereopod 4 = 60:36:31:12, of pereopod 5 = 78:23:22:9, length ratios of pereopod

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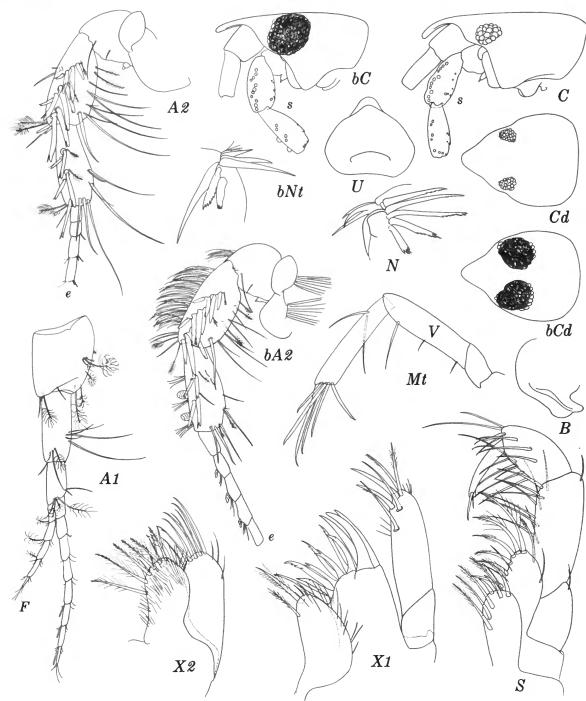


FIGURE 167.—Birubius eleebanus, new species, holotype, female "a," 3.86 mm (b = male "b," 3.57 mm).

3 = 66:33:37:9, of pereopod 4 = 80:52:42:53, of pereopod 5 = 98:25:26:26; article 2 of pereopod 5 reaching apex of article 4; medial apex of article 6 finely combed, bearing obsolescent digital processes. Posteroventral corner of epimeron 1 weakly and sharply protuberant, posterior margin almost straight, anteroventral margin with 1-2 long setae, posteroventral face with one long seta; posteroventral corner of epimeron 2 weakly protuberant, posterior margin convex, facial setae = 6; posteroventral corner of epimeron 3 weakly protuberant, with setule sinus, with small tooth, posterior margin weakly convex, with one large to small dorsal seta, ventral submargin with 4-5 setae mainly in middle of margin. Urosomite 1 naked, articulation line almost complete; urosomite 3 weakly protuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, outer ramus of uropod 1 with 3 dorsal spines, inner with one, outer ramus of uropod 2 with 1-2 dorsal spines, inner shortened, with one dorsomedial spine; peduncle of uropod 1 with 2 apicolateral spines and 2-4 basofacial setae, medially with 5 marginal setae and spines, apicalmost an ordinary spine; peduncle of uropod 2 with 3-4 dorsal spines, medially with one apical spine. Peduncle of uropod 3 with no ventral spines or one setule only, dorsally with one lateral spine, one medial spine and one setule; rami feminine, inner extending to M. 40 on article 1 of outer ramus, apex with one seta, medial and lateral margins naked, article 2 of outer ramus short, 0.17, bearing 2 long setae, apicomedial margin of article 1 naked, lateral margin with 2-3 acclivities, spine formula = 0, setal formula = 1-2-2-2 or 1-2-2. Telson short, length-width ratio = 5:6, not fully cleft, each apex wide, rounded, subtruncate, lateral acclivity broad, shallow, bearing long lateral setule, spine next medial much shorter than setule, midlateral setules diverse. Cuticle with occasional bulbar setule set on edge of coronate plaque in midst of patches of dense polygonal structure formed of fused scales, surface otherwise covered with flat scales, many with central points, emergent setules especially long and branched.

OBSERVATIONS (subadult females).—Midapex of article 6 on pereopod 5 lacking comb in subadults.

Description of Male.—Rostrum smaller than in female. Eyes largely occluded with pigment. Article 2 of antenna 1 with 4 ventral setae; primary flagellum with 8 articles, one calceolus each on articles

1-3 or 1-6, aesthetascs strongly developed; accessory flagellum with 5 articles. Facial spine formula on article 4 of antenna 2 = 0-3-4-4, on article 5 = 2-2, dorsodistal spine of female absent, article 5 with 3 dorsal sets of male setae and 2 calceoli, ventrodistal apex with 2 thin spines; flagellar formula = 21, 2-4, 6, 8...20. Right rakers 7; left rakers 7 plus one rudimentary; right molar with 6 spines and plume, one of these spines short but not disjunct, left molar with 7 spines, one of these short and highly disjunct; basofacial setal formula of article 3 on mandibular palp = 1-2, terminal = 7-8. Palp of maxilla 1 with 3 spines and 4 setae. Inner plate of maxilla 2 with one medial seta, outer plate with 3 apicolateral seate. Coxa 4 shaped as in female but slightly larger in relation to coxa 1; ventral setal formula of coxae 1-4 = 9-8-(7-8)-2. Long posterior setae on article 2 of guathopods 1-2 and percopods 1-2 = 2-2-1-3, long anteriors = 3-5-0-0, short anteriors = 1-1-1-1, no others. Article 6 of gnathopods 1-2 slightly larger relative to article 5 than in female. Facial and setal spine formulas of pereopods 1-2 on article 4 = 4 and 4, on article 5 = 5 and 5, on article 6 = 3 + 4 plus middistal seta. Article 2 of pereopods 3-5 narrower than in female, article 5 of pereopod 5 with special spine. Epimera 1-3 broadened, posterior margin of epimeron 3 shortened; setal formulas, epimeron 1 anteroventral = 6, posteroventral = 1, posterior = 1 + 1, epimeron 2 facial = 6 + 1 (aberrant), posterior = 1 + 1, epimeron 3 posterior = 1 + 1, facial = 6. Spine formulas of uropods, uropod 1 peduncle apicolateral = 2, basofacial = 5, uropod 2 peduncle dorsal = 7, dorsal spines on outer ramus of uropod 1 = 4, of uropod 2 = 2, inner ramus of uropod 1 = 1, of uropod 2 = 1. Urosomite 1 with ventral seta. Ventral spines on peduncle of uropod 3 = 0, spine formula on article 1 of outer ramus = 1-l-l-l-l-l, long setal formula = l-l-l-l-l-ll-1, short setal formula = 0-0-1-1-1-1-1. Telson elongate, distal spines shortened. Scales of cuticle as dense as on female but more evenly concentrated, polygons present but not as strongly, outlined, bare coronate plaques poorly developed.

ILLUSTRATION.—Female coxa 5 with one setule missing.

HOLOTYPE.—The figures herein presented of female "a," 3.86 mm. (Holotype designated as figures because of possible confoundment of holotype specimen; senior author accidentally mixed together

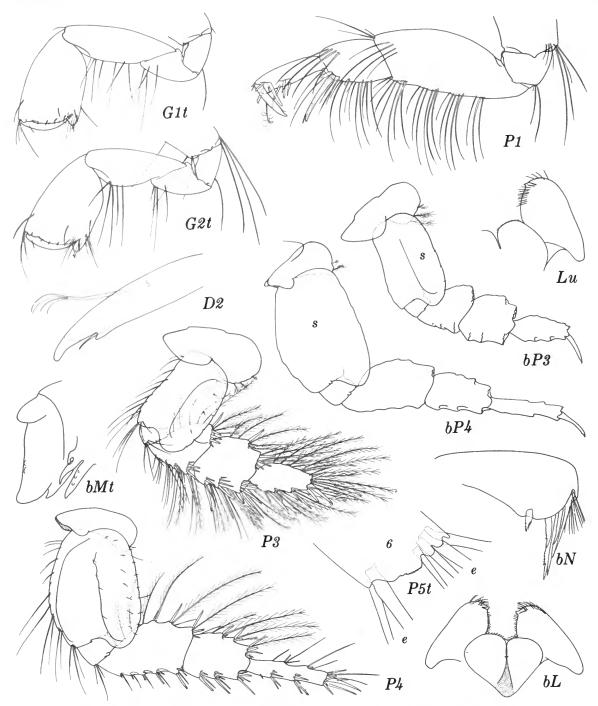


FIGURE 168.—Birubius eleebanus, new species, holotype, female "a," 3.86 mm (b = male "b," 3.57 mm).

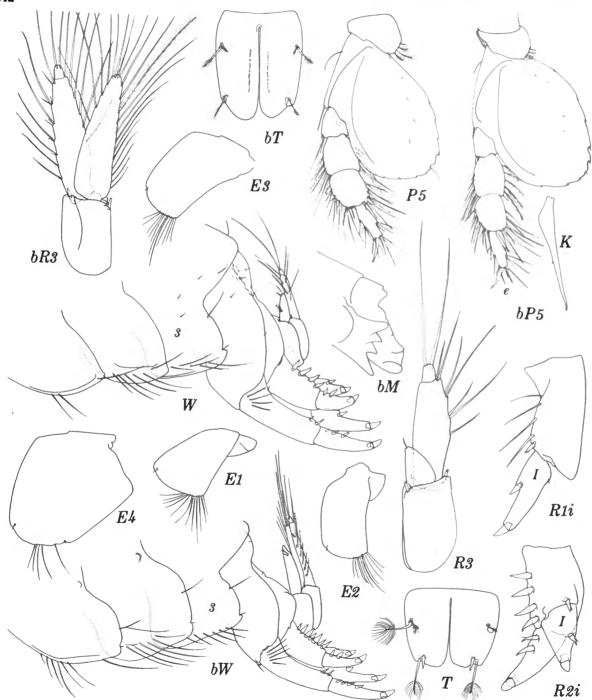


FIGURE 169.—Birubius eleebanus, new species, holotype, female "a," 3.86 mm (b = male "b" 3.57 mm).

parts of this holotype plus holotype of *B. lorus* (2); in process of segregating these parts telson of this species lost; one lower lip and one maxilla 2 of this species possibly mixed in with parts of *B. lorus*.)

TYPE-LOCALITY.—SBS D2S2, 17 May 1972, off Malabar, New South Wales, Australia, 40 m, coarse sand.

VOUCHER MATERIAL.—SBS 4, male "b," 3.57 mm (illus.); SBS A2S3, female "c," 3.22; SBS D2S1, female "d," 3.60 mm.

RELATIONSHIP.—This species differs from B. ularitus (28), for which only the male is known, in the shorter and slightly narrowed rostrum, in the presence of only one notch posteroventally on epimeron 3, the much stouter and fewer spines on male uropod 2, and in the complex cuticle.

Possible affinities of these two species may lie with the B. babaneekus group (16–18) owing to the setose coxa 4 but B. ularitus and B. eleebanus have fully simple and aberrant (see B. ularitus) right lacinia mobili, small tooth on epimeron 3 and the presence of a fully dorsoposterior setule on epimeron 3, itself suggesting affinity with B. narus (19), a satellite member of the B. babaneekus group which also has a large tooth on epimeron 3.

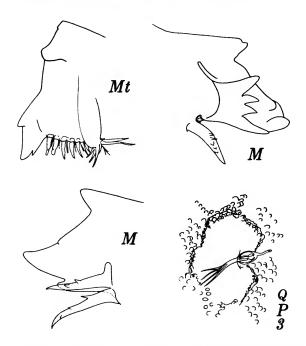


FIGURE 170.—Birubius eleebanus, new species, holotype, female "a," 3.86 mm.

This species is one of those with numerous weblike interrelationships. It may be a close sibling of B. chintoo (13), of which only the male is known. The resemblance is especially close in shape and general setation of epimera 1-3, coxa 4, mandibular molar, telson, uropods 1-2 and gnathopods. Birubius eleebanus differs from B. chintoo in the simple right lacinia mobilis, broader and shorter head, extra spines on article 5 of antenna 2, presence of an anterior ridge on article 2 of pereopod 4, the presence of a long dorsoposterior seta on epimeron 3 while simultaneously having fewer setae on epimera 1-2, and a greater number of setae on epimeron 3. All but one of these characters might be dismissed if B. chintoo were a supermale, because in terminal males there is a tendency for reduction of epimeron 3 setae and reduction of spines on antenna 2 and there may be sexual differences in facial ridges on pereopods. The crucial distinction remains the simple right lacinia mobilis of B. eleebanus, confirmed in the male.

A more distant relationship is seen to B. gallangus (10), B. lorus (2) and B. nammuldus (3), all of which have accessory nails on uropod 1 and a normal right lacinia mobilis. Birubius karobrani (14) has ventral setae on pereopod 5 among other distinctions. The long posterodorsal seta on epimeron 3 of B. eleebanus is reminiscent of this condition in the B. mayamayi (11)—B. karobrani group but it is more ventrally placed in B. eleebanus than in the other species. Basically, B. eleebanus could be termed a member of the B. mayamayi (11) group in which the right lacinia mobilis has been reduced to simplicity. See "Remarks" under Parharpinia villosa.

MATERIAL.—SBS, 4 samples from 3 stations (4). DISTRIBUTION.—New South Wales, off Malabar, 48-49 m, fine sand.

30. Birubius jirrandus, new species

FIGURES 171-175

DESCRIPTION OF FEMALE.—Head about 20 percent of total body length, greatest width about 60 percent of length; rostrum weakly constricted, reaching middle of article 2 on antenna 1. Eyes medium, clear of pigment. Article 1 on peduncle of antenna 1 about 1.5 times as long as wide, about 2.3 times as wide as article 2, ventral margin with 9–13

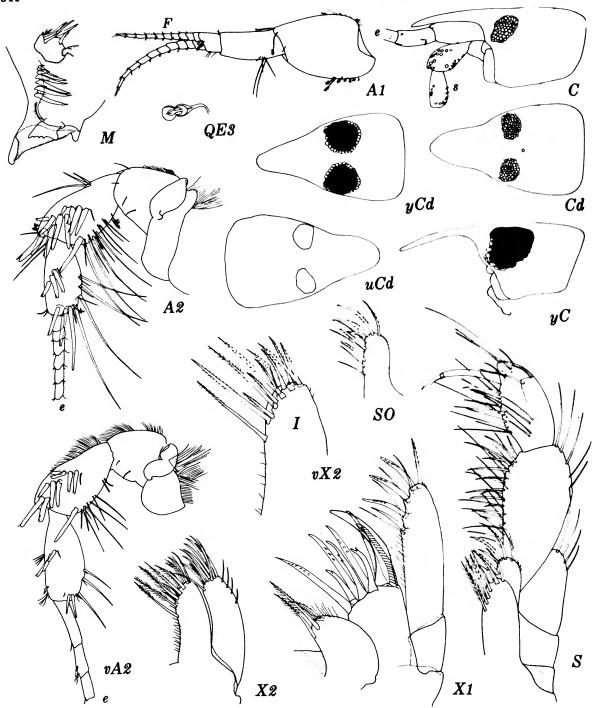


FIGURE 171.—Birubius jirrandus, new species, holotype, female "a," 9.8 mm (u = female "u," 9.00 mm; v = male "v," 8.7 mm; y = male "y," 8.1 mm).

setules, weakly produced dorsal apex with 3 setules; article 2 about 0.65 times as long as article 1, with proximoventral cycle of 5-7 setae; primary flagellum with 10-11 articles, about 0.6 times as long as peduncle, bearing aesthetascs; accessory flagellum with 9-10 articles. Spine formula on article 4 of antenna 2 = 1-3-4-4 or 1-3-3-4, dorsal margin with notch bearing 3 setae and spines, ventral margin with 6 groups of 1-3 long to medium setae, one ventrodistal medium spine; article 5 about 0.9 times as long as article 4, facial spine formula = 1-3 or 1-4, dorsal margin naked, ventral margin with 4-5 sets of 1-2 long to short setae, 2 ventrodistal long to medium spines; flagellum about 1.3 times as long as articles 4-5 of peduncle combined, with 12-14 articles. Mandibles with weak to medium palpar hump; right incisor with 2 teeth; left incisor with 2 humps in 2 branches; right lacinia mobilis simple, short; left lacinia mobilis with 5 teeth plus one accessory tooth; right and left rakers 6-8 plus 1-2 rudimentaries; molar in form of short protrusion demarcated mainly by spines, right molar with 5-6 primarily long spines plus one spine strongly disjunct, left molar with 5 primarily long spines plus one spine strongly disjunct, each molar with plume; palp article 1 short, article 2 with 2-3 medium inner apical setae and 2-3 other shorter inner setae, article 3 almost 0.95 times as long as article 2, oblique apex with 8-9 spine-setae, basofacial formula = 0-1 or 0-2. Inner plate of maxilla 1 large, bearing one long apical pluseta, one shorter similar apicomedial seta, 2 apicolateral much shorter setae; palp article 2 with 4 apicalmedial marginal spines and 4-6 submarginal setae. Plates of maxilla 2 extending equally, slender, outer not broader than inner, with 4 apicolateral setae, inner with 2 medial setae. Inner plate of maxilliped with one large thick apical spine, 2 apicofacial setae, 4 medial setae; outer plate short, with 4-6 medial and apical spines, one apicolateral seta; palp article 1 with 4 apicolateral setae, article 2 with 4-5 apicolateral setae, medial margin of article 2 strongly setose, article 3 protuberant, with 4 proximal facial setae, 2 apicolateral facial setae, nail of article 4 medium, with 2 accessory setules. Coxa 1 strongly expanded distally, anterior margin straight; main ventral setae of coxae 1-4 = 8-9-10-0, posteriormost seta of coxae 1-3 elongate; anterior and posterior margins of coxa 4 strongly divergent, posterior margin very oblique,

convex, posterodorsal corner rounded, posterodorsal margin short, undulant, width-length ratio of coxa 4 = 15:16. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = (1-4)-(6-7)(4-5)-6, and 3 long facials on gnathopod 1, long anteriors = 7-19-0-0, short anteriors = 2-1-2-2. Gnathopods generally ordinary but hands thin; width ratios of articles 5-6 on gnathopods 1-2 = 29:33 and 28:34, length ratios = 70:66 and 63:62; palmar humps ordinary, palms oblique; article 5 of gnathopod l elongate, ovate, posterior margin flat; article 5 of gnathopod 2 ovate, posterior margin shorter, flat, produced. Pereopods 1-2 similar; facial setae formula on article 4 = 4 and 4, on article 5 = 5 and 5; main spine of article 5 extending to M. 80 on article 6, article 5 with 2 proximoposterior spines; spine formula of article 6 = 4 + 4 plus middistal seta; acclivity on inner margin of dactyls of pereopods 1-2 weak, emergent setule long, midfacial pluseta ordinary. Coxae 5-7 posteroventral setule formula = (8-9)-4-4. Articles 4-5 of pereopods 3-4 broad to ordinary, facial spine rows moderately to well developed, facial ridge formula on article 2 of pereopods 3-5 = 0-2-2, anterior ridge on pereopod 5 short; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 37:41:35:17, of pereopod 4 = 60:37:27:14, of pereopod 5 = 70: 25:22:8, length ratios of pereopod 3 = 66:28:32: 35, of pereopod 4 = 75:41:44:55, of pereopod 5 =87:27:25:27; article 2 of pereopod 5 almost reaching apex of article 4; medial apex of article 6 not finely combed, bearing 6 digital processes. Posteroventral corner of epimeron l weakly protuberant, corner with 1-2 setules, anteroventral margin and face with 5-8 medium setae, posteroventral face with 3-4 long setae, posteriormost pair occasionally subvertical; posteroventral corner of epimeron 2 weakly protuberant, with small blunt sinuous tooth guarded by setule sinus, posterior margin weakly sinuous, with or without setule, facial setae = 9-11 crowded forward, posteriormost pair set vertically; posteroventral corner of epimeron 3 weakly protuberant, with setule sinus and small tooth, posterior margin almost straight, with 4-6 upthrust setae, with 1-2 setule notches, ventral margin with 2-6 setae, mainly posterior; epimera 1-3 with setule on posterodorsal margin, (missing on illustration of epimeron 1). Urosomite 1 setose ventrally at base of uropod l, articulation line incomplete, almost absent in full adults, stronger in

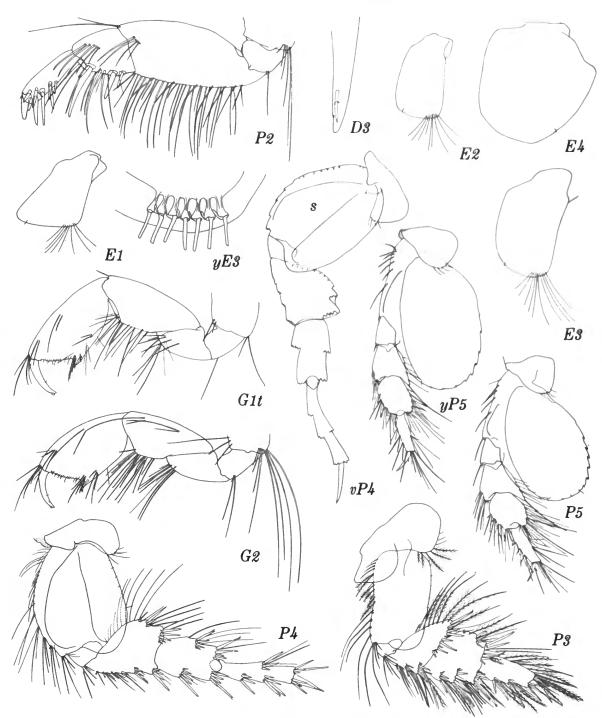


FIGURE 172.—Birubius jirrandus, new species, holotype, female "a," 9.8 mm (v = male "v," 8.7 mm; y = male "y," 8.1 mm).

subadults; urosomite 3 protuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, outer ramus of uropod 1 with 5 dorsal spines, inner with one, outer ramus of uropod 2 with 3-4 dorsal spines, inner with one dorsomedial spine; peduncle of uropod 1 with 3-4 apicolateral spines, and 7-9 basofacial setae, medially with 6 marginal spines, apicalmost enlarged; peduncle of uropod 2 with 8-10 dorsal spines, medially with one small apical spine. Peduncle of uropod 3 with 5-6 ventral spines, dorsally with 1-2 lateral spines, one medial spine and occasional setule; rami submasculine, inner extending to M. 80-90 on article 1 of outer ramus, apex with 2-3 setae, medial and lateral margins setose, article 2 of outer ramus short, 0.14, bearing 2 long setae, apicomedial margin of article 1 setose, lateral margin with 4-5 acclivities, spine forumla = (1)-1-1-1-1, setal formula = 0-1-1-1-(1-2)-2. Telson weakly elongate, length-width ratio = 24:23, not fully cleft, each apex wide, rounded, lateral acclivity broad, shallow, bearing ordinary lateral setule, spine next medial shorter than setule, midlateral setules diverse. Cuticle with sparse bulbar setules, emergent setules especially short.

OBSERVATIONS (female).—Article 3 of antenna 2 with short fuzzy crest reminiscent of male. Outer plate of maxilla 1 with 9 spines.

DESCRIPTION OF MALE.—Rostrum slightly narrower than in female. Primary flagellum of antenna 1 with 11-12 articles, one calceolus each on articles 2-6, accessory flagellum with 9 articles. Facial spine formula on article 4 of antenna 2 = 3-4-4 or 2-3-4, on article 5 = 3, article 5 with 2 dorsal sets of male setae and one calceolus, ventrodistal apex with 2 thin spines and one setule; flagellar formula = 28, 1, 2, 4, 6 . . . 26 or 2, 4, 6 Basofacial setal formula of article 3 on mandibular palp = 2-1 (same face), article 2 with group of 3-4 inner apical setae plus proximal setae. Palp of maxilla 1 with 3 spines and 4 setae. Outer plate of maxilliped elongate; palp articles 1-2 with fewer lateral setae than in female. Coxa 4 broadened but smaller in relation to coxa 1 than in female; ventral setae of coxae 1-4 = fewer than in female and deeply inserted. Article 2 of pereopods 3-5 narrower than in female, articles 5-6 of pereopod 4 more attenuate than in female. Epimera 1-3 broadened, posterior margin of epimeron 3 slightly shortened; setal formulas, epimeron 1 anteroventral = 7-9, posteroventral = 2-3, epimeron 2 facial = 7-8, epimeron 3 posterior = 4,

ventral = 2-3. Articulation lines of urosome strong, posteroventral setae of urosomite 1 much shorter than in female. Spine formulas of uropods, uropod 1 peduncle apicolateral = 3, basofacial = 7-8, uropod 2 peduncle dorsal = 9-12, dorsal spines on outer ramus of uropod 1 = 3-4, of uropod 2 = 3-4, inner ramus of uropod 1 = 1, of uropod 2 = 1 vestigial or 0. Ventral spines on peduncle of uropod 3 = 5; spine formula on article 1 of outer ramus = 1-1-1-1-1-1, setal formula = 1-1-1-1-1-1. Telson elongate, distal spines shortened.

OBSERVATIONS (male).—Male of Western Australia, WAM 414-73, male "h": Right lacinia mobilis free as in typical B. jirrandus; molar lacking disjunct spine. Spine formula on article 4 of antenna 2 = 1-4-3. Nail on dactyl of maxilliped 50 percent as long as article 4. Gnathopods slightly stouter than in typical material (see illustrations of outlines), poorly setose. Setal and spine formulas on pereopods 1-2, article 4 = 3 and 2, article 5 = 4and 4; article 6 = 3 + 3 plus middistal seta; article 5 of pereopod 1 lacking posteroproximal stout spine, of pereopod 2 with one stout spine, dactyls elongate, with faint inner acclivity bearing emergent setule. Pereopods 3-5 with articles generally thinner than in typical specimens (see illustrations of outlines); anterior and posterior facial ridges on pereopod 5 joined together, anterior ridge thus elongate somewhat in resemblance of condition in typical Birubius batei? (24). Epimeron 1 with 5-6 anteroventral setae, 2-3 posterofacial setae; epimeron 2 with 8 horizontal setae, none thrust dorsally; epimeron 3 with 6 posterior setae, 2 fully ventral setal spines. Peduncle of uropod 1 with 4 basofacial setae, 3 apicolateral spines, outer ramus with 2 dorsal spines, inner with one; peduncle of uropod 2 with 10 spines, outer ramus with 2, inner with one. Lateral margin of article 1 on outer ramus of uropod 3 with spine formula of 1-1-2-2-2, setae = 1-1-1-1-1.

This male has the typical right lacinia mobilis of Birubius jirrandus but differs from that species in the elongate anterior ridge on pereopod 5, the absence of a disjunct spine on the mandibular molar, the elongate maxillipedal nail and the doubled spines on the outer ramus of uropod 3. This male merges to a large extent with Western Australian males of B. batei?.

Male "m": Substantially like male "h" but right mandibular molar with small disjunct spine (left

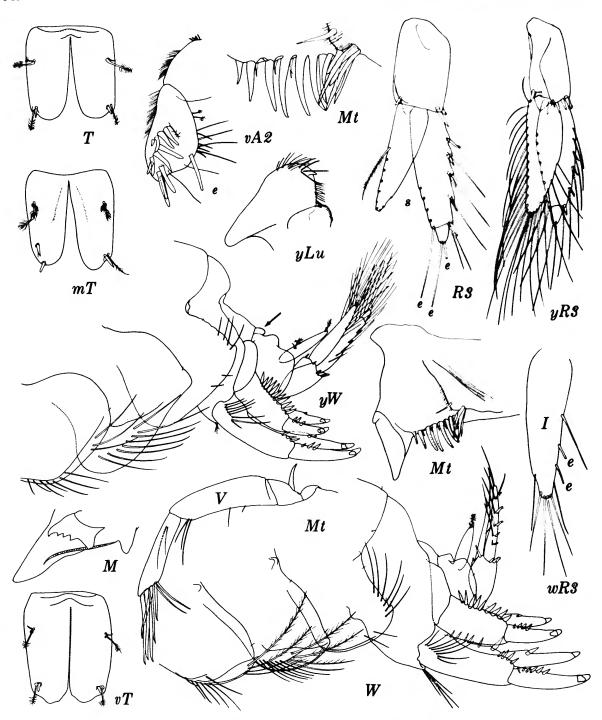


FIGURE 173.—Birubius jirrandus, new species, holotype, female "a," 9.8 mm (m = male "m," 4.01 mm; v = male "v," 8.7 mm; w = female "w," 10.5 mm; y = male "y," 8.1 mm).

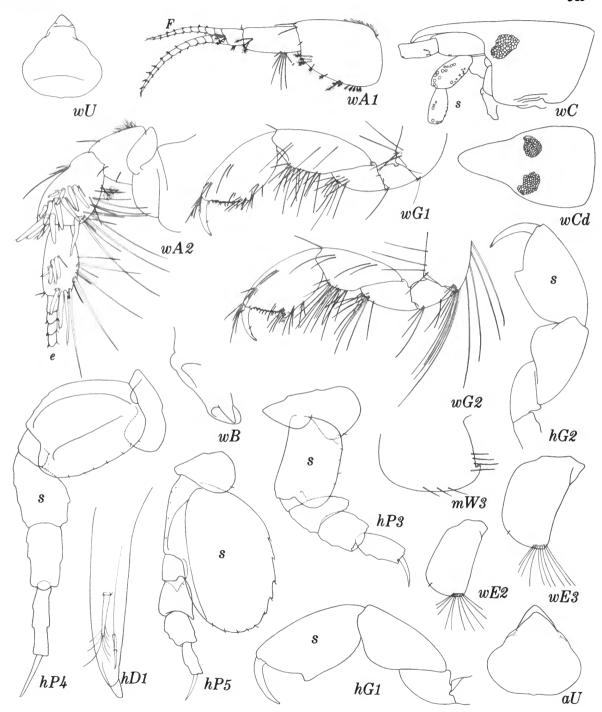


FIGURE 174.—Birubius jirrandus, new species, holotype, female "a," 9.8 mm (h= male "h," 4.00 mm; m= male "m," 4.01 mm; w= female "w," 10.5 mm).

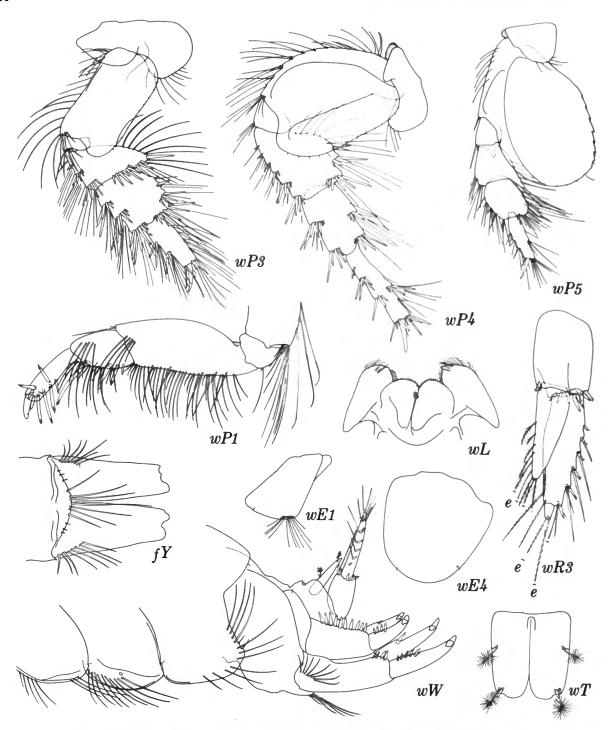


FIGURE 175.—Birubius jirrandus, new species, female "f," 9.0 mm (w = female "w," 10.5 mm; Y = venter of urosomite 1).

side not examined), anterior ridge on pereopod 5 normal, disconnected from posterior ridge, right epimeron 1 normal, left with 3 anteroventral setae and only one posteroventral setule, posteroventral tooth of epimeron 3 sharper than in other material of this species (see illustration), telson left lobe aberrant, perhaps regenerative (see illustration).

ILLUSTRATIONS.—Female left mandible drawn from outwardly rolled position; inner plate of maxilliped and article 3 of palp excessively flattened; bases of missing setae on uropod 3 indicated by circles; male inner plate of maxilla 2 drawn from ventral view; most distal facial spine on article 5 of pereopod 1 (Figure 175: wP1) obscured; male pereopod 4 drawn in outline only for comparison of proportions with female pereopod 4; setae on uropod 3 actually thicker than shown in figure of pleon; preservational defect in urosome marked with arrow (occurs to a greater or less degree in other males examined); female "w," 10.5 mm, extensively illustrated to show condition in extremely large individual, comparative reference to this specimen also made in text; mandibles, maxillae, and maxilliped resembling those of holotype, not illustrated; 2 posterior setae on epimeron 3 reconstructed; dorsoposterior setule on epimera 1-2 occasionally omitted in illustrations.

HOLOTYPE.—NMV, female "a," 9.8 mm.

Type-Locality.—CPBS 41S, 24 Mar 1965, Western Port, Victoria, Australia, 16 m, coarse sand.

VOUCHER MATERIAL (all illustrated).—WAM 414-73: male "h," 4.00 mm; male "m," 4.01 mm. PPBES 984/5: female "f," 9.0 mm. PPBES 984/4: female "u," 9.0 mm. CPBS 42S/4: male "v," 8.7 mm. CPBS 51S/1: female "w," 10.5 mm. PPBES 984/3: male "y," 8.1 mm.

RELATIONSHIP.—Birubius jirrandus fits into Key C of Birubius because of its simple right lacinia mobilis but in other respects it lies outside the species of that key and group because of the special setation on epimeron 3. In that respect it resembles but differs from B. batei? (24) in the simplicity of the right lacinia mobilis, the short apical spines on the telson of the female, the disjunct spine on the molars, short anterior ridge on pereopod 5 and short outer plate of the maxilliped, and, in the majority of specimens, the lack of doubled spine sets on the outer ramus of uropod 3.

Birubius jirrandus fits the description of Birubius rostratus (Dana) presented by Stebbing (1906) and

Pirlot (1932) except that *B. jirrandus* has ventral setae on epimeron 3 and only 9 spines on the outer plate of maxilla 1 and has a somewhat more attenuate rostrum than does *B. rostratus*. On the other hand we can make no positive identification because of our discovery in this study that extremely minute details such as right lacinia mobilis, ridges on pereopods, disjunct spines on molars, and numerous other items constitute the distinguishing characters among phoxocephalids in the southwestern Pacific (and probably other places) and these details are unknown from earlier studies.

The right laciniae mobiles of B. batei? and B. jirrandus demonstrate the stepwise loss of the principal flabellate element in the complex; one must suggest that B. jirrandus has lost the right lacinia mobilis entirely and that the first raker spine has also become reduced in size and now represents the lacinia mobilis. Perhaps in B. batei? the right lacinia mobilis is simply 2 fused raker spines with complete loss of the true lacinia mobilis.

See "Remarks" under B. myallus (4).

MATERIAL.—CPBS, 12 samples from 11 stations (15); WPBES, 9 samples from 6 stations (16); PPBES, 13 samples from 5 stations (30); WAM, one sample (2).

DISTRIBUTION.—Victoria: Western Port and Port Phillip Bay, 1–19 m, sand, coarse sand. Western Australia, Barrow Island, presumably neritic.

31. Birubius yorlunus, new species

FIGURES 176-178

Description of Female.—Head about 22 percent of total body length, greatest width almost 60 percent of length; rostrum constricted, narrow, elongate, exceeding middle of article 2 on antenna 1. Eyes medium to large, clear of pigment, ommatidia especially large. Article 1 on peduncle of antenna 1 about 0.7 times as long as wide, about half as wide as article 2, ventral margin with 5-6 setules, weakly produced dorsal apex with 2 setules; article 2 about 0.55 times as long as article 1, with proximoventral cycle of 5 setae; primary flagellum with 9-13 articles, about 0.7 times as long as peduncle, aesthetascs poorly developed; accessory flagellum with 9-12 articles. Spine formula on article 4 of antenna 2 = 1-3-4-5 or 1-3-4-4, dorsal margin with notch bearing one seta and one spine, ventral margin with

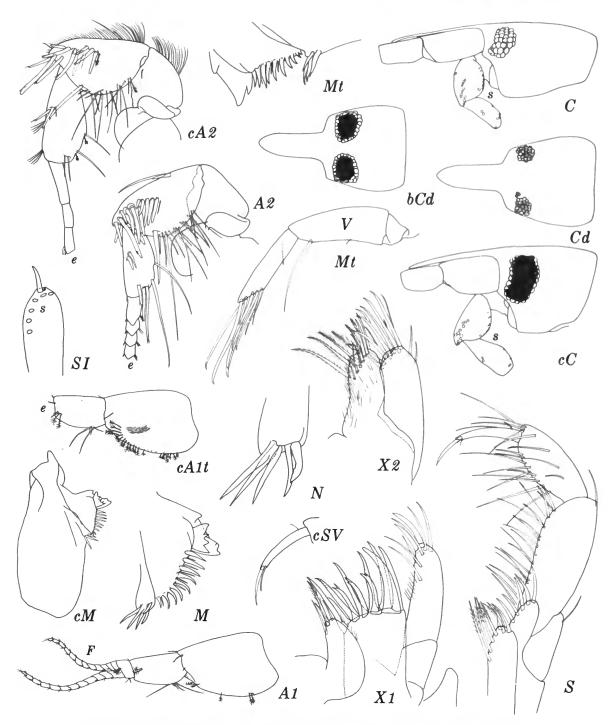


FIGURE 176.—Birubius yorlunus, new species, holotype, female "a," 5.60 mm (b = male "b," 5.51 mm; c = male "c," 5.50 mm).

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6 groups of 2-4 long to medium setae, one ventrodistal long spine; article 5 about 0.72 times as long as article 4, facial spine formula = 1-2, dorsal margin naked, ventral margin with 2 sets of one long seta, 2 ventrodistal long to medium spines, one of these set subdistally; flagellum about 1.1-1.3 times as long as articles 4-5 of peduncle combined, with 11-14 articles. Mandibles with strong palpar hump; right incisor with 3 teeth; left incisor with 3 humps in 2 branches; right lacinia mobilis simple, denticulate; left lacinia mobilis with 4 teeth, middle teeth shortened; right rakers 9; left rakers 8-9; molar in form of short protrusion demarcated mainly by spines, right molar with 4 primarily long spines, none strongly disjunct, left molar with 3-5 primarily long spines, none disjunct, each molar with plume (not illustrated); palp article I short, article 2 with one long inner apical seta and one other short inner seta, article 3 over 0.9 times as long as article 2, oblique apex with 9-11 spinesetae, basofacial formula = 0-1 or 0-0. Inner plate of maxilla I large, thin, bearing one long apical pluseta, one shorter apicomedial seta, 2 apicolateral slightly shorter setae; palp article 2 with 3 apicalmedial marginal spines and 4-5 lateral to medial submarginal setae. Plates of maxilla 2 extending equally, outer scarcely broader than inner, outer with 2 apicolateral setae, inner with one medial seta. Inner plate of maxilliped with one large thick apical spine, 2 apicofacial setae, 4 medial setae, outer plate with 6 medial and apical spines, no apicolateral setae; palp article 1 with one apicolateral seta, article 2 with one apicolateral seta, medial margin of article 2 moderately setose, article 3 with 4 facial setae, no lateral setae, nail of article 4 long, with 2 accessory setules. Coxa 1 expanded distally, anterior margin weakly concave; main ventral setae of coxae 1-4 = 6-7-9-0, or 7-8-8-0 or 5-(6-7)-6-0or 6-6-6-0 (or other variants), posteriormost seta of coxae 1-3 as long as others; anterior and posterior margins of coxa 4 strongly divergent, posterior margin convex, posterodorsal corner rounded, posterodorsal margin ordinary, concave, undulant, width-length ratio of coxa 4 = 9:10. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = (5-6)-6-(5-6)-(4-6), short anteriors = 2-1-1-1, long anteriors = (2-4)-(3-5+3)facial)-0-0, occasional straw-seta posteriorly on pereopod 2. Gnathopods generally ordinary but somewhat stout; width ratios of articles 5-6 on

gnathopods 1-2 = 26:41 and 26:41, length ratios = 50:70 and 46:70; palmar humps medium, palms strongly oblique; article 5 of gnathopods 1-2 ovate-triangular, posterior margin margin rounded, almost lobate. Pereopods 1-2 similar, facial setae formula on article 4 = 3-4 and 3, on article 5 = 5and 5-6; main spine of article 5 extending to M. 75 on article 6, article 5 with 1-(2) proximoposterior spines; spine formula of article 6 = 6 + 8 and 6-7 + 8 plus middistal seta, some spines especially long; acclivity on inner margin of dactyls of pereopods 1-2 sharp, produced as tooth, emergent setule short, midfacial pluseta short. Coxae 5-7 posteroventral setule formula = 1-1-1. Articles 4-5 of pereopods 3-4 of ordinary width, facial spine rows dense, facial ridge formula on article 2 of pereopods 3-5 = 0-2-2 (anterior short); width ratios of articles 2, 4, 5, 6, of pereopod 3 = 40:44:34:14, of pereopod 4 = 60:38:24:10, of pereopod 5 = 80:19:18:8, length ratios of pereopod 3 = 74:34:36:40, of pereopod 4 = 82:45:35:52, of pereopod 5 = 99: 23:23:27; article 2 of pereopod 5 not reaching middle of article 5, ventral margin with 2 long setae; medial apex of article 6 finely combed, bearing 3 weak digital processes. Posteroventral corner of epimeron 1 rounded, posterior margin straight, anteroventral margin with 3-5 medium setae, posteroventral face with 2 long setae set vertically; posteroventral corner of epimeron 2 rounded, quadrate, weakly protuberant, posterior margin almost straight, facial ridge very short, obsolescent, facial setae = 7-8, posteriormost pair or triad set vertically; posteroventral corner of epimeron 3 rounded then with setule sinus, posterior margin straight, with 2 setule notches, face with 2 oblique rows of 4 setae near ventral and posterior margin or as few as one row of 5 plus one posteriorly and one rudimentary; epimera 1-3 with small seta on posterodorsal margin set in weak notch. Urosomite 1 produced ventrally at base of uropod 1, articulation line incomplete, short; urosomite 3 protuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, outer rami of uropods 1-2 and inner ramus of uropod 1 with accessory nails, or these poorly contiguous, outer ramus of uropod 1 with 5-6 dorsal spines, inner with 3, outer ramus of uropod 2 with 4-6 dorsal spines, inner with 2 dorsomedial spines; peduncle of uropod 1 with one apicolateral spine and one basofacial seta, medially with 4-5 marginal spines, apicalmost enlarged;

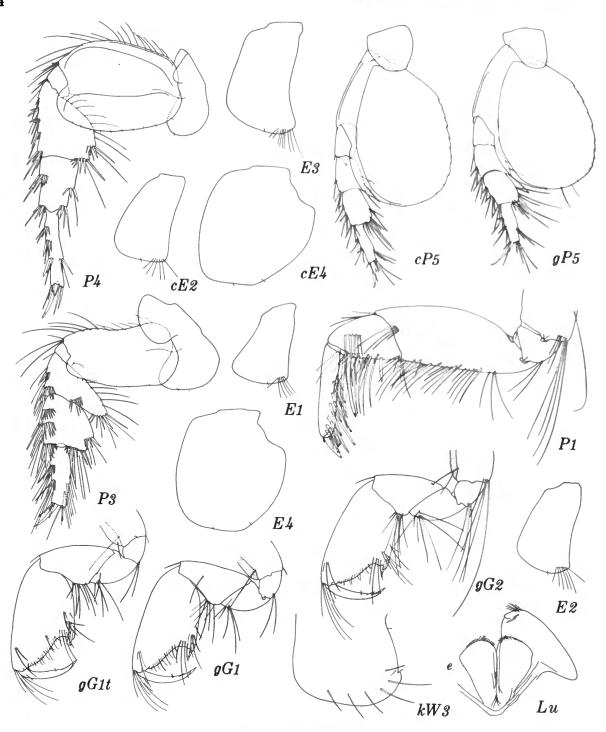


FIGURE 177.—Birubius yorlunus, new species, holotype, female "a," 5.60 m (c = male "c," 5.50 mm; g = female "g," 4.30 mm; k = female "k," 4.57 mm).

peduncle of uropod 2 with 5-6 dorsal spines, medially with one small apical spine. Peduncle of uropod 3 with 5 ventral spines, dorsally with one lateral spine, one medial setule; rami feminine, inner extending to M. 80 on article 1 of outer ramus, apex with 1-3 setae, medial and lateral margins naked, article 2 of outer ramus elongate, 0.30, bearing 2 short to medium setae, apicomedial margin of article 1 naked, lateral margin with 4-5 acclivities, spine formula = 1-2-2-2-2-(2), setal formula = 0. Telson long, length-width ratio = 33:28, not fully cleft, each apex wide, rounded, lateral acclivity deep, narrow, bearing ordinary lateral setule, spine next medial of length equal to setule, mid lateral setules diverse. Cuticle with ordinary bulbar setules, surface bearing fine striations in form of linear fingerprint pattern, emergent setules especially short.

DESCRIPTION OF MALE.—Article 2 of antenna 1 with 5-6 ventral setae; primary flagellum 10-12 articulate, bearing calceolus on articles 1-4 or 1-5; accessory flagellum 8-10 articulate. Facial spines on article 4 of antenna 2 = 3-4-3 or 3-4-4, on article 5 = 2, ventrodistal apex of article 5 with 2 thin spines, dorsal margin with 2-3 sets of male setae, calceolus present or absent; flagellar formula = (25-27 +), 2, 4, 6 . . . (20 or 26) (or other variants). Right mandibular molar with 4 spines, left with 3; left lacinia mobilis with 4 teeth plus one accessory tooth; basofacial setal formula on article 3 = 1-1. Inner plate of maxilliped with only 3 medial setae; accessory setule on dactyl enlarged. Setal formula on coxae 1-4 = 5-6-5-0; coxa 4 broader than in female and with distinctive shape (see illustration). Setal formulas on article 2 of gnathopods 1-2 and pereopods 1-2, long posteriors = 5-5-4-4, long anteriors = 2-3-0-0, short anteriors = 2-1-1-1. Facial seta and spine formulas on pereopods 1-2, article 4 = 2 and 2, article 5 = 3-4 and 4, article 6 = 6 + 8 plus middistal seta, posteroproximal on article 5 = 1 and 1; posterodistal spine on article 5 of pereopods 1-2 slightly enlarged. Article 2 of pereopods 3-4 narrower than in female. Setal formulas on epimera, anteroventral epimeron 1 = 3, epimeron 2 = 8, epimeron 3 = 6. Spine formulas on uropods, apicolateral peduncle uropod 1 = 2, peduncle of uropod 2 = 9, outer ramus = 4, peduncle of uropod 3 = 8. Telson similar to that of female but apical spines shorter, bearing dorsal rows of denticles (mainly based on male "b").

OBSERVATIONS.—Routine identification of this species demonstrates that the continuous dorsal spination on the rami of uropods 1-2 is usually not as strong as shown for the specimen depicted in our illustrations. This is especially true of the inner ramus on uropod 1.

ILLUSTRATIONS.—Outer ramus of uropod 3 on lateral view of pleon on male "c" added from interpolation of same ramus on male "b."

HOLOTYPE.—NMV, female "a," 5.60 mm.

TYPE-LOCALITY.—PPBES 974/2, 13 Oct 1971, Port Phillip Bay, Victoria, Australia, 5 m, sand.

VOUCHER MATERIAL.—Type-locality: male "b," 5.51 mm (illus.); male "c," 5.50 mm (illus.). CPBS 12S/1: female "g," 4.30 mm (illus.). CPBS 12S/5: female "k," 4.57 mm (illus.); male "m," 4.10 mm. EBS 27: female "w," 5.7 mm.

RELATIONSHIP.—Birubius yorlunus combines the following characters: simple right lacinia mobilis, strong ventral setae on epimeron 1 with extra facial setae in adults and poor to absent posterior setae, absence of setae on coxa 4, numerous setae on coxae 1-3, presence of accessory apical nails and continuous spination on the rami of both uropods 1-2. In addition it has these minor attributes: unusual hands and palms of gnathopods, strong proximal placement of setae on article 2 of antenna 1, small outer plate of the maxilliped, and shortened articles on the flagella of antenna 1. The latter characters can be utilized to draw comparisons with the few other species bearing one or more of those attributes. The following discussion is confined to the major set of attributes in attempting to establish relationships.

Birubius yorlunus falls between the B. myallus (4) and B. taldeus (34) groups and bears comparison to B. jirrandus (30). Birubius yorlunus differs from the B. myallus group in the simple right lacinia mobilis, the poorly developed basofacial setae on the peduncle of uropod 1, the very thin rostrum, and the short anterior ridge on article 2 of female pereopod 5.

Birubius yorlunus shares with the B. taldeus group the following characteristics: the poorly developed bulb on the anteroventral setules of coxa 1-4, similarities in right lacinia mobilis, thin rostrum, and poorly developed basofacial setae on uropod 1 but B. yorlunus is distinguished by the strong ventral setae on epimeron 3, the multisetose coxae 1-3, in the continuously spinose rami and

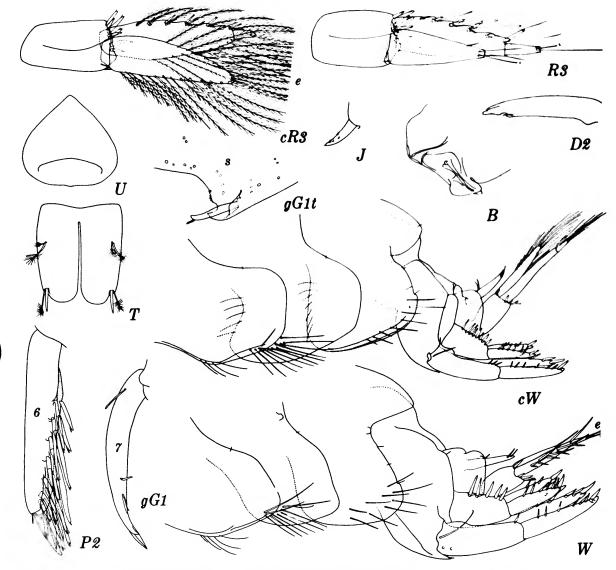


FIGURE 178.—Birubius yorlunus, new species, holotype, female "a," 5.60 mm (c = male "c," 5.50 mm; g = male "g," 4.30 mm).

accessory nails of uropods 1-2, and in the distinctive palms of the gnathopods. In all but uropods 1-2 B. yorlunus could serve as an hypothetical ancestor to the B. taldeus group.

Birubius yorlunus differs from B. jirrandus in the narrow rostrum, poor basofacial setae of uropod 1, absence of true posterior setae on epimeron 3, and the presence of accessory apical nails and continuous dorsal spination on uropods 1-2.

The presence of accessory nails on uropod 2 sug-

gests that B. yorlunus is either more primitive than any other member of Birubius in this one character or that accessory nails can be developed late in the evolutionary sequence.

Many specimens have the so-called "accessory" apical nails, especially on the inner ramus of uropod 1, less strongly developed and not as crowded distally as in our illustrations, so that the routine identificatory differences between B. yorlunus, B. eake (32), and B. kabbulinus (33) are often

obscured. Birubius eake can be distinguished from B. yorlunus in the much shorter rostrum and much more elongate wrists on the gnathopods, while B. kabbulinus, known for the male only, can be distinguished in the absence of a distinct tooth and sinus posteroventrally on epimeron 3 and in the extreme basal position of the single dorsal spine on the inner rami of uropods 1 and 2. These two characters also distinguish B. kabbulinus from B. eake as well as the longer rostrum and shorter wrists on the gnathopods of B. eake.

MATERIAL.—CPBS, 6 samples from 2 stations (252); PPBES, 32 samples from 18 stations (416); EBS, one sample (1); SBS, 5 samples from 3 stations (7).

DISTRIBUTION.—Victoria, Western Port and Port Phillip Bay to Sydney, New South Wales, 2-40 m, sand and silty sand.

32. Birubius eake, new species

FIGURES 179-181

DESCRIPTION OF FEMALE.—Head about 19 percent of total body length, greatest width about 67 percent of length; rostrum constricted, narrow, short, exceeding apex of article 1 on antenna 1. Eyes medium, largely occluded with pigment. Article 1 on peduncle of antenna 1 about 1.15 times as long as wide, twice as wide as article 2, ventral margin with 6-7 setules, unproduced dorsal apex with one setule; article 2 about 0.75 times as long as article 1, with ventral cycle of 4 setae; primary flagellum with 8-9 articles, about 0.95 times as long as peduncle, bearing long aesthetascs; accessory flagellum with 6 articles. Spine formula on article 4 of antenna 2 = 1-3-3-2, dorsal margin with notch bearing 2 setae, ventral margin with 3 groups of 2-3 long to medium setae, one ventrodistal long spine; article 5 about 0.7 times as long as article 4, facial spine formula = 1-2, dorsal margin naked, ventral margin with 2 sets of 1-2 long to short setae, 2 ventrodistal long to medium spines; flagellum about 1.2 times as long as articles 4-5 of peduncle combined, with 9 articles. Mandibles with strong palpar hump; right incisor with 3 teeth; left incisor with 5 humps in 2 branches; right lacinia mobilis simple, pointed, with marginal denticles; left lacinia mobilis with 4 teeth plus one accessory tooth; right rakers 4, plus one rudimentary; left rakers 5; molar

in form of elongate plaque, right molar with 6 primarily long spines plus plumose seta plus one seta strongly disjunct, left molar with 3 primarily long spines plus ciliate seta and one setal spine strongly disjunct; palp article 1 slightly elongate, article 2 with one long inner apical seta and one other short inner seta, article 3 about 0.9 times as long as article 2, oblique apex with 5 spine-setae, basofacial formula = 0. Inner plate of maxilla 1 thin, bearing one long apical pluseta, one shorter apicomedial seta, 2 apicolateral much shorter setae; palp article 2 with 2 apicalmedial marginal spines and 3 submarginal setae. Plates of maxilla 2 extending equally, outer slightly broader than inner, with one apicolateral seta, inner with 2 medial setae. Inner plate of maxilliped with one thin apical spine and one partner seta, 2 apicofacial setae, 3 medial setae; outer plate with 3 medial and apical spines, no apicolateral setae; palp articles 1-2 with apicolateral seta, medial margin of article 2 weakly setose, article 3 unprotuberant, with 2 facial setae, 2 lateral setae, nail of article 4 long, with 2 accessory setules. Coxa 1 scarcely expanded distally, anterior margin straight, main ventral setae of coxae 1-4 = 4-4-0, posteriormost seta of coxae 1-3 as long as others; anterior and posterior margins of coxa 4 weakly divergent, posterior margin almost straight, posterodorsal corner rounded, posterodorsal margin ordinary, concave or V-shaped, width-length ratio of coxa 4 = 6.5. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 2-3-3-3, others not counted. Gnathopods ordinary; width ratios of articles 5-6 on gnathopods 1-2=27:37 and 27:37, length ratios = 68:75 and 62:69; palmar humps ordinary, palms oblique; article 5 of gnathopod 1 slightly elongate, ovate, posterior margin rounded-flat; article 5 of gnathopod 2 ovate, posterior margin rounded, weakly lobate. Pereopods 1-2 similar, facial setae formula on article 4 = 2 and 2, on article 5 = 3 and 3; main spine of article 5 extending to M. 80 on article 6, article 5 with one proximoposterior spine; spine formula of article 6 = 3 + 3plus middistal seta; acclivity on inner margin of dactyls of pereopods 1-2 obsolescent, emergent setule long, midfacial pluseta ordinary. Coxae 5-7 posteroventral setule formula = 1-1-1. Articles 4-5 of pereopods 3-4 of ordinary width, facial spine rows sparse, facial ridge formula on article 2 of pereopods 3-5 = 0-2-1; width ratios of articles

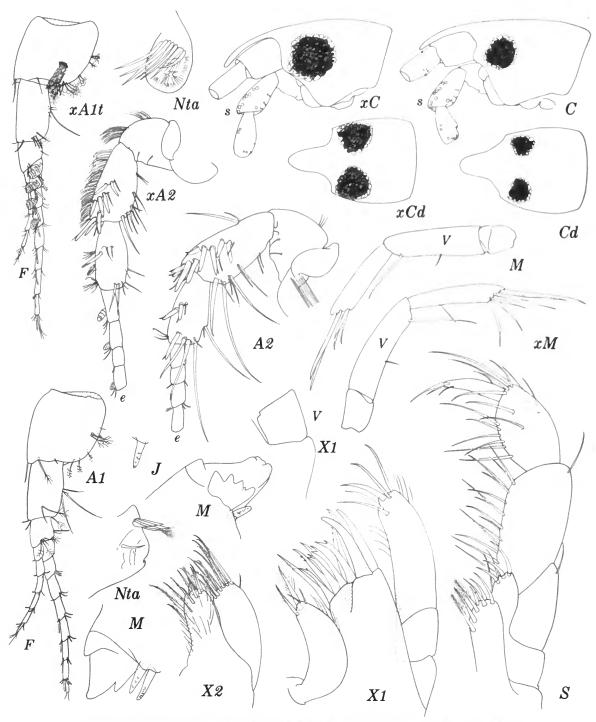


FIGURE 179.—Birubius eake, new species, holotype, female "a," \$.11 mm (x = male "x," \$.18 mm).

2, 4, 5, 6 of pereopod 3 = 46:41:34:16, of pereopod 4 = 68:37:23:12, of pereopod 5 = 77:20:20:10, length ratios of pereopod 3 = 73:27:33:41, of pereopod 4 = 82:48:36:48, of pereopod 5 = 98:21: 21:29; article 2 of pereopod 5 slightly exceeding apex of article 4; medial apex of article 6 finely combed and bearing 5 digital processes. Posteroventral corner of epimeron 1 rounded, posterior margin convex, with setule, anteroventral margin with 3 short setae, posteroventral face with one long seta; posteroventral corner of epimeron 2 rounded, posterior margin strongly convex, facial setae = 7; posteroventral corner of epimeron 3 rounded, weakly and broadly protuberant, with setule sinus, posterior margin weakly convex, ventral face with horizontal crescent of 3 setae near posterior margin. Urosomite 1 with long ventral seta at base of uropod 1, articulation line short; urosomite 3 unprotuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, outer ramus of uropod 1 with 2 dorsal spines, inner with 2, outer ramus of uropod 2 with 2 dorsal spines, inner with one dorsomedial spine; peduncle of uropod 1 with one apicolateral spine and one basofacial seta, medially with 2 marginal spines, apicalmost enlarged; peduncle of uropod 2 with 3 dorsal spines, medially with one small apical seta. Peduncle of uropod 3 with 4 ventral spines, dorsally with one lateral spine, one medial spinule; rami feminine, inner extending to M. 50 on article 1 of outer ramus, apex with one seta, medial and lateral margins naked, article 2 of outer ramus short, 0.15, bearing 2 long setae, medial margin of article 1 with one seta, lateral margin with 2 acclivities, spine formula = 2-2-2, setal formula = 0. Telson ordinary, length-width ratio = 1:1, almost fully cleft, each apex narrow, rounded, lateral acclivity shallow, bearing ordinary lateral setule, spine next medial longer than setule, midlateral setules diverse. Cuticle with ordinary bulbar setules.

DESCRIPTION OF MALE.—Eyes enlarged. Midface of article 1 on antenna 1 bearing small patch of fuzz; primary flagellum with 9 articles, one large calceolus each on articles 1–4; accessory flagellum with 6 articles. Articles 3–4 of antenna 2 fuzzy dorsally; spine formula of article 4 = 1–2–3–2, one ventrodistal spine, ventral margin with 3 groups of short to medium setae; article 5 with one facial spine, 2 setules, 2 ventrodistal apical spines, 2 sets of short ventral setae, dorsal margin with one

calceolus and 2 sets of male setules; flagellar formula = (21-22), 1, 2, 4, 6 . . . 20. Right mandible with 4 rakers plus one rudimentary; left with 4 rakers; right molar with 5 spines, one plumose spine, one disjunct spine, left molar with 5 spines plus one disjunct, no ciliated spine; right incisor lacking fourth notch; mandibular palp with one basofacial seta on article 3. Inner plate of maxilla 2 with one medial seta; outer plate with one apicolateral seta. Formula of long posteroventral setae on coxae 1, 2, 3, 4 = 3-3-3-0, coxa 4 bearing only one posteroventral setule, otherwise coxa 4 like female. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = (1-2)-3-3-3. Pereopods 1-2like female but article 5 of each with only 2 facial setae. Article 2 of pereopod 3 relatively narrower and longer than in female (see illustration), also true for pereopod 4 but this appendage also larger than in female; article 2 of pereopod 5 narrower than in female, bearing 2 ridges. Epimera 1-3 broadened, posterior margin of epimeron 3 shortened; setal formulas, epimeron 1 anteroventral = 5, posteroventral = 1, epimeron 2 facial = 7, epimeron 3 posterior = 2 setules, facial = 1, ventral = 1. Ventral spine on each side of urosomite 1 much shorter than in female and with peculiar falcate shape; articulation line between urosomites 1-2 fully developed. Spine formulas of uropods, uropod 1 peduncle apicolateral = 2, basofacial = 1, uropod 2 peduncle dorsal = 6-7, dorsal spines on outer ramus of uropod 1 = 2, of uropod 2 = 2, inner ramus of uropod 1 = 2, of uropod 2 = 1. Ventral spines on peduncle of uropod 3 = 4, spine formula on article 1 of outer ramus = 1-2-2-2, setal formula = 1-1-1-1. Telson elongate, distal spines shortened.

Young male "n," 2.60 mm: Eyes scarcely larger than those of female. Flagellum of antenna 2 slightly elongate, about 11-articulate, basal articles short, spine formula on article 4 of peduncle = 1-3-3-2, article 5 with 2 facial spines. Epimeron 1 with 3 anteroventral setae, one posterofacial seta; epimeron 2 with 6 facial setae; epimeron 3 with 3 facial setae. Peduncle of uropod 1 with one basofacial seta, 2 apicolateral spines, outer ramus with 2 dorsal spines, inner ramus with one dorsal spine; uropod 2 with 3 peduncular spines, outer ramus with 2 dorsal spines, inner ramus with one. Outer ramus of uropod 3 with 2 acclivities, spine formula = 2-2-2, setae absent on article 1.

DESCRIPTION OF JUVENILE (Juvenile "1," 2.00

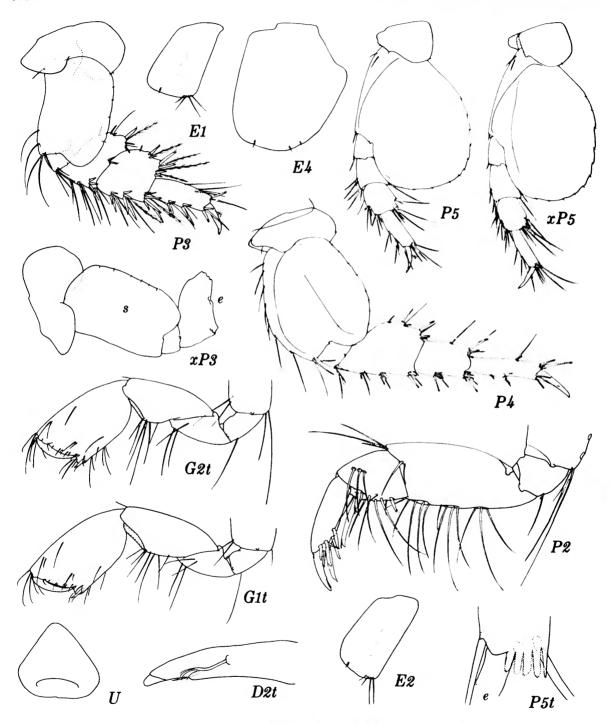


FIGURE 180.—Birubius eake, new species, holotype, female "a," 3.11 mm (x = male "x," 3.18 mm).

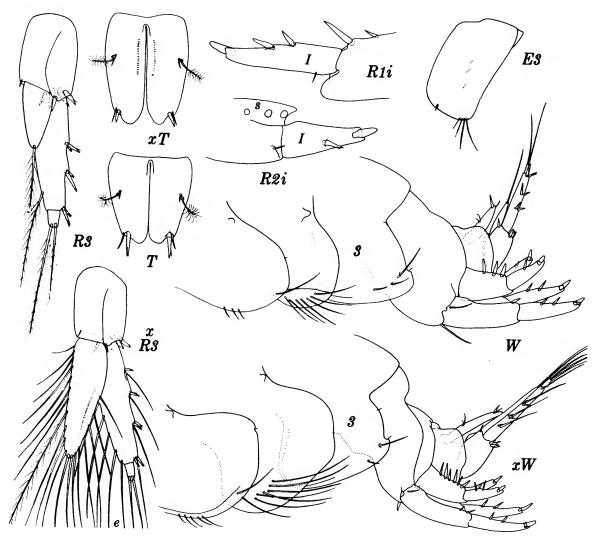


FIGURE 181.—Birubius eake, new species, holotype, female "a," 3.11 mm (x = male "x," 3.18 mm).

mm).—Eyes small. Primary flagellum of antenna 1 with 7 articles; accessory flagellum with 5 articles. Spine formula on article 4 of antenna 2 = 1-3-3-1; article 5 with 2 facial spines. Epimeron 1 with one anteroventral seta, no posterofacial seta; epimeron 2 with 4 facial setae; epimeron 3 with 2 facial setae. Long setae of coxae 1-3=3-3-3. Ventral spine on urosomite 1 thicker and larger relative to body size than in adult female. Peduncle of uropod 1 with one basofacial seta, one apicolateral spine, each ramus with one dorsal spine; peduncle of uropod 2 with 2 spines, each ramus with one dorsal spine; all spines of uropods 1-2 much larger than in adult

relative to body size, spines probably not increasing steadily with body enlargement. Outer ramus of uropod 3 with one lateral acclivity on article 1 bearing one spine.

OBSERVATIONS.—Prebuccal complex convex anteriorly, moderately extended anteriorly; lower lip with one cone on outer lobes, mandibular lobes weakly subsharp and attenuate, like *B. gambodeni* (20), epimeron 1 lacking lateral ridge in holotype, probably obliterated by preecdysical swelling.

ILLUSTRATIONS.—Outer plate of maxilla 1 drawn obliquely; male antenna 2 with one spine missing on face of article 5.

HOLOTYPE.--WAM, female "a," 3.11 mm.

TYPE-LOCALITY.—JLB AUS 3, 1 Sep 1968, Sugarloaf Rock, Cape Naturaliste, Western Australia, intertidal wash of common seaweeds.

VOUCHER MATERIAL.—Type-locality, male "x," 3.18 mm (illus.); JLB AUS 12, small male "n," 2.60 mm; JLB AUS 13, juvenile "1," 2.00 mm.

RELATIONSHIP.—Birubius eake differs from the other members of the B. taldeus (34) group in the denser development of setae on coxa 1, the absence of accessory apical setules on the rami of uropods 1-2, the presence of a few facial setae on epimeron 3, uncrowded setae on epimeron 2 possibly owing to the narrower development of that plate, weaker acclivity on the dactyls of pereopods 1-2, and narrower articles 4-5 of either pereopod 3 or 4.

Birubius eake resembles B. munggai (27) but differs from that species in the simple right lacinia mobilis, the noncrowded setae on epimeron 2 and in the fewer setae of epimeron 3. From B. eleebanus (29), B. eake differs in the fewer ventral setae on epimeron 3, absence of setae on coxa 4 and the fewer basofacial setae on uropod 1. See remarks on this species under B. yorlunus (31).

We leave the reader the task of tracing the possible descent of this species from groups centered by B. myallus (4), B. gallangus (10), B. narus (19), B. gambodeni (20) and B. yorlunus (31). See other interrelationships by tracing through from B. taldeus (34), onward.

MATERIAL.—JLB AUS, 3 samples (7).
DISTRIBUTION.—Southwestern Australia, intertidal flora.

33. Birubius kabbulinus, new species

FIGURES 182, 183

DESCRIPTION OF MALE.—Head (broken) about 21+ percent of total body length, greatest width about 55 (estimated) percent of length; rostrum constricted, narrow, elongate, probably reaching middle of article 2 on antenna 1. Eyes large, clear of pigment but stained deep burgundy, ommatidia especially large. Article 1 on peduncle of antenna 1 about 1.2 times as long as wide, about twice as wide as article 2, ventral margin with about 10 setules, produced dorsal apex with one setule; article 2 about 0.8 times as long as article 1, with ventral cycle of 4 setae; primary flagellum with 10 articles.

about 1.1 times as long as peduncle, lacking aesthetascs; accessory flagellum with 7 articles. Spine formula on article 4 of antenna 2 = 3-4-3, dorsomedial margin of articles 3-4 fuzzy, ventral margin with 4 groups of 1-3 medium setae, one ventrodistal medium spine; article 5 about 0.9 times as long as article 4, facial spine formula = 2, dorsal margin bearing 3 sets of male setae and one calceolus, ventral margin with 2 sets of 2 medium to short setae, 2 thin ventrodistal medium spines; flagellum elongate, flagellar formula = (26-29), 2, 4, 6 . . . 20 or 2, 4, 6 . . . 26. Mandibles with medium palpar hump; right incisor with 3 teeth; left incisor with 4 humps in 2 branches; right lacinia mobilis simple, denticulate; left lacinia mobilis with 5 teeth; right rakers 5; left rakers 8; molar in form of bulbous hump demarcated mainly by spines, each molar with 4 primarily long spines, none disjunct, each molar with plume; palp article 1 slightly elongate, article 2 with one long inner apical seta and 2 other shorter inner setae, article 3 about 0.9 times as long as article 2, oblique apex with 6 spine-setae, basofacial formula = 1-1. Inner plate of maxilla 1 ordinary, bearing one long apical pluseta, one shorter similar apicomedial seta, 2 apicolateral much shorter setae; palp article 2 with 2 apicalmedial marginal spines and 3 submarginal setae. Plates of maxilla 2 extending equally, of equal width, outer with 2 apicolateral setae, inner with one medial seta; [maxillipeds missing]; coxa 1 strongly expanded distally, anterior margin weakly concave; main ventral setae of coxae 1-4 = 3-4-4-0, posteriormost seta of coxae 1-3 longest; anterior and posterior margins of coxa 4 almost parallel, posterior margin convex, posterodorsal corner rounded, posterodorsal margin short, concave, undulant, width-length ratio of coxa 4 = 14:15. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 1-1-2-2, long anteriors = 2-5-0-0, short anteriors = 1-1-1-1, no others. Gnathopods ordinary; width ratios of articles 5-6 on gnathopods 1-2 = 24:36 and 26:37, length ratios = 56:60 and 49:59; palmar humps ordinary, palms oblique; article 5 of gnathopod 1 ovate, posterior margin rounded; article 5 of gnathopod 2 ovate, posterior margin rounded, almost lobate. Pereopods 1-2 similar; facial setae formula on article 4 = 2 and 2, on article 5 = 3 and 2; main spine of article 5 extending to M. 85 on article 6, article 5 with one proximoposterior spine; spine formula of article 6 = 3

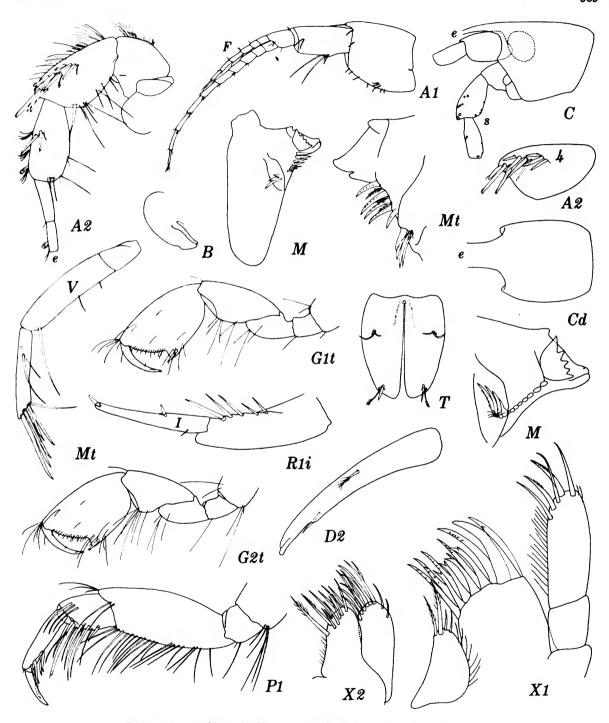


FIGURE 182.—Birubius kabbulinus, new species, holotype, male "a," 3.19 mm.

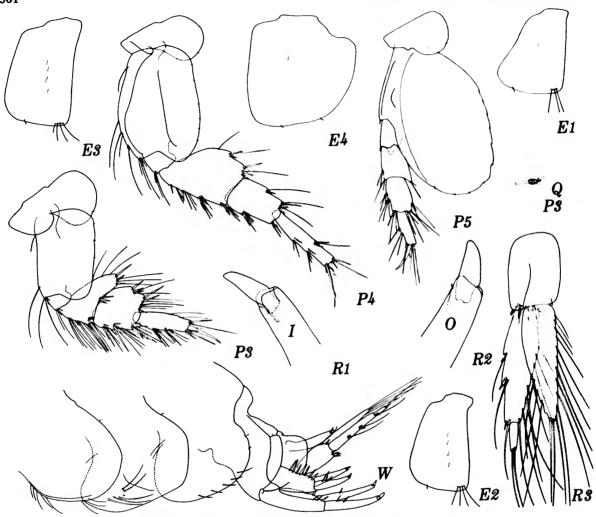


FIGURE 183.—Birubius kabbulinus, new species, holotype, male "a," 3.19 mm.

+ 3, lacking middistal seta, one spine especially long; acclivity on inner margin of dactyls of pereopods 1-2 weak, emergent setule long, midfacial pluseta very short. Coxae 5-7 posteroventral setule formula = 1-1-1. Articles 4-5 of pereopods 3-4 of ordinary width, facial spine rows moderately developed, facial ridge formula on article 2 of pereopods 3-5 = 0-2-2 (see "Observations"); width ratios of articles 2, 4, 5, 6 of pereopod 3 = 39:37:30:12, of pereopod 4 = 54:37:23:10, of pereopod 5 = 73: 17:15:7, length ratios of pereopod 3 = 60:26: 30:36, of pereopod 4 = 77:47:35:49, of pereopod 5 = 106:26:23:23; article 2 of pereopod 5 exceed-

ing apex of article 4; medial apex of article 6 combed, bearing 2 obsolescent digital processes. Posteroventral corner of epimeron 1 rounded, posterior margin deeply convex, anteroventral margin with 4-5 medium setae, posteroventral face with 3 medium setae; posteroventral corner of epimeron 2 rounded? (damaged), posterior margin strongly convex, facial setae = 6, posteriormost triad set vertically; posteroventral corner of epimeron 3 rounded, with setule sinus, posterior margin convex, with one setule notch, ventral margin with 5 setae evenly spread; epimera 1-2 with tiny setule on posterodorsal margin. Urosomite 1 naked, articula-

tion line almost complete; urosomite 3 protuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, outer rami of uropods 1-2 and inner ramus of uropod 1 with one accessory setule, outer ramus of uropod 1 with 2 dorsal spines, inner with one, outer ramus of uropod 2 with 3 dorsal spines, inner with one dorsomedial spine; peduncle of uropod 1 with 3 apicolateral spines and one basofacial seta, medially with 5 marginal spines, apicalmost weakly enlarged; peduncle of uropod 2 with 7 dorsal spines, medially with one apical setule. Peduncle of uropod 3 with 5 ventral spines, dorsally with one lateral spine, one medial setule; rami masculine, inner extending to M. 100 on article 1 of outer ramus, apex with 2-3 setae, medial and lateral margins setose, article 2 of outer ramus elongate, 0.25, bearing 2 long setae, apicomedial margin of article 1 setose, lateral margin with 2 acclivities, spine formula = l-l-1, setal formula = 1-1-1. Telson long, length-width ratio = 6:5, almost fully cleft, each apex narrow, roundedtruncate, lateral acclivity weak, bearing ordinary lateral setule, spine next medial shorter than setule, midlateral setules weakly diverse. Cuticle with ordinary but very sparse bulbar setules.

OBSERVATIONS.—Article 2 of pereopod 5 with 2 anterior ridges, one short and weak and possibly an artifact; upper lip and lower lip poorly observed, damaged during dissection; maxillipeds missing.

HOLOTYPE.—AM, male "a," 3.19 mm. Unique. TYPE-LOCALITY.—AM P.18125, 12 Dec 1939, Antechamber Bay, Kangaroo Island, South Australia, light in net at night.

RELATIONSHIP.—Like B. eake (32), this species lies just outside the B. taldeus (34) group. The right lacinia mobilis is simple, the rostrum narrow, and several rami of uropods 1-2 bear immersed apical setules, but unlike the B. taldeus group, B. eake and B. kabbulinus have more than 2 setae each on coxae 1-2 and bear ventral or ventrofacial setal-spines on epimeron 3. Birubus kabbulinus differs from B. eake in the fully ventral position of the setae on epimeron 3, bears an elongate article 2 on the outer ramus of uropod 3, and lacks the enlarged ventral spine on urosomite 1.

Birubius yorlunus (31) bears continuous dorsal spination on the rami of uropods 1-2 and fully facial setae on epimeron 3. Routine distinctions however, are complicated; see B. yorlunus for re-

marks. Birubius kabbulinus also bears many similarities to B. muldarpus (9) and B. gallangus (10) but those species have bifid right lacinia mobili.

The absence of a distomedial seta on article 6 of pereopods 1-2 is unusual.

Birubius kabbulinus has close resemblance to the several taxa of the Cunmurra group, including Birubius booleus (15) and B. chintoo (13). Birubius kabbulinus differs from Cunmurra itickerus and the two species 13 and 15 in the simple right lacinia mobilis, from C. itickerus and B. chintoo in the broad coxae 1-4, and in addition from Cunmurra in the small gnathopod 2 and short hand of gnathopod 1. From B. booleus, B. kabbulinus also differs in the absence of long setae on coxa 4 and in proportions of that coxa; however, the two species are based on different sexes and other differences may be masked by that factor.

Birubius kabbulinus does not fit the Cunmurra-B. chintoo evolutionary scheme very well but its mandibular molars have their spines reduced to 4 so that it closely approximates the genera of the Paraphoxus-Brolgus group, though B. kabbulinus does not have unusual gnathopods or combs on the uropods.

MATERIAL.—AM, one sample (1).

DISTRIBUTION.—South Australia, Kangaroo Island, neritic.

34. Birubius taldeus, new species

FIGURES 184-186

DESCRIPTION OF FEMALE.—Head about 18 percent of total body length, greatest width about 65 percent of length; rostrum constricted, very narrow, exceeding apex of article 1 on antenna 1. Eyes medium, clear of pigment, stained ochre, ommatidia especially large. Article 1 on peduncle of antenna 1 about 1.4 times as long as wide, about 1.6 times as wide as article 2, ventral margin with 8-10 setules, weakly produced dorsal apex with one setule; article 2 about 0.7 times as long as article 1, with ventral cycle of 4-5 setae; primary flagellum with 12-13 articles, about 0.75 times as long as peduncle, bearing short aesthetascs terminally; accessory flagellum with 8-10 articles. Spine formula on article 4 of antenna 2 = 1-3-4-3 or 1-3-4-4, dorsal margin with notch bearing one short spine, ventral margin with 3 groups of 2 short to medium

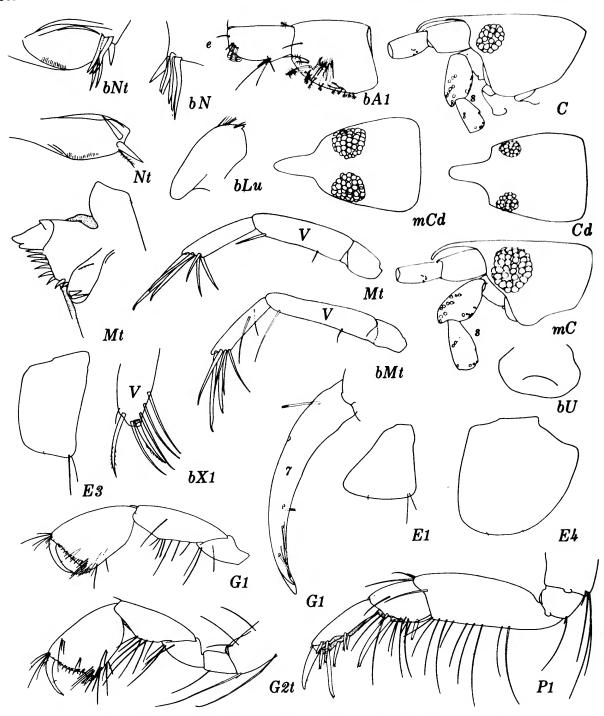


FIGURE 184.—Birubius taldeus, new species, holotype, female "a," 3.5 mm (b = male "b," 3.52 mm; m = male "m," 3.7 mm).

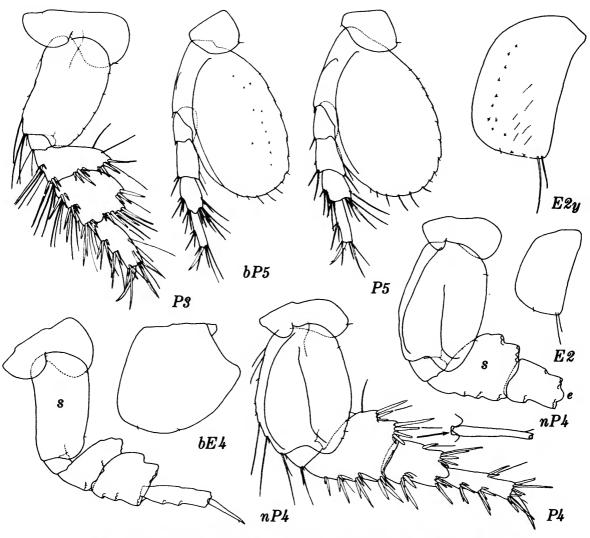


FIGURE 185.—Birubius taldeus, new species, holotype, female "a," 3.5 mm (b = male "b," 3.52 mm; n = male "n," 2.83 mm).

setae, one ventrodistal long spine; article 5 about 0.8 times as long as article 4, facial spine formula = 1-2, dorsal margin naked, ventral margin with 2 sets of 2 medium to short setae, 2 ventrodistal short to medium spines; flagellum about 1.4 times as long as articles 4-5 of peduncle combined, with 10-14 articles. Mandibles with medium to strong palpar hump; right incisor with 3 teeth; left incisor with 3 humps in 2 branches; right lacinia mobilis simple; left lacinia mobilis with 4 teeth; right rakers 7; left rakers 8; molar in form of elongate plaque, right molar with 2-4 primarily

medium spines plus one very tiny disjunct spine, left molar with 5 primarily medium spines plus one tiny disjunct spine, each molar with plusetule; palp article 1 slightly elongate, article 2 with one medium inner apical seta and one other shorter inner seta, article 3 about 0.75 times as long as article 2, oblique apex with 5–6 spine-setae, basofacial formula = 0 (left), 1–1 (right). Inner plate of maxilla 1 large, thin, bearing one long apical pluseta, one shorter similar apicomedial seta, 2 apicolateral scarcely shorter setae, palp article 2 with 2 apicalmedial marginal spines and 3–4 sub-

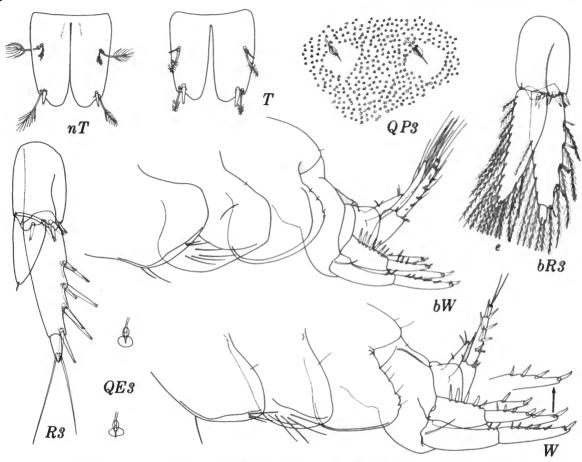


FIGURE 186.—Birubius taldeus, new species, holotype, female "a," 3.5 mm (b = male "b," 3.52 mm; n = male "n," 2.83 mm).

marginal setae, one of those apicolateral. Plates of maxilla 2 extending equally, of equal width, outer with 2 apicolateral setae, inner with one medial seta. Inner plate of maxilliped with one large, thick apical spine, 2 apicofacial setae, 3 medial setae; outer plate with 5 medial and apical spines, no apicolateral setae; palp article 1 lacking apicolateral seta, article 2 with one apicolateral seta, medial margin of article 2 weakly setose, article 3 protuberant, with 3 facial setae, no lateral setae, nail of article 4 long, with 2 accessory setules. Coxa 1 strongly expanded distally, anterior margin almost straight; main ventral setae of coxae 1-4 = 2-2-2-0, posteriormost seta of coxae 1-3 shortened; anterior and posterior margins of coxa 4 divergent, posterior margin oblique, convex, posterodorsal corner subsharp, posterodorsal margin short, concave, undulant, width-length ratio of coxa 4 = 1:1. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 1-1-2-3, long anteriors = 1-1-0-0, short anteriors = 2-3-3-3, no others. Gnathopods ordinary; width ratios of articles 5-6 on gnathopods 1-2 = 19:36 and 21:35, length ratios = 65: 56 and 58:53; palmar humps ordinary, palms weakly oblique; article 5 of gnathopod 1 elongate, narrowly ovate, posterior margin flat; article 5 of gnathopod 2 ovate, posterior margin rounded-flat. Pereopods 1-2 similar; facial setae formula on article 4 = 1 and 1, on article 5 = 1 and 1; main spine of article 5 extending to M. 75 on article 6, article 5 with one proximoposterior spine; spine formula of article 6 = 3 + 4 plus middistal seta, one spine especially long; acclivity on inner margin of dactyls of pereopods 1-2 sharp, produced as tooth, emergent setule long, midfacial pluseta ordinary. Coxae 5-7 posteroventral setule formula = 1-1-1. Articles 4-5 of pereopods 3-4 of ordinary width to broad, facial spine rows moderately developed, facial ridge formula on article 2 of pereopods 3-5 = 0-2-2 (anterior short); width ratios of articles 2, 4, 5, 6 of pereopod 3 = 45:43:38:16, of pereopod 4 = 63:49:29:13, of pereopod 5 = 82:19:17:7, length ratios of pereopod 3 = 76:30:37:40, of pereopod 4 = 87:53:41:50, of pereopod 5 = 117:26:22:29; article 2 of pereopod 5 almost reaching apex of article 5, ventral margin bearing medium sized setae; medial apex of article 6 finely combed and bearing 2 weak digital processes. Posteroventral corner of epimeron 1 rounded-quadrate, posterior margin convex, anteroventral margin with one medium seta, posteroventral face with 2-3 medium setae set vertically; posteroventral corner of epimeron 2 rounded, posterior margin weakly convex, facial setae = 4, weakly crowded, posteriormost pair set vertically; posteroventral corner of epimeron 3 rounded, then weakly protuberant, with setule sinus and small tooth, posterior margin almost straight, convex, serrate, setose (2-5 setae besides posterodorsal seta), ventral margin naked; epimera 1-3 with large seta on posterodorsal margin set in weak notch. Urosomite I naked, produced ventrally at base of uropod 1, articulation line short; urosomite 3 unprotuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, all rami but inner ramus of uropod 2 with one accessory setule, outer ramus of uropod 1 with 4-5 dorsal spines, inner with 2-3, outer ramus of uropod 2 with 2-3 dorsal spines, inner with one dorsomedial spine; peduncle of uropod 1 with 2 apicolateral spines and one basofacial seta, medially with 1-2 marginal setal spines plus apical enlarged spine; peduncle of uropod 2 with 4-5 dorsal spines, medially with one small apical spine. Peduncle of uropod 3 with 3-4 ventral spines, dorsally with 1-2 lateral spines, one medial setule; rami feminine, inner extending to M. 60 on article l of outer ramus, apex with one seta, medial and lateral margins naked, article 2 of outer ramus, ordinary, 0.25, bearing 2 long setae, apicomedial margin of article 1 naked, lateral margin with 3 acclivities, spine formula = 2-2-2-2, setal formula = 0. Telson ordinary, length-width ratio = 12:11, not fully cleft, each apex of medium width, rounded, lateral acclivity broad, shallow, bearing ordinary lateral setule, spine next medial shorter than setule, midlateral setules diverse. Cuticle with ordinary bulbar setules emerging into clear halos densely surrounded by short villi each bearing dark spot or circle, villi especially prominent on body segments, coxae 5-7, and on article 2 of pereopods 3-5, but absent or diminished on coxae 1-4, uropods, and cephalad, emergent setules ordinary.

OBSERVATIONS (female).—Facial setae on article 3 of antenna 2 short. Female "o," 3.75 mm, PPBES 978/1, with 2 apicolateral spines on peduncle of uropod 1.

Description of Male.—Eyes enlarged, clear of occluding pigment, stained eosin in color. Article 2 of antenna 1 with 4 ventral setae; primary flagellum with 9-12 articles, with one calceolus each on articles 1-3 or 1-4, aesthetascs poorly developed; accessory flagellum with 7-8 articles. Spine formula on article 4 of antenna 2 = 3-4-4 or 1-2-4-3, ventral setae of articles 4-5 short; distoventral corner of article 5 with 1-2 short, thin spines plus or minus setule, dorsal margin with 3 sets of male setae, plus or minus one calceolus; flagellar for $mula = (20-27), 2, 4, 6 \dots 22 \text{ (total 27) or } 1, 2, 4,$ 6... 20 (total 21) (or other variants). Right mandible with 6-7 rakers; left with 6-8; each molar with 3-5 thin or flat spines and one stout spine, no setule, plus extremely tiny disjunct spine; apical seta on article 2 of palp elongate, right and left palps with basofacial formula of 1-1 on article 3, each apex with 6 spine-setae. Coxa 4 broader than in female, posterodorsal margin longer. Setal formula for article 2 of gnathopods 1-2 and pereopods 1-2, long posteriors = 2-2-3-3, long anteriors = 2-3-0-0 (plus one long facial on gnathopod 2), short anteriors = 1-1-2-1, no others. Facial seta formula on article 4 of pereopods 1-2=2 and 2, on article 5 = 2 and 2-3, article 5 with one posteroproximal spine. Pereopods 3-4 with narrower articles than in female, or young male similar to female, article 2 of pereopod 5 narrower, anterior facial ridge weaker. Epimera 1-3 broadened, epimera 1-2 extremely protuberant posteriorly, posterior margin of epimeron 3 shortened; setal formulas, epimeron 1 anteroventral = 2, posteroventral = 2 vertical, epimeron 2 facial = 4, epimeron 3 posterior = 2-4 setules. Urosome slightly narrower than in female, articulation line of urosomite 1 complete. Spine formulas of uropods, uropod 1 peduncle apicolateral = 1-2, basofacial = 1, uropod 2 peduncle dorsal = 7-8, dorsal spines on outer ramus of uropod 1 = 3-5, of uropod 2 = 2-4, inner ramus of uropod l=1, of uropod l=1. Ventral spines on peduncle of uropod l=1-6, spine formula on article l of outer ramus l=1-l-2-l-2-2, setal formula l=1-l-1-l-1. Telson not elongate, distal spines slightly shortened. Following parts like those of female: maxillae, maxilliped, coxae l-3.

OBSERVATIONS (male).—Male antenna 2 with number of articles in flagellum variable and not necessarily longer in terminal males than in younger males.

ILLUSTRATIONS.—Following parts of female like those illustrated for *B. maldus* (36) except in minor details given in description: antenna 1, antenna 2, prebuccal, upper lip (as shown for male of *B. maldus*), maxillae 1–2, maxilliped, pereopodal dactyls; mandibles generally like those of *B. maldus* with differences illustrated for *B. taldeus*; male antenna 2 like male of *B. maldus*.

HOLOTYPE.—NMV, female "a," 3.5 mm.

Type-Locality.—CPBS 61N/4, 28 Mar 1965, Western Port, Victoria, Australia, 17 m, sand.

VOUCHER MATERIAL (all illustrated).—CPBS 42S/4, male "b," 3.52 mm; CPBS 61N/3, male "m," 3.7 mm; CPBS 42S/4, male "n," 2.83 mm.

RELATIONSHIP.—The Birubius taldeus group contains B. yandus (35), B. maldus (36) and B. eake (32) and is characterized by: simple right lacinia mobilis, very narrow rostrum, expanded coxa l, ordinary coxa 4 lacking long setae, and, in all but B. eake, the reduction of the setae on coxae 1-3 to 2 in number, the absence of ventral or facial setae on epimeron 3, and the presence of an accessory apical setule on the rami of uropods 1-2. Epimeron 3 is straight to slightly convex posteriorly, has a weak posteroventral protrusion with setule sinus, and, except on B. eake, has 1-5 posterior setules. The anteroventral setule on coxae 1-4 has the basal bulb reduced in size or absent in the B. taldeus group.

The B. taldeus group may have a point of origin near B. yorlunus (31) a species bearing facial and ventral setae on epimeron 3, fully developed accessory nails on uropods 1-2 and fully developed setae on coxa 1. However, this supposition would require the hypothesis that the presence of apical setule-scales on the rami of uropods 1-2 in the B. taldeus group is a case of vestigial reduction in the armament, rather than the reverse hypothesis that accessory setules become accessory nails in an ordinary pathway of evolution.

The B. taldeus group bears close resemblance to B. munggai (27) but the right lacinia mobilis of the B. taldeus group is simple, and except for B. eake, epimeron 3 lacks facial setae and bears fewer setae on epimeron 1.

Two of the species in the *B. taldeus* group share with *B. karobrani* (14) the development of ventral setae on article 2 of pereopod 5 but the *B. taldeus* group otherwise differs from *B. karobrani* in the absence of setae on coxa 4, the simple right lacinia mobilis, the poor basofacial setation on uropod 1, and the absence of true ventral setae on epimeron 3.

The B. taldeus group differs from B. eleebanus (29) in the narrower and longer rostrum, the absence of setae on coxa 4, fewer setae on other anterior coxae, no ventral setae on epimeron 3 (except for B. eake) and the reduced basofacial setation on uropod 1.

One may also trace ancestral lines for the *B. taldeus* group through the following species or groups: *B. muldarpus-B. gallangus* (9-10) and *B. mayamayi* group (11-13) via epimeron 3; *B. narus* (19) through coxa 1, the right lacinia mobilis and the fully posterodorsal setule of epimeror 3; *B. ularitus* (28) in epimeron 3 and right lacinia mobilis but not through coxa 1; and *B. kabbulinus* (33) through epimeron 3 and coxa 1.

MATERIAL.—CPBS, 26 samples from 12 stations (31); WPBES, 8 samples from 5 stations (11); PPBES, 8 samples from 4 stations (24).

DISTRIBUTION.—Victoria: Western Port and Port Philip Bay, 4-19 m, sand, silty sand.

35. Birubius yandus, new species

FIGURES 187-189

Description of Female.—Head about 20 percent of total body length, greatest width about 60 percent of length; rostrum constricted, narrow, elongate, almost reaching middle of article 2 on antenna 1. Eyes medium to large, largely occluded with pigment. Article 1 on peduncle of antenna 1 about 1.25 times as long as wide, about 1.7 times as wide as article 2, ventral margin with about 6 setules, weakly produced dorsal apex with one setule; article 2 about 0.7 times as long as article 1, with proximoventral cycle of 4-5 setae; primary flagellum with 10-11 articles, about 1.1 times as

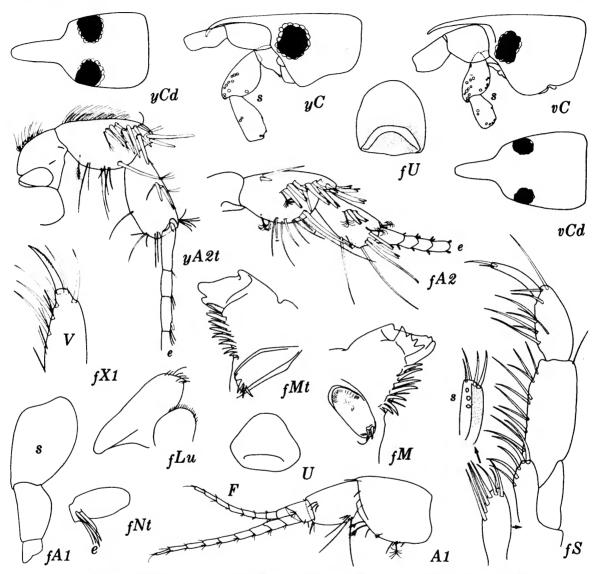


FIGURE 187.—Birubius yandus, new species, holotype, female "w," 3.17 mm (f = female "f," 3.17 mm; v = female "v," 2.91 mm; y = male "y," 2.83 mm).

long as peduncle, bearing very few aesthetascs; accessory flagellum with 8-10 articles. Spine formula on article 4 of antenna 2 = 1-3-4-3, dorsal margin with notch bearing one seta and one spine, ventral margin with 4 groups of 2 long to medium setae, one ventrodistal long spine; article 5 about 0.75 times as long as article 4, facial spine formula = 1-2, dorsal margin naked, ventral margin with 2 sets of 1-2 long to short setae, 2 ventrodistal long to medium spines; flagellum about 1.5 times as

long as articles 4-5 of peduncle combined, with 10-11 articles. Mandibles with strong palpar hump; right incisor with 3 teeth; left incisor with 4 humps in 2 branches; right lacinia mobilis simple; left lacinia mobilis with 4-5 teeth, middle teeth weakly shortened; right rakers 7-8, plus or minus one rudimentary; left rakers 8; molar in form of elongate plaque, right molar with 4 primarily long and one rudimentary spines plus setule, none disjunct, left molar with 5 primarily medium spines, none dis-

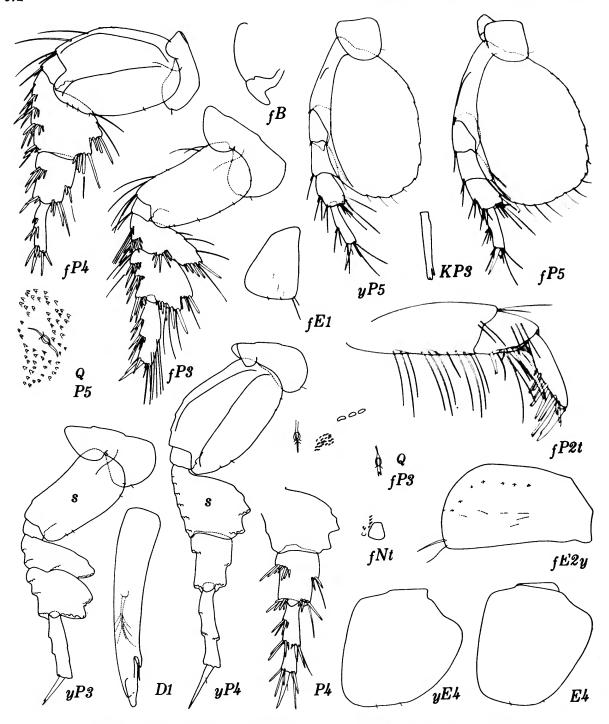


FIGURE 188.—Birubius yandus, new species, holotype, female "w," 3.17 mm (f = female "f," 3.17 mm; y = male "y," 2.83 mm; N = molar detail).

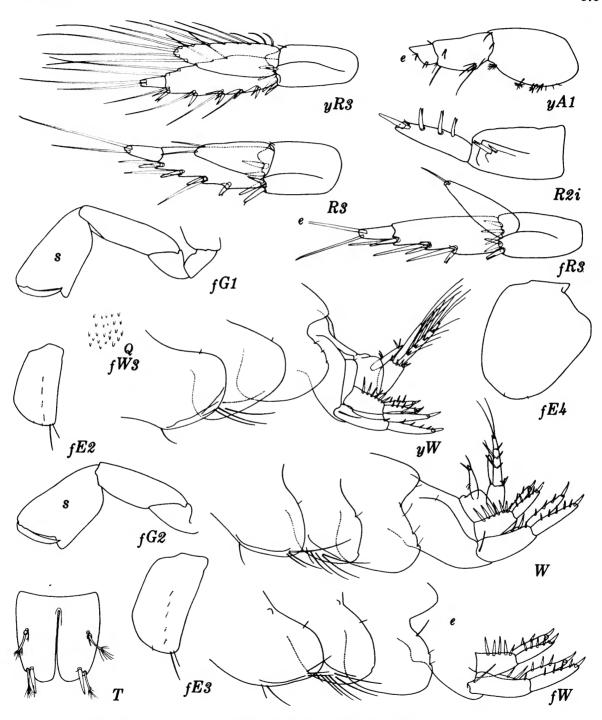


FIGURE 189.—Birubius yandus, new species, holotype, female "w," 3.17 mm (f = female "f," 3.17 mm; y = male "y," 2.83 mm).

junct, each molar with plume; palp article 1 short, article 2 with one long inner apical seta and one other short inner seta, article 3 almost 0.9 times as long as article 2, oblique apex with 6 spine-setae, basofacial formula = 0. Inner plate of maxilla 1 ordinary, bearing one long apical pluseta, one shorter apicomedial seta, 2 apicolateral scarcely shorter setae; palp article 2 with 6 apical-lateralmedial spines and setae. Plates of maxilla 2 extending equally, of equal width, outer with 2 apicolateral setae; inner with one medial seta. Inner plate of maxilliped with one large thin apical spine, 2 apicofacial setae, 4 medial setae; outer plate win 5 medial and apical spines, no apicolateral setae; palp article 1 lacking apicolateral seta, article 2 with one apicolateral seta, medial margin of article 2 weakly setose, article 3 scarcely protuberant, with 2-3 facial setae, no lateral setae, nail of article 4 medium, with 1-2 accessory setules. Coxa 1 strongly expanded distally, anterior margin almost straight; main ventral setae of coxae 1-4 = 2-2-2-0, posteriormost seta of coxae 1-3 shortened; anterior and posterior margins of coxa 4 divergent, posterior margin oblique, almost straight, posterodorsal corner rounded, posterodorsal margin short, weakly concave, width-length ratio of coxa 4 = 17:20. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 1-2-3-4, short anteriors = 2-2-2-2, long anteriors = 1-2-0-0, no others. Gnathopods ordinary; width ratios of articles 5-6 on gnathopods 1-2 = 18:35 and 21:38, length ratios = 70:61 and 63:60; palmar humps large, palms weakly oblique; article 5 of gnathopod 1 elongate, narrow, posterior margin flat, long; article 5 of gnathopod 2 elongate, posterior margin rounded-flat. Pereopods 1-2 similar; facial setae formula on article 4 = 1-1 or 2-2, on article 5 =3-3; main spine of article 5 extending to M. 80 on article 6, article 5 with one proximoposterior spine; spine formula of article 6 = 4 + 5 or 5 + 5 plus middistal seta, one spine especially long; acclivity on inner margin of dactyls of pereopods 1-2 sharp, produced as tooth, emergent setule long, midfacial pluseta ordinary. Coxae 5-7 posteroventral setule formula = 2-1-1. Articles 4-5 of pereopods 3-4broad, facial spine rows dense to moderately developed, facial ridge formula on article 2 of pereopods 3-5 = 0-2-2 (anterior ridge on pereopod 5 short); width ratios of articles 2, 4, 5, 6 of pereopod 3 = 42:48:40:14, of pereopod 4 = 58:48:26:8, of pereopod 5 = 85:19:18:7, length ratios of pereopod 3 = 73:33:42:43, of pereopod 4 = 85:47: 34:45, of pereopod 5 = 111:23:23:28; article 2 of pereopod 5 exceeding middle of article 5, ventral margin with long setae; medial apex of article 6 finely combed, bearing 3 very weak digital processes. Posteroventral corner of epimeron 1 rounded, posterior margin convex, anteroventral margin with 1-2 medium setae, posteroventral face with 2-3 medium setae set vertically; posteroventral corner of epimeron 2 weakly protuberant, posterior margin convex, facial setae = 4-6, posteriormost pair set vertically; posteroventral corner of epimeron 3 broadly rounded, with setule sinus far above, with small tooth, posterior margin weakly to strongly convex, with 0-1 setule notch, ventral margin naked; epimera 1-3 with large seta on posterodorsal margin set in weak notch. Urosomite I naked, produced ventrally at base of uropod I, articulation line incomplete; urosomite 3 protuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, outer rami of uropods 1-2 with accessory setule, outer ramus of uropod 1 with 3-5 dorsal spines, inner with 2-3, outer ramus of uropod 2 with 3-4 dorsal spines, inner with 2 dorsomedial spines, outer rami continuously spinose to apex; peduncle of uropod 1 with one apicolateral spine, and one basofacial seta, medially with 2 thin marginal spines plus apical enlarged spine; peduncle of uropod 2 with 5-7 dorsal spines, medially with pair of apical spines. Peduncle of uropod 3 with 4-5 ventral spines, dorsally with one lateral spine, one medial setule; rami feminine, inner extending to M. 70 on article 1 of outer ramus, apex with 1-2 setae, medial and lateral margins usually naked; article 2 of outer ramus elongate, 0.33, bearing 2 medium to long setae, apicomedial margin of article 1 lacking setae, lateral margin with 2-3 acclivities, spine formula = 2-2-2or 1-2-2-2, setal formula = 0. Telson ordinary, length-width ratio = 12:11, not fully cleft, each apex of medium width, rounded, lateral acclivity shallow, weak, bearing ordinary lateral setule, spine next medial of length equal to setule, or much longer in subadults, midlateral setules diverse. Cuticle with ordinary bulbar setules surrounded by sharp or blunt villi bearing central spots; emergent setules ordinary.

OBSERVATIONS (female).—Female "f": Head malformed, upper lip massively cornified (illustrated),

right molar with extra minute spines around short blunt spine (illustrated), left molar with only 2 spines (illustrated), coxa 4 narrowed distally (illustrated), article 6 of pereopod 4 shortened (illustrated), urosome damaged, cuticle on coxae 5-7 and bases of pereopods 3-5 with villi reduced to minute crescentic studs (illustrated); specimen probably most advanced female available and widely illustrated but basic description including holotype and other similar females.

DESCRIPTION OF MALE.—Rostrum slightly longer and broader than in female. Primary flagellum of antenna 1 with 11 articles, one calceolus each on articles 2, 3, 4, aesthetascs poorly developed; accessory flagellum 8-articulate. Formula on article 4 of antenna 2 = 3-4-3, of article 5 = 2, ventral apex of article 5 with 2 thin spines and setule, dorsal margin with 3 sets of male setae; flagellar for $mula = (24-25), 2, 4, 6 \dots 22 \text{ (total 24) or 3, 5,}$ 7... 21 (total 25). Article 3 of mandibular palp with basofacial setal formula of 1-1; left lacinia mobilis with 4 teeth. Palp of maxilla 1 with 5 setae and spines. Coxa 4 broader than in female, smaller relative to size of coxa 1 than in female. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 1-2-2-2, long anteriors = 1-2-0-0, short anteriors = 2-3-2-1, no others. Pereopods 1-2, article 4 with one facial seta, article 5 with 2, article 6 with 4 + 5 spines plus middistal seta, article 5 with one proximoposterior spine each. Article 2 of pereopods 3-5 narrower than in female. Epimera 1-3 broadened, epimera 1-2 strongly protruding posteriorly, posterior margin of epimeron 3 shortened; setae shortened, setal formulas, epimeron 1 anteroventral = 1, posteroventral = 2vertical, epimeron 2 facial = 4, epimeron 3 posterior = 3. Urosome much smaller than in female. Spine formulas of uropods, uropod 1 peduncle apicolateral = 1, medial = 2, basofacial = 1, uropod2 peduncle dorsal = 6, dorsal spines on outer ramus of uropod 1 = 4, of uropod 2 = 4, inner ramus of uropod 1 = 2, of uropod 2 = 3. Ventral spines on peduncle of uropod 3 = 5, spine formula on article 1 of outer ramus = 2-1-2-2-2 or 2-2-2-2, setal formula = 0-1-1-1-1 or 1-1-1-1. Telson slightly elongate, distal spines scarcely shortened.

ILLUSTRATIONS.—Mandibles and maxillae of holotype not illustrated, mandibles of female "f" illustrated, maxillae generally like those of *B. maldus* (36); setosity of gnathopods generally as in *B. tal-* deus (34); part of urosome on female "f" omitted owing to damage; attachment of inner ramus on uropod 3 of female "f" reconstructed owing to shriveling; calculations for pereopods 3-5 based on holotype.

HOLOTYPE.—NMV, female "w," 3.17 mm. TYPE-LOCALITY.—PPBES 960/2, 16 Feb 1971, Port Phillip Bay, Victoria, Australia, 17 m, sand.

VOUCHER MATERIAL (all illustrated).—PPBES 960/3, female "f," 3.17 mm; PPBES 967/5, male "y," 2.83 mm; PPBES 967/2, female "v," 2.91 mm.

RELATIONSHIP.—Within its subgroup of Birubius, B. yandus is characterized by the evenly continuous dorsal spination on the outer rami of uropods 1-2. In the other species of the group a wide gap occurs between the apex of the ramus and the first spine, a gap wider than the distance between spines 1 and 2. Birubius yandus differs from B. maldus (36) in the villose cuticle and from B. taldeus (34) in the presence of only one apicolateral spine on the peduncle of uropod 1 in adults.

MATERIAL.—PPBES, 14 samples from 4 stations (59).

DISTRIBUTION.—Victoria: Western Port and Port Phillip Bay, 5-17 m, sand.

36. Birubius maldus, new species

FIGURES 190-192

DESCRIPTION OF FEMALE.—Head about 20 percent of total body length, greatest width about 55-60 percent of length; rostrum constricted, narrow, elongate, exceeding middle of article 2 on antenna 1. Eyes medium to large, clear of pigment, ommatidia especially large. Article 1 on peduncle of antenna 1 about 1.3 times as long as wide, about twice as wide as article 2, ventral margin with about 9 setules, weakly produced dorsal apex with one setule; article 2 about 0.7 times as long as article 1, with ventral cycle of 4 setae; primary flagellum with 10 articles, about 0.9 times as long as peduncle, aesthetascs weakly developed; accessory flagellum with 8-9 articles. Spine formula on article 4 of antenna 2 = 1-3-4-3 (one hidden in illustration), dorsal margin with notch bearing one seta and one spine, ventral margin with 2 groups of 2-3 long to medium setae, one ventrodistal long spine; article 5 about 0.7 times as long as article 4, facial spine formula = 1-2, dorsal margin naked,

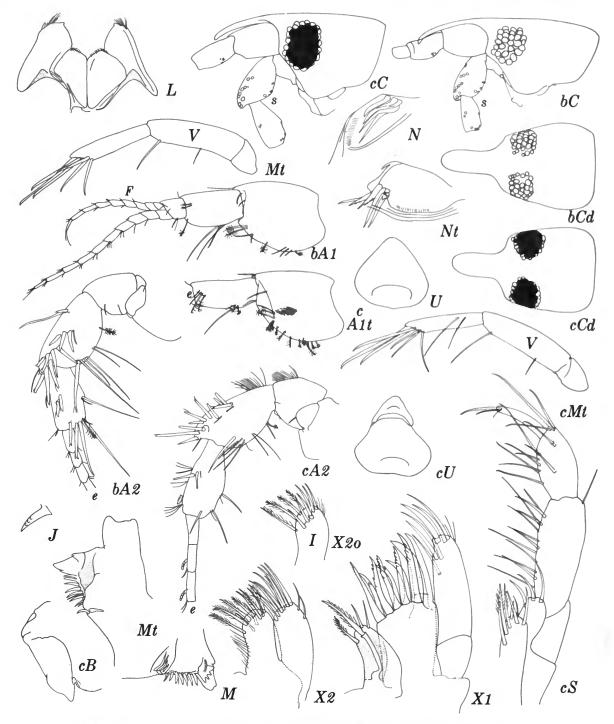


FIGURE 190.—Birubius maldus, new species, holotype, female "a," 3.20 mm (b = female "b," 3.21 mm; c = male "c," 3.10 mm).

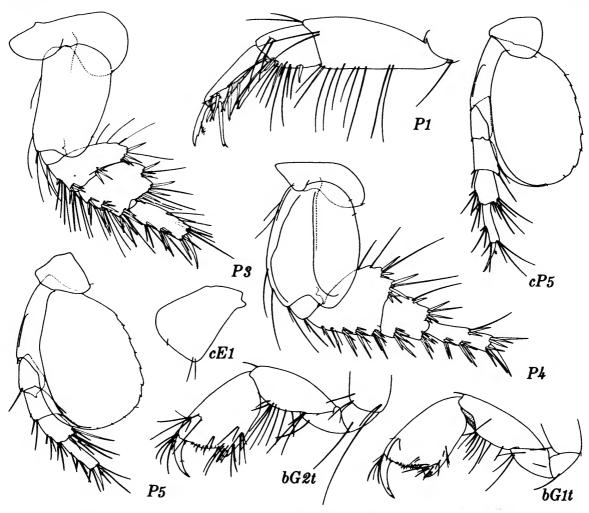


FIGURE 191.—Birubius maldus, new species, holotype, female "a," 3.20 mm (b = female "b," 3.21 mm; c = male "c," 3.10 mm).

ventral margin with 2 sets of 2-3 long to short setae, 2 ventrodistal long to medium spines; flagellum about 1.35 times as long as articles 4-5 of peduncle combined, with 10 articles. Mandibles with strong palpar hump; right incisor with 3 teeth; left incisor with 3 humps in 2 branches; right lacinia mobilis simple, denticulate; left lacinia mobilis with 4 teeth; right rakers 7 plus one rudimentary; left rakers 7-8; molar in form of short protrusion or bulbous hump demarcated mainly by spines, right molar with 4-5 primarily long spines plus one short spine not disjunct, left molar with 4 long spines, each molar with plume; palp article 1 short, article 2 with one medium

inner apical seta and one other shorter inner seta, article 3 about 0.9 times as long as article 2, oblique apex with 6 spine-setae, basofacial formula = 0. Inner plate of maxilla 1 thin, bearing one long apical pluseta, one shorter apicomedial seta, 2 apicolateral scarcely shorter setae; palp article 2 with 2 apicalmedial marginal spines and 4 submarginal setae. Plates of maxilla 2 extending equally, of equal width, outer with 2 apicolateral setae, inner with one medial seta. Inner plate of maxilliped with one large, thick, apical spine, 2 apicofacial setae, 3 medial setae, outer plate with 4 medial and apical spines, no apicolateral setae; palp article 1 lacking apicolateral seta, article 2

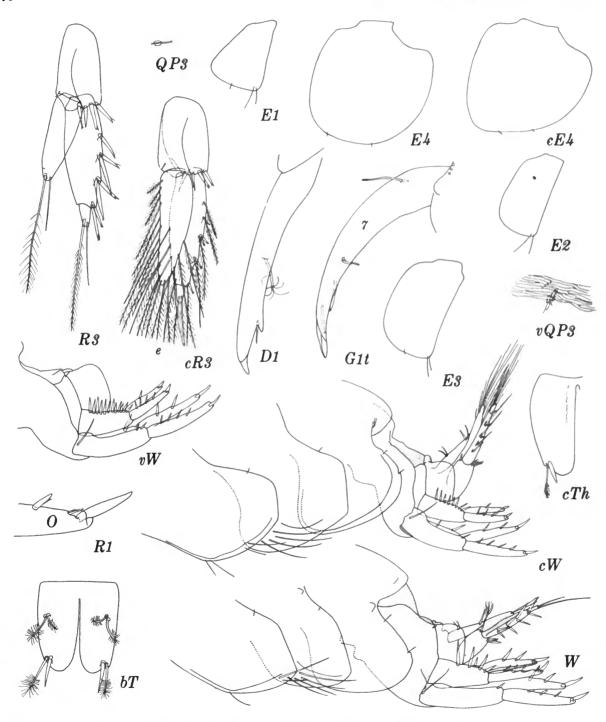


FIGURE 192.—Birubius maldus, new species, holotype, female "a," 3.20 mm (b = female "b," 3.21 mm; c = male "c," 3.10 mm; v = male "v," 3.27 mm).

with one apicolateral seta, medial margin of article 2 moderately to weakly setose, article 3 weakly protuberant, with 2 facial setae, no lateral setae, nail of article 4 long, with 2 accessory setules. Coxa 1 expanded distally, anterior margin straight; main ventral setae of coxae 1-4 = 2-2-2-0, posteriormost seta of coxae 1-3 slightly shortened; anterior and posterior margins of coxa 4 almost parallel, posterior margin very convex, posterodorsal corner rounded, posterodorsal margin short, concave, width-length ratio of coxa 4 = 1:1; long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 2-3-3-3, long anteriors = 2-3-0-0, short anteriors = 1-1-3-1, no others. Gnathopods ordinary; with ratios of articles 5-6 on gnathopods 1-2 = 22:36 and 25:36, length ratios = 65:60 and 60:61; palmar humps large, palms oblique; article 5 of gnathopod 1 elongate, ovate, posterior margin rounded-flat, article 5 of gnathopod 2 ovate, posterior margin rounded. Pereopods 1-2 similar; facial setae formula on article 4 = 2 and 2, on article 5 = 2 and 2, or 3 and 3; main spine of article 5 extending to M. 80 on article 6, article 5 with one proximoposterior spine; spine formula of article 6 = 3 + 4 and 4 + 4 plus middistal seta, one spine especially long; acclivity on inner margin of dactyls of pereopods 1-2 sharp, produced as tooth, emergent setule long, midfacial pluseta short. Coxae 5-7 posteroventral setule formula = l-l-1. Articles 4-5 of pereopods 3-4 of ordinary width to broad, facial spine rows moderately developed, facial ridge formula on article 2 of pereopods 3-5 = 0-2-2 (anterior short on pereopod 5); width ratios of articles 2, 4, 5, 6 of pereopod 3 = 45:46:39:15, of pereopod 4 = 60:47:28:11, of pereopod 5 =80:19:15:7, length ratios of pereopod 3 = 75: 31:37:41, of pereopod 4 = 84:47:32:45, of pereopod 5 = 115:25:21:28; article 2 of pereopod 5 reaching middle of article 5; medial apex of article 6 finely combed and bearing 2 obsolescent digital processes. Posteroventral corner of epimeron 1 rounded-quadrate, posterior margin straight, anteroventral margin with one medium seta, posteroventral face with 2 long setae set vertically; posteroventral corner of epimeron 2 rounded-quadrate, posterior margin straight, facial setae = 4-5, posteriormost pair set vertically; posteroventral corner of epimeron 3 rounded, undulant, weakly protuberant, with setule sinus, posterior margin almost straight, ventral margin naked; epimera 1-3 with

setule on posterodorsal margin. Urosomite 1 produced ventrally at base of uropod 1, articulation line short; urosomite 3 unprotuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, outer rami of uropods 1-2 with one accessory setule, outer ramus of uropod 1 with 3 dorsal spines, inner with 2, outer ramus of uropod 2 with 3 dorsal spines, inner with 2 dorsomedial spines; peduncle of uropod 1 with one apicolateral spine and one basofacial seta, medially with one marginal seta and apical enlarged spine; peduncle of uropod 2 with 4 dorsal spines, medially with one small apical spine. Peduncle of uropod 3 with 3 ventral spines, dorsally with one lateral spine, one medial setule; rami feminine to submasculine, inner extending to M. 75 on article 1 of outer ramus, apex with 1-2 setae, medial and lateral margins naked, article 2 of outer ramus ordinary, 0.22, bearing 2 medium to long setae, apicomedial margin of article 1 naked, lateral margin with 3 acclivities, spine formula = 1-2-2-2, setal formula = 0. Telson ordinary, length-width ratio = 12:11, not fully cleft, each apex of medium width, rounded, lateral acclivity narrow, weak, bearing long lateral setule, spine next medial of length equal to setule, midlateral setules diverse. Cuticle with ordinary bulbar setules, setules especially short.

DESCRIPTION OF MALE.—Article 2 of antenna 1 with 4-6 ventral setae; primary flagellum with 11 articles, one calceolus each on articles 1-5 or 1-6, aesthetascs very poorly developed; accessory flagellum with 9 articles. Facial formula on article 4 of antenna 2 = 3-4-3, on article 5 = 2, article 5 with 3 dorsal sets of male setae and 0-1 calceolus, distoventral corner with 1-2 thin spines and 0-1 setule; flagellar formula, (25-26), 1, 2, 4, 6 . . . (25 or 26), or 2, 4, 6 . . ., or 2, 3, 5, 7 Apical seta on article 2 of mandibular palp more elongate than in female, basofacial setal formula on article 3 = 1-1; right rakers = 8 plus one rudimentary; left rakers = 9; each molar with 5 spines and plume. Inner plate of maxilla 1 with only one apicolateral seta instead of 2 as in female; palp with only 5 spines and setae. Outer plate of maxilliped with 6 spines (2 forming pair). Coxa 4 relatively broader than in female, coxa 1 larger in relation to coxa 4 than in female. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 1-1-2-3, long anteriors = 1-2-0-0, short anteriors = 2-2-2-2, no others. Facial setae on article 4 of pereopods

1-2 = 1 and 1-2, on article 5 = 2 and 2, spines on article 6 = 3 + 4 and 4 + 4 plus middistal seta, article 5 with one posterior spine on both pairs. Article 2 of pereopods 3-5 narrower than in female, articles 4-5 of pereopod 4 more elongate, width ratios of articles 5-6 = 26:11, length ratios = 40:54 (in same enlargement as female). Epimera 1-3 broadened, posterior margin of epimera 1-2 strongly protuberant, posterior margin of epimeron 3 shortened; setal formulas, epimeron 1 anteroventral = 1-2, posteroventral = 2 horizontal or vertical, epimeron 2 facial = 3-5, epimeron 3 posterior = 2. Urosome smaller than in female, articulation line of urosomite 1 almost complete. Spine formulas of uropods, uropod 1 peduncle apicolateral = 1-2, basofacial = 1, uropod 2 peduncle dorsal = 8 (12 in supermale), dorsal spines on outer ramus of uropod l = 4, of uropod 2 = 3-4, inner ramus of uropod 1 = 2, of uropod 2 = 1. Ventral spines on peduncle of uropod 3 = 4 (7 in supermale), spine formula on article 1 of outer ramus = 1-1-2-2-2, or 1-2-2-2-2, setal formula = 1-1-1-11-1. Telson elongate, distal spines shortened. Bulbar setules on cuticle much sparser than in female but cuticle becoming covered with fingerprint striations, grosser in terminal males.

OBSERVATIONS.—Larger or older males and females with apices on outer rami of uropods 1-2 becoming attenuate, distance between apex and first distal spine becoming greater and greater; females "a" and "b" each with one egg in brood pouch, female "a" with additional object, perhaps rotted egg.

ILLUSTRATIONS.—Female upper lip shown without epistomal part; male upper lip drawn with epistomal part, entire figure drawn from slightly oblique dorsal view, but male without ventral hump; illustration of right (to viewer) side of lower lip with outer margin folded.

HOLOTYPE.—NMV, female "a," 3.20 mm.

Type-Locality.—CPBS 12S/3, 18 Mar 1965, Western Port, Victoria, Australia, 2 m, muddy sand.

VOUCHER MATERIAL (all illustrated).—Type-locality, female "b," 3.21 mm (with much enlarged eyes); CPBS 51N/1171, male "c," 3.10 mm; PPBES 974/1, supermale "v," 3.27 mm.

RELATIONSHIP.—This species differs from B. taldeus (34) and B. yandus (35) in the nonvillose cuticle and the poor ventral setation on article 2 of

pereopod 5. From B. yandus, in addition, it differs in the wide gap between the apex and first distal spine on the outer rami of uropods 1-2. From B. taldeus, in addition, it differs in the parallel anterior and posterior margins of coxa 4 in the female, the presence of only one apicolateral spine on the peduncle of uropod 1 (but supermale B. maldus bears 2 spines and females of B. taldeus often have only 1 spine), the longer spines on the telson, presence of 2 elements in dorsal notch on article 4 of female antenna 2, elongate apical setae on the inner ramus of uropod 3 of the female, narrower coxae 1-2, longer spines on the peduncle of uropod 2 and the longer rostra and larger eyes in both sexes.

MATERIAL.—CPBS, 13 samples from 7 stations (22); WPBES, 2 samples from 2 stations (2); PPBES, 19 samples from 10 stations (30).

DISTRIBUTION.—Victoria: Western Port and Port Phillip Bay, 2–25 m, sand, muddy sand, clayey silt, clay.

37. Birubius wulgaru, new species

FIGURES 193-198

DESCRIPTION OF FEMALE.—Head about 15 percent of total body length, greatest width 65-75 percent of length; rostrum obsolescent, scarcely reaching along article 1 on antenna 1. Eyes medium-large, largely occluded with pigment, ommatidia especially large. Article 1 on peduncle of antenna 1 about 1.4 times as long as wide, about 1.75 times as wide as article 2, ventral margin with about 5-6 setules, weakly produced dorsal apex with 1-3 setules; article 2 about 0.75 times as long as article 1, with ventral cycle of 6 setae; primary flagellum with 10-11 articles, about 1.2-1.3 times as long as peduncle, lacking aesthetascs; accessory flagellum with 8 articles. Spine formula on article 4 of antenna 2 = 1-3-4-4, dorsal margin with notch bearing one spine, ventral margin with 2-3 groups of 2-4 long or medium setae, one ventrodistal long spine; article 5 about 0.7 times as long as article 4, facial spine formula = 1-2, dorsal margin naked, ventral margin with 2 sets of 1-2 long to short setae, 2 other ventrodistal long to medium spines disjunct or not from apicoventral spine; flagellum 1.5-1.8 times as long as articles 4-5 of peduncle combined, with 11 articles. Mandibles with me-

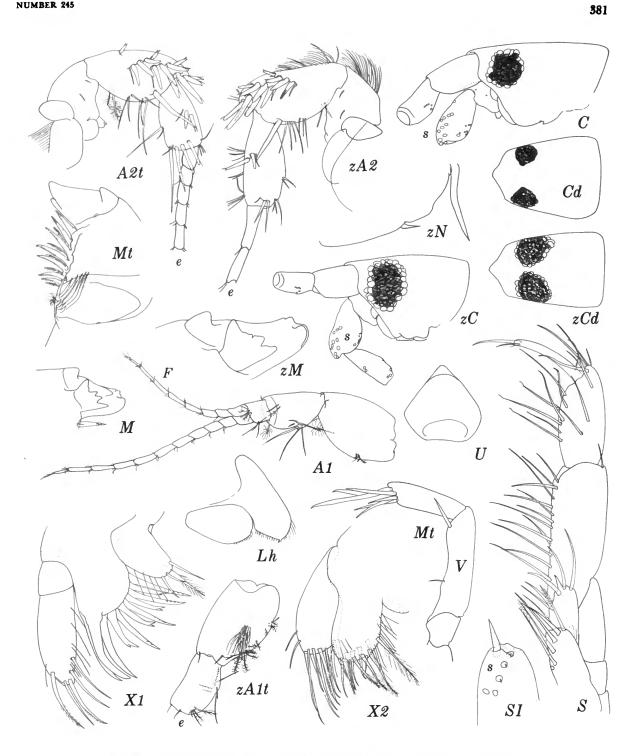


FIGURE 193.—Birubius wulgaru, new species, female "c," 3.3 mm (z = male "z," 3.4 mm).

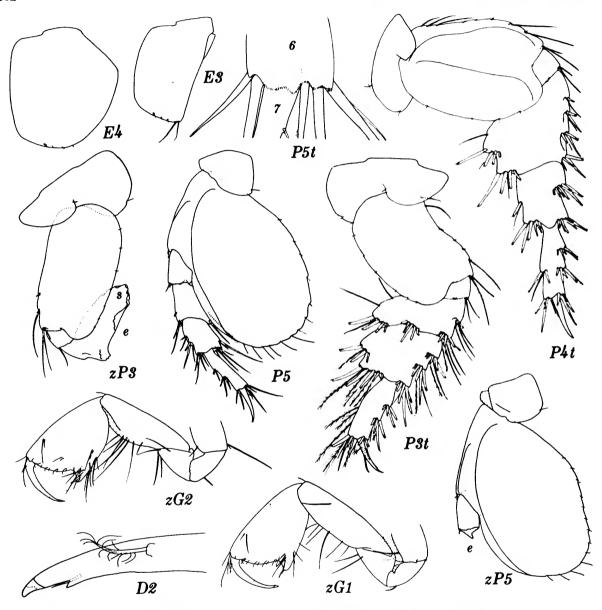


FIGURE 194.—Birubius wulgaru, new species, female "c," 3.3 mm (z = male "z," 3.4 mm).

dium palpar hump; right incisor with 3 teeth; left incisor with 3-4 humps in 2 branches; right lacinia mobilis simple, denticulate; left lacinia mobilis with 4 teeth plus one accessory tooth, middle teeth shortened; right rakers 6; left rakers 7; molar in form of elongate plaque, weakly bulbous, each molar with 6 primarily long spines plus one tiny spine strongly disjunct, usually each molar with plume; palp article 1 slightly elongate, article 2

with one long to short inner apical seta and one other shorter inner seta, article 3 about 0.7-0.8 times as long as article 2, oblique apex with 6 spine-setae, basofacial formula = 0. Inner plate of maxilla 1 ordinary to large, bearing one long apical pluseta, one shorter similar apicomedial seta, 2 apicolateral shorter setae, palp article 2 with 5 apicalmedial-lateral marginal spines and setae. Plates of maxilla 2 extending subequally, outer

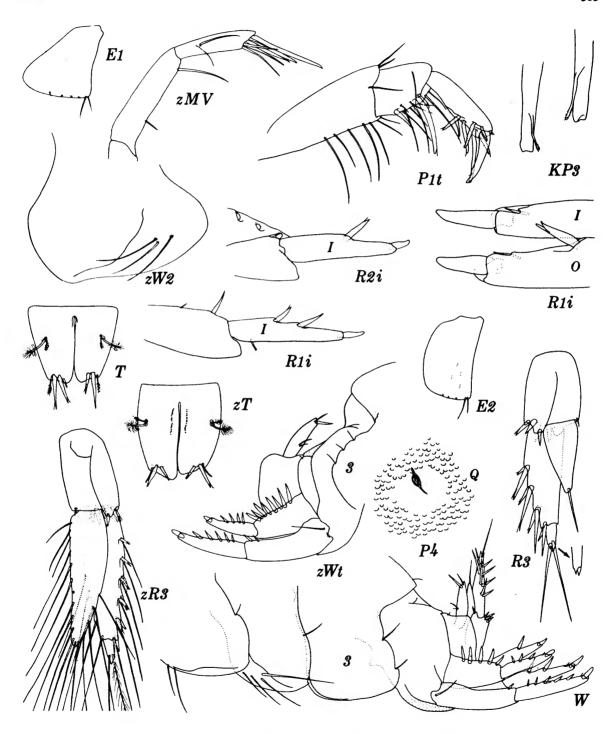


FIGURE 195.—Birubius wulgaru, new species, female "c," 3.3 mm (z = male "z," 3.4 mm).

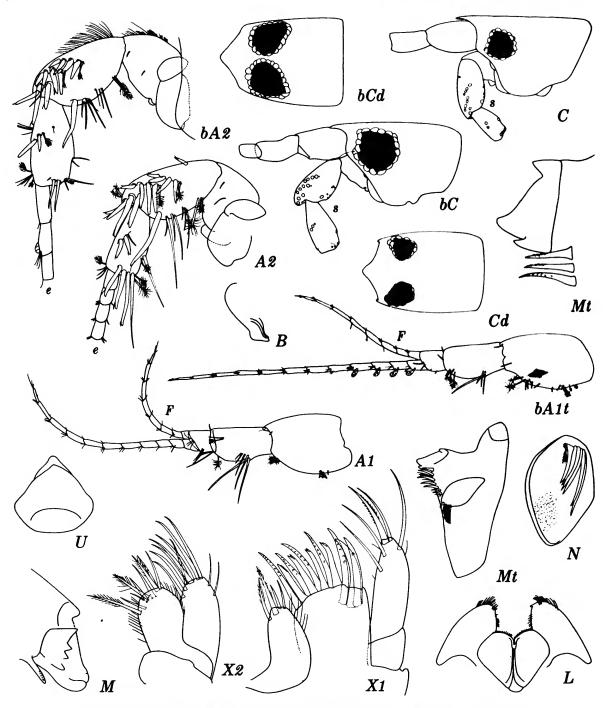


FIGURE 196.—Birubius wulgaru, new species, holotype, female "a," 3.42 mm (b = male "b," 3.49 mm).

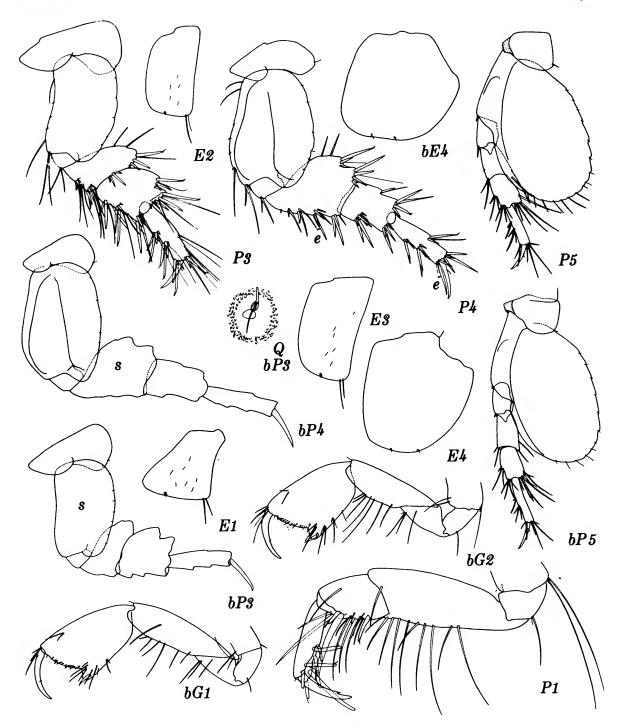


FIGURE 197.—Birubius wulgaru, new species, holotype, female "a," 3.42 mm (b = male "b," 3.49 mm).

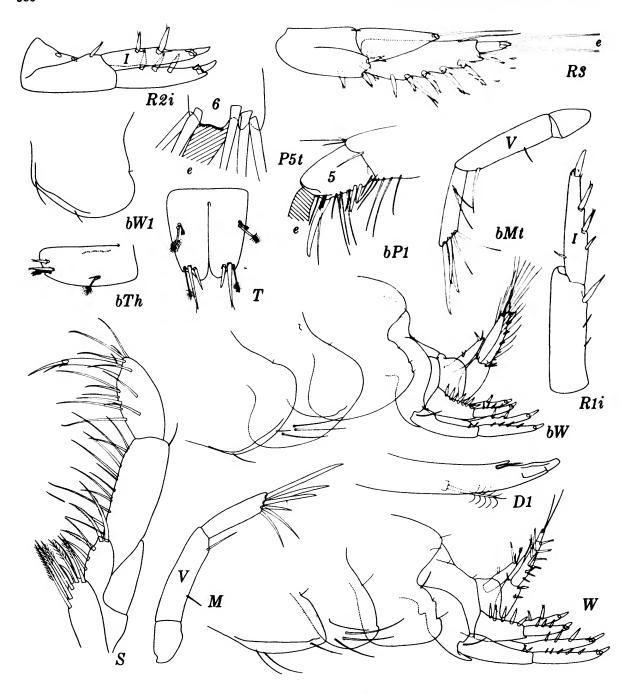


FIGURE 198.—Birubius wulgaru, new species, holotype, female "a," 3.42 mm (b = male, "b," 3.49 mm).

narrower than inner, outer with 2 apicolateral setae, inner with one medial seta. Inner plate of maxilliped with one large, thick apical spine, 2-3 apicofacial setae, 4 medial setae in L-pattern; outer plate with 2-5 medial and apical spines, 1-2 apicolateral setal spines, and weak to strong apical spout; palp article I lacking apicolateral seta, article 2 with one apicolateral seta, medial margin of article 2 moderately setose, article 3 protuberant, with 3 facial setae, no lateral setae, nail of article 4 long, with 2 accessory setules. Coxa 1 strongly expanded distally, anterior margin straight; main ventral setae of coxae 1-4 = 2-2-2-0, posteriormost seta of coxae 1-3 shorter; anterior and posterior margins of coxa 4 divergent, posterior margin very oblique, convex, posterodorsal corner rounded, posterodorsal margin long to ordinary, straight, width-length ratios of $\cos 4 = 7.8$ or 9.10. Long posterior setae of gnathopods 1-2 and pereopods 1-2 = 1-(1-2)-2-3, short anteriors = 2-2-4-4, long anteriors = 1-2-0-0, no others. Gnathopods with elongate wrists and broadened hands; width ratios of articles 5-6 on gnathopods 1-2 = 20:38 and 19:39, length ratios = 73:65 and 65:60; palmar humps large, palms oblique; article 5 of gnathopod 1 ovate, posterior margin flat, long; article 5 of gnathopod 2 ovate, posterior margin rounded-flat. Pereopods 1-2 similar; facial setae formula on article 4 = 1 and 1, on article 5 = 1 and 1; main spine of article 5 extending to M. 80-95 on article 6, article 5 with one proximoposterior spine; spine formula of article 6 = 3 + 4 and/or 4 + 4 plus middistal setule, one spine especially long; acclivity on inner margin of dactyls of pereopods 1-2 sharp, produced as tooth, emergent setule long, midfacial pluseta ordinary. Coxae 5-7 posteroventral setule formula = l-1-1. Articles 4-5 of pereopods 3-4 broad, facial spine rows dense to moderately developed, facial ridge formula on article 2 of pereopods 3-5 = 0-2-2, anterior ridge on pereopod 5 short; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 42:42:34:14, of pereopod 4 = 55:42:26:13, of pereopod 5 = 78:17:16:16, length ratios of pereopod 3 = 73:30:35:43, of pereopod 4 = 78:45:37:45, of pereopod 5 = 106:27:24:30; article 2 of pereopod 5 reaching apex or middle of article 5, ventral margin of article 2 moderately setose; medial apex of article 6 finely combed and bearing obsolescent digital processes. Posteroventral corner of epimeron l rounded-quadrate or weakly

protuberant, posterior margin straight to weakly convex, anteroventral margin with 2 long setae, posteroventral face with 0-1 long seta; posteroventral corner of epimeron 2 weakly protuberant, with small, sharp tooth, posterior margin convex, facial setae = 3-4, posteriormost pair set vertically; posteroventral corner of epimeron 3 rounded, then weakly protuberant, with setule sinus, posterior margin weakly convex, with 0-1 setule notch, ventral margin naked; epimera 1-3 with large seta on posterodorsal margin set in weak to deep notch, epimeron 3 thus with 2-3 posterior setae and setules. Urosomite I naked, articulation line obsolescent or incomplete, often shifted anteroventrally; urosomite 3 unprotuberant dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, outer rami of uropods 1-2 and inner ramus of uropod 1 with one accessory setule, outer ramus of uropod 1 with 4-5 dorsal spines, inner with 2-3, outer ramus of uropod 2 with 3 dorsal spines, inner with 1-2 dorsomedial spines; peduncle of uropod 1 with 1-2 apicolateral spines and one basofacial seta, medially with 2-3 marginal setae and spines, apicalmost an enlarged spine; peduncle of uropod 2 with 4-5 dorsal spines, medially with one small apical spine. Peduncle of uropod 3 with 3-4 ventral spines and occasional extra proximal spine, dorsally with one lateral spine, one medial setule; rami feminine, inner extending to M. 70 on article 1 of outer ramus, apex with one seta, medial and lateral margins naked, article 2 of outer ramus elongate, 0.30, bearing 2 long setae, apicomedial margin of article 1 with 0-1 seta, lateral margin with 3-5 acclivities, spine formula = 2-2-2-2 or 1-2-2-2-2, setal formula = 0. Telson ordinary, length-width ratio = 12:11, not fully cleft, each apex of medium width, rounded-truncate, lateral acclivity deep, broad, bearing long lateral setule, spine next medial longer than setule, and second shorter spine next medial, midlateral setules diverse. Cuticle with ordinary bulbar setules surrounded by clear halo in midst of weak to dense villose-scale pebbling, emergent setules ordinary.

OBSERVATIONS (female).—Female "c": Width ratios of articles 5–6 of gnathopods 1–2 = 22:39 and 22:40, length ratios = 75:65 and 68:61. Posterior margin of article 4 on pereopod 1 with 7 setae between M. 50 and M. 100, on pereopod 2 with 9 setae between M. 33 and M. 100. Width ratios of articles 2, 4, 5, 6 of pereopod 3 = 53:55:46:17, of

pereopod 4 = 68:58:32:17, of pereopod 5 = 93: 22:18:9, length ratios of pereopod 3 = 83:27:40: 47, of pereopod 4 = 95:60:43:50, of pereopod 5 = 120:30:26:35. Articulation line of urosomite 1 almost absent. Lateral margin on article 1 of uropod 3 with 3 acclivities, spine formula = 2-2-2-2. Lateral acclivity on telson weak, occasionally one lobe with third small spine.

DESCRIPTION OF MALE.—Rostrum more attenuate than in female. Article 2 of antenna 1 with 8 ventral setae; flagella elongate; primary flagellum with 12-13 articles, one calceolus each on articles 1-4, aesthetascs absent; accessory flagellum with 8 articles. Facial spine formula on article 4 of antenna 2 = 1-2-4-4, on article 5 = 2; article 5 with 3 dorsal sets of male setae, no calceoli, ventrodistal apex with 2 thin spines and one setule; flagellar formula = 25, 2, 4, 6 . . . 22. Right rakers 7 plus one rudimentary; left rakers 8 plus one rudimentary; left lacinia mobilis with middle teeth obsolescent; right molar with 6-8 spines plus weak plume, usually no disjunct spine, left molar with 5-6 spines, weak plume and disjunct spine or not, basofacial setal formula on article 3 of mandibular palp = 1-1, terminal = 6. Coxa 4 broadened but smaller in relation to coxa 1 than in female. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 1-2-2-(2-3), long anteriors = 0-2-0-0, short anteriors = 2-2-4-3, no others. Spine formula of pereopods 1-2 on article 6 = 4 + 4 plus middistal seta, on posteroproximal margin of article 5 = 1-2. Article 2 of pereopods 3-5 not distinctly narrower than in female but posterior margin of pereopod 5 flattened. Epimera 1-3 broadened, posterior margin of epimeron 3 shortened; setal formulas, epimeron 1 anteroventral = 1, posteroventral = 1, epimeron 2 facial = 3, epimeron 3 posterior = 2-3 setules, dorsoposterior setule on epimera 1-3 small. Spine formulas of uropods, uropod 1 peduncle apicolateral = 2, basofacial = 1, uropod 2 peduncle dorsal = 8, dorsal spines on outer ramus of uropod l = 4, of uropod 2 = 4, inner ramus of uropod 1 = 2, of uropod 2 = 1-2. Ventral spines on peduncle of uropod 3 = 4, spine formula on article 1 of outer ramus = 1-2-2-2-2-2 or 1-1-2-2-2-2, setal formula = l-l-l-l-l. Telson elongate, distal spines slightly shortened.

OBSERVATIONS.—Cuticular villi densest on pereopods 3-5 and dorsally on pleonites 1-3, sparse on epimera, decreasing in density anteriorly on body segments and absent on anterior body segments, absent on urosome except dorsally; note illustrations of truncate spines on pereopods (3-4); each description based on 2 females and 2 males, numerous minor details distinctive as shown in illustrations.

ILLUSTRATIONS.—Holotype, female "a": left molar with dotted setule present only on right molar; apex of palp on maxilla 1 not fully flattened. Female "c": several pereopods illustrated from right side because of damage on left side of specimen. Male "z": left molar enlargement showing disjunct spine but only one spine of elongate group shown for simplicity.

HOLOTYPE.—NMV, female "a," 3.42 mm.

3.3 mm; male "z," 3.4 mm.

Type-Locality.—WPBES 1704/2, 22 Nov 1973, Western Port, Victoria, Australia, 12 m, clayey sand. Voucher Material (all illustrated).—Type-locality: male "b," 3.49 mm. PPBES 980/3: female "c,"

RELATIONSHIP.—Birubius wulgaru is an extension of the B. taldeus (34) group. Strong resemblance occurs in the right lacinia mobilis, coxae 1-4, cuticle, epimera 1-3, and basofacial setae of uropod 1. Birubius wulgaru differs from the B. taldeus group in the much shorter rostrum and presence of two spines on each apex of the telson (in contrast to one spine on each apex).

Birubius wulgaru might be more directly descendent from B. eleebanus (29) than from the B. taldeus group. There is a strong resemblance between the two species in cephalic reduction, shapes of gnathopods, cuticle, maxilla 2, and the posterior margin of epimeron 3 but B. wulgaru differs from B. eleebanus in the strong reduction of coxal setae, much stouter lateral spines on article 1 of the outer ramus on uropod 3 and the absence of ventral setae on epimeron 3.

MATERIAL.—WPBES, one sample (2); PPBES, 3 samples from 2 stations (4).

DISTRIBUTION.—Victoria: Western Port and Port Phillip Bay, 12-31 m, sand.

Yan, new genus

DIAGNOSIS.—Eyes present. Flagella of antennae 1-2 unreduced in female. Article 2 antenna 1 ordinary, ventral setae widely spread or shifted apically. Article 1 of antenna 2 not ensiform; article 3 with 2 setules; facial spines on article 4 in 2 or more rows; article 5 short. Right mandibular incisor with 4+

teeth; molar not triturative, medium, pillowshaped, bearing 4 or more splayed semiarticulate spines, usually not bearing fuzz; palpar hump medium. Palp of maxilla 1 biarticulate; inner plate with 3 setae. Setation of maxilla 2 ordinary. Inner plate of maxillipeds ordinary; apex of palp article 3 weakly protuberant, dactyl elongate, apical nail distinct, medium. Gnathopods ordinary, small, similar, article 5 of gnathopods 1-2 of ordinary length to elongate, free, with or without eusirid attachment; palms oblique, hands of gnathopods 1-2 ordinary to elongate, poorly setose anteriorly. Article 5 of pereopods 1-2 setose posteroproximally. Article 3 of pereopod 3 of broad form, articles 4-5 of pereopods 3-4 broad to medium, article 2 of pereopods 3-4 not setose posteriorly; pereopod 5 ordinary, article 2 naked ventrally, article 3 ordinary, dactyl vestigial. Epimera 1-2 lacking long posterior setae, without midfacial setae above ventral facial ridge, epimeron 3 ordinary. Urosomite 1 generally naked; urosomite 3 without dorsal hook or special process. Peduncle of uropod 1 without apicoventral spike, without special enlarged apicolateral-medial spine, pedunular apices of uropods 1-2 not combed, inner ramus of uropod 1 with marginal spines in one row, some rami continuously spinose to apex, or bearing accessory nails, inner ramus of uropod 2 ordinary. Uropod 3 ordinary to small, article 2 of outer ramus carrying 2 medium apical setae. Telson ordinary, with only one apical spine on each lobe plus set-

Description.—Rostrum fully developed, constricted. [Fuzz on article 1 of antenna 1 in male unknown, calceoli on male antennae 1-2 unknown.] Prebuccal parts ordinary, poorly separated from each other, upper lip dominant. Right lacinia mobilis bifid or simple, thin; mandibular palp thin, article I short to slightly elongate, article 2 without outer setae, apex of article 3 oblique. Lower lip bearing cones. Outer plate of maxilla 1 with 11 spines, one spine especially thickened. Inner plates of maxilliped thick, ordinarily setose; outer plates small. Coxae 2-4 without special anterodorsal humps. All posterior spines on article 6 of pereopods 1-2 thick and stiff, midapical spine or seta present. Article 2 of pereopod 5 without facial setae. Peduncle of uropod 1 with dorsolateral spines confined apically, medial spines confined apically; peduncle of uropod 2 with only one medial spine or setule confined apically. Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with ordinary pair of midlateral or dorsal setules on each side.

Type-Species.—Yan tiendi, new species. Composition.—Yan errichus, new species.

Relationship.—The reduced dactyl of pereopod 5 appears to be a character of degree sufficient to separate these two species from the pool of species in Birubius. The two species of Yan also have slightly shortened second articles of antenna I and fifth articles of antenna 2 and have slightly reduced rami of uropod 3. The type-species, Y. tiendi, is closer to the birubiun root than Y. errichus which bears heavily modified gnathopods. In other respects, Y. tiendi has affinities with B. gallangus (10), a species known only for the male. The male of Y. tiendi is unknown. The two species have numerous differences and are therefore not opposite sexes of the same species. Yan tiendi differs from B. gallangus in the presence of setae on coxa 4, the presence of an accessory apical nail on the outer ramus of uropod 2, the absence of a midfacial ridge on pereopod 3, the presence of one (not zero) spine on the inner plate of the maxilliped, the absence of a large apicomedial spine on the peduncle of uropod 2, a poorly setose midapex on article 4 of pereopods 1-2, broader plates of maxilla 2, the absence of a third main set of facial spines on article 4 of antenna 2, much sharper teeth on the left lacinia mobilis and a broader distal ramus on the right lacinia mobilis.

Yan tiendi differs from B. muldarpus (9) in the vestigial dactyl of pereopod 5, the presence of setae on coxa 4, the accessory nail on the outer ramus of uropod 2, reduced setation on epimeron 3, a short rostrum, the presence of only one apical spine on the inner plate of the maxilliped, and slightly crowded or short row of setae on epimeron 2.

The presence of setae on coxa 4 suggests a point of origin for Y. tiendi in the B. lorus-B. nammuldus (2-3) species group but Y. tiendi differs from those species in the reduction of setae on epimeron 3, the accessory nail on uropod 2, the presence of only one main apical spine on the inner plate of the maxilliped, the relatively short gnathopodal wrists, and the shape of coxa 4, which in those species is somewhat more trapezoidal than in Y. tiendi. Birubius lorus is also characteristized by numerous ventrolateral setae on urosomite 1 and uncrowded, numerous setae on epimeron 2.

Key to the Species of Yan

Yan tiendi, new species

FIGURES 199, 200

Description of Female.—Head about 18 percent of total body length, greatest width about 65 percent of length; rostrum constricted, broad, short, exceeding apex of article 1 on antenna 1. Eyes medium-large, largely occluded with pigment. Article I on peduncle of antenna I about 1.1 times as long as wide, about 2.1 times as wide as article 2, ventral margin with about 9 setules, unproduced dorsal apex with one setule; article 2 about 0.9 times as long as article 1, with ventral cycle of 4 setae; primary flagellum with 7 articles, about 0.9 times as long as peduncle, bearing long aesthetascs; accessory flagellum with 5 articles; spine formula on article 4 of antenna 2 = 1-3-4, dorsal margin with notch bearing 2 setae, ventral margin with 3 groups of 1-3 long to medium setae, one ventrodistal long spine; article 5 about 0.7 times as long as article 4, facial spine formula = 1-2, dorsal margin naked, ventral margin with 2 sets of setae, 2 ventrodistal medium spines; flagellum about 1.2 times as long as articles 4-5 of peduncle combined, with 7 articles. Mandibles with strong palpar hump; right incisor with 3 teeth, one notch, and one accessory tooth; left incisor with 5 humps in 2 branches; right lacinia mobilis bifid, distal branch little shorter than proximal, flabellate, subbifid, proximal branch simple, weakly pointed, with marginal denticles; left lacinia mobilis with 4 teeth; right rakers 5, plus 2 rudimentaries; left rakers 5; molar in form of bulbous hump, right and left molars with 6 primarily long spines plus one short spine strongly disjunct, plume absent; palp article l weakly elongate, article 2 with 2 short inner setae, article 3 about 1.1 times as long as article 2, oblique, apex with 5 spine-setae, basofacial formule = 0. Inner plate of maxilla 1 thin, bearing one long apical pluseta and 2 apicolateral much shorter setae; palp article 2 with 3 apicalmedial marginal spines and 3 submarginal setae. Plates of maxilla 2 extending subequally, of subequal width, outer with 3 apicolateral setae, inner with 2 medial setae. Inner plate of maxilliped with one apical spine, 2 apicofacial setae, 3 medial setae; outer plate with 3 medial and apical spines, no apicolateral setae; palp articles 1-2 each with one apicolateral seta, medial margin of article 2 moderately setose, article 3 weakly protuberant, with 2 facial setae, one lateral seta, nail of article 4 medium, with 2 accessory setules. Coxa 1 scarcely expanded distally, anterior margin almost straight; main ventral setae of coxae 1-4 = 5-5-5-2, posteriormost seta of coxae 1-3 shortened; anterior and posterior margins of coxa 4 divergent, posterior margin almost straight, posterodorsal corner sharply rounded, posterodorsal margin long, concave, undulant, width-length ratio of coxa 4 = 5:6. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2=2-3-3-2, others not counted. Guathopods ordinary; width ratios of articles 5-6 on gnathopods 1-2 = 26:32 and 25:32, length ratios = 64:64 and 58:60: palmar humps ordinary, palms oblique; article 5 of gnathopod 1 elongate, ovate, posterior margin rounded, but almost flat; article 5 of gnathopod 2 weakly elongate, ovate, posterior margin rounded. Pereopods 1-2 similar; facial setae formula on article 4 = 1-1, on article 5 = 3-2; main spine of article 5 extending to M. 75 on article 6, article 5 lacking proximoposterior spines; spine formula of article 6 = 3 + 3 plus middistal seta, some spines especially short; acclivity on inner margin of dactyls of pereopods 1-2 obsolescent, emergent setule long, midfacial pluseta very long, highly distad. Coxae 5-7 posteroventral setule formula = 1-1-0. Articles 4-5 of pereopods 3-4 broad to medium, facial spine rows sparse, facial ridge formula on article 2 of pereopods 3-5 = 0-2-2; width ratios of articles 2, 4, 5, 6 of pereopod 3 =52:42:38:17, of pereopod 4 = 68:41:26:13, of pereopod 5 = 82:18:15:8, length ratios of pereopod 3 = 74:25:35:40, of pereopod 4 = 88:45:40:47, of pereopod 5 = 108:24:15:23; article 2 of pereopod 5 almost reaching middle of article 5, dactyl vestigial; medial apex of article 6 finely combed NUMBER 245

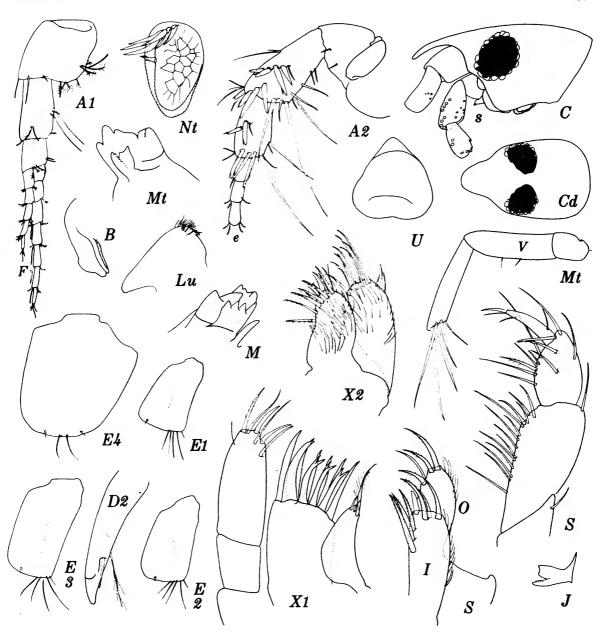


Figure 199.—Yan tiendi, new species, holotype, female "a," 2.47 mm.

and bearing 3 digital processes. Posteroventral corner of epimeron 1 rounded-subquadrate, posterior margin convex, anteroventral margin with 2 medium setae, posteroventral face with one long seta, facial ridge weak; posteroventral corner of epimeron 2 rounded-subquadrate, posterior margin weakly convex, facial setae = 4; posteroventral

corner of epimeron 3 weakly protuberant, with setule sinus, small tooth, posterior margin weakly undulant, with one setule notch, face with oblique horizontal row of 2 setal-spines near ventral-posterior margin. Urosomite 1 naked, articulation line incomplete; urosomite 3 weakly protuberant dorsally. Rami of uropods 1-2 with articulate enlarged

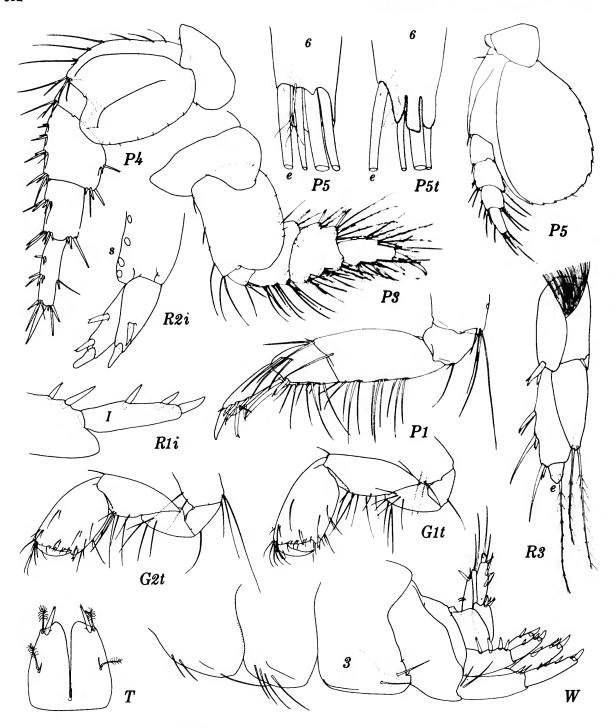


FIGURE 200.—Yan tiendi, new species, holotype, female "a," 2.47 mm.

NUMBER 245

apical nails, outer rami of uropods 1-2 with one accessory nail, inner ramus of uropod 1 with 2 accessory nails, outer ramus of uropod 1 with 3 dorsal spines, inner with one, outer ramus of uropod 2 with one dorsal spine, inner with one dorsomedial spine; peduncle of uropod 1 with 2 apicolateral spines and 2 basofacial setae, medially with 2 marginal spines, apicalmost enlarged; peduncle of uropod 2 with 4 dorsal spines, medially with one apical setule. Peduncle of uropod 3 with 2 ventral spines, dorsally with one lateral spine, one medial spine; rami feminine, inner extending to M. 80 on article 1 of outer ramus, apex with 2 long setae, medial and lateral margins naked, article 2 of outer ramus short, 0.22, bearing 2 long setae, medial margin of article 1 naked, lateral margin with 2 acclivities, spine formula = 1-2-2, setal formula = 1-0-0. Telson ordinary, length-width ratio = 15:14, not fully cleft, each apex of medium width, roundedtruncate, lateral acclivity shallow, weak, bearing ordinary lateral setule, spine next medial longer than setule, midlateral setules diverse. Cuticle with ordinary bulbar setules.

DESCRIPTION OF JUVENILE (juveniles, 1.36-2.00 mm).—Eyes small to very small. Spine formula on article 4 of antenna 2 either 4-3-1 or 3-3-1; article 5 with 2 or 1 facial spines. Setae of coxae 1-3 =3-3-3. Epimeron 1 with one anteroventral seta and 0-1 posterofacial seta; epimeron 2 with 4, 3, or 2 facial setae; epimeron 3 with only one posterofacial seta and one posterior setule. Peduncle of uropod 1 with 1-2 basofacial setae, peduncle with 2 or 1 apicolateral spines, outer ramus with 2 or 1 dorsal spines, apex with nail and one accessory spine, inner ramus with 0-1 dorsal spine, apex with nail and 2 accessory spines; peduncle of uropod 2 with 2-3 spines, outer ramus lacking dorsal spines, apex with nail and one accessory spine, inner ramus with one or no dorsal spine, apex with nail and 0-1 accessory spine, this accessory spine occurring in 1.36 mm juvenile and apparently representing future dorsal spine, similar situation true for inner ramus of uropod 1 on both 1.36 and 2.00 mm juveniles. Uropod 3 with 0-1 lateral acclivity and 0-1 lateral spine.

ILLUSTRATIONS.—Outer plate of maxilla 1 drawn obliquely; maxillipedal palp reduced in magnification in comparison to inner and outer plates; pereopod 3 illustrated from medial view but lateral ridges definitely absent; pereopodal dactyl illus-

trated from oblique view but acclivity obsolescent when turned to precisely lateral view; outer ramus of uropod 2 definitely with 2 apical setae, one missing in illustration.

HOLOTYPE.—WAM, female, "a," 2.47 mm, brood-pouch with 3 large eggs.

Type-Locality.—JLB AUS 11, 30 Sep 1968, Middleton Beach, Albany, Western Australia, intertidal wash of algae and rocks.

VOUCHER MATERIAL.—Type-locality, juvenile "b," 2.00 mm; Slack-Smith 1, juvenile "c," 1.36 mm.

RELATIONSHIP.—See generic remarks and relationships of *Yan errichus*.

MATERIAL.—JLB AUS and Slack-Smith, 3 samples (7).

DISTRIBUTION.—Western Australia, Albany, intertidal.

Yan errichus, new species

FIGURES 201, 202

DESCRIPTION OF MALE (young).—Head about 18 percent of total body length, greatest width about 72 percent of length; rostrum weakly constricted, broad, short, reaching apex of article 1 on antenna 1. Eyes medium, largely occluded with pigment. Article 1 on peduncle of antenna 1 about 1.1 times as long as wide, about twice as wide as article 2, ventral margin with 5-6 setules, weakly produced dorsal apex with 3 setules; article 2 about 0.9 times as long as article 1, with apicoventral cycle of 3 setae; primary flagellum with 7 articles, about 0.85 times as long as peduncle, bearing several aesthetascs; accessory flagellum with 4 articles. Spine formula on article 4 of antenna 2 = 1-3-3-1, dorsal margin with notch bearing 2 setae, ventral margin with 2 groups of 2 long to short setae, one ventrodistal medium spine; article 5 about 0.75 times as long as article 4, facial spine formula = 1-2, dorsal margin bearing 2 setules, ventral margin with one setule and seta-setule pair, 2 ventrodistal short to medium spines; flagellum about 1.6 times as long as articles 4-5 of peduncle combined, with 9 articles. Mandibles with weak palpar hump; right incisor with 3 teeth and accessory notch; left incisor with 2 branches in 5 humps; right lacinia mobilis simple, narrow; left lacinia mobilis with 4 teeth; right rakers 3 plus one rudimentary; left rakers 4

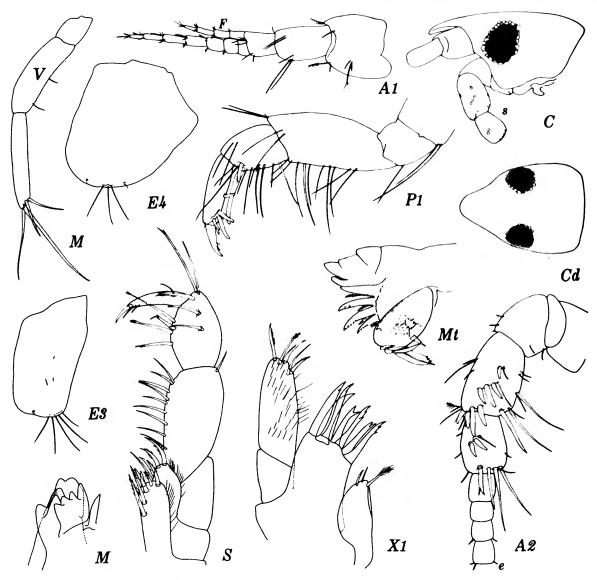


FIGURE 201.—Yan errichus, new species, holotype, male "a," 2.74 mm.

plus 2 rudimentaries; molar in form of elongate plaque, each molar with 5 short to medium spines plus one short spine strongly disjunct, no plumes; palp article 1 slightly elongate, article 2 with 2 short inner setae, article 3 about 1.15 times as long as article 2, oblique apex with 4 spine-setae, basofacial formula = 0. Inner plate of maxilla 1 ordinary, bearing one short apicomedial seta and 2 apicolateral much shorter setae; palp article 2 with 3 apicalmedial marginal spines and 2 submarginal setae. Plates of maxilla 2 extending subequally, of

equal width, outer with 2 apicolateral setae, inner with no medial setae. Inner plate of maxilliped with one large thick apical spine, 2 apicofacial setae, 3 medial setae; outer plate with 4 medial and apical spines, no apicolateral setae; palp article 1 lacking apicolateral seta, article 2 with one apicolateral seta, medial margin of article 2 moderately setose, article 3 weakly protuberant, with 2 facial setae, no lateral setae, nail of article 4 medium, with 2 accessory setules. Coxa 1 scarcely expanded distally, anterior margin weakly convex; main

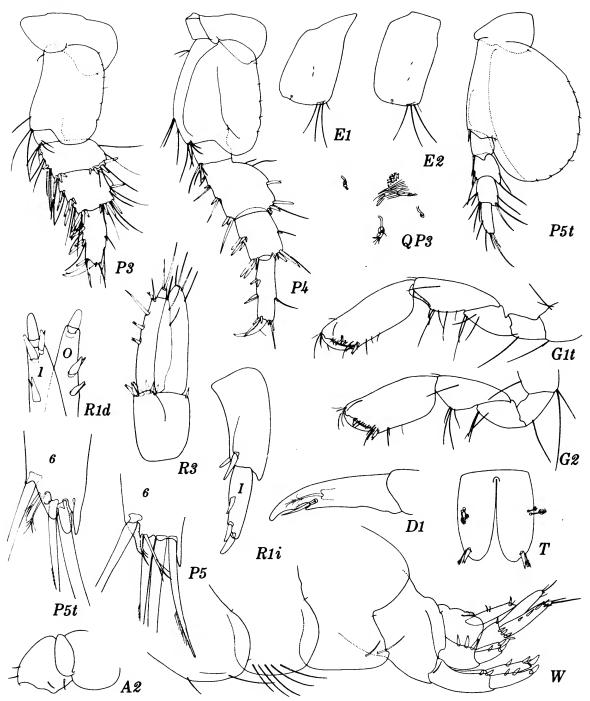


FIGURE 202.—Yan errichus, new species, holotype, male "a," 2.74 mm.

ventral setae of coxae 1-4 = 4-4-5-3, posteriormost seta of coxae 1-3 shortest; anterior and posterior margins of coxa 4 strongly divergent, posterior margin very oblique, posterodorsal corner rounded, posterodorsal margin short, weakly concave, widthlength ratio of coxa 4 = 16:17. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 1-1-2-2, short anteriors = 1-1-1-1, long anteriors = 2-3-0-0, no others. Gnathopods very thin; width ratios of articles 5-6 on gnathopods 1-2 = 21:25 and 21:29, length ratios = 59:68 and 51:65; palmar humps ordinary, sharp, palms oblique; article 5 of gnathopod 1 elongate, ovate, posterior margin rounded; article 5 of gnathopod 2 elongate, ovate, posterior margin rounded. Pereopods 1-2 similar, facial setae formula on article 4 = 2 and 2, on article 5 = 2 and 2; main spine of article 5 extending to M. 90 on article 6, article 5 with no proximoposterior spines; spine formula of article 6 = 3 + 2 plus middistal seta on both pairs, spines short; acclivity on inner margin of dactyls of pereopods 1-2 sharp, produced as tooth, emergent setule long, midfacial pluseta ordinary, highly distad. Coxae 5-7 posteroventral setule formula = 1-1-1. Articles 4-5 of pereopods 3-4 of ordinary width, facial spine rows sparse, facial ridge formula on article 2 of pereopods 3-5 = 0-2-2; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 45:38:34: 16, of pereopod 4 = 58:35:25:13, of pereopod 5 = 75:17:14:8, length ratios of pereopod 3 =67:29:29:37, of pereopod 4 = 80:40:34:41, of pereopod 5 = 100:22:20:21; article 2 of pereopod 5 reaching apex of article 4, dactyl apparently absent; medial apex of article 6 bearing 3 digital processes. Posteroventral corner of epimeron 1 rounded, posterior margin deeply convex, corner with setule, anteroventral margin with one medium seta, posteroventral face with one long seta, ridge absent or faint; posteroventral corner of epimeron 2 rounded, posterior margin strongly convex, facial setae = 5, ridge absent; posteroventral corner of epimeron 3 with small rounded tooth, posterior margin weakly convex, face with horizontal row of 2 setae; epimera 1-3 with setule on posterodorsal margin set in weak notch. Urosomite 1 with articulation line incomplete; urosomite 3 weakly protuberant dorsally. Rami of uropods 1-2 with articulate, enlarged apical nails, inner ramus of uropod 1 with two accessory nails, outer ramus of uropod 1 with 2 dorsal spines, inner with one, outer ramus of uropod 2 with one dorsal spine, inner with none; peduncle of uropod 1 with 2 apicolateral spines, and one basofacial seta, medially with one apical enlarged spine; peduncle of uropod 2 with 3 dorsal spines, medially with one medium apical spine; apicolateral corners on peduncles of uropods 1-2 lacking comb. Peduncle of uropod 3 with 5 ventral spines, dorsally with one lateral spine, one medial spine; rami submasculine, inner extending to M. 120(!) on article 1 of outer ramus, apex with 2 setae, medial margin with 2 setae, article 2 of outer ramus short, 0.11, bearing 2 medium setae, apicomedial margin of article I with one seta, medial margin with 2 other setae, lateral margin with 3 acclivities, spine formula = 1-1-1-2, setal formula = 0. Telson ordinary, length-width ratio = 6:5, not fully cleft, each apex wide, rounded, lateral acclivity obsolescent, bearing short lateral setule, spine next medial of length equal to setule, midlateral setules ordinary. Cuticle with ordinary bulbar setules of varying sizes mixed with pipes, surface bearing fine striations in form of linear fingerprint pattern, emergent setules branched.

ILLUSTRATIONS.—Upper lip as shown for Y. tiendi, but ventral margin straight; epistome-upper lip from lateral view as in Y. tiendi but lacking anteroventral hump on anterior margin; lower lip with one cone on each lobe, mandibular lobes short and broad; general appearance of maxilla 2 as in Birubius karobrani, but inner lobe with 3 facial setae, 4 retrofacial setae and 2 other distal setae; dactyl of pereopod 5 apparently absent, socket on article 6 not present.

HOLOTYPE.—AM, male "a," 2.74 mm. Unique. TYPE-LOCALITY.—AM P.18214, 16 Nov 1970, Long Reef, Collaroy, New South Wales, Australia.

RELATIONSHIP.—This species differs from Y. tiendi in the much thinner gnathopods, the simple right lacinia mobilis, and the absence of an accessory apical spine on the outer ramus of uropod 2; various distinctions in spination and setation can also be seen in the illustrations.

MATERIAL.—AM, one sample (1).
DISTRIBUTION.—New South Wales, Long Reef, Collaroy.

Tickalerus, new genus

DIAGNOSIS.—Eyes present. Flagella of antennae 1-2 unreduced in female. Article 2 of antenna 1

elongate, main setae midventral. Article 1 of antenna 2 not ensiform; article 3 with 2 setules; facial spines on article 4 in 3 rows; article 5 ordinary in size. Right mandibular incisor with 3-4 teeth (interpretive); molar not triturative, ordinary, medium, pillow-shaped, bearing 4 or more splayed, semiarticulate spines, usually not bearing fuzz; palpar hump small. Palp of maxilla 1 biarticulate: inner plate with 4 setae. Setation of maxilla 2 ordinary. Inner plate of maxillipeds ordinary; apex of palp article 3 weakly protuberant, dactyl elongate, apical nail distinct, medium. Gnathopods ordinary, small, similar; article 5 of gnathopods 1-2 free, of ordinary length, or elongate on gnathopod 1, without eusirid attachment; palms oblique, hands of gnathopods 1-2 ordinary, ovatorectangular, poorly setose anteriorly. Article 2 of pereopod 3 of broad form, articles 4-5 of pereopods 3-4 broad, article 2 of pereopods 3-4 not setose posteriorly; pereopod 5 ordinary, article 2 naked ventrally, article 3 ordinary, dactyl normal. Epimera 1-2 lacking long posterior setae, without midfacial setae above ventral facial ridge; epimeron 3 ordinary. Urosomite 1 generally naked; urosomite 3 with dorsal hook or special process. Peduncle of uropod 1 normally elongate, without apicoventral spike, without special enlarged apicolateral or medial spine; peduncular apices of uropods 1-2 not combed; inner ramus of uropod 1 with marginal spines in one row, no rami continuously spinose to apex, inner ramus of uropod 2 ordinary. Uropod 3 somewhat reduced, rami scarcely longer than peduncle, article 2 of outer ramus carrying 2 long apical setae. Telson ordinary, with only one apical spine on each lobe.

DESCRIPTION.—Rostrum fully developed, constricted, small. [Fuzz on article 1 of antenna 1 in male and calceoli on male primary flagellum of antenna 1 and antenna 2 unknown.] Prebuccal parts ordinary, poorly separated from each other, upper lip dominant. Right lacinia mobilis bifid, flabellate; mandibular palp thin, article 1 slightly elongate, article 2 without outer setae, apex of article 3 oblique. Lower lip bearing cones. Outer plate of maxilla 1 with 11 spines, one spine especially thickened. Inner plates of maxilliped thick, ordinarily setose. Coxae 2-4 without special anterodorsal hump. All posterior spines on article 6 of pereopods 1-2 thick and stiff, midapical seta vestigial. Article 2 of pereopod 5 without facial setae. Peduncle of uropod 1 with dorsolateral spines confined apically; medial spines confined apically; peduncle of uropod 2 with only one medial spine or setule confined apically. Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with ordinary pair of midlateral or dorsal setules on each side.

Type-Species.—*Tickalerus birubi*, new species. Composition.—Unique.

RELATIONSHIP.—This monotypic genus differs from *Birubius* in the enlarged and sharp dorsal process on urosomite 3, the shortness of the rami on uropod 3, and in the development of 3 distinct sets of dorsal setae on article 4 of antenna 2. These characters are seen rudimentarily in several species of *Birubius*. For example, *B. apari* (6) has a weakly thrust urosomite 3, *B. gambodeni* (20) has supernumerary dorsal setae on article 4 of antenna 2, and several species show the rudiments of shortness in rami on uropod 3.

Two other species similar to Tickalerus birubi have been segregated into the following genus, Kulgaphoxus, but, as explained therein, they differ from Tickalerus by an unevenly mixed set of generic characters. This implies they are polyphyletic. One of these characters, found only in one species, is the posteroventral bevelment of article 2 on pereopod 5, an attribute unknown in Birubius. The 3 species share similarities in the presence of posterior straw-setae on article 2 of several members of gnathopods 1-2 and pereopods 1-2, but unlike Tickalerus, the two species of Kulgaphoxus have accessory nails on the inner rami of both uropods 1-2. The two genera also share, at least in part, by discounting K. cadgeeus, other characters suggesting that they have a common ancestor: the presence of more than 2 posteroproximal spines on article 5 of pereopods 1-2; the extreme reduction of the middistal seta on article 6 of those pereopods; the loss of plumosities on the midfacial dactylar seta of those pereopods; and the reduction of uropod 3, with elongation of the peduncle.

The single species so far known for *Tickalerus* differs in many other characters from either species of *Kulgaphoxus* but, in general, appears to be the more primitive grade of evolution in terms of greater diversity in spine rows on article 4 of antenna 2, the more primitive molar (similar to *Birubius*), and the shorter article 5 of gnathopod 2. But *Tickalerus* also differs in characters about which the level of primitiveness is unknown, such

as the shape of coxa 4. Illustrations and descriptions of the following parts also should be compared: prebuccal, mandibular palp, right lacinia mobilis, palp of maxilla 1, dactyl of pereopod 5, uropod 3, telson, coxa 1 expansion, coxa 3, and the outer ramus of uropod 1.

Tickalerus birubi, new species

FIGURES 203-205

DESCRIPTION OF FEMALE.—Head about 17 percent of total body length, greatest width about 75 percent of length; rostrum constricted, narrow, short, exceeding apex of article 1 on antenna 1. Eyes medium, clear of pigment, ommatidia especially small. Article 1 on peduncle of antenna 1 about 1.4 times as long as wide, about 2.2 times as wide as article 2, ventral margin with about 13 setules, weakly produced dorsal apex with one setule, article 2 about 0.85 times as long as article 1, with ventral cycle of 11 setae; primary flagellum with 13 articles, about 0.75 times as long as peduncle, bearing several long aesthetascs; accessory flagellum with 10 articles. Spine formula on article 4 of antenna 2 = 1-3-4-6, dorsal margin with 3 notches bearing 3 setae each, ventral margin with 7-8 groups of 2-4 long to short setae, one ventrodistal long spine; article 5 about 0.7 times as long as article 4, facial spine formula = 1-2-2, dorsal margin naked, ventral margin with 7 sets of 1-8 long to short setae, 2 ventrodistal long to medium spines; flagellum about 1.1 times as long as articles 4-5 of peduncle combined, with 14 articles. Mandibles with weak palpar hump; right incisor with 3 teeth and notch; left incisor with 5 humps in 2 branches; right lacinia mobilis bifid, distal branch little shorter than proximal, flabellate, broad, subbifid, denticulate, with weak facial humps, proximal branch simple, pointed, with marginal denticles and facial humps; left lacinia mobilis with 4 teeth; right rakers 12; left rakers 11; molar in form of bulbous hump, right molar with 10 primarily long spines plus one short spine strongly disjunct, left molar with 7 primarily long spines plus one short spine strongly disjunct; palp article 1 slightly elongate, article 2 with one medium inner apical seta and 2 other shorter inner setae, article 1 with 2 short setae, article 3 about 1.1 times as long as article 2, oblique apex with 12 spine-setae, basofacial formula = 3-5. Inner plate of maxilla 1 elongate, thin, bearing one long apical pluseta, one shorter similar apicomedial seta, 2 apicolateral much shorter setae; palp article 2 with 4 apicalmedial marginal spines and 4 submarginal setae. Plates of maxilla 2 extending equally, outer broader than inner, with 6 apicolateral setae, inner with 3 medial setae. Inner plate of maxilliped with 2 large, thick apical spines, 3 apicofacial setae, 5 medial setae; outer plate with 8 medial and apical spines, 3 apicolateral setae; palp article 1 with apicolateral seta, article 2 with 2 groups of 3 apicolateral setae, medial margin of article 2 moderately serose, article 3 with 6 facial setae, set of 3 lateral setae, nail of article 4 medium-short, with 2 accessory setules. Coxa 1 scarcely expanded distally, anterior margin weakly concave, main ventral setae of coxae 1-4 = 12-10-12-0, posteriormost seta of coxae 1-3 shortened; anterior and posterior margins of coxa 4 parallel, posterior margin straight, posterodorsal corner sharp, posterodorsal margin short, concave, width-length ratio of coxa 4 = 2:3(1). Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = (12-13)-(16-19)-13-9, short posteriors = 0-2-3-4, long anteriors = (6-7)-18-1-0, short anteriors = (8-10)-8-11-(4-6). Gnathopods ordinary; width ratios of articles 5-6 on gnathopods 1-2 = 25:34 and 27:37, length ratios = 66:57 and 59:58; palmar humps ordinary to large, palms oblique; article 5 of gnathopod 1 elongate, ovate, posterior margin flat; article 5 of gnathopod 2 ovate, posterior margin rounded, almost lobate. Pereopods 1-2 similar, facial setae formula on article 4 = 8-9 and 5-6, on article 5 =8 and 10; main spine of article 5 extending to M. 85 on article 6, article 5 with 4 and 3 proximoposterior spines; spine formula of article 6 = 7 + 9 or 6+9 or 6+8 and 7+10 plus vestigial middistal seta, some spines especially long; acclivity on inner margin of dactyls of pereopods 1-2 weak but produced as tooth, emergent setule short, midfacial pluseta absent. Coxae 5-7 posteroventral seta formula = 9-10-6. Articles 4-5 of pereopods 3-4 broad; facial spine rows dense, facial ridge formula on article 2 of pereopods 3-5 = 0-2-2, anterior on pereopod 5 short; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 50:60:44:18, of pereopod 4 = 80: 57:42:14, of pereopod 5 = 92:24:18:8, length ratios of pereopod 3 = 86:50:46:39, of pereopod 4 = 107:70:50:55, of pereopod 5 = 120:27:23:23; article 2 of pereopod 5 exceeding apex of article

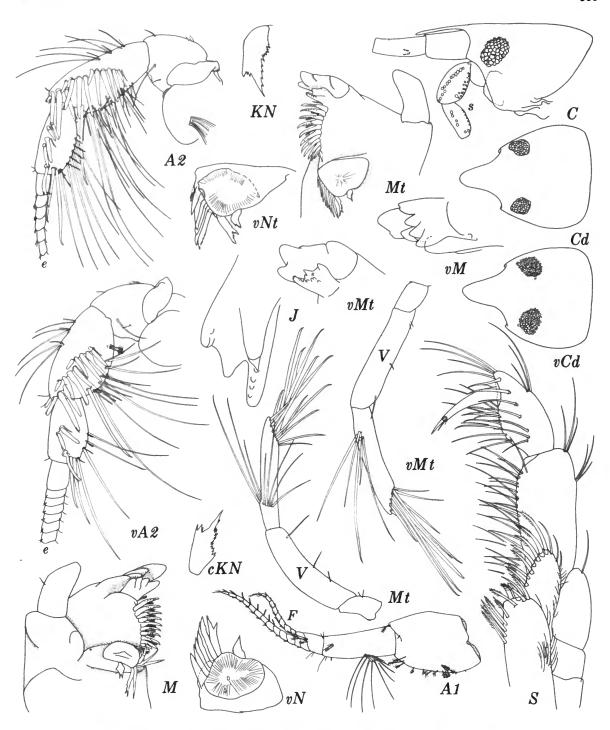


FIGURE 203.—Tickalerus birubi, new species, holotype female "a," 8.1 mm (c = juvenile female "c," 6.30 mm; v = male "v," 6.6 mm; K = spine in molar).

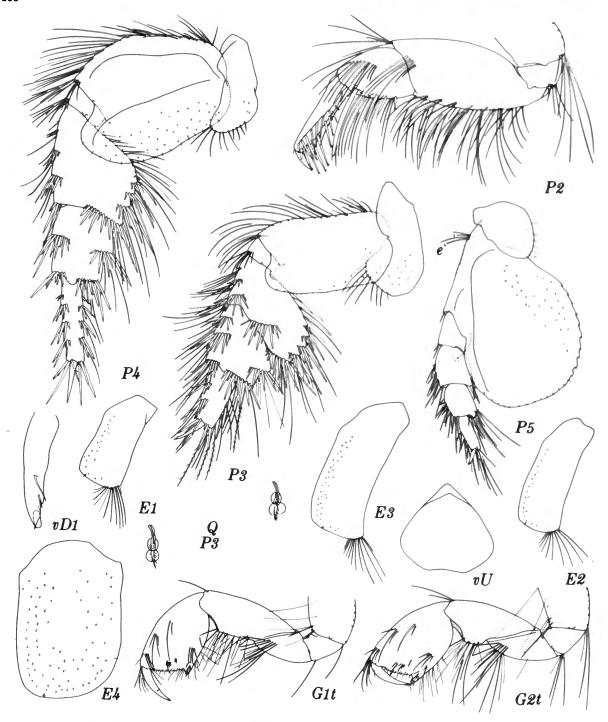


FIGURE 204.—Tickalerus birubi, new species, holotype, female "a," 8.1 mm (v = male "v," 6.6 mm).

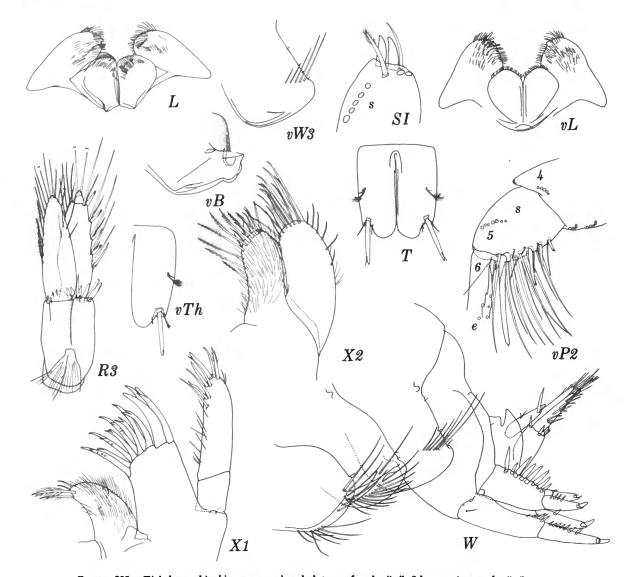


FIGURE 205.—Tickalerus birubi, new species, holotype, female "a," 8.1 mm (v = male "v," 6.6 mm).

4; medial apex of article 6 not combed, bearing 6 digital processes. Posteroventral corner of epimeron 1 rounded, protuberant, posterior margin convex, corner with setule, anteroventral margin with 8 long to medium setae, posteroventral face with 6 long setae, posterior most pair set vertically; posteroventral corner of epimeron 2 rounded, weakly protuberant, with setule sinus, posterior margin weakly convex, with setule notch, facial setae = 12, posteriormost pair set vertically, upper

member above facial ridge; posteroventral corner of epimeron 3 rounded, weakly protuberant, with setule sinus, posterior margin straight, with 3 setule notches, ventral margin naked, midface with oblique row of 6 setae near posterior margin; epimeron 3 with setule on posterodorsal margin set in weak notch. Urosomite 1 naked, articulation line almost complete; urosomite 3 with large hook dorsally. Rami of uropods 1–2 with articulate enlarged apical nails, outer ramus of

uropod 1 with 7 dorsal spines, inner with one, outer ramus of uropod 2 with 4 dorsal spines, inner with one dorsomedial spine; peduncle of uropod 1 with 6 apicolateral spines and one basofacial seta, medially with 2 marginal setae and spines and apical enlarged spine; peduncle of uropod 2 with 8 dorsal spines, medially with one small apical spine. Peduncle of uropod 3 with 6 ventral spines, dorsally with one lateral spine, one medial spine and 3 setules; rami masculine, inner extending to M. 100+ on article 1 of outer ramus, apex with 3 setae, medial and lateral margins setose, article 2 of outer ramus short, 0.12, bearing 2 long setae, apicomedial margin of article 1 setose, lateral margin with 4 acclivities, spine formula = 2-1-1-1-1, setal formula = 1-2-2-2-2. Telson long, length-width ratio = 31:26, not fully cleft, each apex wide, rounded, lateral acclivity deep, broad, bearing short lateral setule, spine next medial much longer than setule, with 1-2 medial setules, midlateral setules diverse. Cuticle with enlarged bulbar setules, emergent setules plumose.

DESCRIPTION OF MALE (very young).—Scarcely distinct from female in secondary sexual attributes such as head, antenna 1, maxilla 1, coxae, pereopods 3-4, uropods 1-3, epimera 1-2, uropod 3 with fewer setae than in female because of youthfulness. Eyes scarcely enlarged. Article 1 of antenna 1 lacking medial fuzz. Spine formula on article 4 of antenna 2 = 1-3-4-5, on article 5 = 1-2; flagellum proliferate. Right lacinia mobilis somewhat more complex than in female; right mandibles with 9 rakers, left with 10 + one rudimentary; basofacial setae on article 3 of mandibular palp = 2 + 3. Maxilla 2 with one fewer seta medially and apicolaterally (2 and 5). Maxilliped less setose. Posteroproximal spines on article 5 of pereopods 1-2 better developed than in female (see illustration), dactyl bearing midfacial nonplumose seta. Article 2 of pereopod 5 slightly broader than in female (juvenoid condition). Epimeron 3 with one anterofacial seta, oblique row with 5 setae. Telson slightly elongate.

OBSERVATIONS.—Prebuccal complex unproduced anteriorly; pereopod 5 with tiny setules on anterior margin of article 2; short posterior setae on article 2 of gnathopods 1–2 and pereopods 1–2 of variety known as "straw."

ILLUSTRATIONS.—Known males scarcely distinct from females, therefore head of male not illus-

trated; disjunct spine on molars difficult to interpret owing to small size, transparency and tendency to roll into arc fitting curve of molar; bulbar setules so conspicuous as to be included on several illustrations; pleonal view of holotype with apices of setae on uropod 3 broken off, one spine on peduncle of uropod 2 reconstructed; palp of maxilla 1 opposite to that illustrated bearing one fewer apical seta; short posterior seta on coxa 2 missing.

HOLOTYPE.—NMV, female "a," 8.1 mm.

Type-Locality.—CPBS 24N/5, 4 Mar 1965, Western Port, Victoria, Australia, 9.1 m, muddy sand

VOUCHER MATERIAL.—CPBS 26N/4, male "v," 6.6 mm (illus.); CPBS 26N/2, juvenile female "c," 6.80 mm (illus.).

Relationship.—See remarks after generic description.

MATERIAL.—CPBS, 6 samples from 2 stations (8). DISTRIBUTION.—Victoria, Western Port, 9.1-10.9 m, sand or muddy sand.

Kulgaphoxus, new genus

DIAGNOSIS.—Eyes present. Flagella of antennae 1-2 unreduced in female. Article 2 of antenna 1 especially elongate, ventral setae narrowly spread and proximal. Article 1 of antenna 2 not ensiform; article 3 with 2 setules; facial spines on article 4 in 2 rows; article 5 short. Right mandibular incisor with 3-4 teeth (interpretative); molar not triturative, ordinary, medium, truncate-conical, bearing 4 or more splayed, semiarticulate spines, not bearing fuzz; palpar hump small. Palp of maxilla 1 biarticulate; inner plate with 4 setae. Setation of maxilla 2 ordinary. Inner plate of maxillipeds ordinary; apex of palp article 3 weakly protuberant, dactyl elongate, apical nail distinct, medium to elongate. Gnathopods ordinary, small, similar; article 5 of gnathopods 1-2 free, elongate, without eusirid attachment; palms oblique, hands of gnathopods 1-2 ordinary, ovatorectangular, elongate, or broadened, poorly setose anteriorly. Article 5 of pereopods 1-2 setose posteroproximally. Article 2 of pereopod 3 of broad form, articles 4-5 of pereopods 3-4 broad, article 2 of pereopods 3-4 not setose posteriorly; pereopod 5 ordinary, article 2 naked or bearing one slightly elongate seta ventrally, article 3 ordinary, dactyl normal or vestigial. Urosomite 1 generally naked except for sparse apicoventral setae or spines near base of uropod 1; urosomite 3 with dorsal hook or special process. Peduncle of uropod 1 slightly shortened, without apicoventral spike, without special enlarged apicomedial spine; peduncular apices of uropods 1-2 not combed; inner ramus of uropod 1 with marginal spines in one row, some rami with accessory apical nails; inner ramus of uropod 2 slightly shortened. Uropod 3 small, rami shortened, article 2 of outer ramus carrying 2 long apical setae. Telson ordinary to short, with 1-2 apical spines on each lobe plus setules. Epimera 1-2 lacking numerous long posterior setae, without midfacial setae above ventral facial ridge, epimeron 3 ordinary.

DESCRIPTION.—Rostrum poorly developed, constricted, small. Fuzz on article 1 of antenna 1 in male present; calceoli on male primary flagellum of antenna 1 present. Calceoli on article 5 of male antenna 2 present; flagellum in male with calceoli. Prebuccal parts ordinary, especially massive, strongly distinct, either upper lip dominant or both parts equally prominent. Right lacinia mobilis bifid, flabellate; mandibular palp thin, article 1 slightly elongate, article 2 without outer setae, apex of article 3 oblique. Lower lip bearing cones. Outer plate of maxilla 1 with 11 spines, one spine especially thickened. Inner plates of maxilliped thick, ordinarily setose. Coxae 2-4 without special anterodorsal humps. All posterior spines on article 6 of pereopods 1-2 thick and stiff, midapical spine or seta vestigial. Article 2 of pereopod 5 without facial setae. Peduncle of uropod 1 with dorsolateral spines confined apically, medial spines confined apically; peduncle of uropod 2 with only one medial setule confined apically. Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with ordinary pair of midlateral or dorsal setules on each

Type-Species.—Kulgaphoxus borralus, new species.

Composition.—Kulgaphoxus cadgeeus, new species.

RELATIONSHIP.—Kulgaphoxus differs from Birubius in the shortened rami of uropod 3 equal to the peduncle in length, and in the enlarged dorsal hook of urosomite 3.

Birubius apari (6) has the rudiments of a dorsal process on urosomite 3 as in Kulgaphoxus and shares many other similarities, such as in gnathopods, narrow spread of setae on article 2 of antenna

1, the somewhat shortened rami of uropod 3 but the inner ramus of uropod 2 in B. apari lacks accessory nails.

Kulgaphoxus differs from Tickalerus in numerous characters among which are many not attributed generic status in Birubius. Kulgaphoxus and Tickalerus, are, however, so divergent, that one must assume for the time being that they had different origins out of Birubius. Indeed, the two species now placed in Kulgaphoxus themselves may not be congeneric.

Kulgaphoxus differs from Tickalerus in the smaller rostrum, more strongly dominant epistome (but not equally so in the 2 species of Kulgaphoxus), the proximal placement of ventral setae on article 2 of antenna 1, the presence of only one dorsal set of setae on article 4 of antenna 2 (like Birubius), the presence of accessory nails on the inner rami of uropods 1-2, and the perfectly rectangular coxa 4.

Somewhat more minor and variable characters include the following: reduction in number of ventral setae on article 2 of antenna 1, presence of only one mid set of facial spines on article 5 of antenna 2, reduction in basofacial setae on article 3 of mandibular palp, reduction in size of molar and loss of disjunctness of one spine, less grossly developed right lacinia mobilis, reduction in facial and lateral seate on article 3 of maxillipedal palp, more elongate article 5 of gnathopod 2, presence of dorsoposterior tooth on article 2 of pereopod 3, even shorter rami of uropod 3, more arcuate coxa 3, reduced spination on outer ramus of uropod 1, and enlargement of spines on uropod 3.

The two species of Kulgaphoxus mix together characters partially shared with Ticklarus so that the evolutionary flow is highly uneven; for example, one or the other but not both species of Kulgaphoxus shares with Tickalerus the following characters: the unusual bevel on article 2 of pereopod 5, similarities in palp of maxilla 1, elongation of article 6 on pereopods 3-4, well developed dactyl of pereopod 5, unexpanded coxa 1, normally elongate telson, and the presence of anterior setules on article 2 of pereopod 5.

One or the other species of Kulgaphoxus also bears many similarities to the genus Yan, among them the essential presence of only 2 rows of facial spines on article 4 of antenna 2, the somewhat reduced rostrum, shortened rami of uropod 3, degree

of vestigiality or absence of midapical seta on article 6 of pereopods 1-2 and the presence of accessory nails on the rami of uropods 1-2. However, as in Kulgaphoxus, the species of Yan are diverse; for example, one species of Yan has 2 full rows of facial spines on article 4 of antenna 2 plus one spine in a third row, and there are strong distinctions in placement of accessory nails on uropods 1-2. Yan can be separated distinctly from Kulgaphoxus only on the absence of a dorsal process on urosomite 3. Both species of Yan have a vestigial dactyl on pereopod 5 whereas this situation occurs only in one species of Kulgaphoxus. Yan has a shorter article 2 of antenna I with ventral setae either in the middle or set distally. Both species of Yan have a much better developed molar than does Kulgaphoxus, somewhat similar to Tickalerus. Both species of Yan have long ventral setae (2 only) on coxa 4 unlike Tickalerus and Kulgaphoxus, but the shape of coxa 4 is alike between Kulgaphoxus and Yan whereas it is perfectly rectangular in Tickalerus.

Kulgaphoxus borralus, new species

FIGURES 206-208

Description of Female.—Head about 15 percent of total body length, greatest width about 95 percent of length; rostrum constricted, broad, short, exceeding middle of article 1 on antenna 1. Eyes medium, largely occluded with pigment. Article 1 on peduncle of antenna 1 about 1.4 times as long as wide, about 2.7 times as wide as article 2, ventral margin with 6-8 setules, weakly produced dorsal apex with 2 setules; article 2 about 1.1 times as long as article 1, with proximoventral cycle of 7-8 setae; primary flagellum with 8 articles, about 0.45 times as long as peduncle, bearing several aesthetascs; accessory flagellum with 8 articles. Spine formula on article 4 of antenna 2 = 1-3-8 or 1-3-7, dorsal margin with notch bearing 2 setae, ventral margin with 7 groups of 2-3 long to short setae, one ventrodistal long spine; article 5 about 0.7 times as long as article 4, facial spine formula = 1-1, dorsal margin naked, ventral margin with 4 sets of one long seta, 2 ventrodistal long spines, one set facially; flagellum about 1.2 times as long as articles 4-5 of peduncle combined, with 12 articles. Mandibles with weak palpar hump; right incisor with 3 teeth and notch; left incisor with 6 humps in 2 branches; right lacinia mobilis bifid, distal branch little shorter than proximal, flabellate, denticulate, proximal branch simple, pointed, with marginal denticles and facial hump; left lacinia mobilis with 4 teeth plus one accessory tooth; right rakers 8; left rakers 10; molar in form of short protrusion demarcated mainly by spines, right molar with 8 primarily long spines, none disjunct, left molar with 10 (3 hidden) primarily long spines, none disjunct; palp article 1 slightly elongate, article 2 with one short inner apical seta and 3 other shorter inner setae, article 3 about 1.05 times as long as article 2, oblique apex with 7 spine-setae, basofacial formula = 0-1. Inner plate of maxilla 1 elongate, thin, bearing one long apical pluseta, one longer apicomedial seta, 2 apicolateral much shorter setae, palp article 2 with 4 apicalmedial marginal spines and 2 submarginal setae. Plates of maxilla 2 extending subequally, outer broader than inner, outer with 3 apicolateral setae, inner with 2 medial setae. Inner plate of maxilliped with 2 large, thick apical spines, 8 apicofacial thick setae, 4 medial thick setae; outer plate with 5 medial and apical spines, no apicolateral setae; palp article l with apicolateral seta, article 2 with 2 apicolateral setae, medial margin of article 2 weakly setose, article 3 with 2 facial setae, no lateral setae, nail of article 4 long, with 2 accessory setules. Coxa 1 not expanded distally, anterior margin weakly convex; main ventral setae of coxae 1-4 = 7-8-8-0, posteriormost seta of coxae 1-3 shortened; anterior and posterior margins of coxa 4 divergent, posterior margin oblique, straight, posterodorsal corner sharp, posterodorsal margin short, almost straight, width-length ratio of coxa 4 = 16:17. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 5-7-7-4, short posteriors = 0-0-1-1, long anteriors = 7-8-0-0, short anteriors = 4-3-4-2. Gnathopods elongate; width ratios of articles 5-6 on gnathopods 1-2 = 25:30 and 27:32, length ratios = 93:63 and 88:62, palmar humps ordinary, palms weakly oblique; article 5 of gnathopods 1-2 elongate, ovate, posterior margin flat, long. Pereopods 1-2 similar, facial setae formula on article 4 = 5-6 and 4, on article 5 = 5 and 4, main spine of article 5 extending to M. 80 on article 6, article 5 with 3 proximoposterior spines, spine formula of article 6 = 5 + 7 and 6 + 7 plus tiny vestigial middistal seta, some spines especially long; acclivity on inner margin of dactyls of pereopods 1-2 sharp, produced

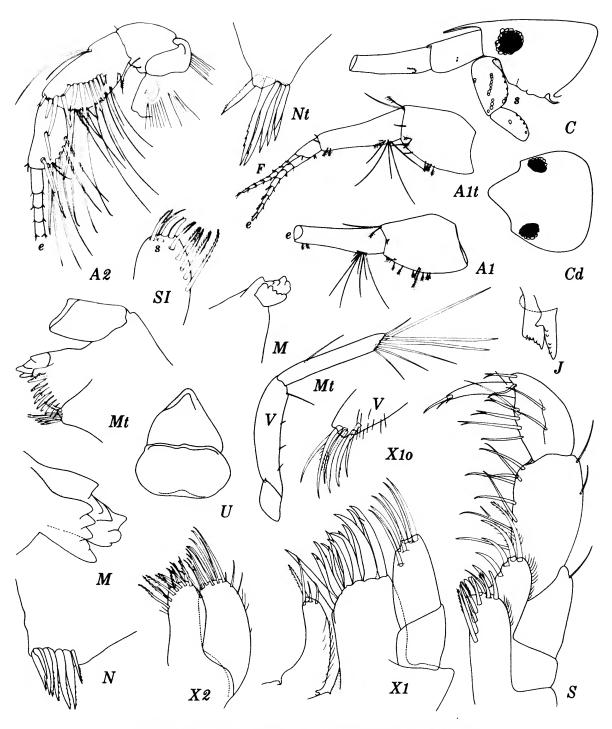


FIGURE 206.—Kulgaphoxus borralus, new species, holotype, female "a," 4.90 mm.

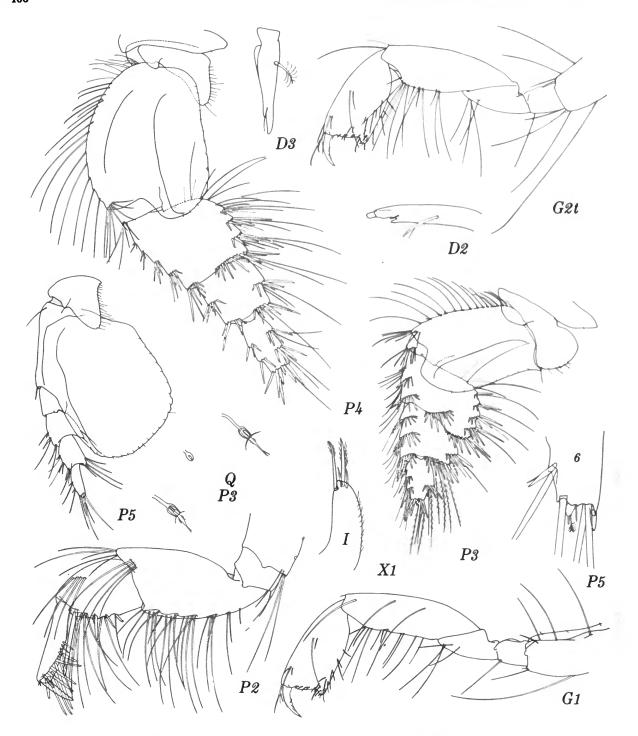


Figure 207.—Kulgaphoxus borralus, new species, holotype, female "a," 4.90 mm.

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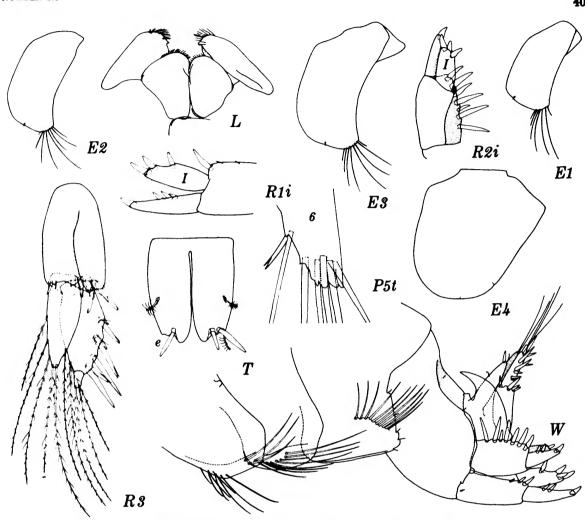


FIGURE 208.-Kulgaphoxus borralus, new species, holotype, female "a," 4.90 mm.

as tooth, setule fully immersed, midfacial seta non-plumose (plumose on pereopods 3-5). Coxae 5-7 posteroventral seta formula = 6-13-16. Articles 4-5 of pereopods 3-4 broad; facial spine rows dense, facial ridge formula on article 2 of pereopods 3-5 = 1-2-2; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 53:54:38:18, of pereopod 4 = 80:80:40:20, of pereopod 5 = 87:20:15:7, length ratios of pereopod 3 = 78:44:35:27, of pereopod 4 = 104:60:40:40, of pereopod 5 = 110:22:22:22; article 2 of pereopod 5 almost reaching apex of article 5, article 2 of pereopod 3 with sharp tooth at posterodorsal corner; medial apex on article 6 of pereopod 5 bearing 4 weak digital processes, dactyl vestigial. Posteroventral corner of epimeron 1

rounded, posterior margin deeply convex, anteroventral margin with 8 long to medium setae, posteroventral face with 3 long setae, anterior pair set vertically; posteroventral corner of epimeron 2 rounded, posterior margin strongly convex, facial setae = 8, posteriormost pair set vertically; posteroventral corner of epimeron 3 weakly protuberant, with 2 setule sinuses, posterior margin straight, with 2 setule notches, ventral marign naked, face with oblique row of 10 setae in middle, epimeron 3 with setule on posterodorsal margin set in deep notch. Urosomite 1 naked, articulation line almost complete; urosomite 3 with large hook dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, inner rami of uropods 1-2 each with two accessory

nails, outer ramus of uropod 1 with 2 dorsal spines, inner with one, outer ramus of uropod 2 with 2 dorsal spines, inner with none; peduncle of uropod 1 with 3 apicolateral spines and one basofacial spinule, medially with 2 marginal setules and apical enlarged spine; peduncle of uropod 2 with 7 dorsal spines, medially with one apical setule. Peduncle of uropod 3 with 5 ventral spines, dorsally with one lateral spine, one medial spine and setule; rami submasculine, inner extending to M. 90 on article 1 of outer ramus, apex with 2 setae, medial and lateral margins setose, article 2 of outer ramus short, 0.18, bearing 2 long setae, apicomedial margin of article 1 with 2 setae, lateral margin with 3 acclivities, spine formula = 2-2-2-2, setal formula = 0. Telson especially long, length-width ratio = 14:11, not fully cleft, each apex of medium width, undulant, lateral acclivity narrow, bearing ordinary lateral setule, spine next medial longer than setule, second spine next medial as long as setule, midlateral setules diverse. Cuticle with ordinary bulbar setules mixed with occasional pipes and spicules, emergent setules ordinary but weakly branched and thorned.

OBSERVATIONS.—Prebuccal mass rounded anteriorly; female "w" with 3 dorsal spines on outer ramus of uropod 1, 9 facial spines on epimeron 3 and 7 facial setae on epimeron 2; juvenile "j" spine formula on article 4 of antenna 2=4-5, peduncle of uropod 1 with 2 apicolateral spines, of uropod 2 with 5 dorsal spines, outer ramus of uropod 2 with only one dorsal spine, formula on article 1 on outer ramus of uropod 3=2-2; epimeron 3 with 7 facial spines.

ILLUSTRATIONS.—View of prebuccal mass from anterior aspect with upper lip not fully flattened; lower lip with narrower illustrated outer lobe not fully flattened, broader lobe fully flattened; apical setae on primary flagellum of antenna 1 broken off; illustration of pereopod 3 reduced to 83 percent of size in pereopods 4–5; outer ramus of uropod 3 with one spine missing on article 1. One side of telson with spines missing.

HOLOTYPE.—NMV, female "a," 4.90 mm.

TYPE-LOCALITY.—PPBES 974/3, 13 Oct 1971, Port Phillip Bay, Victoria, Australia, 5 m, sand.

VOUCHER MATERIAL.—PPBES 974/4, female "w," 3.87 mm; WPBES 1725/3, juvenile "j," 3.32 mm. Male unknown.

RELATIONSHIP.—Kulgaphoxus borralus shares

with *Tickalerus birubi* the following characters not shared with *Kulgaphoxus cadgeeus*; normal telson, unexpanded coxa 1, unstunted article 6 of pereopods 1-2, and the special bevel on article 2 of pereopod 5.

MATERIAL.—PPBES, 2 samples from one station (1): WPBES, 2 samples from one station (2).

DISTRIBUTION.—Victoria: Port Phillip Bay and Western Port, 5-13 m, sand.

Kulgaphoxus cadgeeus, new species

FIGURES 209-212

Description of Female.—Head about 13 percent of total body length, greatest width about 95 percent of length; rostrum constricted, narrow, very short, scarcely reaching along article I on antenna 1. Eyes medium, clear of pigment, ommatidia especially large. Article 1 on peduncle of antenna 1 about 1.5 times as long as wide, about twice as wide as article 2, ventral margin with about 8 setules, weakly produced dorsal apex with 2 setules; article 2 about 0.85 times as long as article 1, with proximoventral cycle of 5 setae; primary flagellum with 10 articles, about 0.8 times as long as peduncle, bearing several long aesthetascs; accessory flagellum with 9 articles. Spine formula on article 4 of antenna 2 = 1-3-7, dorsal margin with notch bearing 2 setae, ventral margin with 3 groups of 2 long to medium setae, one ventrodistal medium stout spine; article 5 about 0.67 times as long as article 4, facial spine formula = 1-3, dorsal margin naked, ventral margin with 2 sets of 2 long to short setae, 2 ventrodistal long to medium spines, one set facially; flagellum about 1.45 times as long as article 4-5 of peduncle combined, with 10-12 articles. Mandibles with medium palpar hump; right incisor with 3 teeth and notch; left incisor with 5 humps in 2 branches; right lacinia mobilis bifid, distal branch little shorter than proximal, distal branch flabellate, denticulate, proximal branch simple, pointed, with marginal denticles and facial humps; left lacinia mobilis with 4 teeth; right rakers 8; left rakers 9; molar in form of short protrusion or bulbous humps demarcated mainly by spines, right molar with 5 primarily long spines plus one short spine weakly disjunct, left molar with 4 long spines, none disjunct, each molar with plume; palp article l elongate, article 2 with one medium inner apical

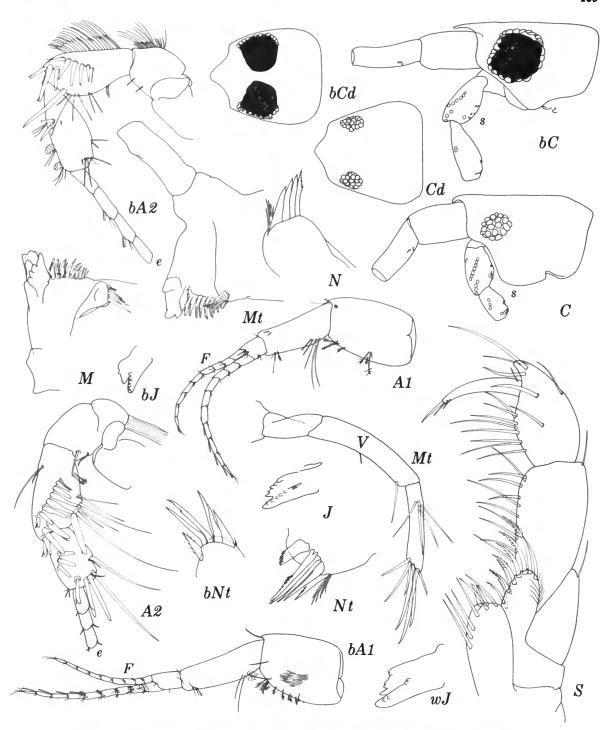


FIGURE 209.—Kulgaphoxus cadgeeus, new species, holotype, female "a," 4.11 mm (b= male "b," 3.25 mm; w= female "w," 5.3 mm).

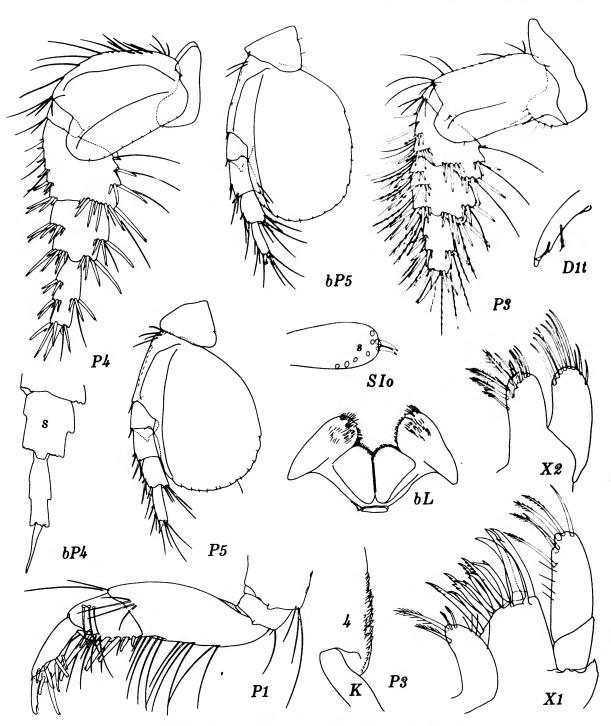


FIGURE 210.—Kulgaphoxus cadgeeus, new species, holotype, female "a," 4.11 mm (b = male "b," 3.25 mm).

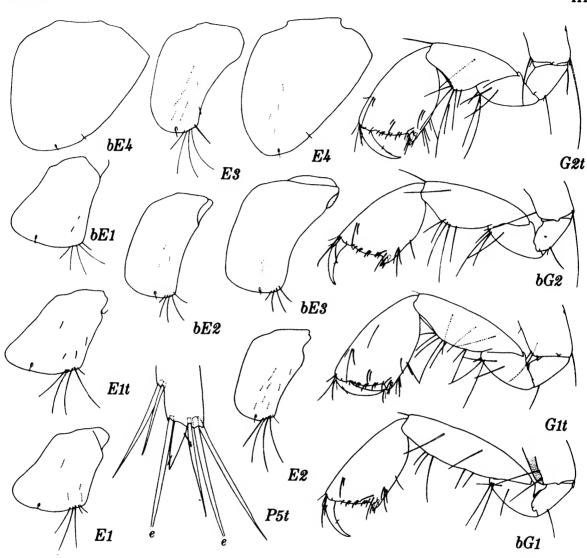


FIGURE 211.—Kulgaphoxus cadgeeus, new species, holotype, female "a," 4.11 mm (b = male "b," 3.25 mm).

seta and one other shorter inner seta, article 3 about 0.8 times as long as article 2, oblique apex with 7 spine-setae, basofacial formula = 2-2 and 2-1. Inner plate of maxilla 1 elongate, thin, bearing one long apical pluseta, one shorter similar apicomedial seta, 2 apicolateral much shorter setae; palp article 2 with 6 apicalmedial spines and setae. Plates of maxilla 2 extending equally, of equal breadth, outer with 3 apicolateral setae, inner with 2 medial setae. Inner plate of maxilliped with 2 large, thick apical spines, 2 apicofacial setae, 4 medial setae;

outer plate with 6-7 medial and apical spines, one apicolateral seta; palp article 1 with apicolateral seta, article 2 with apicolateral seta, medial margin of article 2 weakly setose, article 3 with 2 facial setae, one lateral seta, nail of article 4 long, with 2 accessory setules. Coxa 1 strongly expanded distally, anterior margin weakly concave; main ventral setae of coxae 1-4=5-5-5-0, posteriormost seta of coxae 1-3 shortened; anterior and posterior margins of coxa 4 strongly divergent, posterior margin very oblique, almost straight, posterodorsal corner

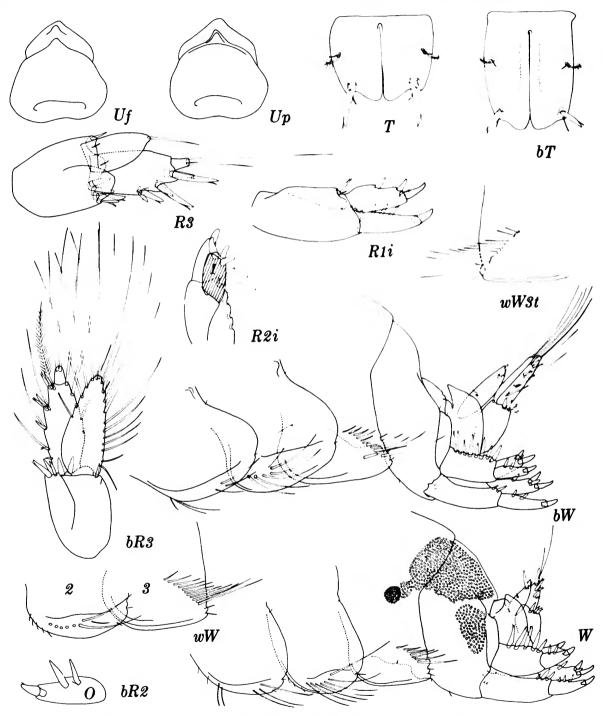


FIGURE 212.—Kulgaphoxus cadgeeus, new species, holotype, female "a," 4.11 mm (b = male "b," 3.25 mm; w = female "w," 5.3 mm).

angular, posterodorsal margin short, convex, width-length ratio of coxa 4 = 8:9. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 2-(3-4)-3-4, short posteriors = (1-2)-(3-5)-5-7, long anteriors = 2-1-0-0, short anteriors = 5-4-11-(8-11). Gnathopods ordinary; width ratios of articles 5-6 on gnathopods 1-2 =25:38 and 29:41, length ratios = 80:70 and 62:62; palmar humps large, palms oblique; article 5 of gnathopod 1 elongate, ovate, posterior margin rounded; article 5 of gnathopod 2 ovate, posterior margin rounded, almost lobate. Pereopods 1-2 similar; facial setae formula on article 4 = 3-4 and 4, on article 5 = 3 and 5; main spine of article 5 extending to M. 83 on article 6, article 5 with 3-4 and 3-4 stout proximoposterior spines; spine formula of article 6 = 3 + 4 and 4 + 4 plus vestigial middistal seta, one spine especially long; acclivity on inner margin of dactyls of pereopods 1-2 sharp, produced as tooth, emergent setule short, midfacial pluseta ordinary. Coxae 5-7 posteroventral setule formula = 6-1-1. Articles 4-5 of pereopods 3-4 broad; facial spine rows dense, facial ridge formula on article 2 of pereopods 3-5 = 1-2-2; width ratios of articles 2, 4, 5, 6, of pereopod 3 = 45:47:42:20, of pereopod 4 = 62:49:39:16, of pereopod 5 = 82:17: 14:7, length ratios of pereopod 3 = 81:42:37:39, of pereopod 4 = 88:54:40:47, of pereopod 5 =110:22:22:23, article 2 of pereopod 5 almost reaching apex of article 5, article 2 of pereopod 3 with large posterodorsal tooth; medial apex on article 6 of pereopod 5 bearing 2 weak digital processes, dactyl stunted. Posteroventral corner of epimeron 1 rounded, protuberant, with setule sinus, posterior margin convex, anteroventral margin with 1-2 medium setae, posteroventral face with 2-3 long setae, posterior pair set vertically; posteroventral corner of epimeron 2 rounded, weakly protuberant, with setule sinus, posterior margin convex, anteroventral margin with setules, facial setae = 5-8, posteriormost or next posterior pair set vertically, posteroventral corner of epimeron 3 weakly protuberant, with setule sinus, posterior margin straight, with 1-2 setule notches, ventral margin naked, face with oblique row of 5-11 setae near posterior margin in middle; epimera 1-2 with setule on posterodorsal margin set in weak notch. Urosomite 1 with 1-2 midventral setules, articulation line incomplete; urosomite 3 with hook dorsally. Rami of uropods 1-2 with articulate enlarged apical nails, inner rami of uropods 1-2 with two accessory nails, outer ramus of uropod 1 with 2-3 dorsal spines, inner with one, outer ramus of uropod 2 with 2 dorsal spines, inner with none; peduncle of uropod 1 with 2-3 apicolateral spines and 2 basofacial setules, medially with 2 apical spines, one enlarged; peduncle of uropod 2 with 5 dorsal spines, medially naked. Peduncle of uropod 3 with 3 ventral spines, dorsally with one lateral spine, one medial spine and setule; rami feminine, short, inner extending to M. 75 on article 1 of outer ramus, apex with one seta, medial and lateral margins naked, article 2 of outer ramus ordinary, 0.25, bearing 2 medium to long setae, apicomedial margin of article 1 naked, lateral margin with 2 acclivities, spine formula = 2-2-2, setal formula = 0. Telson short, length-width ratio = 14:17, not fully cleft, each apex wide, subtruncate, lateral acclivity deep, narrow, bearing ordinary lateral setule, spine next medial much longer than setule, midlateral setules diverse. Cuticle with ordinary bulbar setules.

OBSERVATIONS (female).—Anterior setule of coxae 1-4 rather posteriad; article 4 of pereopod 3 with posterior marginal scales (absent in male); article 2 of pereopod 5 with anterior setules; coxae 2-3 slightly tapering apically; occasional specimens with setule proximal to spines on peduncle of uropod 1 apicolaterally.

Female "w": A superfemale with following attributes similar to holotype female: head, antenna 1, antenna 2, pereopods 3-4, left pereopod 5, maxilla 1, maxilla 2, right mandibular palp [left mandible missing], maxilliped, right mandible with 7 raker spines plus one rudimentary spine. This female like holotype except for the following: right lacinia mobilis (illustrated), right pereopod 5 article 2 slightly broader than in holotype, epimera 2-3 (illustrated), epimeron 1 with 4 long posteroventral facial setae, outer ramus of uropod 1 with 4 spines, peduncle of uropod 2 with 6 spines.

DESCRIPTION OF MALE.—Eyes enlarged. Article 2 of antenna 1 with 2 proximoventral setae; primary flagellum with 9 articles, one calceolus each on articles 1–5; accessory flagellum with 9–10 articles. Facial spine formula on article 4 of antenna 2 = 1–3–5 or 1–3–6, on article 5 = 2, latter with 3 sets of dorsal male setae and 2 calceoli; flagellar formula = 28, 2, 3, 5, 7 . . . 27. Right mandibular rakers 8, left 9; right molar with 5 spines and one disjunct, left with 5 alone; basofacial setal formula on article

3 of palp = 2 + 1. Palps of maxilla 1 with 6 and 7 spines and setae. Coxa 4 broadened, ventral setal formula of coxae 1-4 = 5-5-4-0. Gnathopod 1 thinner than in female. Article 5 of pereopods 1-2 with only 3 posteroproximal spines; setae of article 4 shortened; main spine rows on article 6 = 4 + 4. Article 2 of only pereopod 5 narrower than in female, ventral margin lacking elongate setule, articles 5-6 of pereopod 4 slightly thinner than in female (see illustration). Epimera 1-8 broadened, posterior margin of epimeron 3 not shortened; setal formulas, epimeron 1 anteroventral = 3, posteroventral = 3, 2 of these set vertically, epimeron 2 facial = 5, epimeron 3 posterior = 3 setules, facial = 11 (one aberrant sheathed), ventral = 0. Urosome slender, hook enlarged. Spine formulas of uropods, uropod 1 peduncle apicolateral = 2, basofacial = 2 setules, uropod 2 peduncle dorsal = 8, dorsal spines on outer ramus of uropod 1 = 2, of uropod 2 = 2, inner ramus of uropod 1 = 1, of uropod 2 = 0. Ventral spines on peduncle of uropod 3 = 4, spine formula on article 1 of outer ramus = 1-1-1-2-2, setal formula = 0-1-1-1-1. Telson elongate, distal spines shortened, each lobe with dorsal row of denticles.

ILLUSTRATIONS.—Male epimeron 3 with one abberrant seta bearing rooted sheath (aberrant); female "w," illustration of epimeron 2 based on reconstruction from right and left sides together, both sides slightly damaged; several setae on illustration of male uropod 3 truncated apically for clarity.

HOLOTYPE.—NMV, female "a," 4.11 mm. TYPE-LOCALITY.—CPBS 35S/5, 18 Mar 1965, Western Port, Victoria, Australia, 15.1 m, sand.

VOUCHER MATERIAL.—CPBS 25N/2, female "w," 5.13 mm (illus.); RHM, off Crib Point, 22 Oct 1971, male "b," 3.25 mm (illus.); CPBS 34N/4, female "f," 4.08 mm.

RELATIONSHIP.—Kulgaphoxus cadgeeus shares with Tickalerus birubi the following characters not shared with K. borralus: the presence of anterior setules on article 2 of pereopod 5, the fully medial spines on the palp of maxilla 1, the elongate article 6 of pereopods 3-4 and the well developed dactyl of pereopod 5. Kulgaphoxus cadgeeus differs from K. borralus in these additional characters: shorter telson bearing only one main spine on each lobe, the expanded coxa 1 and the smaller rostrum.

Unlike either K. borralus or T. birubi, Kulga-

phoxus cadgeeus lacks the special bevel on article 2 of pereopod 5, and has a set of 3 facial spines on article 5 on antenna 2.

MATERIAL.—CPBS, 7 samples from 4 stations (9); PPBES, 2 samples from 2 stations (6); RHM, one sample (1).

DISTRIBUTION.—Victoria: Western Port and Port Phillip Bay, 1.0-15.1 m and neritic, sand, coarse sand, clayey sand.

Microphoxus J. L. Barnard

Microphoxus J. L. Barnard, 1960:291.

Diagnosis.—Eyes present. Flagella of antennae 1-2 unreduced in female, article 2 of antenna 1 ordinary, ventral setae widely spread. [?Article 1 of antenna 2 not ensiform; article 3 with 2 setules; facial spines on article 4 in one main row]; article 5 ordinary in size. Right mandibular incisor with 3 teeth; molar not triturative, small [?bearing 4 or more splayed, semiarticulate spines, usually not bearing fuzz]; palpar hump small. Palp of maxilla 1 biarticulate; inner plate with 2 setae. Setation of maxilla 2 ordinary. Inner plate of maxillipeds ordinary; apex of palp article 3 not protuberant, dactyl elongate, apical nail distinct, elongate, bearing large partner. Gnathopods ordinary, small, similar; article 5 free, elongate, with weak eusirid attachment, palms oblique to almost transverse, hand ovatorectangular, heavily setose anteriorly but not trichophoxid in shape. Article 2 of pereopod 3 of broad form, articles 4-5 of pereopods 3-4 broad, article 2 of pereopods 3-4 not setose posteriorly; pereopod 5 ordinary, article 2 naked ventrally, article 3 slightly enlarged, dactyl normal. Epimera 1-2 lacking numerous long posterior setae, without midfacial setae above ventral facial ridge; epimeron 3 ordinary. Urosomite 1 generally naked; urosomite 3 without dorsal hook or special process. Peduncle of uropod 1 normally elongate, without apicoventral spike, without special enlarged apicolateral or medial spine; [?peduncular apices of uropods 1-2 not combed]; inner ramus of uropod 1 lacking marginal spines, some rami of uropods 1-2 continuously spinose to apex, inner ramus of uropod 2 ordinary. Uropod 3 ordinary, elongate article 2 of outer ramus carrying 2 long apical setae. Telson elongate, with 2 apical spines or setae on each lobe plus setules, with special lateral spines or setae.

DESCRIPTION.—Rostrum constricted, small to ob-

solescent. [Fuzz on article 1 of antenna 1 in male unknown, calceoli on male antennae 1-2 unknown. Prebuccal parts unknown. Right lacinia mobilis unknown; mandibular palp thin, article 1 short, article 2 without outer setae, apex of article 3 oblique. [?Lower lip bearing cones. Outer plate of maxilla 1 unknown.] Inner plates of maxilliped thick, ordinarily setose. Coxae 2-4 without special anterodorsal hump. Some posterior spines on article 6 of pereopods 1-2 thin and seta-like, [midapical spine or seta unknown]. Article 2 of pereopod 5 without facial setae. Peduncle of uropod 1 with dorsolateral spine confined apically, medial spine confined apically, peduncle of uropod 2 with medial spines widely spread. Peduncle of uropod 3 lacking extra subapical setae or spines. [?Telson with ordinary pair of midlateral or dorsal setules on each side unknown.]

Type-Species.—Microphoxus minimus J. L. Barnard, 1960 (monotypy).

Composition.—Unique.

RELATIONSHIP.—This genus differs from Birubius in the shorter article 2 of antenna 1, the elongate telson bearing lateral setae, the elongate article 2 on the outer ramus of uropod 3, the strong anterior setation on the hands of the gnathopods, the reduction of setae on the inner plate of maxilla 1; the large accessory nail on the dactyl of the maxilliped, the slightly enlarged article 3 of pereopod 5 and the widespread medial spination on the peduncle of uropod 2. There may be distinctions in the lacinia mobilis and molar. The type-species requires extensive reanalysis.

From Parharpinia and Protophoxus, Microphoxus differs in the absence of a special spine on the peduncle of uropod 1, the broad articles 4-5 of pereopods 3-4, the elongate telson and the strong anterior setation on the hands of the gnathopods.

Microphoxus may have some relationship to the Tipimegus group of genera in view of gnathopod 1, pereopod 5 and the shape of pereopod 4, but Microphoxus differs from those genera in the somewhat broader hands of the gnathopods, the absence of posterior setae on article 2 of pereopod 4 and epimera 1-2, the absence of facial setae on pereopod 5, the absence of a spike on uropod 1, the short article 2 of antenna 1, the strong nail of the maxillipedal palp, the regular shape of article 2 on pereopod 5, and the normal article 5 of antenna 2. See Metharpinia below for further remarks.

Microphoxus minimus J. L. Barnard

Microphoxus minimus J. L. Barnard, 1960:291, pl. 46.

DISTRIBUTION.—Pacific Costa Rica, 4-9 m.

Metharpinia Schellenberg

Metharpinia Schellenberg, 1931:65.

Diagnosis.—Eyes present. Flagella of antenna 1-2 unreduced in female. [Article 2 of antenna 1 unknown precisely, possibly ordinary], ventral setae widely spread. [?Article 1 of antenna 2 not ensiform; article 3 with 2 setules; ?facial spines on article 4 in one main or 2 or more rows; article 5 ordinary in size. Right mandibular incisor with 3 teeth;] molar not triturative, small, elongate, conical, [bearing unknown number of "numerous" spines, ?usually not bearing fuzz]; palpar hump small. Palp of maxilla 1 biarticulate; inner plate with 2 setae. Setation of maxilla 2 weak; inner plate of maxillipeds ordinary; apex of palp article 3 not protuberant, dactyl elongate, apical nail distinct, immense. Gnathopods small, similar, but gnathopod 2 weakly enlarged; article 5 of gnathopods 1-2 free, elongate, without eusirid attachment; palms oblique, hands ordinary, ovatorectangular, moderately setose anteriorly. Article 5 of pereopods 1-2 setose posteroproximally. Article 2 of pereopod 3 of broad form, articles 4-5 of pereopods 3-4 broad, article 2 of pereopods 3-4 not setose posteriorly; pereopod 5 ordinary, article 2 naked ventrally, article 3 ordinary, dactyl normal. [?Peduncle of uropod l normally elongate, without apicoventral spike, without special enlarged apicolateral-medial spine; peduncular apices of uropods 1-2 not combed; inner ramus of uropod 1 with marginal spines in one row,] some rami continuously spinose to apex, inner ramus of uropod 2 ordinary. Uropod 3 ordinary, bearing elongate article 2 of outer ramus, [?carrying 2 medium apical setae]. Telson elongate, with 2+ apical spines or setae on each lobe plus setules, with special lateral setae. [?Epimera 1-2 lacking long posterior setae, without midfacial setae above ventral facial ridge]; epimeron 3 ordinary. [?Urosomite 1 generally naked]; urosomite 3 without dorsal hook or special process.

DESCRIPTION.—Rostrum fully developed, constricted. [?Fuzz on article l of antenna l in male unknown; calceoli on male antennae l-2 unknown.

Prebuccal parts ordinary. ?Right lacinia mobilis bifid, thin; mandibular palp thin, article 1 short, article 2 without outer setae, apex of article 3 oblique. [?Lower lip bearing cones. Outer plate of maxilla 1 with 11 spines, one spine especially thickened.] Inner plates of maxilliped thick, ordinarily setose. Coxae 2-4 without special anterodorsal humps. [?Some posterior spines on article 6 of pereopods 1-2 thin and seta-like, midapical spine or seta unknown.] Article 2 of pereopod 5 without facial setae. [?Peduncle of uropod 1 with dorsolateral spines confined apically, medial spines confined apically; peduncle of uropod 2 with only one medial spine or setule confined apically. Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with ordinary pair of midlateral or dorsal setules on each side.]

Type-Species.—Metharpinia longirostris Schellenberg, 1931 (here selected on the basis of page priority).

COMPOSITION.—Unique. Metharpinia cornuta Schellenberg, 1931, is removed to a new genus to be described (J. L. Barnard, in prep.).

REMARKS.—The diagnosis and description of the genus are sprinkled liberally with brackets containing questioned guesswork about many morphological characters not adequately described.

RELATIONSHIP.—Metharpinia and Microphoxus appear to be closely similar genera in terms of telson, maxillipedal dactyl, pereopods 3-4, article 3 of pereopod 5, molars, outer ramus of uropod 3, gnathopods, inner plate of maxilla 1 and to some extent the head.

Microphoxus differs only in the lack of posterior setae on coxa 4 but so many characters of either genus are unknown that further comments cannot be made.

Metharpinia longirostris Schellenberg

Metharpinia longirostris Schellenberg, 1931:65-67, fig. 34; 1935:232.

Paraphoxus longirostris.-J. L. Barnard, 1960:273, pl. 43.

DISTRIBUTION.—South America, Valparaiso, Corral, and south of mouth of La Plata River, 9-13 m.

PHOXOCEPHALINAE

Diagnosis.—Article 2 of antenna 1 usually shortened; mandibular molar fully triturative or reduced to a small hump with articulate spines; palp of maxilla 1 uniarticulate; setation on maxilla 2 reduced; gnathopod 2 significantly enlarged, or as small as gnathopod 1; article 2 of pereopod 3 of broad form; pereopod 5 ordinary.

Description.—Article 5 of antenna 2 usually reduced in size; epimeron 3 of rounded classification; apices on peduncles of uropods 1-2 combed or not.

Type Genus.—Phoxocephalus Stebbing.

Composition.—Diogodias, new genus; Hopiphoxus, new genus; Japara, new genus; Jerildaria, new genus; Kondoleus, new genus; Leptophoxoides J. L. Barnard; Leptophoxus Sars; Limnoporeia Fearn-Wannan; Metaphoxoides Ledoyer; Metaphoxus Bonnier; Rikkarus, new genus; Uldanamia, new genus; Vasco, new genus.

Key to the Genera of Phoxocephalinae

1.	Article 3 of palp on maxilliped immensely produced
	Article 3 of palp on maxilliped unproduced or scarcely so
2.	Mandibular molar triturative
	Mandibular molar not triturative
3.	Mandibular molar triturative 4
	Mandibular molar not triturative, bearing spines, or molar absent
4.	Hand-wrist of gnathopods eusirid, greatly enlarged, palpar hump of mandible huge, article
	2 on outer ramus of uropod 3 very short
	Hand-wrist of gnathopods weakly eusirid or not, not highly enlarged, palpar hump of man-
	dible small to medium, article 2 on outer ramus of uropod 3 elongate Phoxocephalus
5.	Rami of uropod 3 reduced, shorter than peduncle, outer ramus lacking article 2
	Rami of uropod 3 ordinary 6
6.	Flagellum of female antenna 2 reduced to one article, rostrum obsolete, article 2 of antenna
	l slightly elongate and produced apically, maxilliped with basal spouts, uropods 1-2 with
	dorsal setae, inner ramus of uropod 2 reduced

	Flagellum of female antenna 2 multiarticulate, rostrum present, article 2 of antenna 1 short, unproduced, maxilliped lacking basal spouts, uropods 1-2 with normal rami and lacking dorsal setae
7.	Gnathopods strongly chelate
	Gnathopods subchelate, ocassionally gnathopod 1 weakly parachelate
8.	Wrist of gnathopod 2 highly elongate, dactyls of pereopods 1-2 vestigial
	Wrist of gnathopod 2 not elongate, dactyls of pereopods 1-2 fully developed Limnoporeia
9.	Article 2 on outer ramus of uropod 3 vestigial
	Article 2 on outer ramus of uropod 3 well developed10
10.	Epimeron 3 grossly serrate, hand of gnathopod 2 thin, sinuous, palm extremely oblique Rikkarus, new genus
	Epimeron 3 of rounded classification, hand of gnathopod 2 expanded, palm weakly to moderately oblique
11.	Rami of uropods 1-2 dorsally setose near apices
	Rami of uropods 1-2 neither setose nor bearing dorsal armaments near apices12
12.	Article 5 of gnathopods elongate
	Article 5 of gnathopods short
13.	Dactyls of pereopods 1-2 stunted
	Dactyls of pereopods 1-2 elongate
	Dactyls of pereopous 1-2 elongate

Phoxocephalus Stebbing

Phoxus Krøyer, 1842:150 [not Billberg 1820, Coleoptera]. Phoxocephalus Stebbing, 1888:810-811 [new name].

DIAGNOSIS.—Eyes present but occasionally defective. Flagellum of antenna 2 reduced in female. Article 2 of antenna 1 ordinary to shortened, ventral setae confined apically. Article I of antenna 2 not ensiform; article 3 with 2 setules; facial spines on article 4 in 2 or more rows, plus special apical spines; article 5 thin and short. Right mandibular incisor with 2-3 teeth; molar strongly triturative, large to medium; palpar hump small to medium. Palp of maxilla 1 uniarticulate; inner plate naked. Setation of maxilla 2 weak. Inner plate of maxillipeds ordinary; apex of palp article 3 not protuberant, dactyl elongate to medium, apical nail distinct, short to elongate. Gnathopods dissimilar, gnathopod 2 weakly to strongly enlarged, article 5 of gnathopod 1 of ordinary length, very short and cryptic on gnathopod 2, with weak eusirid attachment; palms oblique to transverse, hands of gnathopods 1-2 ordinary, ovatorectangular to broadened, poorly setose anteriorly. Article 5 of pereopods 1-2 setose posteroproximally. Article 2 of pereopod 3 of broad form, articles 4-5 of pereopods 3-4 narrow to medium, article 2 of pereopods 3-4 not setose posteriorly; pereopod 5 ordinary, article 2 naked ventrally, article 3 ordinary, dactyl normal. Epimera 1-2 lacking long posterior setae, without midfacial setae above ventral facial ridge; epimeron 3 of rounded classification and bearing 3 or fewer long setae. Urosomite 1 generally naked; urosomite 3 without dorsal hook or special process. Peduncle of uropod 1 normally elongate, without apicoventral spike, without special enlarged apicolateral or medial spine, peduncular apices of uropods 1-2 combed; inner ramus of uropod 1 with marginal spines in one row, no rami continously spinose to apex, apical nails poorly developed, inner ramus of uropod 2 ordinary. Uropod 3 ordinary, elongate article 2 of outer ramus carrying 1-2 short apical setae. Telson elongate, with 1-2 apical spines or setae on each lobe plus setules, rarely with special dorsal and lateral spines or setae.

DESCRIPTION.—Rostrum fully developed. Fuzz on article 1 of antenna 1 in male present; calceoli on male primary flagellum of antenna 1 present. Calceoli on article 5 of male antenna 2 present, flagellum in male with calceoli. Prebuccal parts ordinary, poorly separated from each other, upper lip dominant. Right lacinia mobilis bifid, flabellate; mandibular palp medium to thin, article l short, article 2 without outer setae, apex of article 3 oblique. Lower lip lacking cones. Outer plate of maxilla 1 with 7-9 spines, no spine especially thickened. Inner plates of maxilliped especially thin, poorly armed. Coxae 2-4 without special anterodorsal humps. Some posterior spines on article 6 of pereopods 1-2 thin and seta-like, others thick and stiff, midapical spine or seta present. Article 2 of

pereopod 5 without facial setae. Peduncle of uropod 1 with dorsolateral spines confined apically, medial spines confined apically or widely spread; peduncle of uropod 2 with only one medial spine or setule confined apically or with spines widely spread. Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with ordinary pair of midlateral or dorsal setules on each side.

Type-Species.—Phoxus holbolli Krøyer 1842 [selected by Boeck, 1876].

Composition.—Phoxus bassi Stebbing, 1888; Phoxocephalus burleus, new species; Phoxocephalus homilis J. L. Barnard, 1960; Phoxocephalus

keppeli, new species; Phoxus kergueleni Stebbing, 1888; Phoxocephalus kukathus, new species; Phoxocephalus regium K. H. Barnard, 1930; Phoxocephalus rupullus, new species; Phoxocephalus tenuipes Stephensen, 1925; Phoxocephalus tunggeus, new species.

REMARKS.—The type-species has such small gnathopods, scarcely divergent in size, that the other known species of the genus might be removed to a distinctive subgenus at least.

A diversity of dactyls on the maxilliped is also present and the medial spination on the peduncles of uropods 1-2 is variable.

Key to the World Species of Phoxocephalus

(Not including P. keppeli)

_	
1.	Hand of gnathopod 2 only 1.1 times as long as wide
	Hand of gnathopod 2 at least 1.7 times as long as wide
2.	Eyes present, hand of gnathopod 1 about 1.9 times as long as wide
_	Eyes absent, hand of gnathopod 1 about 1.2 times as long as wide
3.	Eyes absent or structurally deficient, gnathopods small, gnathopod 2 scarcely larger than
	gnathopod 1
	Eyes present, large, gnathopod 2 enlarged 4
4.	Outer ramus of uropod 1 as long as inner ramus and dorsally spinose
	Outer ramus of uropod 1 shortened and naked
5.	Facial setae of epimeron 2 confined to anterior third of surface
	Facial setae of epimeron 2 spread fully posterior
6.	Cuticle with villi organized into polygons
	Cuticle with unpatterned striations
7.	Epimeron 3 with long posterior setae, apical setae on article 2 of outer ramus on uropod 3
	elongate
	Epimeron 3 with short posterior setules or none, apical setae on article 2 of outer ramus on
	uropod 3 very short 8
8.	Outer ramus of uropod 2 with 3 setae
	Outer ramus of uropod 2 naked
9.	Inner ramus of uropod 1 with 3 dorsal spines
	Inner ramus of uropod 1 with one dorsal spine

Phoxocephalus bassi (Stebbing)

FIGURES 213, 214

Phoxus bassi Stebbing, 1888:811-815, pl 54.
Phoxocephalus bassi.—Stebbing, 1906:135; 1910:577, 635.—
J. L. Barnard, 1960:298.
Not Phoxocephalus bassi.—K. H. Barnard, 1930:330-331, fig. 9b [see P. keppeli, new species].

Description of Female.—Head about 18 percent of total body length, greatest width about 55 percent of length, rostrum reaching apex of article 3 on antenna 1, unconstricted, tapering almost to point, apex rounded. Eyes of medium size, clear of

pigment core in preservative. Article 1 on peduncle of antenna 1 almost 1.9 times as long as wide, 1.8 times as wide as article 2, apicoventral margin with several setules, strongly produced dorsal apex with 3 setules; article 2 about 0.45 times as long as article 1, apicoventral surface with 5 setae, article 3 attached almost terminally to article 2; accessory flagellum slightly shorter than primary flagellum, 5-articulate, primary flagellum 6-articulate, aesthetascs absent. Spine formula on article 4 of antenna 2 = 1-3-4-5, proximal sets with one accessory setule, spines thin, dorsal margin with set of 3 setae, long to short, ventral margin with 5 subbasal penicillate setules and about 17 long or short setae,

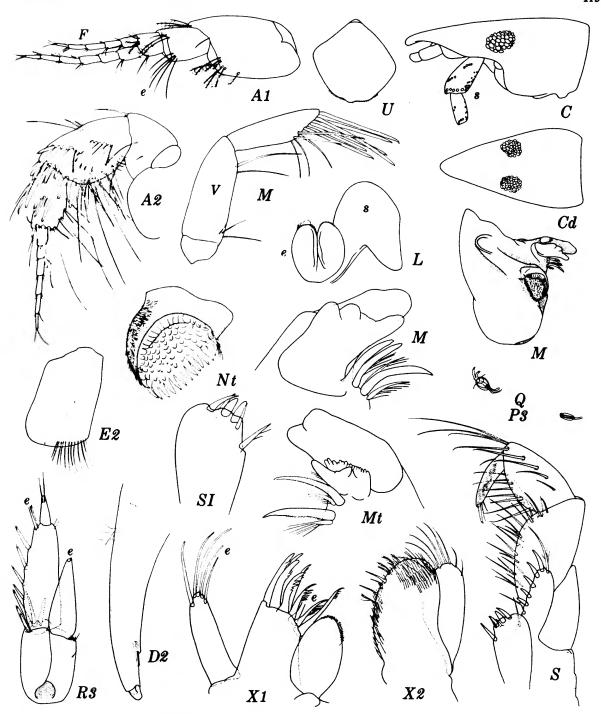


FIGURE 213.—Phoxocephalus bassi (Stebbing), female "a," 9.5 mm.

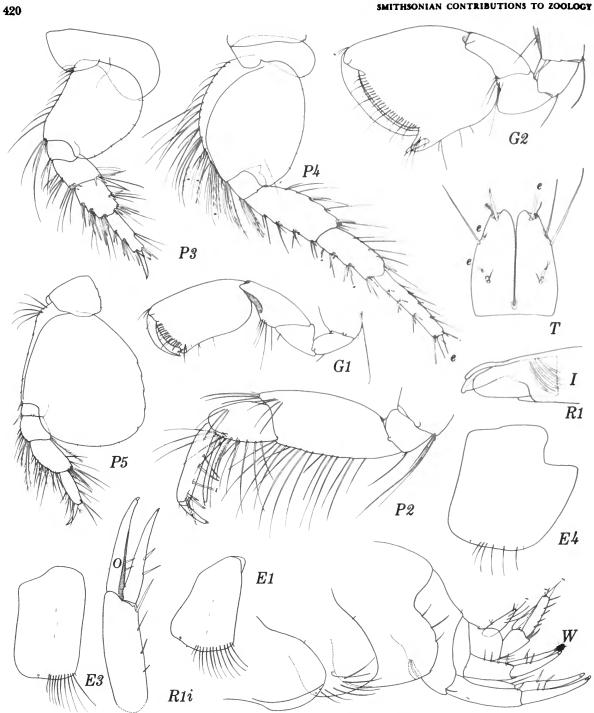


FIGURE 214.—Phoxocephalus bassi (Stebbing), female "a," 9.5 mm.

apex with 2 short spines; article 5 about 0.7 times as long as article 4, facial spine formula = 2, with one accessory setule, full distal margin with 4 short to long spines, dorsal margin smooth, ventral margin with 4 sets of 1-2 long and short setae; flagellum scarcely longer than article 4 of peduncle, 6-articulate. Palpar hump of mandible large; right incisor bidentate, distolateral tooth obsolete; left incisor bidentate, distal branch weakly trifid; right lacinia mobilis flabellate, distal branch with toothed margin, face with humps; left lacinia mobilis flabellate, trifid; right rakers 2, left 3; molar triturative, on medium-length pedicle; palp article 2 with 3 subbasal setae and 2 apical setae on inner margin, article 3 about 0.9 times as long as article 2, oblique apex with 11 setae. Mandibular lobes on lower lip of medium length, weakly attenuate and apically rounded, inner lobes fused together for most of their length but with distinct raphe and turgid faces accentuating raphe. Inner plate of maxilla 1 enlarged, elliptical, naked; outer plate with 9 spines; palp scarcely exceeding outer plate, bearing 2 apical, one apicolateral, and 2 apicomedial setae, some setae strap-shaped. Inner plate of maxilla 2 much broader than and weakly exceeding outer plate, medial margin of inner plate with about 8-10 short setae, outer plate with 8 apical and medial setae and 2 apicolateral setae. Inner plate of maxilliped with one medial spine, 2 stout and 3 slender apical spines; outer plate with 6 stout and one slender medial spines, one apicolateral seta; article 2 of palp moderately setose medially, article 3 with 4 facial setae, article 4 of medium length, apical spine short, bearing 2 accessory setules. Coxa 1 distally expanded and broadly rounded anteroventrally; long setal formula of coxae 1-4 = 12-11-10-6; anterior and posterior margins of coxa 4 weakly divergent, posterior margin weakly convex, posterodorsal corner subsharp, posterodorsal excavation of medium size and L-shaped, ratio of width to length = 19:21. Gnathopod 2 much stouter than gnathopod 1; long posterior setae on article 2 of gnathopods 1-2=3and 7, short posterior setae = 1 and 0, short anterior setae = 0 and (3-4); article 3 weakly elongate on gnathopod 1, gnathopods subeusirid; article 5 thin; article 6 attached to produced apex of article 5, article 6 of gnathopod 1 elongate and rectangular, of gnathopod 2 trapezoidal, nearly as broad as long [broader than long if length measured as

true longitudinal facial axis]; palm oblique, defining hump large on gnathopod 2, small on gnathopod 1, dactyl fitting palm, apex of dactyl on gnathopod l with flake [but apex of dactyl on gnathopod 2 eroded on unique specimen]; posterior margin of article 5 free on gnathopod 1; length ratios of articles 5-6 on gnathopods 1-2 = 54:64and 46:93 [midfacial axis =46:78], width ratios = 22:38 and 21:83. Pereopods 1-2 similar to each other; long posterior setae on article 2 of pereopods 1-2=4 and 5, short posterior setae = 1 and 2, short anterior setae = 2 and 2; article 4 with 4 and 5 facial setae, posterior margins of article 4 moderately setose; article 5 with long distal spine reaching to M.85 on article 6, with very small contiguous spine at base, article 5 with 3 and 3 facial setae on pereopods 1-2; article 6 of pereopods 1-2 with rows of 5 and 2 or 5 and 3 spines plus spine middistally, spines mostly long; dactyl with apical nail distinct and deeply immersed, inner margin with weak acclivity and short setule. Coxae 5-7 posteroventral setule formula = 1-1-3. Width ratios of articles 2, 4, 5, 6 of pereopod 3 = 53:22:21:10, of pereopod 4 = 69:26:19:10, of pereopod 5 = 83: 17:16:9, length ratios of articles 2, 4, 5, 6 of pereopod 3 = 67:21:27:33, of pereopod 4 = 84: 55:48:59, of pereopod 5 = 96:18:28:24; article 2 of pereopod 5 extending to apex of article 4; apex of article 6 finely combed medially. Epimera 1-2 with facial ridge, each with roundedquadrate posteroventral corner and weakly convex posterior margin; epimeron 3 with setule notch at posteroventral corner, posterior margin broadly rounded, bearing 3 setae in notches; epimeron 1 with 2 posteroventral setae in horizontal tandem (marked by dots in illustration); epimeron 2 with horizontal crescent of 6 setae. Urosomite 1 bearing one seta at base of uropod 1, urosomites almost flush dorsally, urosomite I with one seta on each side dorsally. Peduncle of uropod 1 with one small basofacial seta, lateral apex with short spine, medial margin with 4 spine-setae, distalmost elongate; rami of uropods 1-2 with articulate immersed apical nail and complex flake, inner ramus of uropod 2 with one dorsal spine, all other rami with 2 dorsal spines, inner ramus of uropod 1 with subbasal setule (marked by dot on illustration), outer ramus of uropod 1 reaching farther than inner ramus; peduncle of uropod 2 with 4 dorsal spines, apicomedially with one spine, apex of peduncle on

uropod 2 with comb, absent on uropod 1. Uropod 3 long, rami feminine, peduncle with 5 ventrolateral spines, medially with 2 apical setules, inner ramus extending almost to M. 70 on article 1 of outer ramus, apex with ?2 setae [broken off], article 2 of outer ramus weakly elongate, 0.28, bearing 2 short apical setae, outer margin of article 1 with 4 acclivities, spine formula = 1-1-1-2, medial apex with spine. Telson elongate, length-width ratio 14:11, apices weakly tapering, with weak apicomedial lobe, lateral acclivity bearing long spine and shorter lateral setule, main spine in middle of apex, dorsal pair of diverse plusetules near M. 33, additional pair of long lateral setae on each side near M. 70. Bifid bulbar setules of cuticle extremely sparse.

DESCRIPTION OF MALE.—See Stebbing (1888).

OBSERVATIONS.—Prebuccal complex weakly convex anteriorly, weakly extended forward; on unique female in hand, apicoventral spine on inner plate of maxilliped occurring between either main spines 1-2 or 2-3, differing on the two plates.

ILLUSTRATIONS.—Specimen with several defects: eye sunken, full lateral dimensions not shown; lower lip damaged, outline of outer lobe lacking armaments; palp and outer plate of maxilla 1 damaged, illustration of restored view.

VOUCHER MATERIAL.—AM P.18243, female "a," 9.5 mm (illus.), off Sydney, New South Wales, Australia, 18 Jun 1962, 150 m.

REMARKS.—Stebbing (1888) described the male of this species, about 10 mm long, from Bass Strait. Our female apparently belongs to *P. bassi*, fitting the *a priori* concept of a female of the species in dozens of significant characters. Stebbing shows the male uropod 2 bearing more than twice as many spines on the peduncle of uropod 2 than in our female, shows 3 spines on the outer ramus of uropod 2 and none on the inner. Stebbing's view of uropod 1 is apparently lateral whereas his view of uropod 2 is apparently medial; 2 ventral peduncular spines on uropod 2 are interpreted by us to be medial peduncular spines; we visualize the peduncle as heavily flattened in Stebbing's view, forcing the spines ventrad.

Differences in spine counts on uropods 1-2 are common distinctions between males and females of various phoxocephalids.

The mandibles of this species, as seen in our specimen and that of Stebbing, are heavily cal-

cified, with the proximal tooth on the incisors of both sides being reduced in prominence.

K. H. Barnard's identification of *P. bassi* from New Zealand is removed to a new species, *P. kep-peli* (see below).

MATERIAL.—AM, one sample (1).

DISTRIBUTION.—Southeastern Australia, Bass Strait, Wata Mooli; New South Wales, off Sydney; surface to 150 m.

Phoxocephalus kukathus, new species

FIGURES 215-217

DESCRIPTION OF FEMALE.—Head about 19 percent of total body length, greatest width about 55 percent of length, rostrum reaching middle of article 2 on antenna 1, unconstricted, weakly tapering, apically rounded. Eyes large, red in preservative, clear of pigment core. Article 1 on peduncle of antenna 1 about 1.5 times as long as wide, twice as wide as article 2, apicoventral margin with several setules, strongly produced dorsal apex with 4 setules; article 2 about 0.55 times as long as article 1, apicoventral surface with 4 setae, article 3 attached to lateral face of article 2 with override of article 2 medially; accessory flagellum shorter than primary flagellum, 3-articulate; primary flagellum 4-articulate, aesthetascs absent. Spine formula on article 4 of antenna 2 = 1-3-5-3 or 1-3-5-4 or 1-3-4-2, proximal set with 1-2 accessory setules, next set with one accessory setule, spines thin, dorsal margin with one spinule, ventral margin with 2 subbasal penicillate setules and 7-9 long or short setae, apex with 3 thin, short spines; article 5 less than 0.6 times as long as article 4, facial spine formula = 3 or 2, with one accessory setule, dorsodistal corner with 3 spines, dorsal margin smooth, ventral margin with 2 pairs of long-short setae, ventrodistal apex with one long, 2 short setae; flagellum shorter than article 4 of peduncle, 4-articulate. Palpar hump of mandible small; right incisor weakly tridentate, with weak midnotch, accessory notch near tooth 2, left basically bidentate, distal branch weakly quadridentate and bearing weak proximal facial humps; right lacinia mobilis flabellate, distal branch poorly defined, margin toothed, face with or without weak hump; left lacinia mobilis flabellate, irregularly 4-5 toothed; right rakers 2, left 3; molar triturative, on long

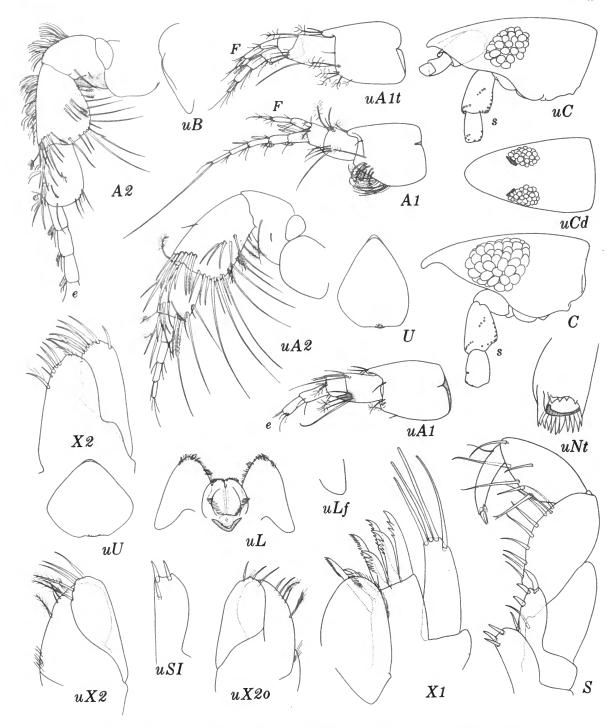


FIGURE 215.—Phoxocephalus kukathus, new species, male "c," 4.76 mm (u = holotype, female "u," 4.40 mm).

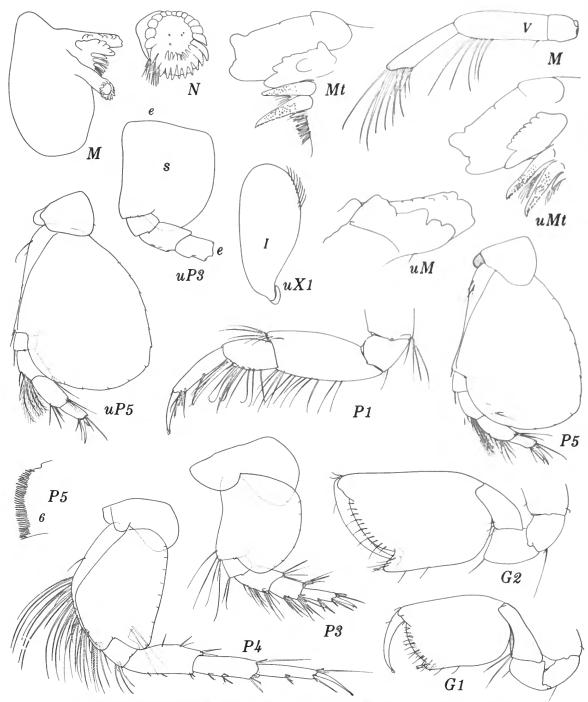


Figure 216.—Phoxocephalus kukathus, new species, male "c," 4.76 mm (u = holotype, female "u," 4.40 mm).

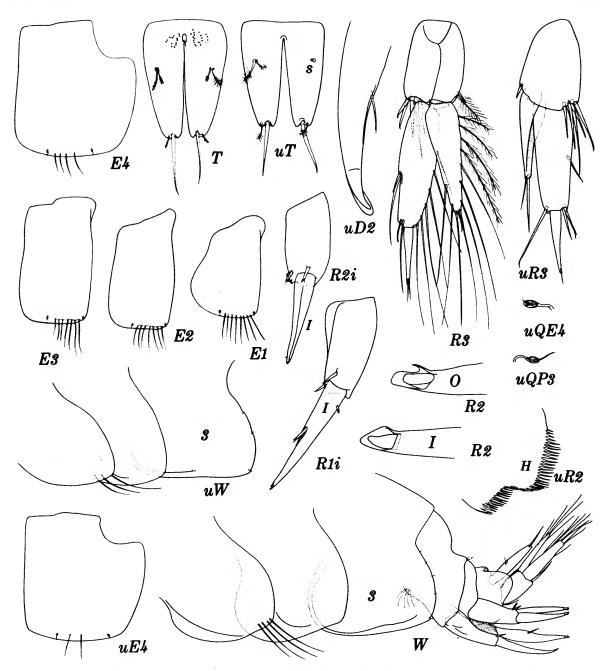


FIGURE 217.—Phoxocephalus kukathus, new species, male "c," 4.76 mm (u = holotype, female "u," 4.40 mm).

pedicle; palp article 2 with one small subbasal seta and 3 subapical setae on inner margin, article 3 about 0.85 times as long as article 2, oblique apex with 10-11 setae. Mandibular lobes on lower lip of

medium length, weakly attenuate and apically rounded, inner lobes fused together for most of their length but with distinct raphe. Inner plate of maxilla 1 large, elliptical, naked; outer plate with 7 spines; palp exceeding apex of outer plate, bearing 3 apical and one apicolateral strap-shaped setae. Inner plate of maxilla 2 much broader and slightly shorter than outer plate, medial margin of inner plate with one disjunct and distinctly medial seta plus 4-5 other short setae on apicomedial margin, perhaps truly apical setae shifted medially; outer plate with 3-5 apical and medial setae. Inner plate of maxilliped with one mediofacial spine and 2 apical spines; outer plate with 4 spines; article 2 of palp with sparse and stout medial setae, article 3 with one facial seta, article 4 long, apical spine short, bearing 2 accessory setules. Coxa 1 distally expanded and broadly rounded anteroventrally; long setal formula of coxae 1-4 = (5-8)-(5-8)(5-7)-(2-5); anterior and posterior margins of coxa 4 almost parallel, posterior margin weakly convex, posterodorsal corner rounded, posterodorsal excavation of medium size and L-shaped, ratio of width to length = 16:17. Gnathopod 2 much stouter than gnathopod 1; long posterior setae on article 2 of gnathopods 1-2 = 5 and 5; gnathopod 1 subeusirid, article 3 weakly elongate, article 5 thin, elongate, article 6 attached to produced apex of article 5, article 6 stout, ovatorectangular, palm oblique, defining hump large on gnathopod 2, small on gnathopod l, dactyl weakly overlapping palm, apices of dactyls with flake, posterior margin of article 5 on gnathopod 1 almost cryptic; length ratios of articles 5-6 on gnathopods 1-2 = 46:69and 39:101, width ratios = 19:47 and 19:66. Pereopods 1-2 similar to each other; long posterior setae on article 2 of pereopods 1-2 = 4-6 and 4-7; article 4 with about 6 apicoanterior setae, 2 of these facial, posterior margins of articles 4-5 moderately setose; article 5 lacking facial setae, with long distal spine reaching to M. 100 on article 6, with very small contiguous spine at base; article 6 with one long posterior setal-spine and rows of 3 and 2 posterodistal setal-spines, some sharp, others rounded apically, dactyl with apical flake and thin inner setule appressed in marginal groove (pulled out to illustrate), apical nail almost fully fused to dactyl. Coxae 5-7 posteroventral setule formula = 1-1-1. Width ratios of articles 2, 4, 5, 6 of pereopod 3 =60:18:15:8, of pereopod 4 = 66:18:12:6, of pereopod 5 = 94:17:14:8, length ratios of pereopod 3 = 70:27:22:25, of pereopod 4 = 91:48:40:39, of pereopod 5 = 116:25:27:16; article 2 of pereopod 5 extending to or exceeding apex of article 4;

apex of article 6 finely combed. Gill vestigial or absent on pereopod 5. Epimera 1-2 with weak facial ridge (omitted on drawing of female on epimeron 1), each with rounded-quadrate posteroventral corner and weakly convex posterior margin; epimeron 3 with weak posteroventral tooth and sinus bearing setule, posterior margin broadly convex, bearing 2-3 setule notches; epimeron 2 with 2-4 facial setae in horizontal row. Urosomite l bearing one lateral setule at base of uropod 1 and 1-3 proximoventral setae on each side, urosomite I weakly produced dorsally and bearing 2 setules; urosomite 3 with long seta at ventral base of uropod 3. Peduncle of uropod 1 occasionally with one basofacial seta, usually naked, each apex of peduncle with one medium spine, no medial marginal spines, inner ramus of uropod 1 and both rami of uropod 2 with apical flake and articulate spine, rami of uropod 2 otherwise naked, inner ramus of uropod 1 with one dorsal spine and one mediobasal spinule, outer ramus of uropod 1 slightly shortened, thinner and more curved than inner ramus, lacking spines, each apex of peduncle on uropod 2 with medium spine, apex of peduncle on uropods 1-2 with lateral comb. Uropod 3 long, rami feminine, peduncle with 5 long ventrolateral spines, medially with one short spine, inner ramus extending to M. 70 on article 1 of outer ramus, apex with 2 setae, article 2 of outer ramus elongate, 0.60, bearing one apical setule, outer margin of article 1 with one spine-seta, apex with 2 spine-setae, medial apex with one long spine-seta. Telson long, length-width ratio about 6:5, apices tapering but broadly truncate, weakly excavate, each bearing long mid spine and small apicolateral setule, dorsal pair of plusetules weakly diverse. Bulbar setules of cuticle extremely sparse.

DESCRIPTION OF MALE.—Eyes much larger than those of female. Article 1 of antenna 1 with medial patch of fuzz; disparity in length of flagella greater than in female, accessory flagellum 3-articulate, primary flagellum 5-articulate, bearing several aesthestascs, one calceolus (6-chambered) each on articles 1-2 and highly elongate apical seta on article 5. Spine formula on article 4 of antenna 2 peduncle = 4-5-2 or 3-5-2, article 5 with 2-3 facial spines and 2-3 apicodorsal spines, articles 3-4 with dorsomedial fuzz, article 5 with one dorsal calceolus and 2 groups of stiff male setae, ventrodistal margin poorly setose; flagellar formula = (25-27), 1-4, 6, 8

... penultimate, or 1-3, 5, 7, ... Article 2 of mandibular palp with 3-6 long subapical setae. Inner plate of maxilla 2 narrower than in female, setae of both plates larger, setae more numerous on outer plate. Mediofacial spine on inner plate of maxilliped very rarely more distally placed than in female. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = (1-4)-(1-3)-(2-4)(2-4). Coxa 4 narrower than in female. Article 2 of pereopods 3-5 more slender than in female. Gill well developed on pereopod 5. Epimera enlarged, epimeron 2 with 2-4 facial setae, epimeron 3 with 2-4 posterior setule notches besides one at ventral corner. Urosome smaller than in female relative to epimera, urosomite 1 with 2-5 proximoventral setae on each side. Body generally longer than in female. Uropod 1 with 1-2 basofacial setae. Rami of uropod 3 masculine, inner extending to M. 87 on article 1 of outer ramus, both margins setose, outer ramus with setose medial margin on article 1, lateral margin with pair of setae closely contiguous, article 2 with 2 apical setules. Telson slightly more elongate than in female, with basal patches of dorsal denticles.

OBSERVATIONS.—Additional variations in facial spine formulas on article 4 of female antenna 2 = 1-2-5-2, 1-3-4-1, 1-3-4-3, and 1-2-4-2. Outer plate of maxilliped on female, 4.1 mm, CPBS 33S, with one outer plate with only 2 thick apical spines and one thinner medial spine. Long posterior setae on article 2 of female gnathopod 1 most commonly 4, but variable between 1-5; on gnathopod 2 varying between 2 and 5. Epimeron 3 of female exceptionally with either 0 or 4 posterior notches besides posteroventral notch. Six known Western Port males and SBS males of comparable size (4.5 mm) differing weakly in shapes of gnathopods, Western Port nektonic male with long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 2-1-2-2, on SBS male = 4-2-3-4, such setae generally fewer in males than in females of comparable size; hands of gnathopods 1-2 in Port Phillip males and females generally thinner than those of Western Port, Port Phillip specimens generally with 8-9 apical setae on mandibular palp compared with 10-11 on Western Port and SBS specimens.

ILLUSTRATIONS.—Apex on outer ramus of uropod 2 as illustrated for male probably aberrant, normal condition as shown in other illustration.

HOLOTYPE.—NMV, female "u," 4.40 mm.

Type-Locality.—CPBS 12N/3, 16 Mar 1965, Western Port, Victoria, Australia, 3 m, Zostera, mud.

VOUCHER MATERIAL.—Type-locality, female "b," 3.77 mm; CPBS 12N/2, male "c," 4.76 mm (illus.).

RELATIONSHIP.—This species differs from P. bassi (Stebbing, 1888), a sympatriot from Bass Strait, in the longer article 6 of gnathopod 2 which in P. bassi is as broad as long, in the absence of an oblique row of facial setae on epimeron 3, and in the slightly shortened and thin outer ramus of uropod 1.

Phoxocephalus kukathus is strongly allied to P. kergueleni (Stebbing, 1888), from Kerguelen Island, and may not be specifically distinct from that species. Only one strong distinction can be discerned in that species, the presence of 3 dorsal spines on the inner ramus of uropod 1, in contrast to one spine in P. kukathus. The right mandibular incisor of P. kergueleni is more strongly toothed and notched than that of P. kukathus. There may be distinctions in the breadth of plates on maxilla 2 and distinctions in uropod 3 but the "female" illustrated by Stebbing has a uropod 3 characteristic of so-called intersexes and may therefore be senile or aberrant; the plates of maxilla 2 in Stebbing's illustrations are closer to the male depicted herein than to the female. Stebbing has either overlooked setae on epimeron 2 or else they are absent in P. kergueleni, a character of good specific value which should be verified.

Phoxocephalus regium K. H. Barnard, 1930, from New Zealand, has the rami of uropod 1 extending equally.

MATERIAL.—CPBS, 15 samples from 9 stations (53); WPBES, 6 samples from 4 stations (10); RHM 1 sample (1); PPBES, 48 samples from 24 stations (249); SBS, 13 samples from 9 stations (132); AM, one sample (14).

DISTRIBUTION.—Victoria: Western Port and Port Phillip Bay, intertidal to 22 m, sand, silty sand, sandy silt, clayey silt, clay. New South Wales, off Malabar, 48–75 m, sand, sandy mud, sandy gravel, South Australia, Kangaroo Island, neritic.

Phoxocephalus tunggeus, new species

FIGURES 218, 219

DESCRIPTION OF FEMALE.—Head about 18 percent of total body length, greatest width about 55

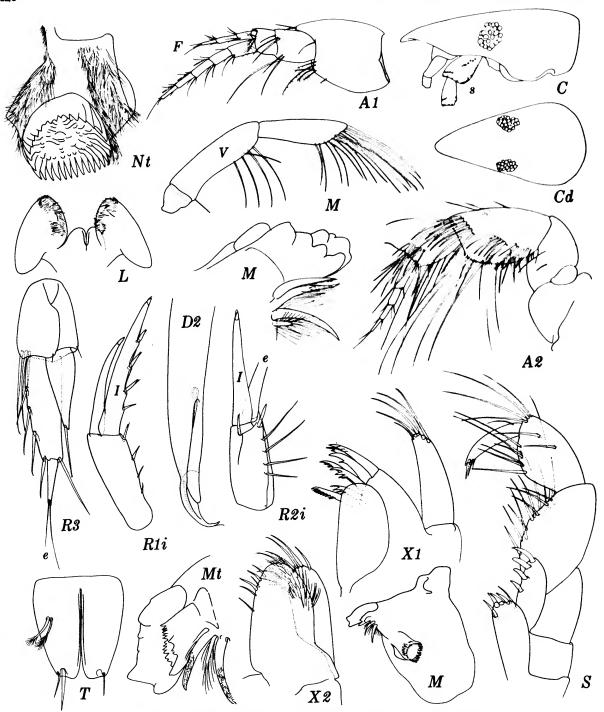


Figure 218.—Phoxocephalus tunggeus, new species, holotype, female "a," 5.66 mm.

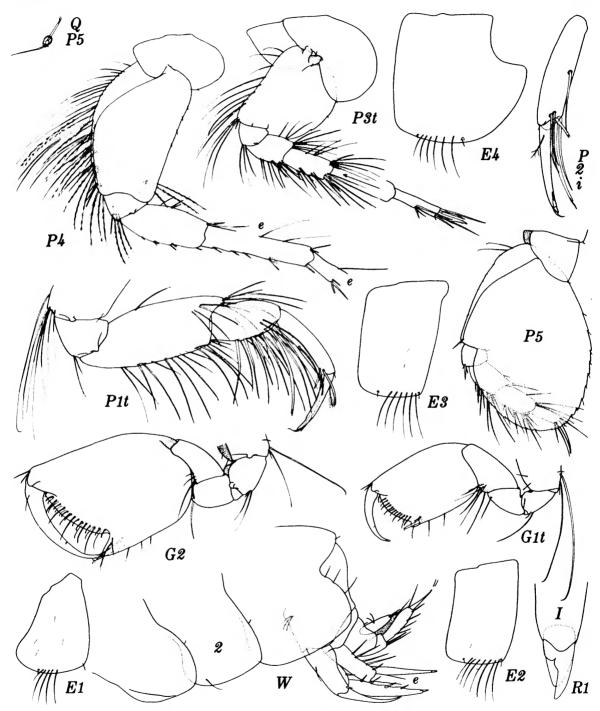


Figure 219.—Phoxocephalus tunggeus, new species, holotype, female "a," 5.66 mm.

percent of length, rostrum reaching apex of article 2 on antenna 1; unconstricted, tapering evenly and strongly, apex rounded, very narrow. Eyes of medium size, clear of pigment core. Article 1 on peduncle of antenna 1 almost 1.4 times as long as wide, 2.2 times as wide as article 2, apicoventral margin with several setules, strongly produced dorsal apex with 3 setules; article 2 about 0.42 times as long as article 1, apicoventral surface with 3 setae; article 3 attached terminally to article 2; accessory flagellum much shorter than primary flagellum, 3-articulate; primary flagellum 5-articulate, aesthetascs present. Spine formula on article 4 of antenna 2 = 3-5-5-1, middle sets each with one accessory setule, proximal set with 3 accessory setules, spines thin, dorsal margin with 2 sets of 1-3 setae, ventral margin with about 9 sets of 1-2 setae and 3 subbasal penicillate setules, apex with one thin spine; article 5 slightly more than 0.5 times as long as article 4, facial spine formula = 3, with one accessory setule, dorsodistal corner with 2 setae and 3 spines, apex with one spine, ventral margin with 5 sets of 1-2 setae, ventrodistal apex with one long seta; flagellum about 0.85 times as long as article 4 of peduncle, 4-articulate. Palpar hump of mandible small-medium; right incisor tridentate, with 2 notches between teeth 1 and 2; left basically bidentate, distal branch weakly 4-dentate; right lacinia mobilis flabellate, distal branch poorly defined, margin toothed, face with ragged hump-line; left lacinia mobilis flabellate, 4-dentate; right rakers 2, left 3; molar triturative, on long pedicle; palp article 2 with 5 long setae on apical margin distally, article 3 about 0.85 times as long as article 2, oblique apex with 14 setae. Mandibular lobes of lower lip of medium length, apically rounded, inner lobes fused together for most of their length but with distinct raphe. Inner plate of maxilla 1 large, elliptical, naked; outer plate with 7 spines; palp exceeding apex of outer plate, bearing 3 apical and 2 apicolateral setae. Inner plate of maxilla 2 almost twice as wide as outer plate, slightly exceeding apex of outer plate, setae all medial; outer plate with one apicolateral, 4 apical and 2 medial setae. Inner plate of maxilliped with one mediofacial seta, 3 apical spines; outer plate with 5 spines; article 2 of palp with medium dense medial setae, article 3 with 2 facial setae, dactyl long, apical spine short, bearing 2 accessory setules. Coxa 1 distally expanded, rounded anteroventrally; long setal formula of coxae 1-4 = 5-7-6-6; anterior and posterior margins of coxa 4 divergent, posterior margin oblique, convex, posterodorsal corner subsharp, posterodorsal excavation of medium size and lunate, ratio of width to length = about 1:1. Gnathopod 2 much stouter than gnathopod 1; long posterior setae on article 2 of gnathopods 1-2 = 11 and 11-14, short posterior setae = 1-1, short anteriors = 3 and 5, long anterolaterals = 2 and 0, article 3 short; only gnathopod 2 weakly eusirid, article 6 broadened but elongate, rectangular, palm oblique, defining hump large only on gnathopod 2, dactyl fitting palm (slight override), apices of dactyls with flake, posterior margin of article 5 on gnathopod 1 free, length ratios of articles 5-6 on gnathopods 1-2 = 44:65 and 38:97, width ratios = 22:44 and 22:73. Percopods 1-2 alike, long posterior setae on article 2 of percopods 1-2 - 10-11 and 13, short anteriors # 2 and 1, article 4 of percopods 1-2 with 4 apicolateral setae each, posterior margins of article 4 moderately setose, of article 5 more densely so, article 5 with 2 and 2 anterofacial setae, with long posterodistal spine reaching to M. 110 on article 6, with small contiguous seta-spine at base, article 6 with one long posterior seta-spine, one short and stouter middistal spine and rows of 2 and 2 long, thin apical spines on each of pereopods 1-2, dactyl with long hooked apical flake bearing apical setule, inner margin with subfacial seta emerging into channel forming one limb of flake, apical nail almost fully fused to dactyl. Coxae 5-7 posteroventral setule formula = 1-1-1. Width ratios of articles 2, 4, 5, 6 of pereopod 3 = 49:18:14:8, of pereopod 4 = 57:24:14:11, of pereopod 5 = 89:17: 14:7, length ratios of pereopod 3 = 65:22:31:34, of pereopod 4 = 92:50:73:unknown, of pereopod 5 = 122:24:26:21; article 2 of pereopod 5 slightly exceeding middle of article 5; apex of article 6 finely combed. Only epimeron 1 with facial ridge, posteroventral corner rounded, posterior margin convex, epimera 2-3 with rounded-quadrate posteroventral corners, epimeron 3 with strongly convex posterior margin bearing 3 setae on dorsal half, epimeron 2 with weakly convex posterior margin, epimera 1-2 each with midposterior setule, epimeron 1 naked, epimeron 2 with one facial anteroventral seta, ventral margin of epimeron 3 naked. Urosomite 1 bearing one lateral seta at base of uropod 1, urosomite 2 with one such seta, urosomites dorsally truncate, ventral base

of urosomite 3 with 3 long setae. Peduncle of uropod I with 1-2 facial setae at M. 30-35, lateral apex of peduncle with one spine, medial margin with 4 short spines, outer ramus short, reaching only M. 70 on inner ramus, curved, naked, apical nail weakly defined, lacking flake (apparently apex poorly preserved), inner ramus with 4 dorsal spines and one mediobasal setule, apical nail articulate but immersed and solidly fixed, bearing complex flake; peduncle of uropod 2 with short apicolateral spine and lateral margin with 4 long setae, fouter ramus apically broken, occurrence of spines unknown], inner ramus naked, apical nail as on uropod 1 inner ramus; peduncular apices of uropods 1-2 uncombed. Uropod 3 long, rami feminine. peduncle with 3 long ventrolateral setae, dorsolaterally and dorsomedially with setule, inner ramus extending to M. 70 on article 1 of outer ramus, apex with one seta, article 2 of outer ramus elongate, 0.44, bearing 2 apical setae, outer margin of article I with 3 acclivities, elongate spine-seta formula = I-I-I-I, medial apex with one spineseta. Telson slightly elongate, length-width ratio = 17:15, apices scarcely tapering, each with weak medial protrusion and weak lateral acclivity bearing one long spine-seta and one ordinary lateral setule, dorsal pair of plusetules alike. Cuticle glass smooth, very sparsely armed with ordinary bulbar setules.

OBSERVATIONS.—Prebuccal complex, epistome and upper lip poorly preserved, apparently like those of *P. kukathus*, Figure 215: *uB* and *uU*.

ILLUSTRATIONS.—Outer ramus of uropod 2 broken distally on both sides; apices of both fourth pereopods damaged or missing.

HOLOTYPE.—AM, female "a," 5.66 mm. Unique. Type-Locality.—AM P.18269, 20 Jun 1962, SW of Cape Everard, Victoria, Australia, 38°15′ S, 149°12′ E, 300 m.

RELATIONSHIP.—Phoxocephalus tunggeus, being based on a single individual, might appear to represent a senile condition of P. kukathus, new species, but the following characters appear to distinguish P. tunggeus adequately: (1) longer setae of epimeron 3; (2) absence of ridge and presence of only one facial seta on epimeron 2; (3) presence of long setae on peduncle of uropod 2; (4) complex scale on dactyls of pereopods 1-2.

Phoxocephalus tunggeus differs from Californian P. homilis J. L. Barnard, 1960, in: (1) placement of

ventral setae on coxa 1 in middle of margin and not posteriorly; (2) broader coxa 4; (3) distally tapering article 2 of pereopod 3; (4) much longer article 2 of pereopod 5; (5) apparent absence of spine-setae on the outer ramus of uropod 2; (6) sparseness of setae on epimeron 2.

Phoxocephalus tunggeus appears most closely similar to P. kergueleni (Stebbing, 1888) but differs from that species in: (1) presence of posterior setae on epimeron 3 (but perhaps overlooked on P. kergueleni); (2) absence of an extra tooth on the right lacinia mobilis; (3) broader coxa 4; (4) presence of setae on peduncle of uropod 2; (5) narrower article 2 of pereopod 4; (6) broader inner plate of maxilla 2; (7) more distally expanded coxa 1. Several important unknown factors of P. kergueleni include the dactylar apices of pereopods 1-2, the facial spine formula on article 2 of antenna 2, and the condition of the inner ramus and the lateral spination on the outer ramus of uropod 3.

J. L. Barnard (1960:300) presented a table containing a typographical error: "Article 2" of line 3 should read "Article 5." Also, *Phoxocephalus kergueleni* is noted in that table as having no thick spine on article 5 of pereopods 1-2. In retrospect one may see that this statement was overemphasized or could be misinterpreted; *P. kergueleni* has the spine, it is simply thin, perhaps like that shown here for *P. tunggeus*. Our examination of Australian species of *Phoxocephalus* suggests that far more valuable characters will eventually be found to distinguish the species than those in the table presented by J. L. Barnard (1960).

MATERIAL.—AM, one sample (1).

DISTRIBUTION.—Victoria, off Cape Everard (now called Point Hicks), 300 m.

Phoxocephalus rupullus, new species

FIGURES 220-222

DESCRIPTION OF FEMALE.—Head about 18 percent of total body length, greatest width about 67 percent of length, rostrum exceeding apex of article 2 on antenna 1, unconstricted, weakly tapering, apically rounded. Eyes small-medium in size, clear in preservative. Article 1 on peduncle of antenna 1 about 1.6 times as long as wide, almost twice as wide as article 2, apicoventral margin with several setules, strongly produced dorsal apex with 5

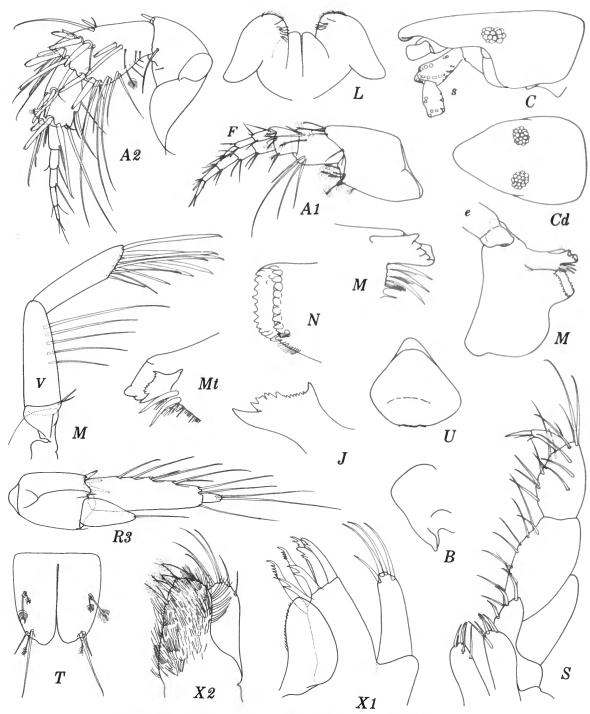


FIGURE 220.—Phoxocephalus rupullus, new species, holotype, female "a," 7.21 mm.

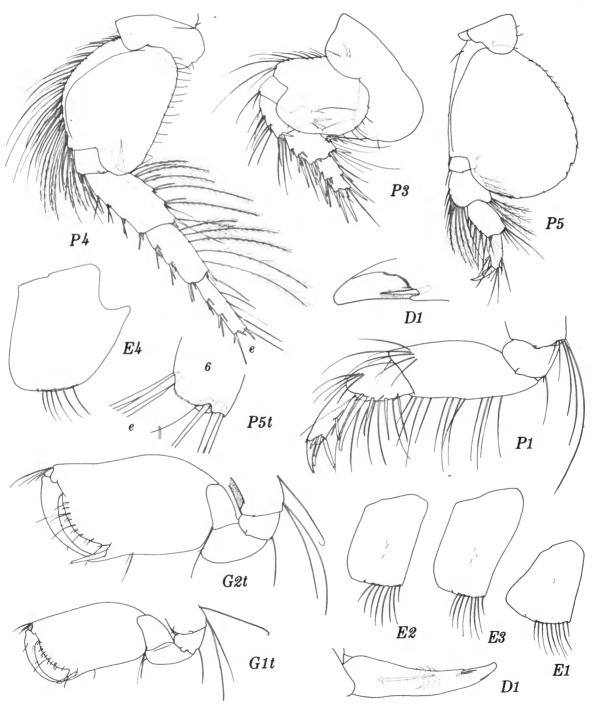


FIGURE 221.—Phoxocephalus rupullus, new species, holotype, female "a," 7.21 mm.

setules; article 2 about half as long as article 1, apicoventral surface with 4 setae; article 3 attached weakly to lateral face of article 2 with override of article 2 medially; accessory flagellum much shorter than primary flagellum, 3-articulate; primary flagellum 5-articulate, aesthetascs present. Spine formula on article 4 of antenna 2 = 1-2-4-2, proximal groups with accessory setule, distal and distoventral margins with 4 spines widely spread, dorsal margin with group composed of setule, spine and long seta, ventral margin with 4 subbasal penicillate setules, 2 faciolateral setules, and 3 groups of 2-3 setae each; article 5 about 0.6 times as long as article 4, facial spine formula = 2-2, with one proximal accessory setule, dorsal margin smooth, ventral margin with 2 sets of 1-2 setae each, distoventral corner with 2 long spine-setae and setule; flagellum almost as long as article 4 of peduncle, 5-articulate. Palpar hump of mandible medium; right incisor weakly tridentate, weakly webbed between two proximal teeth, left basically bidentate; right lacinia mobilis flabellate, distal branch poorly defined, margin toothed; left lacinia mobilis flabellate, 5-toothed; right rakers 2 and some rudimentaries, left 3 and some rudimentaries; molar triturative, on medium length pedicle; palp article 2 with pair of small basal setae and 5 long inner marginal setae in tandem, article 3 about as long as article 2, oblique apex with 10 setae. Lower lip with no apparent cones on outer lobe but with 4-5 emergent salivary ducts, mandibular lobes of medium length, weakly attenuate and apically rounded, inner lobes abutted and appearing separate for much of their length, perhaps raphe extremely distinct. Inner plate of maxilla 1 large, elliptical, naked; outer plate with 7 spines; palp failing to reach apex of outer plate, bearing 2 apical, one apicolateral, one apicomedial setae almost strap-shaped. Inner plate of maxilla 2 broader than but as long as outer plate, medial margin of inner plate with 4 small setae, none apical, outer plate with 6 apical and 4 medial setae. Inner plate of maxilliped with one mediofacial seta, 0-1 medial seta, 2-3 apical spines and one apical setule; outer plate with 3 spines; article 2 of palp weakly setose medially, article 3 with 3 facial setae, article 4 short, apical spine long relative to article 4, bearing 2 accessory setules. Coxa 1 distally expanded, rounded but subacuminate anteroventrally, long setal formula of coxae 1-4 = 9-8-8-6, posteriormost seta of coxae 1-3

short; anterior and posterior margins of coxa 4 divergent, posterior margin almost straight, posterodorsal corner subsharp, posterodorsal excavation of medium size and L-shaped, ratio of width to length = 1:1. Gnathopod 2 much stouter than gnathopod 1, long posterior setae on article 2 of gnathopods 1-2 = 3 and 3, on both gnathopods article 5 small and cryptic, article 6 attached to produced apex of article 5 but held tightly flexed, article 6 stout, ovatorectangular, palm oblique, defining hump large on gnathopod 2, apices of dactyls with flake, length ratios of articles 5-6 on gnathopods 1-2 = 28:72 and 32:110, width ratios = 23:44 and 25:65. Pereopods 1-2 similar to each other, long posterior setae on article 2 = 3 and 5, article 4 with 5 facial setae, article 5 with 4 and 2 facial setae, posterior margins of articles 4-5 moderately setose, article 5 with long distal spine reaching almost fully along article 6, with very small contiguous spine at base, article 6 with rows of 3 and 3 or 3 and 2 (pereopod 2) spines, two of these spines on midposterior margin of article 6, also bearing one middistal spinule, spines blunt, dactyl lacking apical flake, bearing thin inner setule appressed in marginal groove guarded by protrusion, apical nail almost fully fused to dactyl. Coxae 5-7 posteroventral setule formula = 1-1-3. Width ratios of articles 2, 4, 5, 6 of pereopod 3 = 52:30:25:14, of pereopod 4 = 68:29:21:12, of pereopod 5 = 86: 26:17:9, length ratios of articles 2, 4, 5, 6 of pereopod 3 = 61:27:27:26, of pereopod 4 = 89: 52:46:45, of pereopod 5 = 102:24:28:23; article 2 of pereopod 5 slightly exceeding middle of article 4; apex of article 6 finely combed. Epimera 1-2 with facial ridge, epimeron 1 with roundedquadrate posteroventral corner, epimeron 2 broadly rounded posteroventrally, posterior margins convex, epimeron 1 with one ventral seta, epimeron 2 with crescentic row of 8 facial setae and one supernumerary facial seta, epimeron 3 with rounded posteroventral corner, posterior margin convex, bearing setal notches and 6 posterior setae, posteroventral margin with 2 setae in notches, epimera 1-2 with small dorsoposterior setule. Urosomite 1 bearing 2 setules on lateral face at base of uropod 1, urosomite 2 with one such seta, one dorsolateral seta on each side of urosomite 1, urosomite 3 with long seta at ventral base of uropod 3. Peduncle of uropod I lacking basofacial setae (see urosomite 1). apicolateral corner of peduncle with one spine,

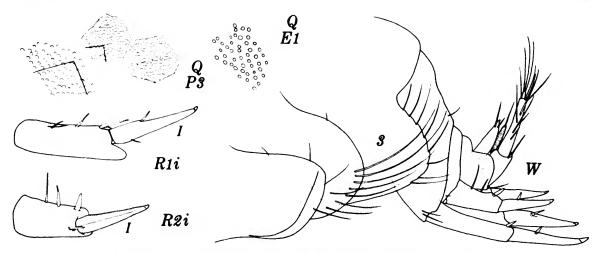


FIGURE 222.—Phoxocephalus rupullus, new species, holotype, female "a," 7.21 mm.

medial margin with 3 spines; rami of uropods 1-2 with apical nail almost fully amalgamated with ramus, outer rami of uropods 1-2 and inner ramus of uropod I with one dorsal spine each, inner ramus of uropod 1 with one mediobasal setule, outer ramus of uropod 1 as long as or longer than inner ramus, almost straight, rami and peduncles of uropods 1-2 lacking combs. Uropod 3 long, rami feminine, peduncle with 3 ventrolateral short spines, medially with setule, dorsolaterally with spinule, inner ramus extending to M. 43 on article 1 of outer ramus, apex with one seta, article 2 of outer ramus short, 0.17, bearing 2 long apical setae, outer margin of article 1 with 4 acclivities, setal formula = 1-1-2-2-2, one seta of some pairs short, medial apex with one long seta. Telson ordinary, length-width ratio = 1:1, apices scarcely tapering, broadly rounded, each with weak lateral acclivity bearing one long seta, one short lateral seta, these separated by shorter plusetule, dorsal pairs of plusetules diverse. Cuticle covered with knobs and villi, these knobs on posterior coxae and article 2 of pereopods 3-5 organized into polygons.

ILLUSTRATIONS.—Upper lip drawn from slightly oblique dorsal view; inner lobes of lower lip seen imperfectly at base; dactyl of pereopod 4 on both sides missing.

HOLOTYPE.—AM, female, "a," 7.21 mm. Unique. [Extremely large, possibly senile but brood plates bearing setae, thus indicating presentility.]

Type-Locality.—AM P.18248, 18 Jun 1962, off

Syndey, New South Wales, Australia, 33°58.4'S, 151°29'E, 150 m.

RELATIONSHIP.—This species bears similarities to Phoxocephalus regium K. H. Barnard, 1930 (see Hurley, 1954), from New Zealand. In P. regium only 3 setae occur on epimeron 3 and the horizontal row of setae on epimeron 2 is confined to the anterior part of the plate; P. regium lacks a dorsal spine on the outer ramus of uropod 1 and no spines on the rami of uropod 2. The inner ramus of uropod 3 is elongate. Article 4 of pereopod 5 is thin in P. regium, articles 4-5 of pereopods 3-4 are even thinner than those of P. rupullus, gnathopod 1 appears much larger than in P. rupullus and article 5 longer on P. regium than in P. rupullus. Coxa 4 has a sharper posterior lobe in P. rupullus, longer apical nail on the dactyl of the maxilliped, and lacks a basofacial seta on article 3 of the mandibular palp.

MATERIAL.—AM, one sample (1).
DISTRIBUTION.—New South Wales, off Sydney,
150 m.

Phoxocephalus burleus, new species

FIGURES 223-225

DESCRIPTION OF FEMALE.—Head about 18 percent of total body length, greatest width about 55 percent of length, rostrum nearly reaching middle of article 2 on antenna 1, unconstricted, weakly taper-

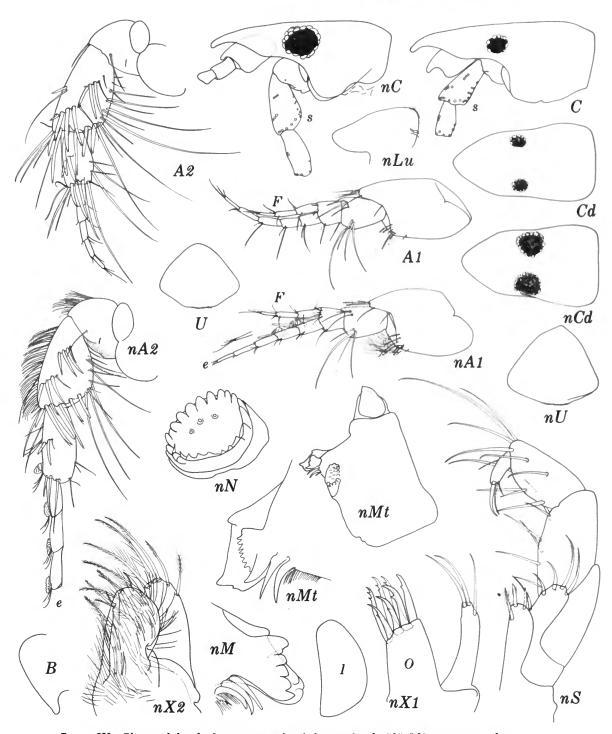


Figure 223.—Phoxocephalus burleus, new species, holotype, female "f," 5.93 mm (n = male "n," 4.54 mm).

ing, apically rounded. Eyes of medium size, dark core surrounded by one partial layer of clear ommatidia in preservative. Article 1 on peduncle of antenna 1 about 1.8 times as long as wide, 1.8 times as wide as article 2, apicoventral margin with several setules, strongly produced dorsal apex with 6 setules; article 2 about 0.42 times as long as article 1, apicoventral surface with 4 setae; article 3 essentially attached terminally to article 2; accessory flagellum shorter than primary flagellum, 3-articulate; primary flagellum 5-articulate, aesthetascs absent. Spine formula on article 4 of antenna 2 = 3-4-3, proximal sets with 1-2 accessory setules, spines thin, dorsal margin with one short spine, one long seta, ventral margin with 3 subbasal penicillate setules and 10 long or short setae, apex with 4 spines; article 5 less than 0.6 times as long as article 4, facial spine formula = 2-2, with one proximal accessory setule, dorsodistal corner with one spineseta, apex with one spine, ventral margin with 2 pairs of long-short setae, ventrodistal apex with one long, one short setae; flagellum about as long as article 4 of peduncle, 5-articulate. Palpar hump of mandible small; right incisor weakly tridentate, with weak accessory tooth between teeth 2 and 3; left basically bidentate, distal branch weakly tridentate; right lacinia mobilis flabellate, distal branch poorly defined, margin toothed; left lacinia mobilis flabellate, irregularly toothed; right rakers 2, left 3; molar triturative, on long pedicle; palp article 2 with 5 long medial setae on distal half, article 3 about as long as article 2, oblique apex with 10 setae. Mandibular lobes of lower lip of medium length, weakly attenuate and apically rounded, inner lobes fused together for most of their length but with distinct raphe. Inner plate of maxilla 1 large; elliptical, naked, outer plate with 7 spines; palp scarcely exceeding apex of outer plate, bearing 2 apical and one apicolateral setae. Inner plate of maxilla 2 scarcely broader than and extending equally with outer plate, medial margin of inner plate with 2 setae, apical margin with 3 setae; outer plate with 2 apicolateral, 3 apical and 3 medial setae. Inner plate of maxilliped with one mediofacial seta, 2 apical spines; outer plate with 4-5 spines; article 2 of palp with sparse medial setae, article 3 with 2-3 facial setae, article 4 of medium length, apical spine long, bearing 2 accessory setules. Coxa 1 distally expanded and narrowly rounded anteroventrally; long setal formula of

coxae 1-4 = (8-10)-(9-10)-(8-10)-(5-8), posteriormost seta of coxae 1-3 shortened (= elongate setule); anterior and posterior margins of coxa 4 divergent, posterior margin weakly convex, posterodorsal corner subsharp, posterodorsal excavation of medium size and V-shaped, ratio of width to length = 73:86. Gnathopod 2 much stouter than gnathopod 1; long posterior setae on article 2 of gnathopods 1-2=2 and 5, short anterior setae = 1 and 3; article 3 short, only gnathopod 2 weakly eusirid, article 6 broadened but elongate, rectangular, palm oblique, defining hump large on both pairs, dactyl fitting palm, apices of dactyls with flake, posterior margin of article 5 on gnathopod 1 free, on gnathopod 2 cryptic; length ratios of articles 5-6 on gnathopods 1-2 = 34:77 and 35:126, width ratios = 22:43 and 18:66. Pereopod 2 slightly thinner than pereopod 1; long posterior setae on article 2 of pereopods 1-2 = 2-3 and 3, short anterior setae = 2 and 1; article 4 of pereopods 1-2 with 6 and 2 subapical anterior setae, posterior margins of article 4 moderately setose, of article 5 more densely so, article 5 with 3 and 2 anterofacial setae, with long posterodistal spine reaching to M. 95 on article 6, with small contiguous spine at base, article 6 with one long posterior setal-spine and rows of 3 and 3 spines and setae, plus middistal spine, some stout, some thin, dactyl lacking apical flake, inner margin with acclivity and tooth bearing setule appressed in wide groove, apical nail fused almost fully to dactyl. Coxae 5-7 posteroventral setule formula = l-l-l. Width ratios of articles 2, 4, 5, 6 of pereopod 3 =55:25:21:12, of pereopod 4 = 72:26:18:10, of pereopod 5 = 89:21:17:8, length ratios of pereopod 3 = 76:24:26:26, of pereopod 4 = 98:57:56:47, of pereopod 5 = 112:20:28:22; article 2 of pereopod 5 slightly exceeding apex of article 4, posterior margin with accessory tightly packed group of dorsoposterior setules; apex of article 6 finely combed. Epimera 1-2 with facial ridge, each with rounded-quadrate posteroventral corner and convex posterior margin, epimeron 3 with rounded posteroventral margin, posterior margin broadly convex, bearing long setae set in notches, margins between notches inflated, setae extending onto postroventral margin, epimeron 1 with one posteroventral seta, epimeron 2 with 5-7 facial setae in horizontal row. Urosomite 1 bearing 2 short lateral setae at base of uropod 1; urosomite 2 with one such seta; urosomites dorsally truncate; urosomite

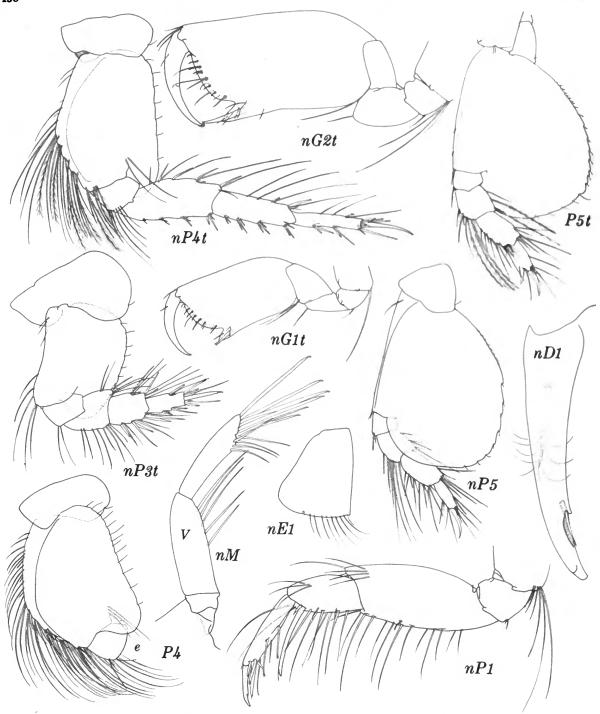


FIGURE 224.—Phoxocephalus burleus, new species, holotype, female "f," 5.93 mm (n = male "n," 4.54 mm).

3 with 2 long setae at ventral base of uropod 3. Peduncle of uropod I with one setule not strongly basal, lateral apex of peduncle with one spine, medial margin with 4 spine-setae; rami of uropods 1-2 with apical nails scarcely articulate but conspicuous, outer ramus of uropods 1-2 with 2 dorsal spines (elongate), inner ramus of uropod I with one spine, of uropod 2 naked, inner ramus of both uropods 1-2 with mediobasal spinule (unusual for uropod 2), outer ramus of uropod 1 slightly longer than inner, of normal dimensions and shape; lateral apex of peduncle on uropod 2 with stout spine, margin with 4 long setae, apicomedial corner of peduncle with long spine-seta; comb on apices of peduncles of uropods 1-2 obsolescent. Uropod 3 long, rami feminine, peduncle with 4 long ventrolateral spine-setae, dorsolaterally with tiny spinule, dorsomedially with tiny spinule, inner ramus extending to M. 60 on article 1 of outer ramus, apex with one seta, article 2 of outer ramus elongate, 0.37, bearing 2 long apical setae, outer margin of article 1 with 3 acclivities, elongate spine-seta formula = 1-1-1-3, medial apex with one spine-seta. Telson slightly elongate, length-width ratio about 14:11, apices scarcely tapering, each with medial protrusion and lateral acclivity bearing one long spine-seta and one short lateral setule, dorsal pair of plusetules diverse. Cuticle armed sparsely with bulbar setules and densely covered with fingerprint striations heavily cornified and thickened.

DESCRIPTION OF MALE (male "n," 4.54 mm, unique specimen).—Eyes enlarged but only of medium size. Article 1 of antenna 1 with medial patch of fuzz; articles 1-2 of primary flagellum each with calceolus and one large aesthetasc. Antenna 2 enlarged, elongate; dorsomedial margins of articles 3 and 4 with fuzz; facial spine formula of article 4 = 3-3-3 plus 3 other apical spines, only one accessory setule with each proximal spine group, setae of articles 4-5 fewer and shorter than in female, article 5 with 3 dorsal sets of male setae and one calceolus; flagellum elongate, flagellar formula = (20), 1-2 3, 5, 7 . . . 19. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 1-2-2-3, short anterior setae = 1-1-1-1. Article 2 of pereopods 4-5 narrower and more elongate than in female. Epimera 1-3 broadened anteroposteriorly, (epimeron 1 poorly preserved but of dimensions commensurate with epimeron 2, presence of one seta undetermined); epimeron 2 with 5 facial

setae; setae on epimeron 3 shorter than in female. Setules on urosomites 1-2 at bases of uropods elongate, urosomite l bearing only one setule. Spines and setae on uropods 1-2 shorter than in female, peduncle of uropod 2 with 9 short lateral spines not divisible into size classes, medial margin with 3 spines, peduncle of uropod 1 with 2 apicolateral spines, otherwise spine formula of uropods 1-2 same as in female. Uropod 3 masculine, inner ramus extending to apex of outer ramus on article 2, both rami setose on both margins, lateral margin on article 1 of outer ramus with 4 acclivities, formula of long setae = l-l-l-l-1, formula of short setae = 1-1-1-1-2; article 2 of outer ramus shorter than in female, spines on peduncle shortened, apicomedial margin of peduncle with 3 setules in 2 groups. Telson of dimensions similar to female, apical spines short, each lobe dorsomedially with row of denticles.

Variations.—Female "h," 4.53 mm, much smaller than other females analyzed, with 7 setae on epimeron 2 and 5 setae plus one spine on lateral margin of peduncle on uropod 1, highest counts found in females of the species.

HOLOTYPE.—AM, female "f," 5.93 mm.

Type-Locality.—SBS CXS4, 22 May 1972, off Malabar, New South Wales, Australia, 92 m, sandy gravel.

VOUCHER MATERIAL.—Type-locality, female "g," 5.31 mm; SBS D3S3, male "n," 4.54 mm (illus.); SBS C7S4, female "h," 4.53 mm.

RELATIONSHIP.—This species has its closest affinities with *P. rupullus*, new species. The latter is based on a giant, perhaps senile female. Some of the character differences between the two species may be based on the senilic condition of *P. rupullus* but the extraordinary difference between the cuticles of the two species confirms their distinction. *Phoxocephalus rupullus* has villi organized into polygons whereas *P. burleus* has thickened striations lacking a pattern. *Phoxocephalus rupullus* has more setae and spines in certain places and fewer in other places than does *P. burleus*; because senile individuals may both gain or lose armaments selectively we leave the reader to compare our illustrations for these differences.

Phoxocephalus regium K. H. Barnard, 1930 (see Hurley, 1954), from New Zealand, is in the species group of *P. burleus* because of equally extending rami on uropod 1 but otherwise is remote morpho-

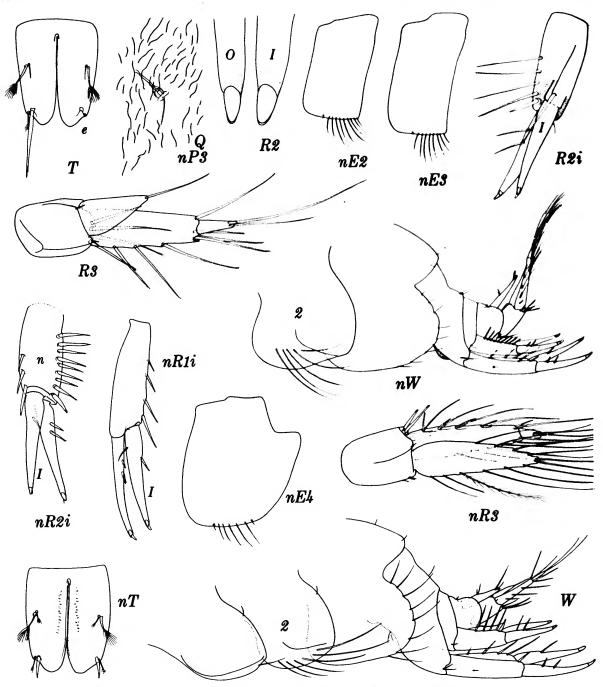


Figure 225.—Phoxocephalus burleus, new species, holotype, female "f," 5.93 mm (n = male "n," 4.54 mm).

logically; among numerous distinctions of *P. regium* from *P. burleus* and *P. rupullus* we emphasize the following: the confinement of facial setae on epimeron 2 to the far anterior region, the shortness of posterior setae on epimeron 3, the absence of posterior setae on article 2 of pereopod 4, and the absence of a dorsal spine on the inner ramus of uropod 1.

MATERIAL.—SBS, 3 samples (4).

DISTRIBUTION.—New South Wales, off Malabar, 71-92 m, sandy gravel, medium fine sand.

Phoxocephalus keppeli, new species

Phoxocephalus bassi.—K. H. Barnard, 1930:350-351, fig. 9b (not Stebbing, 1888).

DIAGNOSIS.—Phoxocephalus from New Zealand with closely packed submarginal bundle of 3 setae on posterior face of epimeron 3, true posterior edge of epimeron 3 broadly rounded and naked. Named in honor of Dr. Keppel H. Barnard.

HOLOTYPE.—Male, 7.5 mm, fig. 9b of K. H. Barnard, 1930, specimen apparently deposited in British Museum (Natural History).

Type-Locality.—"Discovery" Sta. 110, off Three Kings Islands, New Zealand, 6 Aug 1911, surface, night.

REMARKS.—K. H. Barnard described nothing of this species except epimeron 3 plus comments intimating its resemblance to *P. bassi* Stebbing (1888). Barnard suggested that Stebbing overlooked the bundle of 3 setae on epimeron 3 but we, having found a specimen closely matching that of Stebbing's species near his type-locality, doubt that supposition. J. L. Barnard (1972b) found few benthic amphipods of New Zealand conspecific with those from Australia.

DISTRIBUTION.—Northern New Zealand, surface.

Phoxocephalus species

Notes.—A very distinctive and unusual species but damaged and not worthy of specific description; true generic placement unknown. Mandibles undissected but molar seen to be solid, conical, possibly minutely triturative; maxilla 1 with uniarticulate palp; article 2 of antenna 1 with strong conical medial protrusion overriding and exceeding apex of article 3; flagellum of antenna 2 with 3 articles,

article 5 of peduncle elongate (thus like Joubinella); gnathopods stout, article 6 of gnathopod 1 longer than wide, anterior and posterior margins weakly divergent, palm subtransverse, article 5 moderately elongate; gnathopod 2 slightly larger than gnathopod 1, article 6 scarcely longer than wide; article 6 of pereopods 1-2 with spine rows of 1+1plus middistal spine, longest spine shorter than dactyl; outer ramus of uropod 1 slightly shortened and curved, apices of rami on uropods 1-2 bluntly conical apically, with small scales, rami lacking dorsal spines; uropod 3 short, stubby, outer ramus with elongate article 2 bearing 2 long setae (atypical of Phoxocephalus), inner ramus naked, about threefourths as long as article 1 of outer ramus; each apex of telson with one spine towards medial side, apicolateral setule shorter than spine, dorsal pairs of plusetules near M. 75 and extremely elongate (a probable mark of youth).

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MATERIAL.—SBS Long Reef, juvenile, 1.95 mm. DISTRIBUTION.—New South Wales, Long Reef, N of North Head, Sydney, 43 m.

Phoxocephalus holbolli (Krøyer)

Phoxus Holbölli Krøyer, 1842:151-152; 1845:551-563.—Bruzelius, 1859:68.—Smith, 1883a:221; 1883b:228.

Phoxus Holbolli.-Chevreux, 1887:298.

Phoxocephalus holbölli.—J. L. Barnard, 1960:294-298, pls. 47, 48 [with references].

Phoxocephalus holbølli.—Hamond, 1967:118-119.

Phoxocephalus holbolli.—Bousfield, 1973:123-124, pl. 25.1.

DISTRIBUTION.—North and eastern Atlantic from Greenland south to Plymouth, England; into the Baltic Sea to east of Bornholm, Barents Sea, White Sea, Kara Sea; western Atlantic from Greenland south to Long Island Sound; 0-190 m.

Phoxocephalus homilis J. L. Barnard

Phoxocephalus homilis J. L. Barnard, 1960:301-303, pls. 49, 50; 1964c:245; 1966a:90; 1966b:30.

DISTRIBUTION.—Monterey Bay, California to Bahia de San Cristobal, Baja California, 60-2059 m.

Phoxocephalus kergueleni (Stebbing)

Phoxus kergueleni Stebbing, 1888:816-819, pl. 55. Phoxocephalus kergueleni.—Stebbing, 1906:135.—J. L. Barnard, 1960:300; 1964b:21-22, fig. 17; 1967:138, fig. 67. DISTRIBUTION.—Off Cumberland Bay, Kerguelen, 220 m; eastern Pacific Ocean from Panama Basin north to Cedros Trench, Baja California, 842-2398 m.

Phoxocephalus regium K. H. Barnard

Phoxocephalus regium K. H. Barnard, 1930:331-332, fig. 9a.
—Hurley, 1954:594-598, figs. 68-91.—J. L. Barnard, 1960: 299-300.

Phoxocephalus bassi.—Thomson, 1902:463 [not Stebbing, 1888].

Phoxocephalus kergueleni.—Chilton, 1909:618-619 [not Stebbing, 1888].

DISTRIBUTION.—New Zealand, off Three Kings Islands, Otago Harbour; Snares Islands; surface to 91 m.

Phoxocephalus tenuipes Stephensen

Phoxocephalus tenuipes Stephensen, 1925:160-161, fig. 47.— J. L. Barnard, 1960:298.

DISTRIBUTION.—West of Greenland, 66°35'N; North Atlantic, west and southwest of Iceland; 600-1505 m.

Jerildaria, new genus

Diagnosis.—Eyes present. Flagellum of antenna 2 reduced in female. Article 2 of antenna 1 ordinary, ventral setae confined apically. Article 1 of antenna 2 not ensiform; article 3 with 2 setules; facial spines on article 4 in 2 or more rows, plus special apical spines; article 5 ordinary in size. Right mandibular incisor with 3 teeth; molar strongly triturative, bearing fuzz; palpar hump medium to large. Palp of maxilla 1 uniarticulate, inner plate naked. Setation of maxilla 2 ordinary. Inner plate of maxillipeds ordinary, apex of palp article 3 not protuberant, dactyl elongate, apical nail distinct, medium. Gnathopods dissimilar, weakly to moderately enlarged; article 5 of gnathopod 2 of ordinary length, almost cryptic, elongate on gnathopod 1, with eusirid attachment, palms oblique to transverse, hands of gnathopods 1-2 rectangular, broadened, poorly setose anteriorly. Article 5 of pereopods 1-2 setose posteroproximally. Article 2 of pereopod 3 of broad form, articles 4-5 of pereopods 3-4 narrow to medium, article 2 of pereopods 3-4 not setose posteriorly; pereopod 5 ordinary, article 2 naked ventrally, article 3 ordinary, dactyl normal. Peduncle of uropod 1 normally elongate, without apicoventral spike, without special enlarged apicolateralmedial spine, peduncular apices of uropods 1-2 combed, inner ramus of uropod 1 with marginal spines in one row, no rami cominuously spinose to apex, inner ramus of uropod 2 ordinary. Uropod 3 ordinary, short article 2 of outer ramus carrying 2 long apical setae. Telson elongate, with 2-4 apical spines or setae on each lobe, without special dorsal and lateral spines or setae. Epimera 1-2 bearing few long posterior setae, without midfacial setae above ventral facial ridge; epimeron 3 ordinary. Urosomite 1 generally naked except for sparse apicoventral setae or spines near base of uropod 1, urosomite 3 without dorsal hook or special process.

DESCRIPTION—Rostrum fully developed. [Fuzz on article 1 of antenna 1 in male unknown, calceoli on male antennae 1-2 unknown.] Prebuccal parts ordinary, weakly extended forward, distinct, upper lip dominant. Right lacinia mobilis bifid, flabellate; mandibular palp medium to thin, article 1 short, article 2 without outer setae, apex of article 3 oblique. Lower lip bearing cones. Outer plate of maxilla 1 with 9 spines, no spine especially thickened. Inner plates of maxilliped thick, ordinarily setose. Coxae 2-4 without special anterodorsal humps. All posterior spines on article 6 of pereopods 1-2 thick and stiff, midapical spine or seta present. Article 2 of pereopod 5 without facial setae. Peduncle of uropod I with dorsolateral spines confined apically, medial spines confined apically; peduncle of uropod 2 with only one medial spine confined apically. Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with ordinary pair of midlateral or dorsal setules on each side highly medial.

Type-Species.—Jerildaria joubiphoxus, new species.

COMPOSITION—Unique.

RELATIONSHIP.—The superficial and external appearance of this genus suggests relationship to the pelagic Joubinella but Jerildaria has only one article in the first maxillary palp, has gnathopod 2 larger than gnathopod 1, lacks dorsodistal spines and freely articulate nails on the rami of uropods 1-2, and the palms of the gnathopods do not protrude as in Joubinella. Distinctive generic char-

acters of Joubinella also include an elongation of article 4 on pereopod 4, a strongly shortened article 4 of pereopod 5, and the absence of strong lateral spination on article 4 of antenna 2.

Jerildaria differs from Phoxocephalus, also bearing triturative molar, in only one strong character, the greatly enlarged gnathopods with elongate, eusirid-like article 5 of gnathopod 1. The extended palpar base on the mandibular body of Jerildaria is uncharacteristic of Phoxocephalus as are the following characters: the short article 2 on the outer ramus of uropod 3, the thick rami of uropods 1-2, the slightly elongate article 5 of antenna 2, and the extreme shortness of the inner ramus on uropod 3.

Jerildaria differs from the primitive Pontharpinia in the loss of articulation on the first maxillary palp and in the absence of dorsodistal spines on the rami of uropods 1-2. The latter character is not so vital because species in Phoxocephalus have these spines present or absent. In Pontharpinia the body of the mandible is more strongly extended to the base of the palp than in Jerildaria and the gnathopods are much smaller and not eusirid, though gnathopod 2 of Pontharpinia is enlarged.

Jerildaria joubiphoxus, new species

FIGURES 226, 227

Description (female-like).—Head about 18 percent of total body length, greatest width about 64 percent of length; rostrum unconstricted, broad, short, almost reaching apex of article 2 on antenna 1. Eyes medium, largely occluded with pigment. Article 1 on peduncle of antenna 1 about 1.2 times as long as wide, about 2.1 times as wide as article 2, apicoventral margin with about 8 setules, strongly produced dorsal apex with 4 setules; article 2 about 0.85 times as long as article 1, with apicoventral row of 3-4 setae; primary flagellum with 5 articles, about 0.75 times as long as peduncle, bearing several short aesthetascs; accessory flagellum elongate, with 4 articles. Spine formula on article 4 of antenna 2 = 2-4-4 or 2-4-5, one spine of proximal group thin, all others thick, dorsal margin with notch bearing one seta and one spine, ventral margin with 3 groups of 1-2 medium setae, 2 ventrodistal short thick spines and 2 mid-

distal long spines; article 5 about 0.8 times as long as article 4, facial spine formula = 2-2, dorsal margin naked, ventral margin with one set of setae, ventrodistal medium seta, setule and spine; flagellum about as long as article 5 of peduncle, with 4-5 articles. Mandibles with medium palpar hump; right incisor with 3 teeth; left incisor with 2 weak branches; right lacinia mobilis bifid, distal branch little longer than proximal, flabellate, broad, denticulate, with one facial hump, proximal branch simple, pointed; left lacinia mobilis with 4 teeth plus weak accessory teeth, middle teeth shortened; right rakers 2; left rakers 3; molars triturative; palp article 1 short, article 2 with 2-3 long inner apical setae and one other shorter inner basal seta, article 3 about 0.85 times as long as article 2, oblique apex with 8 spine-seta, basofacial formula = 0. Inner plate of maxilla 1 ordinary, naked, palp with 2 apical setae, one apicomedial and one apicolateral setae. Plates of maxilla 2 extending subequally, equally wide, outer with one apicolateral seta, inner with 11 medial setae. Inner plate of maxilliped with 3 thin apical spines and setae, 2-3 mediofacial setae, outer plate with 5-6 medial and apical spines, basalmost thin, medial margin of article 2 moderately setose, article 3 not protuberant, with 5 facial setae, no lateral setae, nail of article 4 medium, with 2 accessory setules. Coxa 1 expanded distally, anterior margin straight; main ventral setae of coxae 1-4 = (4-5)-(4-5)-(4)-(1-2), posteriormost seta of coxae 1-3 shortest; anterior and posterior margins of coxa 4 strongly divergent, posterior margin very oblique, almost straight, posterodorsal corner subsharp, posterodorsal margin Lshaped, width-length ratio of coxa 4 = 1:1. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 0-3-(2-3)-3, short anteriors = 2-2-(2-3)-2, no others; gnathopods with stout sixth article, that of gnathopod 2 larger; width ratios of articles 5-6 on gnathopods 1-2 = 20.70 and 21.73, length ratios = 88:62 and 64:80; palmar humps small, palms almost transverse; article 5 of gnathopod 1 elongate, elliptical, thin, posterior margin weakly rounded, long; article 5 of gnathopod 2 elongate, elliptical, thin, posterior margin rounded, short. Pereopods 1-2 similar; posterior margin of article 4 on pereopod 2 slightly more setose than on pereopod 1, facial setae formula on article 4 = 1-1, on article 5 = 0-0; main spine of article 5 extending to M. 70 on article 6, article 5 with no

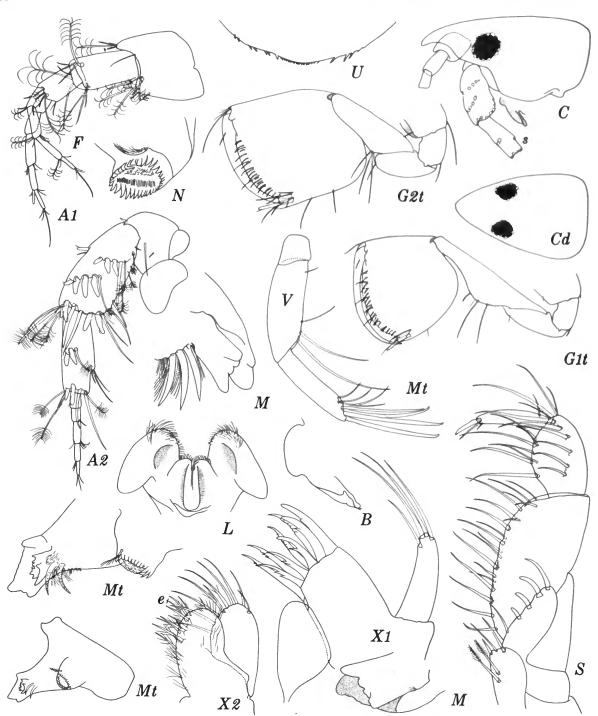


FIGURE 226.—Jerildaria joubiphoxus, new species, holotype, sex unknown "b," 5.50 mm.

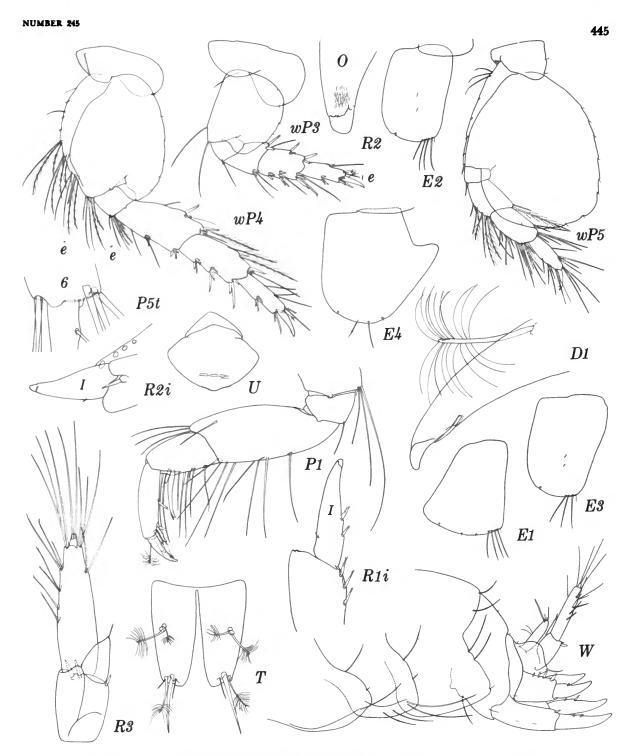


FIGURE 227.—Jerildaria joubiphoxus, new species, holotype, sex unknown "b," 5.50 mm (w = sex unknown "w," 5.46 mm).

proximoposterior spines; spine formula of article 6 = 2 + 2 plus middistal spine plus posterior spine, some spines short; acclivity on inner margin on dactyls of pereopods 1-2 weak, emergent setule long, midfacial pluseta very large, highly proximal, nail weakly distinct. Coxae 5-7 posteroventral setule formula = 1-1-2. Articles 4-5 of pereopods 3-4 narrow, facial spine rows sparse, pereopod 3 especially small, facial ridge formula on article 2 of pereopods 3-5 = 0-1-1; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 44:21:19:11, of pereopod 4 = 66:27:21:12, of pereopod 5 = 90:20:18:10, length ratios of pereopod 3 = 52:19:29:30, of pereopod 4 = 82:50:45:34, of pereopod 5 = 110: 24:30:28; article 2 of pereopod 5 not reaching middle of article 5; medial apex of article 6 very finely combed. Posteroventral corner of epimeron 1 rounded, posterior margin weakly convex, margin above corner with setule, anteroventral margin naked, posteroventral face with one or no long seta; posteroventral corner of epimeron 2 rounded-quadrate, posterior margin straight, bearing one setule, facial setae = 4, posteriormost pair set vertically; posteroventral corner of epimeron 3 weakly protuberant, with setule sinus, posterior margin straight, with 2 long setae set in notches, occasional additional setule notch, ventral margin and face naked; epimera 1-2 with large seta on posterodorsal margin set in weak notch. Urosomite 1 with lateral setule at base of uropod 1, long ventral seta, articulation line complete; urosomite 3 weakly protuberant dorsally. Rami of uropods 1-2 with fused enlarged apical nails, outer ramus of uropod 1 with 2 dorsal spines, inner with 2, outer ramus of uropod 2 with one dorsal spine, inner naked; peduncle of uropod 1 with one small apicolateral spine, medially with 3 marginal spines, apicalmost ordinary; peduncle of uropod 2 with 4 dorsal spines, medially with one small apical spine; apicolateral corners on peduncles of uropods 1-2 lacking comb. Peduncle of uropod 3 with 2 ventral spines, dorsally with one lateral setule, one medial spine; rami feminine, inner extending to M. 33 on article 1 of outer ramus, apex with one short seta, article 2 of outer ramus short, 0.10, bearing 2 long setae, apicomedial margin of article 1 with sets of 2 and 3 setae, lateral margin with 4 acclivities, setal formula = 1-1-2-3-3. Telson ordinary, lengthwidth ratio = 35:31, almost fully cleft, each apex wide, truncate, lateral acclivity weak, bearing lateral setule, spine next medial much longer, medially with short seta, occasionally with extra lateral short seta, midlateral setules ordinary to large. Cuticle with ordinary sparse bulbar setules of varying sizes mixed with pipes, emergent setules occasionally branched.

OBSERVATIONS.—Epistome protruding in front of upper lip, both parts fully articulate, upper lip with weak midhump ventrally, bearing minute sharp cusps; inner lobes of lower lip fused for most of length, marked medially with longtitudinal plaque, each outer lobe with cone. Neither specimen of this species shows any mark of sex except for one possible rudimentary penial process on specimen "w".

ILLUSTRATIONS.—Outline of epistome shown on lateral view of head; left eye of holotype displaced medially in dorsal view of head; left mandible and article 3 of antenna 1 not flattened; apically rounded spines on uropods 1-2 blunted by damage.

HOLOTYPE.—AM, sex unknown "b," 5.50 mm.

TYPE-LOCALITY.—SBS Long Reef, 27 Apr 1972, Long Reef, New South Wales, N of North Head, Sydney, Australia, 43.3 m.

VOUCHER MATERIAL.—Type-Locality, sex unknown "w," 5.46 mm (illus.), only known specimen in addition to holotype.

DISTRIBUTION.—New South Wales, Long Reef, Sydney, 43 m.

Leptophoxoides J. L. Barnard

Leptophoxoides J. L. Barnard, 1962:51.

DIAGNOSIS.—Eyes present. Flagella of antennae 1-2 reduced in female. Article 2 of antenna 1 especially shortened, ventral setae if present confined apically. Article 1 of antenna 2 not ensiform; [? article 3 with 2 setules]; facial spines on article 4 in one main row; article 5 especially short. Right mandibular incisor with 3 teeth; molar strongly triturative, not bearing fuzz; palpar hump small. Palp of maxilla 1 uniarticulate; inner plate naked. Setation of maxilla 2 weak. Inner plate of maxillipeds ordinary; apex of palp article 3 strongly protuberant, dactyl elongate, apical nail distinct, medium. Gnathopods dissimilar, gnathopod 2 strongly enlarged; article 5 of gnathopods 1-2 very short, cryptic, with eusirid attachment, palms oblique, hands of gnathopods 1-2 ordinary to broadened,

poorly setose anteriorly. Article 5 of pereopods 1-2 setose posteroproximally. Article 2 of pereopod 3 of broad form, articles 4-5 of pereopods 3-4 narrow, article 2 of pereopods 3-4 not setose posteriorly, pereopod 5 ordinary, article 2 naked ventrally, article 3 ordinary, [? dactyl normal]. Epimera 1-2 lacking long posterior setae, without midfacial setae above ventral facial ridge, epimeron 3 of rounded classification and lacking long setae. Urosomite I generally naked; urosomite 3 without dorsal hook or special process. Peduncle of uropod 1 normally elongate, without apicoventral spike, without special enlarged apicolateral-medial spine, only peduncular apices of uropod 1 combed, inner ramus of uropod 1 with marginal spines in one row, no rami continuously spinose to apex, inner ramus of uropod 2 ordinary. Uropod 3 ordinary; elongate article 2 of outer ramus carrying one medium apical seta. Telson elongate, with only one apical spine on each lobe plus setules, without special dorsal and lateral spines or setae.

DESCRIPTION.—Rostrum fully developed. [Fuzz on article I of antenna I in male unknown, calceoli on male antennae 1-2 unknown. Prebuccal parts unknown.] Right lacinia mobilis [? bifid or simple], thin; article 1 of mandibular palp short, palp medium to thick, article 2 without outer setae, apex of article 3 oblique. Lower lip lacking cones. Outer plate of maxilla 1 with 7 spines, no spine especially thickened. Inner plates of maxilliped especially thin, poorly armed. Coxae 2-4 without special anterodorsal humps. All posterior spines on article 6 of pereopods 1-2 thin and seta-like, [midapical spine or seta unknown]. Article 2 of pereopod 5 without facial setae. Peduncle of uropod I with dorsolateral spines widely spread, medial spines confined apically; peduncle of uropod 2 with only one medial spine or setule confined apically. Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with ordinary pair of midlateral or dorsal setules on each side.

Type-Species.—Leptophoxoides molaris J. L. Barnard, 1962 (monotypy).

Composition.—Unique.

Leptophoxoides molaris J. L. Barnard

Leptophoxoides molaris J. L. Barnard, 1962:51, fig. 40.

Distribution.—Cape Basin, off South Africa, 4961 m.

Leptophoxus Sars

Leptophoxus Sars, 1895:146.

Diagnosis.—Eyes absent. Flagella of antennae 1-2 reduced in female. Article 2 of antenna 1 especially shortened, ventral setae confined apically. Article 1 of antenna 2 not ensiform; [?article 3 with 2 setules]; facial spines on article 4 in 2 rows; article 5 ordinary in size. Right mandibular incisor with 3 teeth; molar not triturative, small, pillowshaped, bearing semiarticulate spines, [?usually not bearing fuzz]; palpar hump medium. Palp of maxilla 1 uniarticulate; inner plate naked. Setation of maxilla 2 weak. Inner plate of maxillipeds ordinary, apex of palp article 3 strongly protuberant, dactyl elongate, apical nail distinct, short. Gnathopods dissimilar, gnathopod 2 strongly enlarged; article 5 of gnathopods 1-2 very short, cryptic on gnathopod 2, with eusirid attachment, palms oblique, hand of gnathopod 2 broadened, both hands poorly setose anteriorly. Article 5 of pereopods 1-2 setose posteroproximally. Article 2 of pereopod 3 of broad form, articles 4-5 of pereopods 3-4 narrow, article 2 of pereopods 3-4 not setose posteriorly; pereopod 5 ordinary, article 2 naked ventrally, article 3 ordinary, dactyl normal. Epimera 1-2 lacking long posterior setae, without midfacial setae above ventral facial ridge; epimeron 3 of rounded classification and lacking long setae. Urosomite 1 generally naked; urosomite 3 without dorsal hook or special process. Peduncle of uropod I normally elongate, without apicoventral spike, without special enlarged apicolateral-medial spine; [?peduncular apices of uropods 1-2 not combed]; inner ramus of uropod 1 with marginal spines in one row, no rami continuously spinose to apex, inner ramus of uropod 2 ordinary. Uropod 3 ordinary, elongate article 2 of outer ramus carrying 2 short apical setae. Telson elongate, with only 2 apical spines or setae on each lobe plus setules, without special dorsal and lateral spines or setae.

DESCRIPTION.—Rostrum fully developed. Fuzz present on article 1 of primary flagellum on male antenna 1; [fuzz on article 1 of antenna 1 in male unknown; calceoli on male primary flagellum of antenna 1 unknown]. Calceoli on article 5 of male antenna 2 present; flagellum in male with calceoli. Prebuccal parts ordinary, poorly separated from each other, upper lip dominant. Right lacinia mobilis bifid, thin, article 1 of mandibular palp me-

dium to thick, article 1 short, article 2 without outer setae, apex of article 3 oblique. Lower lip lacking cones. Outer plate of maxilla 1 with 7 spines, no spine especially thickened. Inner plates of maxilliped especially thin, poorly armed. Coxae 2-4 without special anterodorsal humps. All posterior spines on article 6 of pereopods 1-2 thin and seta-like, [?midapical spine or seta present]. Article 2 of pereopod 5 without facial setae. Peduncle of uropod 1 with dorsolateral spines widely spread, [?medial spines confined apically, ?peduncle of uropod 2 with only one medial spine or setule confined apically]. Peduncle of uropod 3 lacking extra subapical setae or spines. [?Telson with ordinary pair of midlateral or dorsal setules on each side.]

Type-Species.—Phoxus falcatus Sars, 1883 (monotypy). Monotypic, with 2 subspecies.

Leptophoxus falcatus falcatus (G. O. Sars)

Phoxus falcatus Sars, 1883:84.

Leptophoxus falcatus Sars, 1895:147-148, pl. 50.—J. L. Barnard, 1960:308 [with references to include *Phoxus simplex* Boeck, 1876:217-218, pl. 8: fig. 3].—Nagata, 1965:157.

Distribution.—Greenland, east and west coasts; Norway; North Sea; Skaggerak; Japan; 10-2258 m.

Leptophoxus falcatus icelus J. L. Barnard

Leptophoxus falcatus icelus J. L. Barnard, 1960:308-311, pls. 53, 54; 1966a:87; 1967:135.

Distribution.—Southern California to middle Baja California, 248-1120 m.

Metaphoxus Bonnier

Metaphoxus Bonnier 1896:630.—Stebbing 1906:138.—J. L. Barnard 1960:303.

DIAGNOSIS.—Eyes present. Flagellum of antenna 2 reduced in female. Article 2 of antenna 1 shortened, ventral setae confined apically. Article 1 of antenna 2 not ensiform; article 3 with 2 setules; facial spines on article 4 in 2 or more rows; article 5 ordinary in size to thin and short. Right mandibular incisor with 3 teeth; molar not triturative, medium, elongate, conical, bearing one conical fused spine, bearing fuzz; palpar hump small to large. Palp of maxilla 1 uniarticulate; inner plate

naked. Setation of maxilla 2 weak. Inner plate of maxillipeds ordinary; apex of palp article 3 not protuberant, dactyl elongate to medium, apical nail distinct, medium to elongate. Gnathopods similar to dissimilar, enlarged, gnathopod 2 weakly to strongly enlarged; article 5 gnathopods 1-2 very short, cryptic, with eusirid attachment, palms oblique to transverse to chelate, hands of gnathopods 1-2 various, elongate or broadened, poorly setose anteriorly. Article 5 of pereopods 1-2 setose posteroproximally. Article 2 of pereopod 3 of broad form, articles 4-5 of pereopods 3-4 narrow, article 2 of pereopods 3-4 not setose posteriorly; pereopod 5 ordinary, article 2 naked ventrally, article 3 ordinary, dactyl normal. Epimera 1-2 lacking long posterior setae, without midfacial setae above ventral facial ridge; epimeron 3 of rounded classification and bearing 3 or fewer long setae. Urosomite I generally naked except for sparse apicoventral setae or spines near base of uropod 1; urosomite 3 without dorsal hook or special process. Peduncle of uropod 1 normally elongate, without apicoventral spike, without special enlarged apicolateral-medial spine, peduncular apices of uropods 1-2 combed; inner ramus of uropod 1 with marginal spines in one row, no rami continuously spinose to apex, apical nails weak to absent, inner ramus of uropod 2 ordinary. Uropod 3 ordinary, elongate article 2 of outer ramus carrying 2 short to medium to vestigial apical setae. Telson elongate, with 1-3 apical spines or setae on each lobe plus setules, occasionally with supernumerary dorsal and lateral spines or setae.

DESCRIPTION.—Rostrum fully developed. Fuzz on article 1 of antenna 1 in male present; calceoli on male primary flagellum of antenna 1 present. Calceoli on article 5 of male antenna 2 present; flagellum in male with calceoli. Prebuccal parts ordinary, poorly separated from each other, upper lip dominant. Right lacinia mobilis bifid, flabellate; mandibular palp medium to thin, article 1 short, article 2 without outer setae, apex of article 3 oblique. Lower lip bearing or lacking cones. Outer plate of maxilla 1 with 7-9 spines, no spine especially thickened. Inner plates of maxilliped broad to especially thin, poorly armed. Coxae 2-4 without special anterodorsal humps. Some posterior spines on article 6 of pereopods 1-2 thick and setalike, others thick and stiff, midapical spine or seta present. Article 2 of pereopod 5 without facial

setae. Peduncle of uropod l with dorsolateral spines confined apically, medial spines confined apically or widely spread; peduncle of uropod 2 with only one medial spine or setule confined apically. Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with ordinary pair of midlateral or dorsal setules on each side.

Type-Species.—Metaphoxus typicus Bonnier 1896 (= Phoxocephalus pectinatus Walker, 1896) (monotypy).

Composition.—Phoxocephalus fultoni Scott, 1890, Metaphoxus frequens J. L. Barnard, 1960, and the following new species: M. tuckatuck, M. mintus, M. yaranellus, and M. tulearensis.

REMARKS.—Counts of facial spines on article 4 of antenna 2 appear unusual because the first row at the corner often has medial members of sufficient size or thickness to be counted as spines.

Key to the Species of Metaphoxus

(Compound key)

ı.	Palm of gnathopods 1-2 fully transverse, parachelate
	Palm of gnathopods slightly to strongly oblique
2.	Pereopods 1-2 with stout locking spines
	Pereopods 1-2 with thin setal locking "spines"
3.	Outer ramus of uropod 1 distinct from other rami of uropods 1-2, either shorter, more
	curved, or alone lacking apical nail4
	Outer ramus of uropod 1 like other rami of uropods 1-2 5
4.	Inner ramus of uropod 1 naked, article 1 of outer ramus on uropod 3 naked laterally
	Inner ramus of uropod 1 with one dorsal spine, article 1 of outer ramus on uropod 3 spinose
	laterally
5.	Article 6 of gnathopod 1 only 1.7 times as long as wide, edges not parallel, stenopodous part
	of pereopod 5 elongate
	Article 6 of gnathopod 1 twice as long as wide, slender, edges parallel, stenopodous part of
	pereopod 5 short 6
6.	Article 6 of gnathopod 2 about 1.4 times as long as wide, telson with 2 apical spines on each
	lobe, inner plate of maxilliped very thin, bearing one spine
	Article 6 of gnathopod 2 about twice as long as wide, telson with one apical spine on each
	lobe, inner plate of maxilliped broad, bearing 4-5 spines M. yaranellus, new species
7.	Article 6 of gnathopod 2 only 1.4 times as long as wide
	Article 6 of gnathopod 2 about 1.8+ times as long as wide
8.	Article 6 of gnathopod 1 twice as long as wide, slender, edges parallel, stenopodous part of
	pereopod 5 short
	Article 6 of gnathopod 1 about 1.7 times as long as wide, edges usually not parallel, steno-
	podous part of pereopod 5 elongate
9.	Outer ramus of uropod 3 naked laterally
	Outer ramus of uropod 3 spinose
10.	Article 6 of gnathopod 1 about 1.7 times as long as wide, dactyls of pereopods 1-2 smooth
	Article 6 of gnathopod 1 about 1.9 times as long as wide, dactyls of pereopods 1-2 with tiny
	nodules M. yaranellus, new species

Metaphoxus tuckatuck, new species

FIGURES 228-231

DESCRIPTION OF FEMALE (phenotype A).—Head about 16 percent of total body length, greatest width about 60 percent of length; rostrum reaching apex of article 2 on antenna 1, unconstricted, tapering evenly, apically rounded. Eyes large, with purple core in preservative surrounded by large

ommatidia. Article 1 on peduncle of antenna 1 almost 1.4 times as long as wide, more than twice as wide as article 2, apicoventral margin with several setules, strongly produced dorsal apex with 3 setules; article 2 about 0.4 times as long as article 1, apicoventral corner with 2 setae, article 2 overriding article 3 weakly on medial surface; accessory flagellum shorter than primary flagellum, 3-articulate; primary flagellum 5-articulate, aesthetascs

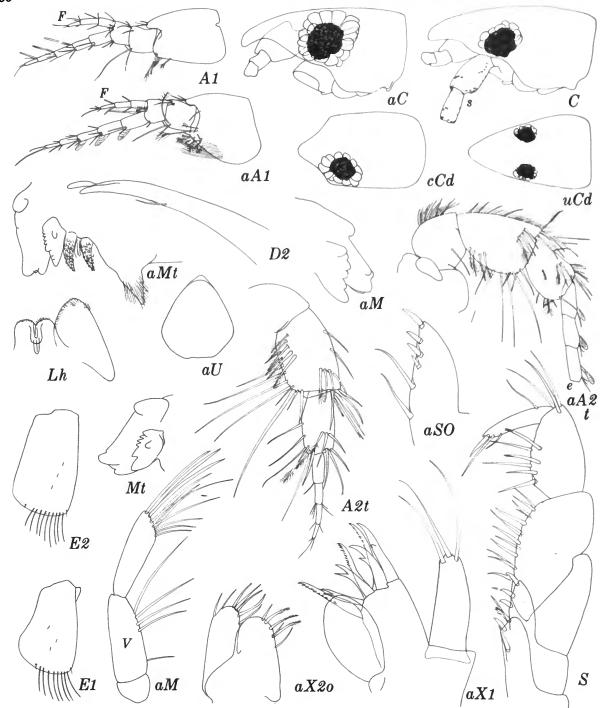


FIGURE 228.—Metaphoxus tuckatuck, new species, holotype, female "b," 3.46 mm, phenotype A (a = male "a," 3.11 mm; c = male "c," 2.82 mm; u = female "u," 3.05 mm).

present. Spine formula on article 4 of antenna 2 = 3-3-3, proximal set with one accessory setule, spines thin, dorsal margin with 2 setae in tandem, ventral face with 5 penicillate setules, ventral margin with about 6-7 short to long setae, apex with thin spine and short seta; article 5 about 0.75 times as long as article 4, facial spine formula = 2, with one accessory setule, dorsodistal corner with 3 spine-setae, dorsal margin smooth, ventral margin with 3 single medium setae, ventrodistal apex with about 5 setae and setules; flagellum as long as article 4 of peduncle, 4-articulate. Prebuccal complex convex anteriorly, well extended forward, epistome and upper lip mostly fused together, ventral margin of upper lip weakly bisinuate. Palpar hump of mandible small; right incisor tridentate, with notch defining second tooth and accessory hump between teeth 2-3; left basically bidentate, distal branch weakly bidentate and bearing weak proximal facial hump; right lacinia mobilis flabellate, distal branch poorly defined, margin toothed, face with weak hump; left lacinia mobilis flabellate, 6-toothed: right rakers 2, left 3; molar conical, setulose; palp article 2 with subbasal seta and 4 subapical long setae on inner margin, article 3 about as long as article 2, oblique apex with 12 setae. Cones on lower lip absent, mandibular lobes of medium length, weakly attenuate and apically rounded, inner lobes cleft about one third their length. Inner plate of maxilla 1 large, ovate, naked; outer plate with 7 spines; palp exceeding apex of outer plate, bearing 2 apical and one weakly apicolateral setae. Inner plate of maxilla 2 much broader and shorter than outer plate, medial margin of inner plate with one disjunct and distinctly medial seta plus 5 other short to medium setae, outer plate with 2 apicolateral, 4 apical and one medial setae. Inner plate of maxilliped with one mediofacial spine and 2 apical spines; outer plate with 5 spines, 2 longest basal spines hidden behind inner plate; article 2 of palp with sparse, stout and short medial setae, article 3 lacking facial setae, article 4 long, apical spine of medium length, bearing 2 accessory setules, first very long. Coxa 1 distally expanded and broadly rounded anteroventrally; long setal formula of coxae 1-4 = 8-9-9-3, each with tiny additional posteroventral bulbar setule; coxa 4 quadratiform, posterodorsal excavation large to medium, L-shaped, ratio of width to length = 1:1. Gnathopod 2 scarcely stouter than gnathopod 1; long pos-

terior setae on article 2 of gnathopods 1-2 = 3-5and 4; gnathopods subeusirid, article 5 small and triangular but apex scarcely produced, article 6 almost slender, slightly more than twice as long as wide, palm oblique, defining hump of medium size, defining spine large, dactyl fitting palm, apex of dactyl with flake, posterior margin of article 6 with 2-3 setae, posterior corner of article 5 almost cryptic; length ratios of articles 5-6 on gnathopods 1-2 = 36:90 and 33:95, width ratios = 23:45 and 22:46. Pereopods 1-2 similar to each other; long posterior setae on article 2 of pereopods 1-2=4and 5-6; article 4 with about 4 apicoanterior setae and 4 apicofacial setae on pereopod 1, 2 apicofacial setae on pereopod 2, posterior margins of articles 4-5 moderately to weakly setose, article 5 with 1, rarely 2 apicofacial setae, with long posterodistal spine slightly exceeding apex of article 6, lacking small contiguous spine at base (possibly represented by facial seta), article 6 bearing one posterior seta, 2 apicofacial setae, one long apical spine, one short spine and one seta, rows therefore composed of 2 and 2 with 2 accessory facial setae, lateral spine row composed of shorter spine plus posterior seta, (also interpreted as 3 + 2 + middle distal spine), medial row composed of longer spine and one seta, dactyl with apical flake and thin inner setule (almost appressed), apical nail not evident. Coxae 5-7 posteroventral setule formula = l-l-l. Articles 4-5 of pereopods 3-4 thin, facial spines absent, pereopods 4-5 with one anterior facial ridge; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 66:17: 15:7, of pereopod 4 = 80:19:13:8, of pereopod 5 = 92:13:11:6, length ratios of pereopod 3 =78:24:24:28, of pereopod 4 = 95:52:47:45, of pereopod 5 = 115:21:23:18; article 2 of pereopod 5 extending to apex of article 4, posterior margin with small setule acclivities, ventral margin with setule scallops; apex of article 6 finely combed. Epimeron 1 with weak facial ridge, absent on epimeron 2, each with rounded-quadrate posteroventral corner and convex posterior margin, each bearing midsetule; epimeron 3 with weak posteroventral tooth and sinus bearing setule, posterior margin deeply convex, bearing 2 setule notches, epimeron 2 with one facial seta, rarely with 2 in horizontal tandem. Urosomite I ventrally naked, weakly produced dorsally and bearing one setule. Peduncle of uropod 1 with tiny basofacial seta, each apex of peduncle with one medium spine, medial mar-

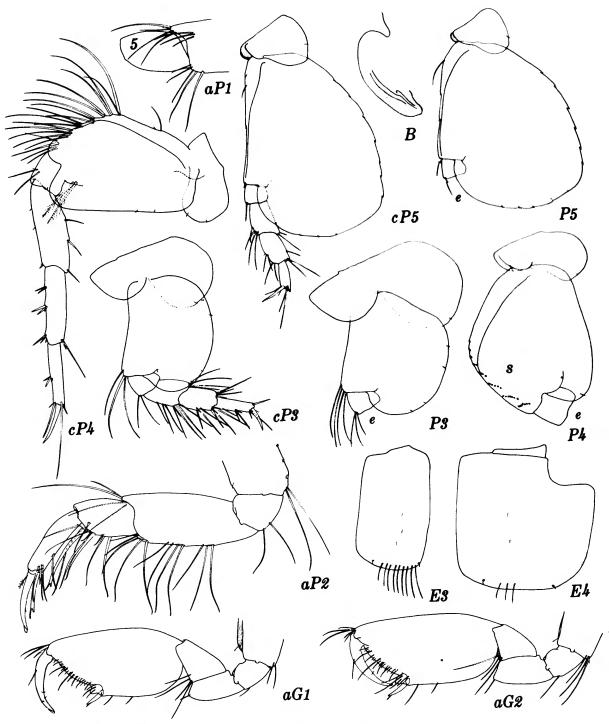


FIGURE 229.—Metaphoxus tuckatuck, new species, holotype, female "b," 3.46 mm, phenotype A (a = male "a," 3.11 mm; c = male "c," 2.82 mm).

gin with one spine, rami of uropods 1-2 naked dorsally, inner rami of uropods 1-2 and outer ramus of uropod 2 with apical flake, inner ramus of uropod l with small mediobasal spinule, outer ramus of uropod 1 slightly shortened, thinner and more curved than inner ramus, uropod 2 with 2-3 dorsolateral spines on peduncle, medial apex with one spine, apex of peduncle on uropods 1-2 with lateral comb. Uropod 3 of medium length, peduncle with 4 long ventrolateral spines, medially with one short spine; rami feminine, inner ramus extending to M. 100 on article 1 of outer ramus, apex with immersed setule, article 2 of outer ramus elongate, 0.50, bearing 2 apical setules, margins naked, lateral apex of article 1 with 2 spines, medial apex with one spine. Telson elongate, lengthwidth ratio about 16:11, apices tapering, narrow, weakly excavate, each bearing medium spine and small apicolateral setule, dorsal pair of plusetules weakly diverse, near middle of each lobe, almost directly centered. Bulbar setules of cuticle extremely sparse.

DESCRIPTION OF MALE (phenotype A).—Eyes much larger than those of female, causing lateral protrusion of head. Article 1 of antenna 1 with medial patch of fuzz, disparity in length of flagella greater than in female; primary flagellum bearing calceolus (6-chambered) on each of articles 1-3. Spine formula on article 4 of antenna 2 peduncle = 4-3-3, articles 3-4 with dorsomedial fuzz, article 5 with one dorsal calceolus and 2 groups of stiff male setae, ventrodistal margin poorly setose; flagellar formula = 24, 1-3, 5, $7 \dots 23$. Apex of mandibular palp with 10 setae. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 2-(1-2)-2-3; article 6 of gnathopods slightly more elongate than in female. Long setae on coxae 1-4 = (7-8)-8-(7-8)-3; coxa 4 smaller in relation to coxae 1-3 than in female and very slightly narrower than in female. Article 4 of pereopods 1-2 with 3-4 and 0 apicofacial setae. Article 2 of pereopods 3-5 narrower than in female. Epimera enlarged, epimeron 2 with 0-1 facial seta, epimeron 3 with 3 posterior setules besides one at ventral corner. Urosome smaller than in female. Apicomedial corner of peduncle on uropods 1-2 with pair of spines in largest male, only one spine in smaller male. Rami of uropod 3 masculine, inner reaching only to M. 90 on article 1 of outer ramus, medial margins of rami setose. Telson

scarcely more elongate than in female, with basal patches of dorsal denticles.

VARIATION (male phenotype A).—One outer plate on maxilliped of male "a" bearing 4 spines of stout kind.

ILLUSTRATIONS (phenotype A).—Specimens poorly preserved, heads of males especially difficult to interpret; dorsal view of male "c" head reconstructed and one damaged eye omitted; anterior lobe of coxa of pereopod 4 on male "c" omitted (damaged); dactyls of pereopods 1–2 with apical flake pulled away from dactyl in illustration, flake often closely appressed to dactyl in many specimens; 2 facial setae on epimeron 2 of male "a" represented only by holes, setae broken away.

HOLOTYPE.—NMV, female "b," 3.46 mm, phenotype A.

TYPE-LOCALITY.—PPBES 919/4, 18 Nov 1971, Port Phillip Bay, Victoria, Australia, 6 m, silty sand.

VOUCHER MATERIAL (phenotype A).—Type-locality: male "a," 3.11 mm (illus.); male "c," 2.82 mm (illus.); female "u," 3.05 mm (illus.).

DIAGNOSIS OF PHENOTYPE B.—Ommatidia of ordinary medium size; mandibular palp article 2 with only 2-3 long inner apical setae; epimeron 2 with 1-4 setae; male right lacinia mobilis poorly serrate.

REMARKS.—This phenotype has the appearance of a distinct species; our lack of extensive material of juveniles in either phenotypes A or B prevents us from tracing the life history of the two forms. We would normally presume that phenotype A represents terminal development and a pelagicneritic phase of this species as marked by the enlarged ommatidia, but these specimens come only from benthic grabs whereas phenotype B occurs in neritic tows. Phenotype A usually has more than twice as many setae on article 2 of the mandibular palp as does phenotype B but usually has fewer setae on epimeron 2, an asynchronous noncorrelation between the two phenotypes suggesting that they might be distinct species. The strange right lacinia mobilis of the male of phenotype B is unexplainable and also a possible mark of speciation. If phenotype B develops into phenotype A then the male right lacinia mobilis must revert to its normal condition in terminal male phenotype A, a strange situation. We know nothing of the life history of the neritic phases of phoxocephalids but suggest the possibility that phenotype B adults

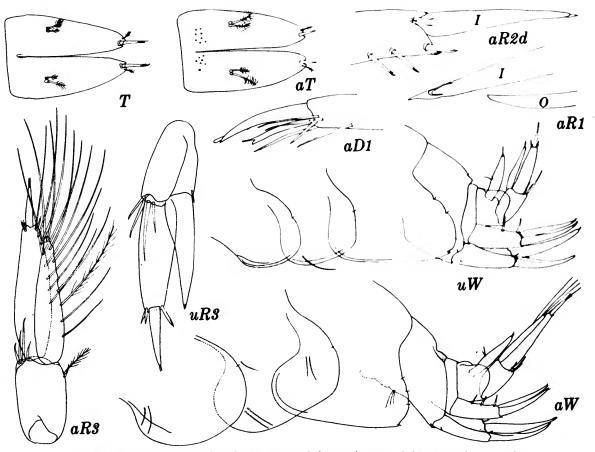


FIGURE 230.—Metaphoxus tuckatuck, new species, holotype, female "b," 3.46 mm, phenotype A (a = male "a," 3.11 mm; u = female "u," 3.05 mm).

may also be terminal and that this species has, as a survival mechanism, two terminal phases, A and

DESCRIPTION OF PHENOTYPE B.—Like phenotype A except in points of diagnosis.

OBSERVATIONS (phenotype B).—Female "m," 2.39 mm: Article 4 of antenna 2 with facial spine formula of 3-3-2, basofacial setae 3 only, ventral margin with 4 long and one short setae only; article 5 with only 2 ventral setae. Mandibular palp article 2 with only 1-2 long inner distal setae, one short basal seta, article 3 with only 9 apical setae. Formula of long setae on coxa 1-4 = 8-8-7-2. Epimeron 2 with 2 setae.

Female "e," size unknown: Ommatidia 11 in number. Epimeron 2 with 2 setae.

Male "f," 3.22 mm: Giant specimen. Facial spine formula on article 4 of antenna 2=2-2-2, flagellar formula = 25, 1-4, 6, 8 . . . 24. Article 2 of mandibular palp with 4 long apical setae. Maxilla 2 normal (like phenotype A; right mandible illustrated). Setal formula of coxae 1-4=6-7-6-2. Epimeron 2 with 3 setae. Peduncle of uropod 1 with one apicolateral spine and one small spine in middle of lateral margin. Uropod 2 with 4 spines on peduncle.

Female "g," 2.71 mm: Ommatidia slightly enlarged (illustrated).

Male "h," 2.70 mm: Palp article 2 of mandible with 3 long inner distal setae. Formula of spines on article 4 of antenna 2 = 1-3-2 only; article 5 like phenotype A but spines longer, article 4 with

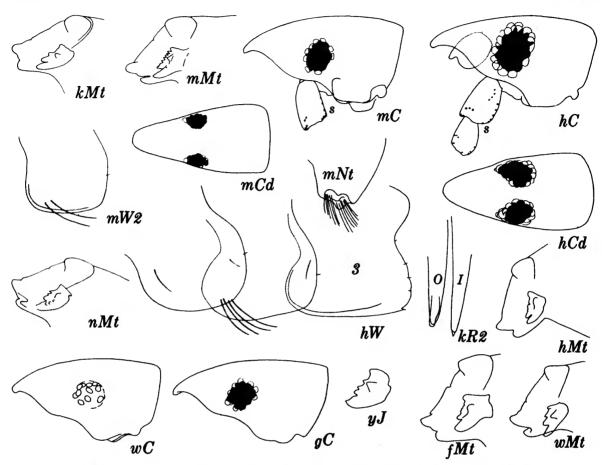


FIGURE 231.—Metaphoxus tuckatuck, new species, phenotype B (f = male "f," 3.22 mm; g = female "g," 2.71 mm; h = male "h," 2.70 mm; k = male "k," 2.44 mm; m = female "m," 2.39 mm; n = female "n," 2.24 mm; w = female "w," 2.41 mm; y = male "y," 3.07 mm).

4 basofacial setae, article 5 with only 3 ventral setules, one dorsal calceolus; flagellar formula = 20, 1-3, 5, 7...19. Formula of long setae on coxae 1-4 = 6-6-6-1. Article 4 of pereopods 1-2 with 2 and 0 facial setae. Article 2 of pereopod 4 slightly stouter than in phenotype A. Epimeron 1 with only one anterodorsal mediofacial seta; epimeron 2 also with only one similar seta but with 4 lateral facial setae. Peduncle of uropod 2 with only 2 lateral peduncular spines and only one medial spine. Inner ramus of uropod 3 with only 6 medial setae, outer ramus with only 5 medial setae. Telson lacking basal denticles.

Female "i," 2.5 mm: Like female "u" but slightly larger. Ommatidia proliferating, each

doubled. Facial spine formula on article 4 of antenna 2 = 3-3-3. Epimeron 2 with 2 setae. Apical scales of uropods 1-2 especially attenuate and elongate, peduncle of uropod 2 with 2 dorsal spines.

Female "j," 3.04 mm: Like female "i" but ommatidia not proliferating, total = 14. Epimeron 2 with only one seta. Coxa I with 10 setae.

Male "k," 2.44 mm: Epimeron 2 with 3 lateral facial setae. Uropod 2 with 3 lateral peduncular spines; apices of rami on uropods 1-2 blunter than in any other specimens of phenotypes A and B, pointed flake poorly developed.

Female "w," 2.41 mm: Sexually mature but very poorly developed, especially right lacinia

mobilis (illustrated). Primary flagellum of antenna 1 with 5 articles; accessory flagellum with 3. Facial spine formula on article 4 of antenna 2 = 3-2-2; flagellum with 4 articles. Article 2 of right mandibular palp with 3 long distal setae, left with 2. Long setal formula of coxae 1-4 = 7-7-6-1. Epimeron 2 with 2 setae. Epimera 1, 3 and uropods 1, 2 normal.

Male "y," 3.07 mm: Eyes large but ommatidia small. Antenna 2 with 5 basofacial plusetules on article 4. Right lacinia mobilis somewhat intermediate between phenotypes A and B (illustrated). Epimeron 2 with 3 setae. Peduncle of uropod 2 with 4 dorsal spines.

Male "z," 3.10 mm: Epimeron 2 with 3 setae. Females associated with males "y" and "z": Eyes small, ommatidia on stalks. Right lacinia mobilis with strong, sharp teeth. Epimeron 2 with 2 setae.

VOUCHER MATERIAL (phenotype B).—RHM: male "f," 3.22 mm (illus.); female "g," 2.71 mm (illus.); male "h," 2.70 mm (illus.); male "k," 2.44 mm (illus.); female "m," 2.39 mm (illus.); female "n," 2.24 mm (illus.); males "p," "q," "s," juvenile "t." CPBS 000/5: female "w," 2.41 mm (illus.). PPBES 906/4: male "y," 3.07 mm (illus.); male "z," 3.10 mm. CPBS 03S/2: female "e," size unknown. CPBS 100/1: female "i," 2.5 mm. CPBS 100/5: female "j," 3.04 mm.

RELATIONSHIP.—This species is generally similar to *M. frequens* J. L. Barnard, 1960, from California but the latter differs from *M. tuckatuck* in the following characters: the stouter article 6 of gnathopod 2, the presence of only one spine on the inner plate of the maxilliped, the absence of setules on epimeron 3, the presence of one dorsal spine on the outer rami of uropods 1–2, the less strongly setose maxilla 2, fewer coxal setae, small ommatidia, fewer setae on article 2 of mandibular palp, poorly developed accessory setule on article 4 of maxillipedal palp, presence of 2 setae on the inner plate of maxilla 1 and the presence of 2 spines and one setule on each apex of the telsonic lobes.

MATERIAL.—CPBS, 16 samples from 11 stations (19); WPBES, 7 samples from 5 stations (15); PPBES, 79 samples from 41 stations (143); RHM, one sample (10).

DISTRIBUTION.—Victoria: Western Port and Port Phillip Bay, 0-24 m and neritic, sand, muddy sand, sand and gravel, clay, silty clay, often heavy seagrass cover.

Metaphoxus yaranellus, new species

FIGURES 232, 233

DESCRIPTION OF MALE.—Head about 17 percent of total body length, greatest width about 66 percent of length; rostrum reaching middle of article 2 on antenna 1, unconstricted, tapering evenly, apically rounded. Eyes medium to medium-large, eosin in color, clear of occluding pigment, ommatidia ovate or elliptical in small-eyed males, becoming elongate in terminal males. Article 1 on peduncle of antenna 1 about 1.2 times as long as wide, twice as wide as article 2, apicoventral margin poorly setulose, produced dorsal apex with one setule, medial face densely fuzzy, fuzz apparently composed of thick aesthetases; article 2 about 0.65 times as long as article 1, apicoventral lateral face with 4-5 setae, article 2 slightly overriding article 3 on medial surface; accessory flagellum slightly shorter than primary flagellum, 3-articulate; primary flagellum 4-articulate, bearing one calceolus each on articles 1 or 1-2 and several aesthetascs. Spine formula on article 4 of antenna 2 = 1-2-2-3 or 1-2-2-4, set 3 with one accessory setule, set 4 with 1-3 accessory setules, spines thin, dorsomedial margin densely fuzzy, fuzz composed of thick aesthetascs, proximoventral margin with 2-3 penicillate setules, distally with pair of setae, ventral apex, with spine and 3 setae; article 5 about 0.8 times as long as article 4, facial spine formula = 2, no accessory setule, dorsodistal corner with 2 spine-setae, dorsal margin with 0-1 calceolus and 1-2 groups of male setae, ventrodistal apex with one spine-seta, pair of short setule-spinules, ventral margin with pair of setules; flagellum elongate, flagellar formula = (15-17), 1, 2, 4, 6, 8 only or 1, 3, 5 only or 1, 3, 5 . . . 15 (from 9 onward calceoli rudimentary), or 1, 2, 3, 5 only, or article 2 only. Prebuccal complex convex anteriorly, poorly extended forward, epistome and upper lip mostly fused together, ventral margin of upper lip weakly bisinuate. Palpar hump of mandible medium, broad; right incisor basically tridentate, with fourth tooth adjacent to tooth 2; left basically bidentate, distal branch strongly tri- or quadridentate; right lacinia mobilis flabellate, proximal branch distinct from serrate distal branch, face naked; left lacinia mobilis flabellate, 5-toothed; right rakers 3 plus 1-3 rudimentaries; left rakers 3 plus one rudimentary; molar conical, setulose; palp

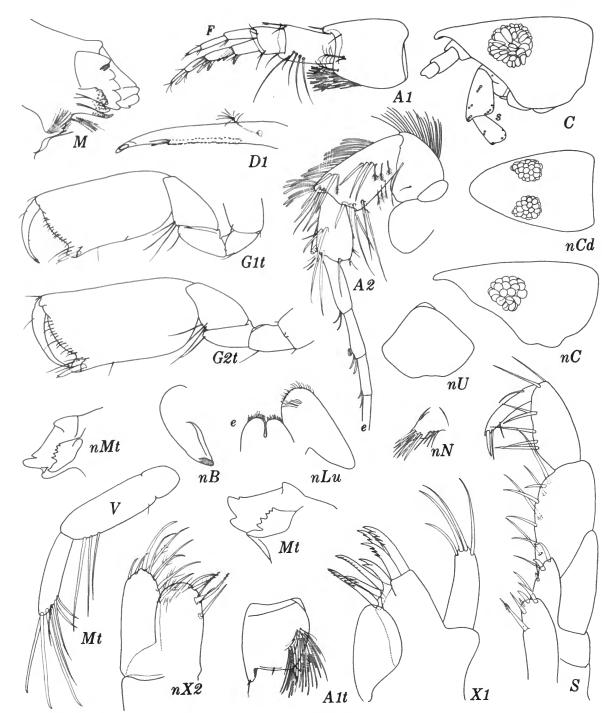


FIGURE 232.—Metaphoxus yaranellus, new species, holotype, male "a," 2.54 mm (n = male "n," 2.63 mm).

article 2 with inner subbasal setule and 2-3 subapical long setae, article 3 about 0.65 times as long as article 2, oblique apex with 8 setae. Each outer lobe of lower lip with cone, mandibular lobes long, weakly attenuate and apically rounded, inner lobes cleft about one-third. Inner plate of maxilla 1 of medium size, ovate, bearing one apicomedial setule; outer plate with 7 spines; palp slightly exceeding apex of outer plate, bearing 2 apical and one apicolateral setae, occasionally a fourth apicomedial seta. Inner plate of maxilla 2 slightly broader and much shorter than outer plate; medial margin of inner plate with one disjunct medial seta plus 5-7 other apicad setae of which one very stout; outer plate with 2 apicolateral, 6 apical and 2 medial setae. Inner plate of maxilliped with one mediofacial spine, one apicomedial spine, and 2-3 apical spines; outer plate with 3 apicomedial spines, one elongate basomedial spine; article 2 of palp with sparse, stout medial setal-spines, article 3 lacking facial setae, article 4 long, apical spine of medium length, bearing 2 accessory setules, first setule elongate. Coxa l scarcely expanded; long setal formula of coxae 1-4 = (2-5)-(4-5)-(3-5)-(0), each with tiny additional posteroventral setule; coxa 4 quadratiform, posterodorsal excavation medium-small, V-shaped, posterodorsal corner rounded, ratio of width to length = 7:9. Gnathopod 2 stouter and longer than gnathopod 1; long posterior setae on article 2 of gnathopods 1-2=1and 1; article 5 small and triangular; article 6 elongate, twice as long as wide, palm weakly oblique, defining hump medium to large, defining spine large, dactyl fitting palm, apex of dactyl with flake, posterior margin of article 6 with 1-2 setae; length ratios of articles 5-6 on gnathopods 1-2 = 48:87 and 46:98, width ratios = 24:47 and 26:54. Pereopods 1-2 similar to each other; long posterior setae on article 2 of pereopods 1-2=2and 2; article 4 with one long apicoanterior seta, no apicofacial setae, posterior margin with sets of 3 and 2 setae on pereopod 1, 4 and 3 on pereopod 2; article 5 with one apicofacial seta, long posterodistal spine reaching M. 80 on article 6, with small contiguous spinule at base; article 6 bearing one posterior seta and apical sets of 3 and 2 spines of medium length; dactyl with apical immersed nail, appearing to have apicofacial meatus, thin inner setule on weak acclivity, inner margin and lateral face bearing minute rows of nodules. Coxae 5-7

posteroventral setule formula = 1-4-4. Articles 4-5 of pereopods 3-4 thin, facial spines absent, pereopods 4-5 with one anterior facial ridge; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 48:24:18:8, of pereopod 4 = 72:25:17:9, of pereopod 5 = 110:20:15:7, length ratios of pereopod 3 = 68:27:29:32, of pereopod 4 = 91:49:46:42, of pereopod 5 = 128:28:28:16; article 2 of pereopod 5 especially large, reaching middle of article 5, posterior margin with small setule acclivities, ventral margin with weak setule scallops; apex of article 6 finely combed. Epimeron 1 with facial ridge, absent on epimeron 2 (illustration showing ventral margin of next instar), each with rounded posteroventral corner and weakly convex posterior margin bearing 2 setules, epimeron 3 with deeply convex and notched posterior margin, posteroventral corner with setule notch, epimeron 2 with 2-4 facial setae in horizontal tandem. Urosomite 1 bearing one setal spine midventrally on each side. Peduncle of uropod I naked basofacially, lateral apex with one medium spine, medial apex with longer spine, medial margin with 1-2 additional spines, rami of uropods 1-2 naked dorsally, apices grossly naked and apparently lacking immersed nail (probably fully absorbed), inner rami often with apical flake, outer rami rarely so, inner ramus of uropod 1 with small mediobasal setulespinule, rami of uropod 1 extending equally, peduncle of uropod 2 with 2 dorsal spines, medial apex with one spine, apex of peduncle on uropods 1-2 with lateral comb. Uropod 3 elongate, inner ramus strongly setose medially but not fully elongate (not fully adult), peduncle with 4-5 ventrolateral spines, medially with short spine and longer seta, dorsolaterally with setule, inner ramus extending to M. 75 on article 1 of outer ramus, apex with one long seta, one setule, article 2 of outer ramus elongate, 0.50, bearing 2 minute apical setules, lateral margin of article 1 with 3 acclivities; seta formula = l(short)-l-l-l, spine formula = 0-l-l-l(variable, setae = l-l-l-0, spines = 0-l-l-2, or setae = l-l-l-1 and spines = 0-l-l-2), medial apex with one spine, one seta. Telson highly elongae, length-width ratio about 7:4, apices tapering, narrow, apically truncate, bearing one short spine in middle of apex and one apicomedial setule, dorsal pair of plusetules alike, near middle of each lobe close to base, dorsal cuticle of telson covered with fuzz except for basal triangle bearing chisel

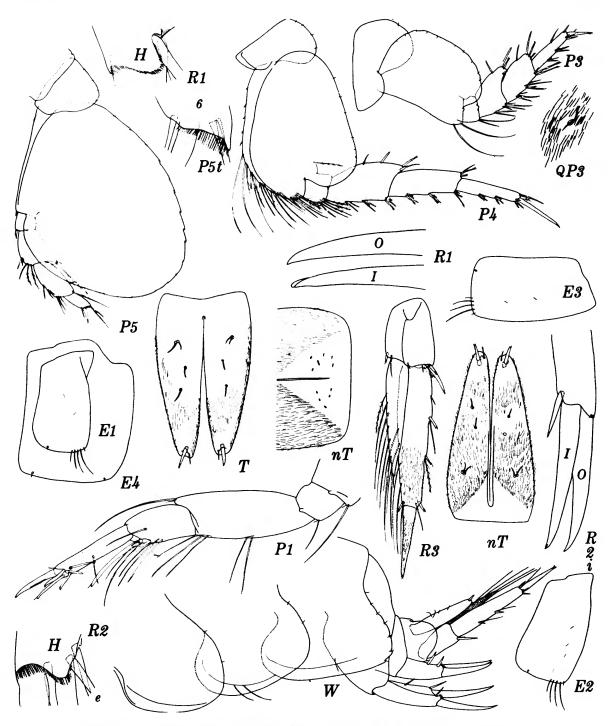


FIGURE 233.—Metaphoxus yaranellus, new species, holotype, male "a," 2.54 mm (n = male "n," 2.63 mm).

SMITHSONIAN CONTRIBUTIONS TO ZOOLOGY

shaped denticles in subcircular group, other stout setules distally. Cuticle covered with fuzz easily visible under medium and low power microscopy and scattered bulbar setules.

Variations.—Apical flakes on rami of uropods 1-2 variable in occurrence, usually borne only on inner rami, often absent, very rarely on outer rami; male "b" with apicomedial spine position on peduncle of uropod 1 bearing pair of spines; only males "a" (holotype) and "d" with oddly elongate ommatidia.

ILLUSTRATIONS.—Head of holotype slightly flattened laterally; holotype telson shown flattened, telson of male "n" shown flattened; body and appendages including uropods and telson almost fully covered with cuticular fuzz but, in those illustrations showing fuzz, only highlights actually depicted, except for naked triangle on base of telson.

HOLOTYPE.—AM, male "a," 2.54 mm.

Type-Locality.—AM P.18125, 12 Dec 1939, Antechamber Bay, Kangaroo Island, South Australia, with light in net at night.

VOUCHER MATERIAL.—Type-locality: male "b," 2.61 mm; male "n," 2.63 mm (illus.); male "d," 2.40 mm; and male "e," 2.41 mm. Female unknown.

RELATIONSHIP.—This species differs from *Metaphoxus tuckatuck* in the unshortened outer ramus of uropod 1, the very narrow coxa 4, fuzzy cuticle, enlarged article 2 of pereopod 5, elongate telson with apical setule on medial side of main spine, the greater spinosity on the lateral face of article 4 on antenna 2, the poorly expanded coxa 1 and the shapes of gnathopods 1–2.

Metaphoxus yaranellus bears the vaguest resemblance to M. frequens J. L. Barnard, 1960, from the northern hemisphere, but differs in numerous characters involving gnathopod 2, epimeron 3, mouthparts, telson, coxae, uropods, and pereopod 5.

MATERIAL.—AM, one sample (5).

Distribution.—South Australia, Kangaroo Island, neritic.

Metaphoxus mintus, new species

FIGURES 234-236

DESCRIPTION OF FEMALE.—Head about 17 percent of total body length, greatest width about 55 percent of length; rostrum exceeding apex of arti-

cle 3 on antenna 1, unconstricted, narrow, elongate. Eyes large, largely occluded with pigment, ommatidia small. Article 1 on peduncle of antenna 1 about 1.4 times as long as wide, about 1.8 times as wide as article 2, apicoventral margin and face with about 9 setules, strongly produced dorsal apex with 3 setules; article 2 about 0.45 times as long as article 1, with apicoventral cycle of 4-5 setae, article 2 scarcely overriding article 3 on medial surface; accessory flagellum shorter than primary flagellum, 3-articulate; primary flagellum 6-articulate. Spine formula on article 4 of antenna 2 = 3-3-5 or 3-3-4, set 2 with one accessory setule, set 3 with 5 accessory setules, spines thin, dorsal margin with 3 sets of 1-3 setae, ventral margin with 6-7 sets of 1-3 long to medium setae, ventral apex with one medium spine; article 5 about 0.63 times as long as article 4, facial spine formula = 3-2, each group with accessory setule, dorsodistal corner with 2 large spines, dorsal margin naked, ventral margin with 2 sets of 2 long to medium setae, ventrodistal apex with 3 long to medium spine-setae; flagellum about 0.63 times as long as articles 4-5 of peduncle combined, with 6 articles. Prebuccal mass flat, weakly extended anteriorly, ventral margin of upper lip with small hump. Palpar hump of mandible medium-strong; right incisor basically tridentate, with fourth tooth adjacent to tooth 2; left basically bidentate, distal branch bifid; right lacinia mobilis flabellate, distal branch distinct from simple proximal branch, face naked; left lacinia mobilis flabellate, 5-toothed, with accessory tooth; right rakers 2, left 3; molar subconical, setulose; palp article 2 with 3 inner subbasal setae and 5 longer subapical setae in tandem, article 3 about 0.9 times as long as article 2, oblique apex with 13-14 setae, basofacial formula = 0-1. Each outer lobe of lower lip with cone, mandibular lobes short, weakly attenuate and apically rounded, inner lobes cleft about one third. Inner plate of maxilla 1 of medium size, ovate, naked; outer plate with 7 spines; palp slightly exceeding apex of outer plate, bearing 3 apical and one apicolateral setae. Inner plate of maxilla 2 slightly broader and much shorter than outer plate, medial margin of inner plate with 5-6 setae, outer plate with 2-3 apicolateral, 13-14 apical and 2 medial setae. Inner plate of maxilliped with 2 mediofacial setae, one apicomedial spine, 4-5 apical spines, outer plate with 6 apicomedial

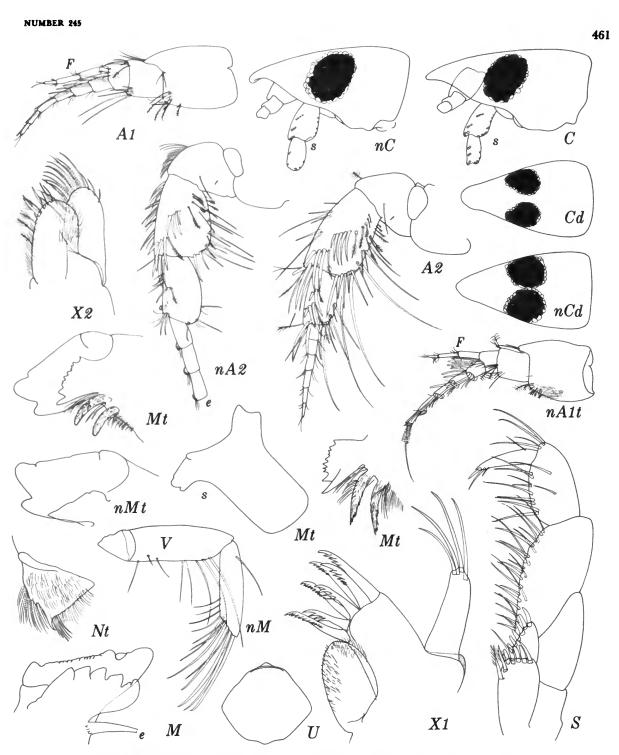


FIGURE 234.—Metaphoxus mintus, new species, holotype, female "a," 4.95 mm (n = male "n," 4.70 mm).

spines, one elongate basomedial spine, article 2 of palp with dense medial setation, article 3 with 2 facial setae, article 4 long, bearing 2 accessory setules, apical spine short. Coxa 1 expanded distally; long setal formula of coxae 1-4 = (11-15)-(8-12)-(7-9)-(2-4), some middle setae shortened, each with tiny additional posteroventral setule; coxa 4 quadratiform, anterior and posterior margins weakly divergent, posterodorsal excavation medium, V-shaped, posterodorsal corner rounded, ratio of width to length = 17:19. Gnathopod 2 scarcely stouter but longer than gnathopod 1; long posterior setae on article 2 of gnathopods 1-2=3and 2-3; article 5 small, triangular; article 6 elongate, almost twice as long as wide, palm oblique, defining hump small, defining spine medium, dactyl overriding palm, apex of dactyl with flake, posterior margin of article 6 with 3 setae; length ratios of articles 5-6 on gnathopods 1-2 =40:82 and 44:89, width ratios = 23:48 and 25:48. Pereopods 1-2 similar to each other; long posterior setae on article 2 of pereopods 1-2=3 and 4; articles 4-5 each with apicofacial row of 3 setae, posterior margin of article 4 with 4 sets of 3-7 setae, long posterodistal spine on article 5 reaching M. 95 on article 6, with tiny contiguous spinule at base; article 6 bearing 2 posterior setae and apical sets of 2 and 2 spines, mostly thin, plus middistal enlarged spine-seta; dactyl with apical immersed nail, thin inner setule on weak acclivity, surface naked. Coxae 5-7 posteroventral setule formula = 1-1-1. Articles 4-5 of pereopods 3-4 thin, facial spines absent, pereopods 4-5 with one anterior facial ridge; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 60:20:17:8, of pereopod 4 =65:22:16:8, of pereopod 5 = 86:19:16:8, length ratios of pereopod 3 = 80:28:27:27, of pereopod 4 = 89:44:38:34, of pereopod 5 = 118:28:26:16; article 2 of pereopod 5 especially large, reaching apex of article 4, posterior margin with weak setule acclivities, ventral margin with weak setule scallops; apex of article 6 finely combed. Epimeron 1 with facial ridge, absent on epimeron 2, each epimeron with rounded posteroventral corner and straight to weakly convex posterior margin bearing one setule, epimeron 3 with weakly protuberant and 2-notch posterior margin, posteroventral corner with notch, epimeron 2 with 4-8 facial setae. Urosomite 1 naked. Peduncle of uropod I naked basofacially, lateral apex with one medium spine, medial apex with one spine, rami of uropods 1-2 naked dorsally except for one spine on inner ramus of uropod 1, apices of all but outer ramus on uropod l with scarcely distinct tiny apical nail, inner ramus of uropod I with small mediobasal setule-spinule, outer ramus of uropod 1 slightly shorter and more curved than inner ramus, peduncle of uropod 2 with 1-2 dorsal spines, medial apex with one spine, apex of peduncle on uropods 1-2 with lateral comb. Uropod 3 weakly elongate, peduncle with 5 ventrolateral spines, medially with 2 spines, dorsolaterally with one spine; inner ramus extending to M. 85 on article 1 of outer ramus, apex with 2 long setae, otherwise naked, article 2 of outer ramus elongate, 0.40, bearing 2 short setules, lateral margin of article 1 bearing 2 acclivities; setal formula = 0, spine formula = 1-1-2, medial apex with pair of setal-spines. Telson highly elongate, length-width ratio about 17:11, not fully cleft, apices tapering, narrow, weakly rounded or notched, bearing one short spine in middle of apex, one apicolateral setule, often one medial setule, dorsal pair of plusetules weakly diverse, near middle of lobe, base with row of denticles on each lobe. Cuticle with sparse bulbar setules, surface bearing patches of fine striations in form of fingerprint pattern, emergent setules especially short.

Variations (female).—Female "b" with 6 facial setae on epimeron 2, female "w" with 8, inner ramus on uropod 1 of female "b" with 2 dorsal spines, but both females "b" and "w" with only 3–0 spines on article 5 of antenna 2; female "w" with aberrant thin spine on dorsobasal face of inner ramus on uropod 1, epimeron 1 with one anterofacial seta, apex of peduncle on uropod 2 with dorsal half of comb much longer and composed of stouter elements than in other specimens except juvenile "g," thus female "w" bearing apparent juvenile condition on uropod 2, though generally more senile than female "a" (holotype) and "b."

Description of Male (male "n," 4.70 mm).— Eyes scarcely larger than in female, some ommatidia larger. Article 1 of antenna 1 with medial patch of fuzz, articles 1-4 of primary flagellum each with calceolus, terminal articles with multiples of elongate aesthetascs. Dorsomedial faces of articles 3-4 of antenna 2 fuzzy; spine formula on face of article 4 = 3-3-4, ventral setae short but

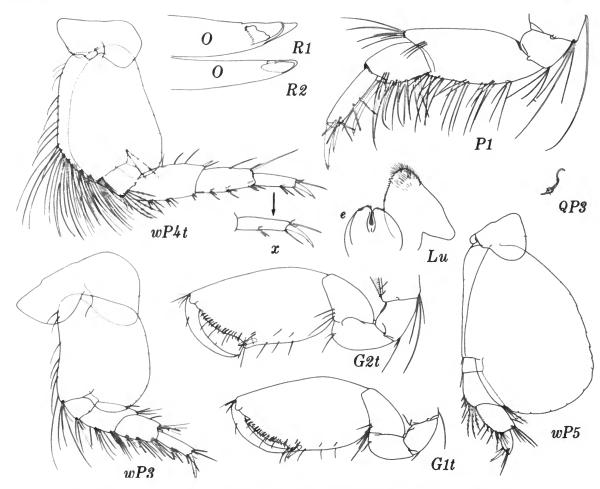


FIGURE 235—Metaphoxus mintus, new species, holotype, female "a," 4.95 mm (w = female "w," 4.51 mm; x = left).

not reduced in number; article 5 enlarged, ventrally and distally with setae reduced in number and shortened, facial spine formula = 2-0, anterior margin with one calceolus and bundles of male setae; flagellum elongate, flagellar formula = 32, 1-3, 5, 7 . . . 31. Upper lip almost evenly truncate ventrally. Right lacinia mobilis almost smooth, not bifid, forming asymmetrical arrow-head. Palpar apex of maxilla 1 with 5 setae. Apex on inner plate of maxilliped with only 3 of stout kind of spine, outer plate with only 5 thick and one thin spines. Long setae on coxae 1-4 = (11-12)-(8)-(6-7)-(2), coxa 1 with one long seta anterior to anteroventral bulbar setule(!); coxa 4 slightly larger relative to

coxa 1 than in female, otherwise narrower. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2=3-1-3-4, short anterior setae = 1-5-3-3, no others. Lateral facial setae on articles 4-5 of pereopods 1-2=2-2 and 0-2; article 6 with spine rows of 2+2 plus middistal seta plus one posterior seta. Article 2 of pereopod 5 scarcely narrower than in female but entire appendage larger relative to size of pereopod 3 than in female. Epimera enlarged, epimeron 2 with 6 facial setae, epimeron 3 with 3 posterior setules above corner setule. Uropod 3 masculine, inner ramus almost extending to apex of article 1 on outer ramus, setose medially and laterally, article 1 of outer

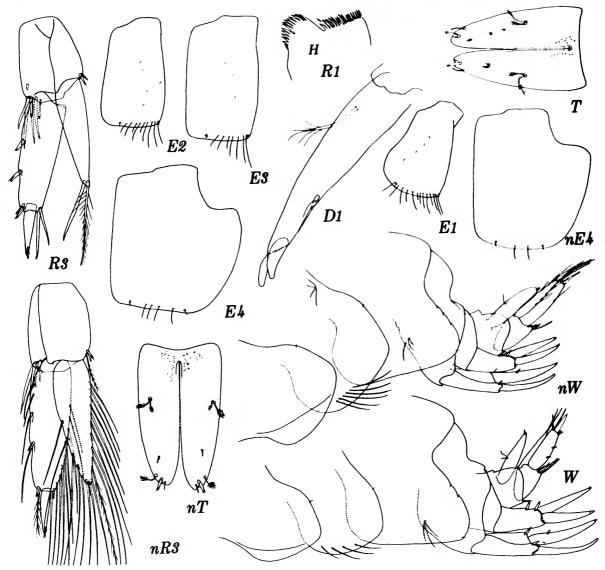


FIGURE 236.—Metaphoxus mintus, new species, holotype, female "a," 4.95 mm (n = male "n," 4.70 mm).

ramus with 2 lateral acclivities but spine formula = 0-0-1-1-2 and setal formula = 1-1-1-1-1. Telson even longer than in female, each apex with additional apical setule medial to main spine, latter shortened, basodorsal denticles more numerous than in female.

OBSERVATIONS.—Male "f," 4.48 mm: Flagellar formula on antenna 2 = 27, $1, 2, 4, 6 \dots 26$. Long setae on coxae 1-4 = 12-9-8-2. Epimeron 2 with 5

setae. Article 1 on outer ramus of uropod 3 with 3 acclivities, spine formula = 0-1-1-2, setal formula = 1-1-1-1.

DESCRIPTION OF JUVENILE.—Juvenile "g," 3.00 mm: Eyes of medium size. Article 2 of antenna 1 with 2 ventrodistal setae; primary flagellum with 5 articles; accessory flagellum with 3 articles. Spine formula on article 4 of antenna 2 = 3-3-2, on article 5 = 2-0; flagellum with 4 articles. Long setae

on coxae 1, 2, and 4 = 8-6-0. Epimeron 2 with 3 facial setae. Peduncle of uropod 2 with one dorsal spine, upper half of apical comb enlarged, elements longer and thicker than in ordinary adults (but see female "w"). Article 1 on outer ramus of uropod 3 with one lateral acclivity, spine formula = 1-2, setal formula = 0-0, apex of inner ramus with one setal spine.

Juvenile "h," 3.10 mm: Accessory flagellum of antenna 1 3-articulate; primary flagellum 5-articulate. Spine formula on article 4 of antenna 2 = 3-3-3, on article 5 = 3-0. Right lacinia mobilis with distal flabellate branch bearing 6 teeth divided into 2 groups of 3 each separated by sinus. Apex of palp on maxilla 1 with 3 distal setae and one apicolateral seta. Long setae on coxae 1-4 = 11-6-5-1. Epimeron 2 with 5 setae. Upper half of comb on peduncle of uropod 2 enlarged. Inner ramus of uropod 3 with one apical spine-seta, outer ramus with one lateral acclivity, spine formula = 1-2, setal formula = 0-0.

ILLUSTRATIONS.—Outer ramus on female uropod 3 disarticulate in drawing.

HOLOTYPE.—AM, female "a," 4.95 mm.

TYPE-LOCALITY.—SBS C1S5, 17 May 1972, off Malabar, New South Wales, Australia, 29 m, shelly gravel, high organic content.

VOUCHER MATERIAL.—Type-locality: female "b," 4.82 mm; female "w," 4.51 mm (illus.); male "n," 4.70 mm (illus.); male "f," 4.48 mm; juvenile "g," 3.00 mm. SBS A2S5: juvenile "h," 3.10 mm.

RELATIONSHIP.—The slightly shortened and curved outer ramus of uropod 1 suggests relationship to Metaphoxus tuckatuck.

The strongest clue to the distinction of M. mintus is the blunt apices on the rami of uropods 1-2 but the following characters of M. mintus also appear to confirm its identity: inner ramus of uropod 1 with dorsal spine; presence of 2 long and thick apical setae on inner ramus of uropod 3; stronger spinosity and setosity of epimeron 2 and article 4 of antenna 2; stronger distal armament on the inner plate of the maxilliped; presence of lateral spines and setae on article 1 of the outer ramus on uropod 3; posteriorly truncate coxa 5; stouter and distinctly shaped articles 4-5 of pereopod 5; and shapes of right lacinia mobilis in both sexes.

MATERIAL.—SBS, 7 samples from 5 stations (16, including 2 dubious).

DISTRIBUTION.—New South Wales, off Malabar,

29-48 m, shelly gravel and medium fine sand.

Metaphoxus frequens J. L. Barnard

Metaphoxus frequens J. L. Barnard, 1960:304-306, pls. 51, 52; 1964c:242; 1966a:88; 1966b:28; 1969b:196; 1971:68.

Distribution.—Oregon to Isla Isabel, Mexico, 13-458 m.

Metaphoxus fultoni (Scott)

Phoxocephalus Fultoni Scott, 1890:327-328; pl. 12: figs. 10-12, pl. 13: figs. 13-19; 1906:148.—Chevreux, 1898:477.—Norman, 1900:336.

Phoxocephalus chelatus Della Valle, 1893:742-743, pl. 5: fig. 10, pl. 35: figs. 29-35.

Phoxocephalus fultoni.—Robertson, 1892:207-208.—Walker, 1895:296.—Calman, 1896:743-748, pl. 31: figs. 1-2.—Scott, 1907:178.—Patience, 1909:118-125, pls. 3, 4 [part].

Metaphoxus Fultoni.—Walker, 1901:299.—Norman and Brady 1909:306.—Chevreux, 1911:189, pl. 9: figs. 17, 18.—Chevreux and Fage, 1925:106-107, figs. 96, 100.—Fage, 1933:203-207.—Candeias, 1934:2.

Metaphoxus fultoni.—Stebbing, 1906:139.—Tattersall, 1913: 6-7.—Stephensen, 1929:84, fig. 21:99.—Plymouth Marine Fauna 1931:189.—Moore, 1937:119.—J. L. Barnard, 1960: 304; 1964a:103, fig. 18; 1964c:242-243; 1966b:28; 1969b:196.—Hamond, 1967:119.—Ledoyer, 1968:191.—G. S. Karaman, 1973:79-84, figs. 18-20.

DISTRIBUTION.—Eastern Atlantic and Mediterranean from Adriatic Sea westward and northward to British Isles; eastern Pacific Ocean from Monterey Bay south to Isla Isabel, Mexico, 0-458 m.

Metaphoxus pectinatus (Walker)

Phoxus simplex Bate, 1857:525 [fide Norman, 1900, not Walker, 1896b]; 1862:97-98, pl. 16: fig. 1.—Bate and Westwood, 1863:140-142, fig. [unnumbered].—Boeck, 1871:135.—Robertson, 1888:27-28.

Phoxus Kroyerii Bate, 1857:140 [= homonym, not Stimpson, 1853].

Phoxocephalus simplex.—Calman, 1896:748-751, pl. 32: fig. 3.
—Norman, 1900:335-336.

Phoxocephalus pectinatus Walker, 1896a:343-344, pl. 16: figs. 1-6; 1896b:156-157.

Metaphoxus typicus Bonnier, 1896:630-633, pl. 37: fig. 1.—Chevreux, 1927:72.

Metaphoxus fultoni.—Patience, 1909:125-130, pls. 3, 4: fig. 1 [in part, not Scott, 1890].

Metaphoxus pectinatus.—Chevreux, 1898:477; 1900:33-34.— Walker, 1901:299-300, pl. 27: fig. 22.—Stebbing, 1906:139-140.—Chevreux, 1911:187-188, pl. 9: figs. 19-20; 1925:295; 1935:73.—Tattersall, 1913:7.—Chevreux and Fage, 1925: 105-106, figs. 98, 99.—Plymouth Marine Fauna, 1931:189.—Fage, 1933:203-207, fig. 10.—Ruffo, 1938:130; 1947:84.—Soika, 1949:197.—J. L. Barnard, 1960:307-308.—Bellan-Santini, 1965:4.—Ledoyer, 1968:191; 1970:15.—G. S. Karaman, 1973:84-91, figs. 21-24.

DISTRIBUTION.—Eastern Atlantic Ocean and Mediterranean Sea, from the Adriatic Sea westward and northward to the British Isles, meropelagic and benthic to 80 m.

Metaphoxus tulearensis, new species

Metaphoxus fultoni.-Ledoyer, 1967:28, pl. 7 [not Scott].

DIAGNOSIS.—Like Metaphoxus fultoni (Scott) but pereopods 1-2 with pair of stout locking spines at base of dactyl; gnathopod 1 parachelate.

HOLOTYPE.—Female, 4 mm, in plate 7 of Ledoyer, 1967.

Type-Locality.—Station 106, Madagascar. Distribution.—Madagascar.

Metaphoxoides Ledoyer

Metaphoxoides Ledoyer, 1970:29-30.

Diagnosis.—Eyes present. [Flagella of antennae 1-2 unreduced in female in M. zavorus, unknown in type.] Article 2 of antenna 1 shortened to ordinary, ventral setae confined apically. [?Article 1 of antenna 2 not ensiform; article 3 with 4 setae in M. zavorus, unknown in type;] facial spines on article 4 in 2 rows; article 5 ordinary (in type) to especially thin; right mandibular [incisor unknown]; molar not triturative [possibly absent]; palpar hump large. Palp of maxilla 1 uniarticulate; inner plate naked (type) or with 3 setae. Setation of maxilla 2 weak. Inner plate of maxillipeds ordinary; apex of palp article 3 not protuberant, dactyl elongate, apical nail distinct, elongate. Gnathopods dissimilar, enlarged; article 5 of gnathopod 2 very short, cryptic, ordinary on gnathopod 1, without eusirid attachment, palms transverse to oblique respectively, hands of gnathopods broadened, poorly setose anteriorly. [Article 5 of pereopods 1-2 unknown.] Article 2 of pereopod 3 of broad form, articles 4-5 of pereopods 3-4 broad to narrow, article 2 of pereopods 3-4 not setose posteriorly; pereopod 5 ordinary, article 2 naked ventrally, article 3 ordinary, dactyl normal. [?Epimera 1-2 lacking long posterior setae, without midfacial setae above ventral facial ridge]; epimeron 3 ordinary, of rounded classification and lacking long setae. [?Urosomite 1 generally naked; urosomite 3 without dorsal hook or special process.] Peduncle of uropod 1 normally elongate, without apicoventral spike, without special enlarged apicolateral-medial spine, [?peduncular apices of uropods 1-2 not combed], inner ramus of uropod 1 lacking marginal spines, no rami continuously spinose to apex, inner ramus of uropod 2 ordinary. Uropod 3 ordinary, outer ramus with or without second article bearing 2-4 long apical setae. Telson ordinary, with 1-4 apical spines or setae on each lobe.

DESCRIPTION.—Rostrum fully developed. [Fuzz on article 1 of antenna 1 in male unknown. Calceoli on male antennae 1-2 unknown. ?Prebuccal parts ordinary, poorly separated from each other, upper lip dominant. Right lacinia mobilis flabellate;] mandibular palp medium to thin, article I short to slightly elongate, article 2 without outer setae, apex of article 3 oblique or rounded (type). [?Lower lip lacking cones.] Outer plate of maxilla 1 with 7 spines, no spine especially thickened. Inner plates of maxilliped especially thin, poorly armed. [?Coxae 2-4 without special anterodorsal humps. ?Some posterior spines on article 6 of pereopods 1-2 thin and seta-like, others thick and stiff, ?midapical spine or seta present.] Article 2 of pereopod 5 without facial setae. Peduncle of uropod 1 with dorsolateral spines confined apically, medial spines confined apically; [?peduncle of uropod 2 with only one medial spine or setule confined apically]. Peduncle of uropod 3 lacking extra subapical setae or spines. [?Telson with ordinary pair of midlateral or dorsal setules on each side, ?reduced to one member on each side.]

Type-Species.—Metaphoxoides picardi Ledoyer, 1970 (monotypy).

Composition.—Metaphoxus zavorus, new species (= Metaphoxus sp., Griffiths, 1973).

RELATIONSHIP.—The vestigiality of article 2 on the outer ramus of uropod 3 is the primary systematic character of this genus.

Metaphoxoides zavorus is placed provisionally in this genus until more facts can be ascertained about the species. It was based on one broken specimen. The vestigial article 2 of the outer ramus on uropod 3 is a clue to its relationship, and there are numerous other similarities between M. zavorus

and M. picardi. However, M. zavorus differs in these potentially crucial characters: poorly developed nail on dactyl of maxilliped in contrast to a well developed nail with large accessory nails on M. picardi; much better developed plates of the maxilliped; inner plate of maxilla 1 enlarged and

setose; palps of maxilla 1 and mandible enlarged. These characters suggest a definite generic distinction we wish not to implement until more material of *M. zavorus* becomes available. Pereopod 5 of *M. zavorus* is depicted strangely, as if it lacks articles 3 and 6 or has a reduced article 6 with tiny dactyl.

Key to the Species of Metaphoxoides

(Provisional)

Metaphoxoides picardi Ledoyer

Metaphoxoides picardi Ledoyer, 1970:29-31, pl. 8.

DISTRIBUTION.—Madagascar.

Metaphoxoides zavorus, new species

Metaphoxus sp.-Griffiths, 1973:296, fig. 10.

DIAGNOSIS.—Metaphoxoides with 4 apical spinesetae on each lobe of telson; gnathopod 1 poorly eusirid, palm weakly oblique; palp of mandible thick, apex of article 3 obliquely excavate, bearing basofacial setae; inner plate of maxilla 1 large (in context), bearing 3 setae, palp highly enlarged; plates of maxilliped well developed.

HOLOTYPE.—Male, 10 mm, as shown in figure 10 of Griffiths, 1973.

Type-Locality.—PED 18 V, southwest of Ponta Zavora, Moçambique, 19 Aug 1964, 25°07'S, 34°34'E, 112 m, dark sandy mud.

REMARKS.—This species is placed provisionally in this genus; it differs from the type-species, *M. picardi*, in the contrast of characters in the diagnosis and eventually should be relegated to a genus of its own. The species is named for a point of land near its type-locality.

DISTRIBUTION.—Southern Africa, 112 m.

Diogodias, new genus

DIAGNOSIS.—Eyes present. Flagella of antennae 1-2 unreduced in female. Article 2 of antenna 1

shortened, ventral setae confined apically. Article 1 of antenna 2 not ensiform; article 3 with 2 setules; facial spines on article 4 in 2 or more rows; article 5 ordinary in size. [?Right mandibular incisor with 3 teeth]; molar absent; palpar hump medium. Palp of maxilla 1 uniarticulate; inner plate naked. [?Setation of maxilla 2 weak.] Inner plates of maxillipeds partly fused together; apex of palp article 3 not protuberant, dactyl elongate, apical nail distinct, elongate. Gnathopods dissimilar, gnathopod 2 moderately to strongly enlarged; article 5 of gnathopod 2 either very short, cryptic, or elongate, of gnathopod I elongate and free, with weak to strong eusirid attachment; palms weakly oblique or transverse, hands of gnathopods 1-2 weakly elongate or broadened, poorly setose anteriorly. Article 5 of pereopods 1-2 setose posteroproximally. Article 2 of pereopod 3 of broad form, articles 4-5 of pereopods 3-4 medium to narrow respectively, article 2 of pereopods 3-4 not setose posteriorly; pereopod 5 ordinary, article 2 naked ventrally, article 3 ordinary, dactyl normal. Epimera 1-2 lacking long posterior setae, without midfacial setae above ventral facial ridge; epimeron 3 of rounded classification and lacking long setae. Urosomite 1 generally naked; urosomite 3 without dorsal hook or special process. Peduncle of uropod 1 normally elongate, without apicoventral spike, without special enlarged apicolateral-medial spine, [?peduncular apices of uropods 1-2 not combed]; inner ramus of uropod I naked or with one spine, no ramus continuously spinose to apex, inner ramus of uropod 2 ordinary. Uropod 3 ordinary, elongate article 2 of outer ramus carrying 1-2 short

apical setae. Telson ordinary to elongate, with 1-2 apical spines or setae on each lobe plus setules [?with special lateral setae].

DESCRIPTION.—Rostrum fully developed, elongate. [Fuzz on article 1 of antenna 1 in male unknown. Calceoli on male antennae 1-2 unknown. Prebuccal parts ordinary, poorly separated from each other, upper lip dominant. Right lacinia mobilis unknown;] mandibular palp medium, article 1 short, article 2 without outer setae, apex of article 3 oblique. [Lower lip bearing or lacking cones.] Outer plate of maxilla 1 with 6 spines, no spine especially thickened. Inner plates of maxilliped especially thin, poorly armed. Coxae 2-4 with weak anterodorsal humps. Some posterior spines on article 6 of pereopods 1-2 thin and seta-like, others thick and stiff, midapical spine present. Article 2 of pereopod 5 without facial setae. Peduncle of

uropod 1 with dorsolateral spines confined apically, medial spines widely spread; peduncle of uropod 2 with only one medial spine confined apically. Peduncle of uropod 3 lacking extra subapical setae or spines. [?Telson with midlateral setules reduced to one member on each side.]

Type-Species.—Metaphoxus longicarpus Ledoyer, 1973 [here selected].

Composition.—Metaphoxus littoralis Cooper and Fincham, 1974; Metaphoxus platyrostris Ledoyer, 1973.

RELATIONSHIP.—The elongate wrist of gnathopod 1 differentiates this genus from *Metaphoxus*. The rostrum is very elongate. The palpar hump of the mandible is enlarged in the type and the flagella of antenna 1 are elongate. This genus is named for Diogo Dias, discoverer of Madagascar. Masculine.

Key to the Species of Diogodias

1.	Apex of rostrum spatulate
	Apex of rostrum tapering evenly
2.	Wrist of gnathopod 2 elongate
	Wrist of gnathopod 2 short, cryptic

Diogodias littoralis (Cooper and Fincham), new combination

Metaphoxus littoralis Cooper and Fincham, 1974:165-168, figs. 5, 6.

DISTRIBUTION.—New Zealand.

Diogodias longicarpus (Ledoyer), new combination

Metaphoxus longicarpus Ledoyer, 1973:86, pls. 27, 28A.

DISTRIBUTION.—Madagascar.

Diogodias platyrostris (Ledoyer), new combination

Metaphoxus platyrostris Ledoyer, 1973:86, pls. 29, 30.

DISTRIBUTION.—Madagascar.

Vasco, new genus

Diagnosis.—Eyes present but weak. Flagella of antennae 1-2 unreduced in female. Article 2 of antenna 1 shortened, ventral setae confined

apically. Article 1 of antenna 2 not ensiform; [?article 3 with 2 setules]; facial spines on article 4 in 2 rows; article 5 ordinary in size. Right mandibular incisor with 3 teeth; molar not triturative, small, pillow-shaped [possibly lacking spines], not bearing fuzz; palpar hump medium. Palp of maxilla 1 uniarticulate; [?inner plate naked. Setation of maxilla 2 weak. Inner plate of maxillipeds ordinary, apex of palp article 3 not protuberant, dactyl elongate, apical nail distinct, elongate.] Gnathopods weakly dissimilar, gnathopod 2 moderately enlarged, article 5 of gnathopods 1-2 very short, cryptic, with eusirid attachment; palms oblique, hands of gnathopods 1-2 rectangular, elongate to broadened, poorly setose anteriorly. Article 5 of pereopods 1-2 scarcely setose posteroproximally. Article 2 of pereopod 3 of broad form, articles 4-5 of pereopods 3-4 narrow to medium, article 2 of pereopods 3-4 not setose posteriorly; pereopod 5 ordinary, article 2 naked ventrally, article 3 ordinary, dactyl normal. [?Epimera 1-2 lacking long posterior setae, without midfacial setae above ventral facial ridge; epimeron 3 of rounded

classification and lacking long setae. Urosomite 1 generally naked; urosomite 3 without dorsal hook or special process.] Peduncle of uropod 1 normally elongate, without apicoventral spike, without special enlarged apicolateral-medial spine, [?peduncular apices of uropods 1-2 not combed]; inner ramus of uropod 1 naked, no rami continuously spinose to apex, inner ramus of uropod 2 ordinary. Uropod 3 ordinary, elongate article 2 of outer ramus carrying 2 short apical setae. Telson elongate, with only one apical spine on each lobe plus setules.

DESCRIPTION.—Rostrum fully developed. [Fuzz on article l of antenna l in male unknown. Calceoli on male antennae 1-2 unknown. ?Prebuccal parts ordinary, poorly separated from each other, upper lip dominant.] Right lacinia mobilis simple, flabellate; mandibular palp thick, article 1 short (assumed), article 2 without outer setae, apex of article 3 rounded-transverse. [?Lower lip lacking cones. Outer plate of maxilla 1 with 7 spines, no spine especially thickened. Inner plates of maxilliped especially thin, poorly armed.] Coxae 2-4 without special anterodorsal humps. Some posterior spines on article 6 of pereopods 1-2 thin and setalike, others thick and stiff, midapical seta present, dactyls stunted. Article 2 of pereopod 5 without facial setae. Peduncle of uropod 1 with dorsolateral spines confined apically, medial spines confined apically; peduncle of uropod 2 with medial spines or setae widely spread. Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with ordinary pair of midlateral or dorsal setules on each side.

Type-Species.—Metaphoxus brevidactylus Ledoyer, 1973 (here selected).

Composition.—Unique.

REMARKS.—The stunted dactyls of pereopods 1-2 remove this species from *Metaphoxus*. The diagnosis and description do not note that article 5 of antenna 2 is especially shortened and thin but this is in relationship to nonmetaphoxin genera because article 4 is so small in this genus that article 5 appears larger than in other metaphoxin genera. This genus is named in honor of Vasco da Gama.

Vasco brevidactylus (Ledoyer), new combination

Metaphoxus brevidactylus Ledoyer, 1973:84-86, pl. 26.

DISTRIBUTION.—Madagascar.

Hopiphoxus, new genus

Diagnosis.—Eyes absent. Flagellum of antenna 2 reduced in female. Article 2 of antenna 1 shortened, ventral setae confined apically. Article 1 of antenna 2 not ensiform; article 2 with 2 setules: facial spines on article 4 in one main row; article 5 short. Right mandibular incisor with 3 teeth; molar not triturative, medium, pillow-shaped, bearing 2 splayed, semiarticulate spines, bearing fuzz; palpar hump small. Palp of maxilla 1 uniarticulate; inner plate naked. Setation of maxilla 2 weak. Inner plate of maxillipeds ordinary, apex of palp article 3 not protuberant, dactyl elongate, apical nail distinct, short. Gnathopods dissimilar, gnathopod 2 strongly enlarged; article 5 of gnathopods 1-2 very short, cryptic; gnathopods 1-2 with weak eusirid attachments; palms oblique, hands of gnathopods 1-2 broadened, poorly setose anteriorly. Article 5 of pereopods 1-2 setose posteroproximally. Article 2 of pereopod 3 of broad form, articles 4-5 of pereopods 3-4 narrow, article 2 of pereopods 3-4 not setose posteriorly; pereopod 5 ordinary, article 2 naked ventrally, article 3 ordinary, dactyl normal. Epimera 1-2 lacking long posterior setae, without midfacial setae above ventral facial ridge; epimeron 3 of rounded classification and lacking long setae. Urosomite I generally naked; urosomite 3 without dorsal hook or special process. Peduncle of uropod 1 normally elongate, without apicoventral spike, without special enlarged apicolateral-medial spine, [?peduncular apices of uropods 1-2 not combed]; inner ramus of uropod 1 with one row of marginal setae, outer ramus shortened, some rami continuously setose to apex, inner ramus of uropod 2 ordinary. Uropod 3 ordinary, elongate article 2 of outer ramus carrying 2 short to vestigial apical setae. Telson elongate, with only one apical spine on each lobe.

DESCRIPTION.—Rostrum fully developed. [Fuzz on article 1 of antenna 1 in male unknown. Calceoli on male antennae 1-2 unknown. ?Prebuccal parts ordinary, poorly separated from each other, upper lip dominant. ?Right lacinia mobilis bifid, flabellate;] mandibular palp medium, article 1 short, article 2 without outer setae, apex of article 3 oblique. Lower lip lacking cones. Outer plate of maxilla 1 with 7 spines, no spine especially thickened. Inner plates of maxilliped especially thin, poorly armed. Coxae 2-4 without special antero-

dorsal humps. All posterior spines on article 6 of pereopods 1-2 thin and seta-like, [?midapical spine or seta present]. Article 2 of pereopod 5 without facial setae. Peduncle of uropod 1 with dorsolateral spines confined apically, medial spines weakly spread; peduncle of uropod 2 with medial setae weakly spread. Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with ordinary pair of midlateral or dorsal setules on each side.

Type-Species.—Metaphoxus simillimus J. L. Barnard, 1967 (here selected).

Composition.—Unique.

RELATIONSHIP.—Among metaphoxin genera this genus is unique in the apically setose rami of uropods 1-2, barring the outer ramus of uropod 1. This genus is named in honor of the Hopi Indians of North America.

Hopiphoxus simillimus (J. L. Barnard), new combination

Metaphoxus simillimus J. L. Barnard, 1967:135-138, fig. 66.

Distribution.—Baja California, Cedros Trench, 2706 m.

Rikkarus, new genus

DIAGNOSIS OF MALE.—Eyes present. [?Flagella of antennae 1-2 unreduced in female.] Article 2 of antenna 1 shortened, ventral setae confined apically. Article 1 of antenna 2 not ensiform; article 3 with 2 setules; facial spines on article 4 in 2 rows; article 5 thin and short. Right mandibular incisor with 3 teeth; molar not triturative, medium, pillowshaped, bearing 1-9 small semiarticulate spines and enlarged penicillate spine, bearing fuzz; palpar hump medium. Palp of maxilla 1 uniarticulate; inner plate naked. Setation of maxilla 2 weak. Inner plate of maxillipeds ordinary; apex of palp article 3 not protuberant, dactyl elongate, apical nail distinct, medium. Gnathopods of medium size; article 5 of gnathopods 1-2 similar, very short, cryptic, with eusirid attachment; palms oblique, hands of gnathopods 1-2 ovatorectangular, elongate, poorly setose anteriorly, article 5 of pereopods 1-2 weakly setose posteroproximally. Article 2 of pereopod 3 of broad form, articles 4-5 of pereopods 3-4 narrow, article 2 of pereopods 3-4 not setose posteriorly; pereopod 5 ordinary, article 2 naked ventrally, article 3 ordinary, dactyl normal. Epimera 1-2 lacking long posterior setae, without midfacial setae above ventral facial ridge; epimeron 3 of rounded classification and bearing 3 or fewer long setae but heavily serrate. Urosomite 1 bearing one of more midventral bundles of setae; urosomite 3 without dorsal hook or special process. Peduncle of uropod 1 somewhat shortened, without apicoventral spike, without special enlarged apicolateralmedial spine, peduncular apices of uropods 1-2 combed; inner ramus of uropod I with no marginal spines, no rami continuously spinose to apex, inner ramus of uropod 2 ordinary. Uropod 3 ordinary, elongate article 2 of outer ramus carrying 2 short to vestigial apical setae. Telson elongate, with only one apical spine on each lobe plus setules, without special dorsal and lateral spines or setae.

DESCRIPTION.—Rostium fully developed; [Fuzz on article 1 of antenna 1 in male unknown.] Calceoli on male primary flagellum of antenna 1 absent, aesthetascs large and multiple on articles. Calceoli on article 5 of male antenna 2 present; [?flagellum in male without calceoli]. Prebuccal parts ordinary, poorly separated from each other, upper lip dominant. Right lacinia mobilis bifid, flabellate; mandibular palp medium, article 1 short, article 2 without outer setae, apex of article 3 roundedtransverse. Lower lip bearing cones. Outer plate of maxilla 1 with 7 spines, no spine especially thickened. Inner plates of maxilliped especially thin, poorly armed. Coxae 2-4 without special anterodorsal humps. All posterior spines on article 6 of pereopods 1-2 thin and seta-like, midapical spine present. Article 2 of pereopod 5 without facial setae. Peduncle of uropod 1 with dorsolateral spines confined apically, medial spines widely spread; peduncle of uropod 2 with only one medial spine confined apically, Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with ordinary pair of middorsal setules on each side highly medial.

Type-Species.—Rikkarus lea, new species. Composition.—Unique.

RELATIONSHIP.—This genus belongs with the Metaphoxus group of genera because of the uniarticulate maxillary palp and poorly setose maxilla 2. Rikkarus appears close to Metaphoxus Bonnier, but differs in the grossly serrate epimeron 3 and in the unexpanded hand of gnathopod 2

with highly oblique palm, gnathopod 1 duplicating the size and shape of gnathopod 2 almost precisely.

Rikkarus lea, new species

FIGURES 237-239

DESCRIPTION OF MALE (juvenile).—Head about 18 percent of total body length, greatest width about 45 percent of length; rostrum almost reaching apex of article 3 on antenna 1, unconstricted, tapering towards apex, apically rounded. Eyes small, dark, with one layer of clear peripheral ommatidia. Article 1 on peduncle of antenna 1 about 1.5 times as long as wide, twice as wide as article 2, apicoventral margin with 7 or more setules, produced dorsal apex with 3 setules, medial face lacking fuzz; article 2 about 0.3 times as long as article 1, apicoventral lateral face with 2 setae; article 3 slightly overriding article 2 on medial surface; accessory flagellum much shorter than primary flagellum, 3-articulate; primary flagellum as long as peduncle, 4-articulate, basal article elongate, all articles bearing large and numerous aesthetascs. Spine formula on article 4 of antenna 2 = 3-1, set 2 with one accessory setule, spines thin, dorsomedial margin fuzzy but elements very elongate and thick, proximoventral margin with 2-3 penicillate setules, ventral margin with 4 setae in tandem, ventral apex with short spine; article 5 about 0.77 times as long as article 4, facial spine formula = 1, with accessory setule, dorsodistal corner with 2 spinesetae, dorsal margin with one calceolus and 2 weakly developed groups of male setae, ventrodistal apex with one seta and 4 setules, ventral margin naked; flagellum weakly elongate, about 2.4 times as long as articles 4-5 of peduncle together, 10-articulate, segments with 1-3 apparent aesthetascs, no calceoli. Prebuccal complex convex anteriorly, poorly extended forward, epistome and upper lip mostly fused together, ventral margin of upper lip truncate. Palpar hump of mandible medium to large, broad; right incisor tridentate; left bidentate with humps; right lacinia mobilis flabellate, distal branch broad, serrate, face with cusp, proximal branch simple, longer than distal branch; left lacinia mobilis broadly flabellate, with 5 teeth; right rakers 2; left 3 plus one rudimentary; molar formed of weak hump bearing 2 densely spinulose or penicillate spines; left molar with reg-

ular spination and penicillate spine; palp stout, article 1 short, article 2 with 3 stout inner distal setae and one wire-like inner basal seta, article 3 about 0.95 times as long as article 2, roundedtransverse apex with 9 spine-setae. Each outer lobe of lower lip with cone, mandibular lobes long, weakly attenuate, apically rounded, inner lobes almost completely fused together (damaged during dissection). Inner plate of maxilla 1 large, linguiform, naked; outer plate with 7 spines; palp reaching apex of outer plate, 1-articulate, bearing 3 apical setae and apicomedial notch. Inner plate of maxilla 2 shorter and broader than outer plate, bearing 3 apical setae; subconical outer plate with one medial, one lateral and 2 apical setae. Inner plate of maxilliped with one apicomedial spine, one apicolateral spine and one thinner midapical spine; outer plate with 3 short medial spines and one elongate (hidden) basomedial spine; palp article 2 sparsely spinose medially, article 3 unprotuberant, lacking facial spine, somewhat slipper-shaped and sparsely spinose medially, dactyl elongate, bearing medium apical nail and adjacent setule plus second setule in notch on inner margin. Coxae 1-3 each with posteroventral cusp and setule near sinus, coxa 1 expanded distally, with concave anterior margin, sharp anterior point above anteroventral bevel (point may be artificial); coxae 2-3 rectangular; long setal formula of coxae 1-4=4-4-1; coxa 4 quadratiform, posterodorsal excavation medium in size, L-shaped, posterodorsal corner rounded, ratio of width to length = 17:18. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 2-3-4-4, long anteriors = 1 (side)-0-0-0, short anteriors = 1-2-2-1, no others. Gnathopod 2 scarcely larger than gnathopod 1; article 5 very small and triangular; article 6 elongate, palm very oblique, defining hump small to medium defining spine large, dactyl fitting palm, posterior margin of article 6 with one seta; length ratios of articles 5-6 on gnathopods 1-2 = 31:95 and 32:97, width ratios = 20:38 and 21:41. Pereopods 1-2 similar to each other; article 4 with one apicofacial seta, article 5 with 2, largest posterior spine far exceeding apex of article 6, posterior margin of article 5 with 4 other similar but shorter spinesetae laterally, with one setule between spines 3-4, article 6 naked proximally but with highly distad set of spine-setae in formula of 2 + 2 plus one middistal spinule, lateral pair of spine-setae short, me-

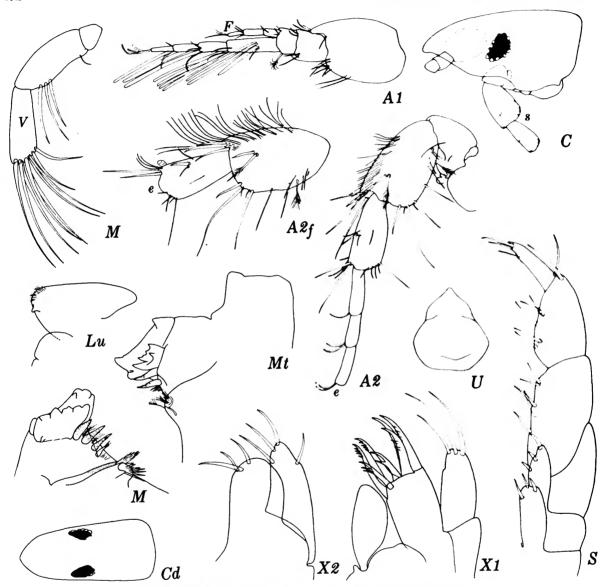


FIGURE 237.—Rikkarus lea, new species, holotype, juvenile male "a," 2.29 mm.

dial pair as long as dactyl, latter bearing apical scale but lacking any inner distal setule, notch or medial pluseta. Coxae 5–7 posteroventral setule formula = 1–1–1. Articles 4–5 of pereopods 3–4 thin, facial spines absent, formula of facial ridges on article 2 of pereopods 3–5 = 0–1–1; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 45:18:15:8, of pereopod 4 = 67:23:16:8, of pereopod 5 = 91:13:12:6, length ratios of pereopod 3 = 61:

22:28:32, of pereopod 4 = 83:50:57:48, of pereopod 5 = 110:27:21:19; article 2 of pereopod 5 especially large, extending to apex of article 4, posterior margin with 4 small setule acclivities, ventral margin with 2; apex of article 6 finely combed. Epimeron 1 with facial ridge, absent on epimeron 2, each with rounded subquadrate posteroventral corner, weakly convex posterior margins with one setule, epimeron 1 otherwise naked,

FIGURE 238.—Rikkarus lea, new species, holotype, juvenile male "a," 2.29 mm.

epimeron 2 with 3 facial setae in tandem horizontally, epimeron 3 with 6 teeth on lower half of posterior margin, upper tooth blunt, others sharp, becoming small and cusp-like ventrally, each with setule or seta in adjacent sinus, epimeron 3 otherwise naked. Urosomites naked, unproduced dorsally. Peduncle of uropod 1 naked basofacially, lateral apex, medial apex and medial margin with one spine, rami of uropods 1-2 naked dorsally,

apices of inner ramus on uropod 1 and both rami of uropod 2 with sharp, attenuate scale and barest indication of completely submerged and fused nail, outer ramus of uropod 1 slightly shortened and thinner than inner ramus, curved, apex simple, blunt, inner rami of uropods 1–2 lacking basomedial setule, peduncle of uropod 2 with 3 dorsal spines, medially with one apical spine, lateral peduncular apices of uropods 1–2 very minutely and

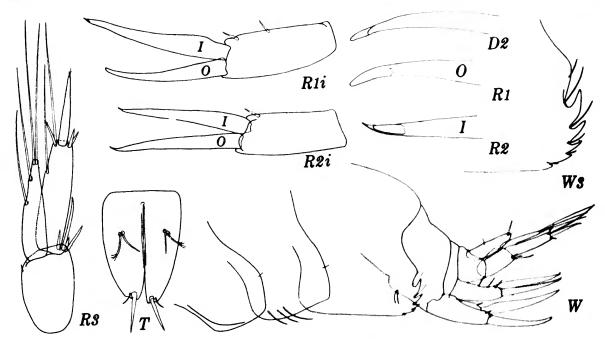


FIGURE 239.—Rikkarus lea, new species, holotype, juvenile male "a," 2.29 mm.

weakly combed. Uropod 3 scarcely elongate, peduncle with 3 ventral spines, one dorsolateral spine, one dorsomedial setule: rami submasculine, inner extending to M. 87 on article 1 of outer ramus, with 2 long apical and 2 medial setae, article 2 of outer ramus elongate, 0.57, bearing 2 apical setules, lateral margin of article 1 naked except for 2 apicolateral spines, medial margin with one long seta, medial apex with one long seta, one short spine. Telson elongate, not fully cleft, lengthwidth ratio = 18:13, apices tapering, of medium breadth to narrow, subtruncate, bearing one long spine and one apicolateral setule, dorsal pair of plusetules alike, near middle of lobe, elongate. Small bulbar setules of cuticle extremely sparse, emergent setules very short, scarcely as long as width of pore.

ILLUSTRATIONS.—Lateral view of head drawn from slightly dorsal aspect, dorsal view of head reconstructed; unique juvenile male with small penial processes.

HOLOTYPE.—AM, immature male "a," 2.29 mm. Unique.

Type-Locality.—SBS 3, 23 Jul 1973, off Malabar, New South Wales, Australia, 150°16′ E, 33°58′42″ S, 66 m.

MATERIAL.—AM, one sample (1).
DISTRIBUTION.—New South Wales, off Malabar, 66 m.

Japara, new genus

Diagnosis.—Eyes present. Flagella of antennae 1-2 reduced in female. Article 2 of antenna 1 ordinary, ventral setae confined apically. Article 1 of antenna 2 not ensiform; article 3 with 2 setules; facial spines on article 4 in 2 rows; article 5 especially short. Right mandibular incisor with 3 teeth; molar not triturative, medium, elongate, conical, bearing 4 or more splayed, semiarticulate spines, bearing fuzz; palpar hump small. Palp of maxilla 1 uniarticulate; inner plate naked. Setation of maxilla 2 weak. Inner plate of maxillipeds partly fused together, apex of palp article 3 not protuberant, dactyl elongate, apical nail distinct, medium. Gnathopods dissimilar, gnathopod 2 strongly enlarged; article 5 of gnathopod 2 very short, cryptic, elongate on gnathopod 1, with eusirid attachment, palms oblique to transverse to chelate, hands of gnathopods 1-2 rectangular, broadened, poorly setose anteriorly. Article 5 of pereopods 1-2 setose posteroproximally. Article 2 of pereopod 3 of broad form, articles 4-5 of pereopods 3-4 narrow to medium, article 2 of pereopods 3-4 not setose posteriorly; pereopod 5 ordinary, article 2 naked ventrally, article 3 ordinary, dactyl normal. Epimera 1-2 lacking long posterior setae, without midfacial setae above ventral facial ridge; epimeron 3 of rounded classification and lacking long setae. Urosomite 1 generally naked; urosomite 3 without dorsal hook or special process. Peduncle of uropod l normally elongate, without apicoventral spike, without special enlarged apicolateral-medial spine, peduncular apices of uropods 1-2 combed, inner ramus of uropod 1 with marginal spines in one row, no rami continuously spinose to apex, inner ramus of uropod 2 ordinary. Uropod 3 small to minute, lacking article 2 of outer ramus, rami minute, shorter than peduncle, extending equally, in female each carrying 1-2 vestigial apical setae. Telson ordinary, with 1-2 apical spines or setae on each lobe plus setules.

DESCRIPTION.—Rostrum small to obsolescent. Fuzz on article 1 of antenna 1 in male present; calceoli on male primary flagellum of antenna l present. Calceoli on article 5 of male antenna 2 present; flagellum in male with calceoli. Prebuccal parts strongly extended forward, massive, distinct, both epistome and upper lip prominent. Right lacinia mobilis bifid, flabellate; mandibular palp thin, article I elongate, article 2 without outer setae, apex of article 3 oblique. Lower lip lacking cones. Outer plate of maxilla 1 with 7 spines, no spine especially thickened, one attached medially and pointing medially. Inner plates of maxilliped poorly armed, thick. Article 3 of gnathopod 1 elongate. Coxae 2-4 without special anterodorsal humps. Some posterior spines on article 6 of pereopods 1-2 thin and seta-like, others thick and stiff, midapical spine or seta absent. Article 2 of pereopod 5 without facial setae. Peduncle of uropod 1 with dorsolateral spines confined apically, medial spines widely spread; peduncle of uropod 2 with only one medial spine confined apically. Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with pair of midlateral or dorsal setules on each side, highly apical.

Type-Species.—Japara papporus, new species (here designated).

Composition.—Unique.

RELATIONSHIP.—The type-species of this genus has general resemblance to Metaphoxus fultoni

(Scott) because of the shape of gnathopod 1; the genus appears close to Metaphoxus because of the uniarticulate palp of maxilla 1, the nontriturative molar, broad article 2 of pereopod 3, unproduced article 3 of the maxillipedal palp and the general appearance of the head, body, coxae, and pereopods. Japara differs from Metaphoxus in the miniaturized rami of uropod 3 and the short, broad inner plates of the maxillipeds. In terms of general knowledge about Phoxocephalidae we suggest that the condition of the maxillipeds represents a primitive state and the condition of the third uropods an advanced state in relation to Metaphoxus. The second maxilla of Metaphoxus, Leptophoxus Sars, and labara also shares similarities in the numerical reduction of setae.

Japara differs from Kondoleus in the absence of spouts on the maxillipeds, the more elongate dactyl of the maxillipeds, the normally subchelate gnathopod 2, the thin pereopod 4, the much shorter rami of uropod 3 and the absence of long distal setae on uropods 1-2.

Japara papporus, new species

FIGURES 240-242

DESCRIPTION OF FEMALE.—Head about 16 percent of total body length, greatest width about 75 percent of length; rostrum obsolete, broad, scarcely reaching along article 1 on antenna 1. Eyes small, largely occluded with pigment, ommatidia especially large. Article 1 on peduncle of antenna 1 about 1.33 times as long as wide, about 1.5 times as wide as article 2, ventral margin with 2 setules, ventral apex with 2 long setules, strongly produced dorsal apex with 2 setules; article 2 about 0.75 times as long as article 1, with apicoventral cycle of 4 setae; primary flagellum with 4 articles, about as long as article 2 of peduncle, bearing large aesthetascs; accessory flagellum with 3 articles. Spine formula on article 4 of antenna 2 = 1-2-1, dorsal margin naked, ventral margin with 3 ventrodistal medium to short spines and 4 basofacial setules; article 5 about 0.60 times as long as article 4, facial spine formula = 1, dorsal apex bearing 2 large spines, ventral margin with 2 sets of setules, 4 ventrodistal short to medium spines and setae; flagellum not half as long as articles 4-5 of peduncle combined, with 4-6 articles. Mandibles with weak

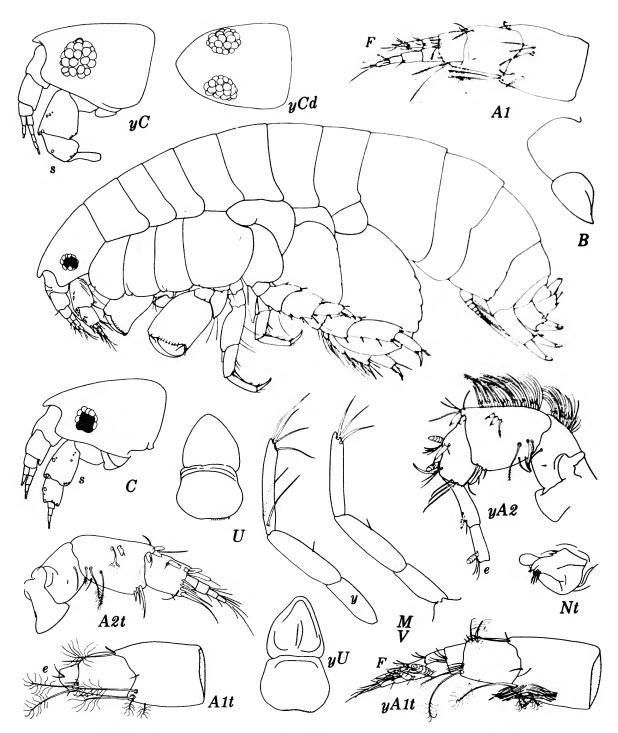


FIGURE 240.—Japara papporus, new species, holotype, female "a," 2.52 mm (y = male "y," 2.64 mm).

palpar hump; right incisor with 3 teeth; left incisor with 5 humps in 2 branches; right lacinia mobilis broadly flabellate, subbifid, denticulate, with one facial hump; left lacinia mobilis with 6 teeth; right rakers 2; left rakers 4; molar in form of bulbous cone, with minute cusps, large spine, setules, plusetule and fuzz; palp article 1 elongate, article 2 with one short inner seta in middle, article 3 as long as article 2, oblique apex with 3 spine-setae, basofacial formula = 0. Inner plate of maxilla 1 ordinary, conical, naked, palp uniarticulate, with 2 apical and one lateral setae. Plates of maxilla 2 extending subequally, of subequal width, setae reduced, outer with one apicolateral seta, inner with 2 medial setae. Inner plate of maxilliped with one large, thick apical spine, 2 apicofacial setae, no medial setae; outer plate with 4 medial spines, no apicolateral setae; palp articles 1-3 lacking apicolateral setae, medial margin of article 2 weakly setose, article 3 unprotuberant, with one facial seta, nail of article 4 medium, with 2 accessory setules. Coxa l scarcely expanded distally, anterior margin weakly convex; main ventral setae of coxae 1-4 = 0-0-0-0; anterior and posterior margins of coxa 4 almost parallel, posterior margin convex, posterodorsal corner sharp-rounded, posterodorsal margin short, concave, width-length ratio of $\cos 4 = 6:7$. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = (1-2)-2-2-4, short anteriors not counted, short posteriors = (1-2)-2-2-2. Gnathopods enlarged; article 3 of gnathopod 1 elongate, wrist-hand attachment eusirid, hand rectangular, article 3 of gnathopod 2 short, hand almost rectangular, slightly larger than hand of gnathopod 1; with ratios of articles 3-6 on gnathopods 1-2 =14:16:25:47 and 23:22:20:61, length ratios = 31:30:62:80 and 18:35:28:86; palmar humps large, palms 1 and 2 parachelate and oblique respectively; article 5 of gnathopod 1 elongate, posterior margin lobate, article 5 of gnathopod 2 short, triangular, lobate, cryptic. Pereopods 1-2 similar; weakly setose, facial setae formula on article 4 = 0 and 0, on article 5 = 0 and 0, main spine of article 5 extending to M. 70 on article 6, article 5 lacking proximoposterior spines, spine formula of article 6 = 2 and 1, spines especially short; acclivity on inner margin of dactyls of pereopods 1-2 absent, marked by slit, lacking emergent setule, midfacial pluseta ordinary, highly proximal and dorsal. Coxae 5-7 posteroventral setule formula =

1-1-1. Articles 4-5 of pereopod 3 of ordinary width, of pereopod 4 narrow, facial spine rows absent, facial ridge formula on article 2 of pereopods 3-5 = 0-1-1, pereopods 3-5 short; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 36:28:25:11, of pereopod 4 = 60:20:15:9, of pereopod 5 =90:20:19:9, length ratios of pereopod 3 = 55: 26:32:23, of pereopod 4 = 80:28:40:25, of pereopod 5 = 112:20:22:20; article 2 of pereopod 5 reaching apex of article 4; medial apex of article 6 finely combed, lacking digital processes. Posteroventral corners of epimera 1-2 rounded, posterior margins convex, posteroventral setae absent, corner of epimeron 3 weakly protuberant, with setule sinus, posterior margin straight, with one setule notch, ventral margin naked, epimera 1-3 with setule on posterodorsal margin set in weak notch, epimeron 3 with total of 3 posterior setules. Urosomite 1 tall, naked, articulation line complete; urosomite 3 weakly protuberant dorsally. Rami of uropods 1-2 with articulate, enlarged apical nails, inner ramus of uropod 1 with one dorsal spine, other rami naked; peduncle of uropod l with one apicolateral spine and no basofacial setae, medially with 2 marginal spines, apicalmost enlarged, peduncle of uropod 2 with one dorsal spine, medially with one thin apical spine, apicolateral corners of peduncles on uropods 1-2 with weak comb. Uropod 3 reduced, peduncle with one ventral spine, dorsally with lateral spinule, one medial spine; rami scarcely half as long as peduncle, conical, extending equally, each apex with 1-2 setules, otherwise naked, article 2 of outer ramus absent. Telson ordinary, length-width ratio = 1:1, not fully cleft, each apex narrow, truncate, lateral acclivity absent, bearing 2 short setules, each subapex with 2 long, diverse plusetules, possibly representing ordinary midlateral setules. Cuticle with widely scattered pipes throughout, surface bearing fine striations in form of linear fingerprint pattern.

OBSERVATIONS (female).—Article 2 of antenna 1 overriding article 3 medially, article 3 of normal shortness. Article 2 of antenna 2 largely fused to neighboring articles. Inner plate of maxilla 1 composed of folded halves forming a cone. Inner plates of maxillipeds apically truncate but nodulose. Short posterior setae of article 2 on gnathopods 1–2 and pereopods 1–2 straw-like. Lobes of telson highly arched and forming ventral channel for apposition of uropod 3.

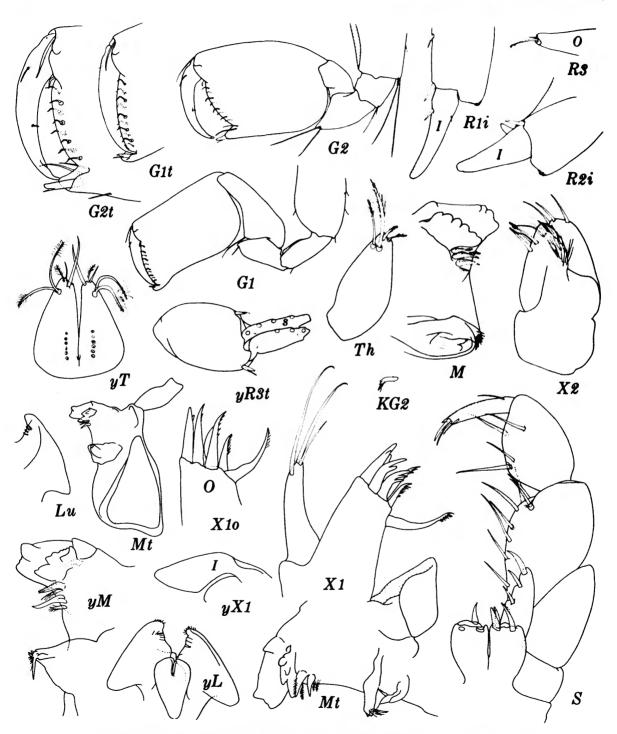


FIGURE 241.—Japara papporus, new species, holotype, female "a," 2.52 mm (y = male "y," 2.64 mm; K = spine of palm on gnathopod 2).

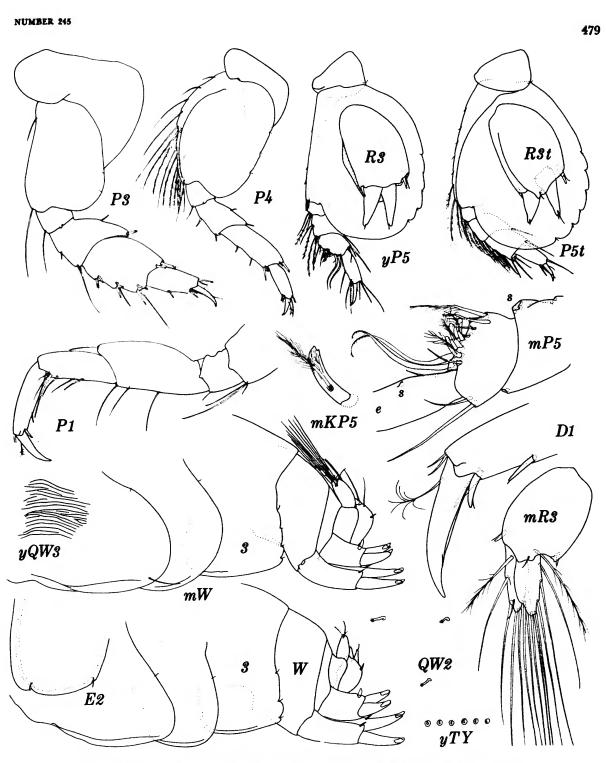


FIGURE 242.—Japara papporus, new species, holotype, female "a," 2.52 mm (m = male "m," 2.86 mm; y = male "y," 2.64 mm; Y = denticles; percopod 3 enlarged, see text).

Eggs: Holotype, female "a," 2.52 mm, with 2 large eggs; female "e," 2.61 mm, 2 large eggs; female "f," 2.32 mm, one large egg.

DESCRIPTION OF MALE.—Following parts like those of female: prebuccal, mandibles (except palps), lower lip, maxillae, maxilliped, gnathopod 1, gnathopod 2 (but hand slightly stouter than in female), pereopods 1-4, uropods 1-2. Parts unlike those of female: eyes larger than in female, ommatidia free of occluding pigment, brass in color. Article 1 of antenna 1 with medial patch of fuzz; primary flagellum with 5 articles, first 2 articles each with large calceolus; accessory flagellum 3articulate. Antenna 2 basally stouter than in female, anterior margins of articles 3-4 with long fuzz, anterior margin of article 5 with male setule tufts and 0-2 calceoli, facial spine formula of article 4 = 2-2, of article 5 = 1; flagellum highly elongate, about 19-articulate, flagellar formula = 19, 1, 2, 4, 6 . . . 18. Article 3 of mandibular palp about 1.2 times as long as article 2, bearing 4 apical spinesetae and with 2 basofacial setae, one on each side. Long posterior setae of article 2 on gnathopods 1-2 and pereopods 1-2 = 1-1-1-2. Coxae 1-4 all slightly narrower than in female. Pereopod 5 with narrower and slightly less extended article 5, articles 4-5 narrower and article 5 shorter than in female, article 5 with sloping anterodistal margin bearing 3 clavate and curved spines and 2 long undulant setae, anterior margin of article 6 bearing one long seta. Epimeron 1 with broadly rounded posterior margin, epimera 2-3 longer anteroposteriorly than in female, epimeron 2 with one facial seta, epimeron 3 with 4 posterior setule notches. Urosomite 1 with one setule on each side at base of uropod 1. Rami of uropod 3 larger than in female but only about two-thirds as long as peduncle, broader, more strap-shaped and less conical, bearing long setae. Telson with row of dorsal denticles on each lobe, most of these denticles reminiscent of rose thorns but those at ends of row more chiselshaped, apex of each lobe with additional long spine seta besides 2 short setules found in female. Cuticular pipes much sparser than in female but bulbar setules, though sparse, more numerous than in female.

ILLUSTRATIONS.—View of dissected female pereopod 3 drawn about 1.4 times larger than views of female pereopods 4 and 5; one spine on outer plate of maxilliped hidden.

HOLOTYPE.—NMV, female "a," 2.52 m. (Carcass of holotype, comprising pereonites 1-7 minus appendages, lost during transferral to repository.)

Type-Locality.—CPBS 41N/1171, 1 Nov 1971, Western Port, Victoria, Australia, 12.8 m, silty sand, gravel.

VOUCHER MATERIAL.—Type-locality: "female "e," 2.61 mm; female "f," 2.32 mm; CPBS 33N/5: male "y," 2.64 mm (illus.). CPBS 23N/2: male "m," 2.86 mm (illus.); female "d," 2.88 mm. SBS Long Reef: male "g," 2.42 mm; female "h," 2.28 mm; juvenile "j," 1.37 mm.

MATERIAL.—CPBS, 39 samples from 9 stations (23); RHM, one sample (1); SBS, one sample (1). DISTRIBUTION.—Victoria, Western Port, neritic and 10–13 m, gravel, sand or shell. New South Wales, Long Reef, N of North Head, Sydney, 43 m.

Kondoleus, new genus

Diagnosis.—Eyes present. Flagella of antenna 1-2 reduced in female. Article 2 of antenna 1 ordinary, ventral setae confined apically. Article 1 of antenna 2 not ensiform; article 3 with 2 setules; facial spines on article 4 circular and spherical, in 2 rows; article 5 especially short. Right mandibular incisor with 5 teeth; molar not triturative, medium, conical, bearing 3 long clumped spines with partly common base, one spine bearing fuzz; palpar hump small. Palp of maxilla I uniarticulate; inner plate naked. Setation of maxilla 2 weak. Inner plates of maxillipeds short, bearing basal spouts pointing laterally; apex of palp article 3 not protuberant, dactyl short, stubby, apical nail distinct, mostly immersed, medium. Gnathopods dissimilar, gnathopod 2 moderately enlarged; article 5 of gnathopod 2 short, cryptic, of gnathopod I elongate, with eusirid attachment, palms chelate, hands of gnathopods 1-2 broadened, poorly setose anteriorly. Article 5 of pereopods 1-2 setose (or spinose) posteroproximally. Article 2 of pereopod 3 of broad form, articles 4-5 of pereopods 3-4 broad, oddly trapezoidal, article 2 of pereopods 3-4 not setose posteriorly; pereopod 5 ordinary, article 2 naked ventrally, article 3 ordinary, dactyl normal. Epimera 1-2 lacking long posterior setae, without midfacial setae above ventral facial ridge; epimeron 3 of rounded classification and lacking long setae. Urosomites 1-2 with large dorsal and glandular humps,

generally naked except for sparse apicoventral setae near base of uropod 1; urosomite 3 without dorsal hook or special process. Peduncle of uropod 1 normally elongate, without apicoventral spike, without special enlarged apicolateral or medial spine, uropods 1-2 with occasional seta, peduncular apices of uropods 1-2 not combed, inner ramus of uropod 1 with marginal spines in one row, one ramus continuously setose to apex, inner ramus of uropod 2 especially shortened, partially fused to peduncle. Uropod 3 small, article 2 of outer ramus carrying 2 long apical setae. Telson elongate, with 2 apical spines or setae on each lobe plus setules.

DESCRIPTION.—Rostrum obsolescent. Fuzz on article 1 of antenna 1 in male present; calceoli on male primary flagellum of antenna 1 absent. Calceoli on article 5 of male antenna 2 absent; flagellum in male with calceoli. Prebuccal parts ordinary, massive, strongly distinct, upper lip dominant. Right lacinia mobilis bifid, flabellate; mandibular palp thin, article 1 elongate, article 2 without outer setae, apex of article 3 oblique. Lower lip bearing cones. Outer plate of maxilla 1 with 7 spines, no spine especially thickened. Inner plates of maxilliped especially thin, poorly armed. Coxae 2-3 tapering distally, coxae 2-4 without special anterodorsal humps. All posterior spines on article 6 of pereopods 1-2 thick and stiff, midapical spine present. Article 2 of pereopod 5 without facial setae. Peduncle of uropod 1 with dorsolateral spines confined apically, medial spines widely spread; peduncle of uropod 2 with only one medial setule confined apically; peduncle of uropod 3 lacking extra subapical setae or spines. Telson with pair of midlateral or dorsal setules on each side.

Type-Species.—Kondoleus tekin, new species (here selected).

Composition.—Unique.

RELATIONSHIP.—Despite similarities to Joubinella Chevreux in gnathopods and flagellum of antenna 2, Kondoleus appears more closely approximate to the Metaphoxus group of genera by virtue of mandibular molar and first maxillary palp. Kondoleus differs from both Metaphoxus and Joubinella in the stubby article 4 of the maxillipedal palp, the shortened inner rami of uropod 2 and further differs in numerous minor characters herein described for the type-species of Kondoleus and not heretofore attributed to generic level, to wit: a huge glandular mass in urosomites 1–2, with dorsal

ducts on those segments; salivary spouts at the base of the inner plates on the maxillipeds; and oddly shaped triangular or trapezoidal articles 4-5 of pereopods 3-4.

This genus is distinguished from Japara, new genus, in the large rami of uropod 3, and the stubby palp article 4 of the maxilliped among numerous characters ranked secondarily (see illustrations and descriptions).

Kondoleus bears considerable resemblance to Limnoporeia and should be studied in detail for its possible origins near that genus. Kondoleus differs from Limnoporeia in its heavily modified antennae, maxillipedal spouts, and stubby maxillipedal dactyl, in the heavy reduction of the rostrum, presence of setae on uropods 1-2, shortened inner ramus of uropod 2, and a host of other specializations.

Kondoleus tekin, new species

FIGURES 243-246

Description of Female.—Head about 15-17 percent of total body length, greatest width about 75 percent of length; rostrum obsolescent, broad, not reaching along article 1 on antenna 1. Eyes medium, largely occluded with pigment, ommatidia especially large. Article 1 on peduncle of antenna 1 about 1.3 times as long as wide, about 1.6 times as wide as article 2, apicoventral margin with 3 setules, unproduced dorsal apex with 2 setules; article 2 0.9-1.1 times as long as article 1, apicoventral corner produced, with 2 long setules; article 3 enlarged; primary flagellum with 3 articles, about 0.75 times as long as peduncular article 3, bearing large aesthetascs; accessory flagellum with 2 articles. Antenna 2 short and thick; article 3 with one facial seta; spine formula of article 4 = 7-4 or 9-4, sometimes distal group appearing divided into subequal groups, these spines nearly spheroidal, very short and almost fully dorsal, ventroproximal face with 3 setules, ventral margin naked, ventrodistal corner with one seta; article 5 about 0.45 times as long as article 4 and narrower, spine formula = 2-1 or simply 3, these spines spheroidal and dorsal, ventral margin with one acclivity and seta, ventrodistal margin with one stout spine and seta; flagellum 2-articulate, very short, basal article almost fully immersed in peduncle. Mandibles with weak-

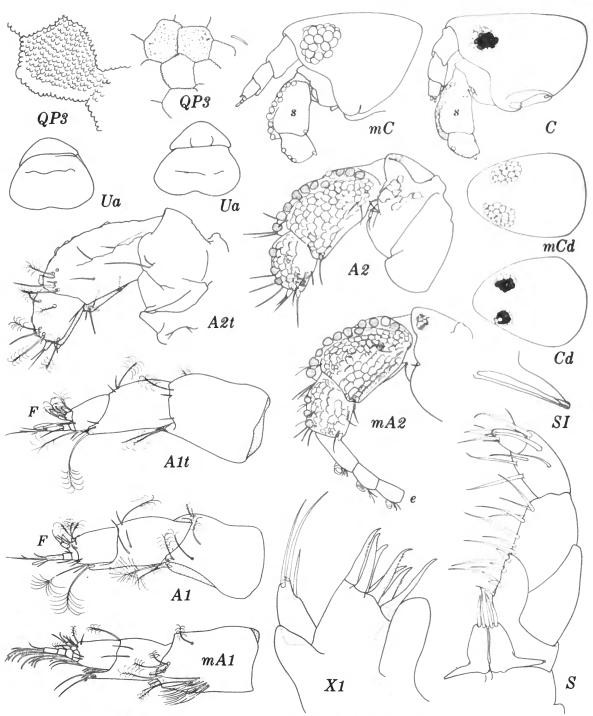


Figure 243.—Kondoleus tekin, new species, holotype, female "a," 3.00 mm (m = male "m," 3.02 mm).

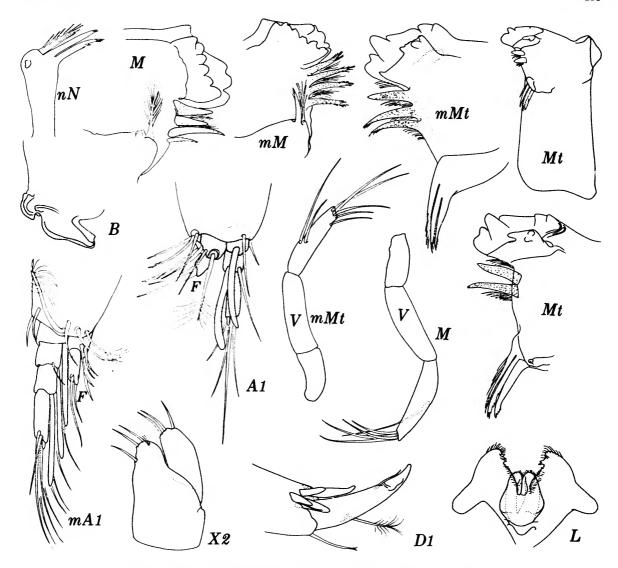


FIGURE 244.—Kondoleus tekin, new species, holotype, female "a," 3.00 mm (m = male "m," 3.02 mm; n = female "n," 3.06 mm).

medium palpar hump; right incisor with 6 teeth and humps, left incisor with 6 humps in 2 branches; right lacinia mobilis broadly flabellate, subbifid, marked by sigmoid notch, denticulate, with 1-2 facial humps; left lacinia mobilis with 6 teeth; right rakers 2; left rakers 3 plus one rudimentary; molar in form of elongate protrusion demarcated mainly by spines, each molar with 3 primarily long spines, one of these plumed; palp article 1 elongate, article 2 naked, article 3 about as

long as article 2, oblique apex with 4 spine-setae, midfacial formula = 0-1. Inner plate of maxilla 1 long, narrow, naked; palp uniarticulate, short, with 3 apicalmedial and lateral setae. Inner plate of maxilla 2 shorter than outer, outer scarcely broader than inner, outer with one apicolateral seta, inner with one medial seta, plates short and poorly setose. Inner plate maxilliped with 2 large, thin apical spines, otherwise naked, bases produced into laterally directed spouts; outer plate with 5 medial

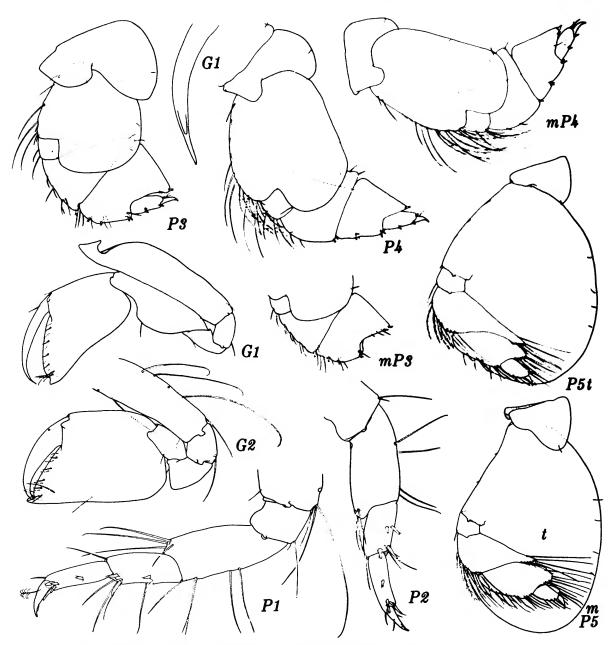


Figure 245.—Kondoleus tekin, new species, holotype, female "a," 3.00 mm (m = male "m," 3.02 mm).

spines (2 forming pair); palp articles 1-2 naked apicolaterally, medial margin of article 2 weakly setose, article 3 with 3 facial setae in triangle, no lateral setae, article 4 short, stubby, nail medium, with 2 accessory setae. Coxa 1 expanded apico-

posteriorly, anterior margin convex, coxae 2-3 weakly pointed; main ventral setae of coxae 1-4=0, setules = 3-3-3-2; anterior and posterior margins of coxa 4 strongly divergent, ventral margin short, rounded, posterior margin very oblique, al-

most straight, posterodorsal corner rounded, posterodorsal margin short, concave, width-length ratio of coxa 4 = 13:14. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 0-(3-4)-6-(5-6), short anteriors = 0-2-1-1, long anteriors = 0-2-4-(2-3), no others. Gnathopods enlarged, article 6 broad, parachelate, hand-wrist attachment eusirid, gnathopod 2 stouter than gnathopod 1; width ratios of articles 5-6 on gnathopods 1-2 = 22:52 and 16:60, length ratios = 72:82and 30:95; palmar humps ordinary; article 5 of gnathopod I elongate, posterior margin rounded, almost lobate, article 5 of gnathopod 2 short, cryptic. Pereopod 1 longer than pereopod 2, especially article 4, posterior margin of latter poorly setose, anterodistal setae formula on article 4 = 4 and 3, on article 5 = 1 and 1, main spine of article 5 extending to M. 20 on article 6, article 5 with pair of proximoposterior spines and poorly setose, spine formula of article 6 = 3 + 1 plus middistal spine, some spines especially short, acclivity on inner margin of dactyls of pereopods 1-2 obsolescent, emergent setule long, midfacial pluseta highly proximal. Coxae 5-7 posteroventral setule formula = 1-1-1. Articles 4-5 of pereopods 3-5 broad, trapezoidal, facial spine rows absent, facial ridge formula on article 2 of pereopods 3-5 = 0-0-0; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 68:61:60:9, of pereopod 4 = 71:53:41:10, of pereopod 5 =108:35:29:10, length ratios of pereopod 3 =72:30:39:22, of pereopod 4 = 92:32:38:22, of pereopod 5 = 128:60:41:18; article 2 of pereopod 5 exceeding apex of article 7 because articles 4-7 flexed backward permanently, article 2 huge, suborbicular, smooth; article 4 of pereopod 5 strongly extended along article 5 posteriorly, also true for extension of article 5 along article 6 on pereopods 3-4; article 6 very short on pereopods 3-5, medial apex of article 6 smooth. Posteroventral corner of epimera 1-2 rounded, posterior margin straight to convex, posteroventral corner of epimeron 3 rounded-quadrate, posterior margin straight, epimera 1-3 naked except for setule on posterodorsal margin. Urosomite 1 with lateral setule at base of uropod 1, articulation line incomplete, short, dorsal urosomite 1 hugely elevated and posterodorsally extended as hump bearing ducts from large gland filling urosomites 1-2 and part of pleonite 3, urosomite 2 also with hump, urosomite 3 weakly protuberant dorsally. Rami of uro-

pods 1-2 with articulate apical nails, outer ramus of uropod 1 with one dorsal spinule, inner with 2 dorsal and one ventral elongate setae, outer ramus of uropod 2 with one long dorsal seta, inner ramus short, essentially fused to peduncle, with one medium dorsal seta; peduncle of uropod 1 with one apicolateral spinule and no basofacial setae, medially with 2 marginal spines, apicalmost an ordinary spine, peduncle of uropod 2 with one long dorsodistal seta, medially with one small apical seta, apicolateral corners of peduncles on uropods 1-2 lacking comb. Peduncle of uropod 3 with one ventral setule, dorsally with one medial setule, laterally naked; rami feminine, inner extending to M. 45 on article 1 of outer ramus, apex with one seta, medial and lateral margins naked, article 2 of outer ramus short, 0.08, bearing 2 long setae, apicomedial margin of article 1 with 2 setae, lateral margin with 2 pairs of setae. Telson especially long, lengthwidth ratio = 14:11, not fully cleft, each apex narrow, rounded, lateral acclivity absent, bearing short lateral setule, seta next medial elongate, next seta medium, midlateral setules large, diverse. Cuticle covered with dense polygonal structure formed by concentrations of villi and pebbles, bulbar setules rarely present, polygons especially heavy on coxae, article 2 of pereopods 3-5, midbody, antenna 2, weaker on epimera and antenna l, in other places villi not organized into polygonal structure, diminished or absent on urosome, head, apices of gnathopods and pereopods.

DESCRIPTION OF MALE.—Following parts like those of female: head shape, epistome, upper lip, right molar, lower lip, maxillae, maxilliped, gnathopods, pereopods 1-2, epimera, medial aspect of uropod 1, length of telson. Eyes larger than in female, clear of occluding pigment, gold in color in preservative. Head about 15 percent of total body length. Antenna 1 with brush of thick setules on lateral (unusual) surface of article 1, aesthetascs more densely developed than in female; primary flagellum 4-articulate. Antenna 2 scarcely thicker than in female; flagellum elongate, flagellar for $mula = 21, 1-4, 6, 8, \dots 20 \text{ or } 15, 1, 3, 4, 6, 8 \dots 12.$ Spine formula on article 4 of peduncle either 7-4 or 7-5, article 5 with either 3 or 4 dorsal spines. Right lacinia mobilis with sigmoid cusp and notch seen in female straightened to right angles; left lacinia mobilis with subdenticulations; right and left rakers = 3 and 4; left molar with 2 spines (one

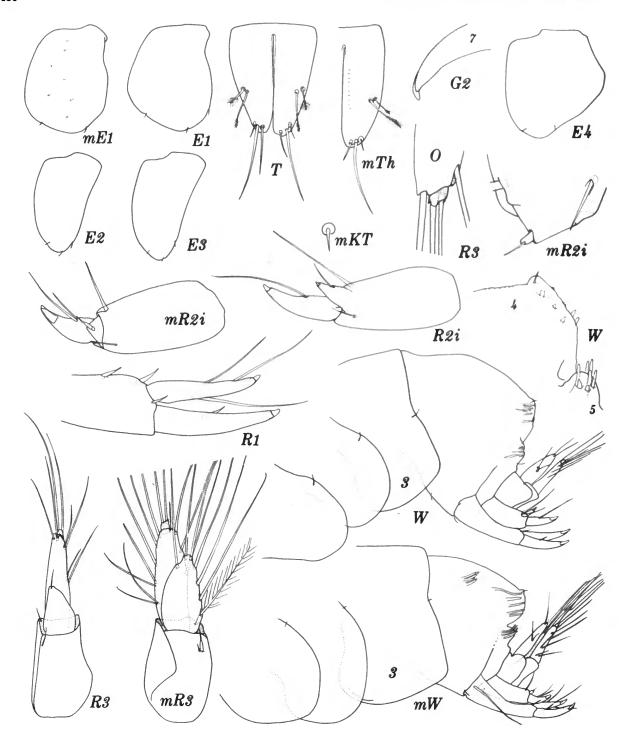


FIGURE 246.—Kondoleus tekin, new species, holotype, female "a," 3.00 mm (m = male "m," 3.02 mm; K = denticle).

ciliate); mandibular palp article 3 with 2 basofacial setae on same face, apex with 4 setae, inner apical acclivity and one subapical seta; slight differences from female in coxa 1 (see illustration). Pereopods 3-5 with weakly distinctive shapes on several articles (see illustrations). Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 0-3(4-5)-5, long anterior setae = 0-3-5-3. Coxa 4 relatively slightly smaller in relation to coxa 1 than is coxa 4 to coxa 1 in female, similar statement for male coxae 2-3. Dorsal protuberances of urosomites 1-2 somewhat more sharply defined than in female. Uropod l with one long basofacial seta; outer ramus of uropod 2 with one or pair of setae dorsally, inner ramus very broad and scaliform. Inner ramus of uropod 3 reaching to M. 67 on outer ramus, both rami with numerous long setae except on outer margin of inner ramus. Telson with row of medial denticles on both lobes, apex of each lobe with one long seta in middle, with lateral short bulbar seta and short medial seta.

ILLUSTRATIONS.—Left mandibular molar of female with 2 spines broken off as shown by 4 basal lines depicting nerve ducts.

HOLOTYPE.—NMV, female "a," 3.00 mm.

Type-Locality.—CPBS B3/5a, 29 Sep 1964, Western Port, Victoria, Australia, 11 m, sand.

VOUCHER MATERIAL.—Type-locality, female "n," 3.06 mm (illus.); CPBS 25S/5, male "m," 3.02 mm (illus.); CPBS A3/5, male "e," 2.91 mm.

MATERIAL.—CPBS, 8 samples from 6 stations (10).

DISTRIBUTION.—Victoria, Western Port, 8.2-18.3 m, sand, sandy mud.

Limnoporeia Fearn-Wannan

Limnoporeia Fearn-Wannan, 1968:37-38.

DIAGNOSIS.—Eyes present. Flagellum of antenna 2 reduced in female. Article 2 of antenna 1 shortened to ordinary to elongate, ventral setae confined apically. Article 1 of antenna 2 not ensiform; article 3 with 2 setules; facial spines on article 4 in 2 or more rows, plus special apical spines; article 5 thin and short. Right mandibular incisor with 3 teeth; molar not triturative, medium, elongate, conical, bearing two or fewer conical fused spines, often with button, bearing fuzz; palpar hump small

to large. Palp of maxilla 1 uniarticulate; inner plate naked. Setation of maxilla 2 weak. Inner plate of maxillipeds ordinary; apex of palp article 3 not protuberant, dactyl elongate, apical nail distinct, elongate. Gnathopods large, dissimilar, gnathopod 2 strongly enlarged; article 5 of gnathopod 1 elongate to ordinary, free, of gnathopod 2 almost cryptic, with weak eusirid attachment; palms chelate, hands of gnathopods 1-2 elongate, poorly setose anteriorly. Article 5 of pereopods 1-2 setose posteroproximally. Article 2 of pereopod 3 of broad form, articles 4-5 of pereopods 3-4 narrow, article 2 of pereopods 3-4 not setose posteriorly; pereopod 5 ordinary, article 2 naked ventrally, article 3 ordinary, dactyl normal. Epimera 1-2 lacking long posterior setae, without midfacial setae above ventral facial ridge; epimeron 3 of rounded classification and bearing 3 or fewer long setae. Urosomite 1 generally naked; urosomite 3 without dorsal hook or special process. Peduncle of uropod 1 normally elongate, without apicoventral spike, without special enlarged apicolateral or medial spine, peduncular apices of uropods 1-2 combed; inner ramus of uropod 1 with marginal spines in one row, no rami continuously spinose to apex, apical nails absent, inner ramus of uropod 2 ordinary. Uropod 3 ordinary, elongate article 2 of outer ramus carrying 2 short to long apical setae. Telson elongate, with 1-4 apical spines or setae on each lobe plus setules, without special dorsal and lateral spines or setae.

DESCRIPTION .- Rostrum fully developed, often with apicoventral process. Fuzz on article 1 of antenna l in male present; calceoli on male primary flagellum of antenna 1 present. Calceoli on article 5 of male antenna 2 present; flagellum in male with calceoli. Prebuccal parts strongly extended forward, massive, strongly distinct, upper lip dominant. Right lacinia mobilis bifid, flabellate; mandibular palp of medium size, article 1 short, article 2 without outer setae, apex of article 3 oblique. Lower lip bearing multiple cones. Outer plate of maxilla 1 with 7 spines, no spine especially thickened. Inner plates of maxilliped especially thin, poorly armed. Coxae 2-4 without special anterodorsal humps. Some posterior spines on article 6 of pereopods 1-2 thin and seta-like, others thick and stiff, midapical spine or seta absent. Article 2 of pereopod 5 without facial setae. Peduncle of uropod 1 with dorsolateral spines confined apically or widely spread, medial spines confined apically or widely spread; peduncle of uropod 2 with only one medial spine confined apically or spines widely spread. Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with ordinary pair of middorsal setules on each side, highly medial.

Gills present on pereonites 2-7 but gills on pereonites 2 and 7 often extremely small, vestigial or absent, brood plates present only on pereonites 3-5.

Attributes eliminated from descriptions of species: posteriormost seta (minute) on coxae 1-3; facial ridge formula on article 2 of pereopods 3-5 = 0-1-1.

Type-Species.—Limnoporeia kingi Fearn-Wannan, 1968 [monotypy].

Composition.—Following new species: Limnoporeia kalduke, L. maranowe, L. ungamale, L. wakkine, L. woorake, and L. yarrague.

RELATIONSHIP.—Limnoporeia bears certain re-

semblances to the *Brolgus* group of genera in terms of its rounded-classification epimeron 3 and combed peduncle of uropods 1-2, but otherwise, *Limnoporeia* differs in its fully chelate gnathopods, uniarticulate palp of maxilla 1 and in the odd mandibular molar bearing shortened to obsolete spines with development of a fuzzy spine or apical plaque.

Apparently Limnoporeia belongs with the Metaphoxus group of genera, by virtue of similar maxillae, maxillipeds, epimera, uropods, enlarged and/ or poorly setose gnathopods. Limnoporeia differs from Metaphoxus primarily in the fully chelate gnathopods.

The species are arranged in the order of increasing complexity of the telson. This is associated with an increasing complexity of setae on pereopods 1-2, and, to some extent, in the increasingly stronger development of gills on gnathopod 2 and pereopod 5.

Key to the Species of Limnoporeia and Uldanamia

l.	Telson with only one spine on each lobe besides any setules 2
	Telson with 2 or more spines on each lobe besides any setules
2.	Epimeron 2 with all setae arranged in tandem horizontally
	Epimeron 2 with 2-3 setae arranged in vertical row
3.	Article 2 of antenna 1 elongate, dactyls of pereopods 1-2 ordinary, bearing inner acclivity
	L. woorake, new species
	Article 2 of antenna 1 not elongate, dactyls of pereopods 1-2 elongate, lacking inner acclivity.
4.	Outer ramus of uropod 1 naked, epimeron 2 with 3 facial setae, epimeron 4 with 4 posterior
	setules, eyes small and dark, ommatidia small, article 6 of pereopod 4 with one posterior seta, coxae 1-4 with 5-4-4-1 setae narrowly confined
	Outer ramus of uropod 1 with one dorsal spine, epimeron 2 with 2 facial setae, epimeron 4
	with 3 posterior setules, eyes large, clear, ommatidia enlarged, article 6 of percopod 4 with
	3 posterior setae, coxae 1-4 with 8-9-9-4 setae widely spreadL. yarrague, new species
5.	Dactyls of percopods 1-2 partially reduced in size, telsonic lobes with apicomedial protrusion
٥.	
	Dactyls of pereopods 1-2 of normal phoxocephalid size, telsonic apices with apicolateral pro-
	trusion
6.	Dactyls of pereopods 1-2 vestigial, discoid, telson with two sets of apical spines on each lobe,
••	one set subdistal, ventral apex of rostrum with fully conical and sharp protrusion
	Dactyls of pereopods elongate, unguiform, telson with only one set of apical spines on each
	lobe, ventral apex of rostrum with rudimentary or no protrusion
7.	Epimeron 2 with pair of vertically oriented setae almost fully posterior, dactyls of percopods
	1-2 ordinary, each telsonic lobe with 2 spines, outer ramus of uropod 2 with 0-1 spines
	L. ungamale, new species
	Epimeron 2 with pair of vertically oriented setae set near middle of epimeron, dactyls of
	percopods 1-2 elongate, curved, each telsonic lobe with 3 spines (one or more thin), outer
	ramus of uropod 2 with 3 spines

Limnoporeia kingi Fearn-Wannan

Limnoporeia kingi Fearn-Wannan, 1968:38-43, figs. 4-7.

HOLOTYPE.—NMV J.153, female, 3.20 mm [newly measured].

Type-Locality.—Jones Bay, Lake King, Victoria, Australia, May 1957.

Voucher Material.—Type-locality, 4 paratypes. Remarks.—The holotype is very similar to L. yarrague as described below, with pereopods 3 and 5 similar to that species and not as illustrated by Fearn-Wannan, figs. 4B,C; article 2 of pereopod 5 is somewhat more protuberant posteriorly than in L. yarrague; article 6 of pereopod 4 bears only one posterior seta. The eyes are dark, smaller than those of L. yarrague, and the ommatidia are concealed, smaller and more irregularly sized and distributed. Apical spines on the telson are shorter than in L. yarrague (despite Fearn-Wannan's figure) and the setae on coxae 1-4 are fewer, = 5-44-1, not counting anterior setule of coxae 1-3 nor 2 short setules of coxae 4. Epimera 2 and 3 are out of phase with uropod 1 as epimeron 2 has 3-4 facial setae, epimeron 3 has 4 posterior setules while the outer ramus of uropod 1 lacks a dorsal spine. In L. yarrague epimeron 2 has 2 setae, epimeron 3 has 3 setules while the outer ramus of uropod 1 has one dorsal spine. The most proximal group of spines on article 4 of antenna 2 in L. kingi is composed of 3 spines, 2 of these of normal length, the third extremely elongate.

Adults of *L. yarrague* reach a larger size than those of *L. kingi* as far as known and some of the paucities of *L. kingi* may be phenotypic owing to earlier maturation, but the nonsymmetric situation among epimera and uropod 1 suggest that *L. kingi* and *L. yarrague* are distinct species.

In respect of head, antennae 1-2, gnathopods, pereopods, especially dactyls of pereopods 1-2, epimera, uropods, and telson, the holotype is extremely close to the illustrations herein presented of L. yarrague. The holotype was not dissected to obtain views of mouthparts nor telson; the telson of L. kingi appears to be somewhat shorter than that of L. yarrague, although Fearn-Wannan shows it with elongate lobes and spines nearly as long as those of L. yarrague; each lobe apically bears one spine and one lateral setule. Fearn-Wannan's illustrations show the palp of maxilla 1 of L. kingi to be shorter than in L. yarrague and article 4 of

antenna 2 lacking the third group of spines but the holotype bears those 2 spines and a setule, for a formula of 3-3-2; *L. kingi* also bears, according to Fearn-Wannan's figures, a seta on article 2 of the mandibular palp, absent in Western Port *L.* yarrague.

Limnoporeia yarrague has also been discovered in Lake King sympatric with L. kingi. One additional specimen of L. kingi was found in a collection of 207 specimens, 206 of which are L. yarrague. The Lake King specimens of L. yarrague are minutely distinct from L. yarrague in Western Port in that article 2 on the mandibular palp bears 2 subapical setae and thus resembles L. kingi in this character. The ventral setae on coxae 1-4 are fewer and variable in number (5, 6, 7, 8), unlike L. yarrague in Western Port. However, L. yarrague from Lake King bears the usual 2 ventral setae on epimeron 2 and 2-3 posterior setules on epimeron 3. A sample from Merimbula, New South Wales, also contains L. kingi sparsely and L. yarrague in great abundance.

Paratypes of L. kingi have been examined as follows: (1) ovigerous female is L. kingi; (2) subadult male with early proliferation of flagellum on antenna 2 is L. kingi; (3) a large headless specimen with excessive epimeral setation appears to be L. kingi on the basis of subtle generalities in urosome and pereopods; (4) a subadult female is L. yarrague. Each specimen has at least one subapical seta on article 2 of the mandibular palp so that in Lake King, L. yarrague and L. kingi are inseparable on this character difference found in Western Port L. yarrague. One additional difference between the two species in Lake King is the presence of 8 setal spines apically on article 3 of the mandibular palp in L. kingi and 10 spines in L. yarrague.

MATERIAL.—NMV, one sample (4, fifth specimen referrable to L. yarrague). Resample of type-locality, Lake King, Paynesville (1). MMD, one sample, 10 Feb 1972 (2).

DISTRIBUTION.—Victoria, Lake King. New South Wales, Merimbula, intertidal, on edge of channel.

Limnoporeia maranowe, new species

FIGURES 247-249

DESCRIPTION OF FEMALE.—Head about 17 percent of total body length, greatest width about 65

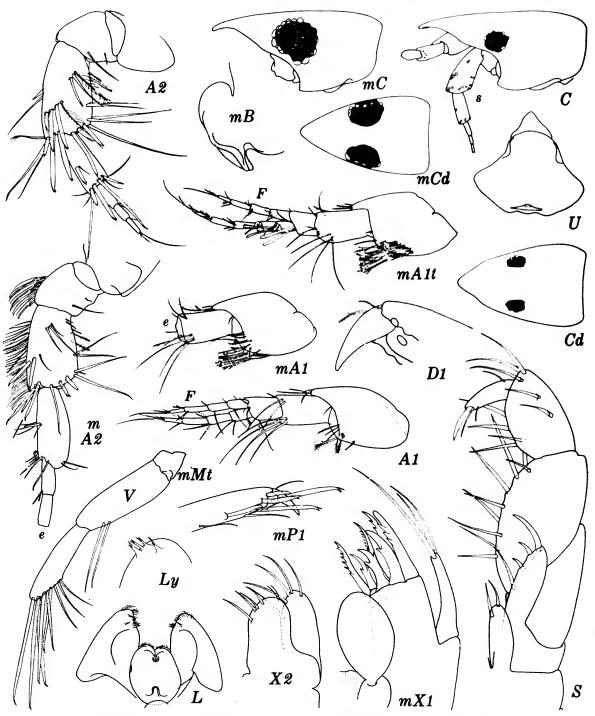


FIGURE 247.—Limnoporeia maranowe, new species, female "d," 2.77 mm (m = male "m," 2.86 mm).

percent of length; rostrum long, reaching at least to apex of article 2 on antenna 1, constricted weakly towards apex (from dorsal view), apex somewhat attenuate but rounded. Eyes small, composed of black core in preservative surrounded by occasional small and clear ommatidium. Article 1 on peduncle of antenna 1 about 1.7 times as long as wide, almost twice as wide as article 2, apicoventral region with 4 setules, strongly produced dorsal apex with about 4 setae; article 2 about 0.6 times as long as article 1, ventral apex with 4 setae; flagella extending subequally, primary and accessory flagella each 4-articulate, aesthetascs absent or one alone present on accessory flagellum. Article 3 of antenna 2 with one long, one short facial setae: spine formula of article 4 = 3-3-2, proximal group thin, both proximal groups with accessory setule, dorsal margin with weak notch bearing spine and setae, ventral margin with 2 groups of 2-3 setae and 3 subbasal penicillate setules, ventrodistal margin with 3 short to medium spines; article 5 almost 0.7 times as long as article 4, facial spine formula = 1 plus accessory setule, dorsal and ventral margins straight and smooth, dorsodistal apex with 2 spines, ventrodistal apex with 2 spines and 2 setae; flagellum as long as article 5 of peduncle, 3-articulate. Prebuccal complex convex anteriorly, moderately extended forward, epistome and upper lip articulate, epistomal part small, upper lip with widely spread lateral alae, ventral margin bisinuate from anterior view. Mandibles with weak palpar hump; right incisor with 3 teeth and notch; left incisor with 5 humps in 2 branches; right lacinia mobilis broadly flabellate, minutely and complexly toothed and bearing facial tooth; left lacinia mobilis broadly flabellate, with 5 teeth; right rakers 2, left 3; mandibular molar small, projecting, subconical, heavily setulose, these setules attached to strongly cornified, clear cone on apex of molar; palp article 2 bearing one inner seta subapically, article 3 about 0.85 times as long as article 2, strongly oblique apex with 8 setae. Lower lip with 4 cones on outer lobe, one cone facial and disjunct from others, mandibular lobes of medium length, rounded apically, inner lobes small, fused together for most of their length. Inner plate of maxilla 1 large, elliptical, naked; outer plate with 7 spines, two of these with one cusp each on opposite sides; palp exceeding apex of outer plate, uniarticulate, thin, bearing 2 apical and one subapical setae.

Inner plate of maxilla 2 broader and slightly shorter than outer plate, setae sparse, inner and outer plates each with one medial seta. Inner plate of maxilliped with one apical and one medial seta; outer plate with 4 medial spines; palp article 2 sparsely setose medially, article 3 with 2 facial setae, article 4 of medium length, not fully unguiform, bearing one apical spine and 2 accessory setae. Coxa l unexpanded distally, setal formula of coxae 1-4 = 5-5-5-2, anterior and posterior margins of coxa 4 parallel, posterodorsal excavation medium, V-shaped, ratio of width to length = 5:6. Gnathopod 1 especially slender, gnathopod 2 as long as but stouter than gnathopod 1; long posterior setae on article 2 of gnathopods 1-2 = 1 and 1. small anterior setae on both members = one middle, one distal; article 3 of both gnathopods, but especially of gnathopod 2, slightly elongate; article 5 on gnathopod 1 long, with flat and free posterior margin, shorter on gnathopod 2, posterior margin somewhat triangulate and almost cryptic; article 6 of both gnathopods long, slightly tapering apically, strongly chelate, apex of palm bearing scale-like protrusion and medium spine, apices of dactyls with especially large apical scale; length ratios of articles 5-6 on gnathopods 1-2 = 69:112 and 55:132, width ratios = 24:36 and 27:49. Pereopods 1-2 generally similar to each other but articles 4-5 of pereopod 2 slightly stouter than on pereopod 1; long posterior setae on article 2 of pereopods 1-2=3 and 4, anterior short setae = 2 and 1, articles 4-5 lacking facial armaments; article 4 with 2 groups of sparse simple posterior setae, produced anterodistal apex with 2 setae; article 5 with several posterior setae, one long distal spine reaching to M. 80 on article 6; article 6 with one midposterior seta and apical rows of 3 and 2 spines on pereopod 1, 3 and 3 on pereopod 2, spines mostly long; dactyl extremely short, curved, conical, lacking acclivities, nail absent (unless represented by chitinous internal remnants). Coxae 5-7 posteroventral setule formula = 2-1-3. Articles 4-5 of pereopods 3-4 narrow, facial spines almost absent; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 52:23:18:10, of pereopod 4 = 68:20:15:9, of pereopod 5 = 91:16:13:7, length ratios of pereopod 3 = 68:26:29:30, of pereopod 4 = 90:50: 39:42, of pereopod 5 = 100:17:27:22; article 2 of pereopod 5 extending to apex of article 4; medial apex of article 6 combed, lacking digits.

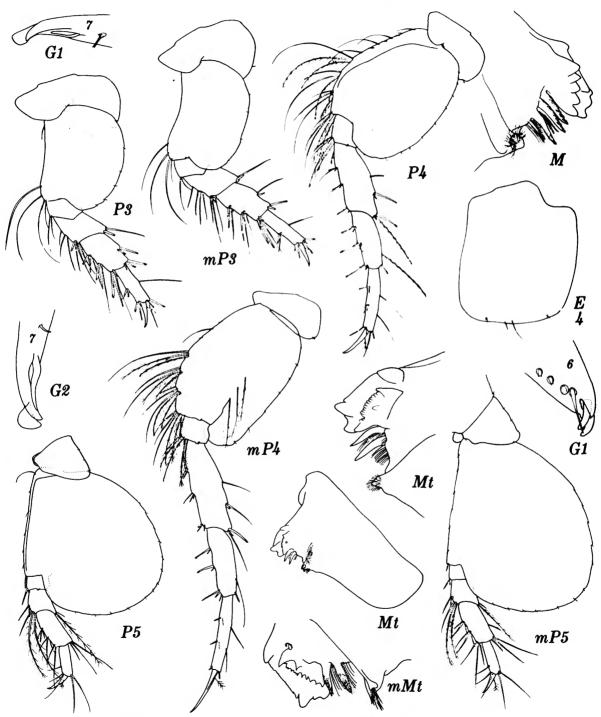


FIGURE 248.—Limnoporeia maranowe, new species, female "d," 277 mm (m = male "m," 2.86 mm).

Posteroventral corners of epimera 1, 2, 3, = rounded, rounded-quadrate, and quadrate, posterior margins = flat, weakly convex, and almost flat, with 3 setules on epimeron 3, epimeron 2 with 5 facial setae, anteriormost 2 of these horizontal, posteriormost 3 of these vertical. Urosomite 1 naked ventrally. Apicolateral corner on peduncle of uropod 1 smooth, with small spine, medial apex with long spine, medial margin with small spine in middle; each ramus lacking apical nail but with weak scale or tiny apical setule, each ramus with one small dorsal spine, apicolateral corner on peduncle of uropod 2 smooth, with one medium sized apicolateral spine, one smaller apicomedial spine, rami like those of uropod 1 apically, outer ramus with dorsal spine, inner naked. Uropod 3 of medium length, peduncle with one ventrolateral spine, one dorsal setule; rami feminine, inner extending to M. 60 on article 1 of outer ramus, inner ramus broad basally, very slender apically, tapering strongly near base, ramus appearing curved basally, bearing one short apical seta, article 1 of outer ramus bearing 2 lateral spines, one apicolateral spine, one long apicomedial spine-seta, article 2 elongate, 0.37, bearing 2 apical setae. Length-width ratio of telson about 3:2, not fully cleft, each apex narrow but with narrow medial lobe, broad lateral acclivity bearing one short spine and one lateral setule of similar length, middorsal pair of plusetules diverse. Cuticle bearing very sparse but unusual bulbar setules, each setule with short tubelike internal tail (nerve duct?), twin bulb and extremely long spike-like external seta and very short accessory setule. Gills on gnathopod 2 and pereopod 5 vestigial.

Description of Male.—Following parts like female: head, prebuccal and upper lip, left mandible, lower lip, maxillae, maxilliped, generalities of gnathopods and pereopods 1–2. Eyes enlarged. Antenna 1 with medial patch of fuzz (stout setules) on article 1; primary flagellum with 5 articles, first 2 each bearing calceolus, basal articles and article 3 of peduncle with stout aesthetascs. Spines and setae on peduncle of antenna 2 shorter than in female, articles 3–4 with dorsomedial fuzz, article 4 facial formula = 3–2–2; article 5 of peduncle relatively longer than in female, ventral margin convex, dorsal margin with one dish-shaped calceolus and 2 sets of male setules; flagellum elongate, bearing 33–35 articles, lacking calceoli. Teeth and facial

cusp of right lacinia mobilis much sharper than in female; article 2 of palp with 2 inner apical setae, article 3 with 9 apical setae. Coxae 1-3 each with only 3 long ventral setae, coxa 4 with only one long ventral seta. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 1-1-2-4, short anterior setae = 2-1-2-1. Article 6 of gnathopod 1 slightly more elongate than in female. Article 6 of pereopods 1-2 each with spine rows of 3 and 3. Article 2 of pereopods 3-5 slightly to greatly narrower than in female, pereopod 4 relatively longer than in female. Epimera 1-2 lacking facial ridges, epimeron 2 with only one facial seta, epimeron 3 with 2 posterior setules. Urosomite 1 bearing setule at base of uropod 1; urosomite 3 with stronger dorsal protrusion basally than in female. Spines on uropods 1-3 very small, apical scales of rami slightly larger than in female. Rami of uropod 3 masculine, inner ramus extending almost to apex of article 1 on outer ramus, medial margins of inner ramus and outer ramus setose, outer margin of inner ramus naked. Telson slightly more elongate than in female, apical spine slightly smaller than in female, rudimentary denticle row present on each lobe near proximal end of cleft. Gill present on pereopod 5.

OBSERVATIONS (male).—The poorly developed calceoli, aesthetascs, and denticle rows on the telson suggest that the males at hand are not fully mature.

ILLUSTRATIONS.—Male coxa 1 magnified same dimensions as male coxa 4 after latter balanced to female coxa 4; male coxae 1-4 thus of similar proportions to those of female.

HOLOTYPE.—NMV, female "a," 3.06 mm.

Type-Locality.—CPBS 42S, 1 Nov 1971, Western Port, Victoria, Australia, 15.1 m, sand.

VOUCHER MATERIAL.—Type-locality: male "m," 2.86 mm (illus.); female "d," 2.77 mm (illus.); male "c," 3.15 mm.

RELATIONSHIP.—Because this species is used as a model for the genus, its relationships are discussed in the comparisons made for other species. Limnoporeia maranowe is selected as the model because of its regular phoxocephalid telson in combination with ordinary head, fully developed right lacinia mobilis, and elongate apical setae on the outer ramus of uropod 3. However, L. maranowe is not the perfect model of primitiveness because of its alate upper lip and shortened dactyls of

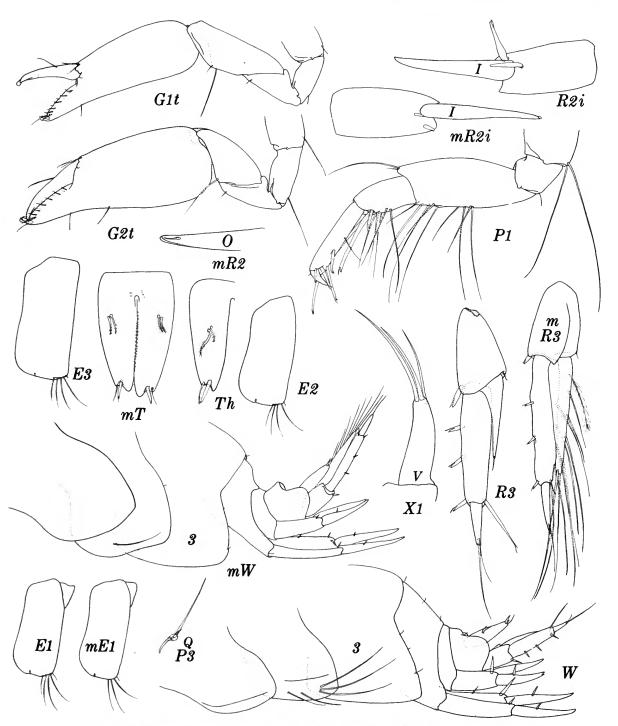


FIGURE 249.—Limnoporeia maranowe, new species, female "d," 2.77 mm (m = male "m," 2.86 mm).

pereopods 1-2.

MATERIAL.—CPBS, 23 samples from 15 stations (41); PPBES, 3 samples from one station (5).

DISTRIBUTION.—Victoria: Western Port and Port Phillip Bay, 8-19 m, sand, muddy sand, sand on clay.

Limnoporeia yarrague, new species

FIGURES 250-254

DESCRIPTION OF FEMALE.—Head about 18 percent of total body length, greatest width slightly less than 60 percent of length; rostrum long, reaching past apex of article 2 on antenna 1, unconstricted, tapering evenly, apex rounded. Eyes medium-small, ochraceous, free of dark pigment in preservative. Article 1 on peduncle of antenna 1 about 1.5 times as long as wide, almost twice as wide as article 2, apiconventral region with about 5 setules (all not illustrated), strongly produced dorsal apex with 4 setules; article 2 about half as long as article 1, ventral apex with 3 setae; accessory flagellum much shorter than primary flagellum, 3-articulate, primary 5-articulate, aesthetascs present, bases tubular, apices flat. Article 3 of antenna 2 with one long, one short facial setae; spine formula of article 4 = 3-3-2, proximal group thin, both proximal groups with accessory setule, dorsal margin with weak notch bearing spine and seta, ventral margin with 2 groups of 3-4 setae and 3 subbasal penicillate setules, ventrodistal margin with 3 medium to long spines, article 5 almost 0.6 times as long as article 4, facial spine formula = 1 plus accessory setule, dorsal margin straight and smooth, ventral margin with one acclivity bearing long seta and 2 setules, dorsodistal apex with 3 medium to long spines, ventrodistal apex with one spine, setule and long seta; flagellum as long as article 4 of peduncle, 4-articulate. Prebuccal complex flat anteriorly, poorly extended forward, flush with mandibular margins, poorly lobed dorsally, epistome and upper lip fused together but regions distinguishable, upper lip not widely alate, ventral margin broadly rounded, anterior face with crescentic ridge. Mandibles with strong palpar hump; right incisor with 3 teeth, notch and accessory tooth; left incisor with 5 humps in 2 branches; right lacinia mobilis broadly flabellate, poorly developed, short, bearing one facial hump, biting margin weakly sinuate; left lacinia mobilis broadly

flabellate, with 6 irregular teeth; right rakers 2, left 3; mandibular molar small, projecting, heavily setulose, these setules attached to strongly cornified clear cone on apex of molar; palp article 2 naked, article 3 about 0.8 times as long as article 2, strongly oblique apex with 10 setae. Lower lip with small contiguous pair of cones on each outer lobe. mandibular lobes long, broad, asymmetrically rounded apically, inner lobes broad, fully fused together and bearing longitudinal facial hump, apex of fused lobes with unusually long setules. Inner plate of maxilla 1 large, subovate, naked; outer plate with 7 spines, two of these with 1-2 cusps each on opposite sides, no spine especially thickened; palp exceeding apex of outer plate, thin, bearing 3 apically flush setae. Inner plate of maxilla 2 broader than and almost flush with outer plate, setae sparse but long, inner plate with medial seta on back face submarginally; outer plate with 2 medial setae. Inner plate of maxilliped long, narrow, with 2 apical setae; outer plate long and thin, with 3 medial spines; palp article 2 moderately setose medially (double rows), article 3 with 2 facial setae, article 4 of medium length, almost fully unguiform, bearing one long apical spine and 2 accessory setae. Coxa 1 weakly expanded distally; setal formula of coxae 1-4 = 8-(9-10)-9-4; coxa 4 very large, anterior and posterior margins weakly divergent, posterodorsal excavation medium, almost L-shaped, ratio of width to length = 15:16. Gnathopod 1 slender, gnathopod 2 as long as but stouter than gnathopod 1; long posterior setae on article 2 of gnathopods 1-2 = 1 and 3, small anterior setae on both members = 1 and 2; article 5 on gnathopod I long, with produced but then flattened posterior margin, this article short on gnathopod 2 and almost cryptic; article 6 of both gnathopods long, constricted in middle, curving and expanding apically, strongly chelate, apex of palm bearing scale-like protrusion and medium spine; apices of dactyls curved but simple and sharp, article 3 of both gnathopods weakly and equally elongate; length ratios of articles 5-6 on gnathopods 1-2 = 65:110 and 55:116, width ratios = 28:43 and 29:52 (base of article 6=35and 47). Pereopods 1-2 generally similar to each other; long posterior setae on article 2 of pereopods 1-2=5 and 6, each with one short posterior seta, naked anteriorly, articles 4-5 lacking facial armaments except for one apicodorsad seta on arti-

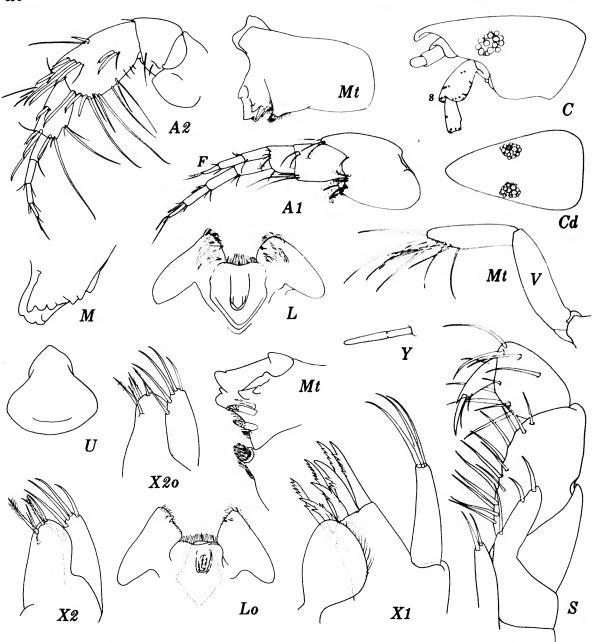


FIGURE 250.—Limnoporeia yarrague, new species, holotype, female "a," 3.86 mm (Y = aesthetasc).

cle 5, article 4 with several groups of weakly dendritic posterior setae, produced dorsal apex with one long, one short setae, article 5 with several posterior setae, one long distal spine reaching about to M. 75 on article 6; article 6 with one midposterior seta on pereopod 1, joined by spine on

pereopod 2, article 6 with apical rows of 3 and 3 spines (or setae); dactyl very long, deeply hooked and sharp, lacking acclivities and nail and basal outer setule. Coxae 5-7 posteroventral setule formula = 0-0-0. Articles 4-5 of pereopods 3-4 narrow, facial spines absent; width ratios of articles

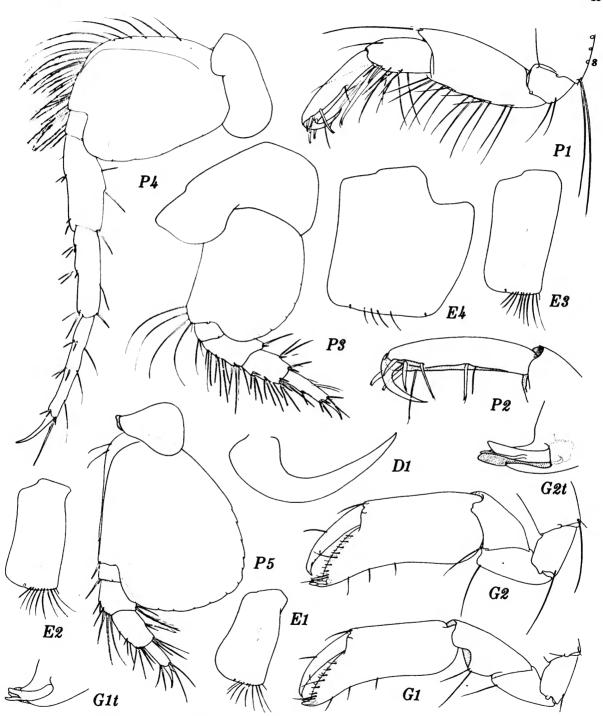


FIGURE 251.—Limnoporeia yarrague, new species, holotype, female "a," 3.86 mm.

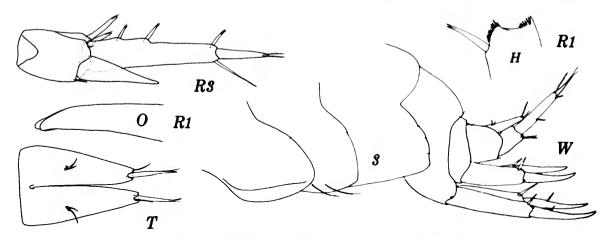


FIGURE 252.—Limnoporeia yarrague, new species, holotype, female "a," 3.86 mm.

2, 4, 5, 6 of pereopod 3 = 68:22:19:9, of pereopod 4 = 81:26:17:9, of pereopod 5 = 95:23:17:8, length ratios of pereopod 3 = 88:29:26:32, of pereopod 4 = 105:59:59:70, of pereopod 5 = 120: 24:29:20; article 2 of pereopod 5 extending to apex of article 4: medial apex of article 6 sinuate and combed. Posteroventral corners of epimera 1, 2, 3 = rounded, quadrate, and weakly protuberant, posterior margins = almost flat, weakly convex, and weakly convex, with one setule each on epimera 1-2 and 3 on epimeron 3, epimeron 2 with 2 facial setae, lacking ridge. Urosomite 1 naked ventrally. Apicolateral corner of peduncle on uropod 1 with medium spine and strong combs, medial apex with long spine, margins otherwise naked, each ramus of uropods 1-2 with poorly defined apical nail (largely obsolescent) and scale, latter poorly developed on uropod 2, rami of uropod 1 each with dorsal spine, rami of uropod 2 naked dorsally, peduncle of uropod 2 with one apicolateral, one apicomedial spine, apicolateral corners with combs. Uropod 3 long, peduncle with 2 ventrolateral spines, one apicomedial spine, rami feminine, inner extending to M. 60 on article 1 of outer ramus, inner ramus lanceolate, bearing one vestigial setule, article 1 of outer ramus attenuate apically, bearing 2 lateral spines, one apicolateral spine, distance between spines 2 and 3 much greater than between spines 1 and 2, article 2 elongate, 0.40, bearing 2 short apical setae. Lengthwidth ratio of telson about 19:13, not fully cleft, each apex very narrow, truncate, bearing long spine and short lateral setule, middorsal pair of

short plusetules diverse. Cuticle bearing very sparse but ordinary bulbar setules with very short setular part emerging into shallow dishpits, epimera with very fine and weak striations. Gill of gnathopod 2 absent, of pereopod 5 vestigial.

OBSERVATIONS (specimens from Merimbula, N.S.W.).—Smallest ovigerous females available.

Female "f," 2.81 mm: Mandibular palp article 2 with one inner apical seta, article 3 with 8. Spine formula on article 4 of antenna 2 = 3-3-1. Setal formula of coxae 1-4 = 6-7-7-1. Article 6 of pereopods 1-2 with 2 disjunct posterior setal-spines. Article 2 of pereopod 5 with only 4 posterior teeth. Epimeron 1 lacking ridge; epimeron 3 with only one posterior setule notch. Article 1 on outer ramus of uropod 3 with only one lateral spine acclivity, article 2 almost 60 percent as long as article 1.

Male "m," 3.15 mm: Eyes enlarged, mostly occluded by pigment. Article 1 of antenna 1 with medial patch of aesthetascs (fuzz); article 2 with 3 apicoventral setae; accessory flagellum 3-articulate; primary flagellum 5-articulate, both bearing aesthetascs. Articles 3-4 of antenna 2 with dorsomedial patches of fuzz, articles 4-5 stout, spine formula on article 4 = 3-3-1 or 3-3-2, ventral margin with 4 short apical setae and setules, apicodistal margin with 3 short spines, article 5 spine formula = 1, apicoventral margin with small spine and several setules, midapex with one spine, dorsal apex with 2 spines and calceolus, flagellum elongate, flagellar formula = 38, 2, 3, 5, 7 . . . 21 or 2, 4, 6, . . . 20. Article 2 of mandibular palp with 3 long

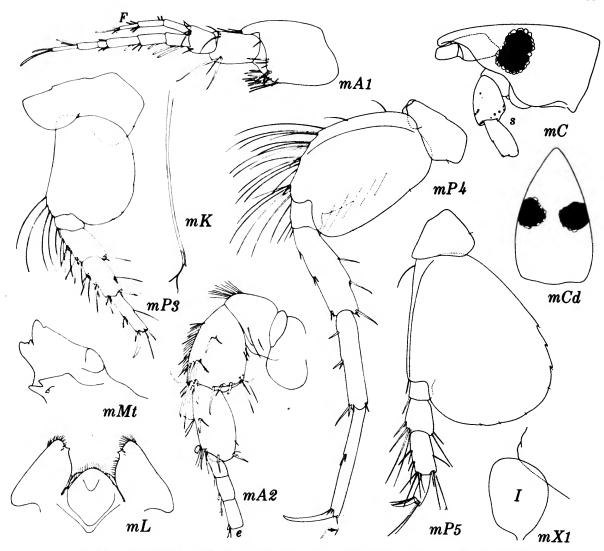


FIGURE 253.—Limnoporeia yarrague, new species (m = male "m," 3.15 mm; K = seta of pereo-pods 1-2).

inner apical setae, article 3 with 10 apical setae; form of right lacinia mobilis shown in illustration. Inner lobes of lower lip more tumid than in female (see illustration). Inner plate of maxilla 1 more circular than in female (see illustration). Outer plate of maxilla 2 with 6 setae. Coxa 1 relatively smaller in ratio to coxa 4 than in female, shape of latter like that of female; setal formula on coxae 1-4 = 6-8-8-3. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 1-1-2-3, short anteriors = 2-2-1-0, no others; article 6 of

gnathopod 1 slightly stouter than in female, ratio of lengths of articles 5-6 of gnathopod 1 = 64:102, widths = 22:36. Article 6 of pereopods 1-2 with spine formula of 3-3 plus 2 setal spines disjunct on posterior margin. Pereopod 3 smaller relative to pereopod 5 than in female, article 2 of pereopod 4 thin. Epimeron 2 slightly enlarged, epimeron 3 shortened posteriorly, lengthened anteriorly (see illustration), epimeron 1 lacking ridge and setae, epimeron 2 with 2 setae, no ridge, epimeron 3 with 2 posterior setule notches. Medial margin of

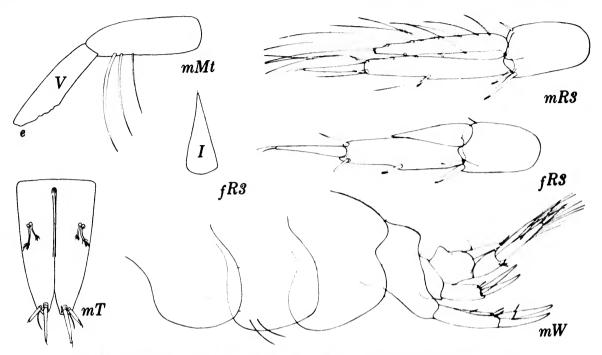


FIGURE 254.—Limnoporeia yarrague, new species (m = male "m," 3.15 mm; f = female "f," 2.81 mm).

peduncle on uropod 1 with 2 spines. Peduncle of uropod 3 with 2 ventral spines; rami submasculine, inner reaching almost to apex of article 1 on outer ramus, setose medially, with one lateral seta and 2 apical setae, article 1 of outer ramus with one lateral acclivity, spine formula = 1-1, setal formula = 1-1, article 2 about 42 percent as long as article 1, bearing 2 short apical setules. Telson elongate, ratio of length to width = 44:27, apices narrowly truncate, each bearing lateral setule, one medium spine and one medial longer spine, dorsal denticle rows absent. Urosome highly modified; urosomite 1 with large dorsal crest-hump; urosomite 2 forming saddle between urosomites 1 and 3; urosomite 3 with erect dorsal hump. Like female: gnathopods 1-2, pereopods 1-2, coxae 1-4 except for items specifically mentioned.

OBSERVATIONS (specimens from EBS).—Male "d," 3.66 mm, EBS 138: Epimeron 2 without setae; flagellum on antenna 2 with 46 articles; humps on urosomites 1 and 3 more strongly produced than in figured male; setae of pereopods 1–2 as in superfemale described below.

Senile superfemale "e," 5.25 mm, EBS 103:

Head elongate. Eyes enlarged as in male. Flagellum of antenna 2 with 9 articles, basal articles short, appearing in proliferative phase. Setal formula of coxae 1-4 = 10-12-10-6. Epimeron 3 with 2 posterior notches. Uropods 1-2 and outer ramus of uropod 3 as in holotype, inner ramus of uropod 3 elongate, reaching to about M. 80 along article 1 of outer ramus, not marginally setose. Telson as in figured male, with 2 apical spines and setule on each lobe. Urosomite 1 with rudimentary hump but urosomite 3 unproduced dorsally. Apices of setae on pereopods 1-2 with trigger extension relatively smaller and shorter than in small adults and not secondarily branched. Broodplates of pereonites 3-5 fully developed.

Specimens from EBS 103, 304, and 313 are somewhat smaller than the holotype but several are sexually mature; female "g," 3.36 mm, from EBS 313 bears 4 eggs. The eyes of all specimens are darkly occluded with purple pigment except for peripheral fractions of a few ommatidia (specimens held in formaldehyde only for short time). In other respects these specimens fit the holotype, except for female "g," which has an elongate article 2 on the

outer ramus of uropod 3, this article being 51 percent as long as article 1 compared with 42 percent for the holotype; all others of these dark-eyed specimens have the second article on the outer ramus of uropod 3 close to the condition figured for the holotype.

ILLUSTRATIONS.—Outer lobes of lower lip unflattened.

HOLOTYPE.—NMV, female "a," 3.86 mm.

TYPE-LOCALITY.—CPBS 00E/4, 5 Apr 1965, Western Port, Victoria, Australia, 2.1 m, bottom unknown.

VOUCHER MATERIAL.—CPBS 00E/2: female "b," 3.20 mm. MMD, on edge of channel, 10 Feb 1972: female "f," 2.81 mm (illus.); male "m," 3.15 mm (illus). EBS 103: female "e," 5.25 mm. EBS 138: male "d," 3.66 mm. EBS 313: female "g," 3.36 mm. EBS 304 (1). EBS 103 (4).

RELATIONSHIP.—This species resembles Limnoporeia maranowe in its general appearance but differs in the following characters, none of which appears to have a particular association with body size because of equivalent sizes of material studied: 1) the absence of a vertical brush of setae on epimeron 2; (2) the elongate dactyls of pereopods 1-2; (3) the narrow apices and long spines of the telson; (4) poorly developed right lacinia mobilis; (5) fully fused inner lobes on the lower lip; (6) poorly alate upper lip; (7) short accessory flagellum of antenna 1; (8) the ordinary bulbar setules of the cuticle; (9) presence of apicolateral combs on the peduncles of uropods 1-2; (10) backside facial seta on inner plate of maxilla 2. Minor differences include the shorter apical setae on both rami of uropod 3, the elongate apical section on article 1 of the outer ramus of uropod 3, the stouter article 2 of pereopod 3 and much smaller articles 3-7 in relation to that article 2, pereopod 3 being greatly larger in relationship to the size of pereopod 5 in this species than in Limnoporeia maranowe, and finally, the stouter and more pyriform article 2 of pereopod 4.

See L. kingi for distinctions from that species and notes on L. yarrague in Lake King.

MATERIAL.—CPBS, 2 samples (2); MMD, 3 samples (75); EBS, 4 samples from 4 stations (9); Lake King, Victoria, Paynesville, one sample (206).

DISTRIBUTION.—Victoria: Western Port, 2 m, muddy sand; Lake King. New South Wales: Botany Bay, Towra Beach, 0.9 m, Zostera and shell grit;

Merimbula, intertidal, muddy sand; Georges River, Woronora, 3 m, sand.

Limnoporeia woorake, new species

FIGURES 255-257

Description of Female.—Head about 15 percent of total body length, greatest width slightly more than 60 percent of length; rostrum long, reaching about to middle of article 2 on antenna 1 (but this article unusually elongate), unconstricted, tapering evenly, apex rounded. Eyes of medium size, ochraceous, free of dark pigment in preservative. Article l on peduncle of antenna l about 1.35 times as long as wide, about 1.7 times as wide as article 2, apicoventral region with about 6 setules, strongly produced dorsal apex with 2 setules; article 2 about as long as article 1, ventral apex with 3 long setae; accessory flagellum slightly shorter than primary flagellum, accessory flagellum 3-articulate, primary 4-articulate, aesthetascs very weak if not absent. Article 3 of antenna 2 with one medium, one short facial setae; spine formula of article 4 = (1?)-3-4-2, thick formed, both proximal groups with accessory setule, one spine of most proximal group elongate and seta-like, dorsal margin with one short thick spine, ventral margin with 2 penicillate setules, one apical acclivity with 2 short setae, ventrodistal margin with one seta, 2 spines, followed by one seta; article 5 about 0.8 times as long as article 4, facial spine formula = 3 plus one accessory setule, dorsal margin straight and smooth, ventral margin with one acclivity bearing 2 medium stiff setae, dorsodistal apex with 2 spines, ventrodistal apex with one long spine and 2 subdistal setae; flagellum about 0.4 times as long as article 5 of peduncle, 3-articulate. Prebuccal complex flat anteriorly, poorly extended forward, flush with mandibular margins, poorly lobed dorsally, epistome and upper lip fully articulate dorsally, upper lip poorly alate, anterior margin with weak crescentic rugosity highly ventrad, lower margin with hump defined laterally on both sides by weak sinus. Mandibles with medium-sized palpar hump; right incisor with 3 teeth and ripples, accessory hump in crotch between 2 proximal teeth; left incisor with 5 humps in 2 branches; right lacinia mobilis broadly flabellate, well developed, with 3 facial teeth, distal margin variously toothed; left lacinia mobilis broadly

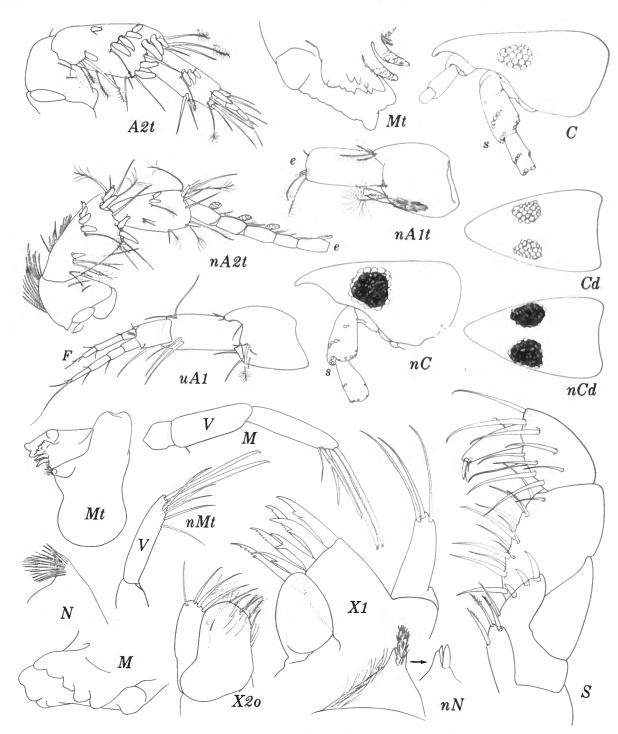


FIGURE 255.—Limnoporeia woorake, new species, holotype, female "a," 4.75 mm (n = male "n," 3.57 mm; u = female "u," 3.76 mm).

flabellate, with 5 teeth; right rakers 2, left 3; mandibular molar small, projecting, heavily setulose, these setules attached to weakly distinct but cornified clear cone occasionally subdivided into 2 branches; palp article 2 with one inner basal setule, article 3 about 1.1 times as long as article 2, oblique apex with 4-5 setae. Lower lip with small pair of cones on each outer lobe, mandibular lobes of ordinary extension, apices narrow and rounded, inner lobes of ordinary width, fused together except for deep apical incision, bearing longitudinal facial hump also divided apically. Inner plate of maxilla I large, ovate, naked, attached by broad base (unusual); outer plate with 7 spines, none with cusps on opposite sides; palp reaching only to apex of outer plate, of medium stoutness, bearing 2 apicomedial and one apicolateral setae. Inner plate of maxilla 2 much broader than and flush with outer, setae on inner plate very short, one seta medial, setae on outer plate very long, one seta medial. Inner plate of maxilliped with one apical, one apicolateral and one medial setae; outer plate with 4 medial spines; palp article 2 moderately setose medially (double rows), article 3 with 3 facial setae, article 4 of medium length, almost fully unguiform, bearing one short apical spine and 2 accessory setae. Coxa 1 strongly expanded distally, adz-shaped; setal formula of coxae 1-4 = 3-3-2-0; coxa l occasionally with midventral bulbar setule; anterior and posterior margins of coxa 4 divergent, with long posterodorsal lobe, posterodorsal excavation medium, almost L-shaped, ratio of width to length = 41:39. Gnathopod 1 very slender (except for article 6), gnathopod 2 as long as but much stouter than gnathopod 1, long posterior setae on article 2 of gnathopods 1-2=0 and 2, short setae = 0 and 3, anterior margins with 4 and 2 short setae, article 3 of both gnathopods of normal length; article 5 of gnathopod 1 highly elongate, with weakly extended posterior margin, article 5 of gnathopod 2 shorter and almost cryptic; article 6 of gnathopods large but diverse, both weakly chelate, apex of palm on gnathopod 2 bearing scalelike protrusion and medium spine, scale thin and spine-like, gnathopod I lacking scale but with strong scale-like elongate tooth and small spine, article 6 of gnathopod 1 expanding distally, posterior margin undulant, this article on gnathopod 2 of more regular trapezoidal form, apex of dactyl on gnathopod 1 subflagellate. Length ratios of articles

5-6 on gnathopods 1-2 = 92.74 and 59.90, width ratios = 21:55 and 20:66. Pereopods 1-2 generally similar to each other; long posterior setae on article 2 of pereopods 1-2=7 and 6, long anterior setae = 1 and 0, short anterior setae = 2 and 1; article 4 slightly shorter on pereopod 2, articles 4-5 lacking facial armaments, posterior margin of article 4 with 2 groups each of 4-5 and 2-3 simple setae, article 5 with several posterior setae and one unusual, short, apically flagellate spine, long distal spine reaching about to M. 60 on article 6; article 6 with one short stout midposterior spine, apical rows of 3 and 1 spines, dactyl of normal phoxocephalid proportions, with strong inner acclivity in form of hook bearing contiguous long setule, apical nail absent or invisible, base of dactyl with ordinary long plusetule. Coxae 5-7 posteroventral setule formula = 1-1-1. Articles 4-5 of pereopods 3-4 of medium stoutness, facial spines moderately developed anteriorly; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 60:27:21:12, of pereopod 4 =78:28:20:11, of pereopod 5 = 115:22:20:10, length ratios of pereopod 3 = 70:23:30:28, of pereopod 4 = 90:45:39:28, of pereopod 5 = 112:27: 31:18; article 2 of pereopod 5 slightly exceeding apex of article 4; medial apex of article 6 slightly ragged but not combed. Posteroventral corners on epimera 1, 2, 3, = rounded, rounded, protuberant and bearing setule sinus, posterior margins all protuberant, with one setule each on epimera 1-2, one seta and one setule on epimeron 3 in deep notches between protuberances, epimeron 2 with one facial seta. Urosomite 1 naked ventrally. Apicolateral corner of peduncle on uropod 1 with small spine, no combs, medial apex lacking spine but margin at base of outer ramus with weak comb; peduncle of uropod 2 with one apicolateral spine, medial apex with setule, no combs on uropod 2; rami of uropods 1-2 all naked dorsally, apical nails large, fused and marked only by striation bank, each bearing scale, mediobasal margin of inner ramus on uropod 1 with tiny setule. Uropod 3 long, peduncle with one ventral spine, one apicolateral and one apicomedial spine; rami feminine, inner ramus very short, leaf-like, apex bearing setule, reaching about M. 40 on article 1 of outer ramus, article 1 of outer ramus bearing one lateral acclivity armed with one short stout spine and 2 long setae, similar armament apicolaterally, medial apex with 2 setae, article 2 slender and ordi-

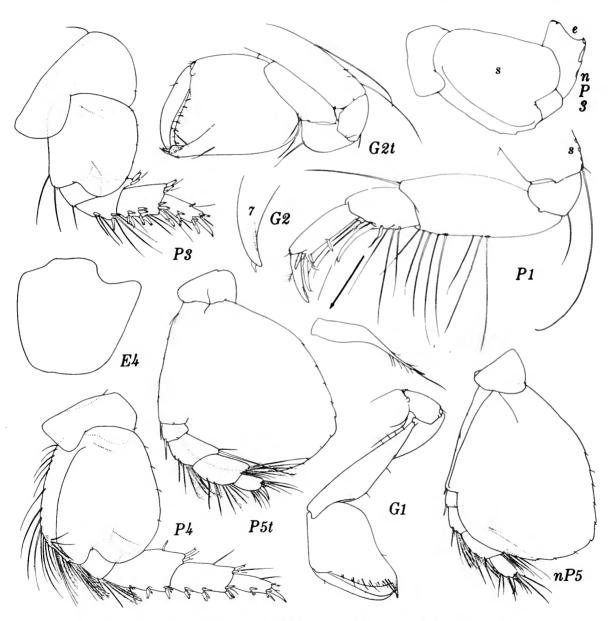


FIGURE 256.—Limnoporeia woorake, new species, holotype, female "a," 4.75 mm (n = male "n," 3.57 mm).

nary, 0.23, bearing 2 apical setae. Length-width ratio of telson about 6:5, not fully cleft, each apex of ordinary width, weakly concave, armed with medium spine and one larger lateral setule, middorsal pair of medium plusetules subequal. Cuticle bearing very sparse and unusually tiny bulbar setules barely emerging into wide and shallow dish-

pits, epimera with very weak and fine striations. Gnathopod 2 with small, leaf-like gill, pereopod 5 with vestigial, knob-like gill.

DESCRIPTION OF MALE.—Head about 19 percent of total body length, eyes enlarged, with deep purple core in preservative surrounded by 1.0-1.5 layers of ommatidia. Primary flagellum of antenna 1

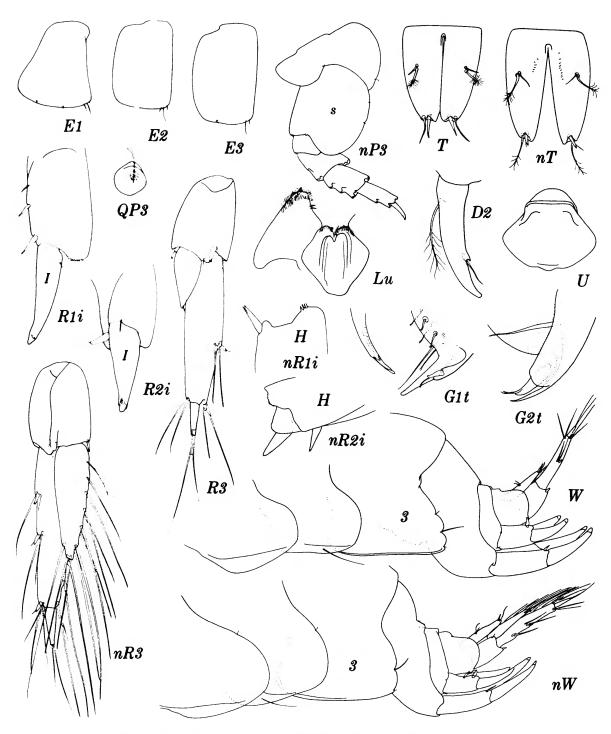


FIGURE 257.—Limnoporeia woorake, new species, holotype, female "a," 4.75 mm (n = male "n," 3.57 mm).

with 5-6 articles, aesthetascs much stronger than in female, primary flagellum with one calceolus each on articles 1 and 2, articles 2-3 otherwise like those of female, ventromedial face of article 1 of peduncle bearing patch of fuzz, elements very stout. Articles 3-4 of antenna 2 like those of female but dorsal margins with fuzz composed of very stout elements almost of magnitude of aesthetascs, dorsal spine of article 4 absent, article 5 broader than in female, facial spine formula = 2, ventral margin with 2 sets of short setae and setule, dorsal apex with only one small spine; flagellum elongate, about one third of body length, flagellar formula = (16-18), 1-3, 5, 7... (15 or 17). Mandibular palp article 3 with 7 apical spine-setae. Coxae 1 and 3 like those of female, coxa 2 about 10 percent taller than in female, coxa 4 slightly narrower (anteroposterior) than in female, coxa 2 with only 2 posteroventral setae. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 1-2-4-4, anterior short setae = 1-0-1-1, medium anterior setae = 0-1-0-0, long anterior setae = 0-0-1-0. Article 4 of pereopods 1-2 slightly thinner than in female and bearing posterior groups of only 4 and 1 setae or 4 and 2. Pereopod 3 much smaller and pereopod 4 slightly smaller relative to pereopod 5 than in female; article 2 of pereopod 3 much narrower, of pereopod 4 slightly narrower than in female, article 2 of pereopod 5 narrower than in female. Epimera wider than in female, posterior margin of epimeron 3 generally with only one long seta and one setule at corner but young males with epimeron 3 like that of female. Urosomite 1 with dorsal denticles. Peduncle of uropod 2 with 2 apicodistal spines, medial apices on peduncles of uropods 1-2 at base of outer ramus with combs, strong and few members on uropod 1. Uropod 3 masculine, strongly setose, article 1 of outer ramus with 2 lateral acclivities each armed with one short spine and 2 long setae, inner ramus extending only to M. 70 on article 1 of outer ramus, peduncle lacking apicolateral spine. Telson longer than in female, main apical spine on each lobe shorter than in female and apicolateral plusetule longer, each lobe with basomedial row of dorsal denticles. Gill on pereopod 5 well developed.

VARIATIONS.—Female "f," 3.66 mm: article 5 of antenna 2 with only 2 facial spines but epimeron 4 with 4 posterior notches and article 1 of uropod 3 with 2 sets of lateral spine-setae. Male "g," 3.43

mm: epimeron 3 with 5 notches posteriorly and article 5 of antenna 2 with stout posterior spine (and setule) in place of thin spine (and setule) seen in figured male of this species.

HOLOTYPE.—NMV, female "a," 4.75 mm.

Type-Locality.—CPBS A3/5, 6 Aug 1964, Western Port, Victoria, Australia, 15.4 m, bottom unknown.

VOUCHER MATERIAL.—PPBES 986/5: male "n," 3.57 mm (illus.); female "u," 3.76 mm (illus.); male "d," 3.43 mm; plus 3 other females and one male. CPBS 32E: female "f," 3.66 mm. RHM: male "g," 3.43 mm, and one other male.

RELATIONSHIP.—This species can be distinguished from both Limnoporeia maranowe and L. yarrague in the presence of only one facial seta on epimeron 2, in the ordinary dactyls of pereopods 1-2 bearing the normal acclivity and setule, in the elongate article 2 of antenna 1, and in the apices of the telson which are broader than those of L. yarrague and lack the medial lobe of L. maranowe. The inner plate of maxilla 2 is much broader than in the other 2 species, and maxilla 1 differs in: the broad basal attachment of the inner plate, the short and stouter palp, and the absence of opposite cuspidation on certain spines of the outer plate. Mandibular palp article 2 is somewhat elongate in this species. The normal right lacinia mobilis stands in contrast to that of L. yarrague. The stout spines of antenna 2 are reminiscent of species thought to be inquilinous in Syndexamine and even Kondoleus. Proportions of gnathopods also distinguish this species from others (see illustra-

MATERIAL.—CPBS, 3 samples from 3 stations (3); RHM (4); PPBES, 5 samples from 3 stations (27). DISTRIBUTION.—Victoria: Western Port and Port Phillip Bay, neritic and 4–15.4 m, sand, sandy gravel.

Limnoporeia ungamale, new species

FIGURES 258-260

Description of Female.—Head about 20 percent of total body length, greatest width about 50 percent of length; rostrum very long, exceeding apex of article 2 on antenna 1, unconstricted, apex narrow but rounded, apicoventral face of rostrum weakly thickened. Eyes of medium size, circular,

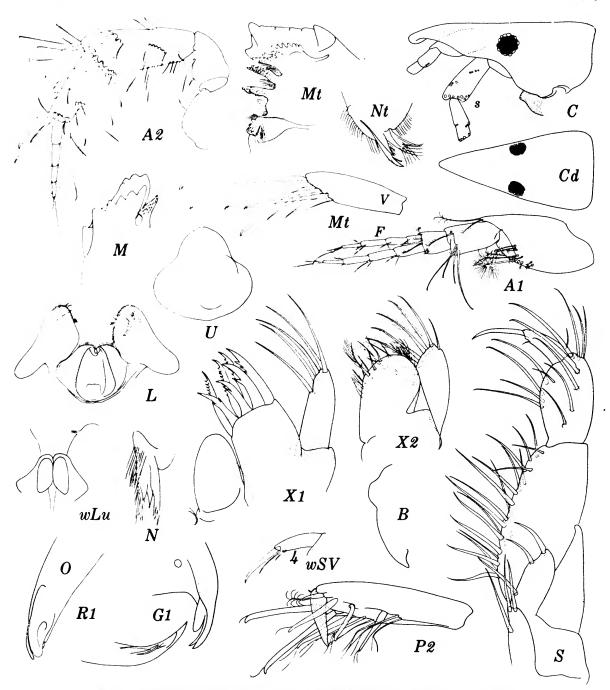


FIGURE 258.—Limnoporeia ungamale, new species, holotype, female "a," 4.29 mm (w = female "w," 3.62 mm).

composed of black core in preservative surrounded by one layer of clear ommatidia. Article 1 on peduncle of antenna 1 about twice as long as wide, twice as wide as article 2, apicoventral region with 8 setules, strongly produced dorsal apex with 2 setules; article 2 about 0.5 times as long as article 1. ventral apex with 4-5 setae; accessory flagellum slightly shorter than primary flagellum, latter with 4 articles, former with 3-4 articles, aesthetascs absent or perhaps one alone present. Article 3 of antenna 2 with one long, one short facial setae; spine formula of article 4 = 3-3-5 or 3-3-3, proximal spines thin, both proximal groups with accessory setules, dorsal margin with weak notch bearing spine and seta, ventral margin straight and naked except for subbasal penicillate setules and one midmarginal setule, ventrodistal margin with 2 medium to short spines and group of 3 setal spines; article 5 almost 0.7 times as long as article 4, facial spine formula = either 1 or 2 plus accessory setule, dorsal margin straight and smooth, ventral margin with acclivity bearing 2-3 spines plus setule, dorsodistal apex with 2 spines, seta and setule, mid- and ventrodistal apex with 2 long spine-setae, 2 setules; flagellum as long as article 5 of peduncle, 4-articulate. Prebuccal complex with epistomal hump moderately extended forward, epistome and upper lip fused together, upper lip with rounded but extended lateral humps, ventral margin with weak middle hump, weak anterior crecentic ridge. Mandibles with strong palpar hump; right incisor with 3 teeth, notches and ripples; left incisor with 5 humps in 2 branches; right lacinia mobilis broadly flabellate, minutely and complexly toothed, bearing toothed facial hump and several small facial teeth; left lacinia mobilis broadly flabellate, with 5 teeth; right rakers 2, left 3; mandibular molar small, projecting, subconical but apically divided into 4 spiniform and setulose teeth; palp article 2 with one subbasal short inner seta, article 3 about 1.3 times as long as article 2, strongly oblique apex with 8 setae. Lower lip with 2-3 cones on outer lobe, mandibular lobes of medium length, rounded apically, inner lobes broad, fused together for most of their length but oral and aboral faces bearing two separate humps or one fused plaque. Inner plate of maxilla 1 large, subovate, naked, base very broad; outer plate with 7 spines, one of these with one cusp on opposite side; palp exceeding apex of outer plate, medium-thin,

bearing 5 apical and subapical setae, one subapical seta in medial notch. Inner plate of maxilla 2 extremely broad and slightly shorter than outer plate, setae sparse, one small medial seta; outer plate with several medial setae. Inner plate of maxilliped with 2 apical and one medial setae; outer plate with 3 medial spines; palp article 2 moderately setose medially (2 rows), article 3 with 4 facial setae, article 4 of medium length but bearing long apical nail and almost fully unguiform, accessory setae on apex of article 4 either 1 or 2, second seta if present elongate. Coxa 1 expanded apically; setal formula of coxae 1-4 = (5-6)-(5-7)(5-7)-(3); coxa 4 strongly quadratiform, anterior and posterior margins parallel, posterodorsal excavation shallow but wide, V-shaped, ratio of width to length = 11:12. Gnathopod 1 especially slender; gnathopod 2 as long as but stouter than gnathopod 1; long posterior setae on article 2 of gnathopods 1-2 = 1 and 1, short anterior setae = 3 and 3; article 3 of both gnathopods slightly elongate; article 5 on guathopod 1 long, with flat and free posterior margin, this article much shorter on gnathopod 2, posterior margin somewhat triangular and almost cryptic; article 6 of both gnathopods long, tapering slightly on gnathopod 2 but constricted in middle on gnathopod 1 and reexpanding apically, strongly chelate apices of palms and curved apices of dactyls similar on both sets of gnathopods, each with long thin scale-like extension and medium spine, apical scale on dactyls scarcely distinct, pointed, essentially nail-like; length ratios of articles 5-6 on gnathopods 1-2 = 87:97 and 60:127, width ratios = 21:38 and 28:54. Pereopods 1-2 generally similar to each other; long posterior setae on article 2 of pereopods 1-2=2 and 4, short setae = 1 and 0, short anterior setae = 5 and 4, only pereopod 1 with posterodistal corner bearing 2 setae (not in normal posterior formula), strongly shifted proximally; articles 4-5 lacking facial armaments, article 4 with 3 groups of dendritic posterior setae, produced anterodistal apex with seta and setule, article 5 with dense posterior setae, long distal spine reaching almost to M. 80 on article 6; article 6 with 2 midposterior sets of 3 setae each (rarely 2 setae in set), apical and posterior rows of 4 and 3 spines, spines mostly long and medium; dactyl of medium (normal) length, almost straight, lacking acclivities and setules but weakly constricted apically and bearing partially fused blunt apical nail.

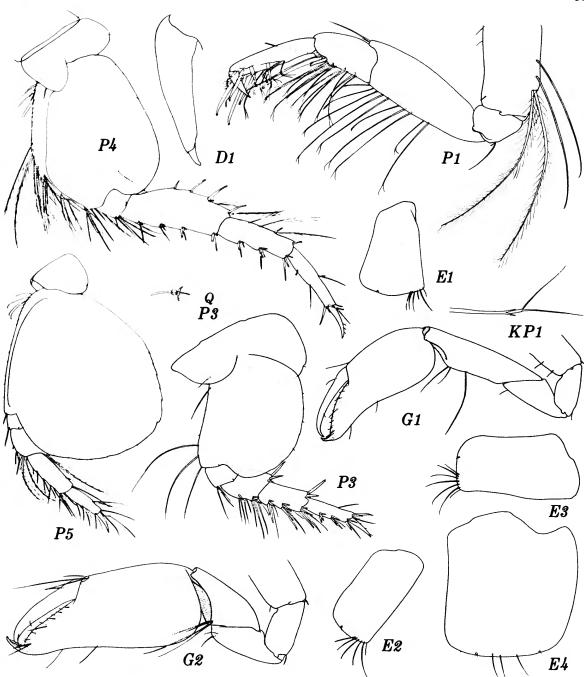


FIGURE 259.—Limnoporeia ungamale, new species, holotype, female "a," 4.29 mm.

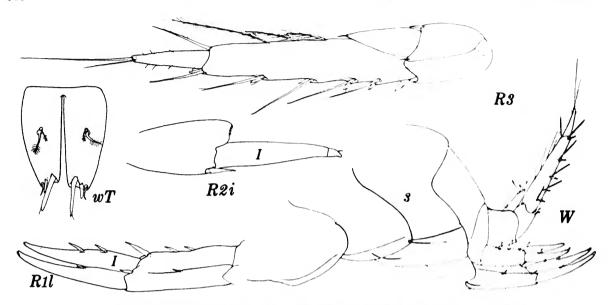


FIGURE 260.—Limnoporeia ungamale, new species, holotype, female "a," 4.29 mm (w = female "w," 3.62 mm).

Coxae 5-7 posteroventral setule formula = 1-1-1. Articles 4-5 of pereopods 3-4 narrow; facial spines almost absent or weakly developed on anterior margins of articles 4-6 of pereopod 3; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 64:21:15:9, of pereopod 4 = 80:27:16:10, of pereopod 5 =102:17:12:8, length ratios of pereopod 3 = 80: 23:30:33, of pereopod 4 = 97:67:49:47, of pereopod 5 = 115:24:33:25; article 2 of pereopod 5 reaching apex of article 4; medial apex of article 6 on pereopod 5 indistinctly ragged. Posteroventral corners on epimera 1, 2, 3 = rounded, rounded-quadrate, and weakly protuberant, posterior margins = protuberant, convex, and convex, with one setule each on epimera 1 and 3, epimeron 2 with one midfacial seta and 2 vertical setae at posteroventral corner. Urosomite 1 naked ventrally but with seta at lateral base of uropod 1; urosomite 2 with similar but smaller seta. Apicolateral corner of peduncle on uropod 1 smooth, with small spine, midlateral margin with 0-1 small spine, medial apex with medium spine, medial margin with 2 other smaller spines, rami of uropods 1-2 with apical nail obsolescent but weak scale present, outer ramus of uropod 1 with one dorsal spine, inner with 1-2, outer ramus of uropod 2 with 0-1 spine, inner naked, comb present only on medial apex of uropod 2 peduncle at base of outer ramus, medial margin of uropod 1 peduncle minutely fuzzy but not combed. Uropod 3 highly elongate, peduncle with 2 ventrolateral spines, dorsally with small medial spine, lateral setule, rami feminine, inner extending to M. 35 on article 1 of outer ramus, inner ramus leaf-like, tapering evenly, bearing apical setule, article 1 of outer ramus with 4 lateral acclivities each with short spine and long seta, similar set apicolaterally, one spine apicomedially, article 2 elongate, bearing 2 apical setae and marginal setules. Telson of ordinary length, length-width ratio = 33:28, not fully cleft, each apex broad, weakly excavate but basically truncate and inwardly oblique, bearing medium medial spine, small lateral spine and lateralmost setule, middorsal pair of plusetules diverse. Cuticle with numerous bulbar setules and weak striations. Gnathopod 2 with large gill, pereopod 5 with small but perceptible gill.

ILLUSTRATIONS.—Palpar hump of mandible similar to that shown for L. yarrague.

HOLOTYPE.—NMV, female "a," 4.29 mm.

Type-Locality.—CPBS 51N, 15 Jan 1972, Western Port, Victoria, Australia, 16.5 m, sand and mud.

Voucher Material.—CPBS C6/1, female "w," 3.62 mm (illus.). Male unknown.

RELATIONSHIP.—The species is unique in the genus for the presence of 2 stout apical spines on each apex of the telson. The dactyls of pereopods 1-2 are of ordinary length, neither elongate nor stunted, lack acclivities or setules and have a poorly defined apical nail-spine. The pair of vertically oriented posterior setae of epimeron 2 are very close to the corner, and this feature combined with the presence of only one ventrofacial seta is another good mark of identity. The head is very elongate but the apicoventral protrusion on the rostrum is very weak. Pereopods 1-2 have complex setae. All of these characters distinguish this species from Limnoporeia maranowe, L. yarrague, and L. woorake.

Limnoporeia ungamale has the unusual kind of inner plate on maxilla 1 seen in L. woorake but the gnathopods of these two species are so strikingly distinct that there can only be an indirect relationship between the two species. See L. kalduke for further distinctions.

MATERIAL.—CPBS, 2 samples from 2 stations (2). DISTRIBUTION.—Victoria, Western Port, 10-16.5 m, sand, muddy sand.

Limnoporeia wakkine, new species

FIGURES 261-263

DESCRIPTION OF FEMALE.—Female "b": about 20 percent of total body length, greatest width about 40 percent of length; rostrum very long, reaching end of article 2 on antenna 1, unconstricted or weakly so apically, apex narrow but rounded, apicoventral face of rostrum weakly thickened. Eyes of medium size, subcircular, composed of black core in preservative surrounded by occasional clear ommatidia. Article I on peduncle of antenna 1 about 2.1 times as long as wide, twice as wide as article 2, apicoventral region with about 7 setules, strongly produced dorsal apex with 4 long setules; article 2 about 0.53 times as long as article 1, ventral apex with 5 setae; accessory flagellum 4-articulate, slightly shorter than primary flagellum, latter also 4-articulate, one aesthetasc present apically on each flagellum. Article 3 of antenna 2 with one medium-long, one short facial setae; spine formula of article 4 = 3-4-4, proximal spines thin, both proximal groups with accessory setule, dorsal margin with weak notch bearing spine, ventral margin straight and naked except for medial penicillate setules extending unusually distad, ventrodistal margin with 3 medium to long spines and group of 3 short setae; article 5 about 0.75 times as long as article 4, facial spine formula = 1 plus accessory setule, dorsal margin straight and smooth, ventral margin with acclivity bearing 2 spines plus seta and setule, dorsodistal apex with 3 short to long spines and several setae, ventrodistal apex with long spine-seta and 2 setules; flagellum as long as article 5 of peduncle, 3-articulate, basal article elongate. Prebuccal complex weakly undulant anteriorly, moderately extended forward, epistome and upper lip fused together, upper lip with weakly excavate ventral margin, weak anterior crescentic ridge. Mandibles with strong palpar hump; right incisor with 3 teeth, notches and ripples; left incisor with 7 humps in 2 branches; right lacinia mobilis broadly flabellate, bifid, proximal branch resembling raker spine with papillate setules, distal branch weakly serrate distally, one facial hump near base of proximal branch; left lacinia mobilis broadly flabellate, with 5 teeth; right rakers 2, left 3; mandibular molar large, forming plaque with apex weakly projecting and bearing 3-4 fixed spine-teeth and one complexly penicillate short seta; palp article 2 with one subbasal short inner seta, article 3 about 1.15 times as long as article 2, strongly oblique apex with 8 spine-setae. Lower lip with 4 cones on outer lobe, 2 of these facial, mandibular lobes short, almost subacute apically, inner lobes of moderate size, fused together for most of their length but aboral face bearing plaque. Inner plate of maxilla 1 large, subovate, naked, base broad; outer plate with 7 spines, none of these with cusp on opposite side; palp exceeding apex of outer plate, medium-thin, bearing 5 apical and subapical setae, most subapical setae in weak medial notch. Inner plate of maxilla 2 extremely broad and slightly shorter than outer plate, setae sparse, one medial seta and 2 large facial setae: outer plate with several medial setae. Inner plate of maxilliped with attenuate apex bearing one seta, apicolateral acclivity bearing second seta, medial margin with seta; outer plate with 3 medial spines; palp article 2 strongly setose medially (3 rows), article 3 with 4 facial setae, article 4 elongate, bearing medium apical nail, two accessory setae, one highly disjunct. Coxa l expanded distally; setal formula of coxae 1-4 = 6-7-8-3; coxa

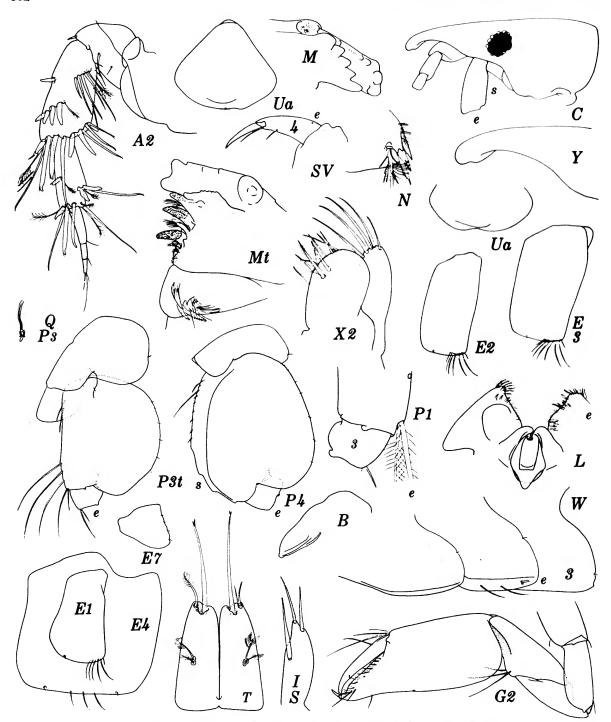


FIGURE 261.—Limnoporeia wakkine, new species, female "b," 4.24 mm (Y = rostrum).

4 strongly quadratiform, anterior and posterior margins parallel, posterodorsal excavation shallow but wide, V-shaped, ratio of width to length = 1:1. Gnathopod 1 especially slender, gnathopod 2 as long as but slightly stouter than gnathopod 1; long posterior setae on article 2 of gnathopods 1-2 = 1-1, short anterior setae = 3-4, no others; article 3 of both gnathopods slightly elongate but more so on gnathopod 2 (length ratio of this article on gnathopods 1-2 = 35:45); article 5 on gnathopod I long, with flat and free posterior margin, this article shorter on gnathopod 2, posterior margin bluntly triangular but not cryptic; article 6 of both gnathopods long, on gnathopod 2 tapering slightly but on gnathopod I weakly constricted in middle and reexpanding apically; strongly chelate apices of palms and curved apices of dactyls similar on both sets of gnathopods, each with long thin scale-like extension and medium spine, apical scale on dactyls scarcely distinct, pointed, essentially nail-like; length ratios of articles 5-6 on gnathopods 1-2 =87:90 and 66:115, width ratios = 18:34 and 27:47. Pereopods 1-2 generally similar to each other and to L. ungamale but articles 5-6 slightly smaller; long posterior setae on article 2 of pereopods 1-2=2 and 3, short anterior setae = 5 and 5, pereopod 1 with normal distal placement of apicoposterior setal pair on article 2; articles 4-5 lacking facial armaments, article 4 with 3-4 groups of simple posterior setae (1 or 2 to 6 setae per group), produced anterodistal apex with 1-2 setae (one a setule), article 5 with dense posterior setae, long distal spine reaching almost to M. 80 on article 6; article 6 with 2 midposterior sets of 3 setae each, rarely 4 (one pereopod only), apical and posterior rows of 4 and 3 spines, spines mostly long and medium; dactyl of medium (normal) length, almost straight, lacking acclivities and setules and bearing almost fully invisible apical immersed nail. Coxae 5-7 posteroventral setule formula = 1-1-4. [Articles 6-7 of pereopod 3 and 5-7 of pereopod 4 missing]; articles 4-5 of pereopods 3-4 narrow, facial spines almost absent or weakly developed on anterior margin of articles 4-5 of pereopod 3; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 65:20:16:?, of pereopod 4 = 80:25:7:7, of pereopod 5 = 100:21:13:9, length ratios of pereopod 3 = 78:24: 28:?, of pereopod 4 = 91:65:?; of pereopod 5 = 110:24:35:25; article 2 of pereopod 5 exceeding apex of article 4. Posteroventral corners

on epimera 1, 2, 3, = rounded (to weakly-roundedquadrate), rounded-quadrate, and weakly but sharply protuberant, posterior margins all convex, with one setule on each epimeron, epimeron 2 with 4 facial setae, anteriormost 2 of these horizontal, posterior 2 of these set vertically (broken in illustration). Apicolateral corner of peduncle on uropod 1 smooth, with spine (as long as in L. ungamale) and one midlateral similar spine, medial margin unknown, damaged, rami of uropods 1-2 with apical nail, obsolescent but weak scale present, outer ramus of uropod 1 with 2 dorsal spines twice as long as those on L. ungamale, inner with 2 of similar dimensions, rami of uropod 2 naked, peduncle of uropod 2 with 2 lateral spines of same size illustrated for L. ungamale, ventrolateral margin of peduncle on uropod 1 with 3 short setae, combs absent on uropodal peduncles. (Uropod 3 mostly missing, unknown.) Length-width ratio of telson = 6:5, not fully cleft, each apex broad, weakly excavate but basically truncate and inwardly oblique, bearing long medial spine-seta, 0-1 small lateral seta and lateralmost setule, middorsal pair of plusetules weakly diverse, elongate. Urosomite 1 naked ventrally but with small seta at lateral base of uropod 1; urosomite 2 with similar seta. Cuticle with bulbar setules and weak striations. Gnathopod 2 with small, leaf-like gill, pereopod 5 with vestigial, knob-like gill.

Female "a," 3.70 mm: Differences from female "b": eyes fully clear of pigment; ventral apex of article 2 on antenna 1 with 4 setae, primary flagellum with aesthetasc also on articles 2-3; spine formula on article 4 of antenna 2 = 4-4-4, article 5 with ventral notch bearing 2 long spinules and long setule; mandibular molar with only 2 spineteeth, palpar apex with 7 spine-setae; palp of maxilla 1 with only 4 setae; long setal formula (including small posterior seta on coxae 1-3) of coxae 1-4 = (6-7)-(7)-(7-8)-(3-4); long posterior setae on article 2 of gnathopod 2 = 1, of pereopods 1-2 = 3and 4, small anterior setae on article 2 of pereopods 1-2 = 3 and 3; article 4 of pereopods 1-2 with only 3 groups of 3-5 posterior setae; setal formula of coxae 5-7 = 1-1-2; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 61:18:15:8, of pereopod 4 =79:28:15:8, of pereopod 5 = 95:17:13:8, length ratios of pereopod 3 = 75:25:27:30, of pereopod 4 = 87:59:45:39, of pereopod 5 = 102:20:30:21; epimeron 2 with 2 ventral setae, posterior face

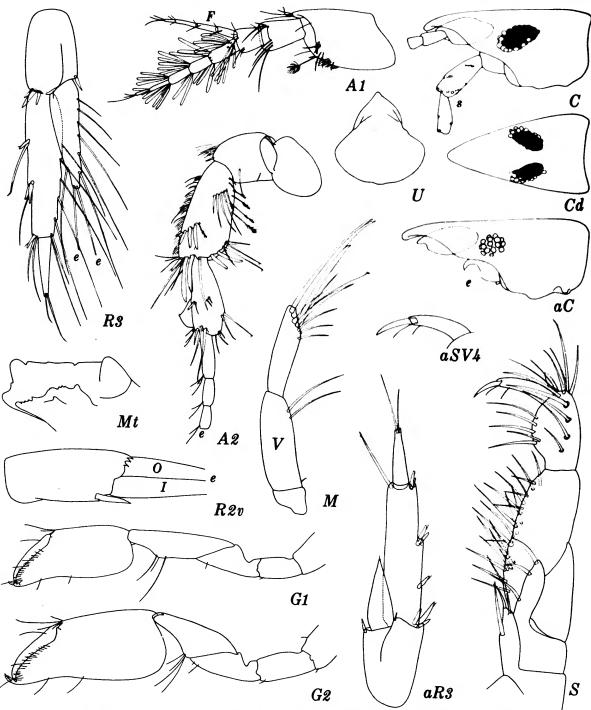


FIGURE 262.—Limnoporeia wakkine, new species, holotype, male "h," 4.72 mm (a = female "a," 3.70 mm).

with only one seta, epimeron 3 with or without midposterior setule notch; medial margin of peduncle on uropod 1 with 3 large spines, outer ramus of uropod l with only one dorsal spine, outer ramus of uropod 2 with one dorsal spine; peduncle of uropod 3 with 3 ventral spines, dorsolaterally with one spinule, medially with one spine. rami feminine, inner short and scale-like, reaching to M. 48 on article 1 of outer ramus, with one tiny apical setule, article 2 of outer ramus elongate, 0.40, bearing 2 long apical setae, apicomedial corner of article 1 with one long spine, lateral margin with 2 acclivities, spine formula = 1-2-2, setal formula = 0; length-width ratio of telson = 15:11, each apex truncatoconcave, bearing tiny lateral setule, then larger setule, then very elongate setal-spine, then shorter setal-spine and finally with small medial setulc.

OBSERVATIONS (female).—Female "a" differs from female "b" primarily in the elongation of the spines in the ventral notch on article 5 of antenna 2, in the presence of only one posterior facial seta on epimeron 2 and in the much heavier apical spinosetation on each lobe of the telson.

Four females accompanying female "a," all specimens of slightly smaller size, also have the stated spines on antenna 2 elongate and thin (either having 2 or 3) and have the normal telsonic spinosetation but like female "b" and unlike female "a" have a pair of posterofacial setae on epimeron 2. These four, like female "a," have clear eyes. The outer ramus of uropod 1 bears either 1 or 2 spines, the inner ramus bears 2, the outer ramus of uropod 2 bears 0-1 spine, the inner ramus lacks spines. The spine formula on article 4 of antenna 2 varies in these ways: 3-3-3 and 3-3-2. Long setae on coxae 1-4 vary in these ways: 6-5-6-3, 6-5-5-3, 5-5-5-3, 5-5-5-2. Both flagella of antenna 1 bear 4 articles.

Description of Male (male "h," holotype).—Head about 19 percent as long as body, eyes slightly enlarged, mainly obscured by pigment. Mandibles, lower lip, maxillae 1–2 as described for female "b" but see illustrations of right lacinia mobilis and mandibular palp. Article 1 of antenna 1 with numerous apicoventral setules; accessory flagellum 4-articulate; primary flagellum 5-articulate, articles 1–4 bearing large medial aesthetascs, article 1 with rows of 3, 7, and 11 aesthetascs, article 2 with 11 apical, article 3 with 8 apical, and article 4 with one apical aesthetascs (some omitted in illustration);

medial face of article 1 on peduncle with small patch of fuzz. Articles 3-4 of antenna 2 with mediodorsal fuzz, article 3 with dorsodistal spine, spine formula on article 4 = 3-1-4; apical and ventral spines on article 5 thin, flagellum elongate, 17articulate, calceoli absent (male young as evidenced by smallness of medial patch of fuzz on antennae 1-2 and shortness of inner ramus on uropod 3). No spine on maxilla 1 with opposite cuspidation. Nail on article 4 of maxillipedal palp shorter than in female. Setae on coxae 1-4 = (7)-(7)-(7)-(4-5); coxa 4 narrower than in female, ratio of length to width = 19:16. Long posterior setae on article 2 of gnathopods 1-2 and pereopods 1-2 = 1-1-3-3, short anteriors = 2-3-3-3, no others. Pereopods 1-2 alike; pereopods 1-4 generally like those of female, pereopod 5 larger; ratios of widths on articles 2, 4, 5, 6 of pereopod 3 = 59:17:15:8, of pereopod 4 = 75:26:15:8, of pereopod 5 = 100:15:13:7, ratios of lengths of pereopod 3 = 77:21:28:30, of pereopod 4 = 88:60:45:40, of pereopod 5 =107:21:31:21; medial apex of article 6 on pereopod 5 finely combed. Epimera 1-2 lacking lateral ridge, epimeron 2 with only one small facial seta. Peduncle of uropod 1 with 4 medial spines, of uropod 2 with one large apicomedial spine, lateral margin of peduncle on uropod 1 with 1-2 spines, apex with 1, peduncle of uropod 2 with either 3 or 4 dorsal spines. Rami of uropod 3 submasculine, inner reaching to M. 70 on article 1 of outer ramus, apex with 2 setae, medial margin setose, lateral margin with one seta, article 2 of outer ramus elongate, bearing 2 medium and short apical setae, lateral margin of article 1 with 2 acclivities, spine formula = 1-2-1, setal formula = 1-1-2, medial margin setose. Telson elongate, ratio of length to width = 8:5, each apex with 5 elements as in female "a" but elements shorter. Pipes and bulbar setules of cuticle much sparser than in female.

OBSERVATIONS.—Male "h" and female "b" with 3 coarse serrations apicoventrally on peduncle of uropod 2, uropod 1 with fine comb apicoventrally, male otherwise smooth, female additionally with fine apicolateral comb on uropod 1, smooth on uropod 2.

ILLUSTRATIONS.—Many features of this species are so similar to those shown for *L. ungamale* that duplicate illustrations have been omitted, particularly those for the following list of parts: antenna 1, maxilla 1, outer plate and article 3 of maxilliped,

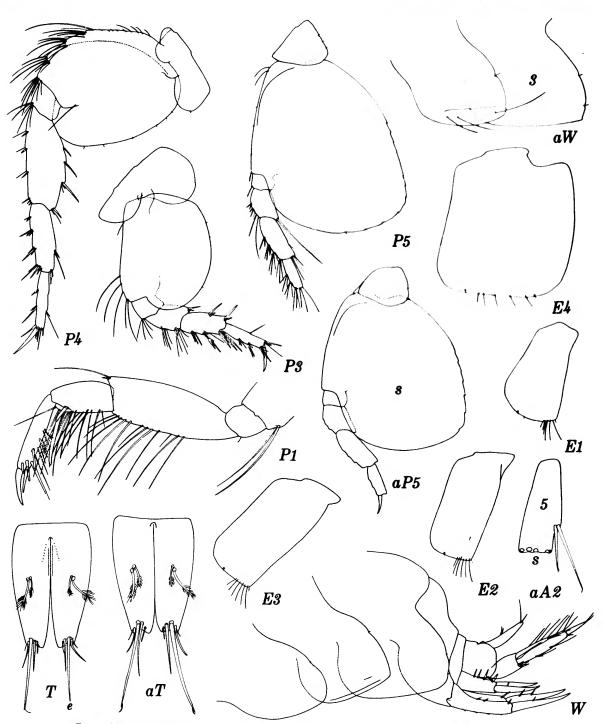


FIGURE 263.—Limnoporeia wakkine, new species, holotype, male "h," 4.72 mm (a= female "a," 3.70 mm).

gnathopod 1, generalities and especially dactyls of pereopods 1-2. Details, however, may vary slightly as given in the description.

Ridge on epimeron 2 of Figure 263: W is ecdysis line.

Articles 4-5 of gnathopod 2 larger relative to article 6 than in *L. ungamale*, but gnathopods smaller overall than in *L. ungamale*; anterior spines on article 2 of percopod 4 longer than in *L. ungamale* (see illustration); article 2 of percopod 5 slightly broader and longer relative to percopod 5 of *L. ungamale* (see dimensions in description; images of percopod 5 from both species superimposed on each other by matching length of anterior margin on article 2).

HOLOTYPE.—WAM, male "h." 4.72 mm.

Type-Locality.—WAM 416-73, trawl sta 6, 24 Jul 1943, Jibbon Point, off Cronulla, New South Wales, Australia, depth and bottom unknown.

VOUCHER MATERIAL.—Type-locality: female "f," 2.81 mm. CPBS 51N/172: female "b," 4.24 mm (illus.). WAM 415-73: female "a," 3.70 mm (illus.); female "c," 3.95 mm; female "d," 3.82 mm; female "e," 3.91 mm; female "j," 4.12 mm.

REMARKS.—The young male is selected as holotype because the two adult females, female "b" and female "a," each have aberrancies as noted in their descriptions and observations. If any splitting of this material becomes necessary in the future the likelihood is that female "b" is a species distinct from L. wakkine, the latter based on specimens with thin ventral spines on article 5 of antenna 2.

RELATIONSHIP.—This species is an apparent sibling of L. ungamale. It has far too many minor differences from that species to be considered a simple variant. Fifteen of these distinctions are as follows: the presence of only one spine in the anterior notch of article 4 on antenna 2; the considerably distinct right lacinia mobilis; the essentially unlobate anterior lobe of the epistome (lateral aspect); the absence of opposite cuspidation on any spine of maxilla 1; the large facial setae on the inner plate of maxilla 2; the attenuate apex on the inner plate of the maxilliped; the disjunct accessory seta on article 4 of the maxillipeds; the broader coxa 4 and narrower coxa 1 of female; the larger eye and larger apical protrusion of the rostrum; the normal placement of the posteroventral setal pair on article 2 of pereopod 1; the longer posterior lobe on coxa 6; the lesser posterior position of the vertically set pair of setae on epimeron 2; the longer spines on the rami of uropod 1; and the elongation of armaments on the telson.

Limnoporeia wakkine differs from L. kalduke in the following characters: shorter head, plain upper lip, in minor details of the right lacinia mobilis, the disjunct accessory setule on article 4 of the maxillipedal palp, broader apical expansion of coxa 1, the thin article 5 of gnathopod 1 and elongate article 3 of gnathopod 2, the stoutness of the shorter contiguous spine on article 5 of pereopods 1-2, the less strongly curved dactyls of pereopods 1-2, the more posterior position of the setae on epimeron 2, the fewer spines on the outer rami of uropods 1-2 and the nonoblique telsonic apices.

MATERIAL.—CPBS, 2 samples from 2 stations (2); WAM, 2 samples, 415-73 and 416-73, with only partial data (10).

DISTRIBUTION.—Victoria, Western Port, 15-16.5 m; New South Wales, off Jibbon Point, 35 m, sand.

Limnoporeia kalduke, new species

FIGURES 264, 265

DESCRIPTION OF FEMALE.—Head about 20 percent of total body length, greatest width about 40 percent of length; rostrum long, exceeding apex of peduncle on antenna l, thin, weakly constricted near apex. latter attenuate and somewhat acute in dorsal view but thickened dorsoventrally. Eyes of medium size, with black core surrounded by occasional small and clear ommatidia. Article 1 of peduncle on antenna 1 about 2.4 times as long as wide, about 1.8 times as wide as article 2, ventrolateral region with about 7 setules, strongly produced dorsal apex with 3 long setules; article 2 about 0.3 times as long as article 1, ventral apex with 5-6 setae; accessory flagellum 5-articulate and shorter than primary flagellum, latter 6-7 articulate, one aesthetasc apically on primary flagellum. Article 3 of antenna 2 with one long, one short facial setae, spine formula of article 4 = 3-3-4 or 3-3-5, spines of proximal group thin, with 3 accessory setules, middle group with one accessory setule, dorsal margin with weak notch bearing spine and seta, ventral margin with one mid group of setae, one apical group of setae and about 7 subbasal penicillate setules, ventrodistal margin also with 3

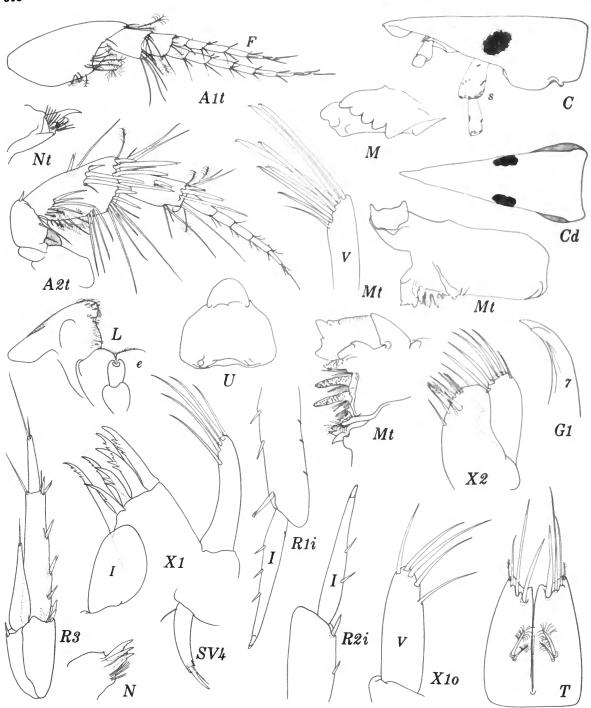


FIGURE 264.—Limnoporeia kalduke, new species, holotype, female "a," 4.00 mm.

medium to long spines; article 5 about 0.7 times as long as article 4, facial spine formula = either 1 or 2 plus accessory setule, dorsal margin straight and smooth, ventral margin with weak acclivity bearing 3 variously sized setae, dorsodistal apex with 3 spines, ventrodistal apex with 2-3 setae; flagellum longer than article 4 of peduncle, 5-6-articulate. Prebuccal complex very flat anteriorly, poorly extended forward, poorly lobed dorsally, epistome and upper lip mainly fused but with weak intermittent articulation ridge, upper lip bell-shaped, ventral margin with broad, weak, flat, or weakly convex invagination. Mandibles with strong palpar hump; right incisor with 3 teeth, accessory tooth, notches and ripples; left incisor with 6 humps in 2 branches; right lacinia mobilis broadly flabellate, incipiently bifid, proximal branch spiniform and armed with papillae as on raker spines, distal branch broad, minutely serrate distally and with 2 low humps near base of proximal branch; left lacinia mobilis broadly flabellate, 5-toothed; right rakers 2, left 3; mandibular molar small, setulose, poorly projecting, bearing 4-5 teeth, these long and sharp on left side, all but one on right side small and blunt; palp article 2 with pair of short setae near base, article 3 about 1.15 times as long as article 2, strongly oblique apex with 8-9 setae. Lower lip with 4 cones on outer lobe, 2 cones disjunct from margin, mandibular lobes long, subrounded apically, inner lobes of medium size, fused together for most of their length, with pair of facial plaques in tandem. Inner plate of maxilla 1 large, elliptical, naked, base somewhat broadened; outer plate with 7 spines, none with opposite cuspidation; palp exceeding apex of outer plate, thin, bearing marginal row of 5-6 apical and medial setae. Inner plate of maxilla 2 broader and shorter than outer plate, setae sparse, medial face with 2 setae, one enlarged; outer plate with 3 medial setae. Inner plate of maxilliped with 2 apical and one medial setae; outer plate with 3 medial spines; palp article 2 strongly setose medially (3-4 rows), palp article 3 with 4 facial setae, article 4 of medium length, apical nail of medium length, accessory setae 2. Coxa 1 scarcely expanded distally, all rounded anteroventrally; setal formula of coxae 1-4 = 7-(6-7)-(6-8)-(3-4); coxa 4 quadratiform, anterior and posterior margins parallel, posterodorsal excavation of medium size, almost L-shaped, ratio of width to length = 17:21. Gnathopod 1 especially slender,

gnathopod 2 stouter and longer than gnathopod 1; long posterior setae of article 2 on gnathopods 1-2 = 1 and 1, small anterior setae on both members = 2 and 3-4; article 3 of gnathopod 2 slightly elongate; article 5 on gnathopod 1 long, with flat and free posterior margin, this article shorter on gnathopod 2, posterior margin triangular and almost cryptic; article 6 of both gnathopods long, with taper followed by weak distal expansion apically, strongly chelate, apex of palm bearing scale-like protrusion and medium spine, protrusion blunt; apices of dactyls ordinary and pointed (presumably scale fused to dactyl); length ratios of articles 5-6 on gnathopods 1-2 = 80:103 and 58:135, width ratios = 25:37 and 30:56. Pereopods 1-2 generally similar to each other; long posterior setae on article 2 of pereopods 1-2=3 and 4, anterior short setae = 5 and 5-6; article 5 with 1-2 dorsolateral setae on apical face, article 4 with 3 groups of sparse dendritic posterior setae, produced anterodistal apex with 2 setae, article 5 with dense posterior setae, long distal spine reaching to M. 75 on article 6; article 6 with rows of 4 and 2 posterior setae and rows of 5 and 4 spines apically (same on both pereopods), spines mostly long, dactyl long, sharply curved, simple. Coxae 5-7 posteroventral setule formula = 1-1-3. Articles 4-5 of pereopods 3-4 narrow, facial spines almost absent; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 63:18:15:8, of pereopod 4 = 79:24:12:6, of pereopod 5 = 102:19:11:6, length ratios of pereopod 3 = 81:22: 27:30, of pereopod 4 = 96:65:51:45, of pereopod 5 = 113:16:30:20, article 2 of pereopod 5 reaching middle of article 5. Posteroventral corners of epimera 1, 2, 3 = rounded, rounded-quadrate, and protuberant with setule sinus, posterior margins = weakly convex, almost straight, and convex, with one setule each on epimera 1-2, 5 setule notches on epimeron 3, epimeron 2 with 5 facial setae, anteriormost 3 of these horizontal, posteriormost 2 of these set vertically. Urosomite 1 naked ventrally; urosomites 1-2 each with setule at lateral base. Apicolateral corner of peduncle on uropod 1 smooth, with small spine, midlateral margin with one small spine, mediolateral apex with large spine, medial margin with 2 spines, ventrolateral margin with several conspicuous setules, rami of uropods 1-2 with apical nails almost fully absorbed, each with small scale, each ramus of uropod 1 with 3 dorsal spines or outer with only 2, outer ramus of

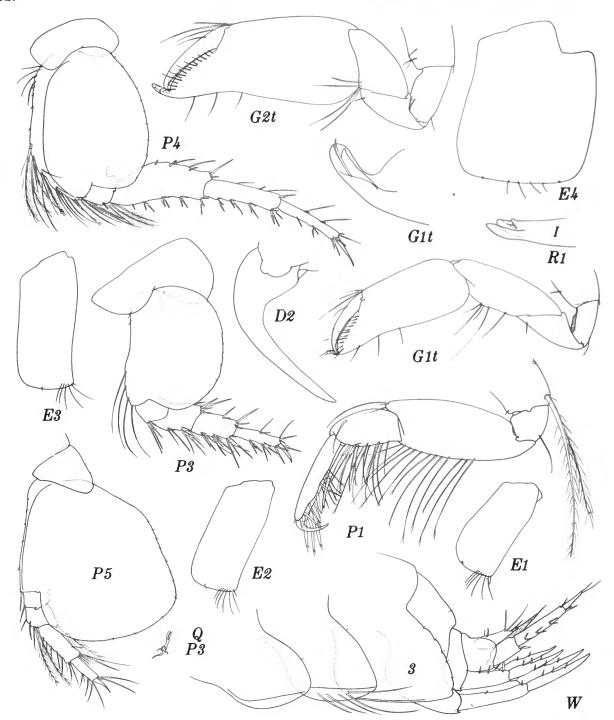


FIGURE 265.—Limnoporeia kalduke, new species, holotype, female "a," 4.00 mm.

uropod 2 with 3-1 dorsal spines, inner ramus with 1-2, peduncle of uropod 2 with one medium apicolateral spine and 2 other smaller lateral spines, apex smooth, medial apex with small spine, medial margin with smaller spine. Uropod 3 long, peduncle with 4-5 ventrolateral spines, medial apex with one spine, dorsolateral apex with one setule; rami feminine, inner extending about to M. 63 on article I of outer ramus, inner ramus weakly broadened basally, tapering sharply near apex, bearing 1-2 apical setae, article 1 of outer ramus bearing 3 pairs of short, subequal lateral spines in acclivities, apicolateral corner with similar pair plus short seta, article 2 elongate, 0.40, bearing one short, one medium apical setae. Length-width ratio of telson about 17:13, not fully cleft, each apex broad, excavate, oblique, with longer limb lateral, each apex with submarginal row of 3 long setal spines and one short lateral setule, dorsomedial pair of plusetules diverse, highly medial on each lobe. Cuticle finely striate and bearing small sparse bulbar setules. Gnathopod 2 with long gill almost reaching end of article 2, pereopod 5 with small, rounded gill.

OBSERVATIONS.—Female "b," 5.37 mm: Much larger than holotype, bearing larger eyes (in relation to head size); inner plate of maxilla 2 with small facial seta distal to larger (reversed in holotype on one side only, see illustration of maxilla 2 on holotype, presumed aberrant); one lobe of telson with 4 long apical setal spines plus setule; epimeron 2 apparently with posteriormost setal group bearing 3 vertical setae (setae missing, only sockets present).

ILLUSTRATIONS.—View of maxilla 2 aberrant as smaller facial seta usually set distally from main facial seta; palmar apices of gnathopods 1–2 similar, illustrated only for gnathopod 1; except where described or partially illustrated, view of maxillipeds like that of *L. ungamale*; in views of dissected uropod 3 and uropod 3 as attached to pleon, distal two-thirds of outer ramus heavily reconstructed by approximation as this appendage poorly preserved and shriveled; setule on coxa 6 missing.

HOLOTYPE.--NMV, female "a," 4.00 mm.

Type-Locality.—PPBES 973/3, 12 Feb 1971, Port Phillip Bay, Victoria, Australia, 13 m, sand.

VOUCHER MATERIAL.—Type-locality, female "b," 5.37 mm; PPBES 973/2, female "c," 4.4 mm. Male unknown.

RELATIONSHIP.—This species differs from the first four listed species of this genus in the presence of at

least 3 long spines on each lobe of the telson and in the presence of 3 (contrast 0-1) spines on the outer ramus of uropod 2. The elongate dactyls of pereopods 1-2 suggest affinities with L. yarrague but L. kalduke otherwise differs from that species in the broad and multispined telsonic lobes, the posterior vertical set of setae and the presence of a ridge on epimeron 2. The head of L. kalduke is even longer and more modified apically than in the first 4 species listed and somewhat transcends those species and L. wakkine and Uldanamia pillare; see these latter species for their relationships to L. kalduke. The vertical set of setae on epimeron 2 suggests affinities with L. ungamale but that species has stunted dactyls of pereopods 1-2 and a "normal" phoxocephalid telson with a medial protrusion on the apex and one spine and one setule on a lateral acclivity. Limnoporeia ungamale also has vertically arranged setae on epimeron 2 but in that species the setae are set more posteriorly than in L. kalduke, the telson has only 2 apical spines on each lobe, both spines being stout and short, and the dactyls of pereopods 1-2 are of ordinary length, though plain. Both L. kalduke and L. ungamale share the same complex setae on pereopods 1-2. From these various similarities one must suggest that L. kalduke has its closest affinities with L. ungamale. Nevertheless, numerous small differences between these 2 species may be seen. Limnoporeia kalduke is characterized by: (1) more numerous posterior setules on epimeron 3; (2) shorter setule at base of uropod 1; (3) more numerous ventral setae of epimeron 2; (4) denser armaments of antenna 2; (5) relatively longer inner ramus of uropod 3 on female; (6) absence of lateral setae on article 1 of uropod 3; (7) narrower coxa 4; (8) longer coxa 7; (9) stouter and shorter article 5 of gnathopod 1; (10) normal placement of posteroventral pair of setae on article 2 of pereopod 1; (11) narrow apex of coxa 1; (12) absence of opposite cuspidation on any spine of maxilla 1; (13) differences in upper lip, maxilla 2, and article 4 on maxillipedal palp, among others. Even though L. kalduke and L. ungamale appear to be a close pair of species, the numerous distinctions between them suggest a manifold and diverse course of descent from their ancestral stock.

MATERIAL.—PPBES, 4 samples from one station (6); WPBES, one sample (1).

DISTRIBUTION.—Victoria: Port Phillip Bay and Western Port, 9-13 m, sand.

Uldanamia, new genus

Diagnosis.—Eyes present. Flagella of antennae 1-2 unreduced in female. Article 2 of antenna 1 especially shortened, ventral setae confined apically. Article 1 of antenna 2 not ensiform; article 3 with 2 setules; facial spines on article 4 in 2 or more rows, plus special apical spines; article 5 thin. Right mandibular incisor with 3-4 teeth; molar not triturative, medium, pillow-shaped to elongate-conical, bearing 2 semiarticulate spines and large plume, bearing fuzz; palpar hump large. Palp of maxilla I uniarticulate; inner plate naked. Setation of maxilla 2 weak. Inner plate of maxillipeds thin; apex of palp article 3 not protuberant, dactyl elongate, apical nail distinct, short. Gnathopods similar, chelate, hands elongate, poorly setose anteriorly; article 5 free, elongate, with eusirid attachment; gnathopod 2 weekly enlarged. Article 5 of pereopods 1-2 setose posteroproximally. Article 2 of pereopod 3 of broad form, articles 4-5 of pereopods 3-4 narrow to medium, article 2 of pereopods 3-4 not setose posteriorly; pereopod 5 ordinary, article 2 naked ventrally, article 3 ordinary, dactyl very small. Epimera 1-2 lacking long posterior setae, without midfacial setae above ventral facial ridge, epimeron 3 of nonrounded classification and lacking long setae. Urosomite 1 bearing one or more midventral setae and setae near base of uropod 1; urosomite 3 without dorsal hook or special process. Peduncle of uropod 1 normally elongate, without apicoventral spike, without special enlarged apicolateral or medial spines, peduncular apices of uropods 1-2 not combed, inner ramus of uropod 1 with marginal spines in one row, no rami continuously spinose to apex, apical nails weak, inner ramus of uropod 2 ordinary. Uropod 3 ordinary, elongate article 2 of outer ramus carrying 2 short to medium apical setae. Telson ordinary, with 6-7 apical spines or setae on each lobe plus setules, without special dorsal and lateral spines or setae.

DESCRIPTION.—Rostrum fully developed, with apicoventral process. Fuzz on article 1 of antenna 1 in male present; calceoli on male primary flagellum of antenna 1 present. Calceoli on article 5 of male antenna 2 absent; flagellum in male with calceoli. Prebuccal parts massive, poorly separated from each other, upper lip dominant. Right lacinia mobilis simple; mandibular palp medium to thin, article 1 short, article 2 without outer setae, apex of article

3 oblique. Lower lip bearing multiple cones. Outer plate of maxilla 1 with 7 spines, no spine especially thickened. Inner plates of maxilliped especially thin, poorly armed. Coxae 2-4 without special anterodorsal humps. All posterior spines on article 6 of pereopods 1-2 thin and stiff, midapical spine absent; dactyls vestigial. Article 2 of pereopod 5 without facial setae. Peduncle of uropod 1 with dorsolateral spines confined apically, medial spines widely spread; peduncle of uropod 2 with medial spines widely spread. Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with ordinary pair of middorsal setules on each side, highly medial. Gills present on pereonites 2-7, brood plates present only on pereonites 3-5.

Type-Species.—Uldanamia pillare, new species. Composition.—Unique.

RELATIONSHIP.—This genus is clearly a product of the ancestral pool from which *Limnoporeia* also descended, and the type-species is simply a highly specialized limnoporeia in which the following attributes have advanced so far from those found in *Limnoporeia* that a separate genus is required to express the discontiguity.

Uldanamia differs from Limnoporeia in the highly elongate wrist of gnathopod 2, the special teeth of epimeron 3 (forcing generic diagnosis to read "nonrounded classification"), the large size of the apicoventral process on the rostrum, the vestigial dactyls of pereopods 1-2, the densely setose pereopods 1-2, and the heavily spinose telson. The state of most of these characters is more primitive in Limnoporeia than in Uldanamia.

Uldanamia pillare, new species

FIGURES 266-269

DESCRIPTION OF FEMALE.—Head about 22 percent of total body length, greatest width about 35 percent of length; rostrum very long, exceeding apex of peduncle on antenna 1, constricted weakly towards apex (from dorsal view), apex bearing ventral conical keel-like projection. Eyes small to medium in size, golden in preservative, clear of pigment core. Article 1 on peduncle of antenna 1 about twice as long as wide, almost twice as wide as article 2, apicoventral region with 8 setules, strongly produced dorsal apex with 3 setules; article 2 about 0.45 times as long as article 1, ventral apex with 5–7 setae; ac-

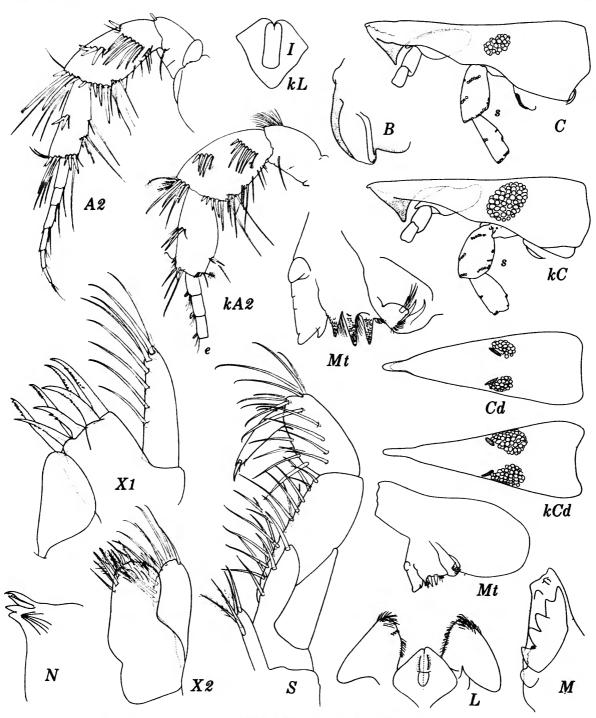


FIGURE 266.—Uldanamia pillare, new species, holotype, female "a," 4.77 mm (k = male "k," 4.82 mm).

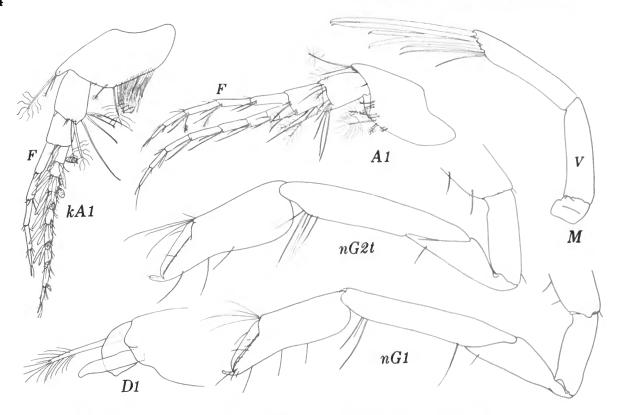


FIGURE 267.—Uldanamia pillare, new species, holotype, female "a," 4.77 mm (k = male "k," 4.82 mm; n = female "n," 5.04 mm).

cessory flagellum slightly shorter than primary flagellum, 5-6-articulate, primary flagellum 7-articulate, aesthetascs rare or present only apically, articles elongate. Article 3 of antenna 2 with one long, one short facial setae; spine formula on article 4 = 4-4-6or 4-4-7, proximal spines thin, both proximal groups with accessory setule, dorsal margin with one spine and 2 setules in group, ventral margin with group of 4 apical setae plus one seta forming part of spine group and 6 subbasal penicillate setules and 2 setules facially, ventrodistal margin with 5 short to medium spines; article 5 about 0.9 times as long as article 4, facial spine formula = 2plus accesory setule, dorsal margin straight and smooth, ventral margin with 2 setal groups, dorsodistal apex with 2 setae and one spine, ventrodistal apex with 3 spines, seta and setule; flagellum about 1.4 times as long as article 4 of peduncle, 6-articulate. Prebuccal complex convex anteriorly, weakly extended forward, epistome and upper lip fused

(or epistomal part extremely small if indeed articulate, see llustration of male upper lip), ventral margin of upper lip rounded or weakly excavate (depending on view) and with scarcely perceptible midhump. Mandibles very bulky and large in relation to mouthpart field, main body almost cylindrical, with incisor and molar projecting from main body; palpar hump huge; right incisor with 3 teeth, notches and ripples; left with 6 humps in 2 branches; right lacinia mobilis simple, appearing similar to raker spine distally, extending onto but blending basally with molarial body, bearing villi similar to those of raker spines; left lacinia mobilis with 5 teeth, right rakers 2, left 3; mandibular molar forming plaque and extended hump bearing 2-4 teeth, some articulate, plus articulate complex setule on right molar; palp article 2 naked, article 3 about 1.25 times as long as article 2, oblique apex with 7-10 spines. Lower lip with 4 cones on outer lobe, mainly facial (or extremely ill-defined), mandi-

bular lobes medium to short, rounded apically, inner lobes broad, fused together for most of their length but with distinct raphe, with plaque on one face (inner lobes of maxilla 1 sliding across faces on inner lobes but edges of plaque forming stop). Inner plate of maxilla 1 large, elliptical, naked; outer plate with 7 spines, none with opposite cuspidation; palp exceeding apex of outer plate, thin, bearing 4 apical and 4 medial setae. Inner plate of maxilla 2 broader than and extending as far as outer plate, setae of moderate density, one seta medial; outer plate with 4 medial setae. Inner plate of maxilliped very narrow, with 2 medial and 2 apical setae; outer plate with 3 medial spines; palp article 2 moderately setose medially (2 rows), article 3 with 5 facial setae, article 4 long, bearing 2 short accessory setae, apical spine short. Coxa 1 strongly expanded distally; coxae 1-4 setal formula = (8-9)-(9-10)-10-(3-4), posteriormost seta of coxae 1-3 very short; coxa 4 quadratiform, anterior and posterior margins almost parallel, posterodorsal excavation small, V-shaped, ratio of width to length = 1:1. Both gnathopods very slender, gnathopod 2 as long as but slightly stouter than gnathopod 1; long posterior setae on article 2 of gnathopods 1-2 = 1-1, short setae = 2-3, short anterior setae = 3and 2-3, medium anterior setae = 2-3 and 2; article 3 of both gnathopods elongate; article 5 very long and narrow, with free and flat posterior margin; article 6 of both gnathopods of medium length, constricted middistally, then expanding apicalwards, strongly chelate, apex of palm bearing long blunt scale-like protrusion and medium spine; dactyl slightly overlapping palmar margin, apices of dactyls hooked and with medium to large apical scale; length ratios of articles 5-6 on gnathopods 1-2 = 120:95 and 129:105, width ratios = 17:27and 23:36. Pereopods 1-2 especially large, generally similar to each other but article 4 of pereopod 2 slightly stouter; long posterior setae on article 2 of pereopods 1-2 = 3 and 4, anterior short setae = 2-4and 5, articles 4-5 lacking facial armaments except for 2 anterior setae on article 5, anterodistal corner of article 4 with 3 setae, posterior margins of articles 4-5 densely setose, in overlapping cycles on article 4, setae dendritic, article 5 with long distal spine reaching M. 60 on article 6; article 6 with rows of 3 and 1 posterior setae and rows of 5 and 5 spines, latter short to medium in length; dactyl extremely short, almost vestigial, crescentic, scarcely pointed,

bearing huge anteromedial setule but otherwise naked. Coxae 5-7 posteroventral setule formula = 3-1-3. Articles 4-5 of pereopods 3-4 slightly expanded, facial spines well developed on pereopod 3, weakly on pereopod 4, facial ridge formula of article 2 = 0-1-1; width ratios of articles 2, 4, 5, 6 of pereopod 3 = 65:27:24:13, of pereopod 4 = 80: 52:14:9, of pereopod 5 = 109:19:11:6, length ratios of pereopod 3 = 77:23:32:40, of pereopod 4 = 95:62:41:33, of pereopod 5 = 110:21:34:23; article 2 of pereopod 5 almost reaching middle of article 5. Posteroventral corner of epimeron 1 rounded, of epimeron 2 rounded-quadrate, posterior margins convex, each with setule, epimeron 2 with 5 facial setae, anteriormost 2 of these horizontal, posteriormost 3 of these set obliquely, epimeron 3 with sharply protuberant posteroventral corner, margin above vertical, then turning sharply oblique and bearing 3 medium upturned teeth accompanied by setule in adjacent notch, margin above teeth almost flat. Urosomite 1 bearing 3 ventral setae on each side and 3-4 anterior setae on each side. Apicolateral corner on peduncle of uropod 1 smooth, with small spine, medial apex with medium to extremely elongate spine (medium version illustrated), medial margin with 3 small setae, each ramus of uropods 1-2 with nail almost fully amalgamated but with strong apical scale, outer ramus of uropod 1 with 4-6 dorsal spines inner with 3-4, outer ramus of uropod 2 with 3-4 spines, inner with 1-2, peduncle of uropod 2 smooth, with 4 dorsal spines, medial margin with 2 small spines, one of these apical. Uropod 3 long, peduncle with 5-7 ventral spines, one mediodorsal spine; rami feminine, inner slender, extending to M. 67 on article 1 of outer ramus, bearing one long, one short apical setae, article 1 of outer ramus with 3-4 lateral acclivities each with 3 spines, one generally enlarged, one generally small, apicolateral corner with 3 spines, medial margin setose, article 2 elongate, 0.45, bearing one medium, one short apical setae. Length-width ratio of telson about 1:1, almost fully cleft, each apex very broad, irregularly truncate, bearing 3 setae and setule, each apex also with subdistal transverse row of 3 long spines, middorsal pair of plusetules weakly diverse. Cuticle with sparse and ordinary bulbar setules, with faint fingerprint striations especially on basal articles of pereopods 3-5 and epimera. Gnathopod 2 with long gill almost exceding article 2, pereopod 5

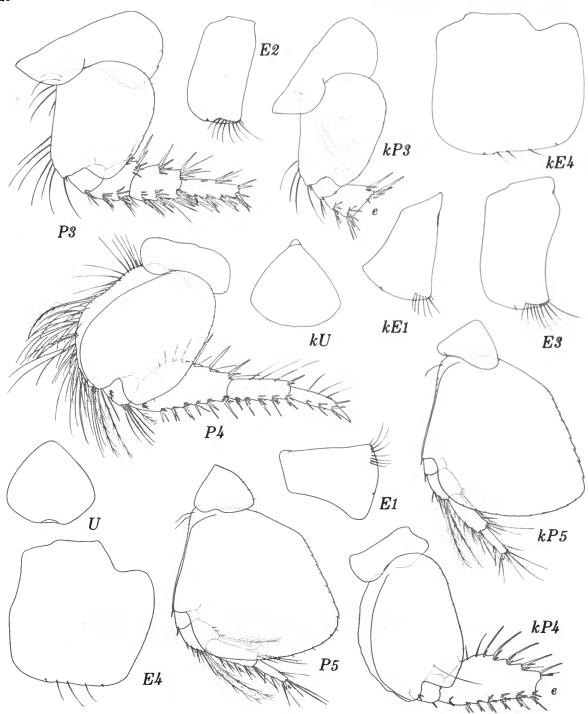


FIGURE 268.—Uldanamia pillare, new species, holotype, female "a," 4.77 mm (k = male "k," 4.82 mm).



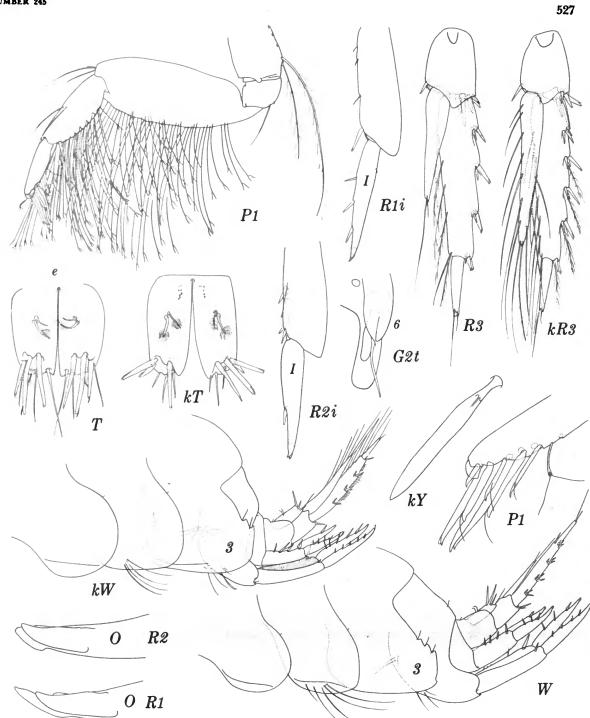


FIGURE 269.—Uldanamia pillare, new species, holotype, female "a," 4.77 mm (k = male "k," 4.82 mm; Y = aesthetasc).

with small gill.

DESCRIPTION OF MALE.—Following parts like female: head; prebuccal: mandibular molars, rakers, incisors, laciniae mobiles, palpar proportions; lower lip; maxillae 1-2; maxilliped; gnathopods; pereopods 1-2; coxae 2-3. Eyes enlarged. Antenna l bearing dense fuzz on ventral margin of article 1; primary flagellum 9-articulate, articles short, first 8 each bearing calceolus, first 7 bearing 2-3 large aesthetascs with tubular bases; accessory flagellum 5-articulate, articles elongate as in female. Articles 4-5 of antenna 2 broader than in female, facial spines therefore occupying less area, ventral margin of article 4 with 2 sets of 3 setae, each set obliquely, plus 2 long marginal setae, facial spines of article 5 longer than in female, dorsal margin with one subdistal calceolus, ventral margin with one set of short setae, ventrodistal corner with short setae, no spines, dorsodistal corner with 3 long spine-setae; flagellum highly elongate, articles not elongate, about 47articulate, flagellar formula = (?47), 1-5, 8, 10, 12 ... (44 or 46). Mandibular palp article 2 bearing 2 inner apical setae, apex of article 3 with 8 spines. Palp of maxilla 1 bearing only 6-7 setae. Coxa 1 with sharper anterodistal corner than in female; coxae 2-3 slightly wider than in female; coxa 4 slightly larger than in female; long setal formula of coxae 1-4 = 7-8-8-3. Long posterior setae on article 2 of gnathopods 1-2 = 0-1, short anterior setae = 4 and 4 [long seta on gnathopod 2 possibly broken off]; article 6 of gnathopods 1-2 slightly larger than in female in relation to length and width of articles 3-5. Long posterior setae on article 2 of pereopods 1-2 = 1 and 4-5 (besides posteroventral pair), short anterior setae = 4-3 and 4; article 4 with only one small anterior subdistal seta on pereopod 1, none on pereopod 2; article 6 with rows of one and one posterior setae, rows of 5 and 5 spines on pereopod 1, 6 and 5 spines on pereopod 2. Article 2 of pereopods 3-5 strongly to slightly narrower than in female (see illustrations). Ridge on epimeron 2 apparently absent, ventral setal row comprising 4 setae tightly constricted; epimeron 3 with posteroventral tooth obsolescent, larger midposterior teeth only 2 in number. Apicolateral spine on peduncle of uropod 1 smaller than in female, ramal spines of uropods 1-2 more numerous (see illustrations), medial margin of peduncle on uropod 1 with one apical, one mid spine and basal setules. Rami of uropod 3 masculine, inner extending almost to apex of article l on outer ramus, marginally setose, outer ramus with 4 lateral spine groups. Telson longer than in female, width-length ratio about 14:17, each lobe with basal group of denticles, apices of lobes sinuous, medial corner weakly produced.

Variations.—Female "n" with aberrant accessory pair of deeply inserted and sheathed setae just anteroventral to normal posterior pair of setae on epimeron 2, left side only. Male "c" not fully developed; eyes enlarged; antenna 1 lacking calceoli and large aesthetascs, primary flagellum 11-articulate, accessory flagellum 6-articulate, article 2 of antenna 1 with 7 setae in main group; flagellum of antenna 2 proliferate, 30-articulate, articles very short, lacking calceoli; epimeron 2 with 5 setae; telsonic denticles absent; this specimen better developed than male "k" in terms of epimeron 2 and articles of antenna 1 but otherwise immature.

ILLUSTRATIONS.—One setule on dorsal apex of article 2 on antenna 1 of female hidden in illustration; right mandibular molar of female shown in flattened view; on male antenna 2, fuzz on medial face of article 4 concealed; left side of telson with one spine missing.

HOLOTYPE.-NMV, female "a," 4.77 mm.

TYPE-LOCALITY.—CPBS 35S/3, 1 Mar 1965, Western Port, Victoria, Australia, 14 m, sand.

VOUCHER MATERIAL.—Type-locality: female "n," 5.04 mm (illus.); male "c," 4.93 mm; male "k," 4.82 mm (illus.).

MATERIAL.—CPBS, 28 samples from 11 stations (63).

Distribution.—Victoria, Western Port, 8-15 m, sand.

HARPINIINAE

Diagnosis.—Article 2 of antenna 1 especially shortened; mandibular molar fully triturative or reduced to a small hump with articulate spines; palp of maxilla 1 uni- or biarticulate; setation on maxilla 2 ordinary or reduced; gnathopod 2 significantly enlarged or as small as gnathopod 1; article 2 of pereopod 3 of narrow form; pereopod 5 usually with enlarged article 3.

Description.—Article 5 of antenna 2 usually reduced in size; epimeron 3 of nonrounded classification; apices of peduncles on uropods 1-2 usually not combed.

Type-Genus.—Harpinia Boeck.

Composition.—Basuto, new genus; Coxophoxus J. L. Barnard; Harpiniopsis Stephensen; Heterophoxus Shoemaker; Proharpinia Schellenberg; Pseudharpinia Schellenberg.

REMARKS.—All phoxocephalid genera with thin article 2 on pereopod 3 are placed in this subfamily.

The Harpiniin Group of Genera

This group of genera is in poor classificatory state. The seven genera do not express the known diversity adequately, numerous species are so poorly described that they cannot be determined generically, and a generic revision of the group cannot be undertaken until the missing details on known species are collected. Part of the problem involves knowing the males adequately.

The Harpiniin group appears to have an evolutionary flow commencing in the subantarctic islands, antiboreal South America, and Antarctica and flowing northward primarily by submergence into the deep sea. During this evolutionary process the eyes of primitive antiboreal littoral forms were lost, even though one genus, *Harpinia*, reemerged in the north Atlantic onto sublitoral shelves.

The primitive antiboreal members of the Harpiniin group have continuous dorsal spination on one or more rami of uropods 1-2 but this decays rapidly to the north, although a few species north of the subantarctic convergence show some vestiges of this spination remaining on the inner ramus of uropod 2.

Two of the dominantly antiboreal genera, Heterophoxus and Pseudharpinia, have a strong ensiform process on article 1 of antenna 2, whereas the other dominantly subantarctic genus, Proharpinia, lacks this process. In the type-species of

Proharpinia and Pseudharpinia, article 2 of pereopod 5 is grossly toothed and although this characteristic deteriorates even within Antarctica, it is often seen in northern deep-sea harpiniins. The distinctive Harpinia, endemic to the North Atlantic, retains the ensiform process typical of Pseudharpinia and often has species with grossly toothed pereopod 5. Most species of the northern Harpiniopsis (abyssal, mainly Pacific, scarce in northern Atlantic) have lost the ensiform process but occasionally bear the heavily toothed pereopod 5.

Whether or not the presence of eyes is a good generic character remains a problem for extensive study. The generic concept of and the lines of descent from *Proharpinia*, *Pseudharpinia*, and *Heterophoxus* into the world abyssal genus *Harpiniopsis* are difficult matters. One may hypothesize a polyphyletic descent from each of the three genera to form various members of *Harpiniopsis*.

The minute details of mandibles especially, but also of other attributes in Harpiniopsis, must be studied before a better solution can be offered than now extant. However, in order to constrain Harpiniopsis more closely than has been done heretofore, we remove many species from Harpiniopsis and place them in Pseudharpinia. These species are characterized by a strong ensiform process on antenna 2 and continuously spinose inner rami of uropod 2. In other respects these species may or may not have outer rami of uropods 1-2 continuously spinose and they vary considerably in the gross dentition on article 2 of pereopod 5. Gross dentition itself may have value in distinguishing genera. We present a new key and new diagnoses for the seven genera and condensed lists of species with emphasis only on those having been described since J. L. Barnard (1960).

Key to the Genera of Harpiniinae

1.	Eyes present 2
	Eyes absent
2.	Antenna 2 strongly ensiform
	Antenna 2 not ensiform 3
3 .	Article 4 of pereopod 4 thick, dactyl of maxilliped very long, apical nail obsolescent Basuto, new genus
	Article 4 of percopod 4 thin, dactyl of maxilliped short, stubby, apical nail highly elongate 4
4.	Mandibular molar triturative, hands of gnathopods rectangular
	Mandibular molar simple, spinose, hands of gnathopods ovate
5.	Flagellum of male antenna 2 short as in female, article 1 of primary flagellum of male
	antenna l elongate and brushy

Coxophoxus J. L. Barnard

Coxophoxus J. L. Barnard, 1966a:84.

DIAGNOSIS.—Eyes present. Flagella of antennae 1-2 unreduced in female. Article 2 of antenna 1 especially shortened, ventral setae confined apically. [?Article 1 of antenna 2 not ensiform; article 3 with 2 setules; | facial spines on article 4 in one main row or mostly apical; article 5 especially thin and short. [?Right mandibular incisor with 3, 4 teeth]; molar triturative, large to medium; palpar hump small. Palp of maxilla 1 uniarticulate; inner plate naked. Setation of maxilla 2 weak. Inner plate of maxillipeds ordinary; apex of palp article 3 not protuberant, dactyl elongate, apical nail distinct, elongate. Gnathopods weakly dissimilar, gnathopod 1 moderately and gnathopod 2 strongly enlarged; article 5 of gnathopod 1 of ordinary length, short and almost cryptic on gnathopod 2, without eusirid attachment, palms oblique to transverse, hands of gnathopods 1-2 broadened, poorly setose anteriorly. Article 5 of pereopods 1-2 scarcely setose posteroproximally. Article 2 of pereopod 3 of narrow form, articles 4-5 of pereopods 3-4 narrow, article 2 of pereopods 3-4 weakly setose posteriorly; pereopod 5 ordinary, article 2 naked ventrally, article 3 ordinary, dactyl normal. Urosomite 1 generally naked; urosomite 3 without dorsal hook or special process. Peduncle of uropod 1 normally elongate, without apicoventral spike, without special enlarged apicolateral-medial spine, [?peduncular apices of uropods 1-2 not combed]; inner ramus of uropod 1 with marginal spines in one row, no rami continuously spinose to apex, inner ramus of uropod 2 ordinary. Uropod 3 ordinary, article 2 of outer ramus carrying 2-3 short to long apical setae. Telson ordinary, with only one apical spine on each lobe plus setules, without special dorsal and lateral spines or setae. Epimera 1-2 lacking long posterior setae, without midfacial setae above ventral facial ridge; epimeron 3 ordinary, almost of rounded classification but bearing 4 or more long setae.

DESCRIPTION.—Rostrum fully developed. [Fuzz on

article 1 of antenna 1 in male unknown; calceoli on male antennae 1-2 unknown], but flagellum of antenna 2 scarcely proliferate or elongate. [Prebuccal parts unknown. Right lacinia mobilis unknown;] mandibular palp thin, article 1 short, article 2 without outer setae, apex of article 3 transverse. Lower lip lacking cones. Outer plate of maxilla 1 with 9 spines, [?one spine especially thickened]. Inner plates of maxilliped poorly armed, thick. Coxae 2-4 without special anterodorsal humps. All posterior spines on article 6 of percopods 1-2 thin and setalike, [?midapical spine or seta present]. Article 2 of percopod 5 without facial setae. Peduncle of uropod 1 with dorsolateral spines widely spread, [?medial spines confined apically; peduncle of uropod 2 with only one medial spine confined apically]. Peduncle of uropod 3 lacking extra subapical setae or spines. [?Telson with ordinary pair of midlateral or dorsal setules on each side.]

Type-Species.—Coxophoxus hidalgo J. L. Barnard, 1966a [originally designated].

Composition.—Phoxocephalus coxalis K. H. Barnard, 1932.

Coxophoxus hidalgo J. L. Barnard

Coxophoxus hidalgo J. L. Barnard, 1966a:84, figs, 37, 38.

DISTRIBUTION.—Off southern California, 1675 m.

Coxophoxus coxalis (K. H. Barnard)

Phoxocephalus coxalis K. H. Barnard, 1932:97-99, fig. 48. Coxophoxus coxalis.—J. L. Barnard, 1966a:84.

DISTRIBUTION.—South Georgia, 0-5 m.

Basuto, new genus

Diagnosis.—Eyes present. Flagella of antenna 1-2 unreduced in female. Article 2 of antenna 1 especially shortened, ventral setae widely spread but mostly apical. Article 1 of antenna 2 not ensiform; article 3 with numerous setae and setules: facial

spines on article 4 in 2 rows set highly apicad; article 5 especially short. Right mandibular incisor with 3 teeth; molar not triturative, small apparently bearing 4 or more splayed, semiarticulate spines, [?usually not bearing fuzz]; palpar hump large. Palp of maxilla 1 biarticulate; inner plate with 3 setae. Setation of maxilla 2 ordinary. Inner plate of maxillipeds ordinary; apex of palp article 3 not protuberant, dactyl elongate, apical nail distinct, medium. Gnathopods dissimilar, gnathopod 2 moderately to strongly enlarged; article 5 of gnathopods 1-2 short, free on gnathopod 1, cryptic on gnathopod 2, with weak eusirid attachment, palms oblique, hands of both gnathopods elongate, broadened in gnathopod 2, poorly setose anteriorly. Article 5 of pereopods 1-2 with posteroproximal setae. Article 2 of pereopod 3 of narrow form, articles 4-5 of pereopods 8-4 narrow to medium, article 2 of pereopods 3-4 not setose posteriorly; pereopod 5 ordinary; article 2 strongly setose ventrally; article 3 ordinary to weakly enlarged; dactyl normal. Epimera 1-2 lacking long posterior setae, without midfacial setae above ventral facial ridge, epimeron 3 ordinary; urosomite 1 generally naked, urosomite 3 without dorsal hook or special process. Peduncle of uropod 1 normally elongate, without apicoventral spike, with special enlarged apicolateral spine, [?peduncular apices of uropods 1-2 not combed], inner ramus of uropod 1 with marginal spines in row, some rami continuously spinose to apex, inner ramus of uropod 2 especially shortened. Uropod 3 ordinary, elongate article 2 of outer ramus carrying 2 long apical setae. Telson ordinary, with only one apical spine on each lobe plus setules.

DESCRIPTION.—Rostrum fully developed. [Fuzz and calceoli on male antennae unknown. Prebuccal parts unknown. Right lacinia mobilis unknown;] mandibular palp medium to thick, article I short, article 2 with outer setae, apex of article 3 oblique. Lower lip bearing cones. Outer plate of maxilla 1 with 9 spines, one spine especially thickened. Inner plates of maxilliped especially thick, ordinarily setose. Coxae 2-4 without special anterodorsal humps. All posterior spines on article 6 of pereopods 1-2 probably thin and stiff, [midapical spine or seta unknown]. Article 2 of pereopod 5 without facial setae. [?Peduncle of uropod 1 with dorsolateral spines confined apically], medial spines confined apically, peduncle of uropod 2 with 2 elongate medial setae confined apically, peduncle of uropod 3 lacking extra subapical setae or spines. Telson with ordinary pair of midlateral or dorsal setules on each side.

Type-Species.—Pontharpinia stimpsoni Stebbing, 1908 (here selected; monotypic).

Composition.—Unique.

RELATIONSHIP.—Basuto resembles Mandibulophoxus but differs in the multisetose article 3 of antenna 2, as in Pontharpinia, the highly narrowed article 2 of pereopod 3, as in the harpiniin genera, has a small inner ramus on uropod 2, two long setae on the medial peduncle of uropod 2, a more enlarged gnathopod 2 and a telson bearing only one apical spine but with normal midlateral setule pairs. This genus is named for a region in southern Africa. Masculine.

Basuto stimpsoni (Stebbing), new combination

Pontharpinia stimpsoni Stebbing, 1908:75-78, pl. 11; 1910: 452.—Reid, 1951:222, fig. 22.

Pontharpinia Stimpsoni.—Chevreux, 1925:296.

Pontharpinia intermedia Schellenberg, 1925:138-140, fig. 11. —Reid, 1951:223.

Mandibulophoxus stimpsoni.—J. L. Barnard, 1957:436-438, fig. 4; 1960:359.—Griffiths, 1974a:250; 1974b:321.

DISTRIBUTION.—Africa, from Senegal southward around South Africa to the Natal Coast, 5-300 m.

Proharpinia Schellenberg

Proharpinia Schellenberg, 1931:80.-J. L. Barnard, 1960:311.

Type-Species.—Eyes present. DIAGNOSIS OF Flagella of antennae 1-2 unreduced in female. Article 2 of antenna 1 especially shortened, ventral setae widely spread or confined apically. Article 1 of antenna 2 weakly ensiform; article 3 with numerous setae and setules; facial spines on article 4 in one main row; article 5 especially short. [?Right mandibular incisor with 3 teeth]; molar not triturative, ordinary, small, pillow-shaped, bearing 3 clumped spines [?with common base, usually not bearing fuzz]; palpar hump small. Palp of maxilla 1 biarticulate; inner plate naked. Setation of maxilla 2 ordinary. Inner plate of maxillipeds ordinary; apex of palp article 3 not protuberant, dactyl short, stubby, apical nail distinct, elongate. Gnathopods ordinary, small, similar; article 5 of gnathopods 1-2 short, free, without eusirid attach-

ment, palms oblique, hands of gnathopods 1-2 ordinary, ovatorectangular to elongate, poorly setose anteriorly. Article 5 of pereopods 1-2 setose posteroproximally. Article 2 of pereopod 3 of narrow form, articles 4-5 of pereopods 3-4 narrow to medium, article 2 of pereopods 3-4 not setose posteriorly; pereopod 5 ordinary, article 2 strongly toothed ventrally, article 3 ordinary, dactyl normal. Epimera 1-2 lacking long posterior setae, without midfacial setae above ventral facial ridge; epimeron 3 ordinary. Urosomite 1 generally naked; urosomite 3 without dorsal hook or special process. Peduncle of uropod 1 normally elongate, without apicoventral spike, without special enlarged apicolateral-medial spine, [?peduncular apices of uropods 1-2 not combed], inner ramus of uropod 1 with marginal spines in one row, some rami continuously spinose to apex, inner ramus of uropod 2 ordinary. Uropod 3 ordinary, elongate article 2 of outer ramus [?carrying vestigial apical setae]. Telson ordinary, with only one apical spine or seta on each lobe, without special dorsal and lateral spines or setae.

DESCRIPTION.—Rostrum fully developed, head with anteroventral tooth. [Fuzz on article 1 of antenna 1 in male unknown; calceoli on male antennae 1-2 unknown. ?Prebuccal parts ordinary. Right lacinia mobilis unknown; mandibular palp thin, article 1 short, article 2 without outer setae, apex of article 3 oblique. [?Lower lip bearing cones.] Outer plate of maxilla 1 with 9 spines, ?no spine especially thickened]. Inner plates of maxilliped especially thick, ordinarily setose. Coxae 2-4 without special anterodorsal humps. [?All posterior spines on article 6 of pereopods 1-2 thin and setalike, midapical spine or seta present.] Article 2 of pereopod 5 without facial setae. Peduncle of uropod 1 with dorsolateral spines widely spread, medial spines widely spread, [?peduncle of uropod 2 with only one medial spine or setule confined apically]. Peduncle of uropod 3 lacking extra subapical setae or spines. [?Telson with midlateral or dorsal setules reduced to one member on each side.]

Type-Species.—Proharpinia antipoda Schellenberg, 1931 (monotypic).

Composition.—Proharpinia hurleyi J. L. Barnard, 1958; Heterophoxus stephenseni Schellenberg, 1931; Proharpinia tropicana J. L. Barnard, 1960 (See J. L. Barnard (1960) for references and distribution).

REMARKS. None of the three species that have been assigned to this genus agree with the type-species in the continuous dorsal spination on the inner ramus of uropod 2 and none of them has a grossly toothed article 2 on percopod 5. Two of the species, *P. stephenseni* and *P. tropicana*, have a poorly toothed epimeron 3. If these 3 species lacked eyes they would fall to *Harpiniopsis*.

Heterophoxus Shoemaker

Heterophoxus Shoemaker, 1925:22.- J. L. Barnard, 1960:318.

Diagnosis.—Eyes present. Flagella of antenna 1-2 unreduced in female. Article 2 of antenna 1 especially shortened, ventral setae widely spread towards apical end. Article 1 of antenna 2 strongly ensiform; article 3 with numerous setules; facial spines on article 4 in one main row; article 5 especially thin and short. Right mandibular incisor with 4+ teeth; molar not triturative, ordinary, small, pillow-shaped, bearing 3 long clumped spines, not bearing fuzz; palpar hump medium. Palp of maxilla 1 biarticulate; inner plate with 2 setae. Setation of maxilla 2 ordinary to weak. Inner plate of maxillipeds partly fused together, apex of palp article 3 not protuberant, dactyl short, stubby, apical nail distinct, elongate. Gnathopods small, similar; article 5 very short, almost cryptic, without eusirid attachment, palms oblique, hands ovatorectangular, elongate, poorly setose anteriorly. Article 5 of pereopods 1-2 setose proximoposteriorly. Article 2 of pereopod 3 of narrow form, articles 4-5 of pereopods 3-4 narrow, article 2 of pereopods 3 or 4 setose posteriorly; pereopod 5 ordinary, article 2 strongly setose and toothed ventrally, article 3 slightly enlarged, dactyl normal. Epimera 1-2 lacking numerous long posterior setae, without midfacial setae above ventral facial ridge; epimeron 3 ordinary. Urosomite 1 generally naked; urosomite 3 without dorsal hook or special process. Peduncle of uropod 1 normally elongate, without apicoventral spike, without special enlarged apicolateral-medial spine, only peduncular apex of uropod 2 combed, inner ramus of uropod 1 with marginal spines in one row, either none or some rami continuously spinose to apex, inner ramus of uropod 2 ordinary. Uropod 3 ordinary, small article 2 of outer ramus carrying 2 long apical setae. Telson ordinary, with only one apical spine or seta on each lobe, often with special lateral spine on each side.

DESCRIPTION.—Rostrum fully developed. Fuzz on article I of antenna I in male present, calceoli present on male primary flagellum of antenna l, and on article 5 and flagellum of male antenna 2. Prebuccal parts extended forward, massive, strongly distinct, epistome dominant. Right lacinia mobilis bifid, flabellate; mandibular palp medium to thin, article 1 short, article 2 without outer setae, apex of article 3 oblique. Lower lip bearing cones. Outer plate of maxilla 1 with 11 spines, one spine especially thickened. Inner plates of maxilliped poorly armed, thick. Coxae 2-4 without special anterodorsal humps. All posterior spines on article 6 of pereopods 1-2 thin and seta-like, midapical spine or seta absent (but apicolateral spine very short and pointed inward). Article 2 of pereopod 5 without facial setae. Peduncle of uropod 1 with dorsolateral spines confined apically, medial spines widely spread, peduncle of uropod 2 with about 2 medial spines widely spread. Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with ordinary pair of midlateral or dorsal setules on each side.

Type-Species.—Harpinia oculata Holmes, 1908 (= Heterophoxus pennatus Shoemaker, 1925) (monotypic); now Heterophoxus oculatus (Holmes, 1908).

COMPOSITION.—Harpinia ophthalmica Schellenberg, 1925; Heterophoxus trichosus K. H. Barnard, 1932; Heterophoxus videns K. H. Barnard, 1930 (see J. L. Barnard (1960) for references and distribution).

REMARKS.—The diagnostic details have been confirmed on specimens of the type-species deposited in the Smithsonian Institution.

Pseudharpinia Schellenberg

Pseudharpinia Schellenberg, 1931:81-82.—J. L. Barnard, 1960: 349

DIAGNOSIS. (based on type-species).—Eyes absent. Flagella of antennae 1-2 unreduced in female. Article 2 of antenna 1 especially shortened, ventral setae widely spread. Article 1 of antenna 2 strongly ensiform; article 3 with numerous setae and setules; facial spines on article 4 in one main row or 2 poorly defined rows; article 5 especially thin and short. [?Right mandibular incisor with 4 teeth]; molar not triturative, medium, pillow-shaped, bearing 4 or more splayed, semiarticulate spines,

[?usually not bearing fuzz]; palpar hump small. Palp of maxilla 1 biarticulate; inner plate with 2 setae. Setation of maxilla 2 weak. Inner plate of maxillipeds ordinary, apex of palp article 3 not protuberant, dactyl weakly elongate, somewhat stubby, apical nail distinct, elongate. Gnathopods small, similar, but gnathopod 2 weakly enlarged; article 5 of both gnathopods very short, free, with weak eusirid attachment, palms oblique, hands ordinary, ovatorectangular, weakly elongate, poorly setose anteriorly. Article 5 of pereopods 1-2 setose posteroproximally. Article 2 of pereopod 3 of narrow form, articles 4-5 of pereopods 3-4 narrow, article 2 of pereopods 3-4 setose posteriorly; pereopod 5 ordinary, article 2 strongly setose and toothed ventrally, article 3 enlarged, dactyl normal. Epimera 1-2 lacking long posterior setae, without midfacial setae above ventral facial ridge; epimeron 3 ordinary. Urosomite 1 generally naked; urosomite 3 without dorsal hook or special process. Peduncle of uropod 1 normally elongate, without apicoventral spike, without special enlarged apicolateralmedial spine, [?peduncular apices of uropods 1-2 not combed], inner ramus of uropod 1 with marginal spines in 2 rows, some rami continuously spinose to apex, inner ramus of uropod 2 ordinary. Uropod 3 ordinary, small article 2 of outer ramus carrying 2 long apical setae. Telson with 2-4 apical spines or setae on each lobe, often with special dorsal and lateral setae.

DESCRIPTION.—Rostrum fully developed. [Fuzz on article 1 of antenna 1 in male unknown, calceoli on male antennae 1-2 unknown. ?Prebuccal parts ordinary. Right lacinia mobilis unknown; mandibular palp thin, article 1 short, article 2 without outer setae, apex of article 3 oblique. Lower lip bearing cones. Outer plate of maxilla 1 with 9 spines, one spine especially thickened. Inner plates of maxilliped thick, ordinarily setose. Coxae 2-4 without special anterodorsal humps. [?All posterior spines on article 6 of pereopods 1-2 thin and setalike, midapical spine or seta present]. Article 2 of pereopod 5 without facial setae. Peduncle of uropod 1 with dorsolateral spines widely spread, medial spines confined apically; peduncle of uropod 2 with only one medial spine or setule confined apically. Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with ordinary pair of midlateral of dorsal setules on each side, highly apicad.

Type-Species.—Pseudharpinia dentata Schellenberg, 1931 (monotypic).

COMPOSITION.—Harpinia abyssalis Pirlot, 1932; Harpinia ayutlanta J. L. Barnard, 1964b (Pacific Panama, 1609–1746 m, ensiform process poorly developed); *Harpinia birjulini Gurjanova, 1953 (but uropod 2 unknown); Harpinia brevirostris Chevreux, 1920, 1927; Harpinia cariniceps K. H. Barnard, 1932 (but uropod 2 unknown); Harpinia cinca J. L. Barnard, 1961, 1962 (Southwest Africa, 990–4680 m); Harpinia excavata Chevreux, 1887, 1900 (= Harpiniopsis sanpedroensis J. L. Barnard, 1960); Harpinia latipes Norman, 1900; Harpinia obtusifrons Stebbing, 1888; Harpinia vallini Dahl, 1954 (Ross Sea, 550 m) (for references and distribution consult J. L. Barnard (1960) except for those described or allocated subsequently).

Rejected species: Harpinia palabria J. L. Barnard, 1961 (Tasman Sea, 610 m), ensiform process unknown but uropod 1 with spike, epimera 1-2 with posterior setae, to be described in a new genus (J. L. Barnard, in prep.)

REMARRS.—Pseudharpinia excavata bears wide medial spination on the peduncles of uropods 1-2; the following species have poorly ensiform antenna 2: Harpinia ayutlanta, H. cinca; the following species have elongate dactyl on the maxilliped: H. abyssalis, H. obtusifrons, and H. spaercki (the latter assigned to Harpiniopsis).

Pseudharpinia dentata Schellenberg

Pseudharpinia dentata Schellenberg, 1931:82-83, fig. 42.— J. L. Barnard, 1960:342, pl. 75.

DISTRIBUTION.—Lagotowia.

Harpiniopsis Stephensen

Harpiniopsis Stephensen, 1925:171.-J. L. Barnard, 1960:325.

DIAGNOSIS.—Eyes absent. Flagella of antennae 1-2 unreduced in female. Article 2 of antenna 1 especially shortened, ventral setae confined apically. Article 1 of antenna 2 not or weakly ensiform; article 3 with numerous setae and setules; facial spines on article 4 in one main row; article 5 ordinary in size to especially short. Right mandibular incisor with 3-4 teeth; molar not triturative, small, pillow-shaped, bearing 2 or more splayed, semi-articulate spines, usually not bearing fuzz; palpar

hump small to medium. Palp of maxilla 1 biarticulate. Inner plate with 2 setae. Setation of maxilla 2 weak. Inner plate of maxillipeds ordinary, apex of palp article 3 not protuberant, dactyl short, stubby, apical nail distinct, elongate. Gnathopods ordinary, small, similar or gnathopod 2 weakly enlarged; article 5 of both gnathopods very short, almost cryptic on gnathopod 2, without eusirid attachment, palms oblique, hands ordinary, ovatorectangular, elongate, poorly setose anteriorly. Article 5 of pereopods 1-2 setose posteroproximally. Article 2 of pereopod 3 of narrow form, articles 4-5 of pereopods 3-4 narrow, article 2 of pereopods 3-4 not setose posteriorly; pereopod 5 ordinary, article 2 naked or weakly to strongly toothed ventrally, article 3 enlarged, dactyl normal. Epimera 1-2 lacking long posterior setae, without midfacial setae above ventral facial ridge; epimeron 3 ordinary or of rounded classification bearing fewer than 3 setae. Urosomite 1 generally naked; urosomite 3 without dorsal hook or special process. Peduncle of uropod I normally elongate, without apicoventral spike, without special enlarged apicolateral-medial spine, [?peduncular apices of uropods 1-2 not combed], inner ramus of uropod 1 with marginal spines in one row, no rami continuously spinose to apex, inner ramus of uropod 2 ordinary. Uropod 3 ordinary, elongate article 2 of outer ramus carrying 1-2 short to long to vestigial apical setae. Telson with 1-4 apical setae on each lobe plus setules, occasionally with special dorsal and lateral setae.

Description.—Rostrum fully developed, head often with anteroventral tooth. [Fuzz on article 1 of antenna 1 in male unknown; calceoli on male primary flagellum of antenna l unknown.] Calceoli on article 5 of male antenna 2 present; flagellum in male elongate, [?flagellum in male with calceoli]. Prebuccal parts ordinary to strongly extended forward, occasionally massive, strongly distinct or poorly separated from each other, dominance of either epistome or upper lip variable. Right lacinia mobilis bifid or simple, flabellate or thin; mandibular palp thin, article 1 short, article 2 without outer setae, apex of article 3 oblique. Lower lip bearing cones. Outer plate of maxilla 1 with 11 spines, one spine especially thickened. Inner plates of maxilliped poorly armed, thick. Coxae 2-4 without special anterodorsal humps. All posterior spines on article 6 of pereopods 1-2 thin and setalike, [?midapical spine or seta present]. Article 2 of pereopod 5 without facial setae. Peduncle of uropod 1 with dorsolateral spines confined apically, medial spines confined apically or widely spread; peduncle of uropod 2 with only one medial spine or setule confined apically. Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with pair of midlateral or dorsal setules on each side, highly apicad.

Type-Species.—Harpiniopsis similis Stephensen, 1925 (monotypic).

Composition.—*Harpinia amundseni Gurjanova, 1946; *Harpinia australis J. L. Barnard, 1961 (Great Australian Bight, 1320-1340 m); *Harpiniopsis capensis (J. L. Barnard, 1962) (as Harpinia laevis capensis, new subspecies, South Africa, 4893-4961 m); *Harpiniopsis emeryi J. L. Barnard, 1960; Harpiniopsis epistomata J. L. Barnard, 1960; Harpiniopsis fulgens]. L. Barnard, 1960; Harpiniopsis galera J. L. Barnard, 1960; *Harpinia gurjanovae Bulycheva, 1936; • Harpinia kobjakovae Bulycheva, 1936; *Harpinia miharaensis Nagata, 1960 (Japan, shallow water); *Harpinia moiseevi Gurjanova, 1953; *Harpinia nadania J. L. Barnard, 1961 (Tasman Sea, 610 m); *Harpiniopsis naiadis J. L. Barnard, 1960; *Harpinia orientalis Bulycheva, 1936; *Harpinia pacifica Bulycheva, 1936; Harpiniopsis percellaris I. L. Barnard, 1971 (Oregon, 600-2600 m); *Harpiniopsis petulans J. L. Barnard, 1966a (California, 1265 m); Harpiniopsis profundis J. L. Barnard, 1960; *Harpinia salebrosa Gurjanova, 1936; *Harpinia schurini Bulycheva, 1936; *Harpinia spaercki Dahl, 1959 (Banda Trench, 6580-7270 m); *Harpinia tarasovi Bulycheva, 1936; *Harpiniopsis triplex J. L. Barnard, 1971 (Oregon, 2000-2800 m); *Harpinia wandichia J. L. Barnard, 1962 (South Sandwich Trench, 2747 m); *Harpiniopsis sp. D, J. L. Barnard, 1960. (See J. L. Barnard (1960) for references and distribution, many of these species placed with Harpinia at that time; others, with literature and distribution subsequently described, as noted; asterisks denote species of which the males remain undiscovered, so that firm generic identification is impossible.)

REMARKS.—Harpinia laevis capensis J. L. Barnard, 1962, is elevated to full specific level because the species cannot be Harpinia laevis from the North Atlantic Ocean owing to the absence of an ensiform process on antenna 2. Harpiniopsis emeryi bears a weak ensiform process, thereby demonstrat-

ing intergradation with ancestral antiboreal taxa. See *Pseudharpinia* for species transferred to that genus.

The species of this genus are poorly known and may be divisible into additional genera. The diagnosis presented above is conceptually based on knowledge of several species but not fully on any one species, including the type-species.

Harpinia Boeck

Harpinia Boeck, 1876:218.—Sars, 1895:150.—Stebbing, 1906: 140.—J. L. Barnard, 1960:344.

Diagnosis.—Eyes absent. Flagella of antennae 1-2 unreduced in female, but male antenna 2 with short flagellum. Article 2 of antenna 1 especially shortened, ventral setae confined apically. Article 1 of antenna 2 strongly ensiform; article 3 with 2 setules; facial spines on article 4 in one main row; article 5 especially thin and short. Right mandibular incisor with 4 teeth; molar not triturative, small, pillow-shaped, bearing 3 or more splayed, semiarticulate spines, usually not bearing fuzz; palpar hump small. Palp of maxilla 1 biarticulate; inner plate with 2 setae. Setation of maxilla 2 weak. Inner plate of maxillipeds ordinary, apex of palp article 3 weakly protuberant, dactyl weakly elongate to short and stubby, apical nail distinct, elongate. Gnathopods weakly dissimilar, gnathopod 2 weakly enlarged; article 5 of both gnathopods very short, free, with weak eusirid attachment, palms oblique, hands ordinary, ovatorectangular, poorly setose anteriorly. Article 5 of pereopods 1-2 setose posteroproximally. Article 2 of pereopod 3 of narrow form, articles 4-5 of pereopods 3-4 narrow, article 2 of pereopods 3-4 not setose posteriorly; pereopod 5 ordinary, article 2 naked or strongly toothed ventrally, article 3 enlarged, dactyl normal. Epimera 1-2 lacking long posterior setae, without midfacial setae above ventral facial ridge; epimeron 3 ordinary or of rounded classification and bearing 3 or fewer long setae. Urosomite 1 generally naked; urosomite 3 without dorsal hook or special process. Peduncle of uropod I normally elongate, without apicoventral spike, without special enlarged apicolateral-medial spine, peduncular apices of uropods 1-2 not combed; inner ramus of uropod 1 with marginal spines in one row, no rami continuously spinose to apex, inner ramus of uropod 2 ordinary. Uropod 3 ordinary, elongate to short article 2 of outer ramus carrying 1-2 long to vestigial apical setae. Telson ordinary, with 1-4 apical spines or setae on each lobe plus setules, rarely with special dorsal and lateral setae.

DESCRIPTION.—Rostrum fully developed, head often with anteroventral tooth. Fuzz on article I of antenna 1 in male present; calceoli on male primary flagellum of antenna l absent, article l of primary flagellum elongate and fuzzy in male. Calceoli on article 5 of male antenna 2 present; flagellum in male without calceoli. Prebuccal parts ordinary, strongly distinct, both epistome and upper lip prominent. Right lacinia mobilis bifid, flabellate or thin, mandibular palp medium to thin, article 1 short, article 2 without outer setae, apex of article 3 oblique. [?Lower lip lacking cones.] Outer plate of maxilla 1 with 7-9 spines, one spine occasionally thickened. Inner plates of maxilliped poorly armed. thick. Coxae 2-4 without special anterodorsal humps. All posterior spines on article 6 of pereopods 1-2 thin and seta-like, [?midapical spine or seta present]. Article 2 of pereopod 5 without facial setae. Peduncle of uropod 1 with dorsolateral spines widely spread, [?medial spines confined apically; peduncle of uropod 2 with only one medial spine or setule confined apically]. Peduncle of uropod 3 lacking extra subapical setae or spines. Telson with ordinary pair of midlateral or dorsal setules on each side. Mouth parts occasionally degenerate in male.

Type-Species.—Phoxus plumosus Krøyer, 1842 (originally designated); now Harpinia plumosa (Krøyer, 1842).

Composition.—Harpinia abyssi Sars, 1885; Harpinia antennaria Meinert, 1893 (= H. neglecta Sars, 1895); Harpinia bidentata Stephensen, 1925; Harpinia cabotensis Shoemaker, 1930; Harpinia crenulata Boeck, 1871; ?Harpinia crenuloides Stephensen, 1925 (male unknown but antenna 2 with ensiform process); Harpinia curtipes Stephensen, 1925; Harpinia dellavallei Chevreux, 1911; Harpinia laevis Sars, 1895; Harpinia mucronata Sars, 1885; Harpinia pectinata Sars, 1895; Harpinia propinqua Sars, 1895, Bousfield, 1973; Harpinia serrata Sars, 1882; Harpinia truncata Sars, 1895 (see J. L. Barnard, 1960, for references and distribution).

REMARKS.—This genus is confined to the North Atlantic region as far as is known. However, the males of many North Pacific species have not been described and there is the possibility that species now assigned to *Harpiniopsis* may belong with *Harpinia*. The male of *Harpinia* is very unusual in the shortness of the flagellum of antenna 2 that apparently lacks calceoli (but calceoli are present on the peduncle), the largeness of the brushes on the antennae and the elongate and brushy article 1 on the primary flagellum of antenna 1.

Appendix

Australian Samples and Localities

- AM. The Australian Museum, New South Wales, Australia, samples and localities:
 - P.3438. Port Jackson, New South Wales.
 - G.5413. Port Jackson, New South Wales.
 - G.5406. Bondi Bay, Sydney, New South Wales.
 - P.18125. Antechamber Bay, Kangaroo Island, South Australia, with light in net, CSIRO Fisheries, 12 Dec 1939.
 - P.18175. Off Tasmanian coast, dredged, 100 fathoms, C. Hedley.
 - P.18187. \$ of Cape Everard, Victoria, 38°12.5'S, 149°05.5'E, 152 m, per L. R. Thomas, 20 Jun 1962.
 - P.18210. S of Cape Everard, Victoria, 37°55'S, 149°E, 77 m, CSIRO Fisheries, per L. R. Thomas, 20 Jun 1962.
 - P.18214. Long Reef, Collaroy, New South Wales, P. Hutchings, 16 Nov 1970.
 - P.18215. Off Sydney, New South Wales, 33°58.4'S, 151° 29'E, 150 m, Gear OPG, CS1RO Fisheries, per L. R. Thomas 18 Jun 1962.
 - P.18219. Same as P.18215.
 - P.18222. Same as P.18215.
 - P.18228. 70 miles S of Lakes Entrance, Victoria, 148°24.50°E, 39°S, sand, 52 fathoms, "Esso-Gipps" Sta 20, per C. Phipps, May 1969.
 - P.18229. Off island in middle of Balmoral Head, Port Jackson, New South Wales, 20 ft [6.1 m], mud bottom, N. Coleman, 27 Jun 1970.
 - P.18242. Same as P.18215.
 - P.18243. Same as P.18215.
 - P.18248. Same as P.18215.
 - P.18253. Same as P.18215.
 - P.18269. SW of Cape Everard, Victoria, 38°15'S, 148°12'E, 300 m, Gear OPG, CSIRO Fisheries, per L. R. Thomas, 20 Jun 1962.
 - P.18270. Same as P.18269.
 - P.18276. S of Eucla, Western Australia, Great Australian Bight, 33°05'S, 128°40'E, 83 m, CS1RO Fisheries, per L. R. Thomas, 5 Jul 1962.
 - P.18285. Off Manly Beach, Sydney, New South Wales, trawled 18-20 ft [5.5-6.1 m], bottom clean sand, P. Hutchings, 30 Jun 1971.
 - P.18312. E of Hood Point, Western Australia, 34°32'S, 121° 31'E, 145 m. CSIRO Fisheries, 9 Jul 1962.
- CPBS. Victoria Division of Fishieries and Wildlife, Crib Point Benthic Survey, in Western Port. Samples were taken at 52 stations (Figure 4) between 19 Feb and 13 Apr 1965, with periodic samplings at stations 300, 31N, 31S, 32N, 32S until 1970, and occasional resampling at some other stations. Phoxocephalids were found at every station and were

- present in 293 of a total of 326 samples. A small preliminary survey of the Crib Point area (Figure 4, inset), was made between 9 Jul and 13 Oct 1964; 43 samples were examined, all containing phoxocephalids.
- EBS. New South Wales State Fisheries, Estuarine Benthic Survey, (Figure 1, insets 1 and 2), samples and localities:
 - 20. Jervis Bay, Murray's Beach, 6 m, Zostera, 25 Apr 1972.
- 22. Same as 20.
- 27. Jervis Bay, Murray's Beach, 6 m, sand, 25 Apr 1972.
- 28. Same as 27.
- 30. Same as 27.
- Jervis Bay, Murray's Beach, 6 m, Halophila, 25 Apr 1972.
- 32. Same as 31.
- Botany Bay, entrance to Woolaware Bay, mud, shellgrit, 2.5 m, 14 Sep 1972.
- 103. Georges River, Woronora, 3 m, sand, 25 Oct 1972.
- 117. Georges River, Panania, 3 m, sand and mud, 25 Oct 1972.
- 138. Botany Bay, Towra Beach, 0.9 m, Zostera, shell-grit, 30 Nov 1972.
- 148. Botany Bay, 500 yds (457 m) off Towra Point, 3 m, sand, shell-grit, 12 Jan 1973.
- 149. Same as 148.
- 196. Botany Bay, off Towra Beach, 3 m, sand, 11 Apr 1973.
- 199. Same as 196.
- 200. Same as 196.
- 304. Botany Bay, Towra Point, 0.9 m, Zostera, 17 Apr 1973.
- 311. Same as 304.
- 313. Same as 304.
- 362. Lake Macquarie, Salt's Bay, 0.3 m, coarse sand, 10 Jul 1973.
- 363. Same as 362.
- JLB AUS. Samples collected by J. L. Barnard in Western Australia with localities:
 - Sugarloaf Rock, Cape Naturaliste, Western Australia, intertidal wash of common seaweeds, 1 Sep 1968.
 - Middleton Beach, Albany, Western Australia, intertidal wash of algae and rocks, 30 Sep 1968.
 - 12. Same as JLB AUS 11, coralline algae.
 - Middleton Beach, Albany, Western Australia, intertidal wash of sandy rocks, coralline algae, 30 Sep 1968.
- Lake King. Specimens from hand samples collected at Lake King, Gippsland, by J. Kudenov, Marine Pollution Studies Group, Victoria Division of Fisheries and Wildlife.
- Macreadie. Plankton sample 710131, collected by V. Macreadie, Monash University, Crib Point in Western Port, 8 Aug 1972.

MMD. Samples collected by Margaret M. Drummond as follows: Merimbula, New South Wales, intertidal shallows, 10 and 16 Feb 1972.

NMV. National Museum of Victoria, Melbourne, Victoria, Australia: all holotype and voucher materials from the surveys of Western Port and Port Phillip Bay are deposited in this museum; in addition a sample with a phoxocephalid from the Port Phillip Survey, 1957-63 is included in this study.

PPBES. Victoria Division of Fisheries and Wildlife, Benthic Survey in the Port Phillip Bay Environmental Study. Sampling was carried out at 112 stations between 17 Oct 1969 and 2 Nov 1972 (Figure 2). Of a total of 452 samples, 314 contained phoxocephalids but they were not taken at stations 918, 933, 935, 940, 945, 947, 952, 954, 956, 958, 962.

RHM. Plankton samples collected by Ralph H. Miller, University of Melbourne, in the Crib Point area of Western Port, 19 Jan 1968, 25 Mar 1968, 22 Oct 1971.

SBS. The Australian Museum, Shelf Benthic Survey, off Malabar, New South Wales, (Figure 1, inset 2), samples and localities:

AIS1. 31 m, coarse gravel, sand, shell fragments, 12 May 1972.

A2S3. 48 m, medium fine sand, 15 May 1972.

A2S5. Same as A2S3.

ClS5. 29 m, shelly gravel, high organic content, 17 May 1972.

C2S2. 69 m, sandy mud, medium fine sand, 17 May 1972.

C4S4. 69 m, medium fine sand, 17 May 1972.

C6S2. 75 m, sandy gravel, 22 May 1972.

C6S3. Same as C6S2.

C7(= Cx)S1. 92 m, sandy gravel, 22 May 1972.

C7(= Cx)S4. Same as C7S1.

DIS1. 31 m, medium sand and shell fragments, 17 May 1972.

D1S2. Same as D1S1.

D1S3. Same as D1S1.

DIS4. Same as DIS1.

D2S1. 49 m, medium sand and shell fragments, 17 May 1972.

D2S2. Same as D2S1.

D2S3. Same as D2S1.

D2S4. Same as D2S1.

D2S5. Same as D2S1.

D3S3. 71 m, medium fine sand, 19 May 1972.

E2S3. 53 m, medium fine sand, 19 May 1972.

E2S4. Same as E2S3.

E4S1. 66 m, gravel with medium sand, 19 May 1972.

E4S3. Same as E4S1.

3. 1.6 km E of Malabar outlet, Sydney, 150°16'E, 33°58'42" S, 66 m, 25 May 1975.

 2 km E of Long Bay, Sydney, 150°17′E, 33°58′50″S, 66 m, 23 May 1973.

5. 2.3 km E of Malabar, 150°16'48"E, 33°59'27"S, 66 m, 23 May 1973.

Little Bay, Malabar, 16.7 m. gravel and sand, 19 Jun 1972. Long Reef, Collaroy, 43 m. 27 Apr 1972.

Off North Head, Sydney, 33 m, 23 May 1972.

Station P. 29 m, gravel and sand, 27 Sep 1972.

Dredge 20. no data.

Shepherd 15. Sample collected by S. A. Shepherd, Pearson Islands, South Australia, 8 m, 2/11 m², horizontal face in algae, Jan 1969.

Slack-Smith 1. Sample collected by S. Slack-Smith, Albany, Cheyne Beach, Western Australia, on weedy rocks, intertidal, 4 Dec 1968.

USNM. Former United States National Museum (specimens now in National Museum of Natural History, Smithsonian Institution, Washington, D.C., U.S.A.); duplicates of speimens from Western Port and Port Phillip Bay surveys deposited in NMNH.

WAM. Western Australian Museum, Perth, Western Australia, samples and localities:

9561. Off Garden Island, Western Australia, night tow, Feb 1920.

414-73. Barrow Island, Western Australia, night tow, 2 Sep 1954.

415-73. Trawl station off water run, 35 m, sand, 3 Feb 1943.

416-73. Trawl station 6, off Jlbbon Point, New South Wales, 24 Jul 1943.

417-73. Eden, New South Wales, 30 m, coarse sand, 8 Oct 1943.

419-73. Antechamber Bay, Kangaroo Island, South Australia, light in net at night.

WPBES. Victoria Ministry for Conservation, Division of Fisheries and Wildlife, Westernport Bay Environmental Study. Benthic samplings were made at 41 stations (Figure 3) between 20 Nov 1973 and 25 Jan 1974 in Western Port; 60, of a total of 123 samples, contained phoxocephalids but they were not found at stations 1702, 1703, 1708, 1710, 1711, 1712, 1713, 1719, 1720, 1723, 1737, 1738. Material from 9 stations in the Western Entrance sampled in 1975, has been examined, but full Western Entrance data are not included here, though some specimens have been used.

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(Names of valid species and genera of Phoxocephalidae and also page numbers for major treatments are in italics; the absence of italics for the specific or generic name (or both) in a binominal taxon of Phoxocephalidae indicates a classification change that is accomplished, proposed, or contemplated.)

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