J. LAURENS BARNARD

# Gammaridean Amphipoda of Australia, Part I

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*J. Laurens Barnard*

# Gammaridean Amphipoda of Australia, Part I

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## ABSTRACT

J. Laurens Barnard. Gammaridean Amphipoda of Australia, Part I. *Smithsonian Contributions to Zoology,* number 193, 333 pages, 194 figures, 1972.—Fourteen families of Australian Gammaridea from shallow marine waters in the warm-temperate zone are treated taxonomically. The family Dexaminidae, with 28 species in 5 genera, dominates the general amphipod fauna, though specimens are extremely abundant only on soft bottoms of embayments. *Paradexamine,* with 17 species occurring in Australia out of 35 now known in the Indo-Pacific-Antarctic region, has many sibling pairs and triads in Australia and probably represents a case of adaptive radiation, but the adaptations to special niches are even more apparent in genera such as *Syndexamine*, derived from *Paradexamine*. *Syndexamine* contains species with special morphological adaptations in the form of prehensile pereopods and a nonskid cuticle apparently as devices for attachment as commensals to sedentary hosts.

Australian shallow waters have an especially significant number of species and endemic genera in the Dexaminidae, Eophliantidae, Phliantidae, Cyproideinae, and in the thaumatelsonin Stenothoidae, suggesting that Australia is a major evolutionary center for these taxa. Sibling radiation in a new genus with affinities to *Pontogeneia* plus the high significance of speciation in the families heretofore mentioned is discussed in a framework employing the principle of the ends-of-the-earth position of Australia in the world ocean. Relationships of the sublittoral fauna to Antarctica and to cold-temperate regions are especially low for a warm-temperate regime. Twelve new genera are described in the Amphilochidae, Colomastigidae, Dexaminidae, Eusiridae, Gammaridae, Phliantidae, and Stenothoidae. Evolutionary sequences in the Dexaminidae, Eophliantidae, Ceinidae, and Phliantidae are discussed. The carinate species formerly placed in *Maera* and *Elasmopus* are removed to a new genus similar to *Parelasmopus*.



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*J. Laurens Barnard*

# Gammaridean Amphipoda of Australia, Part I

## Introduction

This is part of a study on Australian Gammaridea that concentrates on genera in 14 families found on the littoral (intertidal) coast of southwestern Australia from Perth to Albany in warm-temperate waters. Only a few species have ever been recorded from the vast western half of Australia, and few studies on any Australian Gammaridea have been published since Nicholls (1939) (see Fearn-Wannan, 1968a, b). Sheard (1937) published a list of Gammaridea from Australia totalling about 170 species (updated to 1968 herein); but if one may judge from studies in other parts of the world, the warm-temperate region of Australia might have as many as 500 species in littoral and sublittoral depths.

Since this entire study is predicated on continuing field studies over several years and since the present materials are so extensive, I have deemed it necessary to issue the study in parts to avoid unwieldiness. The present part is not necessarily a natural phyletic unit, but it encompasses many of the nestling taxa as contrasted to the domicolous and fossorial members that will be studied later. I had planned to present one faunistic paper on all the intertidal species from southwestern Australia similar to J. L. Barnard (in press) for New Zealand, but many taxonomic problems were encountered that required study of materials from South Australia, Victoria, and New South Wales, the faunistic bases of the previously known Australian species. New information on those areas, so deeply entwined with the discoveries in southwestern Australia, extended the size of this report to its present dimensions.

The families treated herein are the Amphilochidae (only the subfamily Cyproideinae), Ceinidae, Colomastigidae, Dexaminidae (= Atylidae, Prophliantidae), Eophliantidae, Eusiridae, Gammaridae, Leucothoidae (one genus only), Lysianassidae, Nihotungidae, Ochlesidae, Phliantidae, Stegocephalidae, and Stenothoidae (the thaumatelsonin members only). A limited number of genera in these families is included as I have treated only those of which I possess good material.

The treatment by geographic region is uneven since the collections from Western Australia are mainly from littoral epifloras, those from South Australia are mainly from sublittoral epifloras, and those from Victoria, mainly from sublittoral mud bottoms. The three kinds of substrate have yet to be studied equally in the three geographic regions. Since I have found many advantages in studying Australian amphipods by taxon rather than by collection, faunistic summaries accordingly will be delayed.

The taxa treated herein have been considered first because my previous experience with field studies in Hawaii and New Zealand (J. L. Barnard, 1970a, in press) suggested the necessity of making immediate microscopic examination of the samples after collection in the field. This is done in order to facilitate the division of specimens into species according to color and to curate carefully each

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specimen to avoid breakage. In seven months in the field, I was consistently able only to sort and make observations of this kind on the taxa of these 14 families. The domicolous and fossorial taxa plus certain unpigmented members of nestling taxa were ignored, though the samples are now in process of study for some of those groups. Much taxonomic assistance was gained from this color-searching method, though the amount of work was so extensive that the method was utilized only to sort, and no fine details of colors can be reported as in Barnard (1970a). This must await fresh material now that the taxonomy of some of these groups is clarified morphologically.

PROCEDURES.—The lengths of all specimens have been measured as parabolic curves from the side of the animal, along an axis halfway from dorsal to ventral on the head and segments, and from the apex of the rostrum to the base of the telson. Specimens are, therefore, somewhat longer than if they had been measured by being stretched along a microruler.

The term "mark" is used in the descriptive system to indicate a stated distance from the proximal end of a segment or appendage. "Mark 60," thus, indicates a distance of 60 percent from the proximal end of the stated appendage. The terms "setules" and "spinules" are diminutives of setae and spines. The term "quadriform" is used to denote the quadrate shape of a limited portion of an appendage.

All types of western Australian material have been deposited in the Western Australian Museum but a fraction of the specimens of each species is also deposited in the Smithsonian Institution. Types of materials from Victoria and South Australia are deposited in the museums of those states.

The following abbreviations are used throughout this study:

ANZ=Australia-New Zealand
JLB=J. L. Barnard
NMV=National Museum of Victoria
RLB=R. L. Barnard
SAM=South Australian Museum
SI=Smithsonian Institution
WAM=Western Australian Museum
USNM=United States National Museum

New names of species and genera are derived from the many aboriginal languages of Australia, generally from appropriate words concerning the ocean, fleas, lice, or even ceremonial names, except where some obvious geographic name has been used. New genera are considered as masculine, and specific names are used as nouns in apposition to their generic names, except *Tethygeneia, Gondogeneia,* and *Mallacoota* which are feminine and whose roots derive from place names.

The treatment of the taxa varies according to the amount of knowledge in each; some taxa carry diagnoses, others only descriptions. Two non-Australian species in the genus *Paradexamine* also are included (designated in their titles).

The systematic section is presented alphabetically by families, then by genera, and then by species, except where a type-species or model species is moved forward out of its sequence.

Important collecting localities are shown in Figure 1.

FIELD METHODS.—Intertidal samples were made by washing substrates in a bucket of sea water containing 2 ounces of formaldehyde. Biota and debris falling to the bottom of the bucket were preserved in a seawater solution of 5 percent formaldehyde, removed to the laboratory, washed in fresh water, the amphipods sorted into taxa roughly by morphology and color patterns, and then represerved in 70 percent alcohol. In the field each sample required an hour of washing of substrates such as algae, rocks, sand under rocks, and various sessile animals. Sand beaches were not studied.

OTHER SAMPLES.—Extensive collections of amphipods in the Western Australian Museum were examined, and pertinent materials were incorporated into the present study. A large collection of amphipods from South Australia, freshly collected by Mr. Scoresby A. Shepherd, was studied. Two large collections of materials from Victoria, recently assembled by the National Museum of Victoria (through the courtesy of Dr. W. Williams and Director John McNally) and the Victorian Fisheries Department (through the courtesy of Dr. Alistair J. Gilmour and Mrs. Margaret M. Drummond), were incorporated into this study wherever taxonomic problems had to be solved by use of topotypical specimens. Several types and series of topotypical specimens deposited in the Australian Museum, Sydney, were examined through the courtesy of Dr. John Yaldwyn, Dr. D. J. G. Griffin and

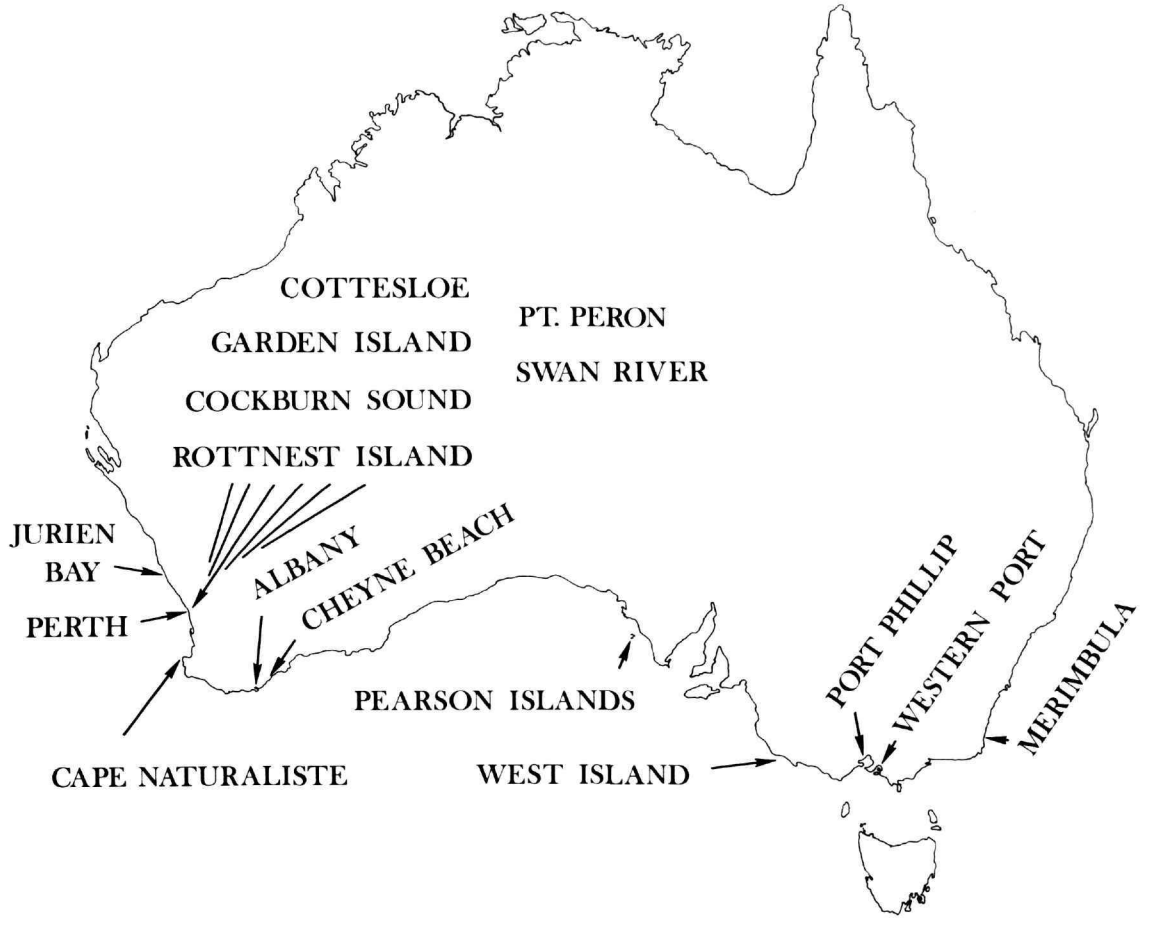


FIGURE 1.—Map of Australia with names of important localities cited herein.

Miss E. C. Pope. Mrs. Shirley M. Slack-Smith made special collections for me at Cheyne Beach, W.A., and Dr. Barry R. Wilson collected underwater samples for me at Cockburn Sound, W. A. Collections made in Western Australia and the Queensland coast by Dr. and Mrs. A. H. Banner of the University of Hawaii have also been used where pertinent.

In the station list presented in the "Appendix," samples from Port Phillip Bay, Victoria (National Museum of Victoria), and from Western Port, Victoria (Victorian Fisheries Department), are not recorded in full detail since this will be done elsewhere in the literature. Nearly 100 samples from Port Phillip and over 300 from Western Port have been examined, but only a small portion of the contents of those samples is reported herein. Within reason, I have quoted the data from other collections precisely as given by the collector, rather than converting English measurements to metric.

ACKNOWLEDGMENTS.—Besides the extensive assistance afforded by persons mentioned in the foregoing section, I wish also to acknowledge the courtesy and help of the following persons in Western Australia: Dr. Ray George, Mr. Roland McKay, Mr. and Mrs. Richard Slack-Smith, and Dr. and Mrs. Barry R. Wilson.

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Dr. I. E. Wallen, Dr. R. B. Manning, Dr. T. E. Bowman. My wife and three children aided me extensively in the field and the laboratory. I made the drawings, the supplies for which were furnished by the Richard Rathbun Fund. The Antarctic materials reported herein were studied with the support of a grant (NSF-GB3285) from the National Science Foundation.

ILLUSTRATIONS.—The figures are lettered according to the following system. Legends are provided for each, but in sets of two or more figures for a species, a detailed legend is provided for only one figure, which applies to the set unless noted otherwise. Each set of figures for a species has one main specimen figured; parts of subsidiary specimens are marked with lowercase letters such as *b, c, f, m, n, w, x,* and *y*. Capital letters are used for major parts, and various other lowercase letters specify positions and minor parts. The letter group for each subfigure is composed of one or more letters, each of which carries a specific meaning; for example, in *rA1n,* the "r" stands for "right," the "*A*" for "antenna," the "*1*" for "one," the "*n*" for a subsidiary specimen specified in the legend. Figures bearing the letter "*r*" are right-sided, and, in the case of gnathopods and pereopods—drawn from a left view —the medial aspect is shown. Pleopods are often omitted from side views; and setae are removed from certain gnathopods and represented by circles at their attachment points. Plumosities are omitted except where they can definitely be seen in the magnification employed.

The capital and lowercase letters used are as follows: *A*=antenna, *B*=labrum (upper lip), *C*=coxa, *D*=dactyl of pereopod, *E*=epimeron, *F*=accessory flagellum, *G*=labium (lower lip), *H*=head, *I*=inner plate, *J*=epistome, *K*=eye, *L*=palp, *M*=mandible, *N*=gnathopod, *O*=outer plate, *P*=pereopod, *Q*=mandibular molar, *R*=ramus, *S*=maxilliped, *T*=telson, *U*=uropod, *V*= urosome, *W*=pleon, *X*=maxilla, *Y*=prebuccal complex, *Z*=mandibular incisor; *a*=anterior, $b^1$=broken, *c*=specimen no. 2, *d*=dorsal, *e*=dactyl, *f*=female, *g*=gland, *i*=inner, *j*=juvenile, *k*=cuticle, *l*=left (lateral), *m*=male, *n*=specimen no. 3, *o*=outer, *p*=posterior, *q*=calceolus, *r*=right (medial), *s*=setae removed, *t*=spine, *u*=one-half, $v^1$=ventral, $w^1$=palm, $x^1$=specimen no. 4, $y^1$=oblique, *z*=dissected; *8*=rostrum, *9*=pleopod.

See also "Notes on Illustrations" under *Paradeximine.*

[1] The letters *b, v, w, x,* and *y* occasionally are used with other meanings, which are noted specifically in the appropriate legend.

## Biogeographic Remarks

One might expect substantial biogeographic conclusions to emerge from a fauna now totaling 250 species in Australia. Such conclusions have been attempted by J. L. Barnard (in press) in the much smaller amphipodan fauna of New Zealand, in large part a microcosm of the greater Australian biota. But numerous families and genera in warm-temperate Australia remain unexplored, and countless habitats have not been touched. Tropical Australia is practically virgin territory for amphipod studies. Many species described or reported from warm-temperate Australia in early days have not been clarified. The few genera and portions of families I treat herein are so unexpectedly diverse that a vast amount of exploratory taxonomy remains to be done. Despite these qualifications, however, several conclusions can be drawn about the position of Australia in the world of biogeography of Gammaridea.

In the many taxonomic problems of families and genera in Gammaridea, one may already see some important clarifications emerging from these studies on Australian species. For example, the amalgamation of the Dexaminidae, Atylidae, Anatylidae, Lepechinellidae, and Prophliantidae was stimulated mainly by the present study (J. L. Barnard, 1970b). One further step in the elaboration of the difficult group embodied in the Eusiridae, Calliopiidae, and Pontogeneiidae is presented herein. The validity of the presently known genera in the Phliantidae (apart from Ceinidae) seems to be confirmed herein, and, from this study and that on New Zealand by J. L. Barnard (in press), there has emerged a different, hopefully better, classification of Eophliantidae, Phliantidae, Ceinidae, and the freshwater amphipods typified by *Chiltonia.* The importance of *Paracalliope* as a centerpiece of amphipod evolution has been discovered; this importance lies in the kinds of morphological characters combined in the genus and in the way one's

evaluation of these characters in relationship to pontogeneiids and oedicerotids can be altered (see J. L. Barnard, in press). Finally, the invalidity of the Thaumatelsonidae is confirmed by these studies.

Two main questions guiding the entire study, including future sections in preparation, are: (1) whether or not Australia represents a significant evolutionary center of higher taxa in Gammaridea by showing (a) that important taxa have their centers of diversity in Australia, (b) that significant outward dispersal can be demonstrated, and (c) that Australia contains primitive taxa linking higher categories or otherwise showing evolutionary directions; and, in contrast, (2) whether or not Australia represents, as it does in certain terrestrial biota, an ends-of-the-earth characteristic in which the biome has been mainly an area of biological demand, a final outpost accumulating relicts but coincidentally preserving primitive or overspecialized taxa.

The two sets of questions are not necessarily exclusive of each other, since Australia could function as an ends-of-the-earth habitat, but it might also back-radiate taxa evolved in that outpost. J. L. Barnard (in press) has already considered the complications of our present knowledge of Gammaridea in relation to the ends-of-the-earth hypothesis by discussing the thermal asymmetricity of the shallow-water environment in the Australian-Tasmanian-New Zealand biome. Shallow waters are connected directly to the north with tropical zones, but they are shielded by the deep southern sea from any contact with cold-temperate or frigid shallow waters of continental dimensions. The coldest parts of New Zealand and Tasmania do not qualify as shallow waters of continental magnitude. In many orders of marine organisms this would have little meaning since those groups have their evolutionary dispersal center in the tropics, but Gammaridea appear to have equivalent dispersal centers in cold waters as evidenced by their generic diversity; hence, an area, like the warm-temperate provinces of southern Australia, lying between the hot waters of the tropics and the cold waters near the poles, might have an equalized pressure of immigration from both thermal regimes at this late stage in marine dispersal. If dispersal from cold waters is partially hampered, the warm-temperate zone in question might contain a disproportionate number of evolutes from the tropical side. If these have not been subjected to the same competitive stress found in other warm-temperate zones, then the phyletic composition might be distinctive; primitive taxa and relicts might be preserved. The strong degree to which this condition might be expected in Gammaridea is lessened to some extent by our knowledge that gammarideans are not very limited in their dispersal mechanisms, with the result that the great distance between the shallow waters of Antarctica and Australia may not be as significant to some amphipods as it is to other marine orders. There is now fairly clear indication that a vast array of shallow-water gammaridean genera does not disperse across the deep-sea benthos; these genera have not been found in the deep sea. Since there is a high correlation between great depth and loss of eyes in gammarideans, an amphipod can be said usually not to undergo a cycle of evolution and migration through the deep sea from one shore to another. There is some evidence (J. L. Barnard, 1970a), however, that certain shallow-water benthic species can migrate long distances in surface waters. On a short-term basis (roughly 3 million years), incongruities may result, such as in the present composition of the Hawaiian Gammaridea (J. L. Barnard, 1970a).

The high generic diversity of Gammaridea in nontropical waters is an enigma (J. L. Barnard, 1969a). If cosmopolitan and subcosmopolitan genera are ignored, one finds most of the remainder, less those in the deep sea, divisible into 3 great bands: tropical, north boreal, and south boreal ("boreal" includes the area between 23° and 90° in either hemisphere). The number of genera in each boreal section is roughly equivalent, and that number in either case, north or south, exceeds the number of genera endemic to the tropics. There are very few so-called biboreal genera, those with species in the north and south but absent in the tropics (or submerged in the deep sea to a thermal depth similar to boreal climates). Cold waters of both hemispheres are therefore well balanced in genera, a fact suggesting that the order is either very old or that it has evolved from tropical ancestors, dispersing fairly evenly into both hemispheres. That situation appears to be normal to many orders of biota, but there has been a recurrent implication in the biogeography of amphipods (see J. L.

Barnard, 1969a) that the most primitive family (-ies) of the Gammaridea today occur high in the northern hemisphere, centered in the freshwater of Lake Baikal, the freshwaters of Eurasia, and in the surrounding cold seas. Members of this family, Gammaridae (and satellites), that occur in the southern hemisphere are presently traceable to taxa that also occur in tropical waters, and these taxa apparently are more advanced than those in the Baikalian regime – or so one may infer. The so-called gammaruses of South Africa especially (and apparently those in southern South America and Australia) probably have evolved from marine ancestors based in, or that have passed through, the tropics as known today. The incongruity of the present generic diversity then might be explained by the hypotheses (1) that Gammaridea evolved in high, northern cold waters are specially preadapted in some way to a higher success in cold waters, but have indeed occupied the tropics and emerged again into the cold waters of the southern hemisphere, where diversity has been enhanced by the thermal preadaptation, and (2) that the present faunas are very old because they are relatively well balanced in diversity in both hemispheres. Because of strong distinctions in the generic and familial composition of cold-water faunas in the north and south, one may suggest that the tropical zone forms a very strong barrier to sublittoral amphipods attempting to pass directly from one cold zone to another. In deeper seas this is not so strong a factor, although the deep-sea Gammaridea are not distributed evenly by taxon throughout all seas. The alternative is obviously that Gammaridea are a young suborder and sufficient time has not elapsed for a uniform distribution to have developed isothermally. The latter possibility has no evident support.

The next question is whether a further fractionation of thermal centers occurred in the evolution of Gammaridea, that is, whether warm-temperate regions between purely tropical and cold-temperate waters have large numbers of endemic genera. Until recently this question could not be clarified because anomalous ecological structures occur in the warm-temperate zones so far studied: Mediterranean Sea, South Africa, and southern Australia. Shallow waters of the Mediterranean are in continuous contact with cold-temperate waters along a zero depth line from Gibraltar to the English Channel, but the entire geography of the Mediterranean suggests many avenues for isolation and evolution of higher taxa in marginal seas that may have been cut off for periods of time in past history. South Africa and Australia both lack any zero depth continuity with a cold-temperate continent. Only recently in the Californian warm-temperate zone has a study (J. L. Barnard, 1966) failed to find any appreciable degree of generic endemicity. The Californian warm-temperate is a relatively normal situation in that the zone is in contact with the tropical and the cold-temperate zones. The thermally disjunct embayment in the Gulf of California does, however, represent a potential place for geographic isolation where evolution of higher taxa might have taken place; a few unusual genera have been found there (J. L. Barnard, 1969c), but these have had little impact on the open-sea part of the warm-temperate zone. The Californian warm-temperate zone is primarily a mixing ground for cold-temperate and tropical species, though a small proportion of endemic species in genera otherwise widely distributed has been found. One may thus provisionally return to the proposition that ultimate mechanisms (term borrowed from Dunbar, 1968) in the evolution of higher gammaridean taxa are somehow connected with two main thermal foci, tropical and nontropical, the latter occurring in two bands.

The world warm-temperate zone cannot, however, be dismissed without exploring the possibility of interrelationships among the various segments. These segments are the most biotopically isolated of any main provincial environments in the world unless one combines all antiboreal segments and divorces them from all boreal segments together. In the present distribution of seas there is no conceivable connection between Mediterranean and southern Australian shores in terms of currents or continuous shallow sea bottoms having warm-temperate thermal characteristics. One would therefore expect no direct faunistic connections in the Amphipoda unless one could infer that these shorelines were contiguous in Paleozoic times when Gondwanaland was in existence. This is an attractive theory, that the present-day warm-temperate regions may have been closer together in Paleozoic times, but this would require that the thermal characteristics of today also existed then, a fact that is not necessarily suggested by locations of the south pole

in old Gondwanaland. If the thermal characters had remained the same since these warm-temperate segments pulled apart, then some of the most ancient parts of the fauna might retain a special similarity between segments today far removed from one another. This probably would not apply to Amphipoda, as no one is certain as to the era of their origin, though they are believed to have existed in the late Mesozoic.

Because of the lack of evidence, the similarities in Gammaridea occurring today in various disjunct portions of the warm-temperate zones cannot be attributed to historic contact. There is a possibility these similarities can be explained entirely from the viewpoint that various commonly distributed tropical taxa formed a base stock for the evolution of siblings in the several warm-temperate provinces; for example, the several members of the *Maera quadrimana* stock in California, Bermuda, Mediterranean, New Zealand, and Japan could all have a common ancestor in the tropics.

To return now to the questions raised earlier, there seems to be ample evidence from the high degree of generic endemicity in warm-temperate Australia that the environment represents, in part, an ends-of-the-earth region comparable to South Africa in that no broad shallow-water contact occurs with cold-temperate continental environments. The degree of generic endemicity one observes in a continental boreal zone thus is shifted in Australia into the warm-temperate province, unlike the normal warm-temperate provinces of California or southern Japan. Owing to the lack of exploration in areas around Australia, no endemic genus can be absolutely delimited but Table 1 contains the potential members of the endemic group. To the degree that new genera have been, and are being, described from Australia, one may expect that the list will not be diminished materially in the future by discoveries of a range extension beyond Australia and New Zealand in some of those genera now on the list.

Since one or more of the precepts stated earlier apply to these groups, the environment also appears to represent for certain groups a major center of evolution. Most of their diversity occurs in Australia, primitive members may still be present, and a suggestion of outward dispersal can be detected. What cannot be demonstrated, however, is whether Australia contains in microcosm the relicts of a greater distribution of some of these groups and whether we are therefore looking not at the center of evolution but simply at the evidence that this evolution took place and that Australia is the place where it is preserved. In the following discussion of these groups a positive attitude is taken to simplify the perspective: that the outward dispersal

TABLE 1.—*Generic endemicity in 17 families of Gammaridea from Australia and New Zealand*

| *Family* | *Total genera in world* | *Genera endemic to Australia-New Zealand* |
|---|---|---|
| Acanthonotozomatidae | 16 | Maoriphimedia, Panoploea† |
| Amphilochidae | 20 | Austropheonoides, Gitanogeiton, Narapheonoides, Neocyproidea, Paracyproidea, Peltopes, Unyapheonoides |
| Ceinidae | 3 | Ceina*, Taihape, Waitomo |
| Corophiidae-Isaeidae-Aoridae | 46 | Dryopoides, Paraoroides, Paracorophium |
| Dexaminidae | 12 | Delkarlye, Paradexamine*, Prophlias, Syndexamine |
| Eophliantidae | 6 | Bircenna, Cylindryllioides*, Eophliantis |
| Eusiridae (Pontogeneiidae, Calliopiidae: shallow water) | 34 | Amphoediceros, Sancho, (Paracalliope)* |
| Gammaridae (marine) | 35 | Mallacoota*, Parapherusa*, Parelasmopus* |
| Haustoriidae | 18 | Limnoporeia, Urohaustorius |
| Leucothoidae | 4 | Paraleucothoe |
| Lysianassidae (shallow-water) | 68 | Amaryllis*, Endevoura, Glycerina*, Parawaldeckia* |
| Nihotungidae | 1 | Nihotunga |
| Oedicerotidae | 27 | Carolobatea*, Exoediceros, Paroediceropsis |
| Phliantidae | 9 | Gabophlias, Iphinotus, Iphiplateia, Quasimodia |
| Podoceridae | 8 | Cyrtophium*, Icilius*, Leipsuropus |
| Stegocephalidae | 7 | Tetradeion |
| Stenothoidae (Thaumatelsoninae) | 19 | Ausatelson, Goratelson, Raumahara* |

† So-called species of *Panoploea* outside of New Zealand appear generically distinct.

* Genera with a plurality in Australia-New Zealand.

now apparent is realistic and that these organisms are in process of further evolution and dispersal. The directions of dispersal are dictated mainly by what is known of taxa in the literature and where amphipods happen to have been moderately well studied. If the dispersal is visualized as lines connected to southern Australia, they can be condensed as follows: (1) toward Japan; (2) toward the south Asiatic coast, continuing through the Red Sea to the Mediterranean (Tethys), to the Caribbean Sea, thence to Pacific America; (3) northeastward through Micronesia and Polynesia, thence possibly to Pacific America; (4) to New Zealand in the Australian warm-temperate currents; (5) to South America in the westwind drift, thence to Antarctica; and (6) to South Africa (in the remotest context, because of the difficulty of presently visualizing any nontropical transport mechanism in that direction but required because of certain unusual relationships with South Africa; in this sense I am attempting to eliminate the shallow-water south Asian pathway).

The input of taxa toward southern Australia seems to come mainly from the tropics in the north, in the westwind drift from colder climes, and in a significant exchange with New Zealand, which may have served as one important place of isolation for speciation and possible evolution. South Africa would appear to be a better place of input toward, than reception from, Australia. Though a reversal is possible in the lines toward Japan, the Mediterranean, and eastern Polynesia, so that they supply Australia with species, the examples I can now present mostly favor an outward dispersal from Australia.

### The Special Australian Gammaridea

A few years ago, at least 57 families of Gammaridea were known, but recent changes in classification (J. L. Barnard, 1969a; 1970b; in press) plus new treatment in the present study have tentatively reduced the number to 46. Undoubtedly this will be revised upward as new families are discovered and as old concepts are divided more realistically than they are now (e.g., Gammaridae, Eusiridae).

Of these 46 families, only 24 are important to this discussion since they concern those families predominantly of littoral or sublittoral provenance and with some degree of diversity (1-genus families are largely omitted). Six families can be dismissed as they are primarily composed of cosmopolitan genera, the exceptional genera showing no pattern detrimental to my theme; e.g., they have little tendency to contain genera endemic to small areas. These families are: Ampeliscidae (except *Triodos* in South Africa), Ampithoidae (except 2 genera in South Africa), Ischyroceridae, Liljeborgiidae, Phoxocephalidae, marine Talitridae (subfamilies Hyalinae and Hyalellinae[2]). The Paramphithoidae and Pleustidae can be dismissed as occurring almost entirely in very cold waters. Sixteen families thus remain to be discussed as those in which the shallow water of southern Australia presently has minor or major representation of endemic genera. These 16 families and 1 small endemic family, plus their genera endemic to Australia and New Zealand, are arranged in Table 1.

Since endemic genera are insignificant in 9 families in Australia and New Zealand, there is little likelihood that the region has been a mainstream for evolution in these groups. They are discussed below, following which is a discussion of the important Australian families.

LOW ENDEMICITY.—The Acanthonotozomatidae primarily are confined to high latitudes in the south. Only 4 genera have been found in the northern hemisphere, plus a fifth genus composed of species previously identified as *Panoploea*. The latter appears to be confined to New Zealand; the other species in the northern hemisphere should be relegated to a new genus. Three species of this family presently are known in Australia, 2 of which are obscure (see J. L. Barnard, 1958), and 2 endemic genera occur in New Zealand. Much more remains to be done with the family in Australia, but the interesting point is that this highly diverse Antarctic family has not been reported heavily in Australia and New Zealand, which seems to support one of two theses: the family primarily is preadapted to cold waters; or the southern sea provides a strong barrier to the dispersal of the family into Australian waters.

The endemicity of Eusiridae (including Calliopiidae and Pontogeneiidae) in Australia is, so far, surprisingly low; again, this family is very diverse

[2] These taxa are treated variously as subfamilies or families in different contexts herein.

generically in cold water of both hemispheres. No endemic genus occurs in the tropics, but shores of warm-temperate places often have many species in widely distributed genera. Australia is no exception, as shown in the taxonomic section herein, but the generic diversity is low. Again, this seems to support the thesis that the southern sea shields Australia from a center of distribution in Antarctic waters. New Zealand has one endemic freshwater genus, *Paraleptamphopus,* and the odd genus *Paracalliope* is also centered on Australia and New Zealand in particular. That genus has representatives in India and the Philippines, but the most logical judgment, in view of the cold-water adaptation of this "family," is that *Paracalliope* in the tropics is a weak outward dispersant from Australia[3].

The Corophiidae, including Aoridae, Isaeidae, and Photidae, have 9 cosmopolitan genera in shallow waters, 7 tropical genera, 22 genera in the northern hemisphere, and only 8 other genera primarily occurring in the southern hemisphere, of which 3 are endemic to Australia-New Zealand. One obtains the impression from the literature that the family may be understudied in southern waters.

Though species of Gammaridae occur abundantly in southern waters, the family is primarily of northern dominance, and the southern species occur mainly in cosmopolitan genera. Some remarks on endemic Australian genera will be presented below.

The Haustoriidae are heavily dominated by northern generic flocks on the coasts of America.

The Lysianassidae are heavily dominated by cold-temperate genera; regional endemism is low, the two great boreal bands containing most of the benthic members of the family; a large pelagic component and a deep-sea benthic component, not included in the 68 shallow-water benthic genera, complicate any attempt to find a significant evolutionary denominator in this family from Australia.

The Oedicerotidae are composed of two superficial groups as yet unelaborated but which might be provisionally called the northern advanced genera and the southern primitive genera. The northern genera represent the typical members with well-developed rostra and contiguous eyes, whereas the primitive members occur mainly in the south and have poorly rostrate, more typically gammaridean heads, occasionally with uncoalesced eyes. The south also has representatives of the advanced members, but few of the primitive kinds seem to have crossed the tropics to the north. Much elucidation is required in the southern members. Australia-New Zealand has 3 endemic genera, which is a remarkably high figure, considering the wide distribution of most of the other genera; however, several genera are confined to extraordinarily high latitudes in the north and thus occupy very little physical space.

The Stegocephalidae have the same complications as the Lysianassidae; they are composed of both benthic and pelagic genera, only 7 of which are mainly benthic. New Zealand has one of these as an endemic genus, which is probably no more significant than the presence of one endemic genus in South Africa of the family Ampeliscidae, a case dismissed earlier.

The Stenothoidae and Thaumatelsonidae, now synonymous, are mainly oriented to cold waters in terms of generic diversity. Only one genus is well represented in the tropics. Until now only one species of the common genus *Stenothoe* has ever been reported from Australia, a few from New Zealand; however, 3 genera in the thaumatelson section have now been found mainly occurring in Australia and New Zealand, and these are in the group with strong Antarctic affinities. Australia does not appear to be a stronghold in the evolution of this family.

HIGH ENDEMICITY.—The remaining families, Amphilochidae, Ceinidae, Dexaminidae, Eophliantidae, Leucothoidae (weakly represented), Nihotungidae (monotoypic), Phliantidae, and Podoceridae, or sections of them, appear to have a very strong center of diversity in Australia-New Zealand. The reasons for this vary with each family. In Ceinidae and Phliantidae the case is strongest for direct evolutionary evidence, strongest in Nihotungidae because it is confined to the region, as far as is known. The case is strong for Eophliantidae because of the heavy diversity of the family in ANZ and because of its poor representation in the Northern Hemisphere, especially in the Atlantic Ocean. The case is good in the Dexaminidae because ANZ represents a

[3] Prof. S. Ruffo (in litt.) states he has one more tropical species of this genus to be described, which reduces even further the importance of the genus in Australia and New Zealand.

center of diversity and because some evolutionary paths can be traced. In the cyproidin section of the Amphilochidae one finds a plurality in ANZ: more endemics than anywhere else of equivalent magnitude. The case in Podoceridae may simply be circumstantial, in that Australia may have served as a refuge in an ends-of-the-earth phenomenon. The one endemic genus, out of four Leucothoidae occurring in Australia, may be taxonomically inconsequential.

Three of these families, Nihotungidae, Leucothoidae, and Podoceridae, are dismissed from this discussion: the first is monotypic and has obscure relationships, and the other 2 are not presently familiar to me.

The presence of 5 families of Gammaridea in which Australia seems to be heavily involved in the evolutionary sense seems fairly remarkable, since few of the other 46 can be so relegated to other small regions — except perhaps Gammaridae and its derived families Haustoriidae and Phoxocephalidae (Eurasia?), Bateidae (Central America), Kuriidae (Red Sea-East Africa), and Cressidae (North Atlantic, but is this a valid family?).

THE CEINIDS AND PHLIANTIDS.—The most interesting evolutionary sequence involves Ceinidae and Phliantidae. J. L. Barnard (in press) has established the Ceinidae for 3 ANZ marine genera previously attached either to the Talitridae (sensu Talitroidea) or to the Phliantidae, and he appended a second subfamily, the Chiltoniinae, which is composed of 3 freshwater genera found in South Africa, Australia, and New Zealand. Two marine genera, *Waitomo* and *Taihape,* so far have been found only in New Zealand, whereas *Ceina* has one species each in New Zealand, Australia, Indonesia, and the Juan Fernandez Islands. The Ceinidae are characterized especially by the lack of a ramus on uropod 3, the placement of that peduncle on the side of the urosome sufficiently to be seen from lateral view, the presence of cuticular pits of a special character, the free base of antenna 2, and the presence of special apical curls on the female brood setae. Marine Ceinidae thus differ from other marine talitroideans (Hyalidae and Hyalellidae) in the absence of the ramus on uropod 3, the cuticular pits, the heavy cuticle, and the curls on brood setae. From neighboring Phliantidae the Ceinidae remain distinct in the free base of antenna 2 and the lateral placement of the third uropodal peduncles. When I established the Ceinidae, I was not aware of the remarkable condition in the phliantid genus *Quasimodia* Sheard, as no aspect in toto of that genus had been published and the dorsal hump of pereonite 1, reflected in the literary name *Quasimodia* (= Quasimodo, for Victor Hugo's hunchback), did not attract my attention. *Quasimodia* was described rightly in the Phliantidae, though I find now that it is an abnormal phliantid in the tallness of its body, the unsplayed coxae, and the presence of special cuticular structures in the form of tubes and occasional pits vaguely resembling the pits of *Ceina.* The four species of *Quasimodia* bear a remarkable resemblance to *Ceina,* as shown in drawings presented herein, but *Quasimodia* is definitely a phliantid because articles 1-2 of antenna 2 are fully enveloped in the head, as in other phliantids, and uropod 3 is attached so far ventrally that it is not visible from lateral view. Cuticular tubes are absent in Ceinidae, but they are apparently present in other phliantids such as *Palinnotus* and *Gabophlias. Quasimodia* cannot be a direct descendent of *Ceina* because *Ceina* has lost the ramus on uropod 3, but the possibility that *Quasimodia* is a descendent of the same stock ancestral to *Ceina egregia* seems apparent. An outline of evolution from Hyalidae (Hyalinae) to Ceinidae to Phliantidae thus emerges, with the marine ceinids also involved as stock basic to the freshwater chiltonias, which heretofore were classed with the Hyalellidae, a mainly American or circumtropical taxon.

Since *Ceina* and *Quasimodia* cannot stand on a direct line of affinity, a convergence in several morphological characters between the two genera is apparent. If *Ceina* alone were extant, it probably would be classed as an aberrant talitroid. The odd cuticle of *Quasimodia* suggests that the genus is a link between the evolution of ceinids from phliantids, but this would require a seemingly impossible reestablishment of a free base on antenna 2. *Ceina* is not the most primitive ceinid, since the mandibular molars of *Waitomo* and *Taihape* have a trituration surface, whereas *Ceina* has the styliform molar of phliantids. One has to propose an ancestral ceinid with a 2-articulate uropod 3 (basically a marine hyalid) and a normal mandibular molar; development of cuticular pits has signaled

the basic ceinids like *Waitomo,* but all three genera, including *Taihape* and *Ceina,* lost the ramus of uropod 3. A 2-articulate ceinid with styliform molar perhaps formed the base stock of *Quasimodia,* but the base of antenna 2 became amalgamated with the head. *Ceina*-stock proceeded also toward the odd head of phliantids, which becomes subspherical and develops a lateral incision; the base of antenna 2 is hidden behind the lateral lobes but remains free.

Further advances in *Quasimodia* are the dorsal splitting of pleonite 6 and a strong reduction of the urosome. One may see in *Ceina egregia* (see J. L. Barnard, in press) how pleonite 6 also has drawn apart dorsally, so that the telsonic base touches pleonite 5, and how pleonite 6 is thus a dorsally gaped shell lacking any dorsocentral connection with pleonite 5.

All of these incongruencies could be explained if we suggest that phliantids also have a 1-articulate or 0-articulate uropod 3 and that the so-called uropod 3 of ordinary phliantids, including *Quasimodia,* is really composed of a basal piece (heretofore called the "peduncle," but really a remnant of pleonite 6). But there are 3 other segments otherwise visible on the ventral side of the urosome in phliantids, thus ruling out this hypothesis.

The indirect relation between *Ceina* and *Quasimodia* appears to demonstrate the direction of evolution from ceinids to philantids: The unique development of cuticular pits in ceinids has had a short life because they have been carried into the phliantids, as far as known, only in *Quasimodia, Palinnotus,* and *Gabophlias.* The weak dorsal hump of pereonite 1 seen in *Ceina egregia* is even better developed in *Ceina wannape,* new species, from Australia; and the dorsal humps of pereonites 1, 7, and pleonite 1 reach their maximum in *Quasimodia,* decline somewhat in *Gabophlias,* and become vestigial or masked by dominance of other processes in other phliantids. The segments of the pereon become tightly held together in phliantids, so that flexion is difficult, whereas the pleon becomes dorsally depressed, generally reduced in volume, and tucked ventrally under the pereon. The anthurial curl-tipped setae of hyalids are regained in phliantids, having gone through a flat-curl stage in ceinids – unless the basic ceinid split off *Quasimodia* before splitting off *Waitomo.* The extraordinary chelate gnathopod 2 of male *Ceina* is no problem to the thesis as gigantism in male gnathopod 2 is characteristic of hyalids, the presumed precursors of ceinids, whereas other ceinids have the reduced but subchelate gnathopod 2 and all but one phliantid *(Plioplateia* K. H. Barnard) have simple gnathopods.

The greatest distributional problem in this sequence is not how marine ceinids dispersed to Juan Fernandez or to Indonesia but how one of the chiltonias reached South Africa from a freshwater habitat. Marine ceinids have not yet been reported from South Africa, where K. H. Barnard studied for nearly 50 years.

THE EOPHLIANTIDS.—The Australian region appears to be a center of diversity in the Eophliantidae. The genus *Biancolina,* from the Mediterranean Sea, has recently been removed from the Eophliantidae (J. L. Barnard, in press), leaving the family composed of 6 genera now confined to the Pacific Ocean and Antarctica. One genus, *Ceinina,* is known from Japan; another, *Lignophliantis,* from California; and the other 4 are confined presently to Australia, New Zealand, Antarctica, and certain subantarctic islands. Eophliantids probably bore into kelps in a fashion similar to the woodboring isopod genus *Limnoria.* Since specimens are usually very small, 0.8-5.0 mm long, they probably have been overlooked with the result that much elaboration may remain to be done in this family. Shorelines of Tasmania and the Bass Strait appear to be the main focus for kelps in Australia; probably only a small portion of Australian shores supports members of this family. One species, *Bircenna fulva* Chilton, is highly prevalent in the intertidal floras of New Zealand, which indicates that, under proper circumstances, eophliantids can become members of the dominant amphipodan fauna.

Eophliantidae form another part of the hyalid-ceinid-phliantid evolutionary problem. I have studied the urosome of several species of eophliantids, but I am unable to find the solution to two alternatives, whether certain eophliantids have a urosome in which the piece heretofore called uropod 3 is really the sixth pleonite, or whether the shelf-like extension posteriorward from the insertion of uropod 2 represents the sixth pleonite fused to pleonite 5. Dorsally, the telson touches pleonite 5 directly but, unlike phliantids, there is a ventral

extension of pleonite 5 on which the so-called uropods are articulated. A definite 3-segmented urosome occurs in *Bircenna* (see J. L. Barnard, in press). Hatched juveniles of phliantids still in the brood pouch of the mother have the gross appearance of eophliantids in the cylindrical body and short coxae, suggesting that eophliantids are neotenous descendents of phliantids.

THE AMPHILOCHIDS AND STENOTHOIDS.—The Amphilochidae contain 2 subfamilies, Amphilochinae and Cyproideinae; of the 11 genera in the latter subfamily, 6 are endemic to ANZ, another is represented there, and the remainder occur in the Caribbean, North Atlantic, South Africa, and the tropical Pacific. Since the subfamily appears to have tropical-subtropical provenance, it may contain many unknown species in the tropics. Specimens are small and ovate, superficially resembling myodocope ostracods; possibly they have been overlooked in tropical collections. Until more exploration has been undertaken, an assessment of the Australian genera seems premature.

The thaumatelsonin section of the Stenothoidae has 2 new genera found in Australian collections. Five other genera have only Antarctic species, except one species occurring in the subarctic. The presence of two genera in southern Australia appears to be the strongest influence of Antarctic faunas on Australian shallow-waters that I have as yet found, either in the present collections or in the literature.

THE DEXAMINIDS.—This family has recently been revised (J. L. Barnard, 1970b) to include the Atylidae, Anatylidae, Lepechinellidae, and Prophliantidae. The most primitive grade of morphology in the family is represented by the old Atylidae *(Atylus),* which bears a mandibular palp. This cosmopolitan genus has 23 species, 16 of which occur in the north boreal region. *Anatylus* of the north boreal region, with one species, now synonymous with *Atylus,* has lost the mandibular palp (as in most of the Dexaminidae), and this has also occurred in a subgenus, *Kamehatylus,* from Hawaii (J. L. Barnard, 1970a). The deep-sea *Lepechinella* and *Paralepechinella* can also be equated as direct derivatives from *Atylus* stock (J. L. Barnard, 1970b). The center of diversity in the most primitive stock thus appears to occur in the northern hemisphere, but the next less primitive genus, *Paradexamine,* appears to have its center of diversity in Australia. Possibly the further evolution of the remaining 9 genera was based on paradexaminid stock. The other genera occurring in the northern hemisphere could be derived from the *Paradexamine* stock, especially the 5-species genus *Dexamine* from the North Atlantic-Mediterranean region; however, the entirely northern *Tritaeta* and the mainly southern *Polycheria* are enigmatical in this regard: the weakly bifid coxae in these genera suggest direct affinities with *Atylus.*

*Dexamine* is primarily a more advanced kind of *Paradexamine* in the partial loss of side teeth on the pleon, the reduction of the inner lobes of the lower lip, and the loss of one article on the maxillipedal palp. Its isolation from *Paradexamine* in the Mediterranean-North Atlantic region by the Suez barrier can be proposed, since 1 or more species of *Paradexamine* occur in the Red Sea or the Indian Ocean. The tropical *Dexaminella,* also from the Red Sea, is more advanced than many species of *Paradexamine* in the loss of the lacinia mobilis and one article of the maxillipedal palp. The ANZ endemic *Syndexamine,* with 5 species, could also be derived from *Paradexamine* by its loss of side teeth.

The subfamily Prophliantinae contains 3 genera, *Prophlias* (monotypic, Australia), *Haustoriopsis* (monotypic, Bismarck Archipelago), and *Guernea* (9 species divisible into 2 subgenera). *Guernea* has 2 advanced northern species in the subgenus *Prinassus* (see J. L. Barnard, 1970b) and 7 other species, of which 5 occur in ANZ and 2 occur in the North Atlantic-Mediterranean region. A slight majority of the species in this subfamily now occurs in ANZ, though the subfamily has probably been overlooked in previous studies. *Prophlias* and *Haustoriopsis* are far more advanced than *Guernea* or *Prinassus,* as the urosome has become more strongly pygidized than in other dexaminids. The pathway of distribution between the extreme geographic ends of this subfamily can presently be visualized through the Red Sea, as it is in *Paradexamine* and *Dexamine.* The Red Sea also contains the poorly known *Sphaerophthalmus* Spandl, which is a member of either Dexamininae or Prophliantinae.

On the basis of diversity centers, one can therefore hypothesize the origin of Dexaminidae in the north boreal, with a secondary center of evolution in the Australian region and the spread of the fam-

ily farther toward Antarctica, into the tropics, and back again into the north boreal region, via the Red Sea and the Mediterranean Sea. The most advanced genera in the several lines of evolution are *Sphaerophthalmus* in the Red Sea, *Prophlias* and *Haustoriopsis* in western Australia and the Bismarck Archipelago, *Dexamine* in the Mediterranean, *Tritaeta* in the North Atlantic, and *Polycheria,* now almost cosmopolitan. The most primitive genus, *Atylus,* is cosmopolitan; the next, *Lepechinella,* has descended entirely into subbathyal depths; while the next two, *Paradexamine* and *Guernea,* have centers in Australia, out of which more advanced genera such as *Syndexamine* have evolved but apparently have not escaped from the Australian region. *Paradexamine* is composed of at least 35 species, of which 17 occur in Australia, 3 in New Zealand, 3 (and 2 undescribed species known to me[4]) in Antarctica, and of which 1 has spread northward to Hawaii, 1 to Micronesia, 1 to the Red Sea *(Dexaminoides),* several to India, where I have seen manuscripts on new species, and to Japan (Nagata, 1965), where several new species possibly occur.

THE GENUS *Mallacoota* (GAMMARIDAE).— The new genus *Mallacoota* is composed of new species and old species originally described in, or subsequently placed in, the genera *Megamoera, Elasmopus,* and *Maera.* The composition of the genus and the geographic distribution of the species suggest that the more primitive members occur in the Indo-Pacific tropics and that the more advanced species occur in southern Australia, in warm-temperate waters. Only in the southern hemisphere (including South Africa) has the genus moved out of the tropics. Heretofore, it appeared that the genus, as now conceived, had only one tropical species, as there was a tendency to synonymize the various tropical species into *E. insignis.* The present study suggests that various morphs in Indonesia and the Indian Ocean may represent good species. *Mallacoota* is probably an advanced genus with its roots in *Elasmopus,* which is heavily dominant in the tropics. Since the falcate mandibular palp article 3 of *Elasmopus* is of minor occurrence in the Gammaridae, one must suggest that it is an advanced characteristic. It is tempting to suggest that *Mallacoota* is the precursor to *Elasmopus* since *Mallacoota* has the normally linear mandibular palp; it also has dorsal carinae on the pleon, suggesting that the development of a falcate palp and the loss of carinae established *Elasmopus* from a stock of *Mallacoota.* But a serious objection to this hypothesis is that many of the species (and morphs) of *Mallacoota* have a tendency or a realization toward palpar reduction. It therefore seems more likely that the evolutionary line proceeded from *Elasmopus* toward *Mallacoota,* the latter becoming a highly specialized offshoot with various stages of palpar reduction and the development of dorsal carinae. The least specialized members of *Mallacoota* remain in the tropics (see the morphs in Pirlot, 1936) along with the dominant fauna of *Elasmopus,* plus the several species of *Parelasmopus,* which forms a twin genus to *Mallacoota.* Both *Parelasmopus* and *Mallacoota* have spread southward into Australia, but nothing as yet found in the morphology of the species suggests that Australia formed the center of evolution of either *Mallacoota* or *Parelasmopus,* though southern Australia might provide the logical zone of isolation necessary for such evolution. Obviously, zones of isolation occur in the tropics in the Indonesian-Indian-Micronesian domains, as evidenced by the closely similar siblings of *Mallacoota* in Pirlot's study and by the occurrence of the new genus *Ifalukia* in Micronesia (q.v.). In contrast to cyproidins, dexaminids, ceinids, and phliantids, *Mallacoota* represents a probable case wherein southern Australia has simply been a center of accumulation of taxa spun off from the tropics.

## The Antarctic Affinities of Australian Gammaridea

The affinity of Gammaridea in Australia to those in Antarctica is low. Sheard's (1937) checklist (updated) of Australian Gammaridea can be compared to the Antarctic literature represented by Pfeffer (1888), Chevreux (1906, 1912), Schellenberg (1926, 1931), K. H. Barnard (1930, 1932, in part), and Nicholls (1938). This low affinity with Antarctica has already been noted in other Australian groups, especially the echinoderms (see Ekman, 1953, for summary). Some marine groups like Ascidiacea (see Kott, 1969) are considered to be ancient, primitive, and of relict survival in Antarctica, thus suggest-

[4] Specimens from *Eltanin* expeditions, deposited in USNM.

ing that a place like Australia, at the margins of west wind drift, might have been a significant outward recipient of these taxa. The situation in Gammaridea seems the opposite, or mixed, for Antarctic Gammaridea appear morphologically to contain some wholly advanced taxa mixed with primitive members of other families, which themselves are highly remote from the more primitive groups in the northern hemisphere. Two advanced families, Acanthonotozomatidae and Paramphithoidae, are mostly confined to Antarctica; they are highly diverse and frequently dominant on the Antarctic shelf. In contrast, one may find in Antarctica most of the oculate (primitive) members in the group of phoxocephalids conveniently called the harpinias; and the presumedly more primitive members of the Oedicerotidae occur mainly in southern waters. Oedicerotidae are highly advanced as a family, whereas Phoxocephalidae appear close to the so-called primitive Gammaridae. One of the most advanced families, Lysianassidae, occurs very abundantly in Antarctica, in reflection of their abundance in cold northern waters. But in contrast to that one may find a high concentration of endemic genera of pontogeneiids, calliopiids, and eusirids (presently considered a single family) in Antarctic waters. This family appears morphologically close to the northern Gammaridae, and the species of "Eusiridae" in Antarctica may actually occupy the general habitat that Gammaridae occupy in northern waters. Eusirids may thus be the substitute for gammarids in southern waters.

The most advanced members of the Stenothoidae occur abundantly in Antarctica. These are the species formerly accorded the rank of a family, the Thaumatelsonidae. Since various thaumatelsonins obviously have diverse origins from several ordinary stocks of Stenothoidae, the Thaumatelsonidae as previously composed did not warrant familial rank. One could of course divide the thaumatelsonins into several new families, all of parallel evolutionary grade (as one could also do in the Eusiridae), but at present this seems unwarranted. Not the least of reasons is the need to study more intensively the ordinary morphological affinities of the various taxa.

Out of the several families of Antarctic Gammaridea so far mentioned, ANZ has a poor representation of Acanthonotozomatidae (2 endemic genera out of 16: see Table 1), though the family has not been widely studied in Australia. In collections at hand from intertidal floras, mud bottoms, and hard bottoms, I have seen only a few specimens of this family. No Paramphithoidae have been found so far in Australian shallow waters. The oculate harpinias are sparse in ANZ.

Three out of 6 southern genera of primitive oedicerotids, however, appear as endemics in ANZ. More may be found there because the sublittoral Australian benthos has been poorly studied. Australia also has a significant abundance of eusirids in shallow waters, although most of these species belong to one genus exhibiting a high degree of adaptive radiation. The Antarctic relationships of these eusirids remain enigmatic, as discussed under "Eusiridae" and seen in Figure 111.

In conclusion, the input of taxa from Antarctica to Australia seems very low if one takes the view that Antarctic representatives of *Paradexamine* and Eophliantidae were derived from an Australian center. The Australian Gammaridea now total approximately 250 species in slightly over 100 genera in 29 families and affinities to Antarctica in this pool of taxa are extremely few.

### Adaptive Radiation and Instability in the Australian Environment

In an ecosystem, maturity is often coordinated with high diversity (Margalef, 1963). Diversity can mean several things from the systematic point of view: (1) a large number of species; (2) those numerous species distributed through a large number of higher taxa such as genera, families, and phyla; and (3) a distribution-diversity correlation: according to some authors the more evenly the individuals of the various species are represented in the ecosystem, the more diverse is the systematic component. In the third item an alternate viewpoint is equally logical: that a greater diversity exists if the number of individuals is very unevenly distributed among the species. One might call this a diversity of uneveness. Perhaps this viewpoint also could be applied to higher taxa in attempting to discuss the consequences of an uneveness in speciation among the taxa; for example, one genus has a high number of species, and another is monotypic.

A genus with a high degree of adaptive radiation is one with numerous closely related, sympatric species. These species are presumed to have evolved in temporarily and repeatedly isolated (in a geological time sense) but contiguous environments. These later are rejoined, and the various species are mixed together but cast into different niches among themselves because of their differing genetic contents and the factors of selection. One of the functions of taxonomy is to distinguish flocks of species in this category from flocks of species in a genus whose members have diverse origins, e.g., wherein the several members of the genus now living sympatrically are not directly descended from one another in an immediate sense but have come together from numerous remote dispersal centers in various directions. The taxonomist is somewhat hard pressed to distinguish a case of adaptive radiation from a linear dispersal phenomenon in which one semi-isolated environment is the constant recipient over geological ages of infrequent immigration of a particular taxon. Each time the immigrant would arrive in the destination it would evolve "slowly" into a distinct species so that, by the time the same parent population again reached the same destination, no genetic interchange would be possible. To add complications, the parent population might of course evolve in its own source area. Perhaps the linear case also should be called adaptive radiation.

The various marine biogeographic provinces of the world – here, for the sake of argument, equated as ecosystems – have highly distinct amphipod faunas. One is impressed that the distinctions are greatest at the specific level and become progressively less so in higher categories such as genera and families. (There is some indication that provincial differences are more marked at familial than at generic level, but obviously genera belong to families, and what differs at family level differs in their missing genera also.) One would expect no diversity or distinctiveness at the subordinal level since one can make the blanket statement that virtually all marine ecosystems have Gammaridea present. But even at the ordinal level, one may hypothesize that amphipods are poorly preadapted to occupy certain habitats or even ecosystems compared with some companion order; thus they have not evolved as far in some ecosystems as they have in others (perhaps true in the tropics). The great age of an ecosystem is, therefore, not always corollary to the number of species or even the diversity of taxa contained within it, as organisms may not in general be preadapted to entering certain kinds of environments. Long-term stability may not always signal the highest number of species of an order, though it is difficult to argue the point at kingdom level. In fact, instability and environmental youthfulness seem to be the phenomena necessary for the development of a flock of sibling species. The flock could be preserved to great age only if subsequently protected from invasion by outside taxa, some of which undoubtedly would replace members of the endemic flock.

One good indication of recent evolutionary activity seems to be the sibling species flock. Since speciation requires isolation in addition to genetic change and selection, a flock should also indicate recent (late in the geological sense) environmental disturbances in the formation and retraction of barriers between isolated gene pools. One could hypothesize – in a highly disturbed system with short (geological sense) but frequent periods of stability – that a larger number of species might evolve and live sympatrically during an interstage than in an old, eternally stable system if both systems were equally exposed to input by normal systems of migration. It could be very difficult to separate, by taxonomic inference and the mere counting of species and higher taxa, an old stable system and a new stable system if the new system lies in an especially favorable center of input.

The numerous marine provinces in shallow water provide a host of niches roughly similar among themselves so that wide-ranging taxa can enter those niches in strong degree everywhere. In the Gammaridea, one may draw an example from genera such as *Ampelisca,* which has at least 100 species in the oceans and which has few-to-many species on almost every sublittoral mud bottom in the world. *Gammaropsis* appears to be a good example of this kind in littoral epifaunas. There are a few other such genera to be found in lists of J. L. Barnard (1969a:19-20), but the vast majority of genera has far more limited distributions, even though similar niches in the disparate provinces are available for occupation and are indeed occupied. One has to describe a niche, in this view-

point, primarily from its physical aspects, as the biological occupant of that niche, in bringing to it a unique phylogeny, will of course contribute a different biotic definition to the niche in every case. One of the most intriguing exercises facing the systematist and ecologist, therefore, is to draw parallels among the phyletically distinct inhabitants of grossly similar niches in different provinces (ecosystems). This should be of enormous help in tracing the evolutionary history of the various provinces, as one may discover niches that remain unfilled, or niches that are filled with siblings which would eventually be displaced if the system under question were better exposed to incoming taxa already more preadapted to fill the niche.

The presence of a sibling flock in a province suggests to me that one or more of the following factors is true: (1) the region is relatively youthful; (2) it has an inordinate amount of shielding against input of taxa from other regions; (3) a recent (in a relative geologic sense) speciation cycle has occurred in which the environment was instabilized (divided into isolated portions and then rejoined); (4) the region remains partially isolated but stands downstream from an infrequently emigrant gene pool. Not all youthful or disturbed regions automatically contain a sibling flock, as one may see in the Hawaiian Gammaridea (J. L. Barnard, 1970a), where numerous species of many genera have become established but the genera containing the highest number of species (8-10 species) are composed of members with diverse geographic and phyletically remote ancestries.

Only a few sympatric sibling flocks of Gammaridea have so far been identified in the world. The most famous is that in Lake Baikal (Siberia), where the stages of instability have been sufficiently numerous to produce many genera and over 250 species. Apparently the province has also been well shielded from much input except for the original stock. In the case of Gammaridea, this shielding need not be very effective, as few other phyletic lines enter freshwater except Gammaridae and their immediate familial descendents. The province, however, may have been shielded from input of some other order or phylum that could successfully compete with amphipods.

In the marine world, a recently discovered flock (Bousfield, 1965) appears to be the haustoriid complex found in eastern North America. The flock is composed of several genera apparently related closely to each other. Another flock of more than a dozen species occurs in the genus *Parawaldeckia* from New Zealand (pers. comm., Dr. D. E. Hurley). This flock may be an example (item 4 above) of an isolated province standing downstream from a source (Australia), where a few species of the genus are known to occur. Flocks of *Anonyx* and *Hippomedon* may occur in the Okhotsk Sea (Gurjanova, 1962). Those genera, like *Parawaldeckia,* occur elsewhere, and the possible sibling relationships in the Okhotsk Sea have not been studied. Perhaps the origins of many species lie in phyletically remote ancestors, in the case of which the Okhotsk Sea simply forms an optimal area for the recruitment of taxa in those genera.

One flock, that of *Paradexamine,* occurs in Australia. The genus occurs elsewere, and, to some extent, the morphological diversity in the genus suggests that sympatric species in Australia have remote ancestries. The diversity approximates that found in the haustoriid complex of New England, where various genera have been founded. Another, far more homogeneous sibling flock, is seen in the new genus *Tethygeneia,* wherein the morphological distinctions as yet have not been connected with any remote geographic region. A third flock of 5 species occurs in *Syndexamine,* confined to Australia-New Zealand. Since none of these flocks has been studied to exhaustion, several more new species undoubtedly will be added to each genus.

The occurrence of an extraordinarily large number of sympatric species in a genus suggests that southern Australia in particular is relatively youthful because fairly recent environmental divisions have occurred and some shielding from input of taxa is chronic. In the latter case, one may apply my earlier remarks regarding the phenomenon of the "ends-of-the-earth" and the low contact Australia has with a cold-temperate continental shore. The alternatives seem to be: *Paradexamine* is an unusually successful kind of amphipod and, thus, has taken the place of, and has excluded, other species; or the southern Australian environment provides an unusually large number of niches, in the case of which one may go to the full extreme and suggest that *Paradexamine* is specially adapted to divide a niche into small parts. If *Paradexamine* is

not a special case, then it must be occupying niches like those in remote regions occupied by other phyletic lines of amphipods. This is an intriguing problem and one I can make few suggestions about. Little is known of *Paradexamine* except that it is apparently a nestler (non-inquilinous, non-domicolous, non-fossorial), lives on mud and sand bottoms or in epifaunas of littoral and sublittoral biotopes, and is characterized especially by dispersant males, which develop natatory morphs bearing large eyes and elongate sensory antennae and which enter the neritic nekton. The latter feature is, thus, similar to that known in *Paraphoxus* and *Synchelidium,* both of which are fully fossorial genera forming burrows in mud. The heavy spination on appendages of *Paradexamine* suggests it also may be fossorial, but its presence in epifaunas is apparently not hindered by these spines. To some extent, the spines do not prevent various species of *Paraphoxus* from living in epifloras, but the genus *Synchelidium* has yet to be reported outside its soft-bottom and neritic habitats. *Paradexamine* may displace phoxocephalids, oedicerotids, and haustoriids on soft bottoms of southern Australia, though these families occur fairly diversely in samples I have at hand from Western Port and Port Phillip Bay.

For the intertidal region, one might suggest that *Paradexamine* displaces genera such as *Maera, Elasmopus,* and *Ceradocus,* or the various pontogeneiids, but, of these, only *Elasmopus* seems scarce in the Western Australian intertidal region, and, in its stead, occurs the very abundant genus *Mallacoota,* which apparently is descended from *Elasmopus.*

One further analogy presents the possibility that species of *Paradexamine* and especially *Syndexamine* occupy niches analogous to those presently being found in the boreal genus *Parapleustes* in California. At least 3 species of *Parapleustes* have been found as commensals in California, 1 on sea-anemones, 1 on the venters of starfish, and 1 on the pleopods of spiny lobsters[5]. Prehensile pereopods and a nonskid cuticle found in the 5 species of *Syndexamine* and in several species of *Guernea* herein, suggest that these taxa also have obligatory commensal relationships. Species with poorly prehensile legs have better development of the nonskid cuticle than do species with heavily prehensile pereopods, which suggests an interesting case of adaptive radiation to different kinds of hosts or to especially slippery substrates.

In conclusion, the ecological, systematic, and evolutionary information to be gained from extended studies in *Paradexamine* — like *Parawaldeckia,* the New England haustoriids, and the lysianassids in the Okhotsk Sea — seems to be of first rank.

## AMPHILOCHIDAE

### CYPROIDEINAE

The description of 3 new genera of cyproidins requires expansion of the key to Cyproideinae, which forms part of the key to Amphilochidae in J. L. Barnard (1969a). These new genera have affinities mainly with the established genera *Hoplopleon, Hoplopheonoides, Neocyproidea,* and *Peltopes.*

[5] Personal communications from Mr. Don Wobber and Drs. R. J. Rosenthal and J. R. Chess. The species from spiny lobsters was reported by Shoemaker (1952). Two other species having the appearance of commensals also were reported in J. L. Barnard (1969b).

**Key to Genera of Cyproideinae**

(Expanded from J. L. Barnard, 1969a)

| | | |
|---|---|---|
| 1. | Article 2 of pereopods 4-5 linear, slender | 2 |
| | Article 2 of pereopod 5, and usually pereopod 4, expanded | 3 |
| 2. | Palm of gnathopod 2 transverse, urosomite 3 vaulting over small telson | *Cyproidea* |
| | Palm of gnathopod 2 oblique, urosomite 3 not vaulting over huge telson | *Paracyproidea* |
| 3. | Urosomite 1 unkeeled, long or short | 4 |
| | Urosomite 1 dorsally keeled, elongate | 5 |
| 4. | Gnathopod 2 simple, uropod 2 shortened, not reaching end of uropod 3 | *Stegoplax* |
| | Gnathopod 2 subchelate, with transverse palm, uropod 2 reaching end of uropod 3. | *Peltocoxa* |
| 5. | Article 2 of pereopod 3 slender, linear | 6 |
| | Article 2 of pereopod 3 expanded | 9 |

**Key to Genera of *Cyproideinae* (cont'd)**

6. Mandible with palp ..... ***Austropheonoides***
   Mandibular palp absent ..... 7
7. Gnathopod 1 simple, palp of maxilla 1 biarticulate ..... ***Hoplopleon***
   Gnathopod 1 subchelate, palp of maxilla 1 uniarticulate ..... 8
8. Article 2 of pereopod 4 basally expanded, pleonite 3 with process ..... ***Narapheonoides***
   Article 2 of pereopod 4 fully rectolinear, pleonite 3 lacking process ..... ***Hoplopheonoides***
9. Mandibular palp absent ..... ***Neocyproidea***
   Mandibular palp present ..... 10
10. Gnathopod 2 simple, telson scarcely reaching end of peduncle on uropod 3 ***Peltopes***
    Gnathopod 2 subchelate, telson extending beyond outer ramus of uropod 3. ***Unyapheonoides***

### *Austropheonoides*, new genus

DIAGNOSIS. — Mandible with 3-articulate palp; antenna 1 with accessory flagellum; palp of maxilla 1 uniarticulate; outer plate of maxilliped reaching nearly to end of palp article 2; gnathopod 1 simple, article 6 rectolinear but weakly expanded proximally, article 5 moderately produced along article 6, dactyl longer than article 5; gnathopod 2 with transverse, weakly chelate palm, article 5 strongly produced along article 6; article 2 of pereopod 3 thin, rectolinear, article 2 of pereopods 4-5 broadly expanded and ovate or subpyriform; pleonite 4 elongate and bearing broad dorsal humpkeel slightly overriding very short pleonite 5, pleonite 6 twice as long as pleonite 5; telson short, horizontal, boat shaped, reaching only to apex of peduncle on uropod 3; outer ramus of uropod 3 half as long as inner ramus.

TYPE-SPECIES. — *Austropheonoides mundoe*, new species.

RELATIONSHIPS. — This genus differs from the Caribbean *Hoplopheonoides* Shoemaker (1956) in the simple gnathopod 1, the expanded article 2 of pereopod 4, the elongate outer plate of the maxilliped reaching palp article 2, and the presence of mandibular palps and accessory flagella. It differs from the South African *Hoplopleon* K. H. Barnard (1932) in the presence of a mandibular palp and accessory flagellum, the elongate dactyl and hand of gnathopod 1, and the uniarticulate palp of maxilla 1. It differs from the New Zealand *Peltopes* K. H. Barnard (1930) in the rectolinear article 2 of pereopod 3 and the subchelate gnathopod 2. And it differs from the New Zealand *Neocyproidea* Hurley (1955) in the presence of a mandibular palp, the rectolinear article 2 of pereopod 3, and the strongly subchelate gnathopod 2. The rectolinear article 2 of pereopods 3-5 distinguishes the Australian *Cyproidea* Haswell and *Paracyproidea* Stebbing, and the unkeeled pleonite 4 distinguishes the North Atlantic *Peltocoxa* Catta and *Stegoplax* Sars.

### *Austrophenoides mundoe*, new species

FIGURES 2–3

DIAGNOSIS. — With the characters of the genus.

DESCRIPTION. — Head not strongly hidden; eyes retaining weak brown pigment core in alcohol; epistome unproduced; mandibular palp naked, article 1 elongate and stout, article 2 shorter than 1, article 3 longer than 1; lacinia mobilis of right mandible thin, of left mandible broad; inner plate of maxilla 1 apically bifid asymmetrically, lacking setae, outer plate with 7 spines and many stout setules, apex of palp with thin attenuate cusp and 3 setae; inner plate of maxilla 2 much shorter than outer; dactyl of gnathopod 1 strongly serrate; rami of uropod 1 equal to each other in length, outer ramus of uropod 2 reaching about 80 percent along inner ramus; pleonite 3 not produced dorsally; cuticle smooth but urosomite 1 with weak surface pits.

HOLOTYPE. — WAM, female, 3.6 mm.

TYPE-LOCALITY. — JLB Australia 11, Middleton Beach, Albany, Western Australia, intertidal, wash of algae and rocks, 30 September 1968.

REMARKS. — Body rusty brown in formaldehyde and alcohol; coxae 3-5 with subcutaneous circular plates, large in coxae 3-4 and small in coxa 5, plates grouped irregularly near coxal margins, appearing similar to carbonate deposits, often with edges divided into circular cells, each plate with central spike, perhaps duct or setule, plates dark rusty brown.

MATERIAL. — JLB Australia 11 (1 female), 14 (1 female).

DISTRIBUTION. — Southwestern Australia, intertidal.

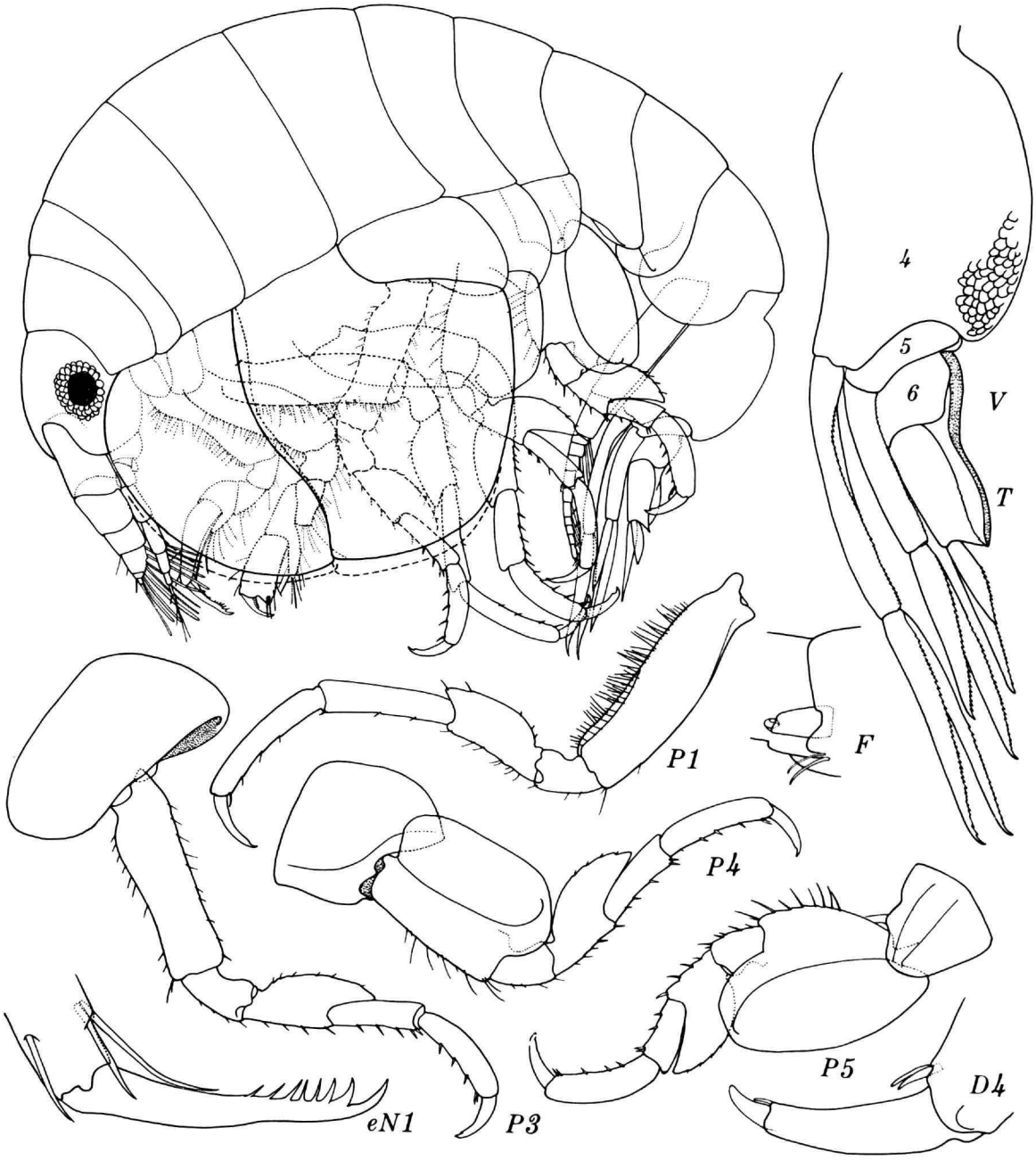


FIGURE 2.—*Austropheonoides mundoe*, new genus, new species, holotype, female, 3.6 mm, JLB Australia 11.

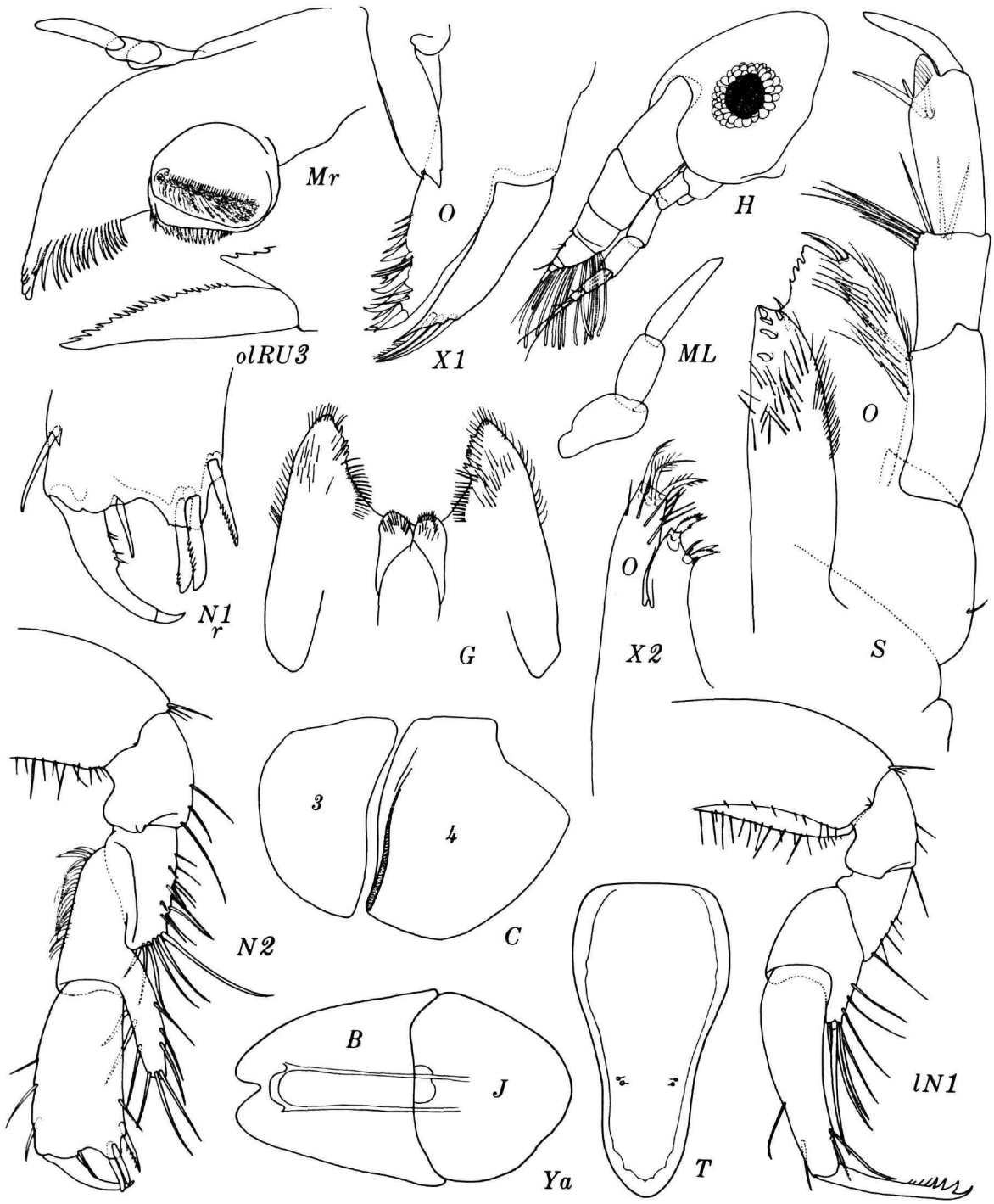


FIGURE 3.—*Austropheonoides mundoe*, new genus, new species.

### *Cyproidea* Haswell

### *Cyproidea ornata* Haswell

FIGURES 4–5

*Cyproidia* [sic] *ornata* Haswell, 1880c:320-321, pl. 18: fig. 1.
*Cyproidea ornata.*—Stebbing 1906:158; 1910a:578.—K. H. Barnard 1925:341.
*Gallea tecticauda* Walker, 1904:256-258, pl. 3: fig. 16, pl. 8: fig. 16.

Since this species has not been adequately illustrated, figures of all the parts are given from a 3.8 mm male. A distinct lateral line separates the base of pleonite 6 from its large tecticaudal process.

Brood lamellae on a female, 3.8 mm, from JLB Australia 3, are very short, not longer than article 3 of pereopods 1-2; perhaps large lamellae are not needed in view of the extraordinarily elongate coxae that touch medially at their distal ends.

The Ceylonese specimen figured by Walker appears to differ from material at hand only in the slightly more elongate article 1 of the mandibular palp.

In 2-day formaldehyde only one specimen (3.1 mm), has been found so far with the lobate pigment pattern mentioned by Stebbing (see Figure 4*C345♀*) composed of morular chromatophores of dark purple on a pink-rust background. The body color in formaldehyde is generally rose pink, and the eyes are red, fading rapidly. One large specimen, 4.4 mm, is a deep burgundy red and has black-brown pigment in the eyes.

Coxae 3 and 4 curl medially; in the body figure, I have added the lower margin of coxa 4 to show it flattened and have added an extra figure of coxa 3 to show it flattened.

MATERIAL. — JLB Australia 3 (5), 5 (16); Slack-Smith 2 (1); Shepherd 9 (2), 13 (2), 22 (1), 49 (1), 52 (1).

DISTRIBUTION. — Australia, Ceylon, South Africa.

### *Narapheonoides*, new genus

DIAGNOSIS. — Mandible without palp; antenna 1 with accessory flagellum; palp of maxilla 1 uniarticulate; outer plate of maxilliped reaching to end of palp article 2; gnathopod 1 subchelate, palm short, transverse, dactyl much shorter than rectangular article 6, article 5 strongly produced along article 6; gnathopod 2 with palm nearly transverse, with article 5 weakly produced along article 6; article 2 of pereopod 3 thin, rectolinear; article 2 of pereopod 4 subtriangular, expanded proximally and tapering distad; article 2 of pereopod 5 broadly expanded; pereonites 6-7 shortened, pleonite 4 elongate and bearing broad dorsal keel not strongly overlapping following segments, pleonites 5 and 6 of equal length, pleonite 3 with posterodorsal process; telson short, horizontal, ovate, not reaching apex of peduncle on uropod 3; outer ramus of uropod 3 slightly more than half as long as inner ramus.

TYPE-SPECIES. — *Narapheonoides mullaya*, new species.

RELATIONSHIP. — This genus has closest affinities with the Caribbean *Hoplopheonoides* Shoemaker (1956) and is closer to the latter than to *Austropheonoides*, new genus, because gnathopod 1 has a palm and pereonites 6 and 7 are shortened, but *Narapheonoides* differs from *Hoplopheonoides* in the presence of an accessory flagellum, the stronger palm of gnathopod 1, the long extension on the outer plate of the maxilliped, the process on pleonite 3, and the basal expansion of article 2 on pereopod 4.

### *Narapheonoides mullaya*, new species

FIGURES 6–7

DIAGNOSIS. — With the characters of the genus.

DESCRIPTION. — Head moderately hidden; eyes retaining weak pink-brown core of pigment in alcohol; epistome unproduced; lacinia mobilis of right mandible thinner than on left; inner plate of maxilla 1 with weak bifidation and 1 apical seta, outer plate with 7 spines and many stout setules, apex of palp bluntly cuspidate; inner plate of maxilla 2 much shorter than outer; dactyl of gnathopod 1 strongly serrate; rami of uropod 1 equal to each other in length, outer ramus of uropod 2 about two-thirds as long as inner; cuticle posterodorsally with weak surface pits, polygonal; pereonites 3-5 strongly swollen laterally and bulging above coxae, largest coxae angled mesiad so that they meet along ventral margins and squeeze pereonal appendages tightly between them.

HOLOTYPE. — WAM, female, 2.9 mm.

TYPE-LOCALITY. — JLB Australia 4, Sugarloaf Rock, Cape Naturaliste, Western Australia, inter-

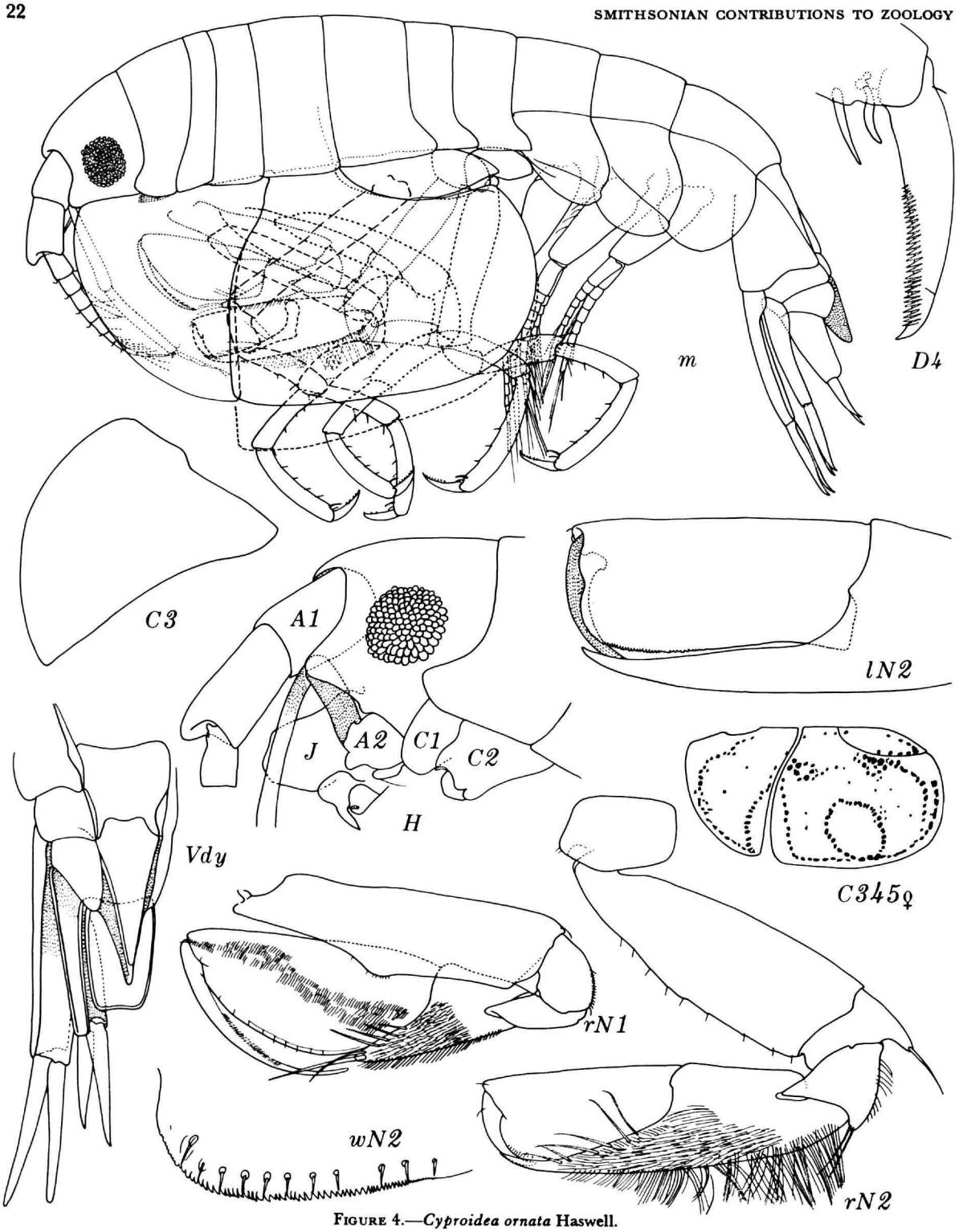


FIGURE 4.—*Cyproidea ornata* Haswell.

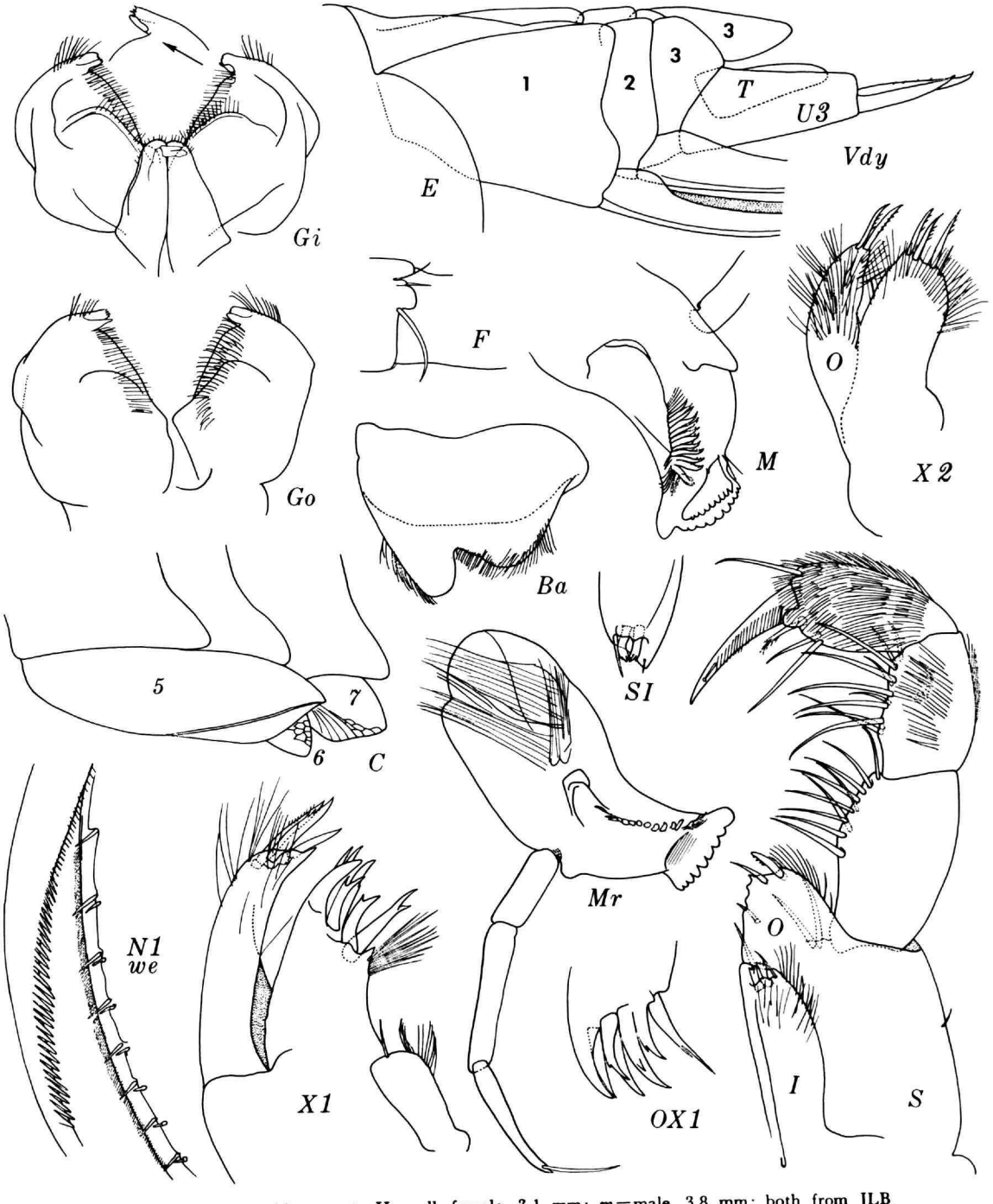


FIGURE 5.—*Cyproidea ornata* Haswell, female, 3.1 mm; *m*=male, 3.8 mm; both from JLB Australia 5. (Coxae 3-4 of female show the chromatophore pattern.)

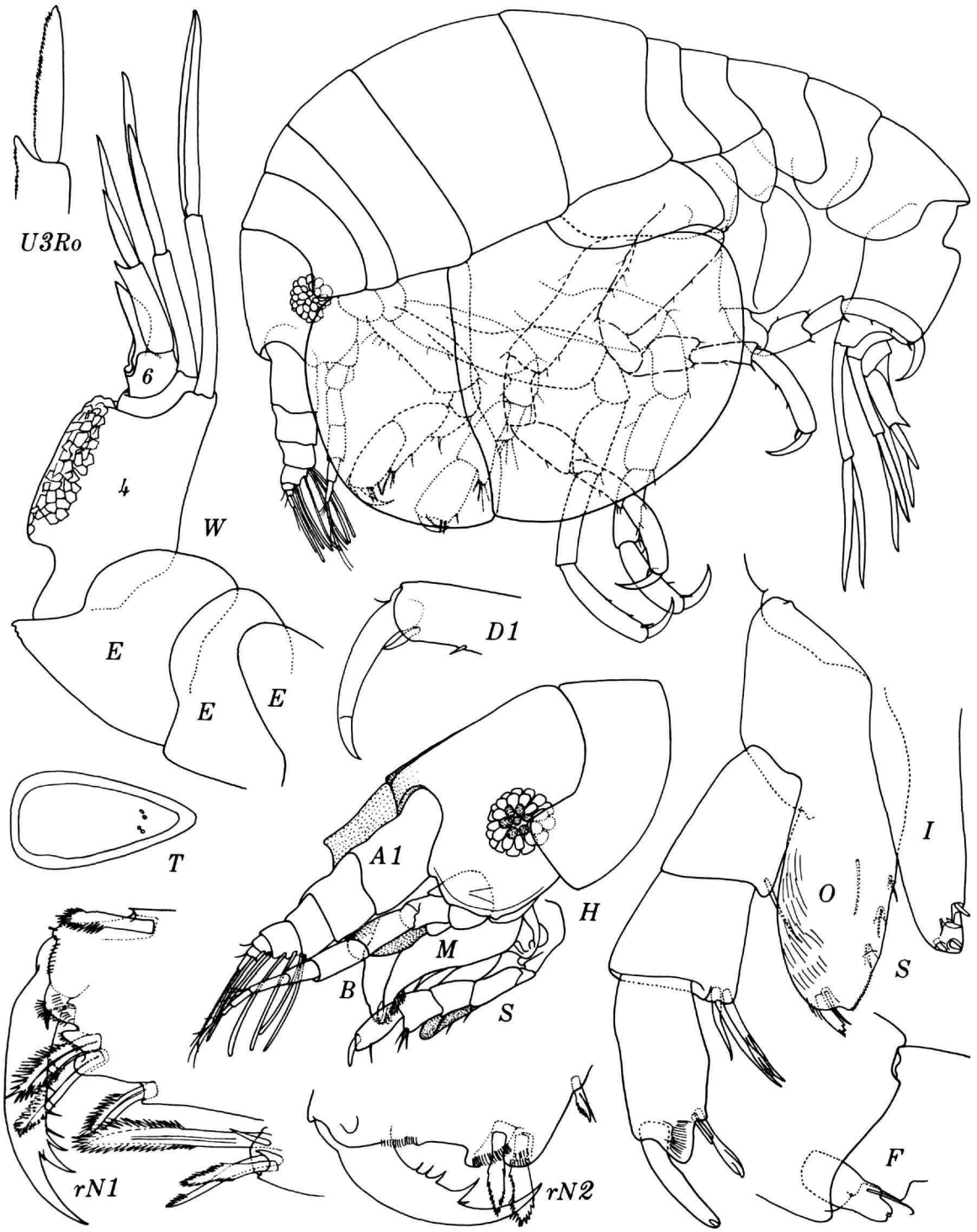


FIGURE 6.—*Narapheonoides mullaya*, new genus, new species.

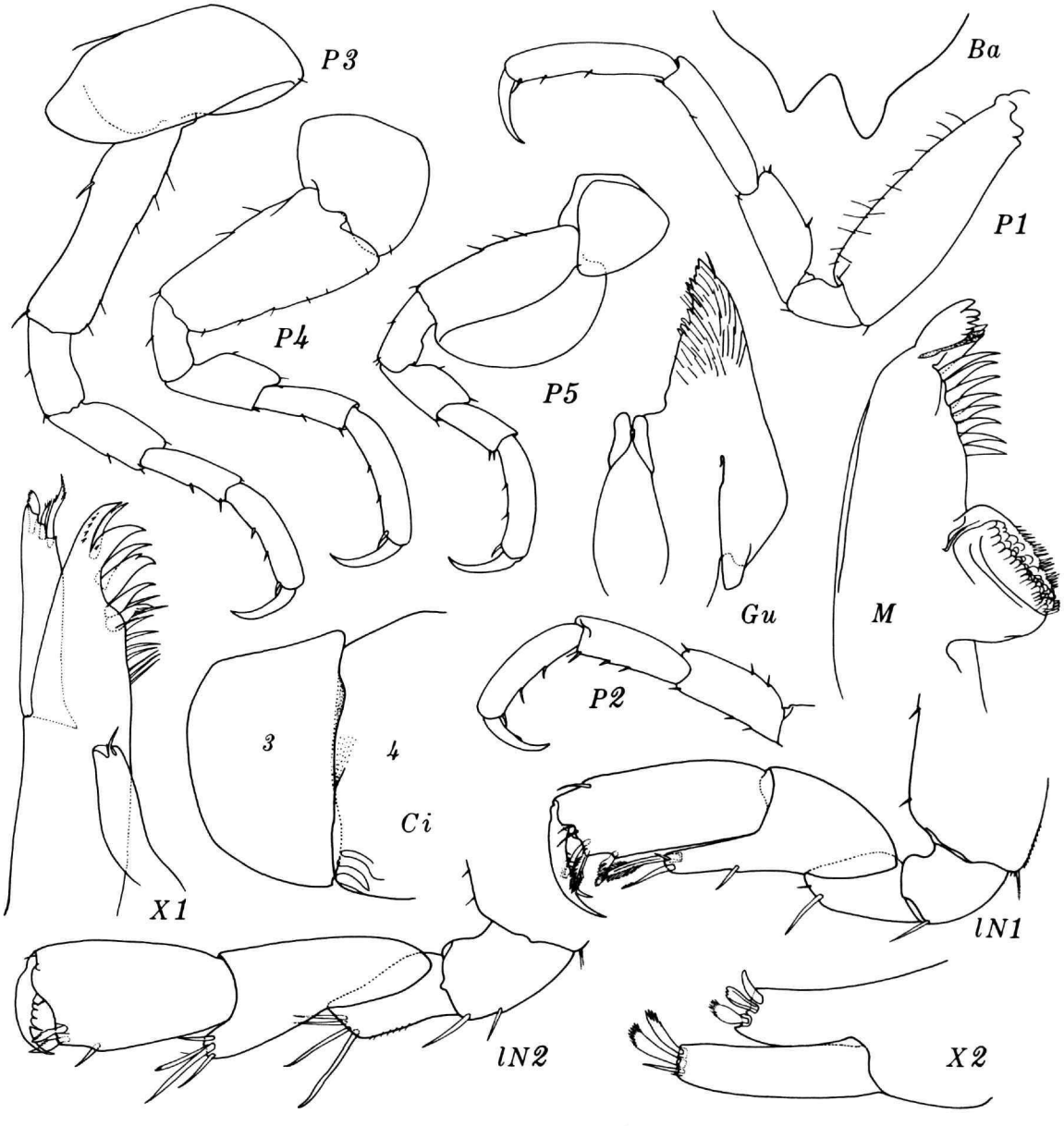


FIGURE 7.—*Narapheonoides mullaya*, new genus, new species, holotype, ?female, 1.85 mm, JLB Australia 4.

tidal, wash of rocks and algae, mainly green *Caulerpa* species, 1 September 1968.

REMARKS. — The drawing of the upper lip represents a slightly damaged and splayed pair of lobes sharper than in *Austropheonoides mundoe*, new species.

MATERIAL. — JLB Australia 4 (4 specimens, holotype; figured sex unknown, 1.85 mm; juveniles, 1.4 and 1.3 mm); 12 (1) 13 (1); Slacksmith 2 (1); Drummond A (7).

DISTRIBUTION. — Southwestern Australia and New South Wales, intertidal.

### *Unyapheonoides,* new genus

DIAGNOSIS. – Mandible with enlarged 3-articulate palp; antenna 1 with accessory flagellum; palp of maxilla 1 uniarticulate; outer plate of maxilliped reaching middle of palp article 2; gnathopod 1 scarcely subchelate, article 6 rectangular, palm very weak, dactyl much shorter than article 6, article 5 weakly produced along article 6; gnathopod 2 with transverse, strongly chelate palm, article 5 not distinctly produced along article 6; article 2 of pereopods 3-5 strongly widened and that of pereopod 3 widest; pleonite 4 elongate and bearing pair of dorsal keels ending bluntly at posterior end but not distinctly vaulting over following segments; pleonite 5 short, pleonite 6 more than three times as long as 5; telson elongate, slightly hollowed dorsally, extending beyond outer ramus of uropod 3; outer ramus of uropod 3 slightly more than half as long as inner ramus.

TYPE-SPECIES. – *Unyapheonoides dabber,* new species.

RELATIONSHIP. – This genus resembles *Austropheonoides* and especially *Narapheonoides* in the tightly appressed major coxae but differs from both in the expansion of article 2 on pereopod 3, in the elongate urosomite 3, the elongate telson, and the weak lobes on article 5 of the gnathopods; from *Austropheonoides* it differs further in the weakly subchelate gnathopod 1 (against simple), and the enlarged mandibular palp; from *Narapheonoides* it differs further in the subequally long plates of maxilla 2 and the presence of a mandibular palp. *Unyapheonodies* and the other genera have numerous other characters of specific and possibly generic value in various ornaments, spines, and shapes related to the head, epistome, maxilliped, gnathopods, uropods, and dorsal body outline (see the figures).

*Unyapheonoides* differs from *Peltopes* K. H. Barnard (1930) and *Neocyproidea* Hurley (1955) in the strongly (not "somewhat") expanded article 2 of pereopod 3, in the weak lobes of article 5 on gnathopods 1-2, and in the chelate gnathopod 2; it differs further from *Neocyproidea* in the presence of a mandibular palp.

*Unyapheonoides* differs from *Hoplopleon* K. H. Barnard (1932) and *Hoplopheonoides* Shoemaker (1956) in the expanded article 2 of pereopod 3, in the weakly keeled urosomite 1, in the elongate urosomite 3, and in the elongate telson; it differs from the former especially in the weak lobes on article 5 of the gnathopods. Gnathopod 2 of *Unyapheonoides* resembles that of *Hoplopheonoides,* but the Australian genus differs further in the presence of an accessory flagellum and the oblique palm of gnathopod 1.

*Peltocoxa* Catta has a small mandibular palp, a somewhat shortened urosomite 1, and an undilated article 2 of pereopod 3, but, like *Unyapheonoides,* it has an elongate telson, an incised ocular lobe, and a fairly short lobe on article 5 of the gnathopods.

### *Unyaphenoides dabber,* new species

FIGURES 8–9

DIAGNOSIS. – With the characters of the genus.

DESCRIPTION. – Rostrum large, eyes large, color rusty in 3-month formaldehyde, lateral cephalic lobe with notch and hook, varying in sharpness and depth from specimen to specimen; epistome strongly produced; lacinia mobilis of right mandible thinner than on left; inner plate of maxilla 1 with weak accessory subdistal column bearing setule, outer plate with 7 or 8 spines and numerous stiff setules, difficult to distinguish eighth spine from setule on some specimens, apex of palp blunt and bearing 3 submarginal spines; plates of maxilla 2 extending subequally; 2 spines on article 2 of maxillipedal palp very stout, blunt, and feathered, dactyls of gnathopods each with 1 inner tooth, dactyl of gnathopod 1 with numerous stiff spinules; rami of uropod 1 extending equally, outer ramus of uropod 2 about two-thirds as long as inner; cuticle posteriorly and dorsally very finely and weakly pitted ("cellular"); pereonites not swollen above coxae, largest coxae angled mesiad but not as strongly as in *Narapheonoides;* urosomite 1 with 2 weak dorsal keels.

HOLOTYPE. – WAM, female, 1.95 mm.

TYPE-LOCALITY. – Slack-Smith 2, Cheyne Beach, east of Albany, Western Australia, intertidal, weedy rocks, 6 December 1968.

REMARKS. – The coxae are held nearly vertically so that flattening them does not increase their length significantly (see added lines in Figure 8). All specimens at hand have articles 6-7 of the pe-

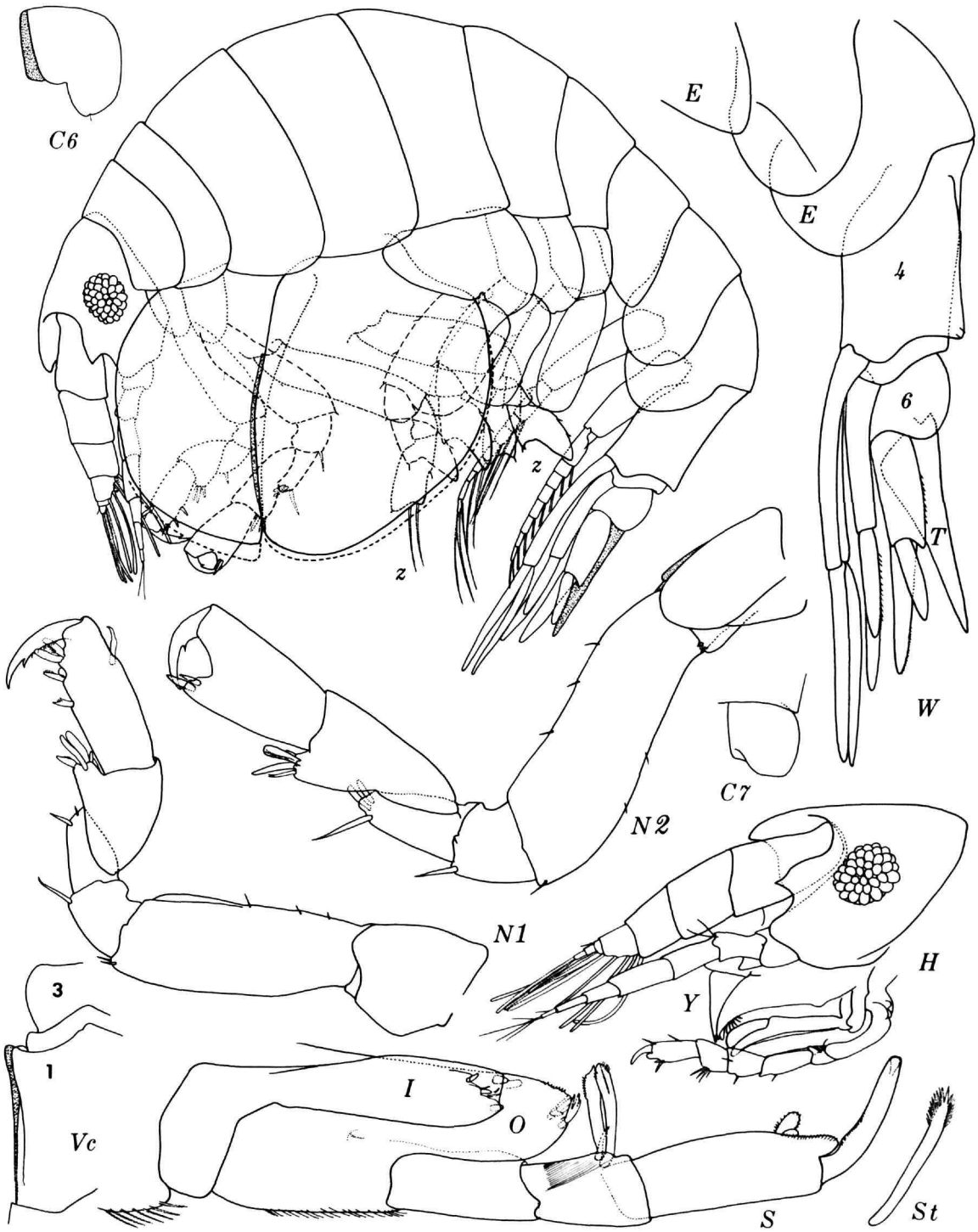


FIGURE 8.—*Unyapheonoides dabber*, new genus, new species.

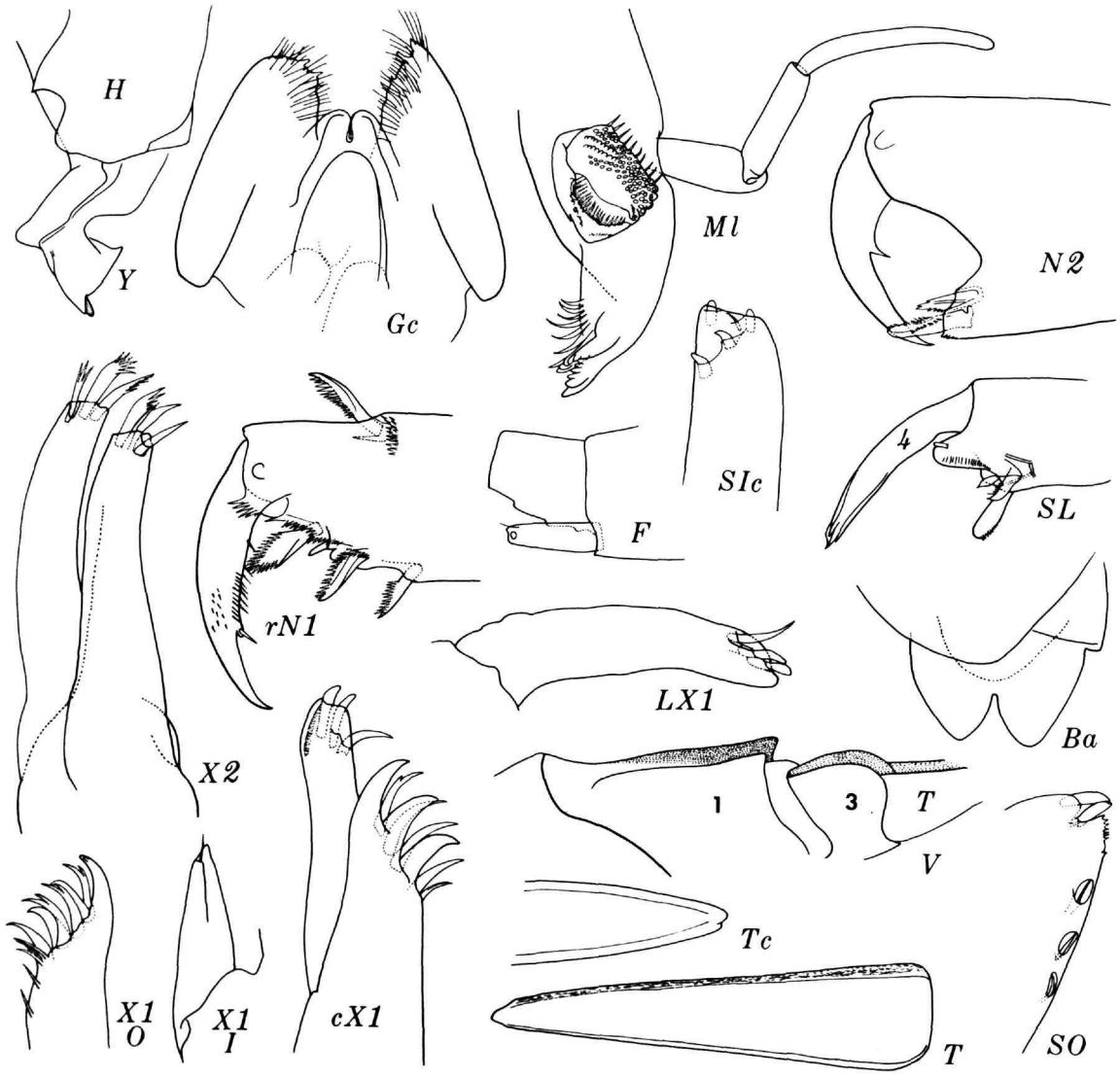


FIGURE 9.—*Unyapheonoides dabber*, new genus, new species, holotype, female, 1.95 mm; *c*= ?female, 1.8 mm; both from Slack-Smith 2.

reopods broken off. Setae of pleopod 3 have been cut off where they cross the uropods on the figure in toto, and the base of pleopod 1 is omitted as it masks other more important lines.

MATERIAL. – The type-locality (6); Drummond A (1).

DISTRIBUTION. – Southwestern Australia and New South Wales, intertidal.

## CEINIDAE, new family

TYPE-GENUS. – *Ceina* Della Valle.

DESCRIPTION. – Talitroidea with laterally compressed bodies, unsplayed coxae and free urosomites; accessory flagellum absent; head laterally compressed and large, antennae nonspinose; basal articles of antenna 2 free; upper lip rarely bilobed weakly; mandible lacking palp, molar ranging from

columnar and fully triturative to styliform and smooth; palp of maxilla 1 very small or absent; article 4 of maxillipedal palp well developed, unguiform; anterior coxae large and of normally quadrate proportions; uropod 3 visible from lateral view, composed only of peduncle; telson weakly cleft in marine taxa, entire in freshwater taxa; setae of brood lamellae bearing flat apical curl; cuticle bearing well-formed hemispherical pits with inner flange formed as a circle constricting opening to pit.

COMPOSITION. – Ceininae (marine and telson cleft slightly); Chiltoniinae (freshwater and telson entire).

### *Ceina* Della Valle

*Ceina* Della Valle, 1893:530.—Stebbing 1906:554–555.—Chilton 1919:119–120.
*Periphlias* Pirlot, 1936:295.

DESCRIPTION.—Rostrum weak and erect; head marked with deep lateral notch, antenna 1 longer than, or equal in length to, antenna 2 and bearing numerous apical aesthetascs; epistome evenly rounded anteriorly; upper lip weakly incised; mandibular molar forming long thorn, smooth; palp of maxilla 1 absent, small inner plate with several setules, outer plate with 8-9 spines; lobes of maxilla 2 subequal to each other in width and length, armed terminally with stout setal spines, inner with medial edge bearing only setules; inner plate of maxilliped as long as outer plate, latter with sparse medial spines, palp very long and thick with elongate and laterally extended article 1 and long unguiform article 4 bearing 1-2 stout apical spines and fascicles of minute setules on inner margin, palp article 3 with midapical comb of setal spines, article 2 with medial group of several spine-setae, palp otherwise moderately setose; gnathopods 1-2 smiliar to each other in female, small, hands elongate, rectangular, palms short but oblique, dactyls fitting palms defined by large spine, article 5 also partially elongate, gnathopod 2 in male occasionally becoming very large, article 5 becoming obsolescent, and article 6 strongly chelate; pereopodal dactyls with luniform slit, 2 large and 1 small setules; pereopods 3-5 poorly setose; pleonites 4-5 not extended posteroventrally; telson formed of flat plate partially cleft; uropod 3 composed only of weakly spinose peduncle; gills formed of simple flattened sac; brood lamellae slightly reniform and bearing curl-tipped setae.

TYPE-SPECIES. – *Nicea egregia* Chilton.

### *Ceina wannape*, new species

FIGURES 10–11

DIAGNOSIS (of male). – Antenna 1 stout, long, bearing about 11 flagellar articles; antenna 2 very thin, long, flagellum bearing about 11 articles; article 1 of maxillipedal palp broadly expanded laterally as wing; gnathopods 1-2 extraordinarily thin, similar to each other in size and shape, article 6 shorter than 5, article 3 elongate on gnathopod 2, palm oblique, rounded, medial surfaces of articles 5-6 bearing numerous simple setal-spines, coxa 1 very small, subrectangular, anteriorly truncate, partially hidden by coxa 2, latter narrow at base, expanding at middle, coxa 3 evenly quadrate, coxa 4 also evenly quadriform except for oblique posterior margin and posterodorsal excavation, posterior tooth softly rounded; pereopods 3-5 small in comparison to *C. egregia* (Chilton) and uropods 1-3 elongate; pereonite 1 with gross dorsal hump, pleonites 1-2 with large dorsal humps, pleonite 3 with smaller angular hump.

DESCRIPTION. – Antenna 1 with numerous aethetascs; eyes red in formaldehyde; head, body, coxae, second articles of pereopods 3-5 covered with scattered pits bearing setal-trigger, pits widening interiorly and bearing horizontal hemiseptum, cuticle between pits bearing numerous fuzzy buttons about size of pits, and remaining surface between pits and buttons very minutely punctate or tuberculate (extremely dim under oil immersion); palp of maxilla 1 absent or denoted by extremely small notch, outer plate with 9 spines; inner ramus of uropod 2 lacking spines.

HOLOTYPE. – WAM, male, 7.5 mm. Unique.

TYPE-LOCALITY. – JLB Australia 14, inside Forsythe Bluff, 12 miles west of Albany, Western Australia, intertidal, wash of dense algae on heavily wave-splashed smooth rocks, 1 October 1968.

RELATIONSHIP. – This species differs from the New Zealand *Ceina egregia* in the following: the larger hump of pereonite 1, the smaller pereopods 3-5, the longer uropods 1-3, the larger antenna 1,

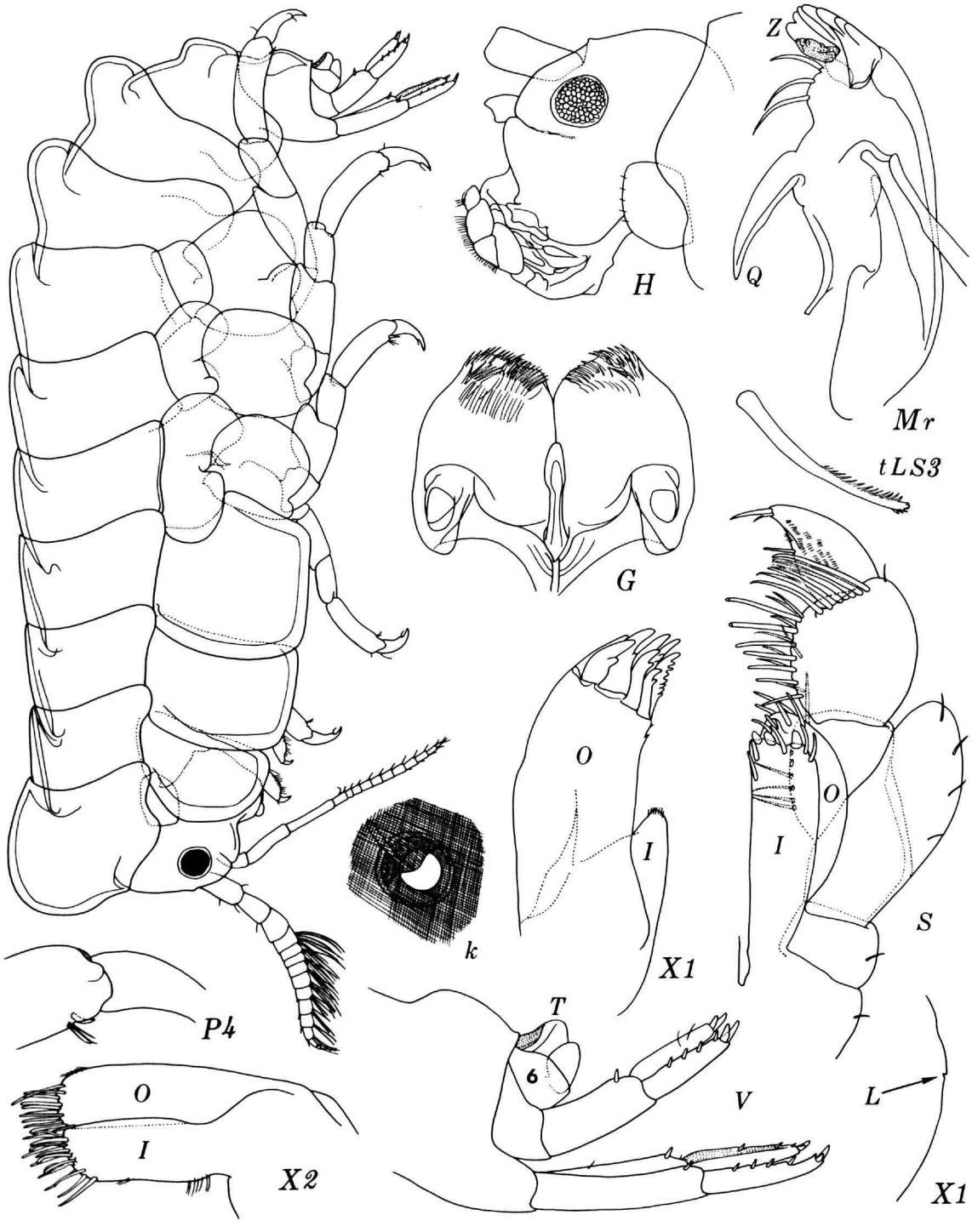


FIGURE 10.—*Ceina wannape*, new species, holotype, male, 7.5 mm, JLB Australia 14.

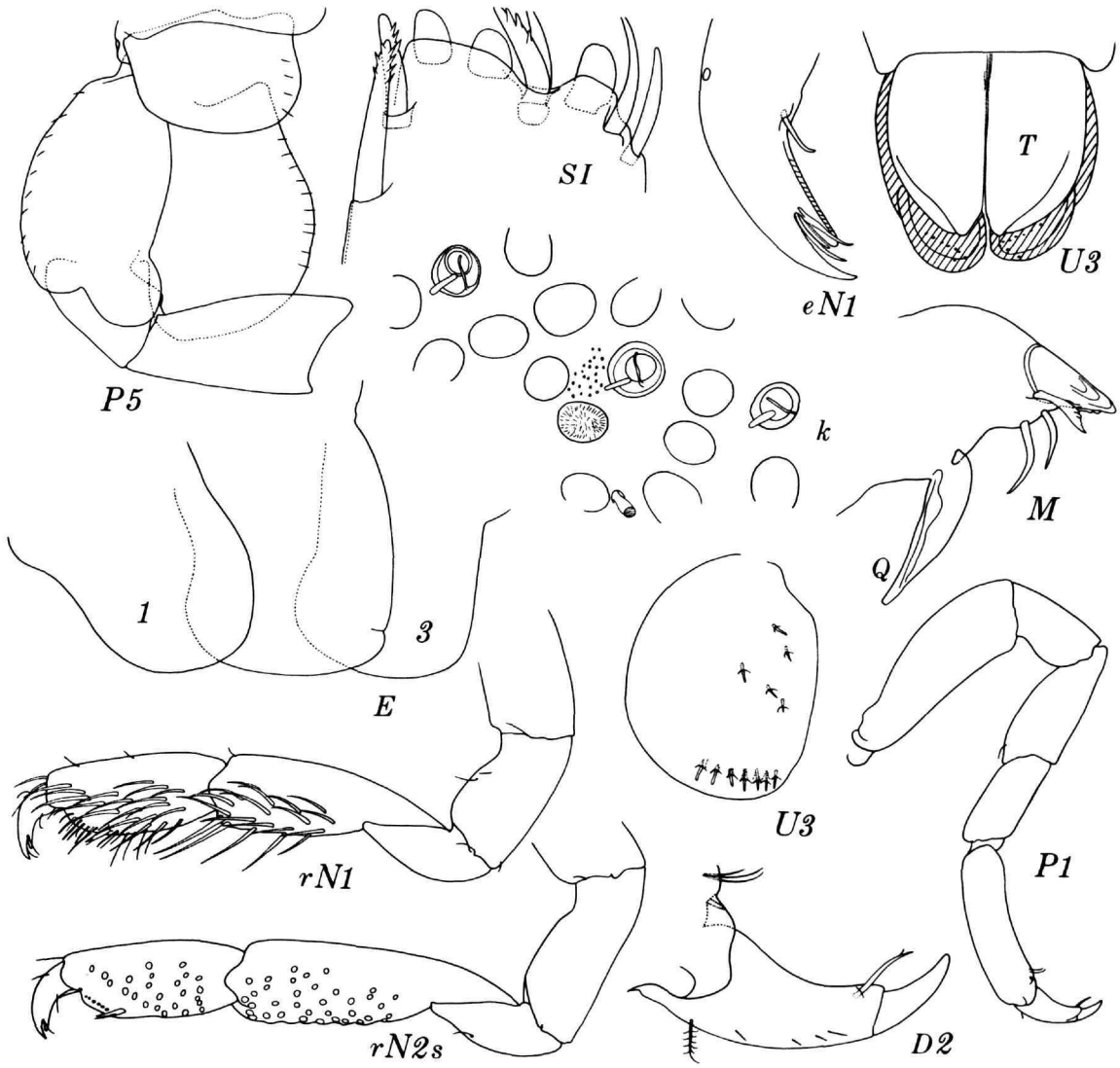


FIGURE 11.—*Ceina wannape*, new species.

the thinner antenna 2, the small coxa 1, the more regularly quadriform coxae 3-4, the wing on the maxillipedal palp, and the completely different gnathopods, the spines of which are simple and not prickled as in *C. egregia*. The New Zealand species has an enormous chelate gnathopod 2 in the male, unlike *C. wannape*.

*Ceina carinata* (Pirlot, 1938) from Indonesia has strongly developed lateral cephalic lobes, no maxillipedal wing, a broad, untapering coxa 2, very broad article 4 on pereopods 3-5, angular processes on pereonite 1 and pleonite 2, and coxa 1 projects anteriorly far more than in *C. wannape*.

*Ceina platei* Schellenberg (1953) from Juan Fernandez, has well-developed humps throughout the pereon and a large coxa 1.

MATERIAL. – The holotype.

DISTRIBUTION. – Southwestern Australia, intertidal.

## COLOMASTIGIDAE

### *Yulumara*, new genus

DIAGNOSIS. – Colomastigid with uropod 3 uniramous; base of pleonite 5 covered by flap of pleonite 4; uropod 1 attached ventrally to pleonite 4 and hidden from lateral view, tucked up flush with urosome; coxae 3 and 4 more than twice as long (deep dorsoventrally) as coxa 7, coxae 1-2 crowded forward, elongate and partially hidden successively by following coxae; antenna 1 many times thicker and longer than antenna 2, latter very reduced and former very enlarged, antenna 1 geniculate between articles 2 and 3; head partially telescoped into pereon.

TYPE-SPECIES. – *Yulumara wallangar*, new species.

RELATIONSHIP. – All of the characters of the diagnosis represent conditions opposite to those in *Colomastix* Grube, the only other genus of this family.

Unlike members of *Colomastix*, the body of *Yulumara* is heavily calcified and very brittle, the pereonites bearing lateral plaques and extremely rough cuticle with irregular to regular polygons, these polygons occurring also on thickened portions of appendages and antennae. *Colomastix* has the anterior coxae short and broad and freely visible; the antennae are large and subequal in size, uropod 3 is normally biramous, and uropod 1 is attached to pleonite 4 in normal gammaridean fashion. Like *Colomastix*, *Yulumara* has pleonites 5-6 coalesced into a single segment. Uropod 3 of *Yulumara* is highly unusual, the enlarged ramus bearing numerous lobes (palmate). Article 1 of antenna 2 is coalesced with the head.

### *Yulumara wallangar*, new species

FIGURES 12–14

DESCRIPTION. – Antenna 1 appearing from lateral view to form a stump, but article 3 flexed medially and carrying a 3-articulate main flagellum and a 1-articulate accessory flagellum, each flagellum bearing long aesthetascs; antenna 2 with 3-articulate flagellum, article 1 hidden and telescoped in flat view; article 1 of peduncle coalesced with head, antenna 2 flush with ventrolateral rounded surface of head; eyes clear in alcohol, formed of few ommatidia in cephalic bulges, rostrum forming bulk of head; eyes clear in alcohol, formed of few om- and upper lip, epistome forming small tub-shaped extension of head bearing heavily cornified hemispherical upper lip; mandible like that of *Colomastix*, lacking incisor, bearing 5 teeth representing spine row (not drawn in figure of mandible, but otherwise like that in *Colomastix*) and normal molar of *Colomastix*; lower lip not seen; maxilla 1 like that of *Colomastix* but inner plate with at least 2 heavy spines, outer with at least 9 small setae, apex of 1-articulate palp complexly serrate and spined; maxilla 2 with 2 weakly divided lobes heavily spinulated; outer plates of maxilliped heavily cornified and ventral cuticle bearing strong polygons, inner lobes fused into single conical plate, palp normally 4-articulate; gnathopod 1 bearing normal distal brush of curled setae, dactyl apparently formed of vestigial cone; gnathopod 2 of normal female morphology in *Colomastix*; pereopods stout, each with only 1 locking spine, no ornaments except weak slit on dactyl, article 2 of pereopods 3-5 especially broad and bearing medially set posterior lobe; inner rami of pleopods slightly shorter than outer, each ramus 4-articulate; ventral portion of pleonites 5-6 (fused) bearing 2 external plates, posterior member longitudinally divided, subanal flap posterior to latter plaque, telson small and broad, entire, and situated dorsal to subanal flap; uropod 3 with thick short peduncle bearing 1 dorsolateral projection, ramus very large, thick, and palmate.

HOLOTYPE. – SAM, female, 3.1 mm. Unique.

TYPE-LOCALITY. – Shepherd 29, D337, Pt. Noarlunga, South Australia, 5 m, reef outside; in algae, 5 September 1968.

REMARKS. – The unique specimen of this very unusual amphipod is extremely brittle. I had the greatest difficulty in excising the mouthparts, though, by proceeding in several stages, I was able to discern characteristics later destroyed at the mere touch of the finest dissecting tools. The maxillipeds cover most of the remaining mouthparts and are easily removed. They have the ordinary shell-like base of other colomastigids. Maxillae 1 and 2 are attached side by side in a row of 4 assemblages, the pair of maxilla 2 attached medially (from ventral view) and each maxilla 1 attached lateral to the pair of maxilla 2. The sclerotic capsule forming the base of these maxillae, thus, is composed of 4

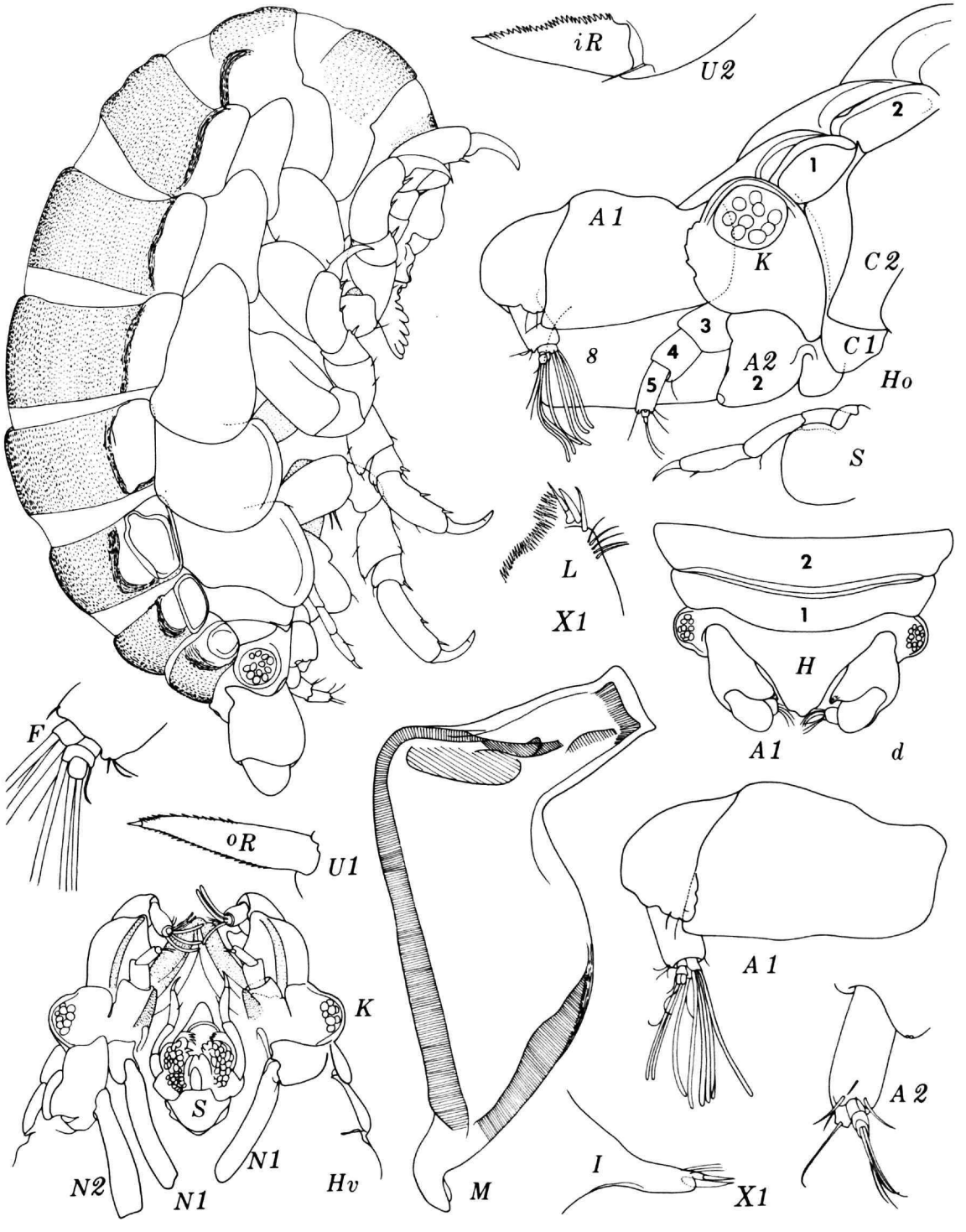


FIGURE 12.—*Yulumara wallangar*, new genus, new species.

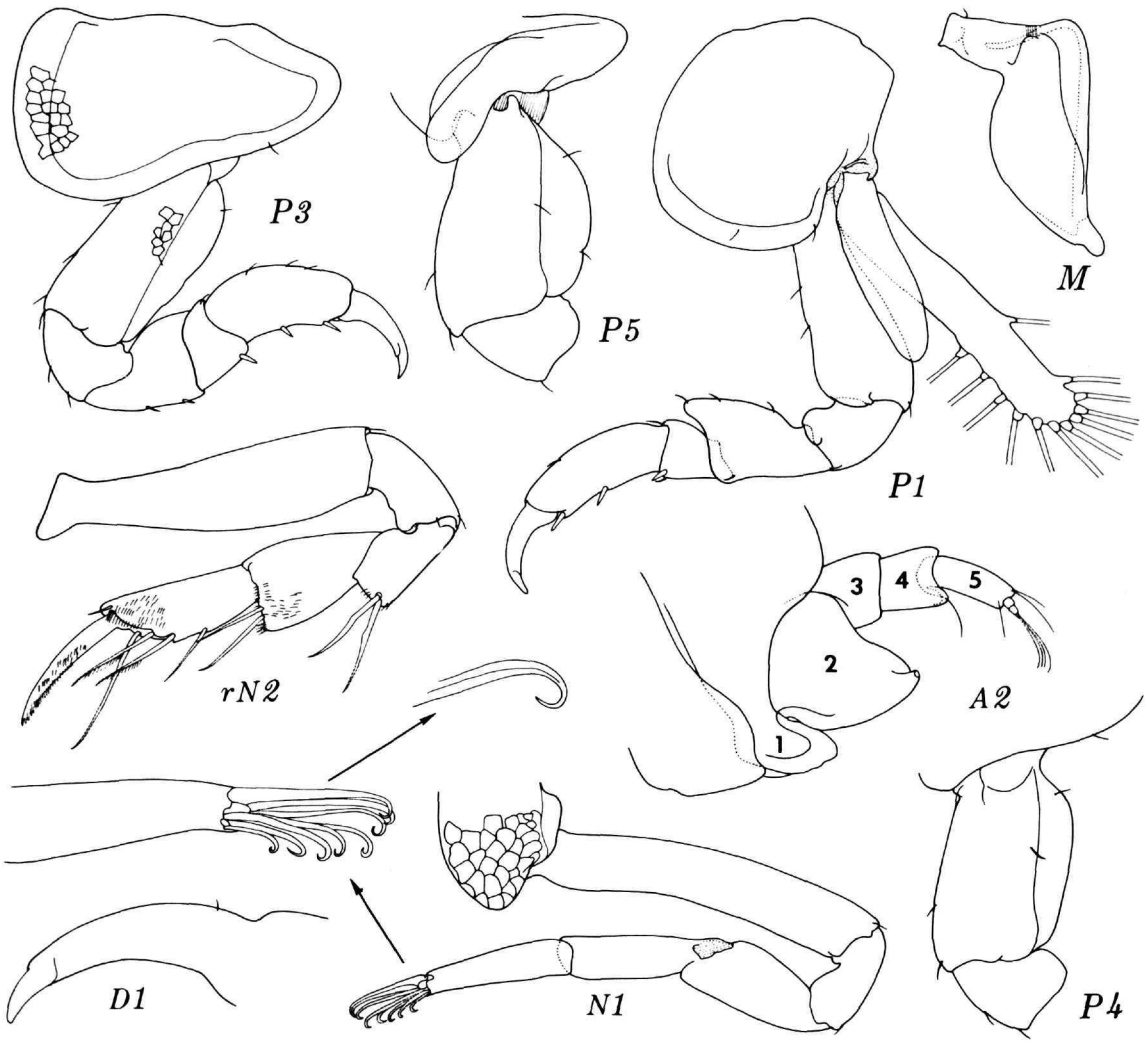


FIGURE 13.—*Yulumara wallanger*, new genus, new species, holotype, female, 3.1 mm, Shepherd 29. (*d*=dorsal, *v*=ventral.)

foramina in one plane and in one line. If a lower lip was present, it was destroyed in the attempt to remove the maxillae; the teeth of the mandibles also shattered during dissection. Maxilla 1 is so fragile that only the apices of its 3 parts could be discerned after their being mounted on a slide and observed with oil-immersion magnification.

DISTRIBUTION. — South Australia, sublittoral.

## DEXAMINIDAE

DIAGNOSIS. — Gammaridean with at least 2 urosomites coalesced together, these being either 2-3 together or 1-3 together; telson not fleshy, weakly to strongly cleft; pereopod 5 not longer than 4 or less than 1.2 times as long as 4, dactyl of pereopod 5 not of elongate setose kind found in Oedicerotidae;

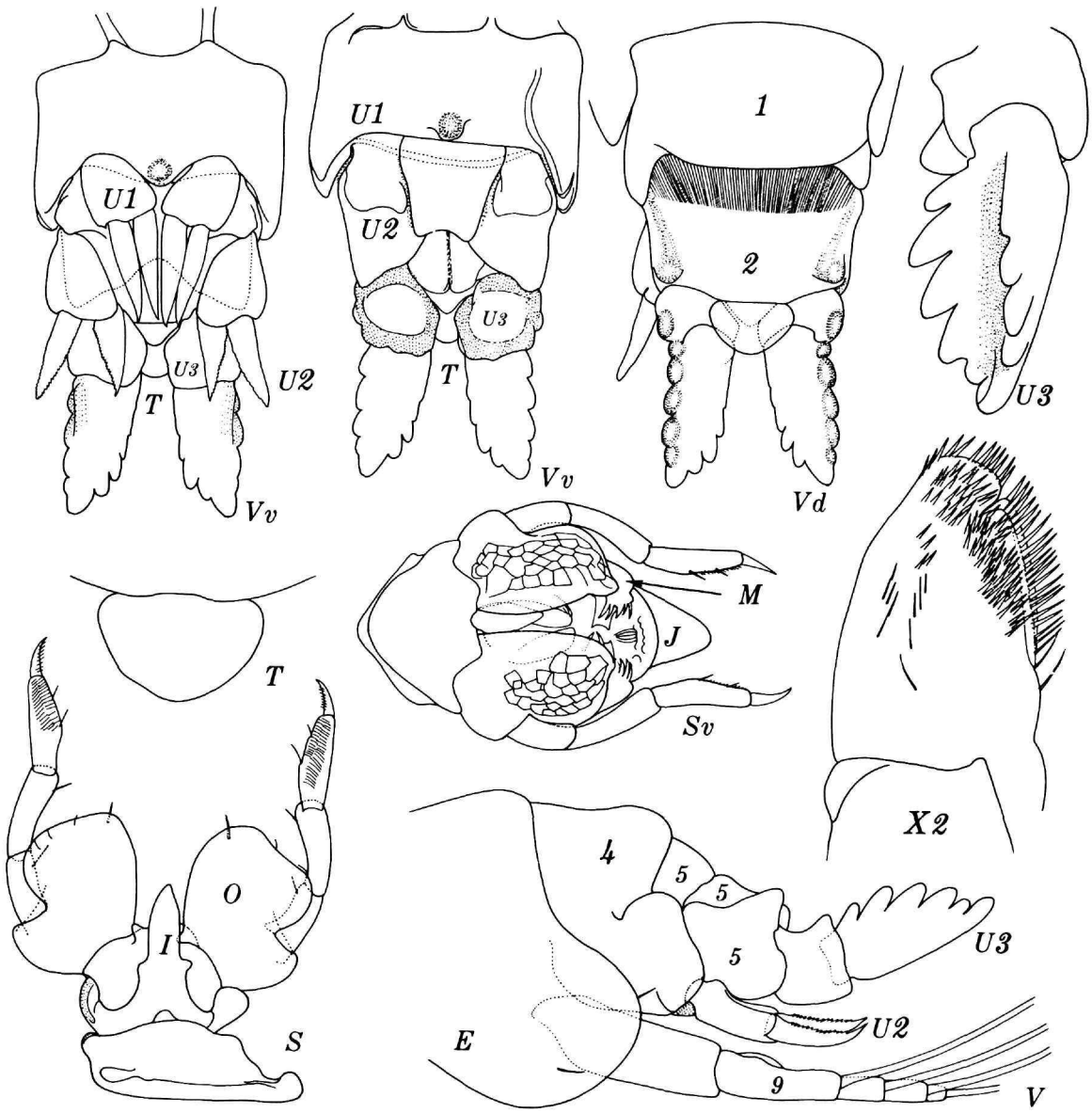


FIGURE 14.—*Yulumara wallangar*, new genus, new species.

if article 4 of pereopods 1-2 grossly elongate as in Ampeliscidae then that article not bearing numerous plumose setae, and pereopods 1-2 lacking web-spinning glands; eyes when present ommatidial; accessory flagellum composed of 1-2 articles, usually vestigial; mandible bearing incisor (generally non-foliate), molar nonacuminate; gnathopod 2 not of form seen in Lysianassidae; article 2 of antenna 1 not telescoped into article 1; body laterally compressed, coxae not splayed, abdomen unflexed; uropod 3 large, biramous; peduncle short; maxilliped with palp; coxa 1 visible and containing at least

half or more of surface area in coxa 2; gnathopod 1 fully present, gnathopods not grossly different from one another, generally subchelate, article 5 not grossly broader than 6; outer lobes of lower lip not grossly separated by median space (as in Astyridae); head neither elongate nor galeate.

TYPE-GENUS. – *Dexamine* Leach.

REMARKS. – This family now includes the Atylidae, Anatylidae, Lepechinellidae, and Prophliantidae (see J. L. Barnard, 1970b). It is divisible into the following two subfamilies.

**Key to Subfamilies of Dexaminidae**

Pereopods 3-5 each similar to one another ..... **Dexamininae**
Pereopods 3-5 dissimilar in morphology to one another ..... **Prophliantinae**

TAXONOMIC CHARACTERS
IN *Paradexamine* AND *Guernea*

The characters of *Guernea* Chevreux (sensu lato) have been discussed by J. L. Barnard (1970b) as far as they are known in the 5 or more species from the northern hemisphere. The 5 named species in the southern hemisphere, 4 new species described herein plus *G. timaru* J. L. Barnard (in press) from New Zealand, are not located for certain in the genus *Guernea,* but the relationship is extremely close, and the main differences at present may be the discontinuity and poor pigmentation of eyes in northern guerneas (including *Dexamonica* J. L. Barnard and *Prinassus* Hansen), whereas southern guerneas have compacted and unevenly sized ommatidia bearing a dark, central pigmentary core.

Like *Paradexamine* Stebbing, the species of *Guernea* have a high diversity of attributes serving as taxonomic characters; to save space, I will discuss the two genera together. The comments on these two apply in part also to *Syndexamine.* Gross differences among sympatric species seem more extreme and numerous than in the average gammaridean genus. Some of these differences have been utilized heretofore in Dexaminidae as characters differentiating genera (Sheard, 1938). But *Paradexamine* is now shown to have species with many intergrading steps in the characters of mandible, lower lip, maxilla 1, maxilla 2, and maxillipeds, so that *Dexaminoides* Spandl, a taxon from the Red Sea, is shown to be a synonym of *Paradexamine;* such peripheral species as *Paradexamine (Wailele) maunaloa* J. L. Barnard (1970a) from Hawaii, and the odd *P. muriwai* J. L. Barnard (in press) from New Zealand probably deserve no subgeneric appellations.

*Guernea* and *Paradexamine* are not closely related to each other since they exist presently in different subfamilies of Dexaminidae, but both have a similar mix of characters. The diagnoses of species presented herein are rudimentary because attributes of many early species of *Paradexamine* have not been reevaluated or determined and because, in both *Paradexamine* and *Guernea,* undescribed species apparently remain to be discovered from the Tropic of Cancer southward. The widest use of known characters has, therefore, not been utilized in the descriptions; some of these have been left for observation in the figures.

Some of the characters heretofore utilized to distinguish genera in Dexaminidae are now considered to have only interspecific value, and these, plus some others, must in any case be assessed with caution because of artifacts induced by preservatives and observational procedures.

The lower lip has been a widely used generic character, but some morphs illustrated in the literature are probably a result of shriveling or hydrophily, depending on kinds of preservatives or mounting media, and are subject to varying interpretations according to the angle of observation, the degree of flattening of the cover slip, and the resolutionary capabilities of the microscope being used. The degee of appression of inner lobes on the lower lip may be highly variable in preserved specimens of one species; and since the mandibular lobes may appear pointed or apically blunt, depending on angle of observation, they may be twisted naturally in some species, presenting an edge to the observer who views the lip directly from the anterior view. This lobe, if flattened, may appear blunt or quadrate, but often it is thin and

upturned. The outer lobe may bear 0-12 cones that are suggestive of salivary spouts.

Mandibles of dexaminids, especially in the genera *Paradexamine, Guernea, Syndexamine,* and perhaps others, are very difficult to prepare for observation. They lack palps and are twisted just enough to appear opposite-sided after dissection. They are so attached sclerotically to the head that a clean break is often difficult to make; the result is that the molar appears to be the posterior boundary of firm chitin. The degree of cuspidation on the incisor and lacinia mobilis, the number and size of accessory spines, the presence or absence of a main ragged seta and other setae on the molar, and the degree of asymmetricity, right and left, are significant specific differences. The spines in the spine row may be of infinitesimal size; between the spine row and the molar there is often a paramolar hump, itself occasionally cuspidate. The overall shape and ruggedness of the mandible also characterize the species so extraordinarily that they seem to have generic distinction.

The following characters are more straightforward than those already discussed, because fewer artifacts can be attributed to their manipulation and observation; however, maxillae 1-2 have to be carefully flattened, and the rami of uropod 3 have to be flattened apart from the peduncle.

The palp of maxilla 1 in members of *Guernea* is either 1- or 2-articulate. Since the articulation line is very difficult to resolve in some species, its resolution often depends upon observing the palp obliquely or partially smashing the palp. It may occasionally be 1-articulate on a right palp and 2-articulate on a left palp of a single specimen. As a generic character, it appears to have little value by itself. The apex may bear 0-3 salivary spouts; the outer plate bears 7-11 spines, and the inner plate may be naked or bear 1-2 setae.

The shape and extent of the inner plate on the maxilliped have been of generic value in Dexaminidae, but in *Paradexamine* they now appear valueless. Undoubted members of *Paradexamine* have the plate fully developed in one species, moderately to poorly developed in some, and obsolete in others. The inner plate can be confused easily with setose ventral lobes of the maxillipedal base if improper flattening of the appendage occurs. I have not found any obvious cases of confusion in the literature, but I have observed species in which this could occur. The degree of palpar projection beyond the outer plate can be altered moderately by flattening of the maxilliped. Little reliance should be accorded tiny differences of this sort in the literature, but there is no escaping the need to flatten the maxillipeds to observe important characters. Maxillipeds in some species of *Paradexamine* have a strongly hemispherical form. Spines on the outer plate have differing degrees of trifidation and shape in different species, and article 4 of the palp has a significant range of size, shape, and spinosity. The inner plate occasionally has facial setae.

ANTENNA 1. — Article 1 may have a dorsal excavation in *Guernea* and a ventral brush in males of both genera; article 2 is usually longer in males than in females of *Paradexamine,* but females may have a spine group ventrally, and occasionally the spines are set in a deep notch or on a projection; article 2 may have a tooth apically; short article 3 frequently has a weak distal process; males of *Paradexamine* have elongate antennæ 1 with setulose peduncles. The flagellum of females may be characteristically thickened.

ACCESSORY FLAGELLUM. — In northern *Prinassus* it has 1 seta and 1 aesthetasc, in southern *Guernea* it generally has 2 (occasionally only 1) or more setae, no aesthetasc, but in one species of *Guernea* the accessory flagellum is absent in females. In *Paradexamine* the accessory flagellum is usually a well-developed tiny barrel bearing 2 or more setae and occasionally an aesthetasc.

ANTENNA 2. — Generally short in females, elongate in males, with article 4 of the peduncle especially long in males and setuliferous; article 5 short in males, the elongate flagellum often being tucked into the mesiocoxal space in preserved males of *Guernea;* the flagellum of the female is said to have as few as 1 long article but generally at least 3 in *Guernea.* The gland cone in gerontic specimens of *P. frinsdorfi* may become vestigial, and article 1 of antenna 2 may bear a lobe.

HEAD. — In *Paradexamine* the presence or absence of a sharp anterior cusp on the ocular lobe is highly specific. The degree of invagination for the reception of antenna 2 differs among the species and, thus also, the degree of posteroventral extension of the head.

EYES. — In southern members of *Guernea,* the eyes usually have dark purple cores (in alcohol) with a layer of clear, compact, irregularly sized ommatidia around the cores; in northern *Prinassus* and in some species of northern *Guernea,* the eyes are composed of regular-sized ommatidia scattered about in the ocular capsule, lacking a special pigmentary core, though pigmented overall, the pigment usually being lost in alcohol, and occasionally the ommatidia showing buds or subdivisions; occasional specimens of northern *Guernea* have tightly compacted ommatidia, possibly as a preservational artifact. *Paradexamine* has regular-sized ommatidia highly compacted, with a faint core of pigment in alcohol. Eyes of males in both genera are enlarged, but eye size differs among the several species of *Paradexamine.*

UPPER LIP. — Generally widely rounded or slightly flattened apically, weakly to moderately setulose; in some material the lower edge has been seen to be flatter than normal, bearing a weak notch that, as yet, I have not been able to prove is not an artifact.

MAXILLA 1. — The presence or absence of setae on the inner plate is a minor character. The outer plate may have 7-11 spines. The palp is a most significant specific variable in that it may be 1- to 2-articulate, short or long, thin or thick, bearing 1-3 terminal cusps (possibly nozzles for salivary ducts), and a fixed number of terminal setae such as 2 only, or it may in another species have a variable number of terminal setae and may also have subapical setae on the medial side.

MAXILLA 2. — In the present study, the morphology of this appendage has been a helpful clue to specific differentiations, but there remains a possibility that significant differences occur between males and females of the same species in this appendage, which suggests that it must be used cautiously in taxonomy. A normal maxilla 2 resembles that of the basic gammaridean, with subequally long and wide plates bearing a few medial, and many terminal, setae, but many variations in width of plates, degrees of setosity, and bluntness of the apex of the inner plate occur as specific differences. The inner plate may have no apical truncation and may have the so-called terminal setae located mesiad, whereas the opposite extreme is a short, highly truncate plate bearing a fixed number of setae, such as 2. The outer plate may become apically curved mesiad, and it may have a large outer acclivity bearing an enlarged spine. Occasionally it has a few facial setae that serve as a specific character.

COXAE. — The shape, setosity, and ventral serrations of coxae 1-6 are noticeable as specific characters in *Guernea,* but also, especially, in *Paradexamine;* the expansion or nonexpansion and the presence or absence of anterior setae on coxa 1 are important characters; occasionally coxa 2 strongly tapers and occasionally coxa 3 is strongly prolonged posterodistally; coxa 4 may be broad or narrow; coxa 5 may have a long posterior lobe either quadrate or tapered; coxa 6 rarely has an elongate anterior lobe in one species of *Guernea.* Posterior spines occasionally occur on coxae 1-3, the formula being of specific character.

GNATHOPODS 1-2. — In *Paradexamine* more than in *Guernea,* the gnathopods have very characteristic specific differences. The typical gnathopods 1-2 are of equal breadth, but gnathopod 2 usually is slightly longer than 1, occasionally much narrower than 1, and usually males have slightly elongate articles 5-6. The hand usually has a sloping palm, but this varies from transverse to extremely oblique; the palm may be minutely serrate, weakly scalloped, or smooth; the dactyl generally has an inner tooth and several blunt setules, and rarely is it pectinate. The medial face of the hand has an oblique row of setae in the middle, generally from 2 to 5 in number, often simple but becoming much enlarged and pectinate in many species; the distal seta may become especially elongate; near the anteromedial margin one or more groups of heavy facial setae may also occur, and the kind and number of setae are often specific, though small differences may occur in the two sexes.

PEREOPODS 1-2. — These vary from species to species in the thickness of articles, the relative length of articles. the number of spines on articles 4-6, and the questions of whether the anterior margin of article 6 has, or does not have, a spine on either pereopod 1 or 2 and whether the spines are blunt or sharp. The dactyls may have the anterior and posterior pair of setules, plus the base of the apical nail, occurring distally or fairly proximally. The minute structure of the locking spines may also

have specific value, whether frayed, simple, or apically hooked.

PEREOPOD 3. — The shape of article 2 is characteristic in various species, but it is more irregular in gross outline in *Guernea* than in *Paradexamine*. The density and length of anterior setae on article 2 are significant and may rarely differ between the sexes of one species.

PEREOPOD 4. — Article 2 is characteristic, especially in terms of minor differences in the posteroventral lobation or extension and spination.

PEREOPOD 5. — This differs strongly between *Paradexamine* and *Guernea,* but in the latter only modest differences occur in shape and proportion of articles, whereas in *Paradexamine* the degree of lobation and spination of article 2 and the degree of elongation of article 5 are often significant. One species of *Guernea* has a vestigial dactyl.

UROPOD 1. — The ventrolateral margin of the peduncle near the basal end has a variable number of spines and setae, these varying in stoutness and length; rarely the dorsolateral peduncular margin has a gap in the regular spination. The inner ramus is rarely shortened.

UROPOD 2. — The inner ramus is rarely shortened in *Guernea,* and in *Paradexamine* the outer ramus is often significantly shortened. The length of apical spines is a specific character in *Guernea.*

UROPOD 3. — The rami usually are broadly lanceolate and well spined except in small-bodied species of *Guernea;* ramal setae often develop in large-bodied species of *Paradexamine* in both sexes. Rarely, the most apical portion of the peduncle has a pair of spines transversely adjacent to each other.

TELSON. — In *Paradexamine* the apical ornamentation of each telsonic lobe is fairly specific; the apex may be very broad and bear 10 or more cusps and 1 articulate spine, perhaps 2, whereas some species have a moderately broad apex with 2 or 3 sharp cusps on each side of a spine, and apparently the most reduced extreme has a nearly simple apex with 1 spine. The size of the row of lateral spines on each side of the telson is characteristic specifically, and minor setae on the dorsal surface may occur in pairs or singly in characteristic patterns. Rarely, the lateral spine positions have pairs of spines. In *Guernea* the main variables of the telson concern length against width and the question whether or not a slightly proximal accessory seta joins the normal terminal seta on a simple apex.

DORSAL CRESTS. — These occur infrequently on the telson. A few species of *Paradexamine* differ from others in that genus by having the telsonic lobes partially fused basally. The position of the minor setal pairs on each lobe is usually basal, but one species has them distad.

PLEONAL EPIMERA. — In *Paradexamine* epimera 1-2 generally have a lateral ridge, a slightly to strongly bowed posterior margin and a small to large posterodistal tooth; epimeron 3 lacks a lateral ridge, bearing a small to large tooth but a flatter posterior margin. The posterior edges of the epimera may be smooth or serrate; the ventral margins may have a specific formula of spines, spinules, or setules; male epimera generally are only slightly larger than they are in females. In *Guernea* the posteroventral teeth and the lateral ridges are generally absent, though very weak posteroventral cusps may be present. Male epimera generally are very much larger and smoother than in the female but also bear long ventral setae. The ventral margin of urosomite 1 in *Guernea* may have a characteristic setosity or none, 1 seta occurring at the base of uropod 1 or on the proximoventral margin ahead of uropod 1; occasionally 2 setae occur there.

DORSAL TEETH. — In *Paradexamine* pleonites 2-3, apparently always in adults, and occasionally pleonite 1 and pereonites 5-7 may have a single mediodorsal tooth and 2 lateral teeth, 1 on each side; these apparently develop sequentially forward from pleonite 3, so that adults of a species with many teeth will show stages of development toward the head as growth proceeds. A fixed number of teeth apparently occurs in terminal adults, as several species seemingly never develop teeth on pleonite 1 no matter what stage their maturity. Teeth may not develop evenly, as some species may have a dorsal tooth without laterals, and others, a lateral tooth without dorsals. Tooth formulae are thus of specific value only if one can judge with fair precision the maturity of individuals. Pleonite 4 always has a dorsal tooth but often lacks the laterals; the lateral teeth on all segments generally are part of a lateral ridge, which on pleonite 4 usually bears a proximal spine; in those species lacking the lateral tooth and ridge on pleonite 4 the spine may remain. Pleonites 5-6 (fused) have lateral ridges

bearing 2 dorsal spines in tandem on each side in all of the species I have seen, but the literature contains species in which these spines do not occur; possibly they were overlooked. In the ordinary members of *Paradexamine* the dorsal teeth point posteriorward, but in an occasional species the dorsal members may point dorsad, especially those of pleonites 3-4, and in a few species the dorsal tooth is slightly anterior to the laterals. The teeth may be very blunt, or extraordinarily lumpy, or rarely subrugose.

PLEONITES IN *Guernea*. — In the subgenus *Prinassus*, weak and sharp dorsal teeth may occur on the metasome and posteriorly on the pereon, but in other members of *Guernea* these segments are dorsally smooth; in *Prinassus* pleonite 4 bears a large reverted cusp, but in other guerneas it is dorsally rounded, or slightly keeled, or has a pair of crests. Pleonites 5-6 (fused) are tall in *Guernea* and form a pair of lateral crests with a deep hollow between them; the crests may have a dorsal notch where the old segmental line between 5 and 6 is apparent, or they may be smooth, occasionally with 1 spine or deeply notched and spinose; in one species the central hollow has numerous setae; the projection of the urosome at the base of uropod 3 may also be specifically characteristic.

CUTICLE. — In *Paradexamine* it is fairly clear but does have a weak pattern of spicules, villi, setules, ridges; but these have not been studied specifically in *Paradexamine*, except where definite crescents occur so prominently as to be of specific value. In *Guernea* the surficial sculpture pattern is so gross that it has been studied specifically and has been found to differ among the several species as far as known; the texture may be primarily polygonal, with the cells having thin walls, or it may be mainly circular with thick walls (appearing as round pits scattered on a flat surface). The sculpture often is well developed on the coxae and the bases of pereopods 3-5, and it may be composed of slightly enlarged units on males. Depending upon the preservative, surficial patterns apparently disappear in aged preserved specimens.

VARIABILITY. — In the characters discussed above, intraspecific variations appear to be most frequent in the pereopods and the antennae. The precise ratio in lengths of articles in antennae and pereopods is unreliable as specific criteria, but undoubtedly it will become useful when life histories are fully known. The numbers of spines in spine groups usually increase in number with increased body size, but in a few species they may decrease in number in gerontic stages (*P. flindersi*). Article 5 of pereopod 5 often increases in length in relation to other articles. The widths and degree of ornamentation on article 2 of pereopods 3-5 may change with increased body size. The inner plate of the maxilliped changes radically in gerontic specimens of *P. flindersi*.

The number of dorsal teeth on the pereon and pleon generally increases with age up to sexual maturity. These develop first dorsally, then laterally, then commence on the next segment forward of pleonite 3 until the maximum specific number is reached. Many species never develop teeth anterior to pleonite 2. Teeth in juveniles 2.0 mm or smaller are often so rudimentary as to be useless in specific identification. Indeed, the identification of species in these genera is presently impossible in juvenile stages except by association with adults or in the case of special unique characters such as absence of mandibular spines.

MALES. — The characters of males are recapitulated since males differ more or less strongly from females in *Guernea* and *Paradexamine*. The overall appearance of males suggests a thinner more streamlined body than that found in females, with anterior pereonites more or less shortened relative to those of the metasome, which become enormously enlarged, especially in *Guernea*, along with their pleopods, possibly in relation to an improved swimming function. The change in segments correlates with changes in coxal widths. The eyes become enlarged, the antennae elongate, setulose, and spines found in the female are often lost. Gnathopods in *Paradexamine* become thinner or more elongate; uropod 3 may develop swimming setae, but these also may be found in some females of *Paradexamine*. Males occasionally may have shorter maxillipedal palps than do females, and maxilla 2 may be distinct between the sexes, though this problem is not yet clarified. Possibly, cones on the lower lip differ in certain species from female to male.

Males of many species are poorly elucidated presumably because the majority of fully developed males occurs in the neritic nekton and they have not yet been collected and matched with the benthic females. There are probably numerous morpho-

logical tangles to be elucidated in terminal and transforming males.

NOTES ON ILLUSTRATIONS. — Specimens of *Paradexamine* have articles 3-5 of the peduncle on antenna 2 turned on edge, facing the observer, so that drawings of the head, with antennae attached, do not show the full thickness of the peduncle of antenna 2; occasionally, this is flattened and redrawn; flagella generally have been flattened to show their full widths.

Subtle variations in degree of roundness, truncation, or slight invagination of the upper lip have been ignored in the various species.

Parts like the lower lip, maxillipeds, and uropod 3 have been mounted on excessively wet slides (glycerine) and the cover slip slowly squeezed during observation under the compound microscope until the part is just caught but not squeezed by the cover slip; hence, outer plates of maxillipeds and rami of uropod 3 are not completely flattened, and these have a strong curl longitudinally, the hollow occuring on the side toward the observer (as drawn throughout this paper). Epimeron 1 of the pleon and, to some extent, epimeron 2 are slightly rolled mesiad and have not been flattened in these drawings. The palps of maxilla 1 and the maxillipeds are drawn in flattened conditions, or nearly so, or in far flatter condition than normal to the animal; after the basal plates are drawn, the cover slip is further depressed until the palps become as flat as possible without obvious proportional changes occurring. Apical ends of pereopods 3-5, from article 6 onward, generally are twisted to point laterally and these are flattened in the drawings; the dactyl tends to point either forward or backward when the appendage is slightly pressed by the cover slip; the base of article 6 resembles the ball of a ball-and-socket joint in mammals. Pleopods generally are omitted from lateral drawings to avoid obfuscation of epimera. When seen laterally, gnathopod 2 is generally held lateral to gnathopod 1, pereopod 1 lateral to gnathopod 2, and pereopod 2 lateral to pereopod 1. Almost all preserved specimens have antenna 1 slightly disjointed from the head; this presumably is unnatural. Many preserved specimens have the rami of uropods 1-2 shriveled, curled, or damaged, and these often are omitted from drawings. I have found no significant taxonomic characters in these rami in *Paradexamine,* but apical spine formulae have not been studied extensively. In *Guernea* these do have significant taxonomic characters.

## DEXAMININAE

### *Delkarlye,* new genus

DIAGNOSIS. — Ocular lobe of head rounded; accessory flagellum a small cube with 3 setules; mandible small for member of Dexaminidae, mandibular molars obsolescent, forming smooth, low, broad hump, lacking setae, incisor toothed, lacinia mobilis present, spine present, palp absent; inner lobes of lower lip distinct, mandibular lobes large, extended, blunt; palp of maxilla 1-uniarticulate; inner plates of maxilliped small, bearing 1 long seta each, palp 3-articulate; pereopods 3-4 heavily prehensile, other pereopods slightly so; coxae not acuminate or bifid, coxa 5 shorter than 4 and not enlarged; body lacking side teeth, pleonite 4 with low dorsal hump; only pleonites 5-6 fused together.

ADDITIONAL UNUSUAL CHARACTERS (not cited in diagnoses of other dexaminid genera). — Anterior portion of head between antennae with wide keel projecting as far as rostrum; upper lip heavily lobate anteriorly and matched by epistome; 1 spine on mandible fused to body of appendage; gnathopod 1 nearly typical of dexaminids but more like that of certain oedicerotids, hand narrow, palm transverse, gnathopod 2 extraordinary, hand with thin extended and rounded flange forming palm, lined with numerous long spines, medial face of hand without setae or spines, dactyl strongly curved and flagellate; pereopod 5 extremely short, only about 60-65 percent as long as pereopod 4; inner rami of uropods 1-2 strongly shortened; telson highly parabolic and lacking spines; pleonites 5-6 (fused) lacking dorsal spines.

PRONUNCIATION. — "Del-Kar-lee."

TYPE-SPECIES. — *Delkarlye enamalla,* new species.

RELATIONSHIP. — The type-species of this genus belongs in the Dexamininae because pereopods 3-5, though diverse, contain a different measure of diversity than found in Prophliantinae. Pereopod 5 is extremely short but otherwise not structurally dissimilar to pereopod 4, nor to pereopod 3. Gnathopod 1 does not have a bend at the base of article 2, so common to prophliantins. Like one species

of *Guernea (G. gelane), Delkarlye enamalla* has shortened inner rami of uropods 1-2, but, otherwise, *Delkarlye* does not appear to be related to *Guernea*.

In the Dexamininae, *Delkarlye* probably has its closest affiinities to the various species of *Syndexamine*, and it may be a highly advanced product of that genus, but the unusual characters cited in the diagnosis, plus the loss of one article on the palp of the maxilliped, suffice very well to separate *Delkarlye* from all members of *Syndexamine*. The loss of all spines on pleonites 5-6 is a strong departure from similar dexaminid genera such as *Syndexamine, Paradexamine,* and *Dexamine,* but this situation is common to the more primitive dexaminids such as *Atylus*. The bulbous protrusion of the upper lip and the midantennal cephalic keel also are unusual features.

In *Syndexamine, Delkarlye enamalla* appears closest to *S. nuttoo,* new species, mainly because of the mandibular incisor, cuticle, lower lip, and inner plates of the maxilliped.

Perhaps the most difficult generic distinction to make is that between *Delkarlye* and *Dexaminella* Schellenberg (1928), because so many characters stated verbally in the two diagnoses are similar. Both have a 3-articulate maxillipedal palp, both lack side teeth on the segments, both have elongate pereopodal dactyls, and, in addition, *Dexaminella* appears to have the rudiments of several characters fully expressed in *Delkarlye;* for example, the gnathopods of *Dexaminella* have curved and slightly flagellate dactyls, but *Dexaminella* is far more like *Paradexamine* than it is like *Syndexamine* and *Delkarlye* in the pointed ocular lobes of the head, the equally thin and elongate antennae, the elliptical telson (in contrast to the parabolic), the wide and heavily serrate article 2 of pereopods 3-5, the large and laterally visible gland cone. Furthermore, *Dexaminella* has an unusual mandible, which appears to be composed of a large columnar molar and a flabellate incisor lacking spines and lacinia mobili.

### *Delkarlye enamalla,* new species

FIGURES 15–17

DIAGNOSIS. – With the characters of the genus.

DESCRIPTION. – Based on one female 3.2 mm, and her hatched juvenile, 0.90 mm, completely filling her brood pouch; antenna 1 extremely large, cylindrical, article 2 bearing ventral trough, allowing article 3 to be attached geniculately to article 2 and to be bent ventrally; antenna 2 small and slender, gland cone occurring mesially; head and pereonite 1 each with small dorsolateral hump on each side anteriorly; lacinia mobili and 1 spine fused solidly to body of mandible, unknown whether two parts form only lacinia mobilis or not, or whether both represent spines; one lobe of outer lip bearing 1 cone, other lacking cone; inner plate of maxilla 1 linguiform, naked; outer plate with 7 spines; dactyl of gnathopod 2 with long comb of spinules on medial face; coxa 1 with weak posterior seta; article 6 of perepods 1-2 slightly tumid, spines small but appendage not distinctly prehensile, though dactyl long and curved; pereopods 3-4 with article 6 falconiform, bearing proximal spined protrusion, dactyls long and curved; pereopod 5 very small, article 6 intermediate between that of pereopods 1-2 and that of pereopods 3-4; pereopod 3 with hump (like a gall with heavy cuticular divisions reminiscent of the dinoflagellate *Peridinium)* on article 5 similar to humps on head and pereonite 1 (consistent on both sides of animal); lateral face of peduncle on uropod 3 dorsally extended, inner ramus extremely flabellate; telson very broad subproximally (appearing squashed in Figure 17 but actually natural); cuticle bearing polygons of moderate development but especially well developed on epimera, coxae, and proximal articles of pereopods 3-4, polygons irregularly developed and of various sizes.

JUVENILE (0.90 mm). – Generally identifiable with adult because of similarities in uropods 1-2, gnathopods 1-2, upper lip, head, and coxae, but eye very small and unclearly discerned, and pereopods 3-4 with immensely elongate article 6, bearing only 1 spine on main protrusion, dactyls of pereopods 1-5 all immensely elongate, otherwise pereopods similar to adult except that flange on article 2 of pereopod 5 undeveloped. One may suggest that juveniles are born with articles 6-7 of pereopods 3-4 highly enlarged but that, as growth proceeds, these articles have a disproportionately low rate of size increase in comparison to the proximal articles of these pereopods. One may say the same about the setule at the posteroventral corner of

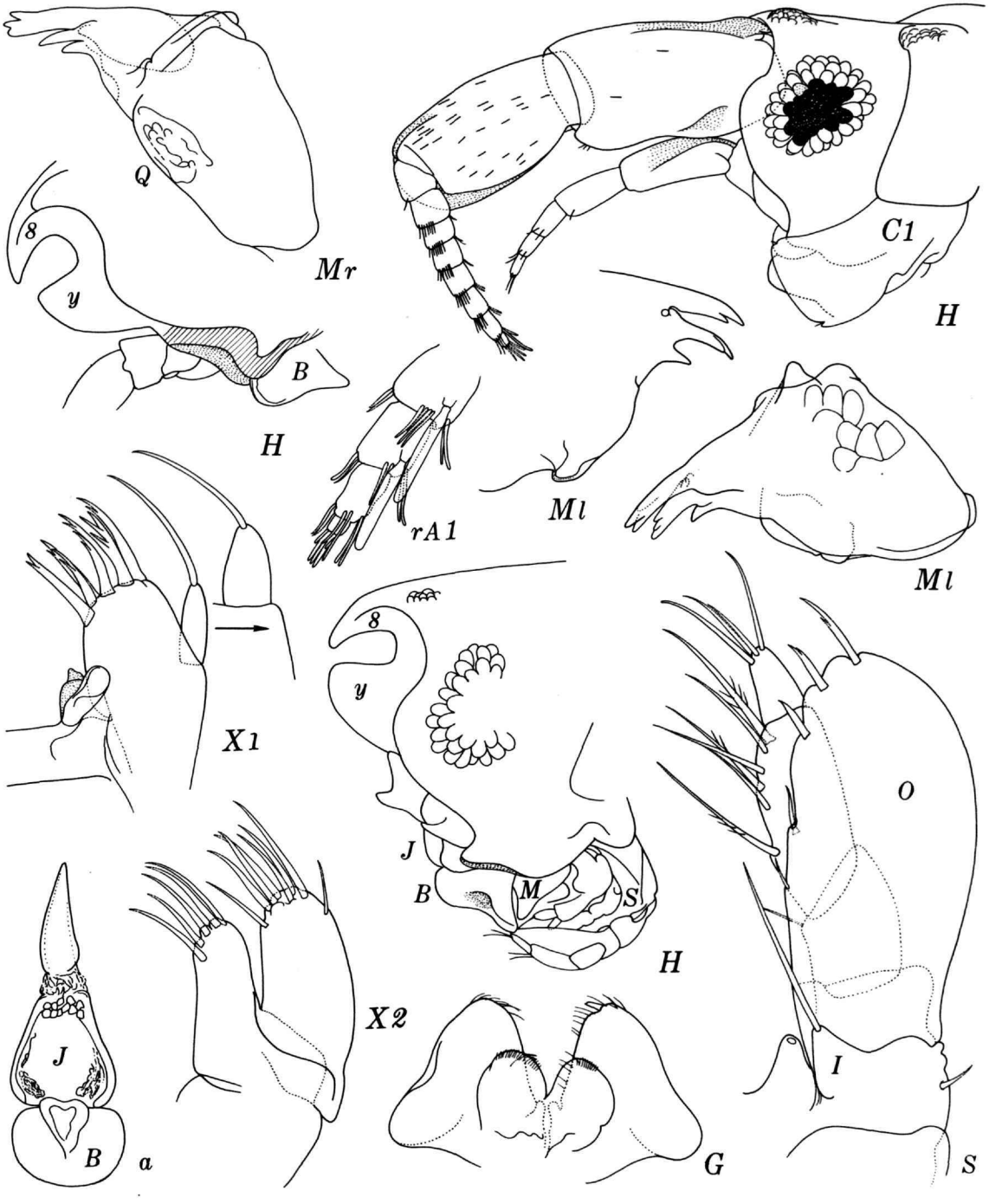


FIGURE 15.—*Delkarlye enamalla*, new genus, new species, holotype, female, 3.2 mm; *n*=juvenile, 0.9 mm; both from Shepherd 18. (*y*=keel of head.)

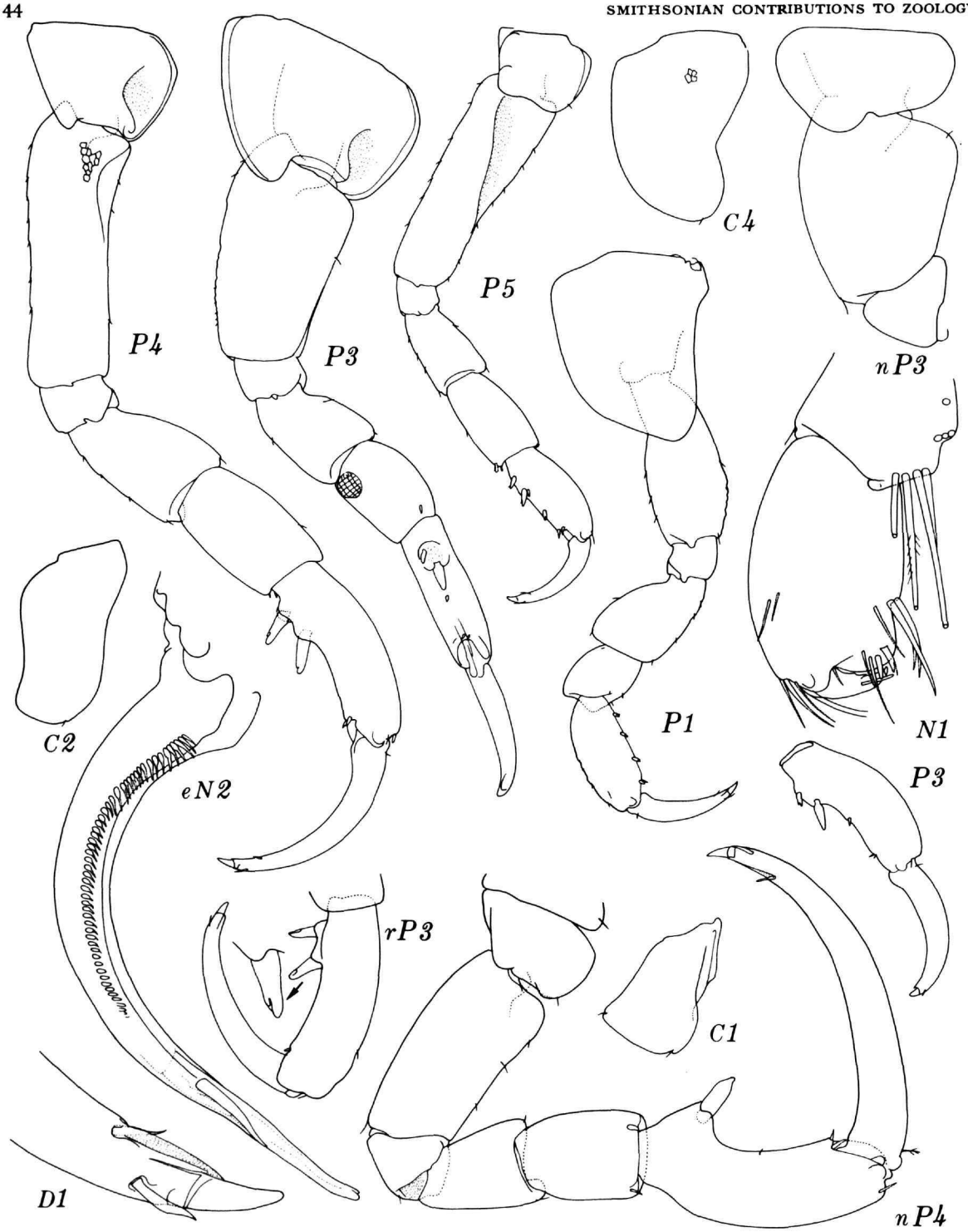


FIGURE 16.—*Delkarlye enamalla*, new genus, new species.

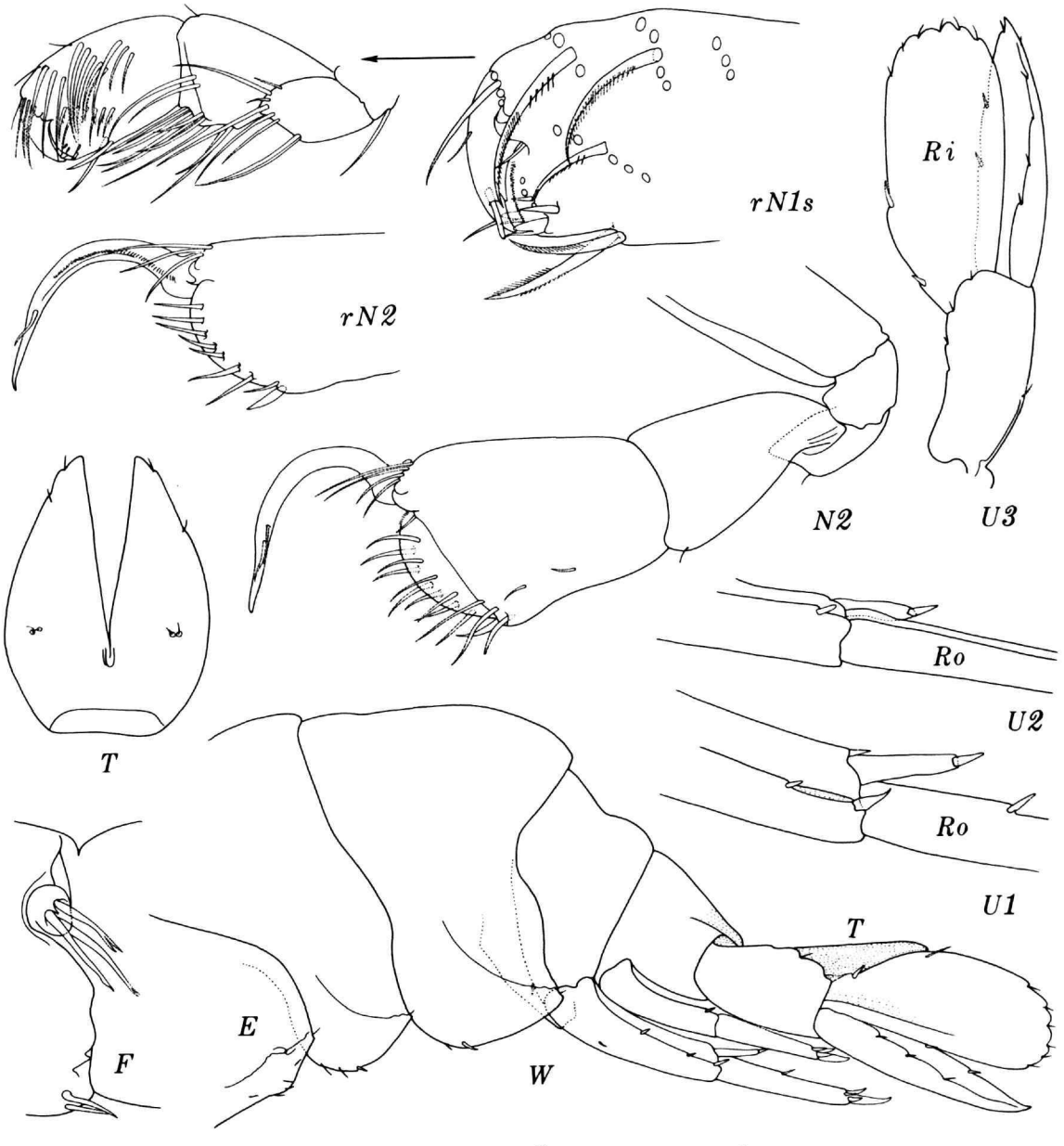


FIGURE 17.—*Delkarlye enamalla*, new genus, new species.

epimera 1-3, as it is as large as that found in the adult.

HOLOTYPE. – SAM, female, 3.2 mm.

TYPE-LOCALITY. – Shepherd 18, Toad Head, West Island, South Australia, 4 m, vertical face, in algae, 13 October 1968.

MATERIAL. – The holotype and her offspring.

DISTRIBUTION. – South Australia, sublittoral.

### *Paradexamine* Stebbing

*Paradexamine* Stebbing, 1899b:210–211.
*Dexaminoides* Spandl, 1923:87.

DIAGNOSIS (revised). – Ocular lobe of head never verticalized; accessory flagellum a small cube with 1 or more setules and aesthetascs; mandibular molars moderately triturative to nearly smooth, with or without ordinary setae and ragged setae, incisors multitoothed or simple, occasionally heavily cornified, rarely lacking spines, palp absent; inner lobes of lower lip distinct, mandibular lobes long to short, blunt to thin and curled; palp of maxilla 1 uniarticulate; inner plates of maxilliped vestigial to large, setae large or obsolescent, palp 4-articulate; pereopods generally simple, pereopods 3-5 generally similar to one another; coxae not acuminate or bifid; coxa 5 much shorter than coxa 4, body always with a few side teeth on posterior segments, pleonite 4 with sharp dorsal tooth; only pleonites 5-6 fused together.

TYPE-SPECIES. – *Dexamine pacifica* Thomson.

RELATIONSHIP. – In the expanded Dexaminidae (see J. L. Barnard 1970b), this genus must have statements about mandibular palp, urosome, telson, and head not heretofore necessary. The nearest genus appears to be *Dexamine* Leach, which occurs only in the Mediterranean and North Atlantic if one considers the high probability that *D. serraticrus* Walker (1904) (from Ceylon) is a member of *Paradexamine*. Walker did not describe or figure the mouthparts. *Dexamine* differs from *Paradexamine* in the 3-articulate maxillipedal palp, the vestigial inner lobes of the lower lip, and two of its 4 well-known species lack pleonal side teeth. Because they all have pointed ocular lobes and no side tooth on pleonite 4, they appear similar to group IIC of *Paradexamine*, but, like group IIB3j, they all have the telsonic lobes partially fused basally. Since the loss of maxillipedal palp article 4 would be presumed to be irreversible, the direction of evolution, if any, would appear to occur from *Paradexamine* toward *Dexamine*.

See "Taxonomic Characters in *Paradexamine* and *Guernea*" under "Dexaminidae."

#### KNOWN SPECIES AND PROBABLE NEW SPECIES

*alkoomie*, new species; Australia
*barnardi* Sheard, 1938; New Zealand
*barnardi* of Nagata, 1965; Japan
*churinga*, new species; Australia
*dandaloo*, new species; Australia
*echuca*, new species; Australia
*fissicauda* Chevreux, 1906; Antarctica
*flindersi* (Stebbing, 1888); Stebbing, 1910a; Australia
*flindersi* of Nagata, 1965; Japan
*flindersi* of Pirlot, 1938; Indonesia
*frinsdorfi* Sheard, 1938; Australia
*goomai*, new species; Australia
*houtete* J. L. Barnard, in press; New Zealand
*lanacoura*, new species; Australia
*linga*, new species; Australia
*marlie*, new species; Australia
*maunaloa* J. L. Barnard, 1970a; Hawaii
*miersii* (Haswell, 1885); Australia (unclarified)
*moorhousei* Sheard, 1938; Australia
*muriwai* J. L. Barnard, in press; New Zealand
*nana* Stebbing, 1914; Schellenberg, 1931; Antarctica
*narluke*, new species; Australia
*orientalis* Spandl, 1923, 1924; Red Sea
*orientalis* of J. L. Barnard, 1965; Micronesia
*otichi*, new species; Australia
*pacifica* (Thomson, 1879) (see synonymy herein); New Zealand
*pacifica* of Nagata, 1960
*quarallia*, new species; Australia
*ronggi*, new species; Australia
?*serraticrus* (Walker, 1904); Ceylon
*sexdentata* Schellenberg, 1931; Antarctica
*thadalee*, new species; Australia
*windarra*, new species; Australia

#### INTERRELATIONSHIPS OF SPECIES

The differences among species of *Paradexamine* in Australia, New Zealand, Hawaii, and Micronesia have been found to be based on such small and heretofore minor characters that the following taxa, not as yet clarified in many characters, cannot be discussed at present: *Dexamine miersi* Haswell (1885), *Dexaminoides orientalis* Spandl (1923), *Paradexamine nana* Stebbing (1914), and *P. sexdentata* Schellenberg (1931). The identifications by Nagata (1960, 1965) from Japan of *P. pacifica*, *P. barnardi*, and *P. flindersi* may represent species distinct from those in the southern hemisphere. The Micronesian species is *Dexaminoides orientalis* as identified by J. L. Barnard (1965).

The relationships of taxa that can be considered are developed in the following key from my concept of the general phyletic order, which is discussed immediately after the key.

Note that *P. flindersi* (Stebbing) is placed in section I, but if no side tooth really occurs on pleonite 4, the species falls into the same couplet of II, as *P. thadalee* and *P. dandaloo*, from which *P. flindersi* differs in many ways (see Stebbing, 1910a).

## Phyletic Key

I. Pleonite 4 with side tooth (ocular lobe always rounded; epimera generally lacking facial spines, at least facial spines not found in rows or clumps; head with strong anteroventral invagination for reception of antenna 2; mandibular lobes blunt, except *P. flindersi* and *P. alkoomie*; article 2 of pereopod 5 broad though occasionally beveled posteroventrally; maxilla 2 lacking facial setae on lobes).

A. Article 2 of pereopod 5 strongly beveled posteroventrally.

1. Coxa 3 with exaggerated posteroventral extension and angular anteroventral corner ..... *P. goomai*

1. Coxa 3 with poorly extended posteroventral corner and rounded anteroventral margin ..... *P. frinsdorfi*

A. Article 2 of pereopod 5 horizontally truncate or lobular posteroventrally.

2. Flagellum of female second antenna 4-articulate or less, and short.

a. Article 1 of antenna 1 with ventrodistal process and article 2 of pereopod 5 with protruding posteroventral lobe (also see male *P. narluke*) ..... *P. lanacoura*

a. Article 1 of antenna 1 lacking ventrodistal process and article 2 of pereopod 5 horizontally truncate.

b. Flagellum of female antenna 2 composed of 1 elongate article, article 2 of peduncle on antenna 1 with distal tooth, mandibular lobes of lower lip pointed and slightly curled ..... *P. flindersi*

b. Flagellum of female antenna 2 about 3- or 4-articulate, article 2 of peduncle of antenna 1 simple, mandibular lobes of lower lip blunt, straight.

c. Coxa 1 quadrate, coxa 3 posteroventrally extended grossly, anteroventral corner angular, peduncle of uropod 1 with gap in spines ..... *P. otichi*

c. Coxa 1 an asymmetrical triangle, coxa 3 not posteroventrally extended grossly, anteroventral margin rounded, uropod 1 with continuous dorsal spination.

d. Inner plate of maxilliped very short or obsolescent, gnathopodal palms oblique ..... *P. maunaloa*

d. Inner plate of maxilliped very large, gnathopodal palms transverse ..... *P. ronggi*

e. Flagellum of female second antenna more than 4-articulate, usually elongate.

e. Side teeth of pleonites 1-3 lobular, thick, blunt ..... *P. quarallia*

f. Coxa 3 with 2 posterior spines, telson with 2 apical spines on each lobe ..... *P. muriwai*

f. Coxa 3 lacking posterior spines, telson with 1 apical spine on each lobe.

g. Coxa 1 setose anteriorly, telson apically broad, peduncle of uropod 1 with gap in dorsal spination, palms of gnathopods transverse ..... *P. windarra*

g. Coxa 1 setose anteriorly, telson apically broad, peduncle of uropod 1 with scarce gap in dorsal spination, palms of gnathopods nearly transverse ..... *P. alkoomie*

g. Coxa 1 naked anteriorly, telsonic apices narrow, uropod 1 lacking gap in dorsal spination, palms of gnathopods oblique (only the male is known) ..... *P. narluke*

II. Pleonite 4 lacking side tooth (ocular lobe variable; epimera generally with rows of facial spines, except Micronesian species; head lacking strong definition at base of antenna 2; mandibular lobes of lower lip usually thin, sharp, and curled, except *P. fissicauda* and Micronesian species; article 2 of pereopod 5 not broadened; maxilla 2 bearing facial setae on outer lobe).

B. (See C below.) Ocular lobe rounded or quadrate anteriorly.

3. Mandibular lobes of lower lip blunt (telson not fully cleft, bearing pairs of lateral spines, apices narrow with 1 notch, body weakly to strongly covered with slit-pits, peduncle of uropod 3 with 2 apical spines, inner plate of maxilliped large) ..... *P. fissicauda*

3. Mandibular lobes of lower lip acute, curled.

h. Distalmost lateral margin of telsonic lobe not serrate.

i. Lateral spines on telson paired, telsonic lobe with high longitudinal crest, inner plate of maxilliped very small, dorsal teeth of pleonites 3-4 simple (body with slit-pits) ..... *P. thadalee*

i. Lateral spines on telson single in tandem, telsonic lobe lacking high crest, inner plate of maxilliped large, dorsal teeth of pleonites 3-4 serrate or divided (body with slit-pits) ..... *P. dandaloo*

h. Distalmost lateral beveled margin of telsonic lobe serrate.

j. Inner plate of female maxilliped small, article 2 of antenna 1 longer than article 1, gnathopod palms bluntly castellate, body without slit-pits ..... *P. churinga*

j. Inner plate of female maxilliped of medium size, article 2 of antenna 1 shorter than article 1, gnathopodal palms sharply and deeply serrate, body with slit-pits or setules ..... *P. echuca*

[Note: *P. nana* and *P. sexdentata* occur in this group.]

C. Ocular lobe with sharp anterior tooth.

4. Mandibular lobes of lower lip thick and blunt ..... Micronesian species

4. Mandibular lobes of lower lip thin, pointed, and curled.

k. Mandibular spines absent.

l. Mandibular incisor heavily cornified, thick and unserrate, peduncle of uropod 3 with 2 distal spines. *P. moorhousei*

**Phyletic Key (cont'd)**

l. Mandibular incisor not heavily cornified, thin and serrate, peduncle of uropod 3 with 1 distal spine. *P. barnardi* and *P. marlie*

k. Mandibular spines present, occasionally small.
m. Pleonite 1 developing teeth early in life, mandibular spines very thin and feeble ..... *P. houtete*
m. Pleonite 1 never developing teeth (except aberrantly), mandibular spines thick and normal.
n. Coxae 2-3 with 1 posterior spine each, peduncle of uropod 3 with 1 apical spine ..... *P. linga*
n. Coxae 2-3 naked posteriorly, peduncle of uropod 3 with 2 apical spines ..... *P. pacifica*
[Note: *P. orientalis* occurs in this group.]

No conclusion regarding the primitive state of any group of *Paradexamine* is implied in the order of the above phyletic key. One should note that no species with both a side tooth on pleonite 4 and an ocular tooth has evolved (or has been discovered yet). The relationships delineated in the specific descriptions that follow do not always include every paired relationship for every species; the reader should consult the "Phyletic Key" to discern the network of relationships.

The three main groups of species (I, IIB, IIC) do not yet imply any possibility of establishing subgenera as the various exceptions occur in group characteristics noted in the key. Mandibular lobes of lower lip are occasionally uncharacteristic, as are facial spines of epimera. There are undoubtedly other ways to arrange the taxa in terms of mandibular lobes, flagella of antenna 2, and anterior coxae, but so many species probably remain to be described that any further analysis will not prove valuable until these have been found.

The evidence that straight-line phyletic relationships occur in various groups or that characters do not mutate (in an evolutionary sense) from one alternative to another may be seen in the strong similarities between *P. thadalee* and *P. fissicauda,* in telsonic spine pairing and in slit-pits, but the mandibular lobes of the lower lip in the two species differ strongly. Similar evidence is also present in (1) *P. flindersi,* which has mutant mandibular lobes but which otherwise occurs in a group with blunt lobes; and in (2) the "Micronesian species" with blunt lobes otherwise placed in a group with thin curled lobes. An odd coxa 3 crops up in *P. otichi* and *P. goomai* that, with other characters, demonstrates their closeness in a statistical cluster, but the differences in their pereopod 5 and uropod 1, plus many other characters, tend to disperse these two species.

Whether groups I, IIB, and IIC each represent monophyletic flocks is open to question, especially on the basis of phenetic taxonomy, in which characters have no rank. One might thus consider *P. fissicauda* a member of group I, with only one character of difference: the loss of the side tooth on pleonite 4. The species is an aberrant member of group IIB because the mandibular lobes are blunt and straight and it has a slight anteroventral invagination of the head and the narrow telsonic lobes also characteristic (more or less) of group I. But it fits group IIB equally well because of the facial setae on maxilla 2, the thin article 2 of pereopod 5, the facial spines of the epimera, and because, like a few other members of group IIB never found in Group I, it has paired telsonic spines and a slight fusion of the telsonic lobes basally. *Paradexamine fissicauda,* therefore, forms a unit between the two clusters, but whether the loss of the side tooth of pleonite 4 came first or later cannot be decided.

By ranking the latter character, one judges it came first or it is a major character change. One then has to judge whether *P. fissicauda* could be closer to the basic stock of group IIB than to other species, like some of its siblings that share its unique characters, such as *P. churinga* or *P. thadalee* (indicated by cleft and spines of telson). As a bridge species, it will deserve great attention in further studies of the evolution of this genus.

One also may point to the Micronesian species (identified as *Dexaminoides orientalis* Spandl by J. L. Barnard, 1965) as a taxon that has lost the side tooth of pleonite 4, bearing acute ocular lobes, but that still bears the blunt mandibular lobes of group I, yet otherwise has affinities with *P. moorhousei* in mandibles. There is no way as yet to decide whether the direction of evolution has been the gain or loss of a side tooth, or of an ocular cusp,

or the change in mandibular lobes, nor whether the alternatives can be regained, once lost — or lost, once gained.

In conclusion, the scheme presented has the advantage of placing together pairs and triads of species considered to be siblings, and thus it demonstrates that flocks of species do occur in the genus, that clusters of species do occur, and that bridge or satellite species represent links between the clusters.

## Dorsal Pleonal Teeth

The number of dorsal pleonal teeth increases with growth in the juveniles of *Paradexamine,* but in adults the teeth remain fairly stable in their count. Juveniles of the few species known so far have rudimentary teeth on pleonites 4-5 similar to those in adults, but, anterior to pleonite 3, teeth are usually absent. In most species the dorsal tooth of pleonite 2 appears to develop first, then the 2 laterals, and then the sequence is repeated on pleonite 1 and on pereonite 7 (if that point is reached by the species in question). Some species, however, especially *P. moorhousei,* have lateral teeth developing before the dorsal tooth. The following formulae are those found so far in Australian species. The formulae are of occasional assistance in the identification of specimens known to be adult, but caution should be used because aberrancies and even the ranges of normal formulae are unknown in several of the rarer species. The species with the largest numbers of specimens examined in this study have been fairly consistent in tooth formulae: *churinga, frinsdorfi, lanacoura, moorhousei, quarallia.* The very large dorsals of *P. lanacoura* are especially noticeable, and the poorly developed teeth of *P. quarallia* represent the opposite extreme. The side teeth on pleonite 4 of *P. quarallia* are very difficult for one to see without mounting the specimen and examining it through a compound microscope, but the lobular side teeth of pleonites 2-3 make this procedure unnecessary. The odd situation on pleonite 1 of *P. moorhousei* is characteristic also of the majority of specimens.

To facilitate printing the formulae, I have quoted them from rear to front, commencing with pleonite 4 and progressing forward to pereonite 6. The six theoretical formulae not yet found on any Australian species are omitted. Number "3" means the segment has 1 dorsal and 2 side teeth; "2" means the dorsal tooth is absent and only the side teeth are present; "1" means only the dorsal tooth is present. *Paradexamine flindersi* (Stebbing) probably has lateral teeth on pleonite 4, since the species is otherwise similar to several species bearing these teeth.

## Dorsal Tooth Formulae

(Rear to front, commencing with pleonite 4)

| | |
|---|---|
| 3–3–3–3–3–1 | *frinsdorfi* |
| 3–3–3–3–3–0 | *alkoomie, frinsdorfi* |
| 3–3–3–3–2–0 | *windarra* |
| 3–3–3–3–1–1 | *?flindersi, lanacoura, otichi, ronggi, windarra* |
| 3–3–3–3–0 | *quarallia* |
| 3–3–3–1–0 | *narluke, quarallia* |
| 3–3–3–0 | *goomai* |
| 3–3–0 | juveniles of *goomai, quarallia* (and probably others) |
| 1–3–3–3–0 | *churinga* (females, rare, Victoria), *?moorhousei* |
| 1–3–3–2–0 | *?moorhousei* |
| 1–3–3–1–0 | *churinga* (Victoria) |
| 1–3–3–0 | *churinga* (Western Australia), *dandaloo, echuca, linga, marlie, ?moorhousei* (male) |
| 1–3–1–0 | *thadalee* |
| 1–3–0 | juveniles of *thadalee* |

The young male, in the process of changing from its female appearance and acquiring the male secondary characteristics, can be a difficult specimen to identify as it may actually lose some characteristic typical of the female and yet not definitely appear to be a male in other respects. For example, in Key B-1, couplet 2, following, the young male may lose the ventrodistal process on article 1 of antenna 1 before the specimen otherwise is easily recognizable as a male; therefore, it appears to be a female without that process, which is so misleading as to prevent exact identification. Specimens that do not readily fit the keys and their alternatives should be set aside temporarily until more observation is made, when perhaps some could be identified by a process of elimination discussed under "Identification." Many stages of transformation in the males of *Paradexamine* have yet to be described, and of course undiscovered species also may occur.

## Key to Females from Australia

(Males fit key occasionally. Alternatives for Keys B and C have been composed, so that the observer, depending upon his approach, may choose either; for example, he would not choose Key B-1 if the second antenna is missing on the specimen.)

### Basic Key

1. Ocular lobe of head with strong anterior points (see also *P. churinga* in Key C) ..... A
   Ocular lobe of head rounded or quadrate anteriorly ..... 2
2. Pleonite 4 with side tooth on each side ..... B-1 or B-2
   Pleonite 4 lacking side tooth ..... C-1 or C-2

### Key A

1. Incisor of mandible simple, thick, heavily cornified, peduncle of uropod 3 with pair of terminal spines ..... ***P. moorhousei***
   Incisor of mandible serrate, thin, not heavily cornified, peduncle of uropod 3 with only 1 terminal spine ..... 2
2. Mandible with thin, long spines, article 2 of pereopod 5 slightly broadened ..... ***P. linga***
   Mandible lacking spines, article 2 of pereopod 5 not broadened ..... ***P. marlie***

### Key B-1

1. Female antenna 2 flagellum short, usually shorter than article 4 of peduncle and usually 4-articulate (exceptions occur) ..... 2
   Female antenna 2 flagellum long, much more than 4-articulate ..... 5
2. Female antenna 1, article 1 with strong ventrodistal process, article 2 of pereopod 5 with posteroventral lobe broad and distinctly produced (not always), apex of telson with broad medial truncation ..... ***P. lanacoura***
   Female antenna 1, article 1 lacking ventrodistal process, article 2 of pereopod 5 with broad posteroventral lobe not produced, apex of telson with narrow medial cusp, bifid or rounded ..... 3
3. Female antenna 1, article 2 with distal tooth, flagellum of antenna 2 with 1 elongate article ..... ***P. flindersi***
   Female antenna 1, article 2 lacking distal tooth, flagellum of female antenna 2 about 3- or 4-articulate ..... 4
4. Coxa 1 quadrate, coxa 3 with strong anteroventral corner, posteroventrally extended strongly, peduncle of uropod 1 with spine gap, gnathopods not distinctly mitten shaped ..... ***P. otichi***
   Coxa 1 an asymmetrical triangle, coxa 3 with rounded anteroventral corner, posteroventrally extended weakly, peduncle of uropod 1 evenly spinose, gnathopods very small and mitten shaped ..... ***P. ronggi***
5. Article 2 of pereopod 5 without strong posteroventral protrusion ..... 6
   Article 2 of pereopod 5 with strong posteroventral protrusion ..... 8
6. Coxa 3 extended posteroventrally in exaggerated condition ..... ***P. goomai***
   Coxa 3 not so extended ..... 7
7. Coxa 1 with anterior setae, coxae 2-3 with posterior spines ..... ***P. frinsdorfi***
   Coxa 1 naked anteriorly, coxae 2-3 naked posteriorly ..... ***P. narluke***
8. Side teeth of pleonites 1-3 blunt, lobular ..... ***P. quarallia***
   Side teeth of pleonites 1-3 sharp ..... 9
9. Coxa 1 with anterior setae above halfway mark, coxa 2 with large posteromedial spine, cuticle smooth, tooth on article 2 of antenna 2 blunt and poorly protuberant, mandibular lobes of lower lip straight and blunt, inner plate of maxilla 2 broad ..... ***P. windarra***
   Coxa 1 with no anterior setae above halfway mark, coxa 2 with very small or no setae posteromedially, cuticle with weak crescents, tooth on article 2 of antenna 2 sharp and protuberant, mandibular lobes of lower lip thin and curled, inner plate of maxilla 2 very thin ..... 10

10. Posterior spines on article 6 of pereopods 1-2 closely crowded apicalward, epimeron 2 lacking facial spines, apices of telson broad, with about 7 serrations ..... ***P. alkoomie***
Posterior spines on article 6 of pereopods 1-2 not closely crowded, epimeron 2 with facial spines, apices of telson narrow, with 3-5 poorly formed serrations ..... ***P. narluke***

### Key B-2

1. Article 2 of pereopod 5 with definitely protruding posteroventral lobe ..... 2
Article 2 of pereopod 5 without protuberant posteroventral lobe ..... 4
2. Side teeth on pleonites 2-3 blunt ..... ***P. quarallia***
Side teeth on pleonites 2-3 sharp ..... 3
3. Epimeron 3 with at least 8 long setae ..... ***P. lanacoura***
Epimeron 3 with fewer than 8 long setae, or setae short ..... couplets 9-10 of B-1
4. Coxa 3 ventrally and strongly extended posteroventrally, deeply serrate ..... 5
Coxa 3 of ordinary dimensions, rectangular, poorly serrate ..... 6
5. Rostrum blunt, female antenna 2 flagellum elongate, coxae 2-3 with posterior spine, peduncle of uropod 1 with continuous spination ..... ***P. goomai***
Rostrum sharp, female antenna 2 flagellum very short, coxae 2-3 posteriorly naked, peduncle of uropod 1 with gap in spination ..... ***P. otichi***
6. Palms of gnathopods highly oblique ..... 7
Palms of gnathopods transverse ..... 8
7. Coxa 1 with anterior setae, epimeron 2 lacking side spines, pleonite 1 with tooth. ***P. frinsdorfi***
Coxa 1 lacking anterior setae, epimeron 2 with side spines, pleonite 1 lacking tooth. ***P. narluke***
8. Article 2 of antenna 1 with distal tooth, flagellum of antenna 2 short and formed of 1 long article ..... ***P. flindersi***
Article 2 of antenna 1 lacking distal tooth, flagellum of antenna 2 short but formed of 3 articles ..... ***P. ronggi***

### Key C-1

1. Telson smooth lateral to apical spine, first lateral spine not highly distad ..... 2
Telson serrate lateral to apical spine and first lateral spine highly distad ..... 3
2. Dorsal teeth of pleonites 3-4 bifid or trifid, lateral telsonic spines single ..... ***P. dandaloo***
Dorsal teeth of pleonites 3-4 simple, some lateral telsonic spines occurring in multiple groups of 2-3 ..... ***P. thadalee***
3. Cuticle with slit-pits or setules, inner plate of maxilliped medium, article 2 of antenna 1 (female) shorter than article 1 ..... ***P. echuca***
Cuticle smooth, or bearing setules (no slits), inner plate of maxilliped obsolescent, article 2 of antenna 1 (female) longer than article 1 ..... ***P. churinga***

### Key C-2

1. Dorsal teeth of pleonites 3-4 multifid ..... ***P. dandaloo***
Dorsal teeth of pleonites 3-4 simple ..... 2
2. Article 2 of antenna 1 shorter than article 1 (slit-pits present) ..... ***P. echuca***
Article 2 of antenna 1 longer than article 1 ..... 3
3. Pleonite 2 usually bearing side teeth, rostrum attenuate and sharp, slit-pits absent. ***P. churinga***
Pleonite 2 usually lacking side teeth, rostrum blunt or short, slit-pits present ..... ***P. thadalee***

### Identification

Besides the phyletic key to *Paradexamine,* another list of recognition characters for Australian species is given below. This list is useful for rapidly recalling special features in a limited number of species contained in each category, and it is especially helpful in making rapid identifications of large amounts of material wherein specimens may be broken and certain attributes lost. Generally, one uses the list in a negative sense; for example, one may have a specimen similar to *P. lanacoura,* but if the rostrum on the specimen is blunt, *P. lanacoura* is ruled out because it is listed under item 1 with a sharp rostrum.

In a positive sense, a useful way is to check the rostrum on the specimen first and then narrow the identification to the six species under the category of "rostrum sharp." If the specimen is a female and antenna 1, article 1, has a protrusion that item 3 shows is present in *P. lanacoura,* one also finds *P. echuca* and *P. churinga* in this group. But, three species of item 1 are already eliminated. If the flagellum of antenna 2 is short (item 5), the final two species are eliminated, leaving *P. lanacoura* as the best choice. It is then wise to check the remaining characters on the specimen for which *P. lanacoura* is positive or negative.

### Unusual Characters Found in Certain Australian Species

(Parentheses indicate borderline cases)

1. Rostrum sharp: (*alkoomie*), *churinga, echuca, flindersi, lanacoura, otichi, rongii,* (*quarallia*).
2. Article 2 of antenna 1 not longer than article 1: *dandaloo, echuca, flindersi,* (*goomai,* almost), (*quarallia,* almost).
3. Article 1 of antenna 1 with strong ventrodistal protrusion in female: (*churinga*), (*echuca*), *lanacoura,* (*windarra*).
4. Article 2 of antenna 1 with ventrodistal protrusion in female: *flindersi.*
5. Flagellum of antenna 2 very short (4 articles or less): *flindersi, lanacoura, ronggi, otichi.*
6. Mandibular incisor untoothed and heavily cornified: *?moorhousei.*
7. Mandibular spines (in spine row) vestigial or absent: *marlie, ?moorhousei.*
8. Mandibular lobes of lower lip sharp and thin and usually curled or curved apically: *alkoomie, churinga, dandaloo, echuca, flindersi, linga, marlie, ?moorhousei,* (*narluke*), *thadalee.*
9. Inner plates of maxilliped very small: *alkoomie, churinga, lanacoura, narluke, quarallia, thadalee, windarra.*
10. Coxa 1 setose anteriorly: (*alkoomie*), *frinsdorfi, goomai, lanacoura,* (*linga*), *otichi,* (*quarallia*), *rongii, windarra.*
11. Coxa 1 with anterior protuberance: *alkoomie, frinsdorfi.*
12. Coxae 2-3 lacking stout posterior spine(s): *alkoomie, ?moorhousei* (setae), *narluke, otichi, quarallia, ronggi,* (*windarra,* absent on coxa 3 only).
13. Coxa 3 grossly extended posteroventrally: *goomai, otichi.*
14. Palms of gnathopods transverse: *flindersi,* (*goomai*), *lanacoura, otichi, ronggi, windarra.*
15. Article 2 of pereopod 5 with posteroventral lobe actually protruding ventrally: *alkoomie,* (*lanacoura,* weak), (*narluke*), *quarallia, windarra.*
16. Peduncle of uropod 1 with long gap between dorsolateral spines: (*flindersi* is unknown), *otichi, windarra,* (weak gap occasionally occurs in specimens of *churinga, quarallia, thadalee*).
17. Distal spine position on peduncle of uropod 3 paired (2 spines side by side at distolateral apex of peduncle): *churinga,* (*echuca* is unknown), *?moorhousei.*
18. Lateral margins of telson with serrations toward apical end: *churinga, echuca.*
19. Lateral spines of telson paired or in multiples (in bundles of 2 or more side by side): *thadalee.*
20. Only species so far reported with a dorsal tooth on pereonite 7 in adults: *alkoomie, flindersi, frinsdorfi, otichi, ronggi, windarra.*
21. Only species so far reported with a dorsal tooth on pleonite 1 in adults: *alkoomie, flindersi, frinsdorfi, lanacoura, ?moorhousei* (occasionally), *narluke* (weak), *otichi, quarallia, ronggi, windarra.*
22. Pleonite 1 believed to lack tooth at all times: *churinga, dandaloo, echuca, goomai, linga, marlie,* (*?moorhousei,* occasionally), *thadalee.*
23. Dorsal teeth of pleonites 3-4 multifid: *dandaloo.*
24. Dorsal teeth of pleonites 2-3 rounded (especially the side teeth): *quarallia.*
25. Dorsal teeth of pereonite 7 rounded (especially the side teeth): *alkoomie.*
26. Facial spine rows present on epimera 2-3: *churinga, dandaloo, echuca, linga, marlie, ?moorhousei, narluke, thadalee.*
27. Eight or more very long setae on posterior margin of epimeron 3: *lanacoura.*
28. Cuticle with texture other than smooth or villose or spiculate, generally composed of slits or slit-pits or crescents and especially apparent on article 2 of pereopod 3: *alkoomie, dandaloo,* (*echuca,* weak), (*flindersi* is unknown), *narluke, thadalee.*

### Sorting Sequence in VicFish Samples from Western Port

The seven most common species of *Paradexamine* in Western Port have been identified by use of the following sorting sequence; the sequence delimits

the extent of error in making rapid identifications of large numbers of specimens. All points of identification can be seen under a dissecting microscope except for cuticular pits and telsonic serrations, which can be verified rapidly by placing the specimen in a depression slide filled with alcohol, placing a wet (from alcohol) cover slip over the specimen, and observing cuticle and telson under medium power of a compound microscope. Cuticular pits and setae are best seen on coxa 5 and article 2 of pereopod 3; the specimen can be rotated slightly by moving the cover slip to obtain a view of the apicolateral margin of the telson; the latter is often missing on specimens collected by mass methods.

1. Gnathopodal palms transverse and hands large, pleonites usually with very large dorsal teeth (check presence of long setae on epimera, sharp rostrum, and presence of side tooth on pleonite 4) ..... *P. lanacoura*
2. Gnathopodal palms oblique or hands small, pleonites with medium to small dorsal teeth.
3. Side teeth of pleonites blunt ..... *P. quarallia*
4. Side teeth of pleonites sharp.
5. Ocular lobe pointed (check heavy mandible with untoothed incisor) ..... *P. ?moorhousei*
6. Ocular lobe quadrate or rounded.
7. Side tooth present on pleonite 4 ..... *P. frinsdorfi*
8. Side tooth absent on pleonite 4.
9. Ocular lobe quadrate (rarely rounded), cuticle lacking slit-pits and setules very sparse or absent, inner plates of maxillipeds small, telson with apicolateral serrations ..... *P. churinga*
10. Ocular lobe rounded, cuticle with slit-pits or many setules.
11. Inner plates of maxillipeds small, telson smooth apicolaterally ..... *P. thadalee*
12. Inner plates of maxillipeds large, telson serrate apicolaterally ..... *P. echuca*

### *Paradexamine alkoomie*, new species

FIGURES 18–20

DESCRIPTION (of female-like specimens).—Lateral cephalic lobe rounded, thick, head with distinct anteroventral definition at base of antenna 2, rostrum medium to small and weakly pointed; article 1 of antenna 1 lacking ventral protrusion, bearing 3 long spines in tandem, article 2 about 1.5 times as long as article 1, apically simple and bearing several long ventral spines, flagellum about 1.25 to 2.0 times as long as peduncle; flagellum of antenna 2 about 1.3 to 1.5 times as long as peduncle, peduncular articles 4-5 with many long spines, article 3 especially produced ventrally; mandibles with large spines, 2 on right, 3 on left, molar heavily triturative, accessory bulges numerous and blunt, both molars with ordinary setae, and 1 ragged seta; outer lobe of lower lip with 5-6 medium cones, mandibular lobes tapering and apically curled; palp of maxilla 1 small, shorter than outer plate, narrow, bearing 2 apical setae and rounded cone, inner plate thin, naked; plates of maxilla 2 narrow, appressed, curved inner plates reaching about 75+ percent along outer, inner with subtruncate apex and 4 setae; inner plates of maxilliped vestigial, each bearing 2 spinules, outer plate large, bearing bifid spines, palp thin and small, scarcely exceeding outer plate, palp article 4 of medium elongation: coxa 1 with slight anterior bulge near mark 65, below that tapering and bearing anterior setae below bulge, coxae 1-3 lacking posterior spines, coxae otherwise of ordinary dimensions, well setose ventrally, 5-6 with thin ventral spines; gnathopods large, elongate, gnathopod 1 with article 6 about 0.82 times as long as article 5, about 0.72 times on gnathopod 2, fifth articles of medium width, expanding apically, palms oblique but weakly so, extremely finely castellate, dactyls smooth proximal to main inner tooth, palmar faces on gnathopod 1 with oblique row of 2 pectinate and 3 simple setae, anteriorly with 2 sets of 4 and 3 setae, on gnathopod 2 oblique row with 1-2 pectinate and 2-3 simple (total 3-5) setae, anterior sets with 3 and 1 setae each; pereopods 1-5 very thin distally, spines generally sharp, but spine sets on articles 4-5 with several sausage-shaped, tumid spines with granulated matrix, appearing finely spotted, ratio of articles 4-7 on pereopods 1-2 about 18:21:24:12; article 2 of pereopod 3 of medium breadth, with regular posteroventral lobe; article 2 of pereopod 4 circulopyriform, posteroventral lobe well developed but bearing only setules; article 2 of pereopod 5 ovatopyriform, posteroventral region with large spinose lobe, posterior margin deeply serrate, ratio of articles 4-7 about 20:38:26:11; pleonal epimera 1-2 with lateral ridge, epimeron 1 with tiny posteroventral tooth, epimera 2-3 with medium to long tooth, epimeron 3 especially serrate posteriorly and bearing rudimentary setae, epimeron 1 with 1-2 anteroventral spine (s) or 1 seta instead of spine, epimeron 2 with 5

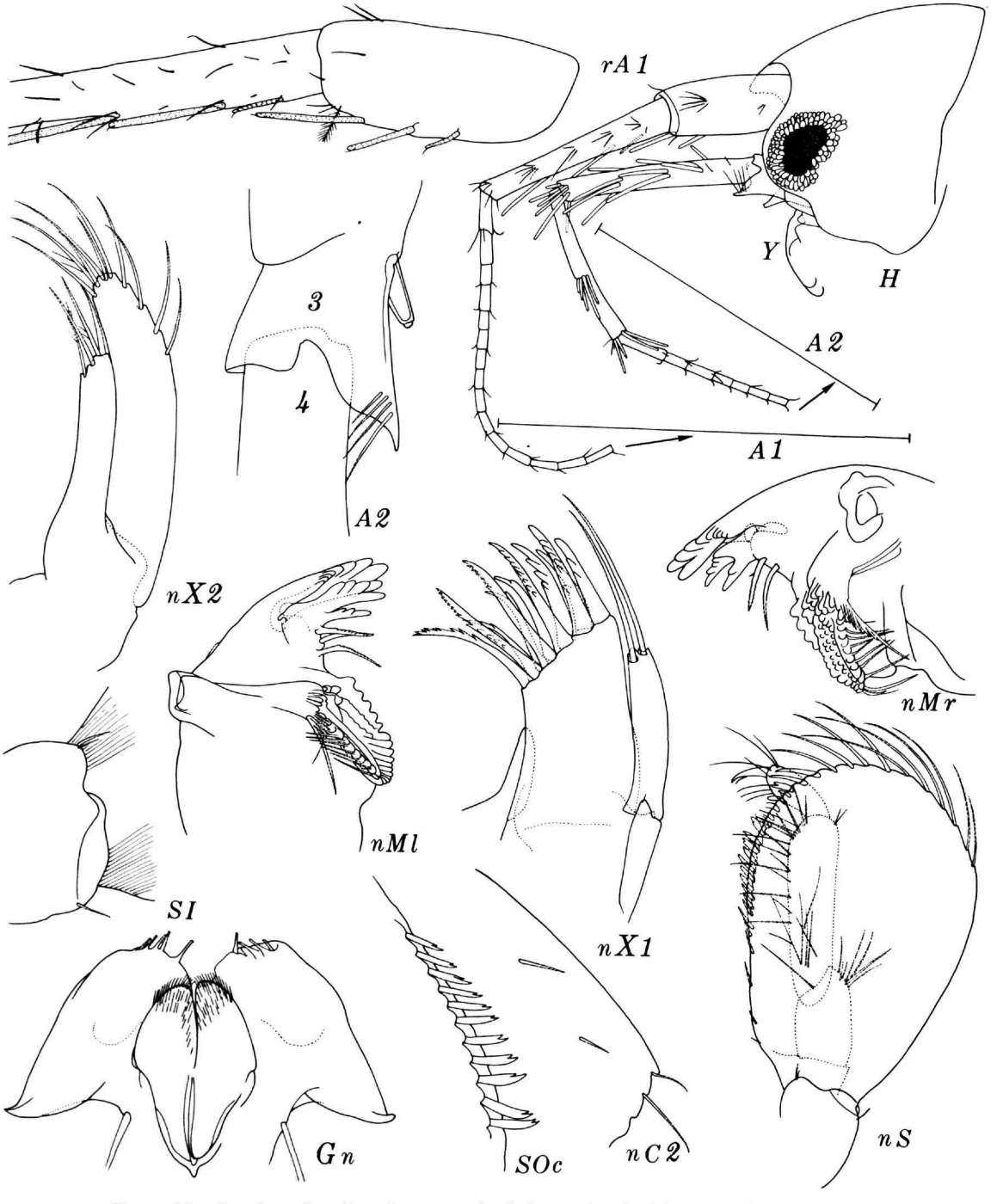


FIGURE 18.—*Paradexamine alkoomie*, new species, holotype, female, 4.9 mm; *c*=female, 4.2 mm; *n*=male, 4.1 mm; all from Shepherd 30. (*v*=sternum of pereon.)

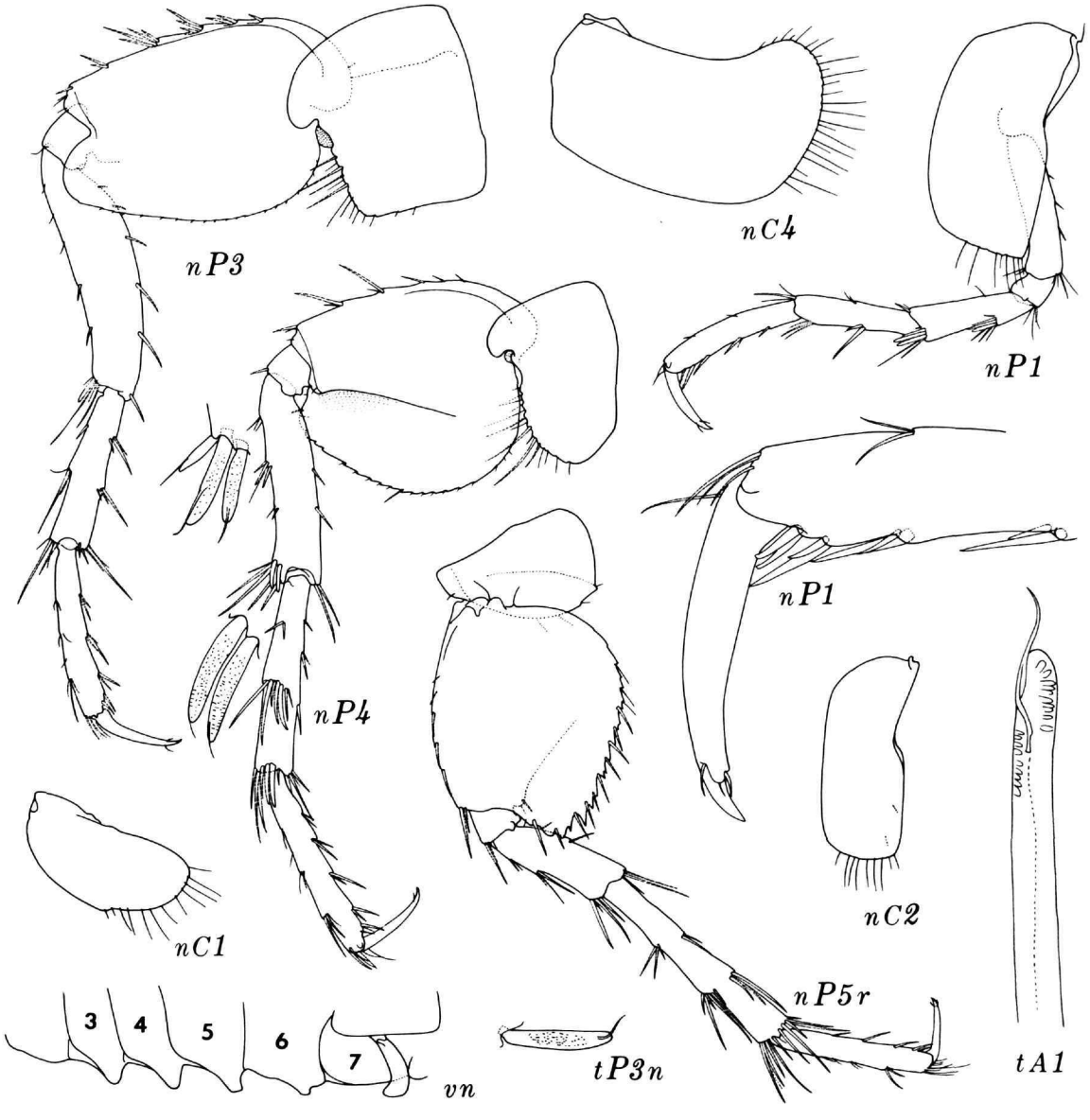


FIGURE 19.—*Paradexamine alkoomie*, new species.

ventral spines, epimeron 3 with 6 ventral spines, no facial spines; pereonite 7 with 3 lobular teeth dorsally; pleonites 1-4 each with 3 sharp teeth, dorsomiddle tooth low, pleonite 4 with spine on lateral ridge, pleonites 5-6 (fused), with 2 short spines in tandem on each side; dorsal margin of peduncle of uropod 1 evenly spinose or almost so, small apparent gap near apex according to interpretation, lateral base of peduncle with 2 spines; uropod 3 far exceeding apex of telson, rami of uropod 3 bearing only spines; telson flat, apices of medium breadth, each with about 7 serrations and 1 small apicolateral spine, lateral margins with 5-6 medium spines in tandem, none paired; cuticle

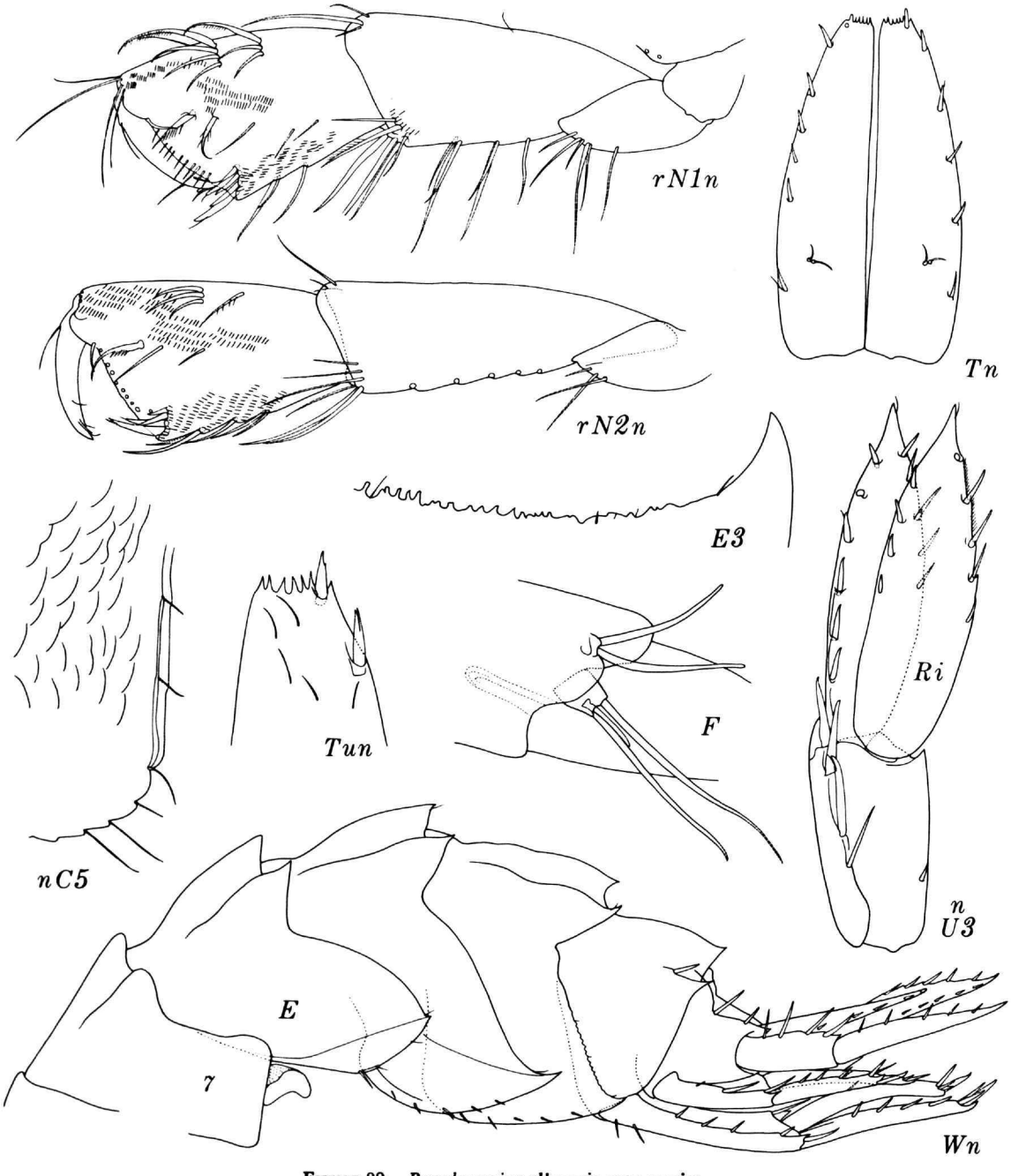


FIGURE 20.—*Paradexamine alkoomie*, new species.

of epimera, middle coxae, article 2 of pereopod 3 covered with weak crescent slits, setules extremely rare.

VARIATIONS AND ILLUSTRATIONS. — Posterior spines on article 6 of pereopods 1-2 closely crowded toward apex; flagella of antennae on view of head drawn mainly as straight lines to show true lengths; illustration of gnathopod 2 from medial surface converted from left-sided appendage; the 4.1 mm specimen from Shepherd 30 has both penial processes and brood plates but otherwise retains the apparently normal female characteristics, though it is highly unique in the materials of *Paradexamine* from Australia in having sternal teeth (Figure 19*vn*) especially on pereonites 3-6; in the figure, pereonite 7 has 1 penial process, shaped like a boomerang, hanging ventrad.

HOLOTYPE. — SAM, female (ovigerous), 4.9 mm.

TYPE-LOCALITY. — Shepherd 30, Pearson Islands, South Australia, station B, 15-40 feet, algae, 8 January 1969.

RELATIONSHIP. — This species and *P. narluke* may be synonymous; the single male of *P. narluke* is small and comes from Western Australia, whereas *P. alkoomie* is based on 5 large (relatively one-third larger) specimens from South Australia, none of which is an ordinary male; hence, the differences listed below may be those associated with sexual and size characteristics. *Paradexamine alkoomie* differs from *P. narluke* in the absence of facial spines on epimeron 2, the apically crowded posterior spines on article 6 of pereopods 1-2, the presence of a distinct anterior bulge on coxa 1, with several setae occurring anteriorly, the even smaller inner plate of the maxilliped, the deeper lobe on article 2 of pereopod 5, the broader and more strongly serrate telsonic lobes, the presence of side teeth on pleonite 1, and the presence of 3 large rounded teeth on pereonite 7. *Paradexamine narluke* has the rudiments of a bulge on coxa 1 seen in *P. alkoomie,* but the first two differences cited above appear to confirm that genetic difference occurs between the two groups of specimens.

*Paradexamine alkoomie* is also related to *P. windarra* in approximately the same way that *P. narluke* is, but *P. windarra* differs far more from both species than do either of the latter from each other. *Paradexamine windarra* has a heavy spine on coxa 2, broad lobes on maxilla 2, much stouter and shorter gnathopods, no indication of an anterior bulge on coxa 1, and many setae above the halfway mark on the anterior margin, straight, blunt mandibular lobes on the lower lip, no cuticular slits, a definite gap in the spination on uropod 1, poorly projecting uropod 3, and blunt article 3 on antenna 2.

*Paradexamine alkoomie* also resembles *P. lanacoura* sufficiently to cause some confusion in routine identifications, but *P. alkoomie* differs in the shorter, almost blunt rostrum, the absence of a protrusion on article 1 of antenna 1 in females, the long flagellum of antenna 2 in females, the anterior setae and bulge of coxa 1, the absence of posterior spines on coxae 2-3, the presence of cuticular crescents, and the rudimentary setae on the posterior margin of epimeron 3.

MATERIAL. — Shepherd 13 (1), 30 (3), 52 (1).

DISTRIBUTION. — South Australia, sublittoral in epifauna.

### *Paradexamine churinga*, new species

FIGURES 21–27

DESCRIPTION (of female). — Lateral cephalic lobe rounded-quadrate anteriorly, often with flange, head with scarce anteroventral definition at base of antenna 2, rostrum sharp, attenuate; article 1 of antenna 1 with weak ventral protrusion, spines thin and arranged in 2-3 groups of 2-5 each, article 2 about 1.2 times as long as article 1, apically simple and lacking thick spines ventroproximally, flagellum about 1.8 times as long as peduncle; flagellum of antenna 2 twice as long as peduncle, multiarticulate; mandibles bearing 2 large spines on right, 3 on left, molar moderately to strongly ridged, ragged seta each side, weaker on left, regular setae only on right, accessory bulge weak, rounded; outer lobe of lower lip bearing 1 long, 1 medium cone plus accessory facial cusp at base of long cusp, mandibular lobes thin, apically upturned; palp of maxilla 1 large, broad, or medium, exceeding or surpassing spine bases on outer plate, bearing 1 small apical cone and medial and terminal setae, inner plate of normal size and naked; inner plate of maxilla 2 narrower than outer, both appressed, inner with apex strongly oblique, outer scarcely curved, inner reaching 75 percent along outer, bearing facial setae; inner plate of maxilliped small, bearing 2

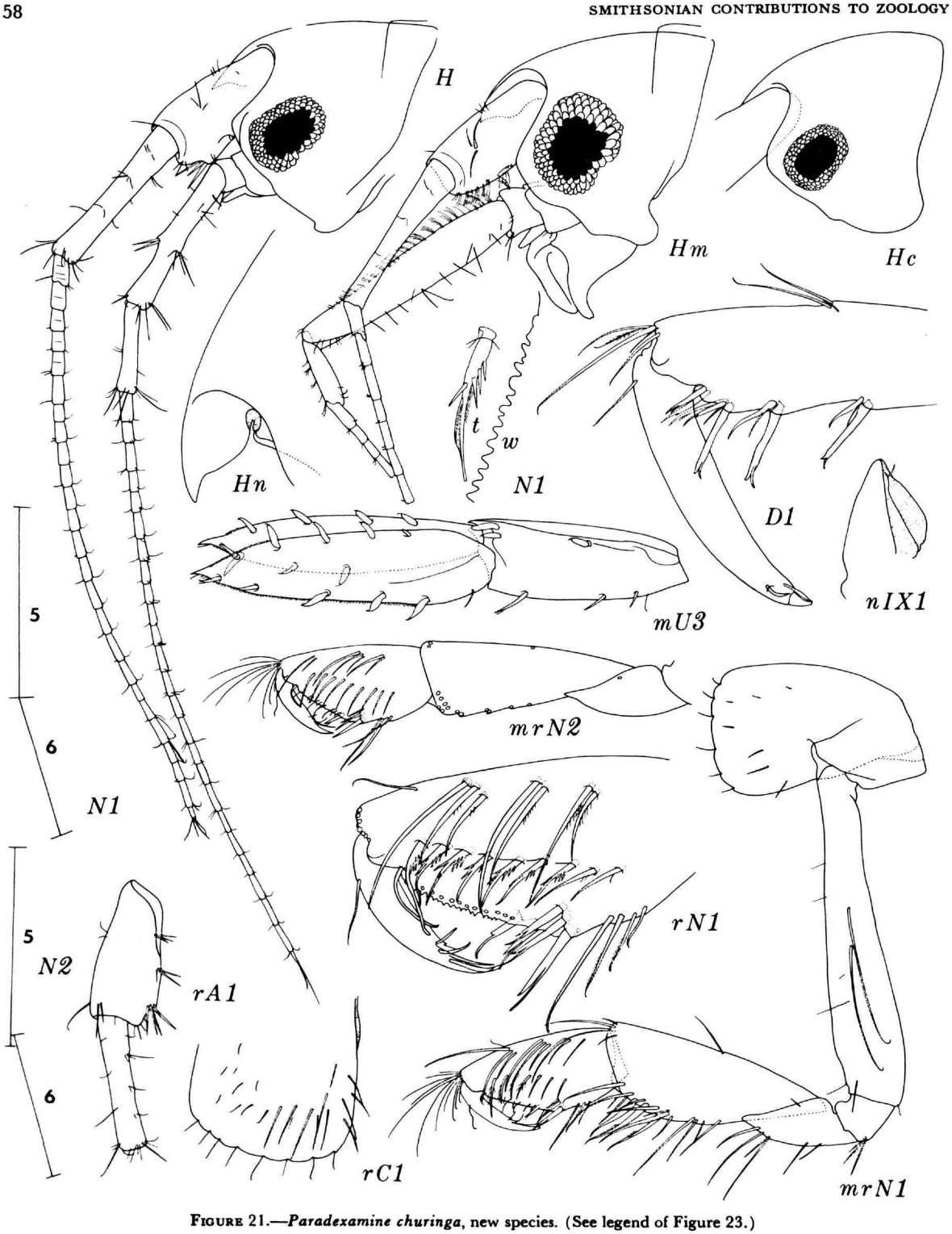


FIGURE 21.—*Paradexamine churinga*, new species. (See legend of Figure 23.)

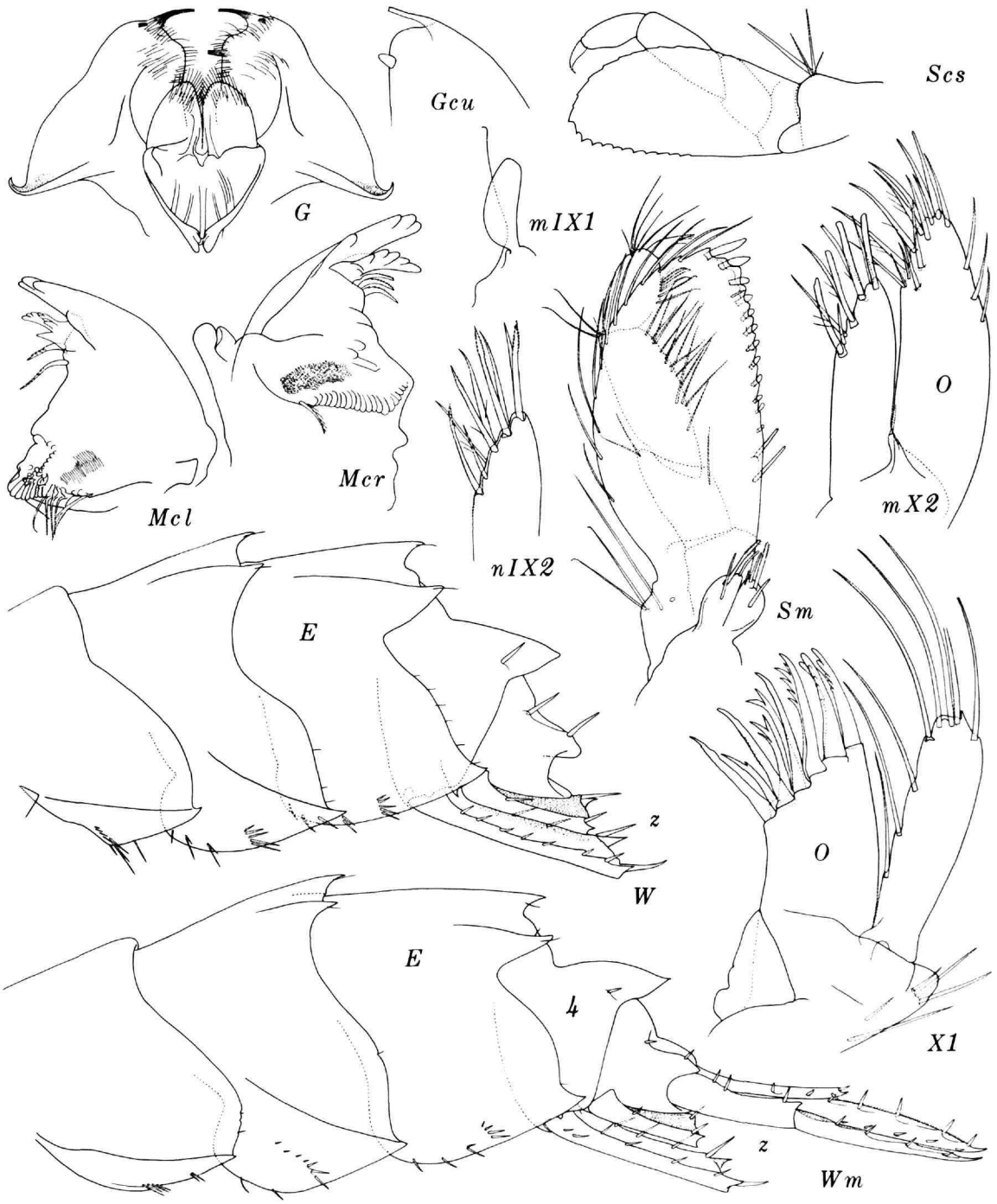


FIGURE 22.—*Paradexamine churinga*, new species. (See legend of Figure 23.)

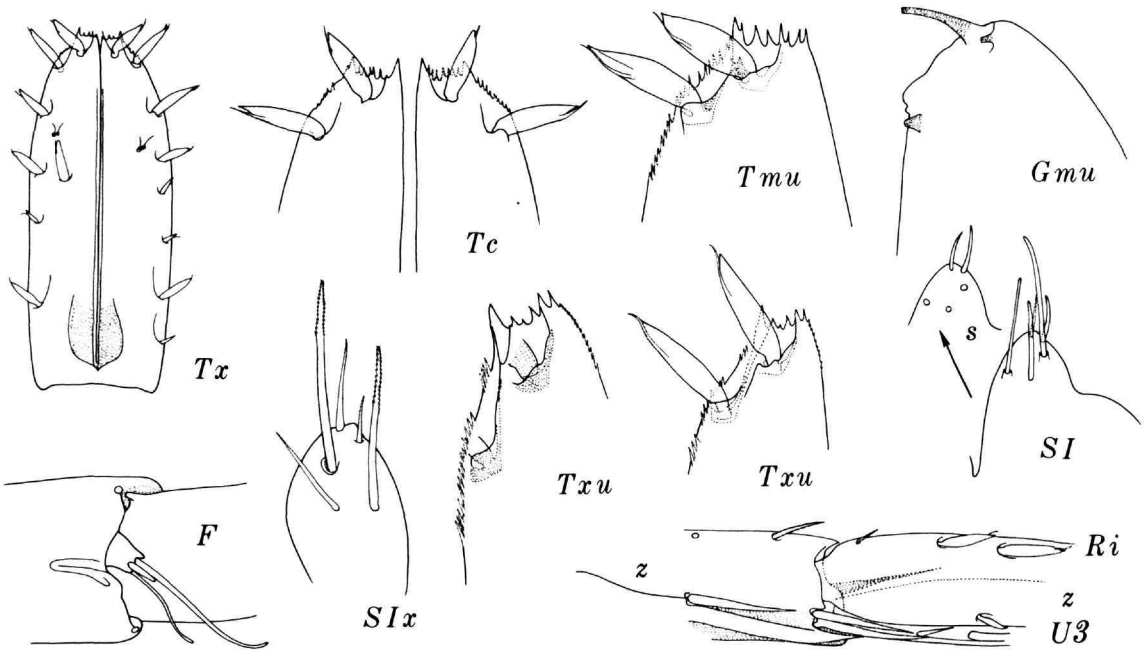


FIGURE 23.—*Paradexamine churinga*, new species, female, 4.0 mm; *m*=male, 4.1 mm; *c*=holotype, female, 3.4 mm; *n*=male, 3.7 mm; *x*=female, 3.25 mm; all from JLB Australia 2. (*mX2* has amberized setae on the inner plate.)

apical spines and 3 facial setae, outer plate of ordinary size, spines small, simple, palp of medium robustness, slightly exceeding outer plate; coxa 1 slightly expanded apically, naked anteriorly, weakly setose ventrally, scarcely scalloped, bearing 2 thin posterior setal-spines, coxae 2-3 rectangular, poorly setose ventrally but with strong subventral setal row medially, scarcely scalloped, each bearing 1 posterior spine, coxae 5-6 with thin posteroventral spines; gnathopod 1 with article 6 about 0.74 times as long as article 5, on gnathopod 2 about the same, gnathopods slightly thin, palm oblique, weakly castellate, medial faces of hands with 7-9 pectinate setae, apical member especially attenuate, anterior face with 3 rows of setae, dactyls bearing 1-2 serrations proximal to main inner tooth; pereopods 1-5 thin, with sharp spines, ratio of articles 4-7 on pereopods 1-2 about 21:18:22:13, dactylar ornaments especially distad; article 2 of pereopod 3 of ordinary stoutness, posteroventral lobe broad but not very deep, article 2 of pereopod 4 pyriform, posteroventral lobe obsolescent but spinose; article 2 of pereopod 5 thin, rectangular, scarcely tapering, posterior margin serrate and posteroventral corner spinose, ratio of articles 4-7 about 24:38:35:18, pereopods 4-5 unusually elongate; pleonal epimera 1-2 with lateral ridge, each with medium sharp tooth, epimeron 3 with small sharp tooth, posterior margins of epimera smooth, setules weak, epimeron 1 with facial row of about 7-8 spines and 1 other ventral spine, epimeron 2 with facial row of 3-5 spines, and 3 spine sets anteroventrally (with 1-2 spines each), epimeron 3 with facial row of 5 spines and 3-4 anteroventral sets of 1-2 spines each (rarely paired); pleonite 1 dorsally smooth, pleonites 2-3 with sharp dorsal tooth and sharp side tooth, pleonite 4 with large, sharp, recumbant dorsal tooth, no lateral; lateral spine present on weak ridge, pleonites 5-6 (fused) with 2 dorsolateral spines on each side; dorsal margin of peduncle on uropod 1 evenly spinose or with weak gap near apex; rami of uropod 3 lacking setae; peduncle with apical pair of spines (unusual); telson flat, not fully cleft, apices of me-

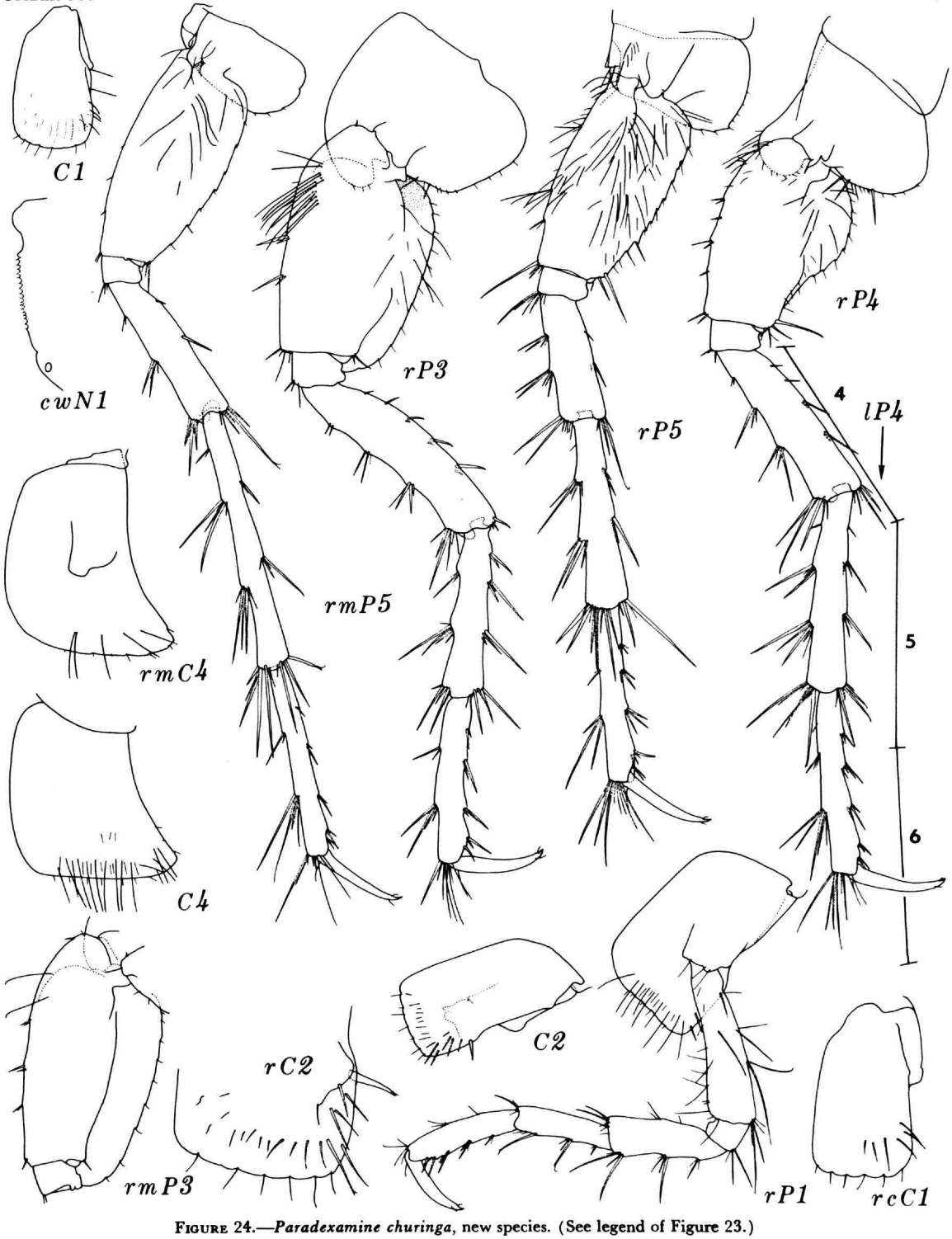


FIGURE 24.—*Paradexamine churinga*, new species. (See legend of Figure 23.)

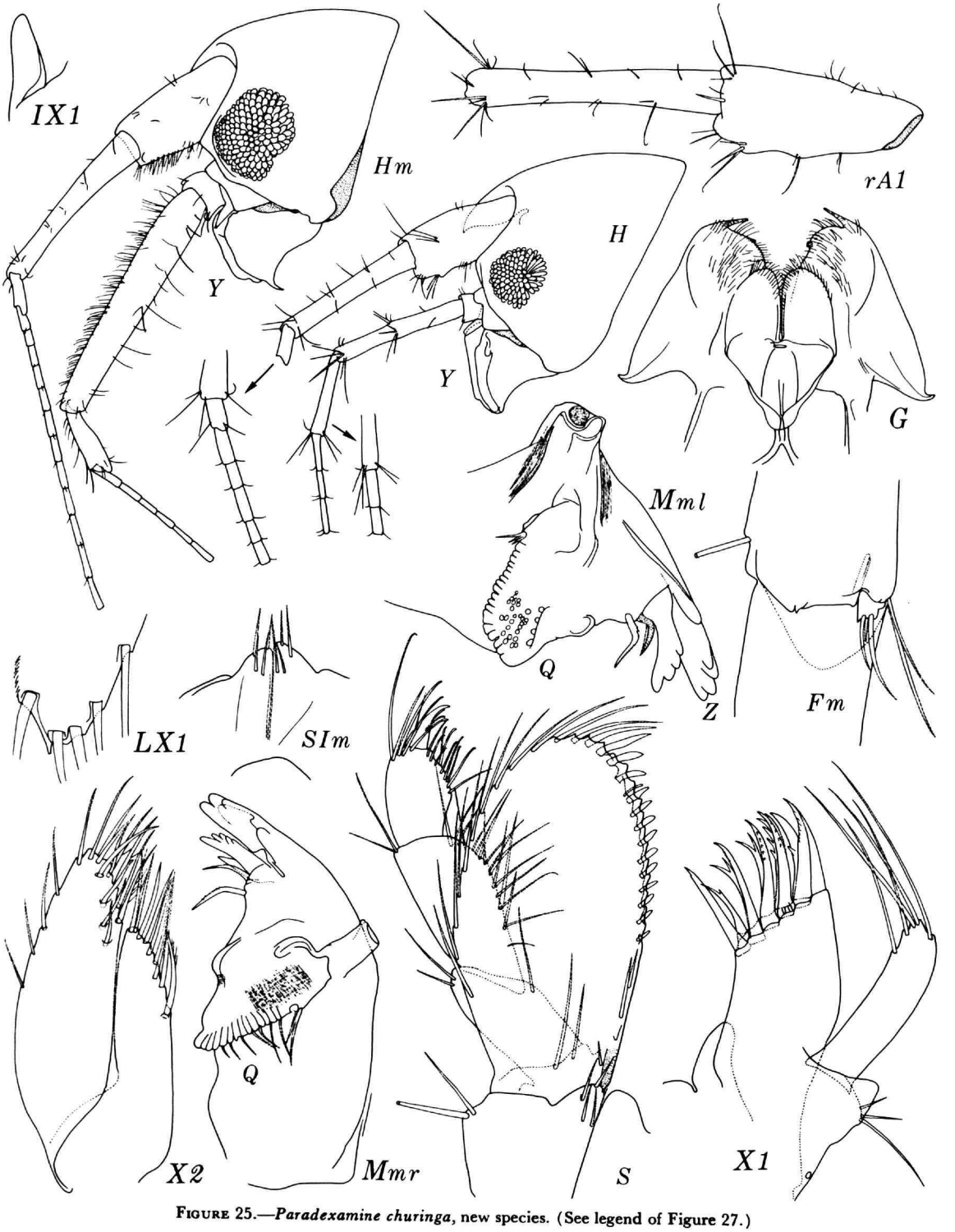


FIGURE 25.—*Paradexamine churinga*, new species. (See legend of Figure 27.)

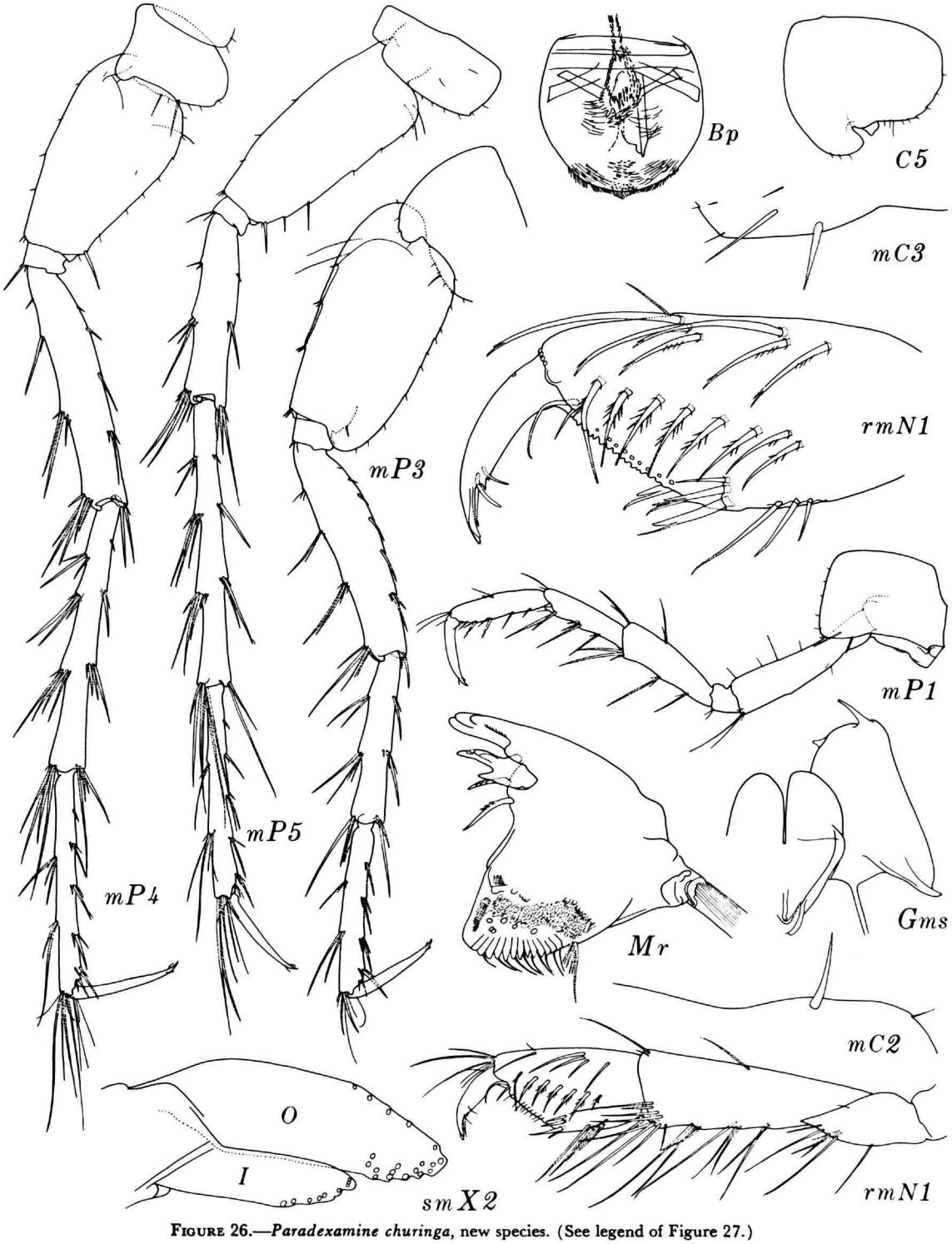


FIGURE 26.—*Paradexamine churinga*, new species. (See legend of Figure 27.)

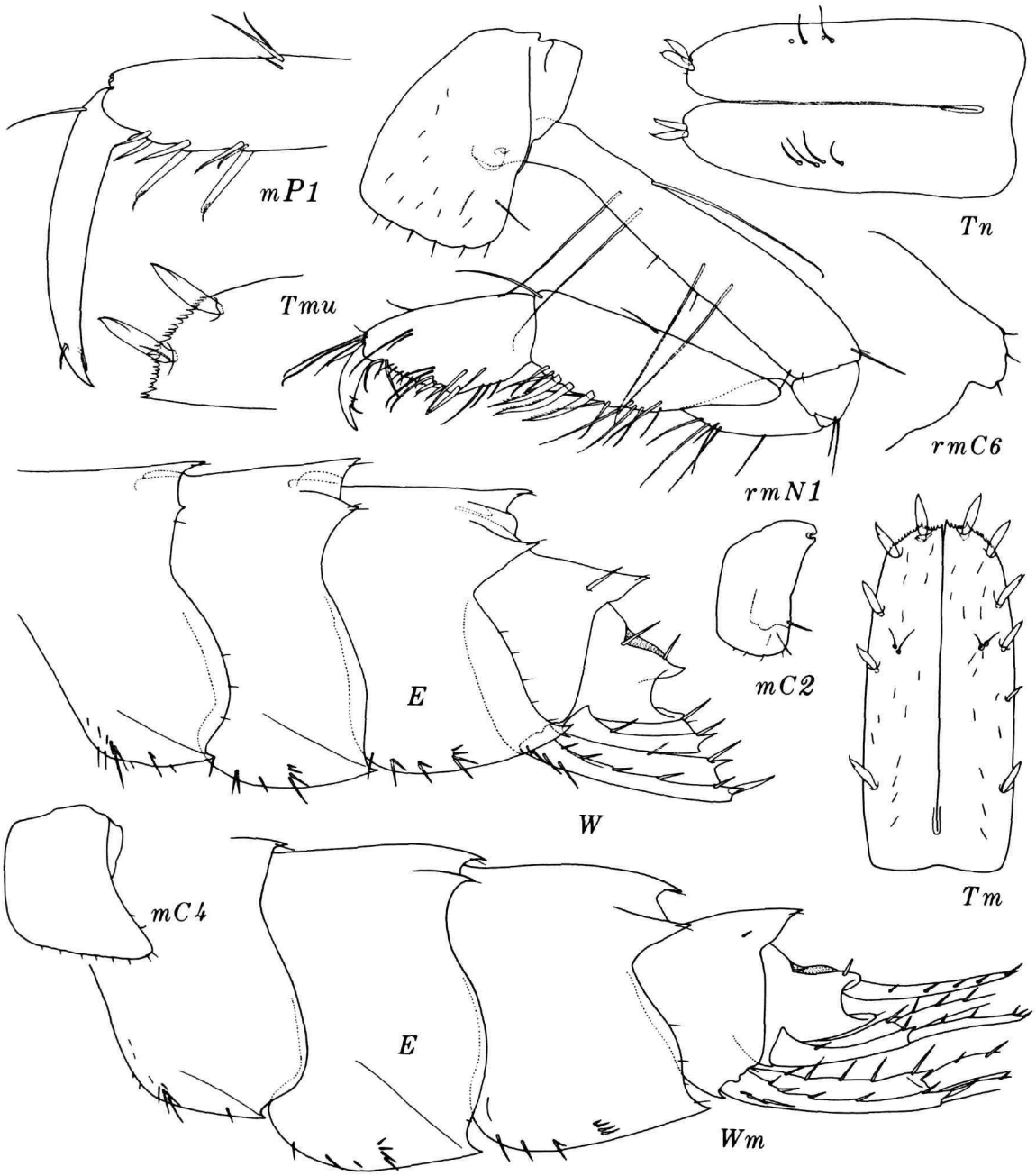


FIGURE 27.—*Paradexamine churinga*, new species, female, 3.95 mm, VicFish 62; *m*=male, 3.6 mm, VicFish 62; *n*= male, 4.1 mm, VicFish 17.

dium width, telsonic taper of high degree terminally, apex with 6-9 sharp cusps, 1 large spine in notch space, lateral margins of each lobe with 5-6 large to small spines, first side spine very close to apex, with lateral serrations occurring apically on lateral telsonic margin, one aberrant specimen with 1 spine position paired; cuticle of posterior body segments smooth or weakly spiculate, but body and coxae covered sparsely with weak setules.

MALE. — With ordinary male characters in antennae such as elongate article 2, ventral brushes of article 1, short article 5 of antenna 2, and setules on article 4 of antenna 2, eyes enlarged, spines of urosome, uropod 3, and telson very short, pereopods 4-5 especially elongate (see Figure 26), article 2 of pereopods 3-5 thinner than in female, coxae and article 2 of pereopods 3-5 much less setose than in female, inner plate of maxilla 1 apparently bearing 1 small medial seta (difficult to observe in two males because of amberization); gnathopods not significantly more elongate than in female.

ALLOPATRIC COMPARISON. — The diagnosis is drawn mainly from the material from Western Australia; material from Victoria, mainly Western Port, differs in small ways but possibly not sufficiently for subspecific distinction; flagellum of female antenna 1 nearly 4 times as long as peduncle; palp of maxilla 1 slightly shorter than outer plate in female but normal in male; ratio of articles 4-7 on pereopods 1-2 about 20:17:18:13, on pereopod 5 about 36:55:42:19, pereopods 4-5 unusually elongate; well-developed females with epimeral formula (s= setule on ventral margin, all other spines considered facial, formula quoted rear to front): epimeron 1: s-2-2-7-1-1, epimeron 2: 4-1-2-1, epimeron 3: 4-2-2-1; pleonite 1 with or without dorsal tooth, generally developing after length of 2.5 mm reached, but in male, tooth developing very late, side tooth always absent in male but often developing after dorsal tooth in female.

ABERRATIONS. — One female, 3.9 mm long, from VicFish 56 has 3 long spines, instead of 1 spine, in the left anteroventral position on pleonites 5-6.

Two well-developed females from VicFish 86 have the ocular lobe almost pointed and have a dorsal tooth on pleonite 1. A male, 4.1 mm long, from VicFish 17 and another specimen from VicFish 96 have have an aberrant telson as shown in Figure 27*Tn*. Four main setae on the inner plate of maxilla 2 in one male illustrated herein are amberized and appear strap shaped, but apparently they normally are minutely and tightly pectinate or serrate. The secondary medial cusp on the lower lip is occasionally absent on one side.

HOLOTYPE. — WAM, female, 3.4 mm.

TYPE-LOCALITY. — JLB Australia 2, Jervois Bay, Cockburn Sound, Western Australia, on groin 1.6 miles southeast of Woodman Point, 1 meter, algae on rocks, collected by Dr. Barry R. Wilson, 10 June 1968.

RELATIONSHIP. — The cephalocular lobe of this species is intermediate between the two main classes of species in this genus in that it is not perfectly rounded nor is the quadrate cusp (or flange) sharply pointed. This lobe resembles the ocular lobe of *P. muriwai* J. L. Barnard (in press) from New Zealand, but otherwise *P. churinga* differs from that species in many characters, especially in the absence of a side tooth on pleonite 4 and in the lack of anterolateral cephalic definition at the base of antenna 2.

If this species is considered to be related to others with a rounded ocular lobe, the absence of side teeth on pleonite 4 suggests a relationship with *P. churinga, P. thadalee,* and *P. dandaloo.* This species has close affinities with *P thadalee* (q. v., for remarks on differences). The aberrant telson of one female of *P. churinga,* in which one spine position is paired, is a measure of the close relationship, but *P. churinga* does not have telsonic crests among many other small differences. Both *P. thadalee* and *P. dandaloo* differ from *P. churinga,* as both have no apicolateral serrations and no proximate spine on the telson, and both have a seta on the inner plate of maxilla 1; *P. thadalee* has multispinose telsonic positions, a short rostrum, and pectinate dactyls on the gnathopods; *P. dandaloo* has multifid dorsal processes and an enlarged inner plate on the maxilliped.

Though *P. churinga* is very close to *P. marlie, P. linga,* and *P. moorhousei,* its sympatriots, the absence of a cusp on the ocular lobe places *P. churinga* in the species group containing *P. fissicauda, P. nana, P. sexdentata,* and *P. dandaloo,* which, like *P. marlie,* have no side tooth on pleonite 4. *Paradexamine churinga* differs from *P. fissicauda* in the slightly stouter article 2 of pereopod 5, the broader telsonic apices, the weak inner

plate of the maxilliped, the thinner mandibular lobes of the lower lip, the absence of teeth anterior to pleonite 2, the recumbant dorsal tooth of pleonite 4, and the attenuate rostrum.

By lacking side teeth on pleonite 2, *P. sexdentata* has a tooth formula weakly similar to *P. churinga,* but *P. sexdentata* has a dorsal tooth on pleonite 1, and the side teeth of pleonite 3 are sharp. *Paradexamine fissicauda* has a simple telsonic apex with 1 main notch and spine.

*Paradexamine nana* apparently has the same tooth formula as *P. churinga,* but presumably the side teeth of pleonite 3 are sharp; very little else is known of *P. nana* from the Falkland Islands.

In the group of species with a fully developed, sharp cephocular cusp, *P churinga* appears similar to *P. marlie, P. moorhousei, P. linga, P. houtete,* and *P. pacifica.* The latter two species have a combination of 2 setae on the inner plate of maxilla 1, a large inner plate on the maxilliped, and no apicolateral telsonic serrations. *Paradexamine linga* and *P. moorhousei* have weak to vestigial mandibular spines, pectinate dactyls on the gnathopods, and large inner plates on the maxillipeds. *Paradexamine marlie* has no mandibular spines, a seta on the inner plate of maxilla 1, no apicolateral serrations on the telson, and pectinate gnathopodal dactyls.

The following characters have been relied on to identify this species in the enormous VicFish collections (because each specimen has not been dissected, there may be cryptosiblings overlooked): lateral cephalic lobe, pleonite 4, rostrum.

MATERIAL. — JLB Australia 2 (8); VicFish 1-105, 21 samples (20); Shepherd 30 (1).

DISTRIBUTION. — Warm-temperate Australia, sublittoral, bays.

### *Paradexamine dandaloo,* new species

FIGURES 28–30

DESCRIPTION (of female). — Lateral cephalic lobe rounded, head lacking anteroventral definition at base of antenna 2 (but support extended medially), rostrum medium, thin, blunt; article 1 of antenna 1 with ventral spines sharp, stout, and arranged in tandem, about 5 positions, terminal position paired; article 2 about 0.75 times as long as article 1, apically simple, and bearing pair of spines ventroproximally, flagellum about 2.8 times as long as peduncle; flagellum of antenna 2 about 2.5 times as long as peduncle, multiarticulate; mandibles with 2 long spines on right, 3 on left, no accessory bulge, molar strongly triturative, ragged seta each side, ordinary setae each side, slightly shorter on left; outer lobes of lower lip each with 3 apicomedial cones, one long, others vestigial or short, mandibular lobes thin, sharp, and apically upturned; palp of maxilla 1 large, of medium width, exceeding apex of outer plate, bearing apical and medial setae and long apical cone, inner plate unusually small, bearing 2 setae; maxilla 2 thin, inner plate narrower than outer, both appressed, inner with apex tapering (or very oblique), outer uncurved, inner reaching nearly 90 percent along outer; inner plate of maxilliped of medium to large size, apically tapered, bearing 2 facial setae and about 6 terminolateral setae; outer plate of ordinary size, spines simple, of medium-to-small size, palp robust, strongly exceeding outer plate; coxa 1 weakly expanded apically, naked anteriorly, ventral margin scarcely scalloped and setules obsolescent, posterior margin with 1 stout spine, coxae 2-3 rectangular, also poorly setose, each with 1 posterior spine; coxae 5-6 with strongly spinose posteroventral margins: gnathopod 1 with article 6 about 0.86 times as long as article 5, gnathopod 2 about the same, gnathopods slightly stout, palms very oblique, medial faces of hands, respectively, with 10-11 and 11-12 plumose spines in spine row, anterior faces with 3 and 2 rows of setae on gnathopods 1 and 2, dactyls smooth proximal to main inner tooth, palms minutely serrate; pereopods 1-5 thin, with sharp spines, ratio of articles 4-7 on pereopods 1-2 about 15:15:21:12; article 2 of pereopod 3 of ordinary stoutness, posteroventral lobe broad and deep, article 2 of pereopod 4 quadrovate, posteroventral lobe well developed, spinose; article 2 of pereopod 5 rectangular, of medium width, posterior margin serrate, posteroventral quadrate corner spinose, ratio of articles 4-7 about 25:35:31:15; pleonal epimera 1-2 with lateral ridge, medium sharp tooth on each posteroventral corner, epimeron 3 with thick, small blunt tooth, posterior margins of epimera mainly smooth, epimeron 1 with facial row of about 9 spines and 4 other spines arranged irregularly, epimeron 2 with row of 4 and 3 accessory spines trailing anteriad plus 2 other groups of 2 and 1

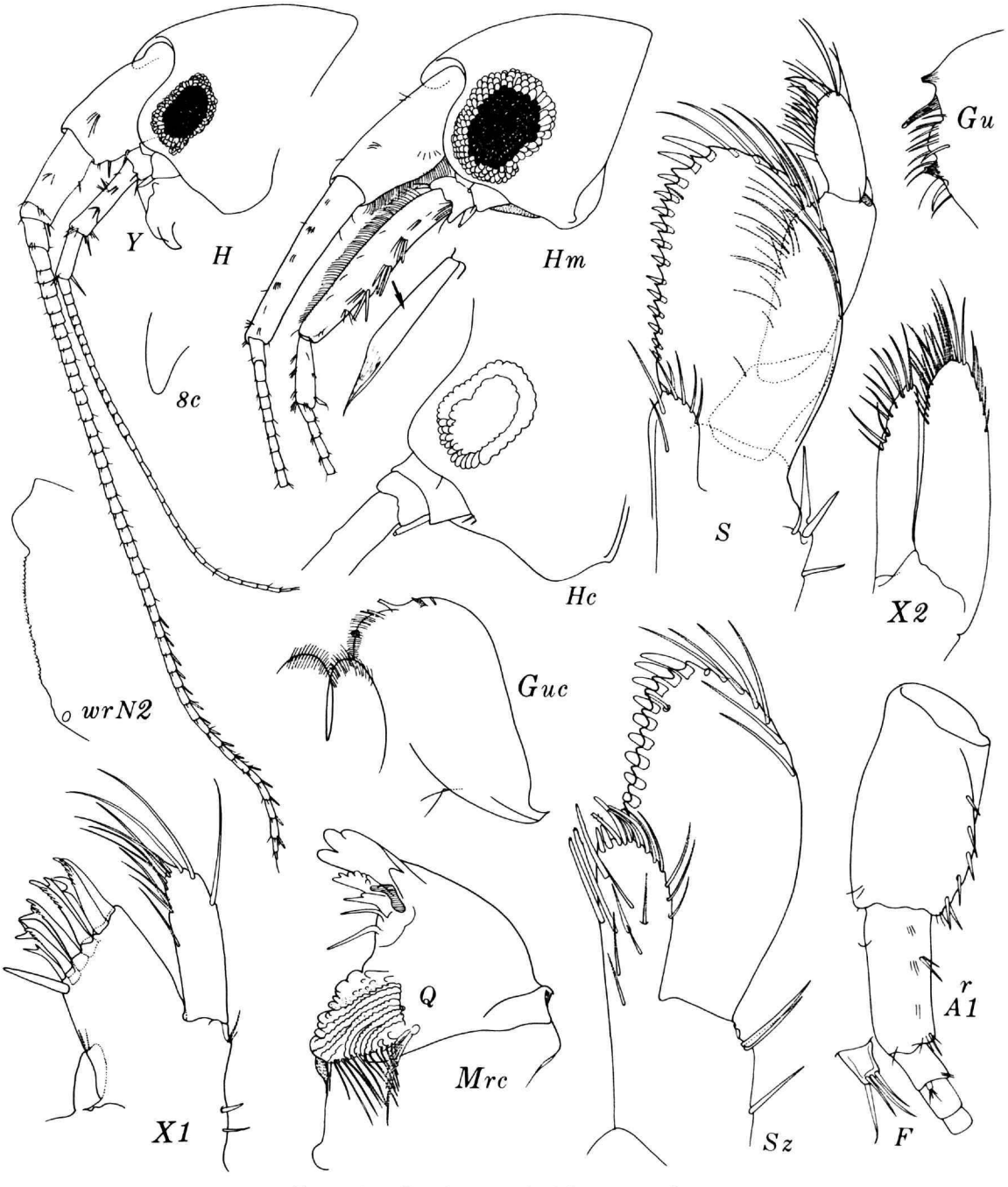


FIGURE 28.—*Paradexamine dandaloo*, new species.

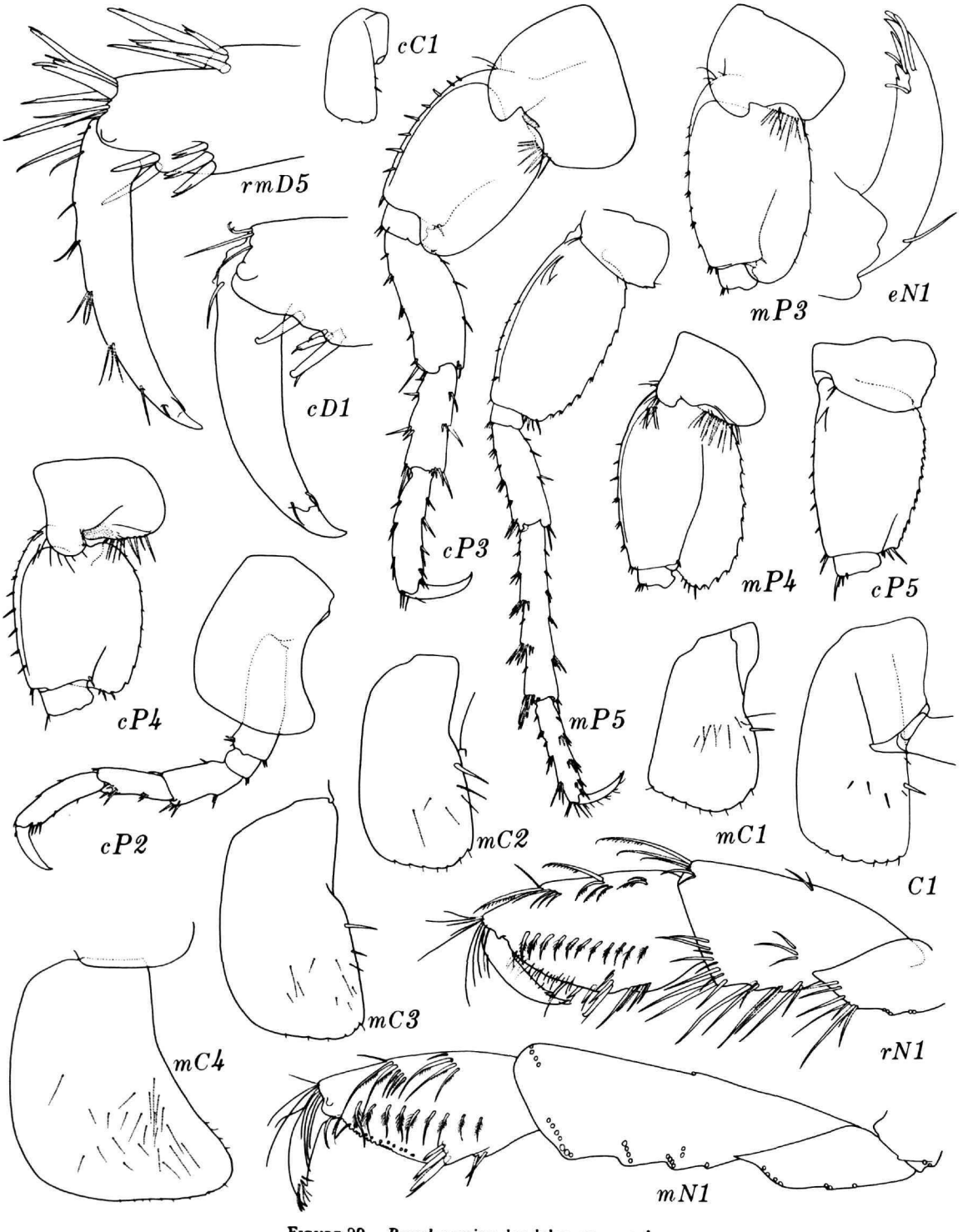


FIGURE 29.—*Paradexamine dandaloo*, new species.

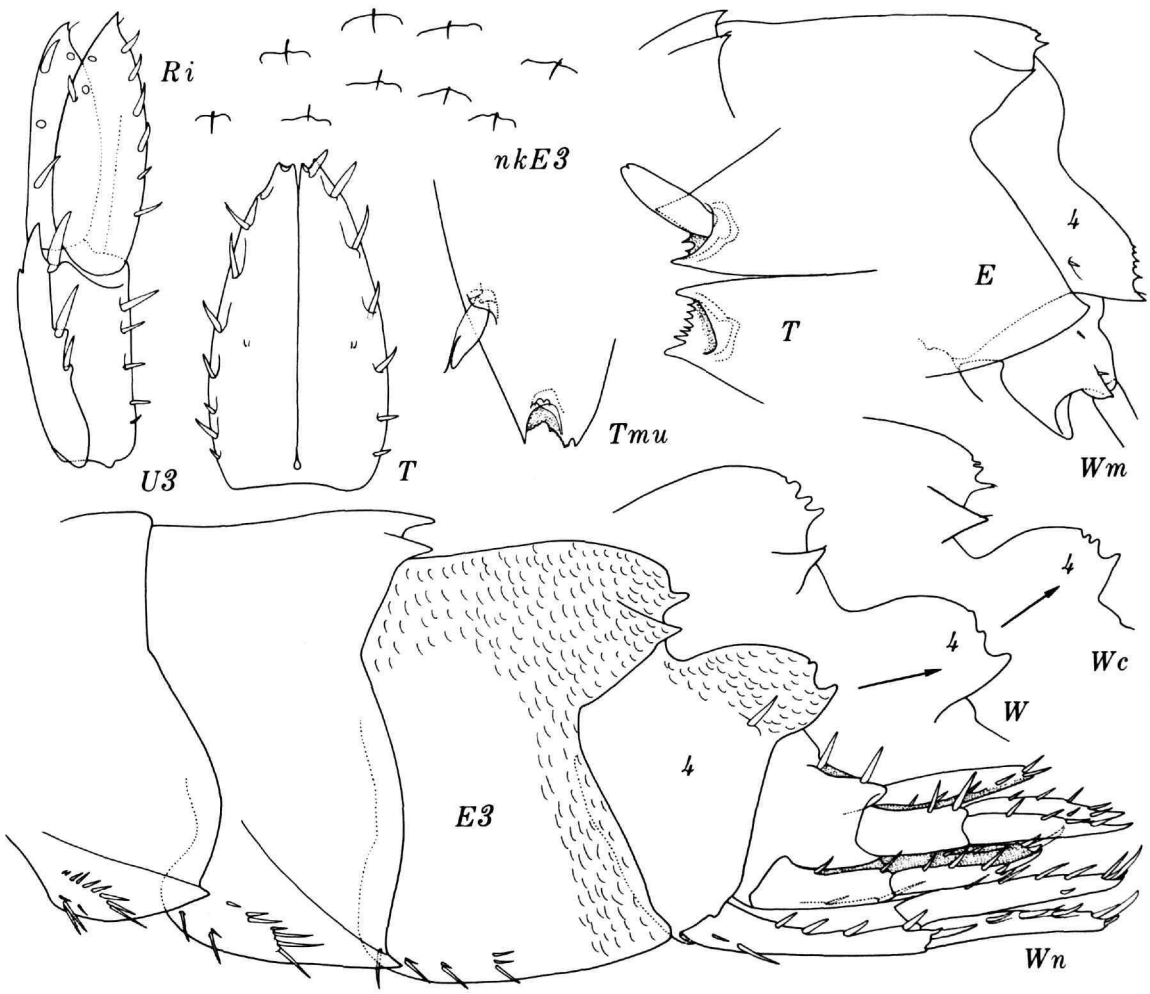


FIGURE 30.—*Paradexamine dandaloo*, new species, holotype, female, 6.4 mm, Shepherd 46; *c*=female, 6.3 mm, Shepherd 46; *n*=female, 5.2 mm, Shepherd 46; *m*=male, 5.8 mm, Shepherd 14. (Slit-pits omitted on *Wn*.)

spines each, epimeron 3 with formula, posterior to anterior, of 3,2,2,1; pleonite 1 dorsally smooth, pleonite 2 with sharp dorsal and sharp sidetooth, pleonite 3 with blunt dorsal tooth on heavy shoulder, shoulder often multifid, pleonite 4 with dorsal crest formed of mutifid shoulder, no lateral tooth, but lateral spine present on weak ridge, pleonites 5-6 (fused) with 2 dorsolateral spines on each side; dorsal margin of peduncle on uropod 1 evenly spinose; rami of uropod 3 lacking setae; telson with narrow apices, each apex with about 8 small cusps including enlarged laterals, main spine large and covering nearly half of apical width, lateral margins with 6-8 long to medium spines in tandem; cuticle of body segments, head, coxae, article 2 of pereopods 3-5 covered with highly visible slit-pits.

MALE (5.8 mm, Shepherd 14, one specimen known). – With ordinary male characters such as enlarged eyes, elongate antennae, especial enlargement and disproportion of articles 4-5 of antenna 2; left mandible bearing only 1 ragged seta, no ordi-

nary setae; lower lip lacking small cone accessory to main cone; palp of maxilla 1 with one side bearing 2 long cusps, other side bearing 1 long, 1 short cusp on palpar apices; maxilla 2 normal; maxilliped with inner plates strongly enlarged, palp otherwise like that of female; coxa 1 more strongly expanded than in female; gnathopods apically elongate, similar to each other, article 6 of equivalent size and length but article 5 longer in gnathopod 2 than gnathopod 1, ratio of articles 5 and 6 in gnathopod 1 about 130:78, in gnathopod 2 about 143:78; see Figure 29*mN1* for gnathopod 1; comparison of gnathopod 2: 9 spines in oblique facial row; formula of anterior facial setae, apical to proximal: 1-4-2, posterior margin of hand with 5 setae; pereopods generally spinier than in female, and dactyls of pereopods with numerous extra enlarged setae on outer margins, pereopods 1-2 with 2 extra pairs, pereopod 3 with 4 extra pairs, pereopods 4-5 with 5 sets having formula proximal to apical of 1-2-3-3-1; second articles of pereopods 3-5 larger in relation to coxae than in female, article 2 of pereopod 4 with larger posteroventral lobe; serrations of telson reduced to about 3; uropod 3 missing; spines on urosome very small; uropod 1 with 4 proximolateral spines on peduncle; facial spine formulae on epimera 1-3, rear to front, epimeron 1: 1-12-5 plus 5 marginal irregular groups, epimeron 2: 13-1-1-1-1, epimeron 3: 4-4-3-3-2-1-1.

HOLOTYPE. — SAM, female, 6.4 mm.

TYPE-LOCALITY. — Shepherd 46, Judith Cove, West Island, South Australia, 15 feet.

RELATIONSHIP. — Presumably this species has affinities with those members of *Paradexamine* in which the side tooth of pleonite 4 is absent and which lack a cephocular cusp. Only three other Australian species have that combination of characters: *P. churinga, P. echuca,* and *P. thadalee.* Like *P. dandaloo, P. thadalee* has surficial slit-pits, but it differs from *P. dandaloo* in the broad telsonic apices and the multispinose lateral spine positions, the slightly less oblique gnathopodal palms with enlarged and fewer castellations, the larger inner plate of maxilla 1 bearing a side seta (not terminal), the short palp of maxilla 1, the highly reduced inner plate of the maxilliped, and the absence of medial setae on the inner plate of maxilla 2.

*Paradexamine churinga* differs from *P. dandaloo* in the broad, nonsetose inner plate of maxilla 1, the absence of ordinary setae on the left mandible, the small inner plate of the maxilliped in the female, the extremely distal position of the dactylar ornamentation of the pereopods, and the highly apical location of the distalmost lateral spine on each side of the telson.

*Paradexamine echuca* differs from *P. dandaloo* in the sharp rostrum, the facial setae on the inner plate of maxilla 2, and the presence of apicolateral serrations on the telson.

MATERIAL. — Shepherd 2 (1), 3 (1), 7 (2), 9 (4), 14 (1), 15 (1), 22 (1), 31 (3), 40 (3), 46 (5); VicFish 87 (1).

DISTRIBUTION. — South Australia and Victoria, sublittoral.

### *Paradexamine echuca,* new species

FIGURES 31–33

DESCRIPTION (of female). — Lateral cephalic lobe rounded anteriorly, head with moderate definition at base of antenna 2, rostrum sharp, attenuate; article 1 of antenna 1 with weak ventral protrusion bearing 6 spines, other ventral spines in 3 groups of 2 each, some weak, article 2 only 0.66 times as long as article 1, with weak medioapical protrusion and 1 main set of thin ventral spines, flagellum 4.5 times as long as peduncle; accessory flagellum bearing only 2 setules, no aesthetasc (unusual in *Paradexamine*); flagellum of antenna 2 about 3.3 times as long as peduncle, multiarticulate; mandibles bearing 2 large spines on right, 3 on left, molar moderately ridged, very short ragged seta on both sides, weak regular setae only on right molar, accessory bulge strong, blunt, left lacinia mobilis unusually serrate for *Paradexamine;* outer lobe of lower lip bearing 1 long, 1 medium cone, mandibular lobes thin, apically upturned weakly; palp of maxilla 1 broad or medium, exceeding outer plate, bearing 1 small apical cone and medial and terminal setae, inner plate of normal size and bearing 1 seta; inner plate of maxilla 2 narrower than outer, both appressed, inner with apex strongly oblique, outer scarcely curved, inner reaching about 70 percent along outer, bearing facial setae; inner plate of maxilliped of medium size, bearing 3 facial setae, 1 terminal and 4 apicolateral, outer plate large, some spines slightly bifid, palp robust, slightly exceeding outer plate; coxa 1 evenly rectangular,

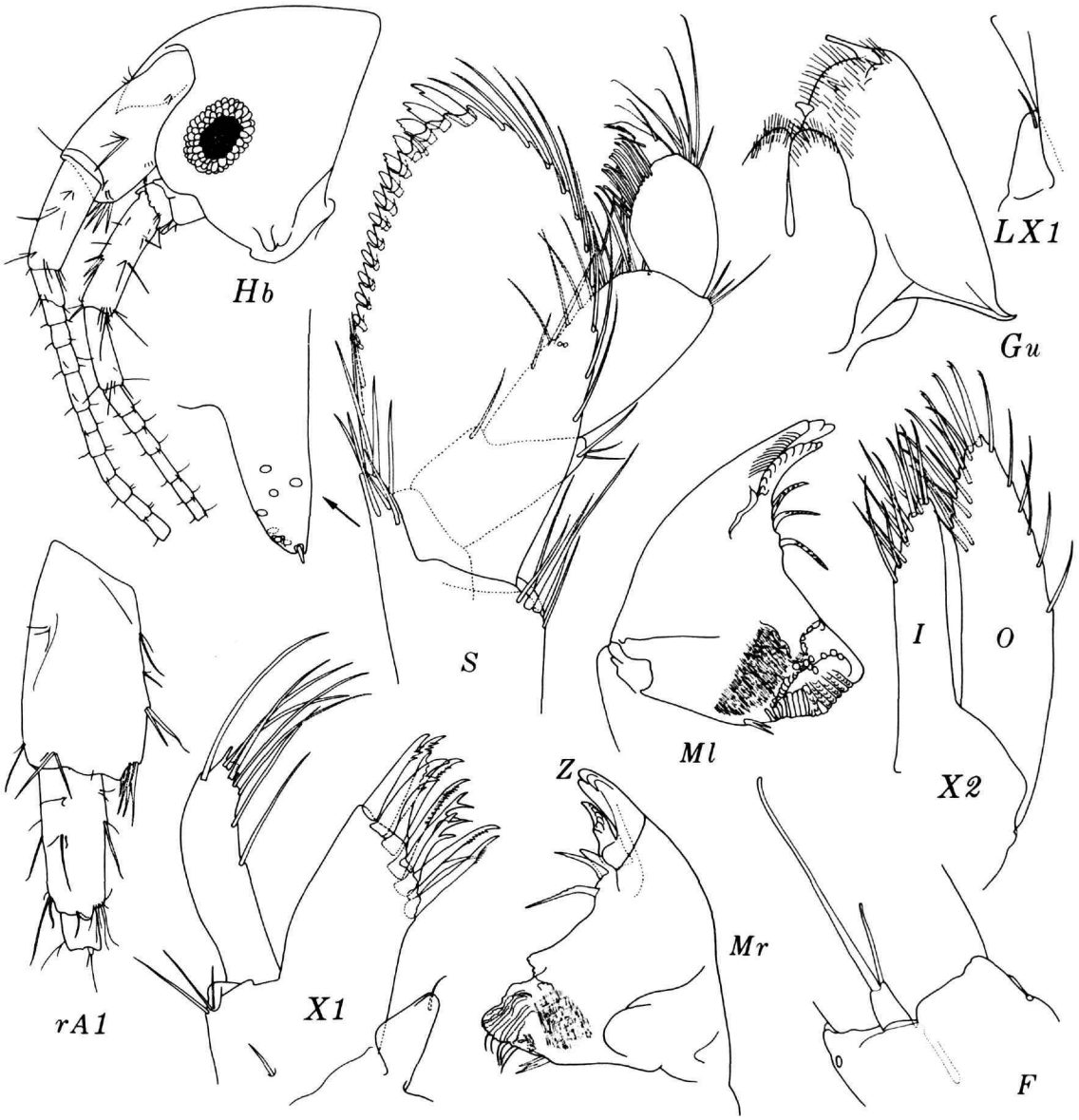


FIGURE 31.—*Paradexamine echuca*, new species, holotype, female, 4.12 mm; *b*=female, 4.0 mm; both from Shepherd 30.

naked anteriorly, normally setose ventrally, scarcely scalloped, bearing 3 posterior setae, coxae 2-3 rectangular, each with stout posterior spine, normally setose ventrally, coxae 5-6 with thin posteroventral spines; gnathopod 1 with article 6 about 0.67 times as long as article 5, on gnathopod 2 about 0.60 times; gnathopods feeble, thin, palm very oblique, strongly and sharply serrate; medial faces of hands with 8 pectinate setae, apical member especially attenuate, anterior faces with 3 rows of setae, dactyls short, with 1 serration proximal to main inner tooth; pereopods 1-5 thin, with sharp spines

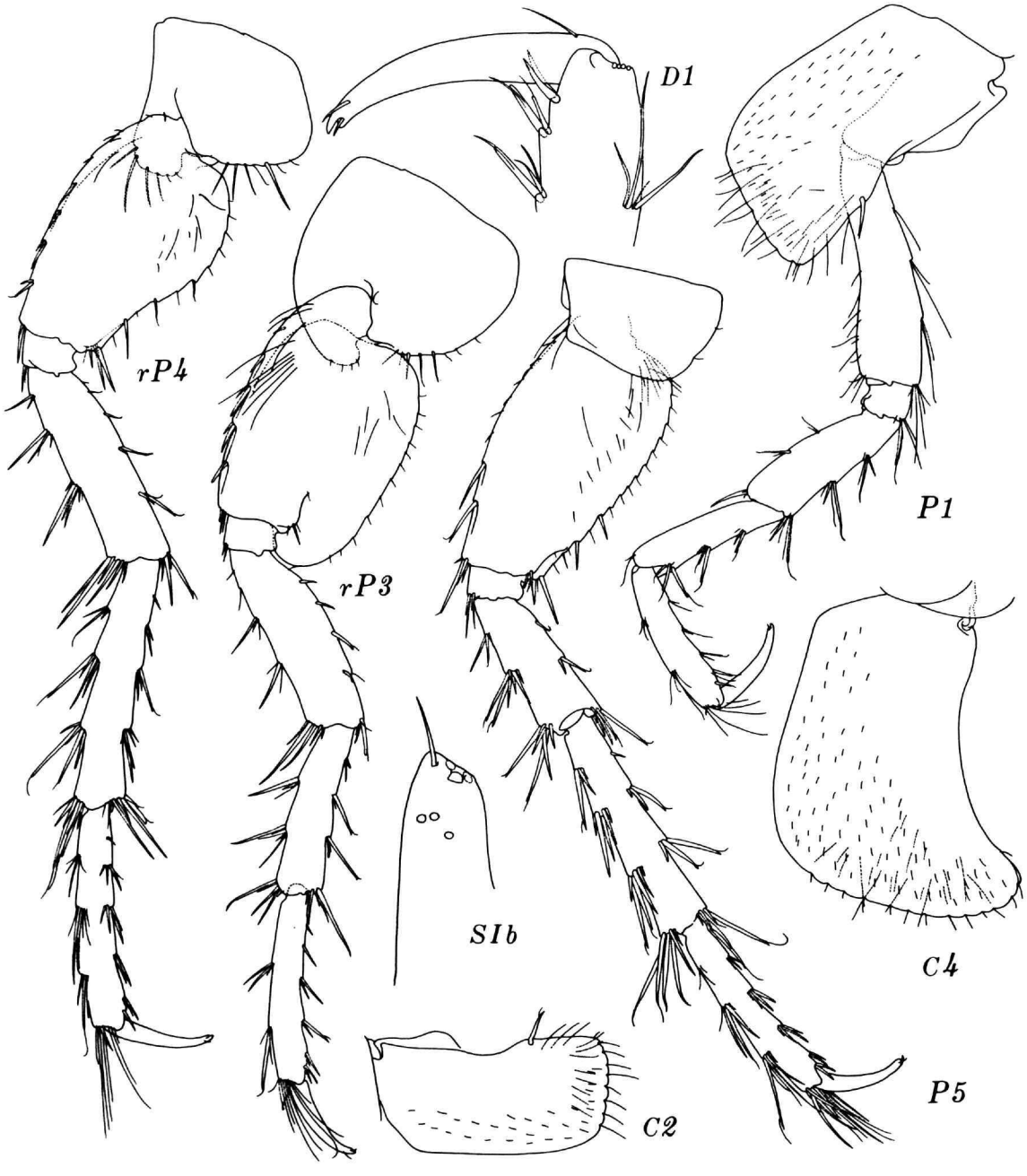


FIGURE 32.—*Paradexamine echuca*, new species.

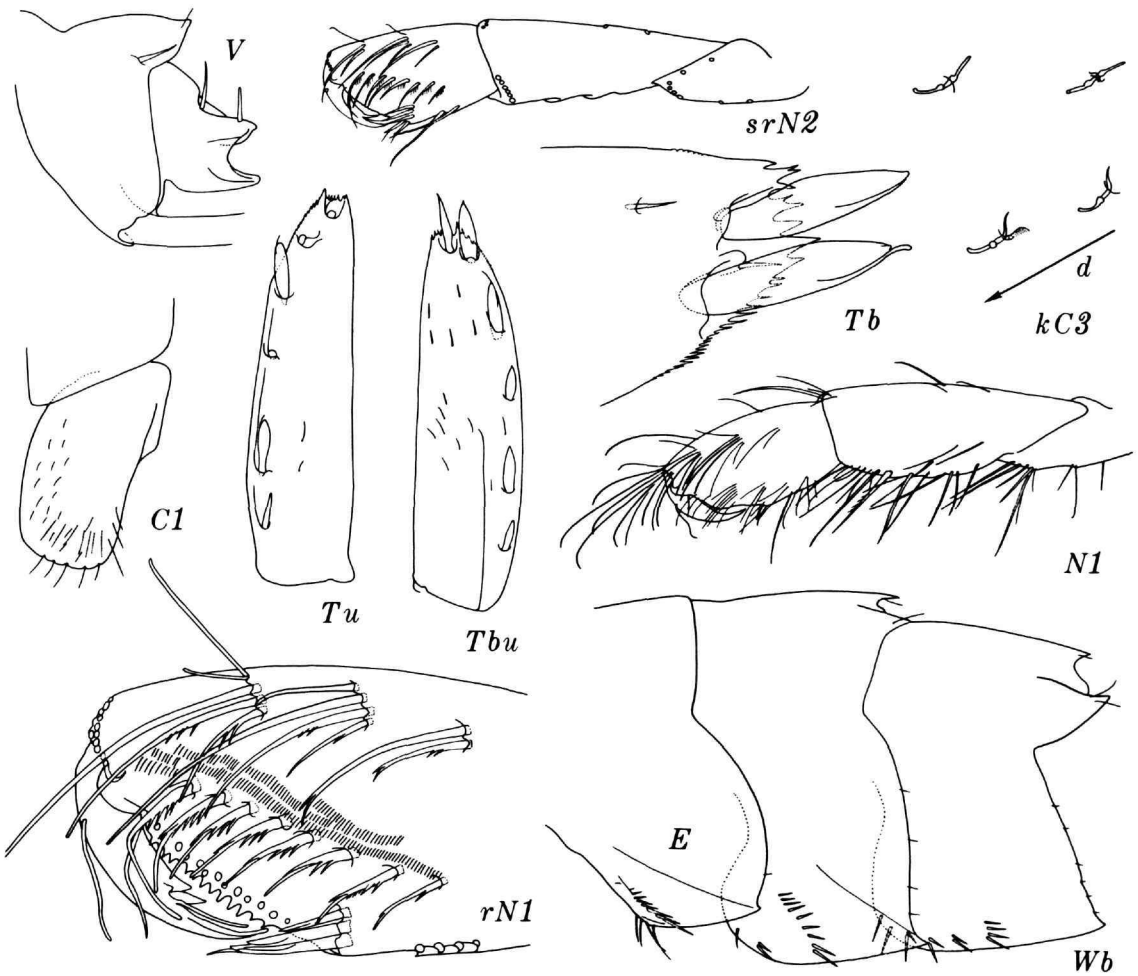


FIGURE 33.—*Paradexamine echuca*, new species.

bearing especially elongate triggers, ratio of articles 4-7 on pereopods 1-2 about 26:25:27:18, dactylar ornaments especially distad and bulge at constriction especially prominent; article 2 of pereopod 3 of ordinary stoutness, posteroventral lobe broad and deep, article 2 of pereopod 4 pyriform, posteroventral lobe obsolescent but spinose, posterior margin spinose; article 2 of pereopod 5 thin, ovatorectangular, posterior margin serrate and with several spines, posteroventral corner spinose, ratio of articles 4-7 about 26:42:36:15, pereopods 4-5 unusually elongate; pleonal epimera 1-2 with lateral ridge, each with posteroventral tooth, that on epimeron 1 small, epimeron 3 with small blunt tooth; posterior margins of epimera smooth, setules weak; epimeron 1 with facial row of 8 spines and 4 ventral setae; epimeron 2 with facial row of 9 spines, 2 ventral sets; epimeron 3 with posterior to anterior facioventral formula of 4-2-2-2-1-1; pleonite 1 dorsally smooth; pleonites 2-3 with sharp dorsal tooth and sharp side tooth, pleonite 4 with large, sharp recumbant dorsal, no lateral, lateral spine on weak ridge; pleonites 5-6 (fused) with 2 dorsolateral spines on each side; dorsal margin of

peduncle on uropod 1 evenly spinose (uropods 1-2 as figured for *P. churinga);* uropod 3 missing and unknown; telson flat or with weak basal crest, apices of medium width, telsonic taper of high degree terminally, apex with about 9 sharp cusps, 1 large spine in notch space, lateral margins of each lobe with 5 large to medium spines, first distolateral spine often crowded very close to terminal spine, with lateral serrations occurring apically on lateral telsonic margin; cuticle of urosome minutely punctate, no spicules, on epimera bearing occasional slit-pit and occasional setule (slit-pits very dim); sparse slits and setules covering parts of coxae 1-7, very rare on coxa 7, sparse on article 2 of pereopods 3-4, very rare on pereopod 5, cuticle with striae composed of minute punctations running vertically on epimera, horizontally on article 2 of pereopod 5, these punctations and striae extraordinarily fine under oil-immersion.

MALE (3.7 mm, Shepherd 30). – Article 2 of antenna 1 not longer than article 1, but articles 1-2 with normal brushes of ventral setae, article 5 of antenna 2 short, article 4 elongate and bearing dorsal brushes; eyes enlarged; spines of urosome slightly smaller than in female, spines of urosome and telson very large, uropod 3 generally like that in Figure 54, spines very large, especially on inner ramus, but 3 dorsal spines on peduncle evenly spaced, inner margin with 3 spines, outer ramus with 6 outer and 5 inner spines, inner ramus with 5 outer and 7 inner spines, inner edge of outer ramus and both edges of inner ramus with heavy comb of serrations; gnathopods slightly more elongate than in female and more setose, medial faces of hands with 11 spines in oblique row; telson with 7 large spines on each lobe.

ABERRANT MALE (3.2 mm, Shepherd 52). – Inner plates of the maxillipeds slightly larger than those of *P. churinga,* but much shorter and broader than those of *P. echuca,* bearing penial processes, eyes scarcely enlarged, antenna 2 with article 4 elongate and article 5 short, but form otherwise like that of female, no setular fuzz present on antennae; bearing 6 characters significant to *P. echuca* and 3 characters significant to *P. churinga;* characters of *P. echuca*: size and crowding of telsonic spines, cuticular setae, only 2 setae on accessory flagellum, heavily ridged mandibular molars, shape of ocular lobe, slight enlargement of cones on lower lip; characters of *P. churinga*: inner plate of maxilla 1 naked, article 2 of antenna 1 elongate, distoventral corner of article 1 on antenna 1 with same shape and spination as *P. churinga.* Uropod 3 on this specimen is like that found on *P. churinga,* with a distal pair of spines on the peduncle; uropod 3 of *P. echuca* is not known otherwise from a normal specimen.

ABERRANT JUVENILE (2.4 mm, Shepherd 22). – This specimen is the only other available with uropod 3 besides the aberrant male above; right uropod 3 is very stunted and regenerative; left uropod 3 is of normal size but the peduncle and rami lack spines except for a small subapical spine on the inner ramus; the outer ramus is slightly shorter and narrower than the inner.

HOLOTYPE. – SAM, female, 4.12 mm.

TYPE-LOCALITY. – Shepherd 30, Pearson Islands, South Australia, station B, 15-40 feet, algae, 8 January 1969.

RELATIONSHIP. – Despite the presence of slit-pits and cuticular setules, which lend this species a superficial resemblance to *P. thadalee, P. echuca* resembles *P. churinga* sufficiently to suggest that they are siblings. Besides setule-pits, *P. echuca* differs from *P. churinga* in the enlarged inner plate of the maxilliped in the female, the short article 2 of antenna 1, the short ragged setae of the molars, the presence of a seta on the inner plate of maxilla 1, the sharpness of the palmar serrations on gnathopods 1-2, and the anteroposterior shortness of coxa 5 (of pereopod 3). The absence of an aesthetasc on the accessory flagellum of *P. echuca* so far is unique in the genus *Paradexamine.*

*Paradexamine echuca* differs from *P. thadalee* in the enlarged inner plates of the maxillipeds, the short article 2 of antenna 1, the unexpanded coxa 1, the long and medially setose palp of maxilla 1, the sharp rostrum, the sharp palmar serrations on the gnathopods, the unpaired telsonic spines with the first lateral occurring highly distad, the distad and bulging ornament of the pereopodal dactyls, and the attenuate distal seta in the oblique facial row of the gnathopods.

MATERIAL – Shepherd 22 (1), 30 (3), 52 (4).

DISTRIBUTION. – South Australia, sublittoral.

### *Paradexamine fissicauda* Chevreux, Typical Phenotype A, Antarctica

FIGURES 34–36

*Paradexamine fissicauda* Chevreux, 1906:88–93, figs. 51–53. —Chilton 1912:181.—Schellenberg 1931:210.—K. H. Barnard 1932:217.—Sheard 1938:185.—Stephensen 1938: 241; 1947:66.

*Paradexamine pacifica* Chilton.—1912:501–502 [not Thomson; fide K. H. Barnard, 1932].

NOMENCLATURE. — Except for the original description, which fits the material at hand, the references cited are unverified as to their identification.

DESCRIPTION. — These specimens fit the description of phenotype B (which follows) except that pereonites 6-7 each bear 1 dorsal tooth, coxa 1 bears about 11 medium-to-long setae and 1 stout posterior spine, coxa 2 bears about 6 ventral setae, coxae 3-4 each bear about 4 medium ventral setae, and the palp of maxilla 1 is longer and thinner than in phenotype B (compare same scale Figure 34*x1* with Figure 34*nLx1*).

The inner plate of maxilla 1 has a point, the spines on the maxilliped are definitely bifid, and coxa 7 has a distinctly larger tooth posteroventrally, though this tooth varies in size; finally, the cuticle is more transparent and far better furnished with highly visible and elongate slit-pits (under medium power), many of them furnished with immersed setae; for instance, article 1 of antenna 1 has more than 15 of these ultrafine setules, dorsal margin of pleonite 3 has more than 8 of these setules, and coxa 5 has many of these setules quite enlarged.

These specimens are identified as phenotype A, with Chevreux's original description, because of the teeth on pereonites 6-7. One specimen has a middorsal spine on the peduncle of uropod 2, but the other specimens lack the spine as typical of phenotype B.

MATERIAL (of phenotype A). — Hoseason Island, Palmer Peninsula (1); Eltanin 436 (3).

### *Paradexamine fissicauda* Chevreux, Phenotype B, Antarctica

FIGURES 34–36

DESCRIPTION (of female, 19.2 mm, AH 5-30). — Lateral cephalic lobe rounded-truncate anteriorly, head with weak anteroventral definition at base of antenna 2, rostrum short, blunt; article 1 of antenna 1 with 4 pairs of spines in tandem, or with 5 sets of 2-2-2-1-3, apex above terminal spine with small tooth, article 2 about equal in length to article 1, apically simple and with 3 sets of ventral spines, flagellum about 2.2 times as long as peduncle; flagellum of antenna 2 about 1.3 times as long as peduncle, multiarticulate; mandibles bearing 2 medium spines on right, 3 on left, molars scarcely triturative, each molar with ordinary setae and ragged setae, ordinary setae of left slightly weaker than those on right; accessory bulges slightly sharpened; outer lobe of lower lip bearing weak accessory lobe, with 1 medium cone and 1 vestigial cone or 3 vestigial cones, mandibular lobes blunt, rounded; inner plate of maxilla 1 of normal size, bearing about 4 setae, palp exceeding outer plate, broad, medially and apically setose, apical cones vestigial; inner plate of maxilla 2 narrower than outer, reaching nearly 80 percent along outer, lobes appressed, outer scarcely curved, inner with weak apical truncation, both lobes with submarginal facial setae; inner plate of maxilliped large, broad, highly setose, outer plate ordinary, spines essentially simple, palp slightly exceeding outer plate, claw short; coxa 1 evenly wide along its full length, bearing only 3 marginal setae, 1 anterior, 2 ventral, 1 thick posterior seta and 1 thin posterior seta, coxa 2 with 1 ventral seta, posterior margin with stout spine, coxae 2-3 evenly rectangular, 3 with 2 stout posterior spines, 1 ventral seta, 1 stout posteroventral spine medially, coxa 4 with 1 ventral seta, coxae 5-7 with thin ventral spines; gnathopod 1 with article 6 about 0.90 times as long as article 5, on gnathopod 2 about 0.82 times, gnathopods of ordinary stoutness, palms very oblique, dactyls failing to extend palmar lengths, palms weakly castellate, dactyls smooth proximal to main tooth, oblique setal row with 17-22 pectinate setae, anterofacial areas with several sets of setae; pereopods slightly stout, pereopods 1-2 with ratio of articles 4-7 of 22:15:24:13; article 2 of pereopod 3 of ordinary width, with weak posteroventral lobe, article 2 of pereopod 4 narrowly pyriform, posteroventral lobe absent but corner spinose, article 2 of pereopod 5 thin, rectangular, spinose posteriorly and at posteroventral corner, ratio of articles 4-7 about 30:33:26:13; pleonal epimera 1-2 with lateral ridge,

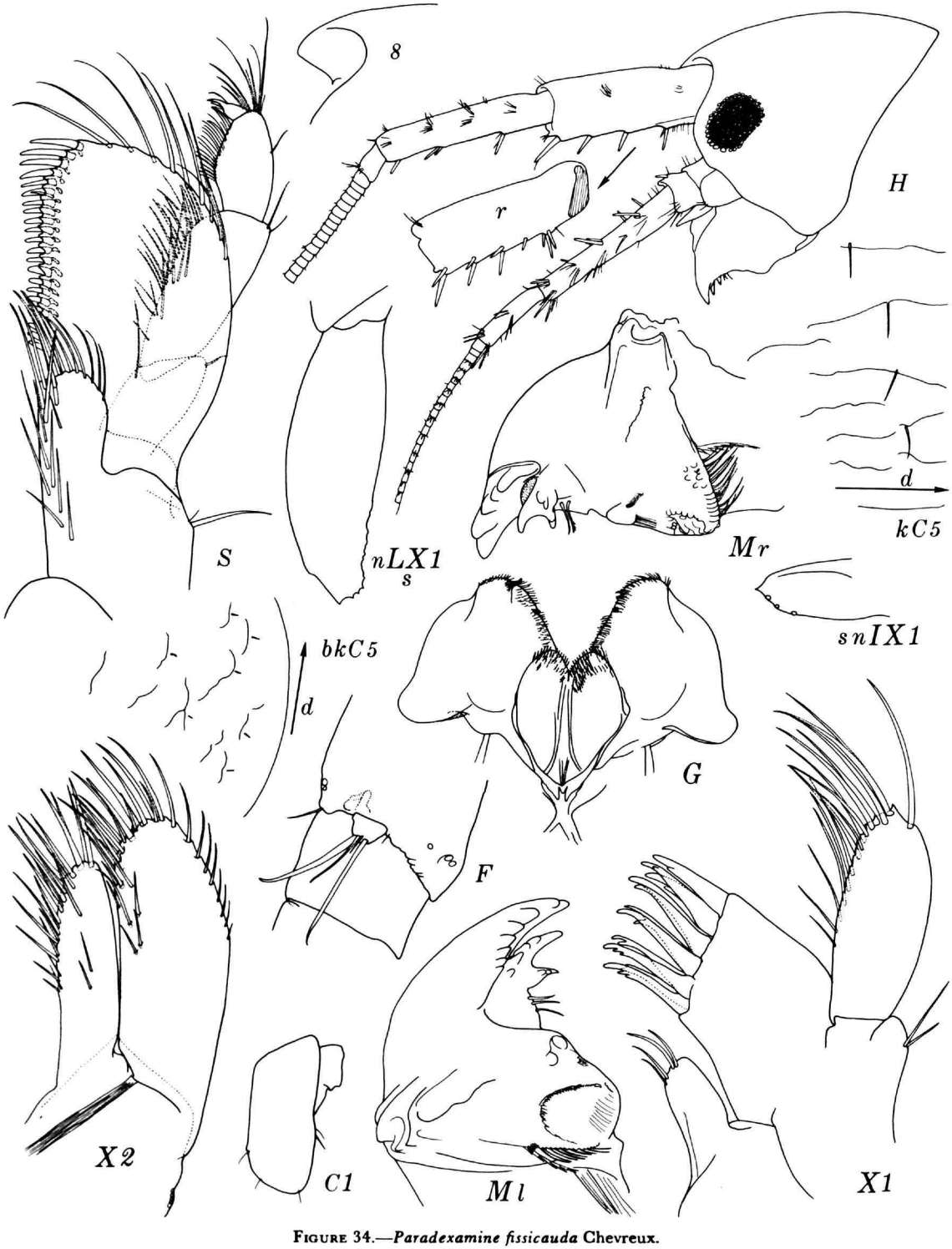


FIGURE 34.—*Paradexamine fissicauda* Chevreux.

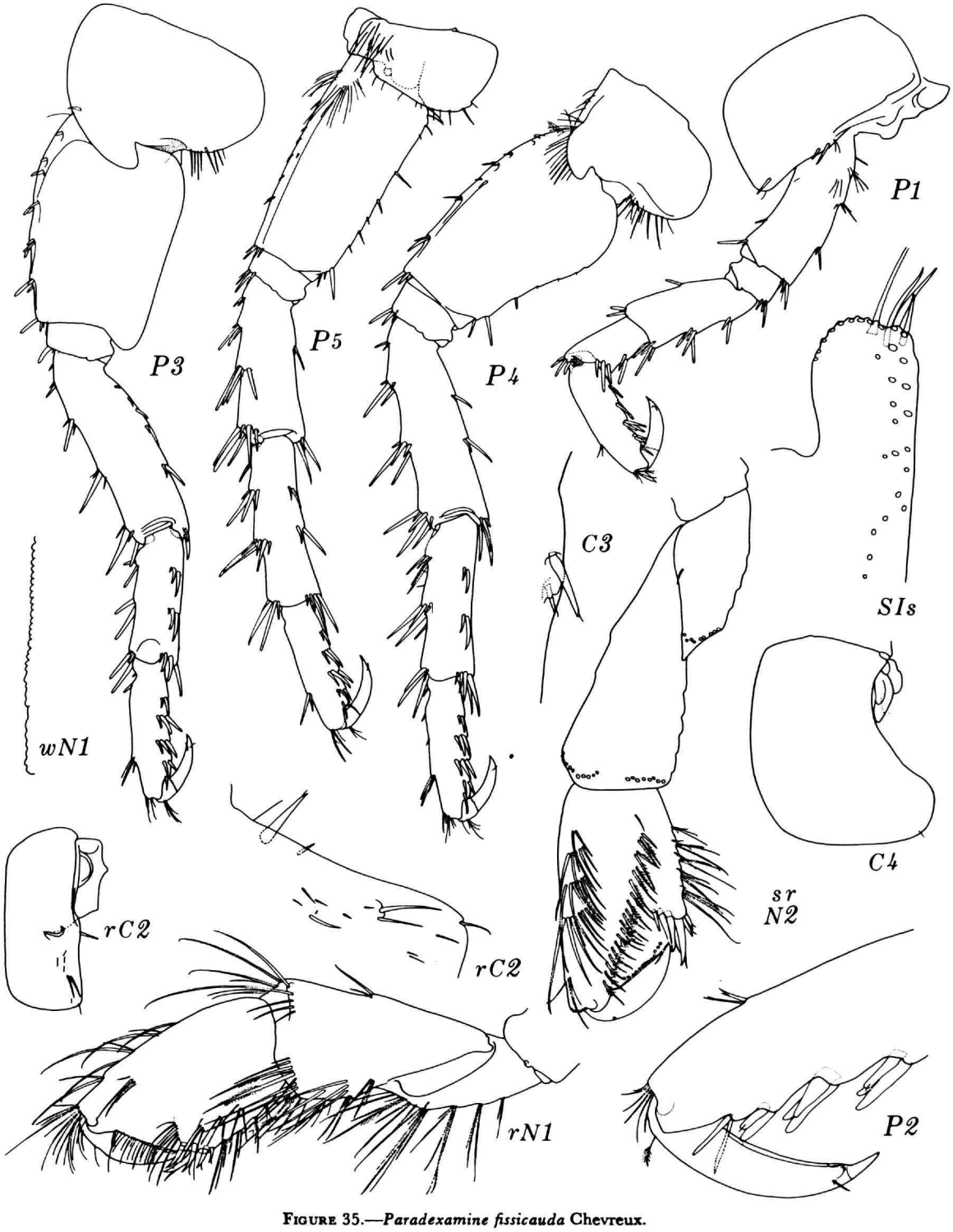


FIGURE 35.—*Paradexamine fissicauda* Chevreux.

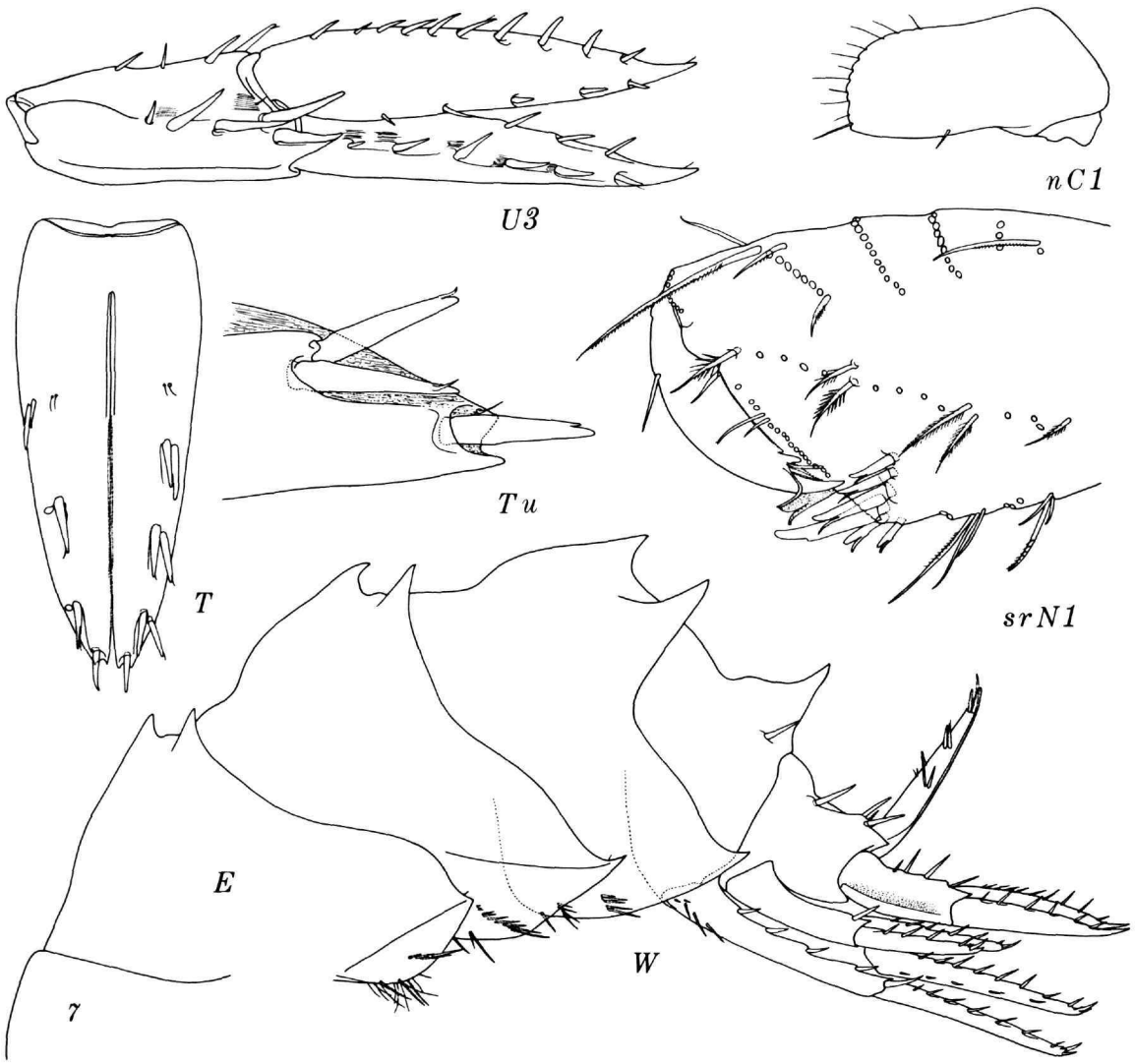


FIGURE 36.—*Paradexamine fissicauda* Chevreux, female, 13.0 mm; Antarctica AH5–30; *b*= female, 19.2 mm, Antarctica AH5–30; *n*=female, 13.0 mm, Hoseason.

1 with weak blunt tooth, 2 with long thin tooth, epimeron 3 with similar thin tooth, epimeron 1 with 8 facial spines and numerous spines and setae anteroventrally, epimeron 2 with 12 facial spines and 2 spine sets anteroventrally (2-1), epimeron 3 with 5 facial spines, then 4 facial spines, then 1 anteroventral spine (commencing from posterior); pereonites toothless, pleonites 1-3 with medium sharp dorsal tooth, medium (pleonite 1) to long (pleonite 3) side tooth, dorsal teeth of pleonites set anteriad, pleonite 4 with dorsal tooth fully erect and partially to strongly attenuate, lateral tooth absent, lateral spine present but no lateral ridge usually present, pleonites 5-6 (fused) with 1 anterolateral spine each side and 1-3 posterolateral spines in group each side; dorsal margin of peduncle on uropod 1 evenly spinose; uropod 3 with pair of very long apical spines on peduncle,

rami with spines, no setae; telson long, flat, apices very narrow, each with notch and 1 spine, sides of each lobe with 2-3 pairs of large dorsal spines along distal half of margins beyond pair of small dorsal setae, cleft of telson incomplete; cuticle not spiculate but chitin very dense and opaque, surface with scattered, extremely weak slit-pits with extremely rare, short, immersed setae; for example, lateral surface of article 1 of antenna 1 with 2-3 of these ultrafine setae, dorsal margin of pleonite 3 with one of these setae, coxa 5 posterior margin with several.

JUVENILE (4.4 mm, associated with form B adults). – Very similar to adult and recognition unquestionable: Ventral spines of article 1 on antenna 1 thin and in 2 sets, thin and in 1 set proximally on article 2, with 1 middle seta also; article 3 of antenna 2 with small seta instead of spine dorsally; mandibular molars slightly better triturative than in adult; each lobe of lower lip with 1 long, 1 vestigial cone; inner plate of maxilla 1 with 2 setae; plates of maxilla 2 lacking submarginal setae; maxilliped inner plate highly setose like adult; coxa 1 also with only 3 setae, coxae 1, 2, and 3 each with stout posterior spine, coxa 3 lacking ventral setae, 4 with 1 ventral seta; gnathopods 1-2 with 5 and 6 pectinate spines in oblique row on face of hand, anterior facial rows on gnathopod 1 in distal to proximal order with formula of 0-3-3, on gnathopod 2: 1-3; epimeral spine formulae, posterior to anterior, epimeron 1: 3-1-1, epimeron 2: 4-1, epimeron 3: 3-1-1; pleonal teeth poorly developed, side teeth of pleonite 1 absent and dorsal tooth rudimentary, dorsal tooth of pleonite 3 short and blunt, pleonites 5-6 with only 1 posterior spine on each side and 1 anterior spine each side; distal spine pair on peduncle of uropod 3 normal; telson with only 2 pairs of lateral spines each side.

MATERIAL (of phenotype B). – AH-3 (1), AH4-20 (7), AH4-25 (9), AH4-30 (12), AH4-35 (3), AH5-30 (6).

REMARKS. – This phenotype (or possibly cryptosibling species) differs in the adult from the typical phenotype A of *P. fissicauda* Chevreux in the stouter palp of maxilla 1, the simple spines of the maxilliped, the poorly setose coxae 1-4 with only a seta, no posterior spine on coxa 1, the absence of dorsal teeth on pereonites 6-7, and in the very opaque cuticle bearing few weak slit-pits and almost no cuticular setae. Specimens of phenotype B reach 19 mm in length, whereas the largest specimen of A is about 13 mm long. Specimens of B appear like overgrown juveniles, thus neotenic. The juveniles associated with B, however, have an almost normal cuticle like phenotype A.

DISTRIBUTION. – Antarctica.

### *Paradexamine frinsdorfi* Sheard

FIGURES 37–46

*Paradexamine frinsdorfi* Sheard, 1938:182–185, figs. 6T, 8A–L, 9.

DESCRIPTION (of medium female, about 4.5-5.0 mm). – Lateral cephalic lobe rounded anteriorly and very tumid and thick side to side, head well defined at base of antenna 2, rostrum medium blunt; article 1 of antenna 1 with ventral spines thick and arranged in 1 group of 2 (with pair of proximal setae), article 2 about 1.3 times as long as article 1, apically simple and with 1 set of strong spines ventrally, flagellum about 0.9 times as long as peduncle; flagellum of antenna 2 only 0.6 times as long as peduncle, multiarticulate; mandibles bearing 2 large spines on right, 2 on left, molar strongly ridged, ragged seta each side, regular setae both sides, slightly longer on right, accessory bulge small, sharp, outer lobe of lower lip bearing 2-4 large cones; mandibular lobes straight, blunt; palp of maxilla 1 of medium width, not reaching apex of outer plate, bearing apical and medial setae, no apical cone, inner plate very large, naked, nearly reaching apex of outer plate; inner plate of maxilla 2 narrower than outer, both appressed, inner with apex evenly tapering, outer not curved, inner reaching 90 percent along outer; inner plate of maxilliped attenuate, large, long, bearing 2-3 long apical spinules, and 3 short laterals, outer plate of ordinary size, spines of medium size, slightly bi-trifid, palp of medium robustness, slightly exceeding outer plate, article 4 especially elongate; coxa 1 slightly tapering apically, with weak anterior acclivity, strongly setose anteriorly and ventrally, well scalloped, coxa 2 slightly rounded below, coxa 3 rectangular and slightly extended posteroventrally, coxa 4 also sharply but weakly extended, all moderately setose, coxae 2-3 with

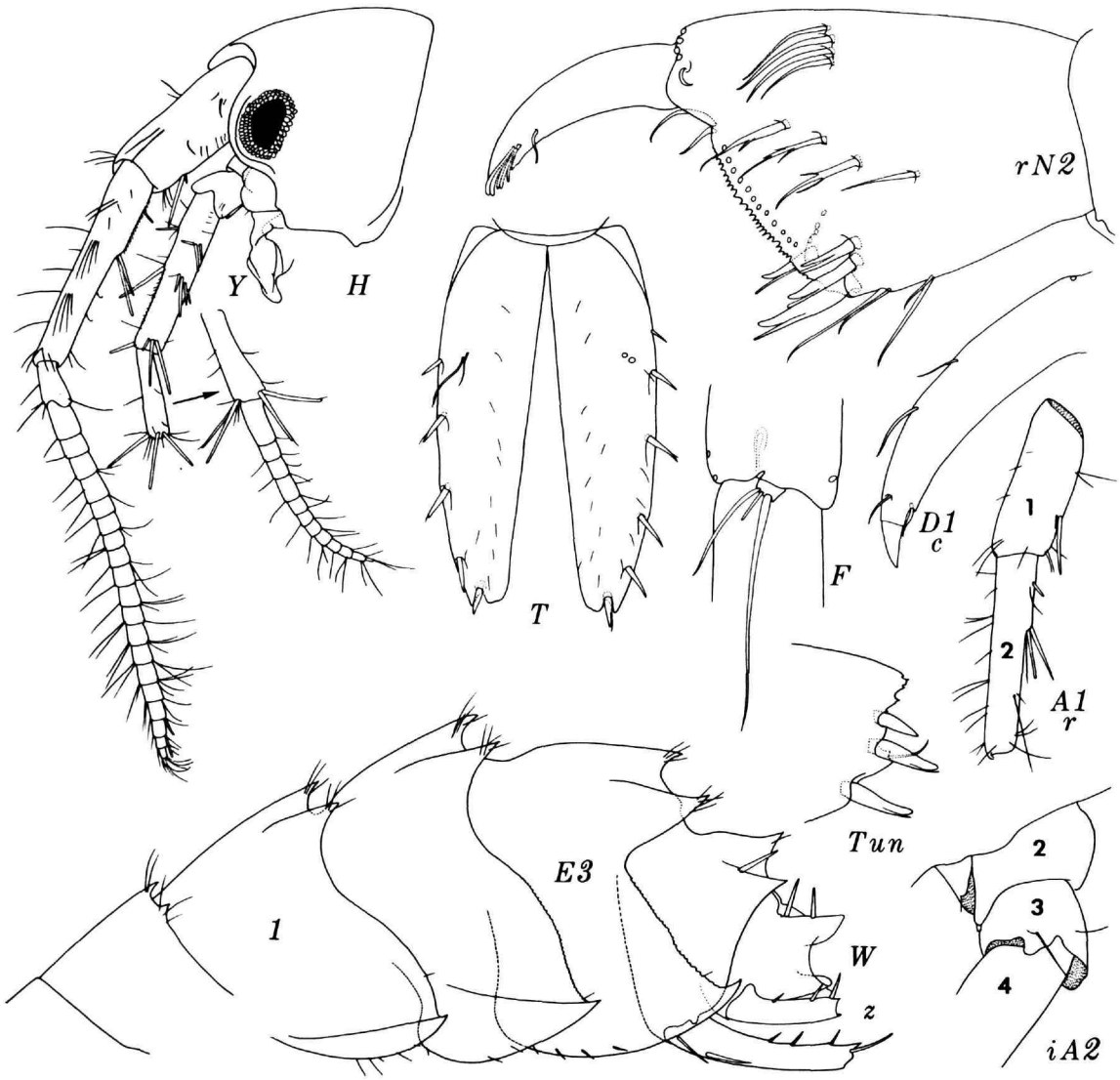


FIGURE 37.—*Paradexamine frinsdorfi* Sheard, female, 4.75 mm, Shepherd 6; *c*=female, 7.5 mm, Shepherd 16; *n*=female, 7.2 mm, Shepherd 13. (See also Figure 52.)

posterior spine, coxae 5-6 moderately setose-spinose ventrally; gnathopod 1 with article 6 about 0.74 times as long as article 5, on gnathopod 2 about the same (0.71), gnathopods of ordinary stoutness, hands widely expanded apically and palms oblique, hands thus subtriangular, palms weakly serrate, medial faces of hands with oblique setal row composed of 1-2 simple setae and 2-3 stout pectinate setae, anterior setal row on face single, dactyls smooth proximal to main inner tooth, latter highly distad; pereopods 1-2 slightly stout, with blunt spines, ratio of articles 4-7 about 16:15:22:12, dactylar ornaments moderately distad; article 2 of pereopod 3 of ordinary stoutness, posteroventral lobe deep and narrow, article 2 of pereopod 4 pyriform, posteroventral lobe obsolescent but

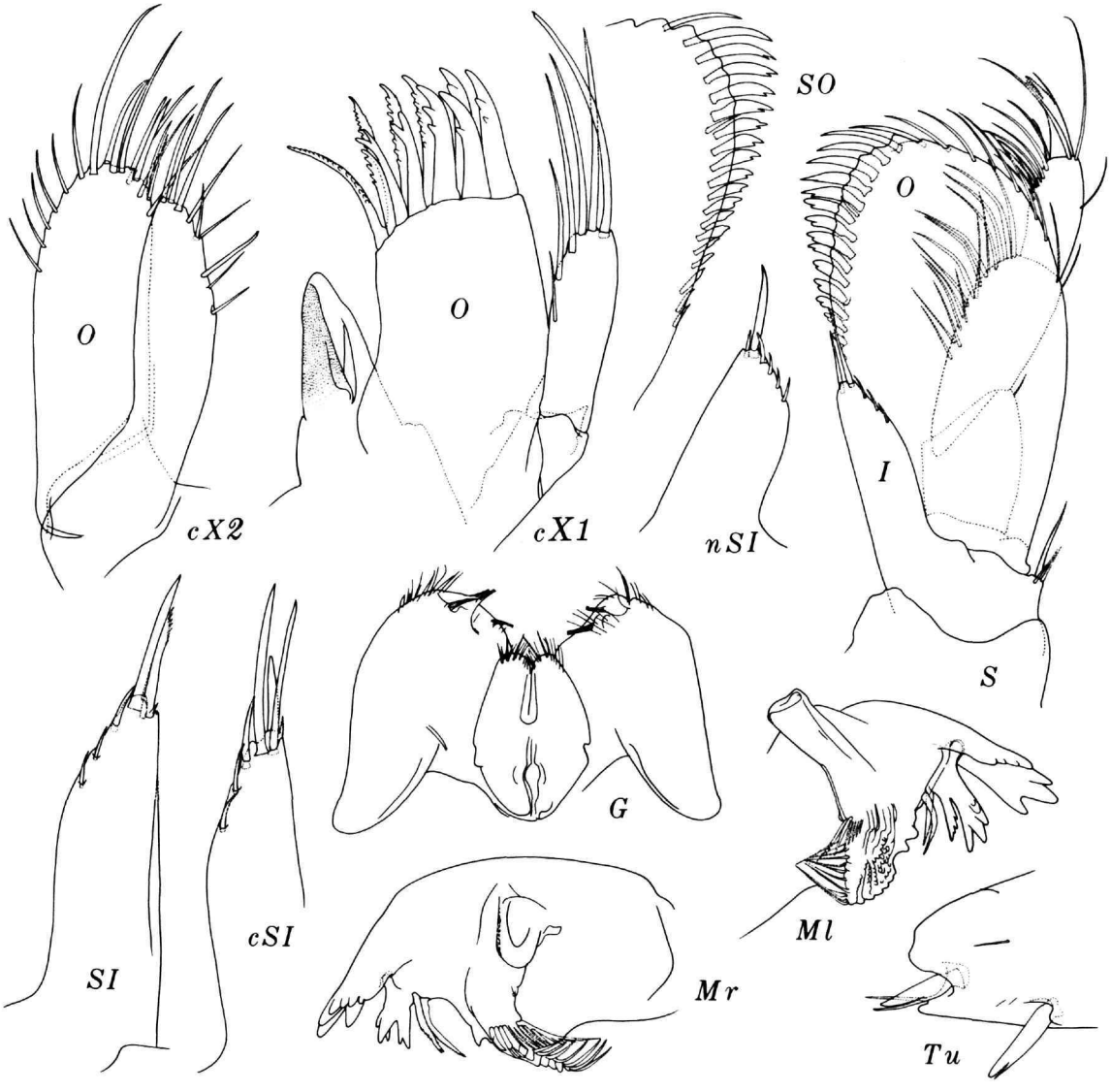


FIGURE 38.—*Paradexamine frinsdorfi* Sheard. (See legend of Figure 37.)

spinose; article 2 of pereopod 5 broadly quadropyriform, expansion mainly proximal, posterior margin deeply serrate and sparsely spinose, ratio of articles 4-7 about 19:40:25:13, pereopods 3-5 otherwise thin distad of article 2; pleonal epimera 1-2 with lateral ridge, each with small-medium sharp tooth, epimeron 3 with medium sharp tooth, posterior margins of epimera very weakly and irregularly serrocastellate, epimeron 1 ventrally with about 5 setules near middle, epimeron 2 with 2 spinules in tandem, epimeron 3 with about 5 ventral spinules; pereonite 7 with small dorsal tooth and side tooth and setae (occasionally side teeth absent), pleonites 1-4 with sharp dorsal tooth and sharp side tooth, dorsal

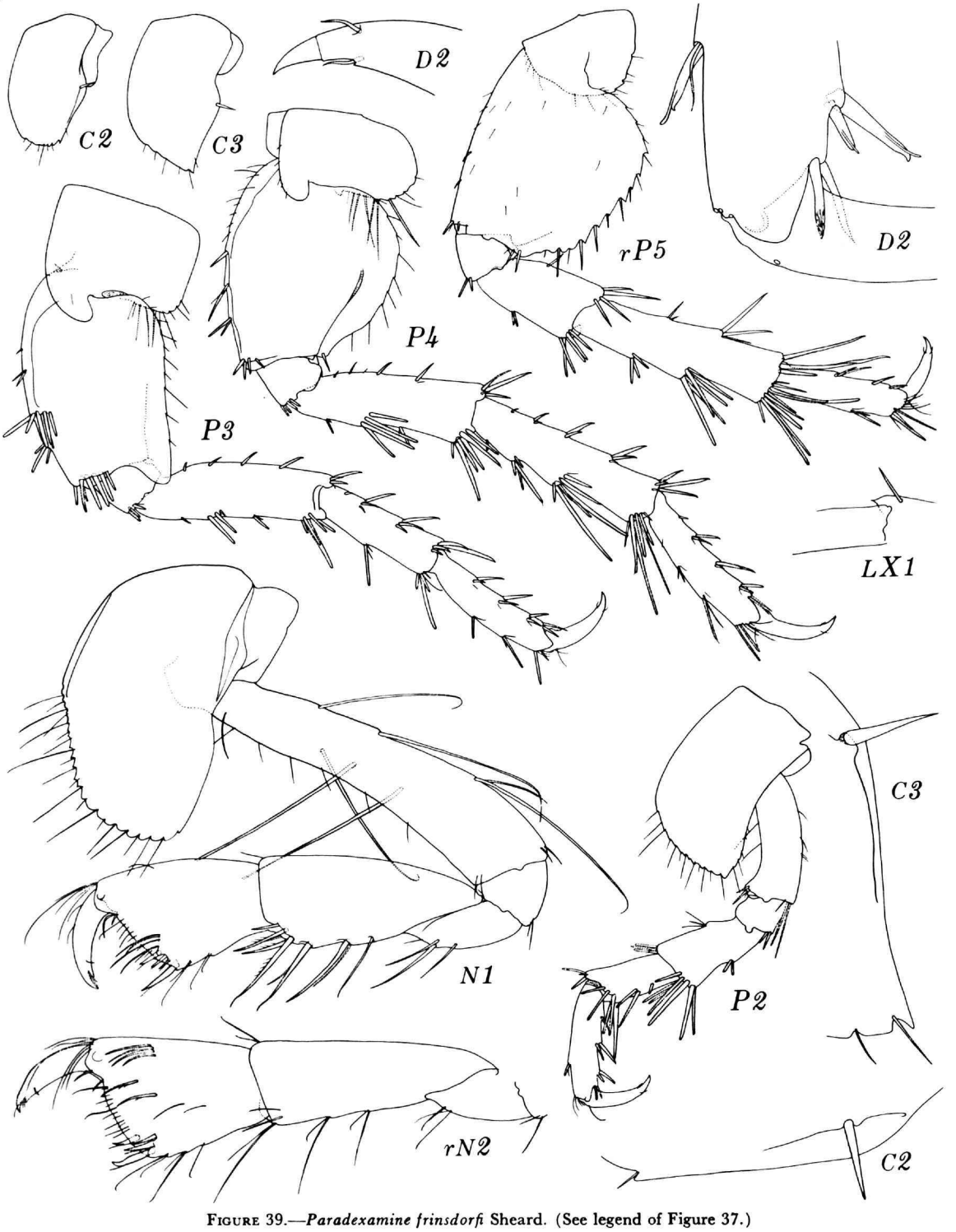


FIGURE 39.—*Paradexamine frinsdorfi* Sheard. (See legend of Figure 37.)

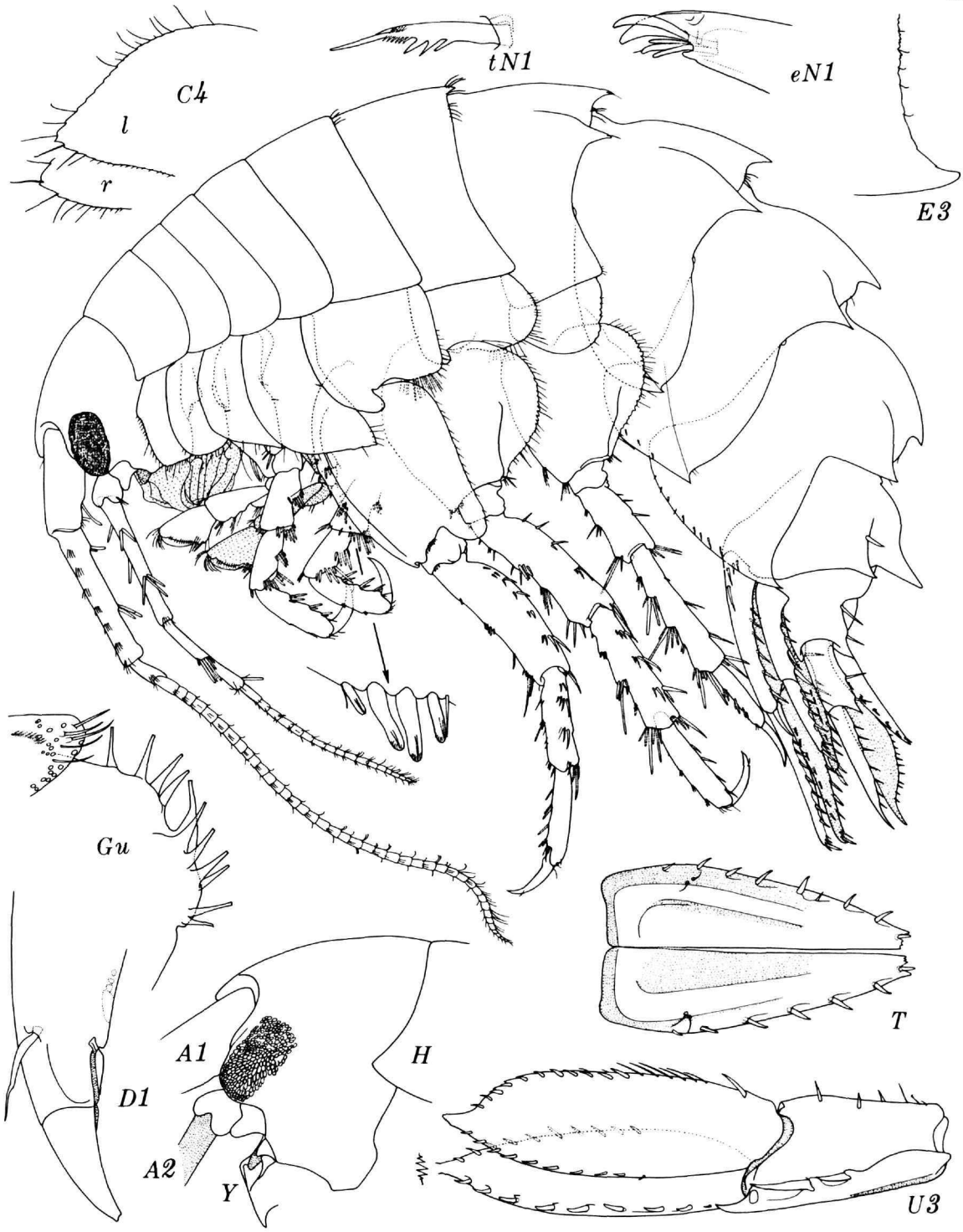


FIGURE 40.—*Paradexamine frinsdorfi* Sheard, female, 12.1 mm, Bunbury.

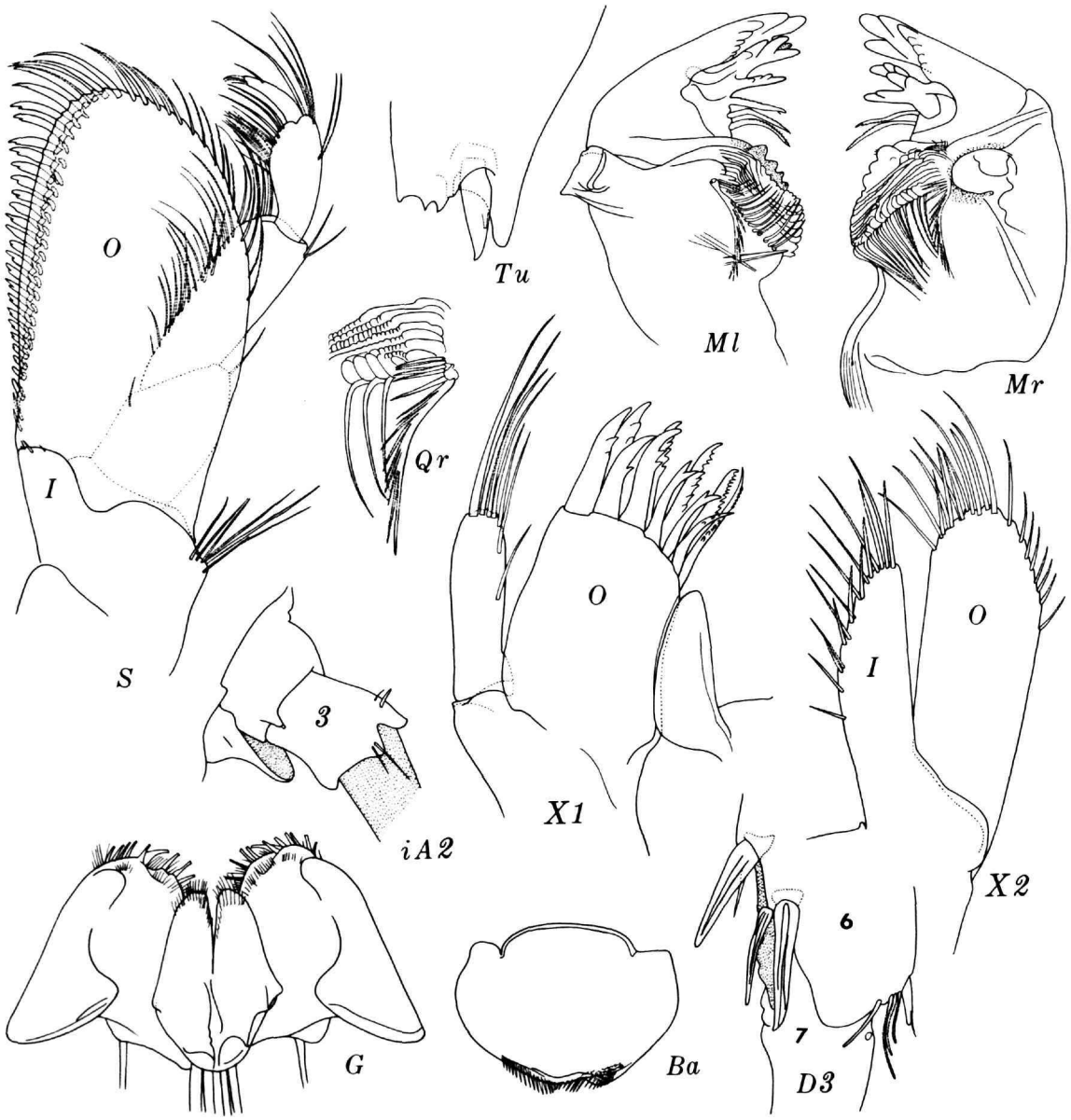


FIGURE 41.—*Paradexamine frinsdorfi* Sheard, female, 12.1 mm, Bunbury.

tooth of pleonite 3 slightly anteriad and decumbant, dorsal tooth of pleonite 4 projecting nearly vertically and with weak anterior shoulder, lateral ridge of pleonite 4 with spine, pleonites 5-6 (fused) with 2 dorsolateral spines each side; dorsal margin of peduncle on uropod 1 evenly spinose; inner rami of uropod 3 with short setae proximally; telson uncrested, apices tapered, of medium width, each bearing small spine in main notch and with medial protrusion blunt, lateral margin of each lobe with 4-5 medium-to-long spines in tandem; cuticle on posterior body segments heavily spiculate.

FIGURE 42.—*Paradexamine frinsdorfi* Sheard, female, 12.1 mm, Bunbury.

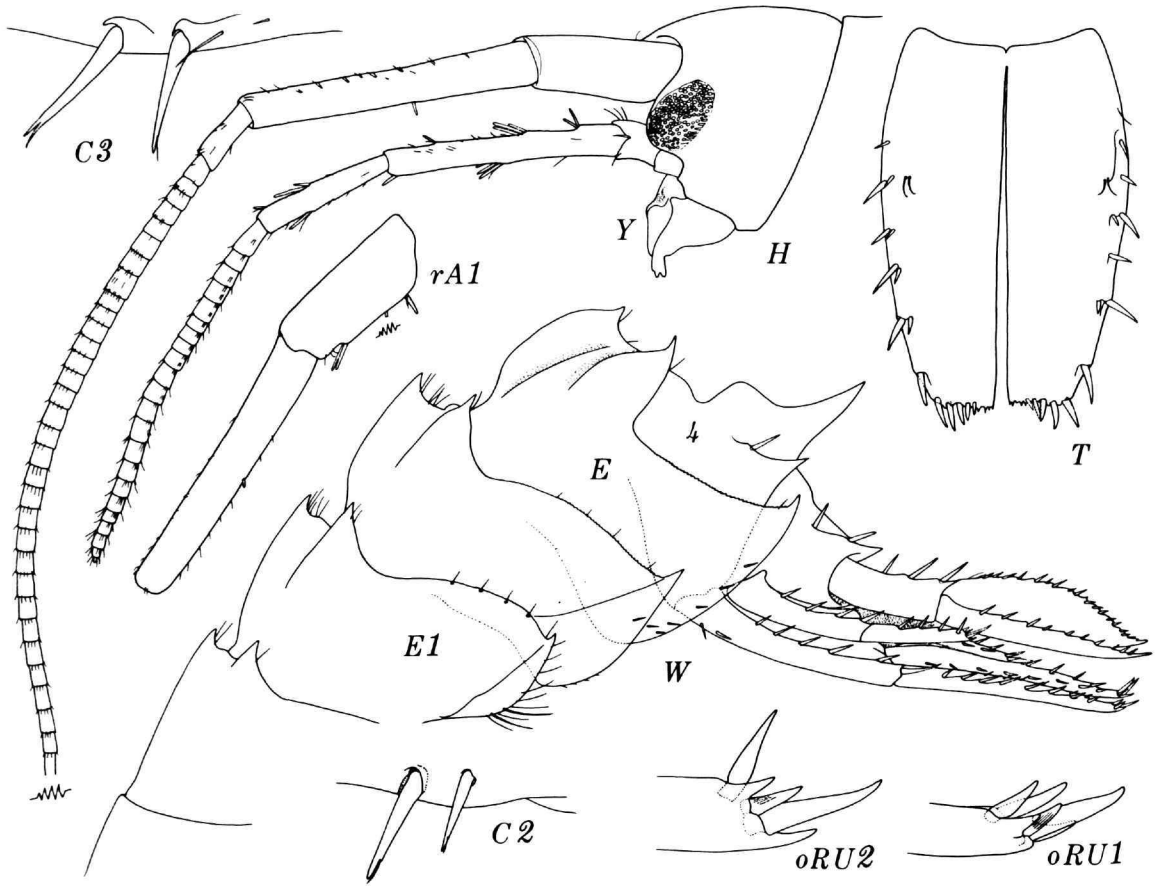


FIGURE 43.—*Paradexamine frinsdorfi* Sheard, female, 11.3 mm, Bunbury.

MALE (terminal, 4:1-5.2 mm). — Ocular lobe not evenly rounded but with weakly quadrate protrusion (like *P. churinga*), rostrum thick and blunt, eyes very large, antennae elongate and normally setulose, article 5 of antenna 2 not especially shortened relative to known males of other species, article 3 of antenna 2 with mediodorsal tooth; each lobe of lower lip bearing 2 large cones; inner plate of maxilla 2 bearing distinctly truncate apex; inner plate of maxilliped elongate, slightly attenuate, bearing 4 long apical spines and 2 laterals (or 3 apical and 3 laterals, depending on interpretation); spines on outer plate bifid; coxa 1 slightly like that in female, with very weak indication of anterior protrusion, coxa 2 lacking posterior spine, coxa 3 with very short ventral setae and 1 thick posterior spine; gnathopod 1 of ordinary kind in genus, thin and unlike that of female, hand scarcely expanded, article 5 elongate, article 6 only 0.77 times as long as article 5; gnathopod 2 also with article 5 very elongate, article 6 only 0.73 times as long as 5, but hand slightly expanded as in female, palms of gnathopods more oblique than in female; pereopods 1-2 much like those of female, dactyls each bearing 4 extra setae in tandem on outer margin; pereopod 3 like that of female; article 2 of pereopod 4, however, becoming more like pereopod 5, more quadrate and with posteroventral margin nearly horizontal; lobe on article 2 of pereopod 5 weak, article 5 very elongate; ratio of articles 4-7 on pereopod 5 about 28:54:35:18; crests on telson weak; spines on urosome small,

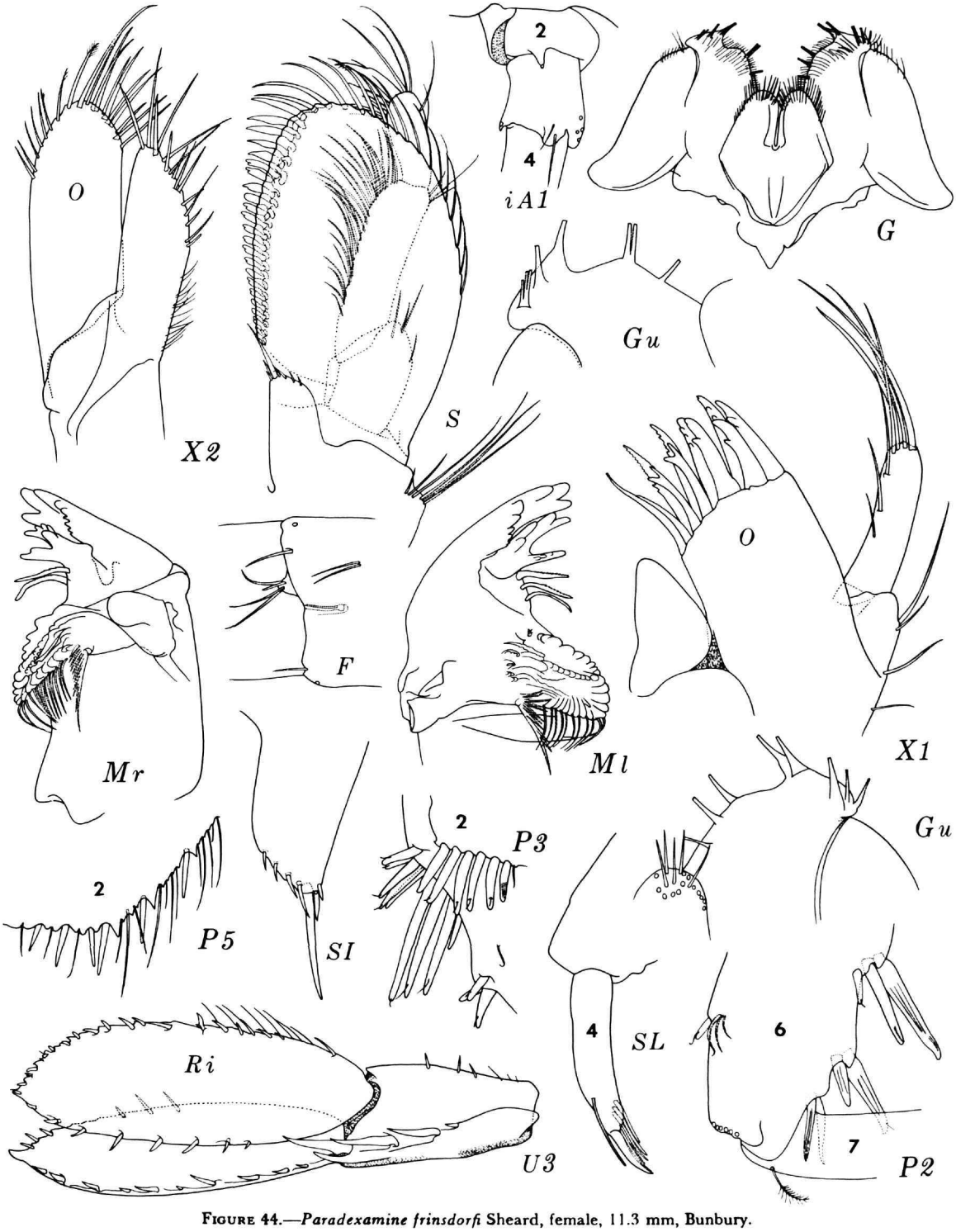


FIGURE 44.—*Paradexamine frinsdorfi* Sheard, female, 11.3 mm, Bunbury.

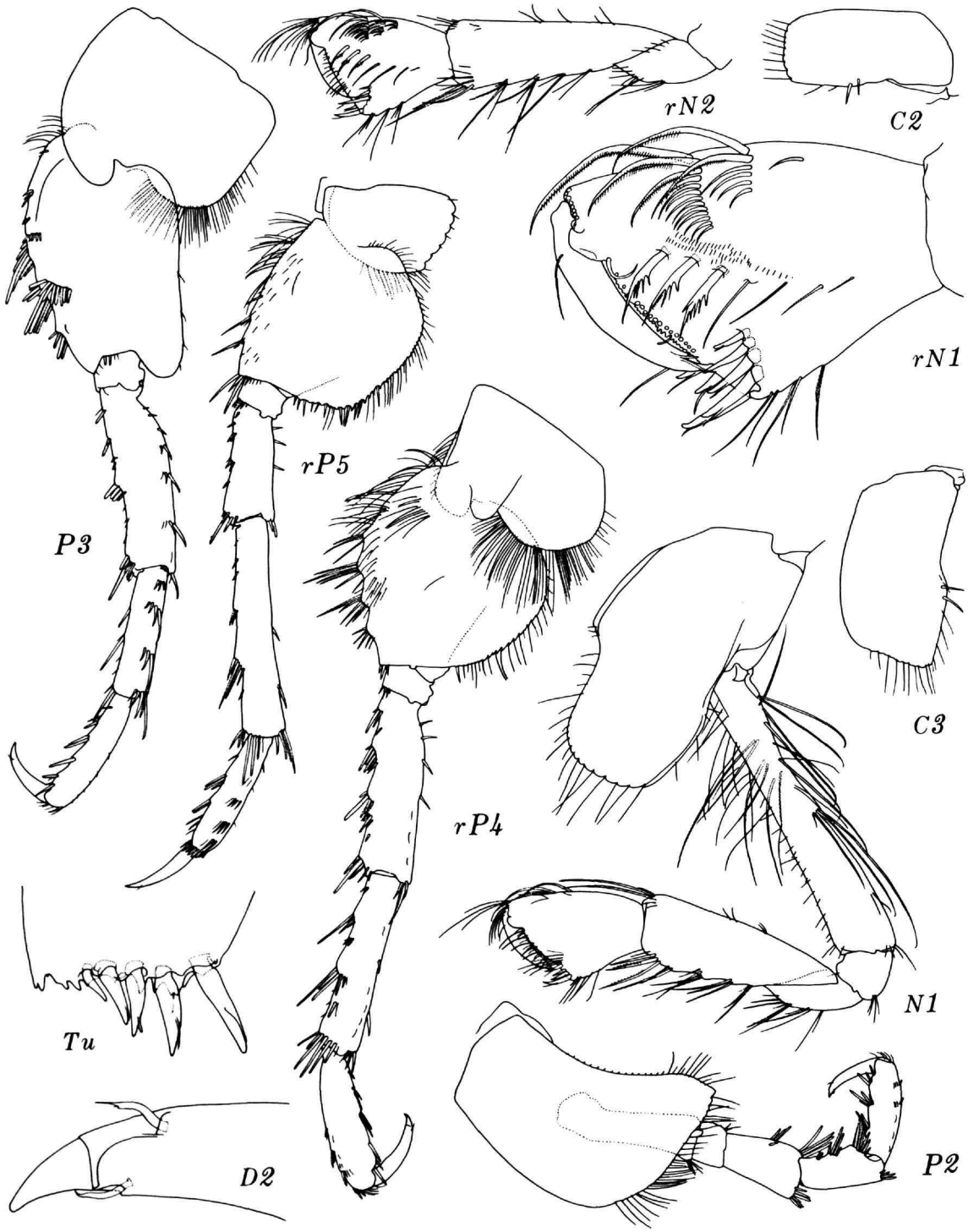


FIGURE 45.—*Paradexamine frinsdorfi* Sheard, female, 11.3 mm, Bunbury.

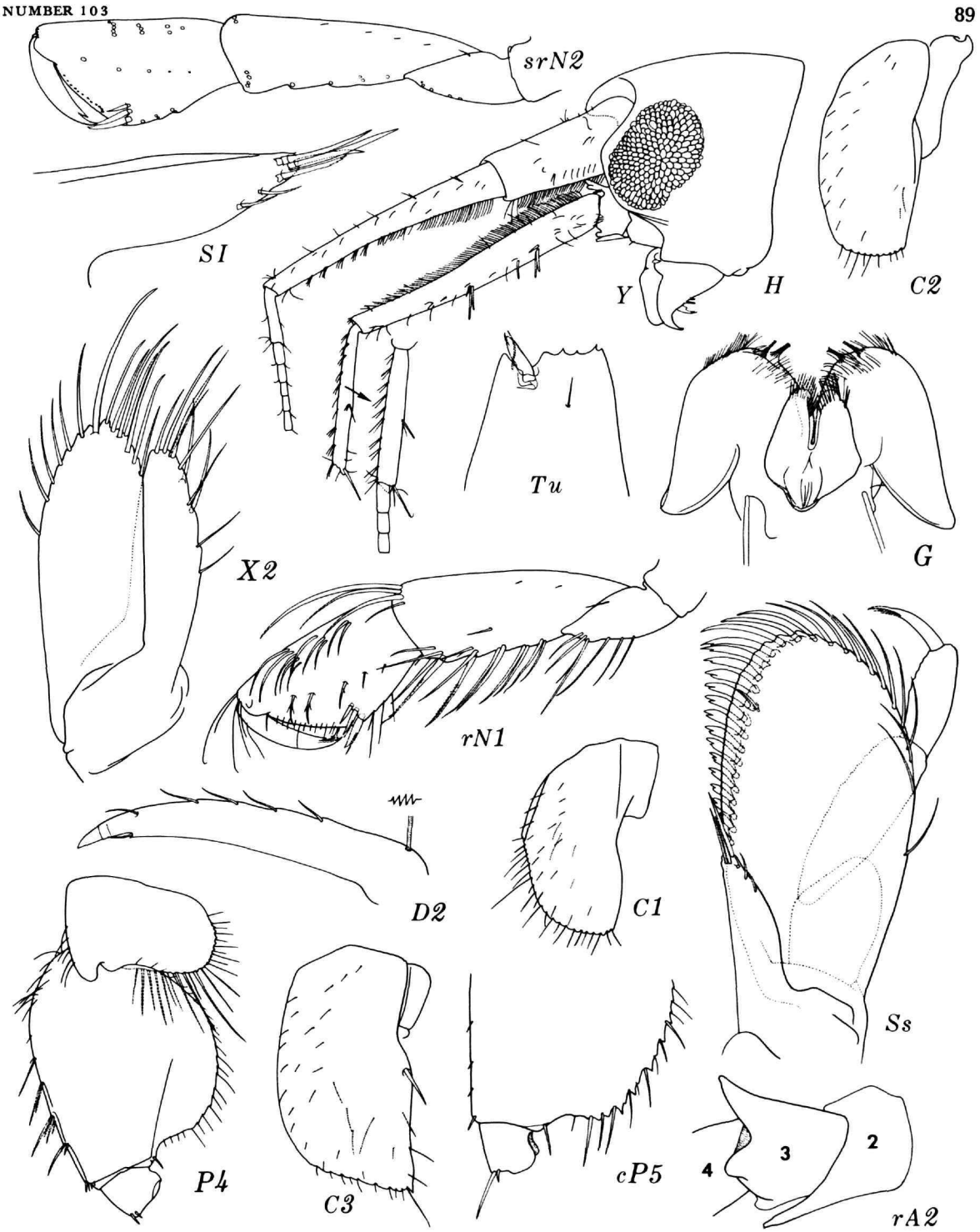


FIGURE 46.—*Paradexamine frinsdorfi* Sheard, male, 4.1 mm, VicFish 60; *c*=male, 5.2 mm, VicFish 56.

dorsal teeth otherwise like those of female, apparently no lag in development of anterior teeth; urosomite 1 lacking anteroventral setae; uropod 3 unknown; epimeron 1 with 9-14 ventral setae of various sizes, epimeron 2 with 3 ventral spines, 1 facial seta, epimeron 3 with 7 ventral spines, 1 facial spine, 1 anteroventral seta; basolateral face of peduncle on uropod 1 with 3 spines.

TRANSFORMING MALE (Shepherd 15, 6.4 mm). — Scarcely different from female, eyes slightly enlarged, article 1 of antenna 2 with medium lobe, cones on lower lip 4 and 3 on either side, pereonite 6 lacking tooth, 3 teeth of pereonite 7 weak; telson and maxillipeds normal; gnathopod 1 with 2 dorsomedial facial rows of setae of 6 and 1 each. This specimen is possibly a monster intersex or a sexually retarded giant.

DEVELOPMENT AND VARIABLES. — The 7.5 mm female from Shepherd 16 differs from 4-5 mm females in the presence of 2 short setae in tandem on the outer curved margin of the dactyls of pereopods 1-2, 4-5, and 3 setae on pereopod 3, in the presence of 2 well-developed sets of spines on each of articles 1 and 2 ot antenna 1, in the weak development of cusps on the medial protrusion of the telson, in the presence of 6 setae on the oblique row of the hand of gnathopod 1 and of 6 setae in the anterior row, in the stronger seto-spinosity of the epimera, epimeron 1 with 8 setae and 1 spine ventrally, epimeron 2 with 3 ventral and 1 facial spinules, epimeron 3 with 8 ventral and no facial spinules; the outer lobes of the lower lip are similar in having 2 cones on one side and 4 on the other.

The first gerontic female of WAM Bunbury, 12.1 mm long, has the following characters differing from the 7.5 mm and 4.5 mm stages: brood plates slightly vestigial and lacking setae, article 2 of antenna 1 about 1.5 times as long as article 1, flagellum 1.7 times as long as peduncle, flagellum of antenna 2 about 0.7 times as long as peduncle, article 1 of antenna 2 with extended lobe; gland cone vestigial; mandible with 3 spines on left side, outer lobes of lower lip with 9-11 cones on accessory lobe, inner plate of maxilla 2 about 80 percent as long as outer: inner plate of maxilliped short, broad, obliquely truncate, with about 4 very small spines; acclivity of coxa 1 strong, setae weak, sparse, ventral scallops weak, article 6 of gnathopod 1 about 0.83 times as long as article 5, hands highly triangular; pereopods 1-2 slightly stouter, ratio of articles 4-7 about 24:25:33:20, lobe on article 2 of pereopod 3 broad, article 2 of pereopod 5 broadly pyriform, resembling pereopod 4, articles 4-7 with length ratio of 24:40:21:14; epimeron 1 with 2 ventral spinules, 9 setules in middle, 3 setules posteroventrally, epimeron 2 with 3 ventral spinules, 1 facial; pereonite 5 with dorsal setae, pereonite 6 with dorsal tooth and side setae, pereonite 7 with 3 teeth like those on pleonites, shoulder of dorsal tooth on pleonite 4 well developed, medial protrusion of telsonic apex with 3 sharp cusps; cuticle scaliform.

The second gerontic female of WAM Bunbury, 11.3 mm, differs radically from the 12.1 mm female in the reduction or loss of ventral spines on article 2 of antenna 1, their reduction or loss on antenna 1 (right and left sides vary), in the lack of a lobe on article 1 of antenna 2, in the medium-sized inner plate of the maxilliped showing some rudiments of truncation but bearing 1 long apical spine and several lateral and medial spines, in the long setae of the anterior coxae, the development of a second dorsal row of setae on the hand faces of the gnathopods, in the far better developed facial spines of article 2 on pereopod 3, more like the 4.5 mm stage than the 12.1 mm female, in the broad article 2 of pereopod 5 bearing a horizontal ventral margin, the elongate article 5 of pereopod 5 (more like youthful stages), in the subcircular article 2 of pereopod 5, the presence of 2 spines each on the posterior margins of coxae 2-3, the absence of dorsal ornamentation on pleonites 5 and 6, the highly enlarged dorsal crest, tooth, and shoulder of pleonite 4, and, finally, in the lateral pairing of spines on the telson and the extremely widened and spinose apices.

At first it was believed that the two Bunbury specimens represented different species, but an intergrading stage was found in a 7.2 mm female from Shepherd 13, with an intermediate telsonic stage. Apparently aberrations occur in giant specimens of this species, but they are not synchronous nor consistent: in some specimens the telson remaining normal, in others having the apices broadened and spinose; in some specimens having only 1 anterior face row of setae on the hands of the gnathopods, in others having an extra row; in some specimens article 2 of pereopod 5 developing

normally in breadth and spinosity, whereas in others becoming pyriform like pereopod 4, with the distal portion strongly narrowed; in some specimens article 5 of pereopod 5 not becoming elongate or becoming shortened in senility; and, finally, in some specimens having the facial spinosity of article 2 on pereopod 3 reduced. The specimen from Shepherd 13 and the 11.3 mm specimen from Bunbury show the stages between the normal inner plates of the maxilliped and the aberrant terminal condition of the 12.1 mm specimen from Bunbury, in which the plate becomes shorter, broader, loses the attenuation, and loses the long apical spines or has them reduced in length.

The odd gland cone of the giant specimens from Bunbury, Western Australia, has not been found in specimens from South Australia, though none from South Australia is as large as those from the west.

The female from Shepherd 13 with intermediate telson has no tooth on pereonite 6, the cones on the lower lip are 6 and 5 on either lobe, the gland cone is of medium size, and article 2 of antenna 1 has only 1 short ventral spine. The telson has 2 terminal spines, and one spine position on one lateral margin has 2 spines.

Specimens as small as 3.0 mm from Western Port, Victoria (e.g., VicFish 62) have extra setae on the outer margins of the pereopodal dactyls, 1 seta on pereopods 1-2, and 2 setae on pereopods 3-5. The left mandible has 3 spines, the medial edge of the palp of maxilla 1 has only 1 seta, the lower lip has 3 cones on each lobe, and the gnathopods have only 3 setae in the oblique row.

A male, 4.6 mm, from VicFish 102, has a sharp dorsal tooth on pereonite 7, but the dorsal tooth on pleonites 1-2 is obsolescent and the side teeth of pleonite 1 are very small.

One aberrant male, 5.1 mm from Vic Fish 13, has a poorly spinose epimeron 3 bearing a grossly enlarged and distorted posteroventral tooth (Figure 52*xE3*).

Remarks (on the original description). — Sheard pointed out the heavily folded gills of this species, seen especially well in the specimens nearly 12.0 mm long but clearly apparent in those of 7.5 mm length. Sheard's citation of figure "7J" is erroneous, as he means "8J" for the brood lamella. His figure 8 is cited as showing the type male, but the pereopods have vestigial brood lamellae (he does mention the problem of intersexes). He shows the long inner plate of the maxilliped and he describes this plate as small, but the spines are unclear. The lower lip lacks any cones in his figure and description; the outer plate of maxilla 2 is more flabellate than in material at hand. He has the form with narrow telsonic apices, but his gnathopods are of the form seen only in my specimens nearly 12.0 mm long, whereas his specimens are 6-8 mm long. He shows 4 (or 3, depending on interpretation) anterior setal rows on the gnathopodal hand faces. The rostrum is acute only from dorsal view. Since I have one specimen with more than one anterior row of setae on the gnathopodal hands, this point can be dismissed. The other discrepancies are probably interpretive; apparently Sheard overlooked the cones on the lower lip of other species, such as *P. pacifica,* though he used them elsewhere taxonomically.

Relationship. — This species differs from *P. flindersi, P. ronggi,* and *P. otichi* especially in the triangular hands of the gnathopods (the three latter species have transverse palms). *Paradexamine windarra* and *P. narluke* have a posteroventral lobe on article 2 of pereopod 5 plus normal gnathopods or those nearly like *P. flindersi. Paradexamine goomai* comes close to *P. frinsdorfi* in telson, coxae, and pereopod 5, but the extension of coxa 3 is much more exaggerated (in a much smaller range of body length); otherwise, one might visualize *P. goomai,* a small species, as simply representing juveniles of *P. frinsdorfi,* but it lacks dorsal teeth anterior to pleonite 2.

Neozelanican *P. muriwai* also has some elements that suggest it is a normal growth stage of *P. frinsdorfi,* but, because it is fairly unusual in having 2 apical spines on each lobe of the telson and a rectoquadrate article 2 of pereopod 5, it resembles more nearly the aberrant 11.3 mm specimen of *P. frinsdorfi.*

Males of *P. frinsdorfi* differ from females in several characters typical of *P. lanacoura*: the epimera on small males, 4.2-5.0 mm, have setae nearly as dense as in *P. lanacoura,* but in males larger than about 5.5 mm the epimera become serrulate as in

the normal adult female and the setae are fewer or not so prominent; the telsonic apices have the widened medial truncation, but it is slightly serrate (2-3 serrations) and thus does not fully conform to *P. lanacoura* females. Small males also have a distinct posteroventral lobe on article 2 of pereopod 5 like *P. lanacoura*, but males exceeding 5.5 mm in length have pereopod 5 much like that of females.

MATERIAL. – Shepherd 6 (1), 13 (1), 14 (1), 15 (1), 16 (1), 17 (1), 23 (2), 25 (1), 26 (1), 30 (1), 52 (1); VicFish 1-105, 11 samples (25); WAM, Bunbury (2).

DISTRIBUTION. – Warm-temperate Australia, sublittoral.

***Paradexamine goomai*, new species**

FIGURES 47–49

DIAGNOSIS (of female). – Lateral cephalic lobe rounded anteriorly, head with strong anteroventral definition near base of antenna 2, rostrum short, blunt; article 1 of antenna 1 with ventral setae arranged in 2 groups of 2-4 each, article 2 about 1.1 times as long as article 1, apically simple and with 2 sets of ventral spines, flagellum about 1.6 times as long as peduncle; flagellum of antenna 2 about 1.4 times as long as peduncle, multiarticulate; mandibles bearing 2 large spines on right, 3 on left, molar strongly ridged, ragged seta both sides, ordinary long setae both sides; outer lobe of lower

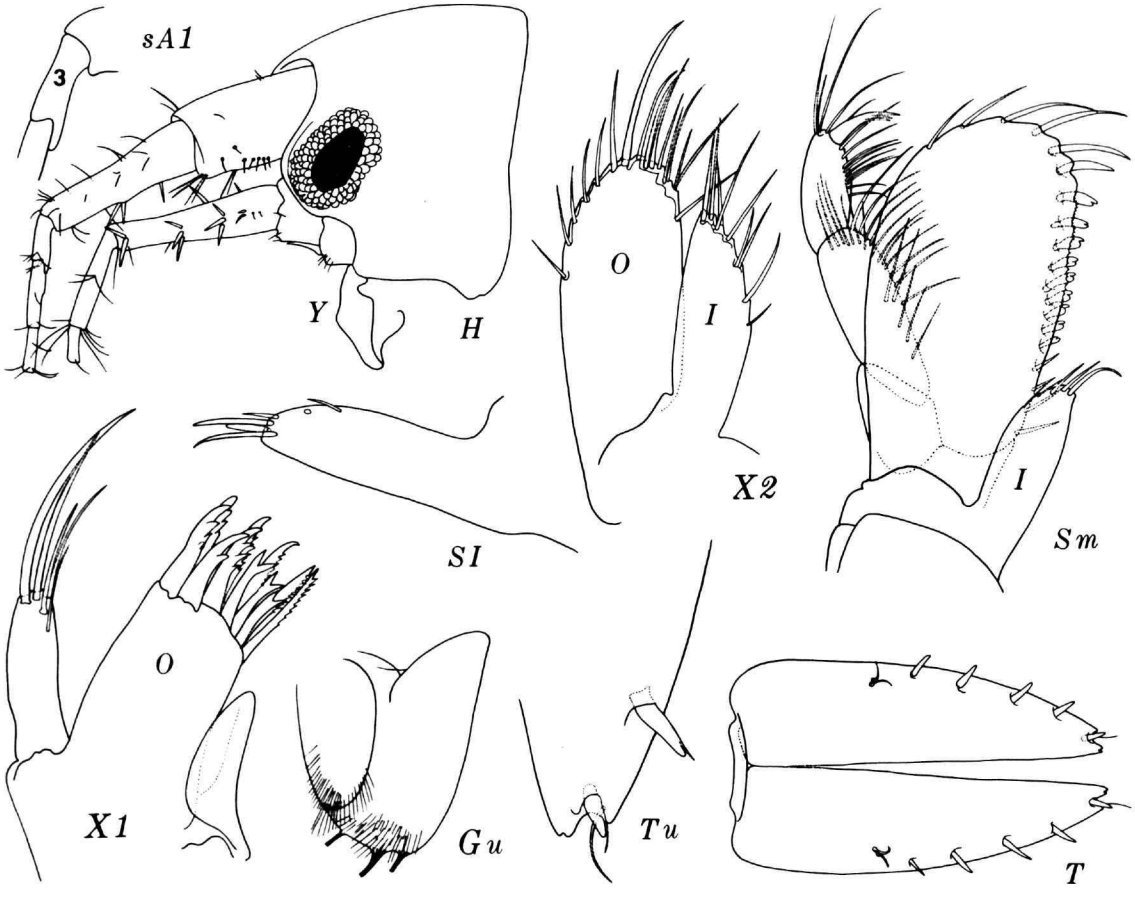


FIGURE 47.—*Paradexamine goomai*, new species, holotype, female, 5.3 mm, JLB Australia 5; *m*=male, 3.8 mm, JLB Australia 4.

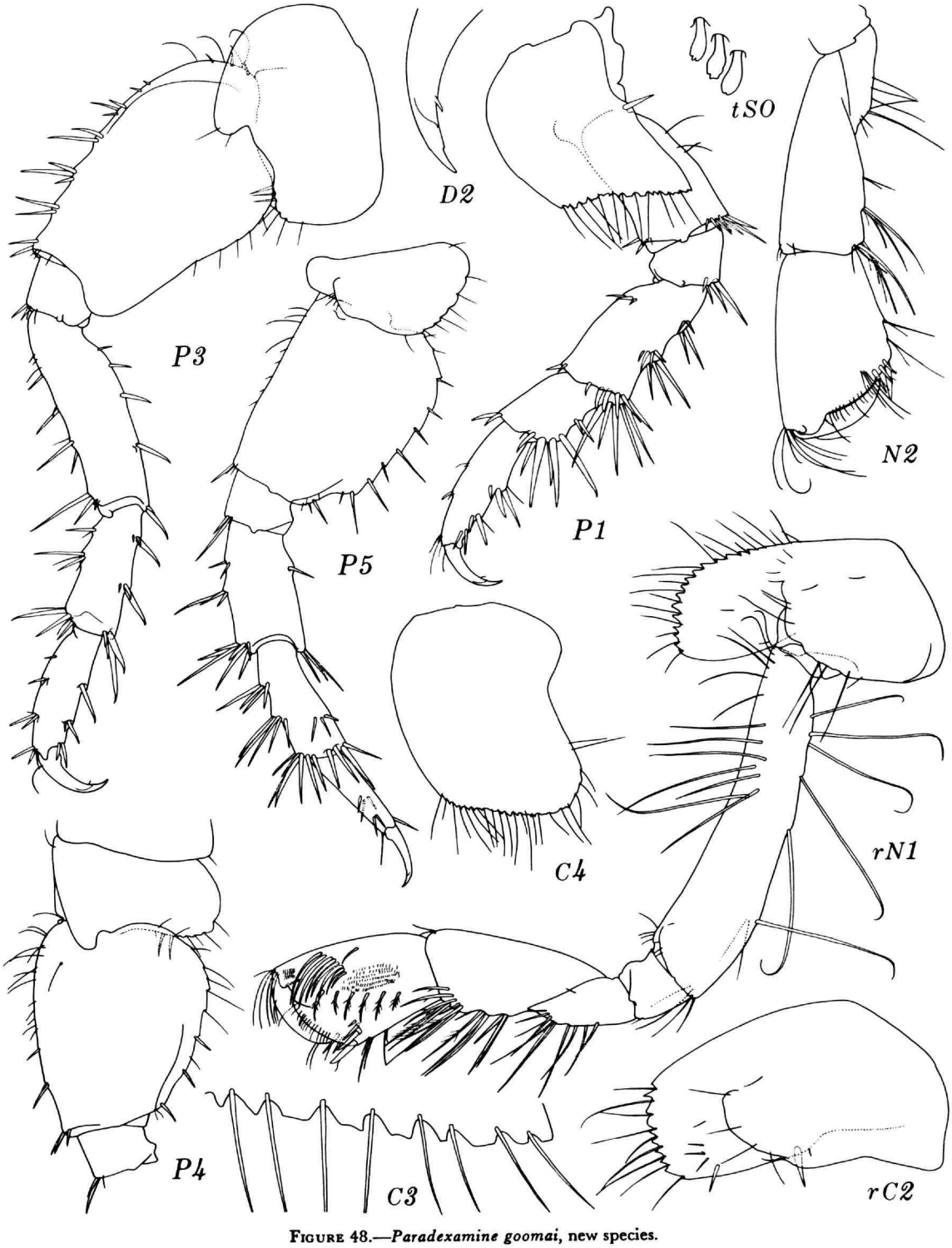


FIGURE 48.—*Paradexamine goomai*, new species.

lip with 3 long cones, mandibular lobes thick, blunt, straight; palp of maxilla 1 of medium breadth and not reaching apex of outer plate, bearing 4 apical and 1 medial setae, no strong cusps, inner plate thin, naked; inner plate of maxilla 2 much narrower than outer, reaching 80 percent along outer, outer not curved, both appressed, inner with narrow truncate apex and medial setae reaching halfway to base; inner plate of maxilliped long but thin, bearing 4 apical and 2 lateral spines, outer plate of ordinary size, spines bifid or trifid, of medium size, palp slightly exceeding outer plate, dactyl elongate; distal half of coxa 1 significantly narrower than proximal half, part of anterior and all of ventral margins deeply serrate and strongly setose, coxae 2-4 also serrate and setose, coxa 2 rectangular and bearing strong posterior spine, coxa 3 trapezoidal, broad, posteroventrally extended and with strong posterior spine, coxa 4 broad, softly rounded posteroventrally, coxae 5-6 weakly spinose ventrally; gnathopods stout, gnathopod 1 with article 6 about 0.85 times

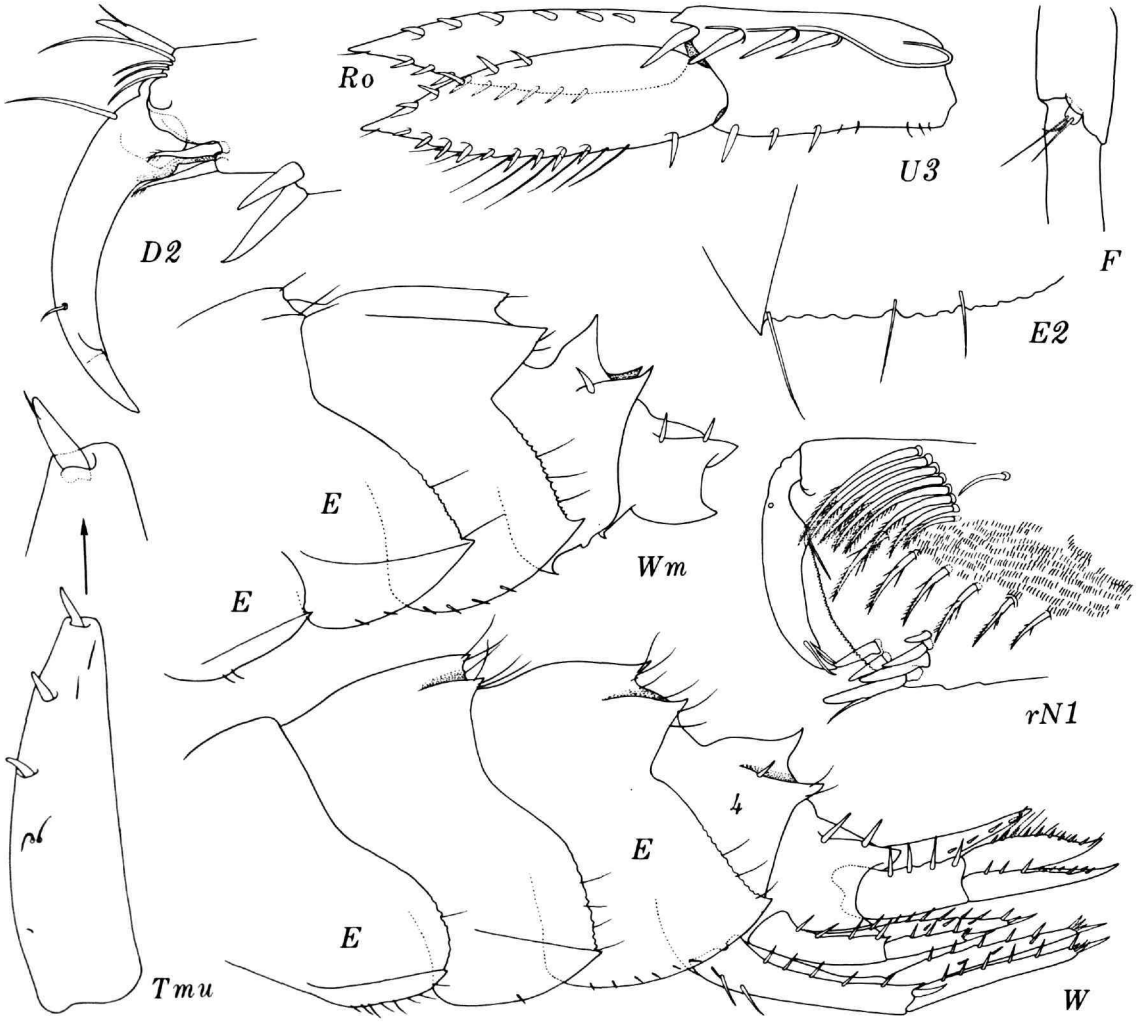


FIGURE 49.—*Paradexamine goomai*, new species.

as long as article 5, in gnathopod 2 about 0.90 times, palm slightly oblique, extremely finely serrate; dactyls short, medial oblique setal row of hand with 6 plumose spines, anterofacial setae on gnathopod 1 in rows of 8 and 1, dactyls smooth proximal to main inner tooth; pereopods stout, spines stout but sharp, ratio of articles 4-7 on pereopods 1-2 about 26:15:26:13, outer distal spinule of dactyl attached unusually proximally; article 2 of pereopod 3 slightly stout, posteroventral lobe poorly developed, article 2 of pereopod 4 ovatopyriform, posteroventral lobe obsolete, posterior margin sparsely spinose, article 2 of pereopod 5 quadrate but with posteroventral bevel, no posteroventral lobe but posterior and posteroventral margins spinose, ratio of articles 4-7 about 25:25:18:11; pleonal epimera 1-2 with lateral ridge and weak posteroventral tooth, epimeron 3 with small posteroventral tooth, posterior margins of epimera minutely ragged, epimeron 1 with about 8 short ventral setae, epimeron 2 with 1 ventral seta, epimeron 3 with about 6 ventral spinules in tandem; pleonite 1 dorsally smooth, pleonites 2-3 with small sharp dorsal tooth and side tooth, dorsal tooth on 3 placed anteriad, pleonite 4 with large erect sharp dorsal tooth, large lateral tooth and lateral spine; pleonites 5-6 (fused) with 2 dorsolateral spines on each side; dorsal margin of peduncle on uropod 1 evenly spinose; inner ramus of uropod 3 with plumose setae besides spines; telson flat, apices of lobes narrow, each bearing deep notch armed with small spines, each medial projection weakly bifid, lateral margins of lobes each with 4 small-to-medium spines; cuticle of dorsal parts of posterior body segments covered with numerous minute villi or papillae.

MALE (based on 3.8 mm, JLB Australia 4). — Male characters not fully developed, teeth of pleonite 2 poorly developed, dorsal tooth of pleonite 4 projecting completely erect; apex of each telsonic lobe truncate, quadratiform; following characters like female: maxillipeds, plates and palp of maxillae, cones of lower lip, mandibles, epimera, pereopods, coxae.

JUVENILES (smallest, 1.5 mm, based on JLB Australia 4 (1), 5 (3). — Lateral ridges on pleonite 3 weak, middle tooth obsolete, teeth absent on pleonite 2 but distinct on pleonite 4; other juveniles developing middle tooth on pleonite 2 with lateral teeth added in larger juveniles (or those better developed morphologically); size and morphological development not necessarily congruent.

HOLOTYPE. — WAM, female, 5.3 mm.

TYPE-LOCALITY. — JLB Australia 4, Sugarloaf Rock, Cape Naturaliste, Western Australia, intertidal, wash of algae, mainly green *Caulerpa* species, 1 September 1968.

RELATIONSHIP. — This species is close to *P. narluke* (q.v., for a discussion of relationships).

A few distinctions of similar species are mentioned in the following statements: *Paradexamine windarra* has a well-developed lobe on article 2 of pereopod 5, a small inner plate on the maxilliped, and a less bizarre coxae 1-4 than does *P. goomai*. *Paradexamine otichi* has coxae similar to those of *P. goomai* but has a poorly developed flagellum on antenna 2, a sublobate article 2 of pereopod 5, a spination gap on the peduncle of uropod 1, transverse palms of the gnathopods, smooth mandibular molars, and no cones on the lower lip. *Paradexamine quarallia* has characteristically blunt dorsal teeth, a normally expanded coxa 1, a lobe on article 2 of pereopod 5, and a small inner plate on the maxilliped. *Paradexamine frinsdorfi* has a poorly developed flagellum on antenna 2, a protrusion anteriorly on coxa 1, an enlarged inner plate on maxilla 1, and a quadropyriform article 2 on pereopod 5. *Paradexamine ronggi* also has a short flagellum on antenna 2 and characteristically mitten-shaped hands on the gnathopods.

*Paradexamine goomai* resembles *P. muriwai* J. L. Barnard (in press) from New Zealand but differs from it in the less strongly defined anteroventral cephalic corner, the short palp of maxilla 1, the long inner plate of the maxilliped (in the female), the different pattern of medioanterior setae on the hand of gnathopod 1 (compare Figures 47-49 and J. L. Barnard, in press), the serrate coxae, the posteroventrally extended coxa 3, the sharpness of spines on all pereopods, the narrower article 2 and shorter article 5 of pereopod 5, and the narrower apices of the telson, bearing only 1 (not 2) apical spine.

MATERIAL. — JLB Australia 4 (2), 5 (4), 6 (1).

DISTRIBUTION.—Southwestern Australia, intertidal.

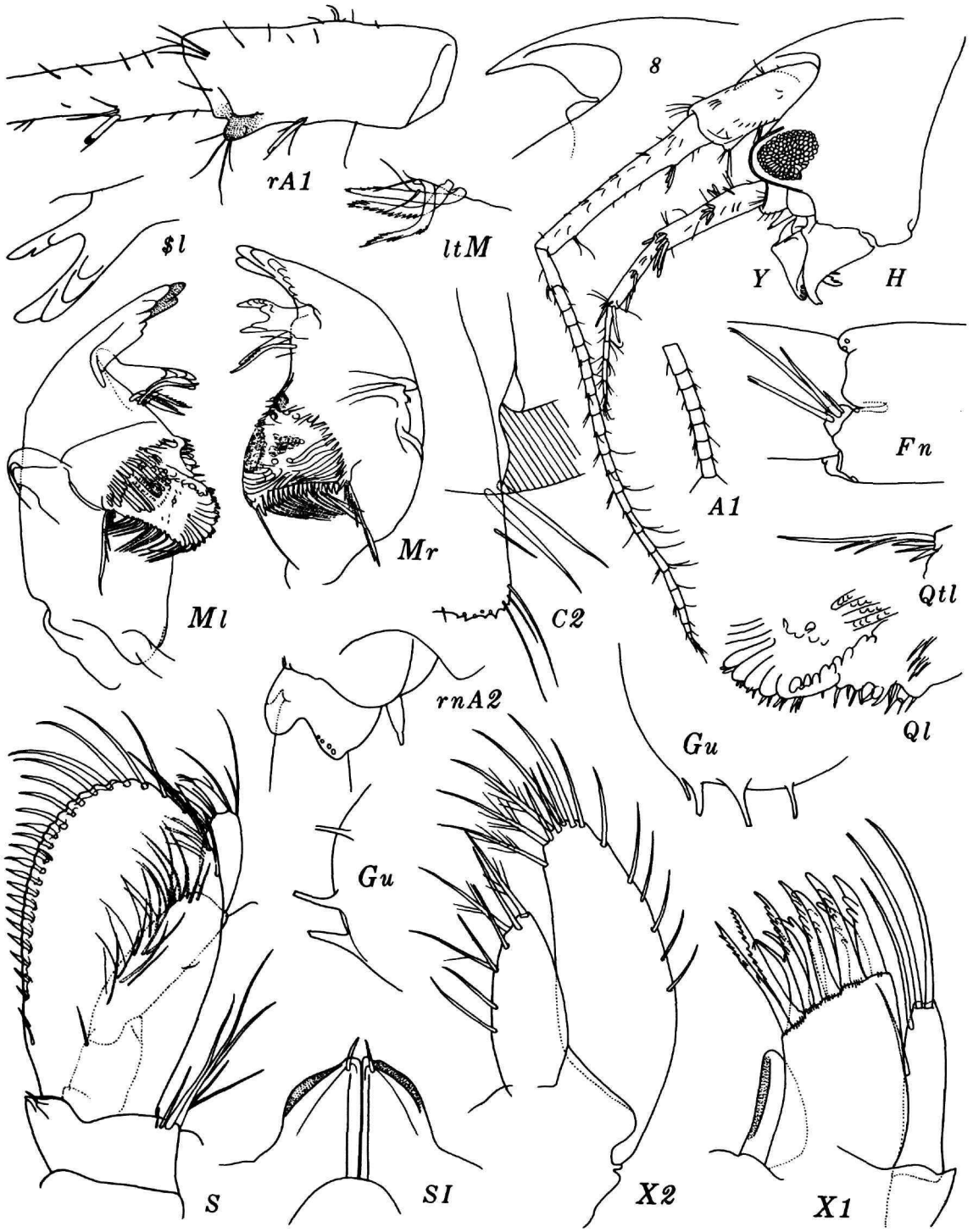


FIGURE 50.—*Paradexamine lanacoura*, new species.

***Paradexamine lanacoura*, new species**

FIGURES 50–52

DESCRIPTION (of female). – Lateral cephalic lobe rounded, protruding, thick side to side, head with distinct anteroventral definition, rostrum extremely thin and attenuate; article 1 of antenna 1 with 1 set of ventral spine(s), 1 set of setae, strong ventrodistal tooth with setae, article 2 about 1.5 times as long as article 1, apically simple but with strong spine set ventroproximally, flagellum about equal in length to peduncle; flagellum of antenna 2 only 3-4 articulate, not as long as article 4 of peduncle (see "Aberrations"); mandibles with large spines, 2 on right, 3 on left, molar heavily triturative, both sides with ragged seta and ordinary setae, accessory bulges rounded, bearing thick sparse setules, these doubled setules also on upper smooth portion of molar and several very thin setules mixed among spines of spine row; outer lobe of lower lip with 3-4 medium-to-long cones, mandibular projections thick and blunt; palp of maxilla 1 of ordinary breadth, much shorter than outer plate, bearing 2 apical setae, 2 medial setae, no apical cones, inner plate large, naked; inner plate of maxilla 2 narrower than outer, reaching only 67 percent along outer, latter with curved outer margin, plates not appressed, inner with no distinct apex and several

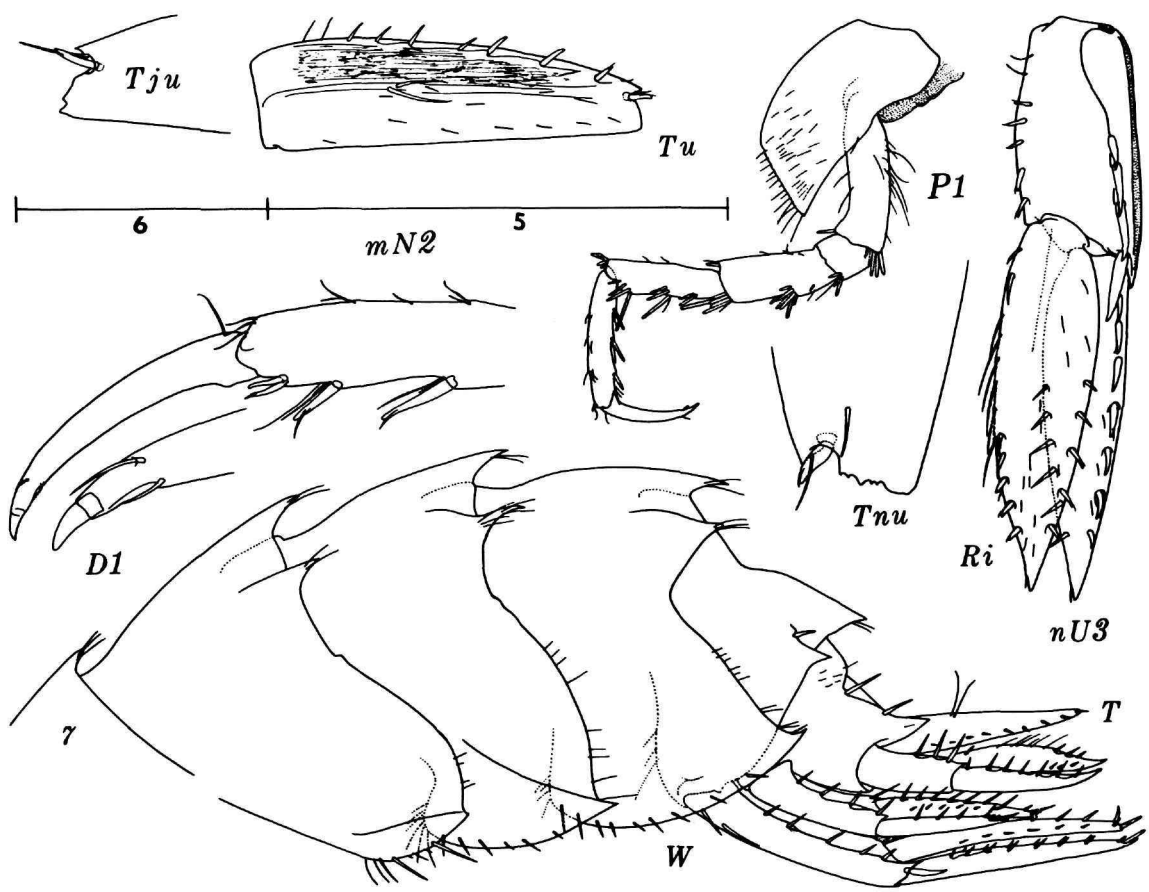


FIGURE 51.—*Paradexamine lanacoura*, new species, holotype, female, 5.6 mm, VicFish 69; *c*=female, 4.8 mm, VicFish 69; *n*=female, 5.0 mm, VicFish 69; *m*=male, 4.1 mm, VicFish 60; *j*=juvenile, 3.0 mm, VicFish 56.

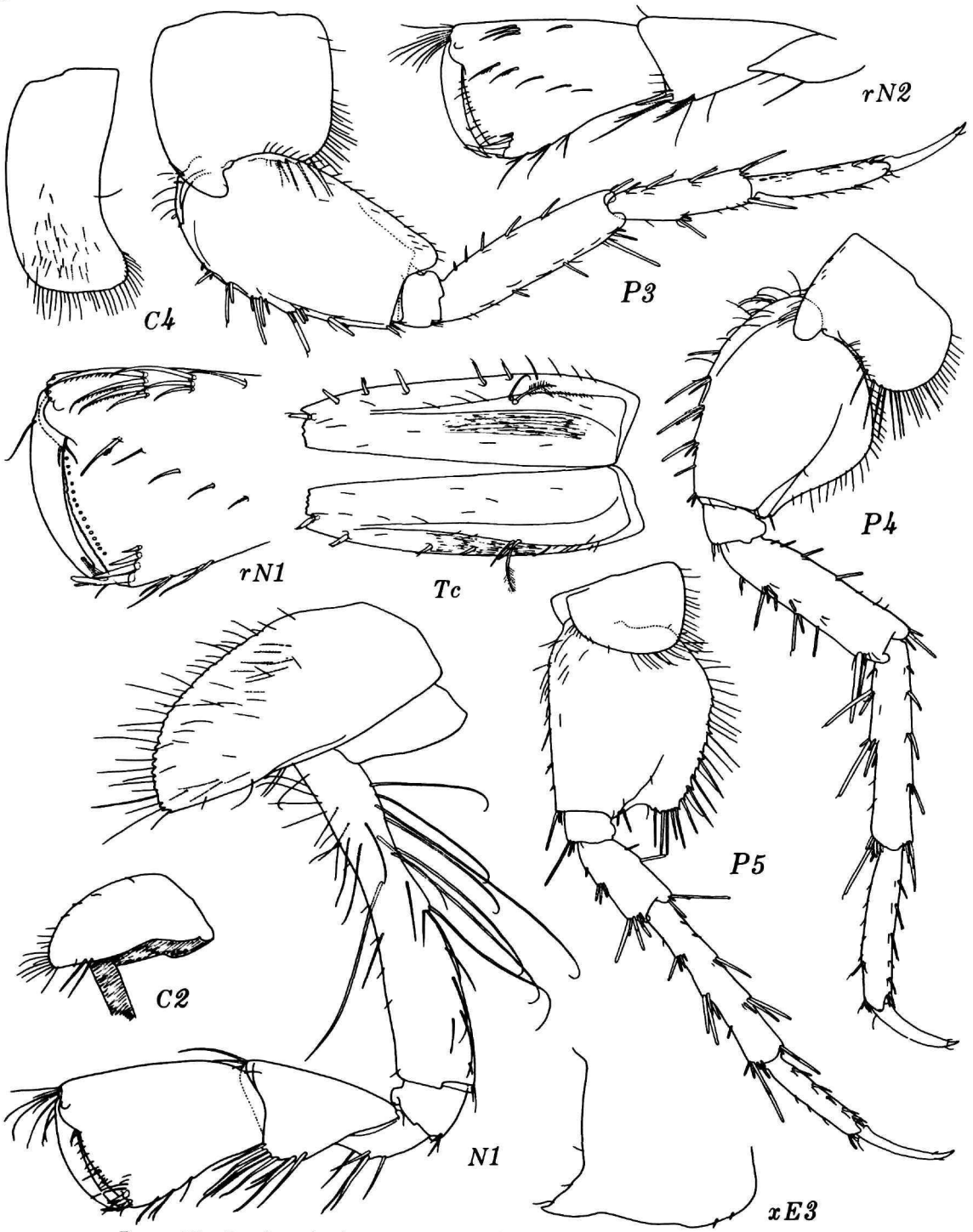


FIGURE 52.—*Paradexamine lanacoura*, new species (see legend of Figure 51). *Paradexamine frinsdorfi* Sheard, *x*=male, 5.1 mm, VicFish 13.

medial setae; inner plates of maxilliped very small, each bearing 1 small spinule, palp slightly exceeding outer plate, latter ordinary, with simple medium spines, palp article 4 elongate; coxa 1 narrow, tapering, anteriorly and ventrally setose and weakly serrate, coxa 2 also tapering, bearing 2 long and large spines posteriorly and attached medially, ventral setae long, coxa 3 slightly prolonged, scarcely serrate, setae of medium length, no posterior spine but 1 weak posterior seta present, coxa 4 with long setae, coxae 5-6 with numerous thin spines and setae; gnathopods stout, gnathopod 1 with article 6 about 1.25 times as long as article 5, about 1.12 times on gnathopod 2, article 5 broad, expanding apically, palm slightly oblique, extremely finely serrate, dactyl with apical ornaments highly distad, not pectinate proximal to main inner tooth, oblique setal row on medial face of hand with 5 thin setae, distal 1-2 setae weakly pectinate, 3 and 2 anterior setal rows on faces of gnathopods 1 and 2 respectively; pereopods 1-5 of regular stoutness, with numerous blunt spines, ratio of articles 4-7 on pereopods 1-2 about 17:18:21:14; article 2 of pereopod 3 moderately narrow, with regular posteroventral lobe; article 2 of pereopod 4 pyriform, posteroventral lobe obsolete, bearing spine, posterior margin setose; article 2 of pereopod 5 quadropyriform, posterior margin serrate, posteroventral margin with weak, spinose lobe, article 5 slightly elongate, ratio of articles 4-7 about 17:37:21:17; pleonal epimera 1-2 with weak lateral ridge, epimeron 1 with small, sharp posteroventral tooth, epimera 2-3 with medium tooth, epimera smooth posteriorly but with numerous long setae, irregularly or very regularly spaced, epimeron 1 with 2-3 ventral spines and 5-6 setae, epimeron 2 with 5-6 ventral spines and 4-5 anteroventral setae, epimeron 3 with 8-9 ventral spines and 2-4 anteroventral setae, anteroventral margin of urosomite 1 with 2-3 setae; pereonite 7 with sharp dorsal tooth; pleonites 1-4 each with sharp dorsal and sharp side tooth, pleonite 4 with spine on side ridge, pleonites 5-6 (fused) with 2 dorsolateral spines on each side; dorsal margin on peduncle of uropod 1 evenly spinose; inner ramus of uropod 3 with setae; telson with high longitudinal crests, apices broad, nearly truncate or weakly serrate, each bearing small apicolateral spine, sides of each lobe with 4-6 thin spines and 3 setae; cuticle of posterodorsal body segments scarcely spiculate but bearing large setules.

MALE (5.2 mm, VicFish 43, probably subterminal). – Eye enormously enlarged, reaching dorsally to level of dorsal edge of antenna 1; article 1 of antenna 1 bearing distoventral lobe like that of female, article 2 lacking ventral spines, setulation of antennae typical, article 4 of antenna 2 elongate but with lateral spine sets, 4 spines at mark 35, 1 spine at mark 60, article 4 slightly elongate and article 5 also elongate, ratio of 5 to 4 about 47:100, article 5 with slight apicoventral tooth; medial setae on coxae 1-4 fewer and longer than in female; medial oblique row on hands of gnathopods 1-2 composed of 4-5 setae, varying (right-left) from 2-4 pectinate and 0-3 simple on gnathopod 1, 4 pectinate and 2 simple on gnathopod 2, anterior hand setae on face of gnathopod 1 in sets from distal to proximal of 5-4-5 setae each, on gnathopod 2 of 5-3-2; article 5 of gnathopods slightly elongate compared with female; epimeron 1 with posteroventral tooth obsolescent; following characters unknown: distal articles of pereopods 4-7, telson and uropod 3 (all missing); following characters like those of female: rostrum, all mouthparts, pereopods, uropods 1-2, epimera 2-3, dorsal pleonal teeth, and posterior armaments of coxae 1-4.

TRANSFORMING MALE (VicFish 78, 5.0 mm.).–Apparently males do not necessarily transform from female-like morphology as early as 4.0 mm; this specimen combines characters of the female and terminal male to demonstrate the proper identification of the terminal male. The following characters are like those of the female: rostrum, epimera, inner plate of maxilliped (but with 2 spines each), spines on outer plate of maxilliped (but scarcely bifid), mandibular setules, setose molars, lower lip, 2 spines of coxa 2, gnathopods, shape of coxa 1, lobe on pereopod 5, and strong terminal anteroventral lobe on article 1 of antenna 1, despite setulation normal to male. These characters are like the terminal male: ventral setulation of article 1 on antenna 1 but only basally on article 2, setulation fully developed dorsally on articles 4-5 of antenna 2; pereopod 4 fully developed; tooth on article 3 of antenna 2 of medium size, shaped like a hump basally; urosomal spines small.

Another transforming male (VicFish 35, 4.3 mm) is generally like the female but bears penial proc-

esses, antenna 2 with 9-articulate flagellum, and inner plates of maxillipeds slightly enlarged.

JUVENILES (2.8-3.0 mm.) – Female-like with following characters adequately similar to adult female for purposes of identification: antenna 2 (flagellum 3-4 articulate), article 1 of antenna 1, rostrum, bulging ocular lobe, mandibles, lower lip, maxilliped, coxae 1-2, pereopods 4-5, epimeral setae (posterior edges), and the tooth formula of the pleon, with dorsal teeth on pleonites 1-2 relatively larger than in most adult females and side teeth of pleonite 4 difficult to see unless pleonites 5-6 extirpated; telsonic crests large, inner ramus of uropod 3 with inner margin bearing setae and spines in formula PSSPPP proximal to distal (P=spine, S=seta); ventral margin of epimeron 1 with 1 spine, 1 seta, 1 setule; epimeron 2 with 2 spines, no facials; epimeron 3 with 3 ventral spines; lateral base of peduncle on uropod 1 with 2 spines; gnathopods like adult but oblique facial row with only 3 simple setae, anterodorsal facial setae of gnathopod 1: 2, 1, on gnathopod 2: 1 only; palp of maxilla 1 with only 2 apical setae, no medials, and 1 short cone; maxilla 2 like adult but outer margin of outer plate with 4 setae, apex with 7, inner margin of inner plate with 3 setae, apex with 3. Generally in younger specimens article 2 of pereopod 5 has the posteroventral margin truncate like *P. ronggi*, but gnathopods remain like *P. lanacoura*.

ABERRATIONS. – One specimen of VicFish 107 lacks setae on epimeron 3 on both sides of the animal but bears normal setae on epimeron 2; the dorsal segmental teeth are very small. One female (5.4 mm, VicFish 27) has the flagellum of antenna 2 about 11-articulate and 1.4 times as long as article 4 of the peduncle.

NOTES. – The majority of specimens of this species in the VicFish collections from Western Port have perfectly transverse palms on the gnathopods. On occasional specimens one can turn articles 2 and 3 of antenna 1 in such a way as to create a point on article 2 like that described by Stebbing (1910a) for *P. flindersi*.

HOLOTYPE. – NMV, female, 5.6 mm.

TYPE-LOCALITY. – VicFish 69, Western Port, Victoria, Station 22N-2-1 and 2.

RELATIONSHIP.–*Paradexamine lanacoura* appears to have the fewest of differences from *P. windarra*, differing from that species in the evenness of spination on the peduncle of uropod 1, in the short flagellum of antenna 2, in the more acute rostrum, in the unserrate epimera, in the absence of seta on the inner plate of maxilla 1, and in the smoother apices of the telson. The two species are very similar in coxae 1-2 spination, pereopods 4-5, mandibles, gnathopods, maxillae, and maxillipeds.

The female of *Paradexamine lanacoura* differs from *P. ronggi* in the lobation of pereopod 5, the spines of coxa 2, the small inner plate of the maxilliped, the broader hands of the gnathopods with more oblique palms, the unserrate epimera, the better trituration and setosity of mandibular molars, the better development of spines on the left mandible (but only 3 spines instead of 4), and the broader apices of the telson. *Paradexamine lanacoura* also differs from females of *P. ronggi* in pereopod 5, epimera, molars, and telson, but no male of *P. ronggi* is known.

A close relationship occurs with *P. flindersi*, an open-sea sympatriot of *P. lanacoura*, but more differences occur than with *P. ronggi* and *P. windarra*. *Paradexamine lanacoura* differs from *P. flindersi* in the lobe of pereopod 5, the 3-4 articulate flagellum of antenna 2 (these articles apparently coalesced in *P. flindersi*), the absence of a tooth on article 2 of antenna 1, the small inner plate of the maxilliped, the shape of coxa 1 bearing anterior setae, probably the shape and spination of coxa 2 (not fully known in *P. flindersi*), the unserrate epimera, the more apically expanded hands of the gnathopods with slightly oblique palms, and the broad apices of the telson. The male fits these differences in pereopod 5, coxa 1, and the telson and, moreover, has thin gnathopods with very oblique palms.

*Paradexamine lanacoura* differs from *P. goomai* in the broad smooth telsonic apices, the small inner plate of the maxilliped, the normal coxa 3, lobation on pereopod 5, the short flagellum of antenna 2, the tooth on article 1 of antenna 1, the short inner plate of maxilla 2, the narrow coxa 4, and the poorly serrate coxae. The male of *P. lanacoura* fits the differences stated in telson, coxa 3, pereopod 5, coxa 4, and coxal serrations.

*Paradexamine lanacoura* differs from *P. frinsdorfi* in the lack of a protrusion on coxa 1, the lobation of pereopod 5, the broad telsonic apices, the small inner plate of the maxilliped, the short flagellum of antenna 2, the unserrate epimera (apparently

only some specimens of *P. frinsdorfi* have serrations), the more than one set of anterior setae on the faces of the gnathopodal hands, the sharp rostrum, the tooth on article 1 of antenna 1, the short inner plate of maxilla 2, the double spines of coxa 2, and the lack of spines on coxa 3. The male of *P. lanacoura* fits the differences in coxa 1 only weakly, pereopod 5 weakly, but fits strongly on telson, epimeral serrations, and gnathopodal hand setal formulae plus the thin gnathopods, and especially gnathopod 1.

Finally, *P. lanacoura* differs from *P. otichi* in many strong characters such as the enlarged spines of the mandibles, the triturative molar with setae, the large cones on the lower lip, the less rectangular inner plate of maxilla 2, the tapering coxa 1, the unextended coxa 3, the smaller inner plate of the maxilliped, the spines of coxa 2, the lobe on pereopod 5, and the broad apices of the telson.

The elongate article 4 of the maxillipedal palp is a character also found in the first five species mentioned above, but the rostrum of the female appears to be distinct from that of those species.

MATERIAL. — VicFish 1-105, 38 samples (252).

DISTRIBUTION. — Western Port, Victoria.

### *Paradexamine linga*, new species

FIGURES 53–55

DIAGNOSIS (of ?female; male unknown) — Lateral cephalic lobe with sharp anterior cusp, head lacking anteroventral definition at base of antenna 2, rostrum short, blunt; article 1 of antenna 1 with ventral spines thin and arranged in 2 groups of 3 each, article 2 about 1.35 times as long as article 1, apically simple and bearing set of spines midventrally, flagellum twice as long as peduncle; flagellum of antenna 2 nearly 1.3 times as long as peduncle, multiarticulate; mandibles with thin long spines, 1 right, 3 left, molar with regular setae on right, nearly smooth except for weak castellations, only ragged seta on left, molar bulge weak but bearing scale-like castellations; outer lobe of lower lip bearing 1 long, 1 short cusp, mandibular lobes very thin, upturned, palp of maxilla 1 large, of normal breadth, extending beyond apex of outer plate, bearing apical and medial setae and 2 apical cusps, inner plate of normal size, naked; inner plate of maxilla 2 slightly narrower than outer, both appressed, inner with apex very oblique, outer scarcely curved, inner reaching more than 80 percent along outer, outer plate with 3 subproximal setae on inner face; inner plate of maxilliped large, bearing 6-7 apical, lateroapical setae and 3 subapical facial setae, outer plate of ordinary size, rather thin, spines small, simple, palp robust, slightly exceeding outer plate; coxa 1 expanded at distal mark 67, weakly setose anteriorly, strongly setose ventrally but poorly serrate, coxae 2 and 3 rectangular, setose ventrally, bearing 1 midposterior spine, coxae 5-7 with thin ventral spines; gnathopod 1 with article 6 about 0.8 times as long as article 5, on gnathopod 2 about 0.76 times, gnathopods moderately thin, palms oblique, medial faces of hands with 5-6 thin, weakly pectinate setae or simple seta rarely, anterofacial setae in rows of 2 and 3 on gnathopods 1 and 2 respectively, dactyls bearing minute pectinations proximal to inner tooth, palms regularly and deeply serrate; pereopods 1-5 thin, with very sharp spines except for a few posterodistal members on article 6 of pereopods 1-2, ratio of articles 4-7 on pereopods 1-2 about 19:13:19:13; article 2 of pereopod 3 of ordinary stoutness, posteroventral lobe broad and deep; article 2 of pereopod 4 pyriform, jagged and spinose posteriorly, posteroventral lobe obsolescent but spinose; article 2 of pereopod 5 lesser pyriform, posterior margin well serrate and with several spines, article 5 elongate, ratio of articles 4–7 about 20:36:24:15; pleonal epimera 1-2 with lateral ridge, small sharp tooth on 1, medium sharp on 2, epimeron 3 with large sharp, basally thick tooth, posterior margins of epimera smooth, epimeron 1 with bundle of 3-4 spines in facial row, epimeron 2 with facial row of 8-9 spines and 2 anteroventral spines in tandem, epimeron 3 with facial row of 3-4 and 4-5 anteroventral spines in tandem; pleonite 1 dorsally smooth, pleonites 2-3 with sharp dorsal tooth and sharp tooth on ridge of each side, pleonite 4 with sharp, subprostrate dorsal tooth, no lateral tooth but with spine on lateral ridge, pleonites 5-6 (fused) with 2 dorsolateral spines on each side; dorsal margin of peduncle on uropod 1 evenly spinose; rami of uropod 3 lacking setae; telson very long, with high crest on each lobe, apices broad, with 10-13 deep serrations, 1 main small spine in notch space, lateral margins of each lobe with about 6 long spines (occasionally short alternatively);

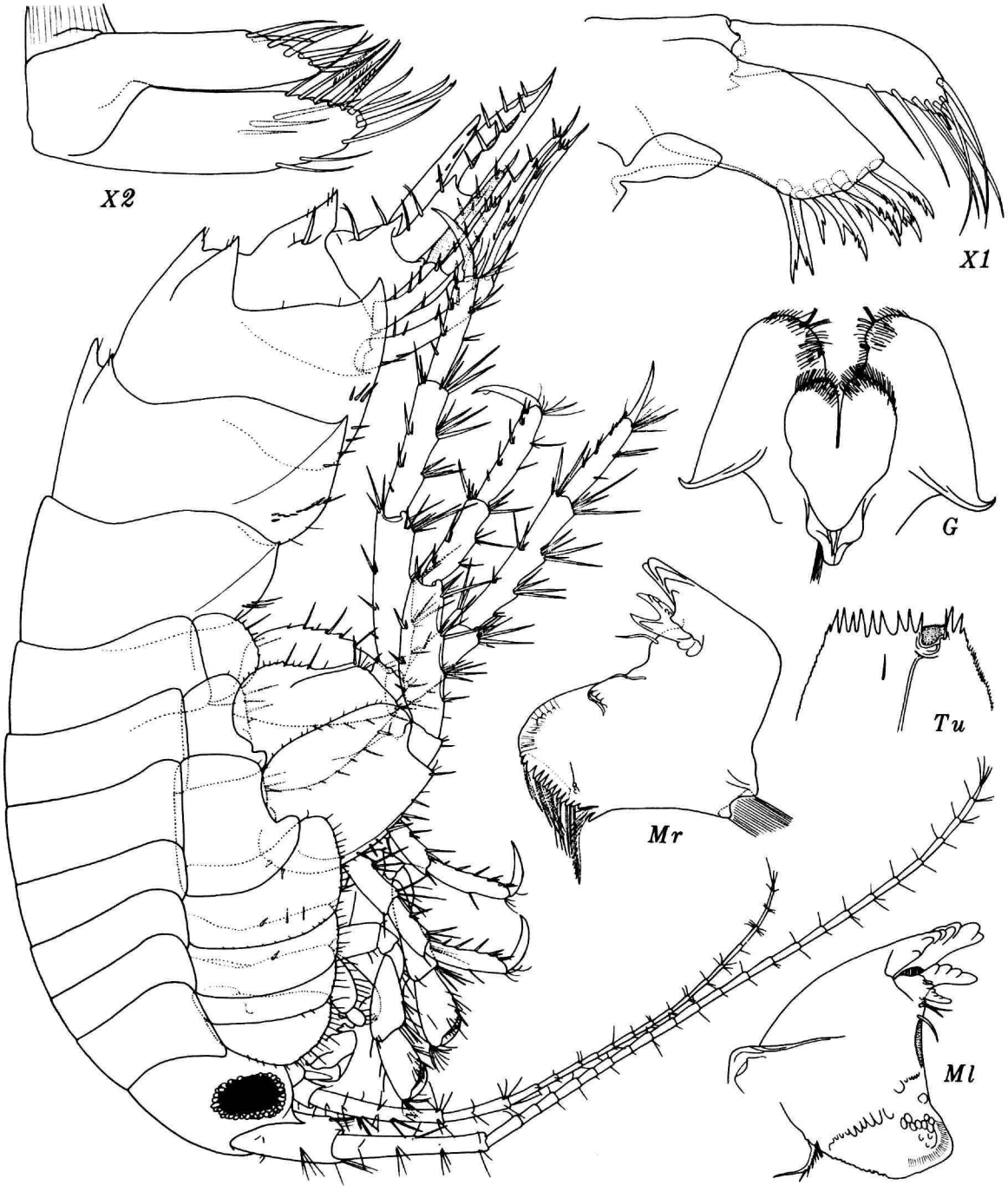


FIGURE 53.—*Paradexamine linga*, new species.

cuticle of posterior body segments weakly setulose-spiculate.

HOLOTYPE. – WAM, ?female, 3.4 mm. Unique.

TYPE-LOCALITY. – JLB Australia 8, 3 miles northeast of Dunsborough, near Cape Naturaliste, Western Australia, wash of sponges and tunicates on pilings of old jetty, 2 September 1968.

RELATIONSHIP. – The single specimen of this species is externally similar to *P. marlie* but was recognized because of the shorter antenna 1 and the gross serrations and spines on article 2 of pereopods 4-5, and the wider article 2 of pereopod 5. The presence of spines on the mandible of *P. linga* is the main specific character, but the regularly serrate telsonic lobes, the larger inner plate of maxilla 2 (in female-like specimen), the absence of a seta on the inner plate of maxilla 1, and the slightly enlarged inner plate of the maxilliped also characterize *P. linga*. The two species form a pair of cryptosiblings and may be difficult to identify in subadult condition unless mandibles are dissected in every specimen.

The mandibular spines of *P. linga* are much larger than those of *P. houtete*, and the latter has 1 or more setae on the inner plate of maxilla 1 plus tridentation on pleonite 1. *Paradexamine pacifica* is a fourth member of this sibling group, and *P. linga* apparently differs from *P. pacifica* in the fewer, larger, and more irregular serrations of the telson, the absence of a seta on the inner plate of maxilla 1, the presence of strong spines on coxae 2-3, the single apical spine on the peduncle of uropod 3, and the single spine on the right mandible. I remain confused by Sheard's (1938) Figure 5E as to whether or not he has illustrated mandibular spines or a branch of the lacinia mobilis; I presume spines since a partially hidden branch of the lacinia mobilis also occurs. A fifth member, *P. barnardi*, has

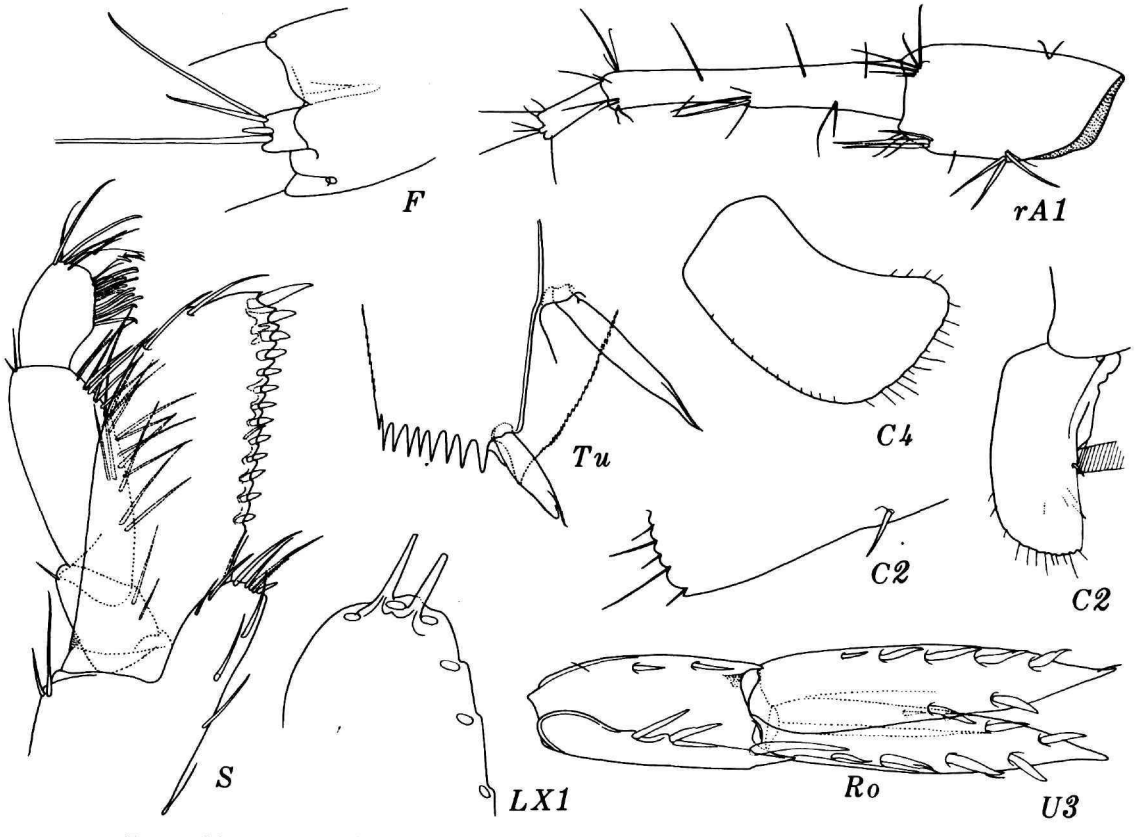


FIGURE 54.—*Paradexamine linga*, new species, holotype, female, 3.4 mm, JLB Australia 8.

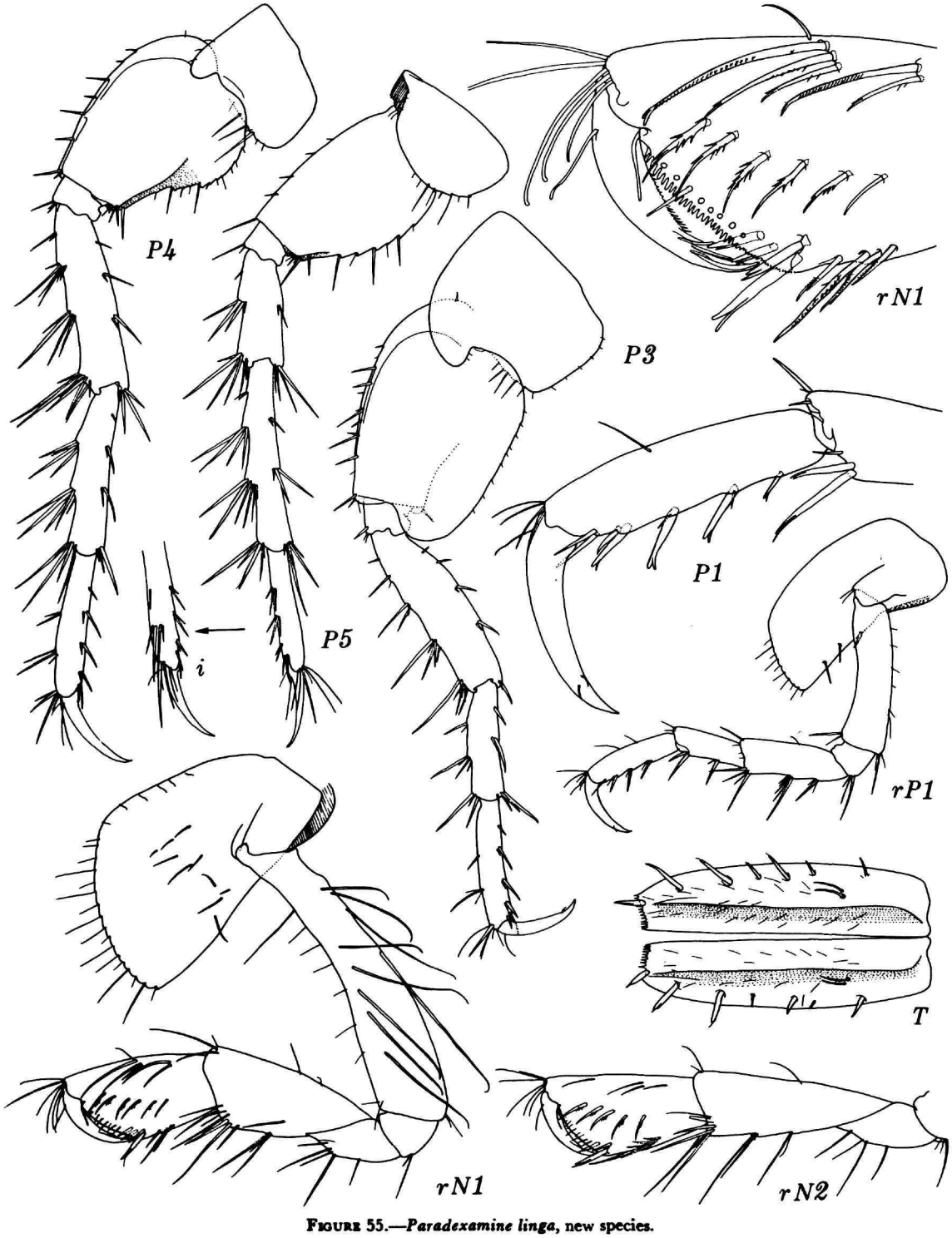


FIGURE 55.—*Paradexamine linga*, new species.

only 1 cone on each lobe of the lower lip, shortened maxillipedal palps, slightly elongate gnathopods, and, like *P. marlie,* no spines on the mandibles. Possibly a small cone on *P. barnardi* could have been overlooked, and, since the species is based on males, it may differ from *P. linga* mainly by the presence of setae on the inner plate of maxilla 1 and the absence of spines on the mandibles, whereas the characters of *P. barnardi* are very close to *P. marlie.* The latter males differ from males of *P. barnardi* mainly in the normally long palp of the maxilliped and in the presence of only half as many facial hand setae on the gnathopod oblique row. *Paradexamine barnardi* is said to have only 1 spine on each side of pleonites 5-6; none is shown on pleonite 4, but Sheard also did not show it on *P. pacifica,* where it is known definitely to occur.

MATERIAL. — The type-locality (1).

DISTRIBUTION. — Southwestern Australia, intertidal.

### *Paradexamine marlie,* new species

FIGURES 56–58

DESCRIPTION (of female). — Lateral cephalic lobe with sharp anterior cusp, head lacking anteroventral definition at base of antenna 2, rostrum very short, blunt; article 1 of antenna 1 with ventral spines thin and arranged in 2 groups of 3 each, article 2 about 1.15–1.33 times as long as article 1, apically simple and bearing a set of spines ventroproximally, flagellum 3.5 times as long as peduncle; flagellum of antenna 2 about 1.7 times as long as peduncle, multiarticulate; mandibles lacking spines, molar with regular setae on right, nearly smooth except for castellations, only ragged seta on left, accessory molar bulge distinct; outer lobe of lower lip bearing 1 medium-to-long cone, 1 short cone, mandibular lobes very thin, upturned; palp of maxilla 1 large, of normal breadth, extending beyond apex of outer plate, bearing apical and medial setae and 2 weak-to-moderate apical cones (differing on left-right); inner plate of normal size, bearing 1 seta; inner plate of maxilla 2 narrower than outer, both appressed, inner with apex very oblique, outer weakly curved, inner reaching 70 percent along outer, outer plate with 2 subproximal setae on inner face; inner plate of maxilliped of medium size, bearing about 3 large and 1 small apical setae and 2-3 facial setae, outer plate of ordinary size, rather thin, spines small, simple, palp robust, slightly exceeding outer plate; coxa 1 expanded at distal mark 67, naked anteriorly, weakly setose ventrally and scarcely serrate, coxae 2-3 rectangular, weakly setose ventrally, bearing one midposterior spine, coxae 5-6 with thin ventral spines; gnathopod 1 with article 6 about 0.7–0.8 times as long as 5, on gnathopod 2 about 0.66 times, gnathopods moderately thin, palms oblique, medial faces of hands with 4-6 thin, weakly pectinate setae, gnathopod 1 with 3 rows of anterofacial setae, gnathopod 2 with 2–3 single setae, dactyls bearing very minute pectinations proximal to inner tooth, palms regularly and deeply serrate; pereopods 1-5 thin, with sharp spines except for a few weakly blunt spines on article 6 of pereopods 1-2, ratio of articles 4–7 on pereopods 1-2 about 17:14:18:11; article 2 of pereopod 3 of ordinary stoutness, posteroventral lobe broad and deep, article 2 of pereopod 4 pyriform, posteroventral lobe obsolescent but spinose; article 2 of pereopod 5 thinly pyriform, posterior margin weakly serrate, not spinose, article 5 elongate, ratio of articles 4-7 about 21:32:24:13; pleonal epimera 1-2 with lateral ridge, small sharp tooth on 1, medium sharp on 2, epimeron 3 with medium basally thick tooth, posterior margins of epimera smooth, epimeron 1 with bundle of 4 spines in facial row, epimeron 2 with facial row of 8-10 spines, epimeron 3 with posterofacial row of 5 spines, then anteriorly groups of 2-3, 1, and 1 spines; pleonite 1 dorsally smooth, pleonites 2-3 with sharp dorsal tooth and sharp tooth on ridge of each side, pleonite 4 with sharp, subprostrate dorsal tooth, no lateral tooth but with spine on lateral ridge, pleonites 5-6 (fused) with 2 dorsolateral spines on each side; dorsal margin of peduncle on uropod 1 evenly spinose; rami of uropod 3 lacking setae; telson with long high crest on each lobe, apices broad, with about 8-11 serrations but about 3 of them grouped as bifid, 1 small spine in notch space, lateral margins of each lobe with about 5-6 medium-to-long spines; cuticle of posterior body segments smooth.

MALE. — Eyes enlarged; antennal peduncles with numerous marginal setule groups but spines of pleonites 4-6 half as long as on female; gnathopodal dactyls usually lacking long pectinae, weakly developed in young males; fully adult male with tooth

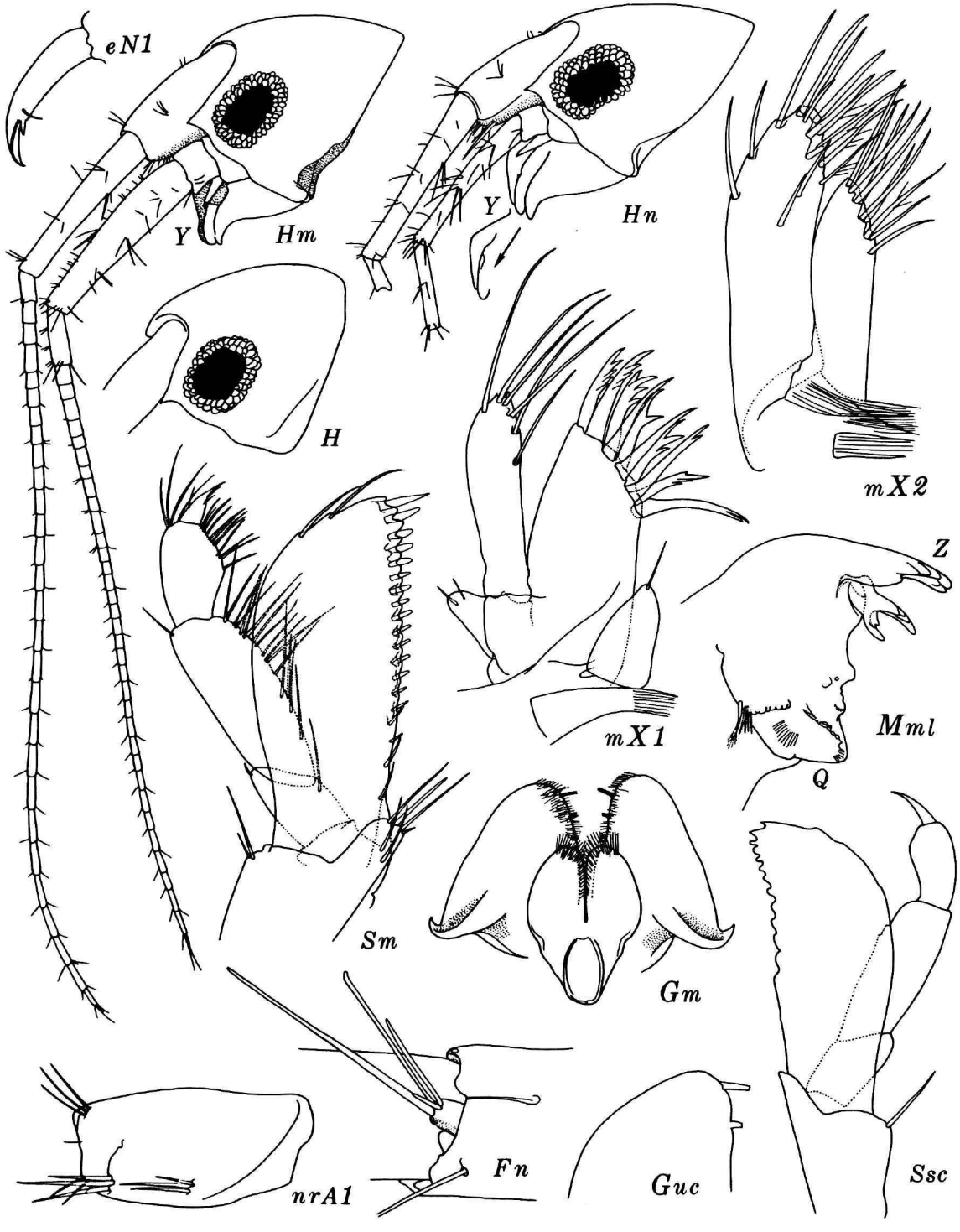


FIGURE 56.—*Paradexamine marlie*, new species.

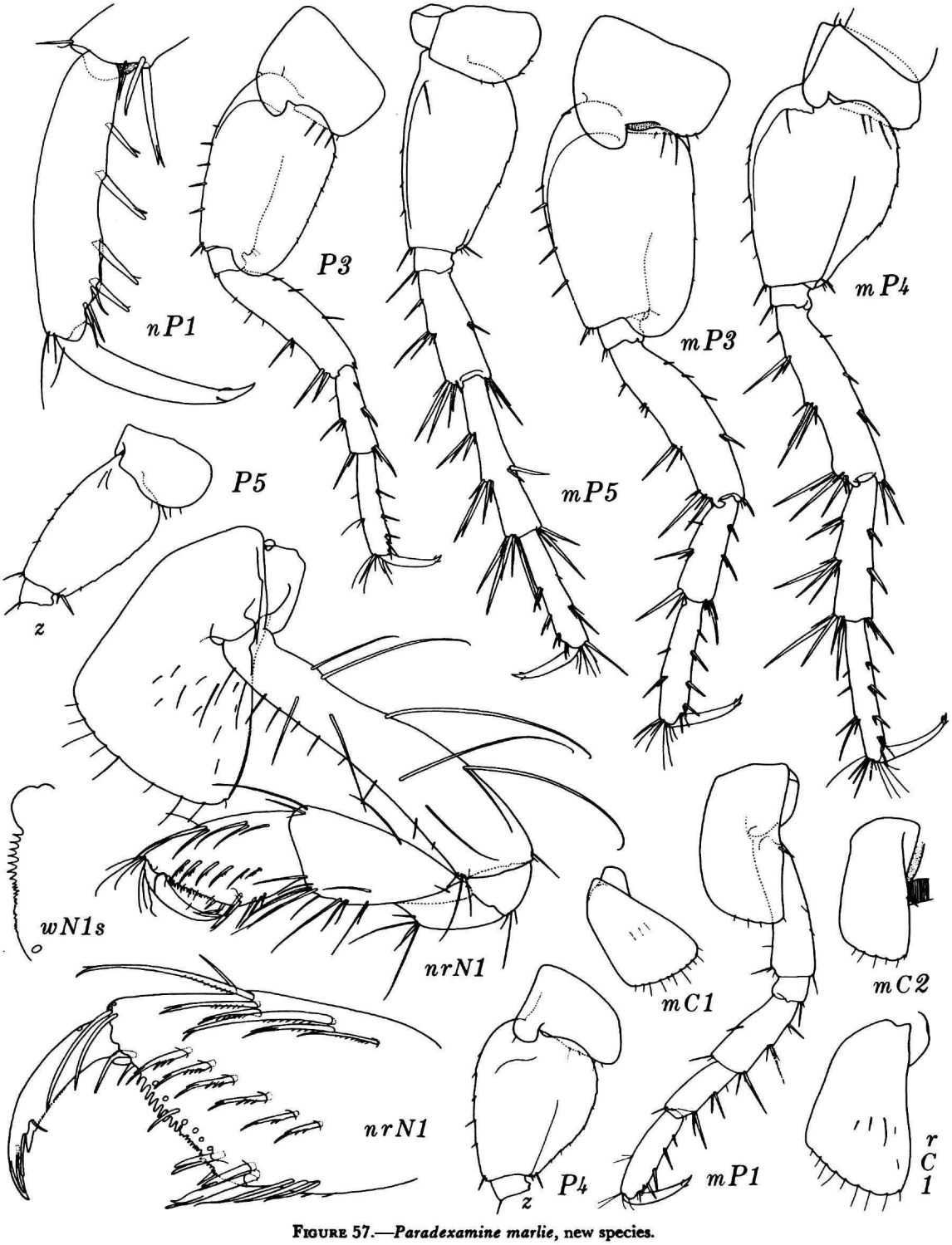


FIGURE 57.—*Paradexamine marlie*, new species.

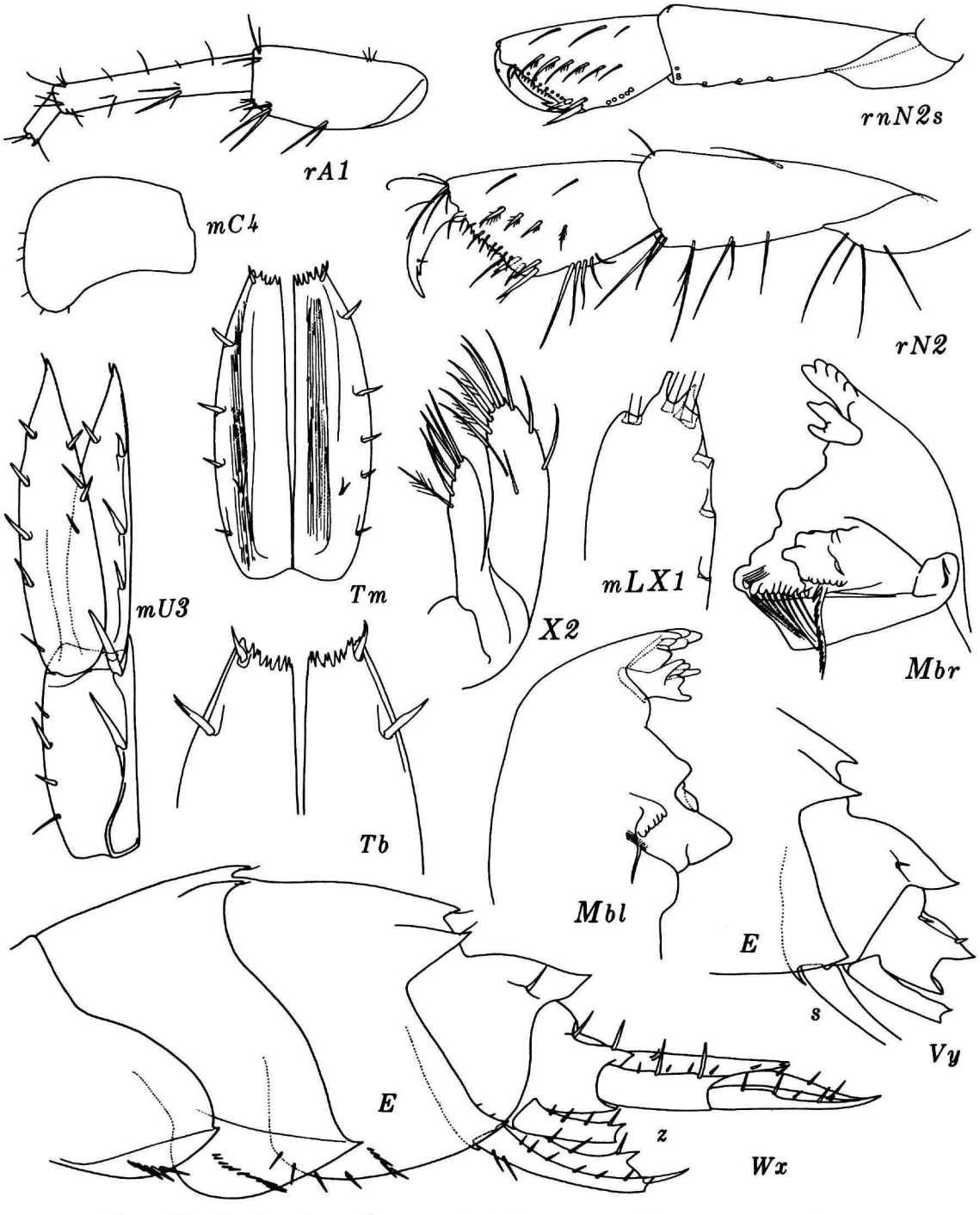


FIGURE 58.—*Paradexamine marlie*, new species, holotype, female, 3.3 mm; *c*=female, 3.7 mm; *m*=male, 3.4 mm; *n*=female, 3.8 mm; *x*=female, 3.4 mm; *y*=male, 3.6 mm; all from JLB Australia 2.

on epimeron 3 obsolescent; inner plate of maxilla 2 longer than in female.

HOLOTYPE. – WAM, female, 3.3 mm.

TYPE-LOCALITY. – JLB Australia 2, Jervois Bay, Cockburn Sound, Western Australia, on groin 1.6 miles southeast of Woodman Point, 1 meter, algae on rocks, collected by Dr. Barry R. Wilson, 10 June 1968.

RELATIONSHIP. – The taxonomic status and relationships of this species are complicated by enigmas regarding Sheard's (1938) lectotypes of *P. pacifica* from New Zealand. Sheard showed *P. pacifica* with no teeth on pleonite 1, no cones on the lower lip, and an elongate article 2 of female antenna 1. The first and last characters are typical of this new Australian species, but J. L. Barnard (in press), and herein, studied collections of *P. pacifica* from New Zealand and found 2 cones on each outer lobe of the lower lip. Stephensen (1927) also had a *Paradexamine,* like Sheard's lectotype, from Auckland and the Campbell Islands, with no teeth on pleonite 1 and an elongate article 2 of antenna 1; the lower lip was not described.

*Paradexamine marlie* differs from *P. pacifica* in the absence of mandibular spines, the smaller inner plate of the maxilliped, the presence of 1 strong posterior spine on coxae 2-3, and the singularity of the distal spine position on the peduncle of uropod 3.

This species, being distinguished by the mandible, could be classified as a race of *P. pacifica* in view of Sheard's lectotypes, but it is a distinct species in comparison to *P. houtete,* differing from it in pleonite 1, mandible, maxilla 2, article 2 of pereopod 3, antenna 1 of female, and telson. Its racial rank is also confuted by the presence of a "sibling-cryptic" species associated sympatrically with it. That species, *P. linga,* is characterized by the long spines on the mandibles and by the absence of a seta on the inner plate of maxilla 1. The characters of mandible and cephalic lobe have been observed in small juveniles, indicating that the two morphs are not simply post-ephebic phenotypes; they might remain generalized phenotypes except for the fact that the condition of the mandibular spines has been found to be a good specific character in other species of this genus.

The general aspect of *P. marlie* in resembling *P. pacifica* has not been figured because the figures of Sheard (1938) are comparable. This species has a pleon like *P. pacifica* in the absence of teeth on pleonite 1, the head and antennae are generally similar, with male antenna 2 and article 2 of antenna 1 being elongate normally, and the mandibular and inner lobes of the lower lip are similar, but the palp of maxilla 1 is slightly thinner and shorter in the Australian species (Sheard's figures differ from specimens of *P. pacifica* in this regard), and the gnathopods and coxae 1-4 and 7, the accessory flagellum, and the upper lip are similar.

*Paradexamine marlie* differs from *P. moorhousei,* a species definitely known in the male sex only, in the presence of spines on pleonites 5-6, in the short maxillipedal palp, which in *P. moorhousei* extends well beyond the outer plate, in the presence of cones on the lower lip, and in the much stouter gnathopods.

*Paradexamine marlie* is very close to *P. barnardi,* especially in the absence of spines on the mandible. Sheard wrote that only 1 cone occurred on each lobe of the lower lip, but the small cones can easily be overlooked, confused with setules, or, in shriveled lower lips, they are often not observed. *Paradexamine barnardi* is based only on males from New Zealand, which are neritic and possibly more advanced in their development than those remaining on the bottom. Males of *P. marlie* differ from those of *P. barnardi* in the normally extended maxillipedal palp, which in *P. barnardi* is shortened, and in the sparsity of setae in the main setal row of the gnathopodal hand faces, which in *P. barnardi* has 10 setae as opposed to 6 in *P. marlie.* Several characters of *P. barnardi,* plus its female, have not been clarified, including the questions of whether pleonites 5-6 have 1 or 2 spines on each side, whether pleonite 4 has a spine on each side, what are the characters of spines on coxae 2-3, and what are the details of pereopods 1-5. K. H. Barnard (1930) wrote that *P. barnardi* has dorsal and lateral teeth on pleonite 1, a characteristic that differs from both *P. marlie* and *P. linga.*

*Paradexamine moorhousei* is another species from Australia based on males (presumably, though Sheard called them females). *Paradexamine marlie* resembles *P. moorhousei* in the lack of mandibular spines, the seta on the inner plate of maxilla 1, the shape of the first maxillary palp, and generally maxilla 2, but *P. moorhousei* has a slightly more elongate

maxillipedal palp, a broader article 2 of pereopod 5, and extremely thin gnathopods, with article 5 of gnathopod 2 very elongate. Perhaps *P. moorhousei* is an advanced male of *P. marlie,* but Sheard has not stated the details of spination on urosomites 1-3 nor clarified the other following characters: pereopods 1-4, coxae 1-4, mandibular lobes of lower lip, telsonic apices, epimeral spination.

MATERIAL. — JLB Australia 2 (11), 4 (1).

DISTRIBUTION. — Southwestern Australia, intertidal and sublittoral.

### *Paradexamine ?moorhousei* Sheard

FIGURES 59–61

*?Paradexamine moorhousei* Sheard, 1938:180–182, figs. 6s, 7A–I, L.

NOMENCLATURE. — Specimens at hand are identified with Sheard's species mainly by a process of elimination, as males like his have not been seen. Sheard stated that he described and figured a female, but the extraordinarily large eyes, the elongate antennae, the short article 5 of antenna 2, and the setular fuzz on the antennae suggest he had males. There seem to be several errors in Sheard's depiction, some of them assumed because they are generalizations not known in any *Paradexamine* so far examined by me:

The anteromedial facial setae of the hands on the gnathopods are thrown heavily toward the margin, perhaps because the gnathopod was squashed. Article 2 of pereopod 5 shown in his Figure 7L appears like pereopod 4, and only one gerontic female of another species *(P. frinsdorfi)* has that kind of aberration; thus, Figure 7L probably is pereopod 4. Sheard possibly overlooked medial setae on the palp of maxilla 1, because the palp was not flattened. The short inner plate of maxilla 2 is not typical of my material, but it may be a feature of pelagic males. Article 6 of gnathopod 1 appears very thin, but I have seen shriveled mounts from other species resembling his drawing. He stated that the lower lip lacks cones.

DESCRIPTION (of female, about 4.0 mm long). — Lateral cephalic lobe with anterior cusp, head poorly defined at base of antenna 2, rostrum short, blunt; article 1 of antenna 1 with 2 ventral spine groups, article 2 about 1.4 times as long as article 1, often much shorter, apically simple and with 1 weak setal group ventrally, flagellum exceeding 2.4 times length of peduncle; flagellum of antenna 2 exceeding 1.3 times length of peduncle, multiarticulate; mandibles with spines so strongly vestigial as to be nearly invisible, molars mainly covered with setular velvet, both sides with ragged seta, only right side with ordinary setae as well, incisor untoothed, mandible very heavily cornified even in small individuals, accessory bulge absent; outer lobe of lower lip with 1 long and 1 short cone, mandibular lobes thin and curled apically; palp of maxilla 1 of ordinary width, exceeding outer plate, bearing apical and medial setae and several long apical cones, inner plate small, bearing 2 (or 1) apical setae; inner plate of maxilla 2 narrower than outer, reaching 80 percent along outer, both appressed, inner with highly oblique apex, outer scarcely curved, outer bearing 2 or more submarginal setae; inner plate of maxilliped large, strongly spinose, outer plate unusually narrow, spines small to medium in size, thick, simple, palp robust, exceeding outer plate, article 4 very short and stout; coxa 1 slightly expanded apically, generally rectangular, weakly scalloped and poorly setose ventrally, naked anteriorly, coxae 2-3 rectangular, bearing weak posterior seta, coxa 3 with medioposterior facial lobe bearing seta, coxa 4 ordinary, coxae 2-4 poorly setose, coxae 5-6 weakly spinose ventrally, coxa 7 with posteroventral tooth; gnathopod 1 with article 6 about 0.77 times as long as article 5; gnathopod 2 with article 6 about 0.73 times as long as article 5; gnathopods thin, hands slightly expanded apically, palms very oblique and weakly to moderately serrate, medial faces of hands with setal row composed of 5-6 pectinate setae, dorsal setae 2 in number (pair on gnathopod 1, widely separated singles on gnathopod 2), dactyls strongly pectinate proximal to inner tooth; pereopods 1-2 ordinary, ratio of articles 4-7 about 17:13:19:12; article 2 of pereopod 3 of ordinary stoutness, posteroventral lobe deep and broad, article 2 of pereopod 4 weakly pyriform, posteroventral lobe of moderate development, spinose, posterior margin with occasional spine; article 2 of pereopod 5 thin, weakly trapezoidal, posteroventral lobe obsolete, spinose, posterior margin weakly serrate and with occasional spine, ratio of articles 4-7 about 22:36:27:19, pereopods 3-5 otherwise of ordi-

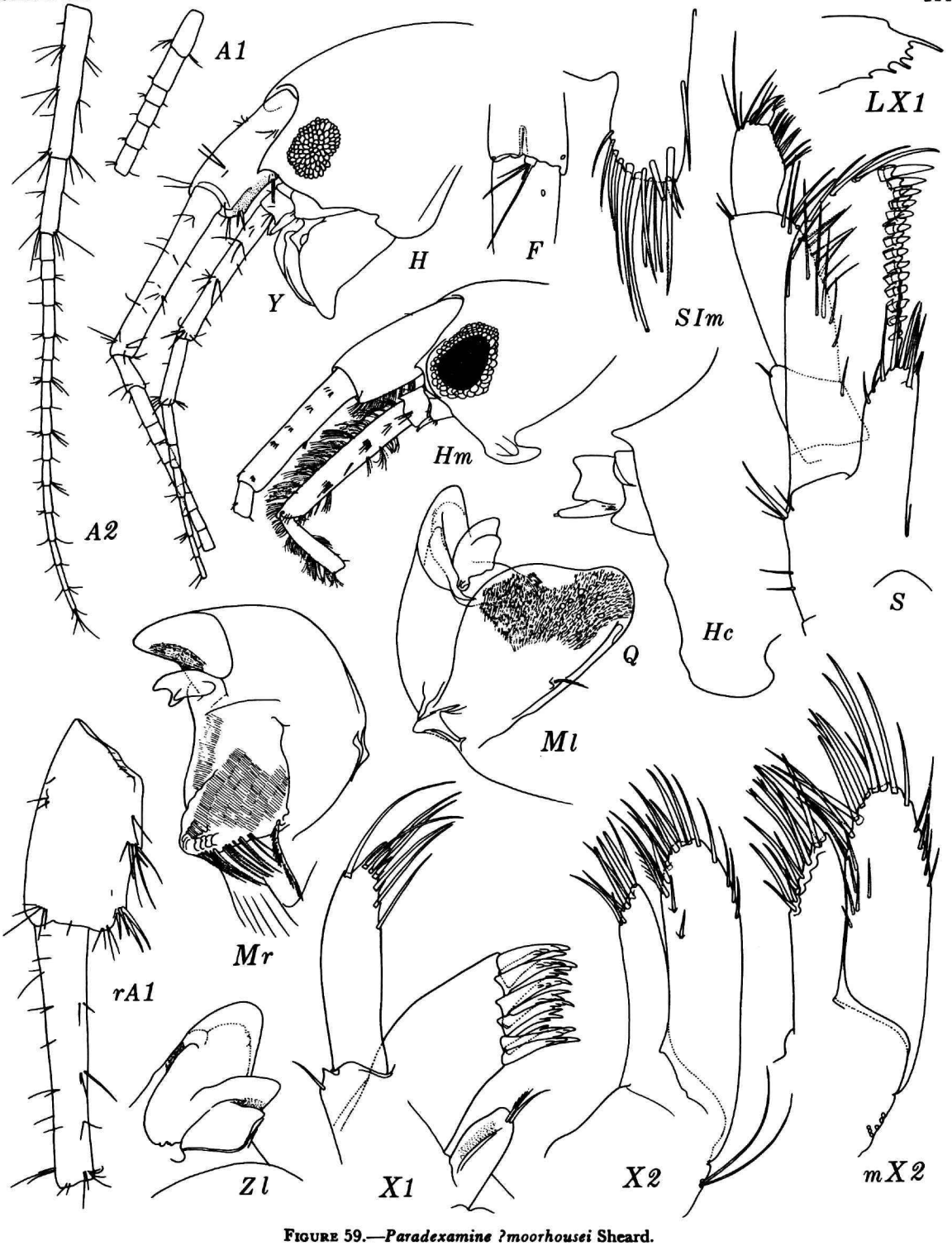


FIGURE 59.—*Paradexamine ?moorhousei* Sheard.

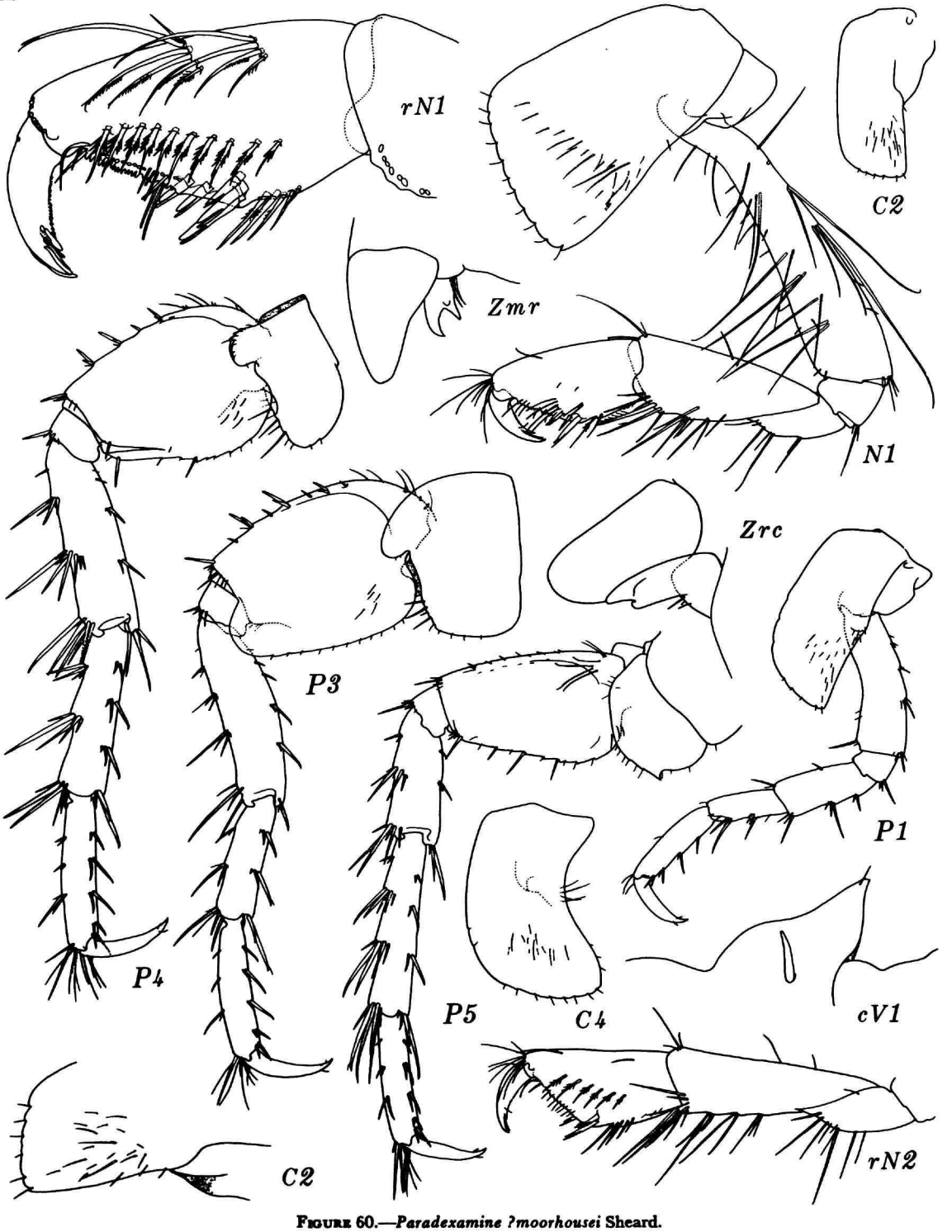


FIGURE 60.—*Paradexamine ?moorhousei* Sheard.

nary dimensions; pleonal epimera 1-2 with lateral ridge, each with sharp medium tooth, epimeron 3 with medium sharp tooth, posterior margins smooth, epimeron 1 with facial row of 6 spines, 1 tiny accessory and 3 short ventral setae, epimeron 2 with 9 spines in facial row, ventral margin anteriorly with 3 groups of 1-2 spinules, epimeron 3 with facial formula, rear to front, of 3-2-2-1-1; pleonite 1 rarely with teeth, occasionally with only sharp lateral each side, or weak dorsal and weak lateral each side, pleonites 2-3 with sharp dorsal and side tooth, pleonite 3 with dorsal tooth offset anteriad, pleonite 4 with large sharp dorsal tooth, no side tooth, large spine on weak side ridge, pleonites 5-6 (fused) with

FIGURE 61.—*Paradexamine ?moorhousei* Sheard, female, 3.9 mm, VicFish 62; *c*=female, 8.2 mm, Shepherd 3; *m*=male, 6.8 mm, Shepherd 15.

2 spines each side in tandem; dorsal margin of peduncle of uropod 1 evenly spinose; inner rami of uropod 3 with short setae in middle of medial edge, peduncle with distal spine position paired; telson weakly crested, apices broad, each minutely serrate in singles, pairs, triads, about 10 serrations together, lateral margins each with 4-5 small-to-medium spines in tandem, apex with small lateral spine; cuticle smooth; unusual feature noted in posterodistal lobe on lateral side of article 5 on gnathopods.

LARGE FEMALES (7.0-8.2 mm). — Flagella of antennae only 1.1-1.2 times as long as peduncles, article 1 of antenna 1 often with third set of ventral spines and article 2 with second set of ventral spines (occasionally also in females 4.5 mm long), rostrum becoming much shorter and blunter, spines of mandibles, though small, more discrete, 3 (or 2?) on right side, 2 on left side, lower lip cones remaining 2 in number, palp of maxilla 1 bearing 5 lateral setae as well as additional medial setae, the lateral setae occurring between positions 24 and 68, all appendages generally more setose than smaller female, but coxae 1-4 generally even more poorly setose, setae appearing not to grow in relation to coxae, spines of pereopods stouter, oblique setal row of gnathopods 1-2 with 10 and 11 setae, posterior hand margins with 5 and 10 setae each, anterior setae in 2 rows of 6-4 and 4-2 setae respectively on gnathopods 1-2, uropod 1 peduncle with 5 or more proximolateral spines, pleonite 1 with or without 3 weak teeth, teeth of pleonites stouter; spine formulae of epimera 1-3, rear to front, epimeron 1: 12 facial and 7 ventral, epimeron 2: 13-2-2-2-1, epimeron 3: 5-3-2-3-2, tooth of epimeron 3 even more elongate; first lateral spine of telson more distally located toward apicolateral spine, telsonic crests well developed.

MALE (6.8 mm). — Benthic phase apparently, no males present like those of Sheard; eyes scarcely larger than in female, antennae of typical male morphology, with numerous setular bundles, article 5 of antenna 2 shortened but not strongly so; lacinia mobilis more strongly bifid than in female and mandibular spines much longer, apparently 3 on right and 2 on left member, though 1 spine of right side very small; lower lip similar to female, cones not enlarged; maxilla 2 similar to female; inner plate of maxilliped stouter and shorter and more heavily spinose than in female, palp not shortened; gnathopods generally similar to female but dorsal setal rows of medial faces on gnathopod 1, distal to proximal, composed of 6, 5, and 3 setae, on gnathopod 2 with formula of 4, 4, and 2, oblique middle row with 13 setae on both gnathopods; telson with first lateral spine moved almost completely apically to join apicolateral spine; following parts like female: uropod 3, urosome and its spines; pleonite 1 lacking teeth.

ABERRATION. — Inner plates of figured female, 3.9 mm, covered by basal plate more strongly than in other specimens at hand; normal lower lip as figured herein for male.

REMARKS. — The crucial identifying characters of this species appear to be the combination of a pair of terminal spines on the peduncle of uropod 3 and the heavily cornified mandible without serrations on the incisor. To some extent, the lobe on article 5 of the gnathopods is also characteristic. This species belongs in the species-group containing *marlie-linga-houtete-pacifica-barnardi,* in which the ocular lobe has an anterior cusp and pleonite 4 has no side teeth. *Paradexamine moorhousei* differs from *P. marlie* in the 2 crucial characters cited first above; it differs from *P. linga* in these also and, in addition, in the presence of 2 setae on the inner plate of maxilla 1 and the vestigial spines on the mandibles. *Paradexamine moorhousei* differs from neozelanican *P. houtete* in the unserrate mandibular incisor, but it has the pair of distal peduncular spines on uropod 3 also found in *P. houtete*. The absence of ordinary setae on the left mandibular molar also distinguishes *P. moorhousei* from *P. houtete*. The vestigial mandibular spines in the female distinguish *P. moorhousei* from neozelanican *P. pacifica;* the latter also has a sharp rostrum and an ordinary mandibular incisor.

No differences between *P. moorhousei* and *P. barnardi* can be determined since only the male of *P. barnardi* is known. Sheard distinguished the two species, both of which were described in the pelagic male stage, presumably by the absence of cones on the lower lip of male *P. moorhousei*. This fact is not true of the benthic males at hand. Until benthic females and males of *P. barnardi* can be described and pelagic males of *P. moorhousei* reexamined, any present differences between *P. barnardi* and *P. moorhousei* are figmentary.

The better development of mandibular spines in benthic males of *P. moorhousei* as opposed to that in the females is a highly unusual situation.

MATERIAL. — Port Phillip 5 (1); Shepherd 8 (1), 12 (1), 13 ( 1), 15 (3), 22 (1), 30 (1); VicFish 1-105, 5 samples (15).

DISTRIBUTION. — Victoria and South Australia, sublittoral and bays.

### *Paradexamine narluke*, new species

FIGURES 62–63

DESCRIPTION (of male; female unknown). — Lateral cephalic lobe rounded, head with distinct anteroventral definition at base of antenna 2, rostrum of medium length and apically blunt; article 1 of antenna 1 ventrally setose, otherwise simple, article 2 about 1.3 times as long as article 1, apically simple and scarcely setose ventrally, flagellum about 1.8 times as long as peduncle, flagellum of antenna 2 about 1.7 times as long as peduncle, article 4 of peduncle elongate and anteriorly setose, with 3 sets of lateral spines, article 5 about half as long as 4; article 3 especially produced ventrally; mandibles with large spines, 2 on right, 3 on left plus setule, molar heavily triturative, accessory bulges numerous and sharp, both molars with ordinary setae and 1 ragged seta; outer lobe of lower lip with 3-4 long cones, mandibular lobes blunt when flattened, otherwise axially curled so as to appear tapering; palp of maxilla 1 small, much shorter than outer plate, very narrow, bearing 2 apical setae, no cones; inner plate of ordinary size, naked; plates of maxilla 2 narrow, appressed, inner reaching about 70 percent along outer, inner with definite truncate apex and 2 setae,

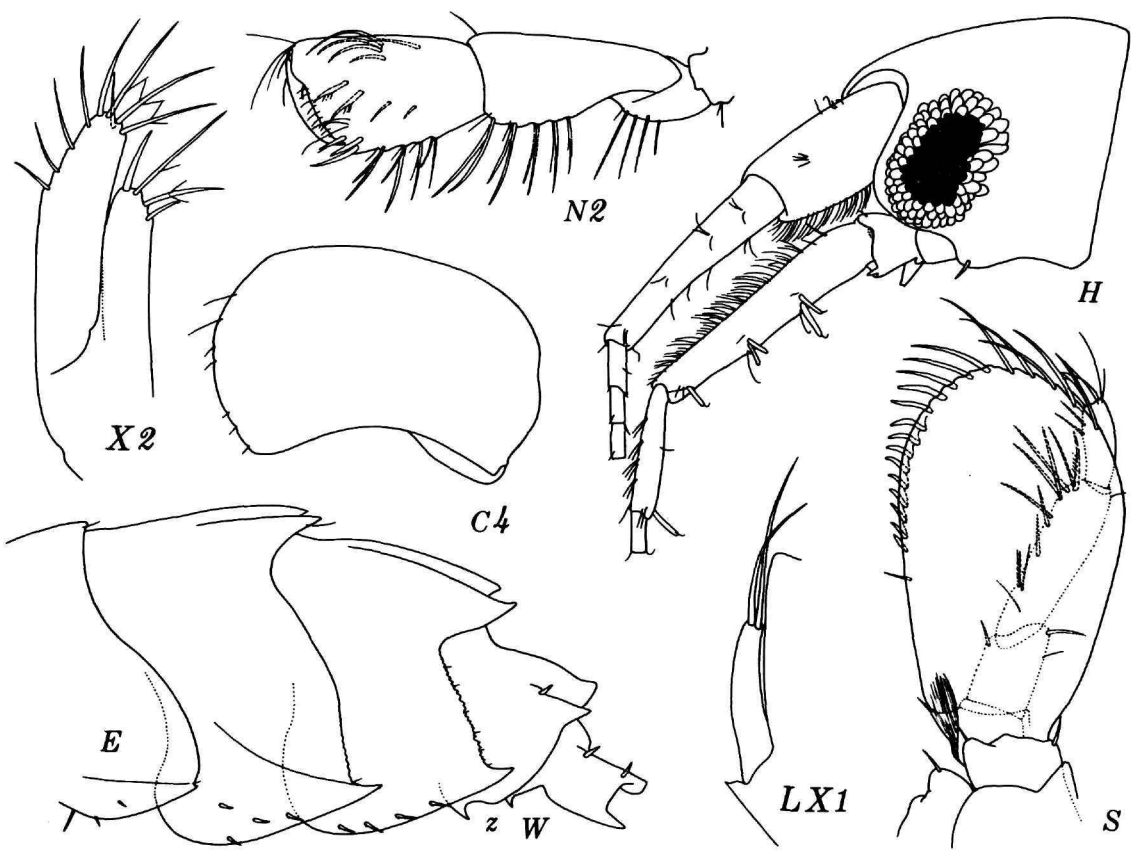


FIGURE 62.—*Paradexamine narluke*, new species, holotype, male, 3.3 mm, JLB Australia 3.

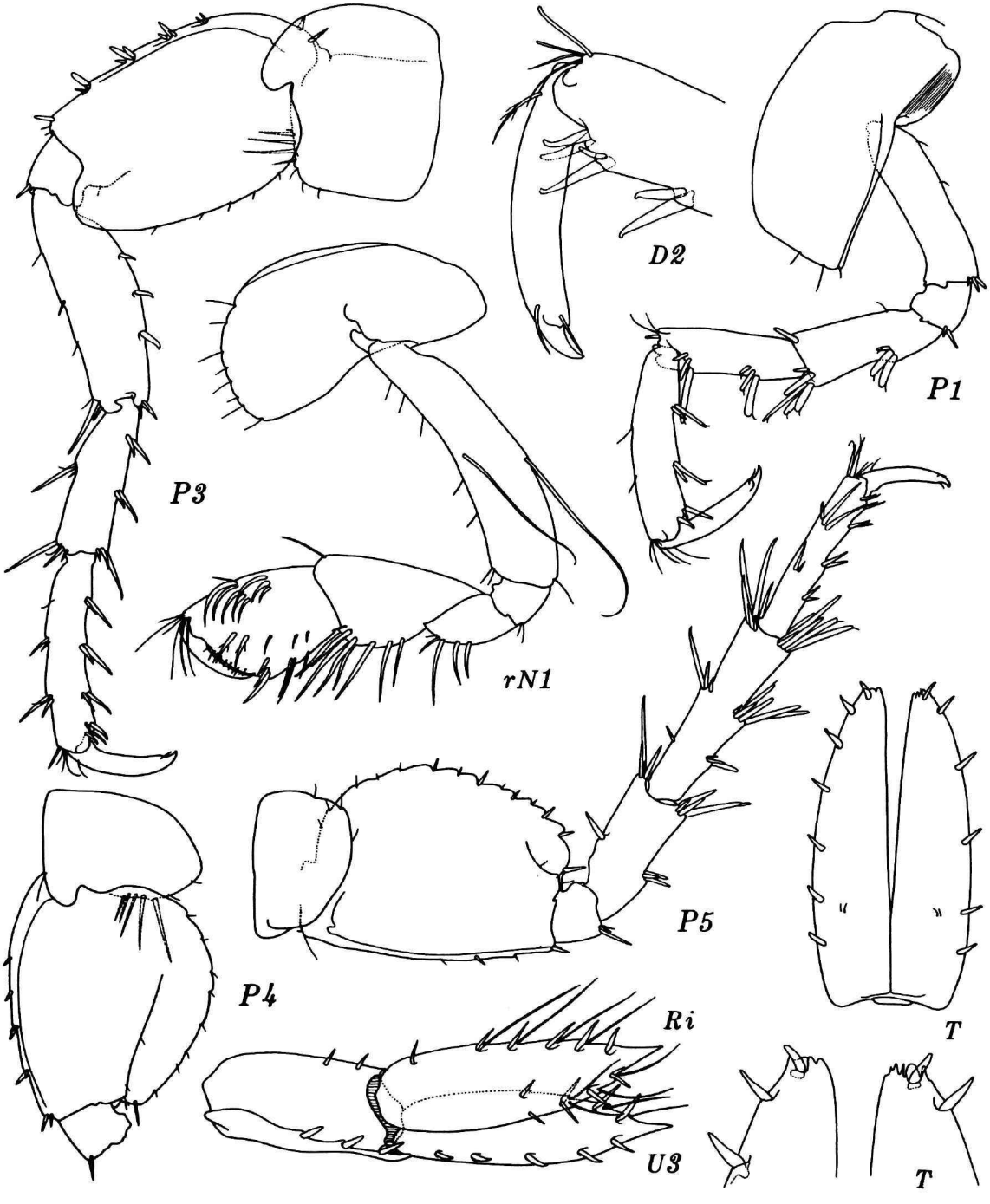


FIGURE 63.—*Paradexamine narluke*, new species.

then 2 subterminal embevelments each with seta; inner plates of maxilliped vestigial, each bearing spinule, outer plate of ordinary to slightly tumid dimensions, bearing simple spines, palp thin, scarcely exceeding outer plate, palp article 4 of medium elongation; coxa 1 expanding slightly apically, anteriorly naked, with weak indication of anterior acclivity highly distad, ventral setae of coxae 1-4 sparse and short, posterior margins of 1-4 naked, coxae 2-3 softly rectangular, coxae 5-6 ventrally spinose; gnathopods stout, gnathopod 1 with article 6 about 0.84 times as long as article 5, about 0.90 times on gnathopod 2, fifth articles broad, expanding apically, palms oblique, extremely finely castellate, dactyls smooth proximal to main inner tooth, palmar faces on gnathopod 1 with oblique row of 2 pectinate and 2-3 simple setae, anteriorly with sets of 6 and 3 setae, on gnathopod 2 oblique row with 2 pectinate and 2 simple setae, anterior sets with 5 and 2 setae each; pereopods 1-5 of regular stoutness, with numerous blunt spines, ratio of articles 4-7 on pereopods 1-2 about 24:27:36:20, article 2 of pereopod 3 of medium breadth, with regular posteroventral lobe; article 2 of pereopod 4 circulopyriform, posteroventral lobe weak but distinct, bearing spine, posterior margin weakly setulose; article 2 of pereopod 5 ovatorectangular, posterior margin strongly serrate and bearing thick short spines, posteroventral region slightly tumid but lobe not distinctly projecting, also spinose, ratio of articles 4-7 about 24:36:34:15; pleonal epimera 1-2 with lateral ridge, epimeron 1 with tiny posteroventral tooth, 2-3 with medium sharp tooth, epimeron 3 especially serrate posteriorly and bearing 5-6 weak posterior setae, epimera 1-2 with increasingly weaker serrations and fewer setae, epimeron 1 anteroventrally with 1 seta, 1 spinule, 1 facial spinule, epimeron 2 with 1-2 ventral spines, broadly spread row or group of 3-4 facial spines, epimeron 3 with 4 ventral spines; pereonite 7 dorsally smooth; pleonite 1 with extremely weak dorsal tooth, pleonites 2-4 with sharp and low dorsal tooth, sharp side tooth, pleonite 4 with spine on lateral ridge, pleonites 5-6 (fused) with 2 short spines in tandem; dorsal margin on peduncle of uropod 1 evenly spinose, lateral base of peduncle with 1 stout spine, rami of uropod 3 with several setae; telson flat, apices narrow, bearing 3-5 weak, diverse serrations and 1 small apicolateral spine, lateral margins with 5-6 medium spines in tandem, none paired; cuticle of epimera and urosome covered densely with crescent slits lacking setules, cuticle of coxa 5 and article 2 of pereopod 3 covered densely with setules apparently arising from slit-pits, pits and setules rare to absent elsewhere.

HOLOTYPE. — WAM, male, 3.3 mm. Unique.

TYPE-LOCALITY. — JLB Australia 3, Sugarloaf Rock, Cape Naturaliste, Western Australia, intertidal, wash of common seaweeds, 1 September 1968.

RELATIONSHIPS. — *Paradexamine narluke* has a superficial resemblance to *P. thadalee,* because of the presence of either slit-pits or numerous setules on the cuticle in several places, but otherwise the two species are in completely different species flocks because of the absence of a lateral tooth on pleonite 4 in *P. thadalee. Paradexamine narluke* further differs from *P. thadalee* in the well-defined head at the base of antenna 2, the blunt mandibular lobe of the lower lip, the posteriorly naked coxae 1-3, the broad ovatopyriform article 2 of pereopod 5, the lack of tightly bundled rows of facial spines on epimera 2-3, and the flat telson.

*Paradexamine narluke* appears to have more characters in common with *P. muriwai* from New Zealand than with any other known species. The Australian species differs from *P. muriwai* in the absence of teeth on pleonite 1, the much smaller body, the slightly smaller inner plate of the maxilliped, the presence of only 1 terminal spine on each lobe of the telson, the short palp of maxilla 1, the shorter inner plate of maxilla 2, the posteriorly naked coxae 1-3, and the anteriorly naked coxa 1.

*Paradexamine windarra* has some resemblance to *P. narluke,* but the latter has blunter dorsal teeth, none on pereonite 7 and pleonite 1, stout epimeral spines and facial spines on epimeron 2, anteriorly naked coxa 1, more oblique palms of the gnathopods, nonfeathered, nonstriate locking spines on pereopods 1-2, and blunt spines otherwise on article 6, poorly setose coxae 2-4, no distinct lobe on article 2 of pereopod 5, and several other minor differences.

*Paradexamine narluke* differs from *P. frinsdorfi* in the short inner plates of the maxillipeds, the anteriorly naked coxa 1 with the vestigial acclivity moved highly distad, no posterior spines on coxae 2-3, the broadness and nearly lobate article 2 of pereopod 5, the facial spines of epimeron 2, and

the absence of dorsal teeth on pereonite 7 and pleonite 1.

*Paradexamine lanacoura* has some resemblances to *P. narluke,* but the latter differs from *P. lanacoura* in the blunt rostrum, the absence of setules on the accessory bulges of the mandible, the anteriorly naked coxa 1, no posterior spines on coxa 2, the poorly developed posterior setae of the epimera and the castelloserrate margins, the facial spines on epimeron 2, the flat telson, the simple article 1 of antenna 1 (even in the male of *P. lanacoura* a process occurs on article 1), and the absence of teeth on pereonite 7 and pleonite 1.

*Paradexamine narluke* differs from *P. goomai* in the presence of facial spines on epimeron 2, the better-developed article 2 of pereopod 5, the unextended coxa 3 and weak setae of coxae 2-4, the distinct locking spines of pereopods 1-2, the more distad ornaments on the pereopodal dactyls, the small inner plate of the maxilliped, the distally expanded coxa 1, the thin plates of maxilla 2, and the thin and short palp of maxilla 1.

MATERIAL. – The type-locality (1).

DISTRIBUTION.—Southwestern Australia, intertidal.

### *Paradexamine otichi,* new species

FIGURES 64–66

DESCRIPTION (of female; male unknown). – Lateral cephalic lobe rounded, protruding, head

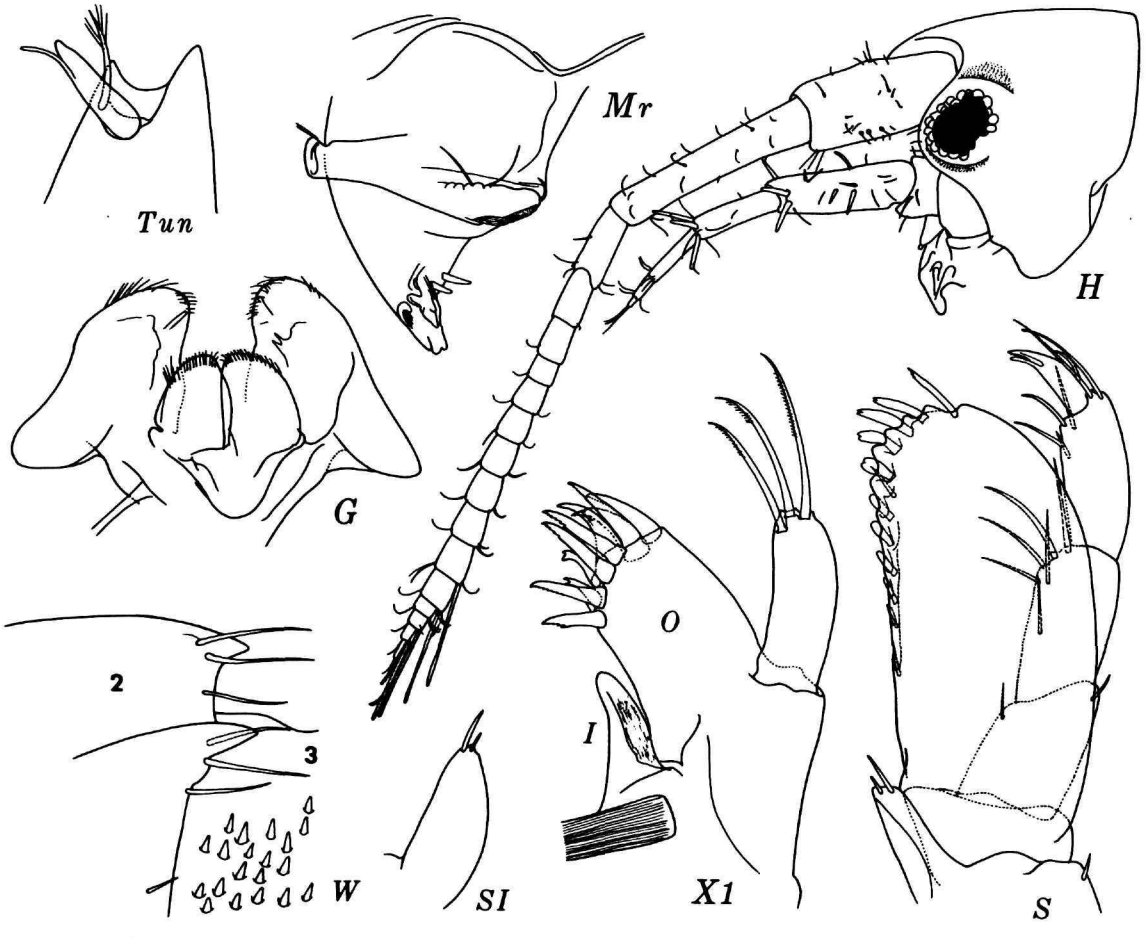


FIGURE 64.—*Paradexamine otichi,* new species, holotype, female, 2.85 mm, JLB Australia 13; *n*=female, 2.40 mm, JLB Australia 8.

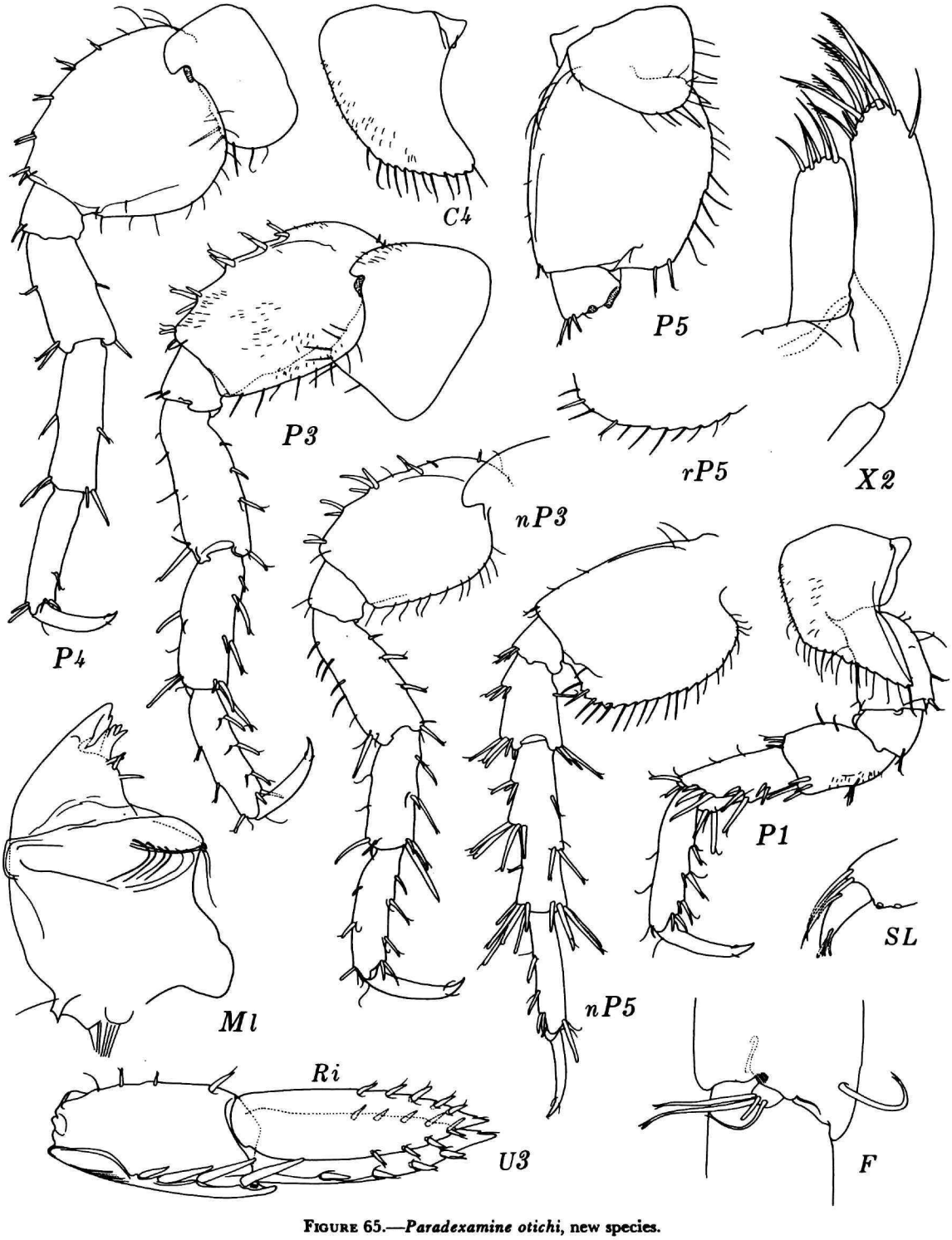


FIGURE 65.—*Paradexamine otichi*, new species.

with moderate anteroventral definition, rostrum medium sharp, slightly attenuate; article 1 of antenna 1 with about 3 apical setae on slightly quadrate apicoventral corner, article 2 about 1.3 times as long as article 1, apically simple, with no ventral spine, flagellum equally as long as peduncle; flagellum of antenna 2 very short, about 3-articulate; upper lip ventrally truncate (unusual); mandibles with medium-sized smooth spines, 2 right, 3 left, molars nearly smooth and accessory molar bulges smooth, setae of both molars very thin; outer lobe of lower lip lacking cones, mandibular lobes blunt; palp of maxilla 1 of normal breadth, shortened, reaching only 80-85 percent along outer plate, apex slightly protuberant but uncuspidate, bearing 3 apical setae, inner plate of normal size, naked; plates of maxilla 2 subequal in width, outer slightly broader but both appressed, inner subrectangular, outer weakly curved its full length, inner reaching only 75 percent along outer; inner

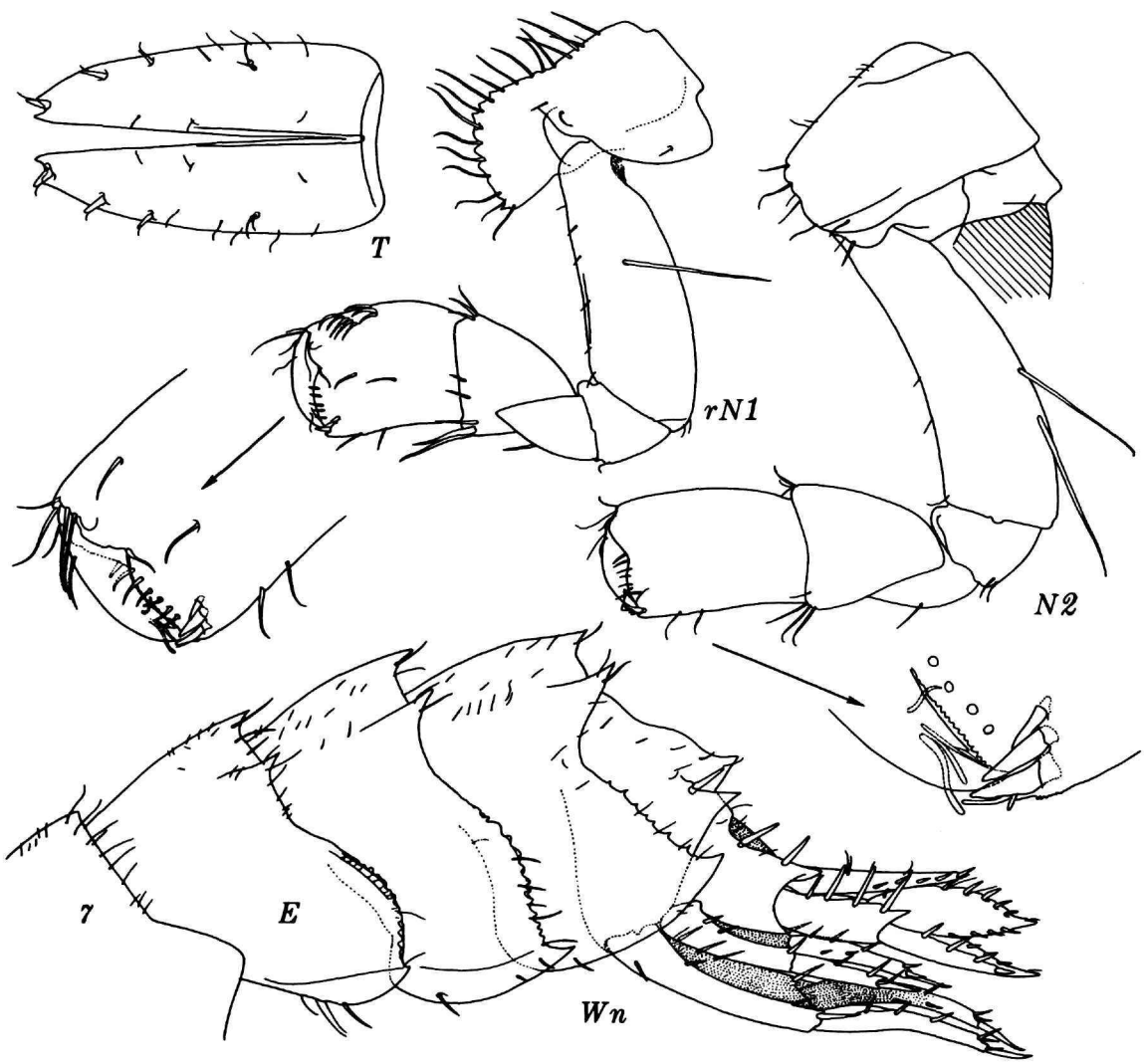


FIGURE 66.—*Paradexamine otichi*, new species.

plate of maxilliped of medium size, bearing 2 apical spinules, outer plate of ordinary size, palp slightly exceeding outer plate; coxa 1 subrectangular, strongly serrate ventrally and strongly setose anteriorly and ventrally, coxa 2 subquadrate, weakly setose, with 2 setae on accessory inner flange, base of gnathopod 2 attached far distally on the coxa (exceptionally so in genus), coxa 3 greatly prolonged and sharp posteroventrally, coxae 5-6 weakly setose-spinose ventrally; gnathopod 1 with article 6 about 1.25 times as long as article 5, on gnathopod 2 about 1.3 times, gnathopods of medium size, palms transverse, bulging, medial faces of hands with 2 (rarely 1 on gnathopod 2) simple, thin setae, anterior faces with 1 row and none on gnathopods 1 and 2 respectively, dactyls bearing only inner tooth, palms regularly but weakly and minutely scalloped; pereopods 1-5 slightly stoutened, with few blunt spines on anterior margins of pereopods 3-5, ratio of articles 4-7 on pereopods 1-2 about 15:20:28:18; article 2 of pereopod 3 of ordinary stoutness, posteroventral lobe obsolescent; article 2 of pereopod 4 broadly pyriform, lobe obsolete, posterior margin sparsely setose; article 2 of pereopod 5 subquadrate, posterior margin spinose or setose posteriorly and ventrally; in specimen no. 2, article 5 elongate, unknown in holotype; ratio of articles 4-7 on specimen number 2 about 15:33:25:18; pleonal epimera 1-2 with lateral ridge, large sharp tooth on epimeron 2, small sharp tooth on epimeron 1, epimeron 3 with medium, slightly blunt tooth, posterior margins of epimera 1-2 especially deeply scalloped, 3 with weak serrations (cones), epimeron 1 with about 2-4 ventral setae, epimeron 2 with 1-2 ventral spines, epimeron 3 with 1-2 ventral spines; pereonite 7 with weak dorsal tooth, pleonites 1-4 with sharp dorsal tooth and sharp tooth on ridge of each side, pleonite 4 with 1 spine on subdorsal ridge and pleonites 5-6 (fused) with 2 dorsolateral spines on each side; dorsal margin of peduncle on uropod 1 with long gap between basal and distal spines; rami of uropod 3 lacking setae; apices of telsonic lobes thin, with 1 notch bounded by 1 sharp cusp on each side; notch bearing medium spine, no accessory cuspules; cuticle of posterior segments with many dorsal spines, very stout, and, under medium magnification, highly visible compared with other species from Australia reported herein.

VARIANT (from Western Port, female, 3.1 mm, VicFish 113). — Left mandibular molar bearing 1 large seta, no small setae, right mandible with 1 large seta, 1 small seta; outer lobes of lower lip with 1 medium-sized apicomedial cone, 1 small cone on medial margin; inner plate of maxilla 2 beveled apicomedially and bearing setae more proximally than in specimens from Western Australia; gnathopod 1 with 3 anterior rows of setae on article 6; article 2 of pereopod 5 weakly protuberant posteroventrally; telson with 4 lateral spines on each lobe.

VARIATION (specimen). — Smaller than holotype but some characters better developed, such as heavier spination on article 2 of pereopod 5, more spinules on epimera (the maximum stated in diagnosis) but, in contrast to holotype, lateral ridges of epimera 1-2 nearly obsolete.

HOLOTYPE. — WAM, female, 2.85 mm.

TYPE-LOCALITY. — JLB Australia 13, Middleton Beach, Albany, Western Australia, intertidal, wash of sandy rocks, coralline algae, 30 September 1968.

RELATIONSHIP. — This species has unusual characters of two other species mixed together. It strongly resembles *P. ronggi* in the short antenna 2, the mandibles with nearly smooth molars, the apically simple telson, the maxilla 2, and the maxilliped, but it differs from *P. ronggi* in the absence of ventral spines on article 2 of antenna 1, the spination gap on uropod 1, the weak lobe on article 2 of pereopod 3, the absence of cones on the lower lip, the more strongly extended coxa 3, the longer palp of maxilla 1, the shorter and stouter article 4 of pereopods 1-2, the short, broad, and quadrate coxae 1-2, a more strongly developed double spine row on the dorsomedial hand margin of gnathopod 1 (in the stouter gnathopods), and the proximally untapered hand.

*Paradexamine otichi* has characters of *P. windarra*, such as the gap in the spine row of uropod 1, the untapered coxa 1, and the well-developed double row of medioanterior spines on the hand of gnathopod 1, but it differs more numerously, among other characters, in the short antenna 2, the smooth molar, spines, and accessory process of the mandibles, the absence of cones on the lower lip, the stout palp of maxilla 1, the regular maxilla 2, the regular maxilliped with medium inner plates and ordinary outer plates, the short coxae 1-2, the extended coxa 3, the unexpanded hands of the

gnathopods with transverse palms, the short article 4 of pereopods 1-2, the weak lobe of article 2 on pereopod 3, the lack of a ventral lobe on pereopod 5, and, finally, the simple telson.

*Paradexamine otichi* shares more characters in common with *P. goomai* than it does with *P. windarra*: article 1 of antenna 1, the palp of maxilla 1, the inner and outer plates of the maxilliped, coxa 3, the absence of a lobe on article 2 of pereopod 5, and essentially the telson. But *P. goomai* has a strongly beveled article 2 on pereopod 5, offset dorsal teeth of pleonites 3-4, short epimeral teeth, cones on the lower lip, expanded hands of the gnathopods with oblique palms, a long coxa 2 with a main posterior spine (like *P. windarra*), and few, if any, blunt spines on the pereopods.

*Paradexamine narluke* (male only known) has obsolescent inner plates and enlarged outer plates of the maxilliped, ordinary gnathopods like *P. goomai*, a normal coxa 3, and extra telsonic ornamentation, in contrast to *P. otichi*.

MATERIAL. – JLB Australia 8 (1), 11 (1), 13 (2); VicFish 113 (1).

DISTRIBUTION. – Southwestern Australia and Victoria, intertidal and shallow water.

### *Paradexamine pacifica* (Thomson), New Zealand

FIGURES 67–69

*Dexamine pacifica* Thomson, 1879:238, pl. 10B: fig. 4.—Thomson and Chilton 1886:149.—Thomson 1889:262.

*Paradexamine pacifica*.—Stebbing 1899b:210.—Chilton 1909:632.—Stebbing 1910a:602 [key].—Chilton 1911:308.—Thomson 1913:243.—Stephensen 1927:345–347, figs 21, 22; 1938:246–247.—Sheard 1938:176–178, figs. 5, 8M.—J. L. Barnard, in press.

Not *Paradexamine pacifica*.—Chilton 1912:501–502 [=*P. fissicauda*, fide K. H. Barnard, 1930, and Stephensen, 1938]; 1925:179.—K. H. Barnard 1930:389–390, fig. 49 *a-c* [=*P. barnardi* Sheard].

DESCRIPTION (of female). – Lateral cephalic lobe with sharp anterior cusp, head lacking anteroventral definition at base of antenna 2, rostrum short but subacute; article 1 of antenna 1 with ventral spines thin and arranged in 2 groups of 3-4 each, article 2 about 1.33 times as long as article 1, apically simple and bearing set of thin setal spine(s) ventrally, flagellum about 3.0 times as long as peduncle; flagellum of antenna 2 about 1.8 times as long as peduncle, multiarticulate; mandibles with 2 long thin spines on right, 3 on left, molar moderately to poorly ridged, mainly fuzzy, ragged seta on each side, ordinary setae on right side only, accessory bulges weak, rounded; outer lobe of lower lip bearing 1 medium, 1 short cone, mandibular lobes thin, shortly upturned; palp of maxilla 1 large, of normal breadth, exceeding outer plate, bearing apical, medial, and lateral setae and 4 strong-to-weak apical cones, inner plate of normal size, thin, bearing 2 apicosubapical setae; inner plate of maxilla 2 much narrower than outer, reaching slightly more than 80 percent along outer, both appressed, inner with apex very oblique, outer with several submarginal setae on inner face, outer weakly curved; inner plate of maxilliped of medium size, broad, bearing several apical, apicolateral, medial, and facial setae, outer plate of ordinary size, moderately thin, spines small to medium, simple, palp robust, slightly exceeding outer plate, article 4 of short kind in this genus; coxa 1 apically widened, naked anteriorly, ventral margin setose and weakly scalloped, coxae 2-3 rectangular, 2 slightly rounded ventrally, neither with large spines, coxae 2-4 poorly setose ventrally, 5-7 spinose ventrally; gnathopod 1 with article 6 about 0.92 times as long as article 5, on gnathopod 2 about 0.84 times, gnathopods ordinary to thin, palms oblique, medial faces of hands with 6-7 pectinate setae in oblique row and 3 rows of anterior setae, palms and dactyls strongly pectinate; pereopods 1-5 thin, with sharp spines except on article 6 of pereopods 1-2, ratio of articles 4-7 on pereopods 1-2 about 18:15:23:13; article 2 of pereopod 3 of ordinary stoutness, posteroventral lobe broad and deep, article 2 of pereopod 4 pyriform, posteroventral lobe obsolescent but spinose, posterior margin with several spines; article 2 of pereopod 5 thinly pyriform, posterior margin weakly serrate and spinose, ratio of articles 4-7 about 21:35:29:15; pleonal epimera 1-2 with lateral ridge, small sharp tooth on epimeron 1, medium sharp on epimeron 2, epimeron 3 with medium-to-long sharp tooth, posterior margins of epimera smooth, epimeron 1 with facial row of 5 spines with spines and setae in tandem on anteroventral margin, epimeron 2 with facial row of 10 spines and 2 ventral spinules, epimeron 3 with approximate formula, rear to front, of 5-3-2-2-1 or 5-4-3-2-1; pleonite 1 dorsally smooth, pleonites 2-3 with sharp dorsal tooth and

sharp tooth on ridge of each side, middle tooth of pleonite 3 somewhat anteriad, pleonite 4 with sharp, subprostrate dorsal tooth, no lateral tooth but with spine on weak lateral ridge, pleonites 5-6 (fused) with 2 dorsolateral spines on each side; dorsal margin of peduncle on uropod 1 evenly spinose; rami of uropod 3 lacking setae, peduncle with incipient distal pair of spines, 1 large spine always present, medial to it 1 wire-like seta in specimens smaller than 4.5 mm, larger than that

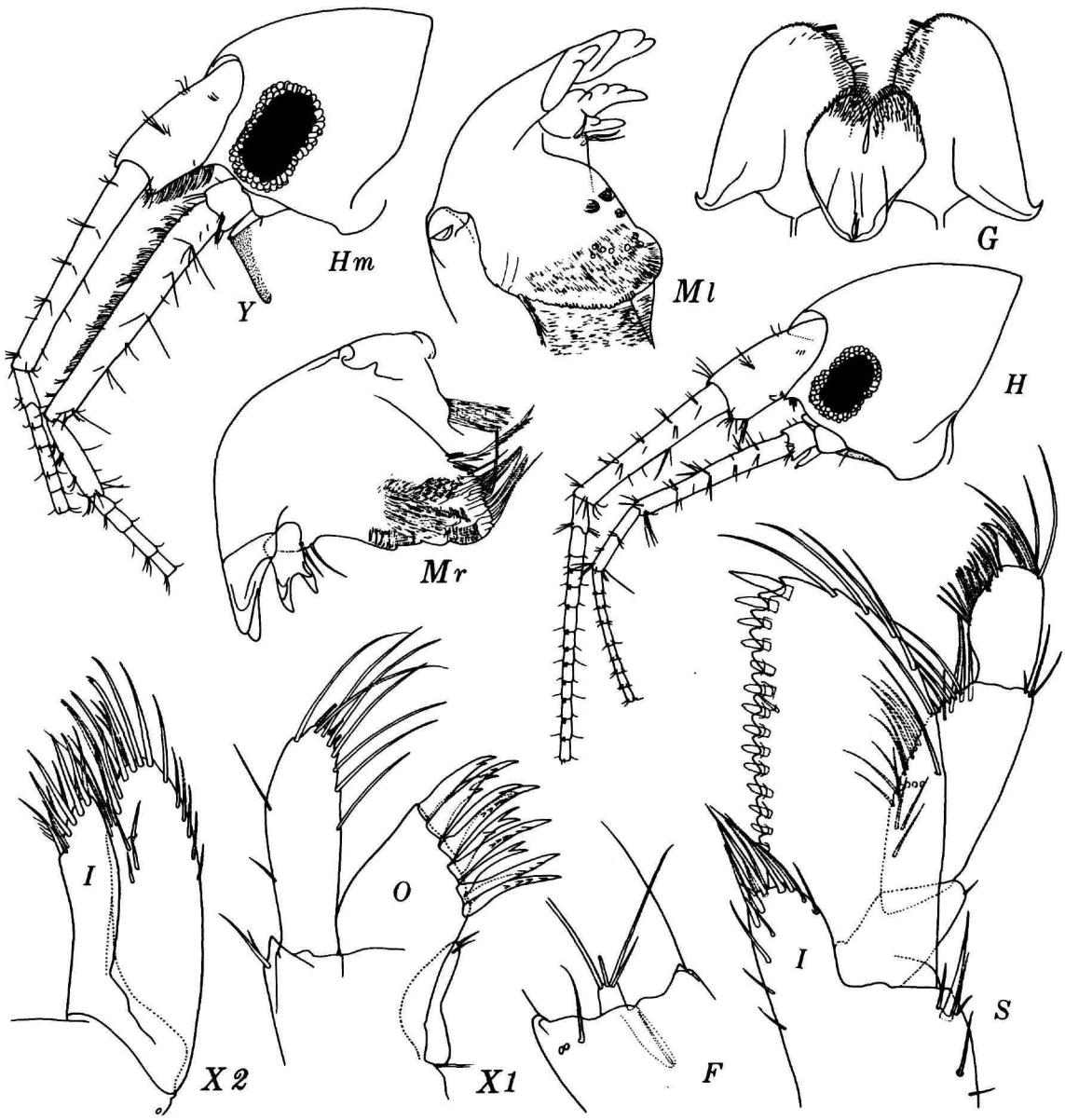


FIGURE 67.—*Paradexamine pacifica* (Thomson), female, 5.2 mm; *m*=male, 3.9; both from Chaffers Passage, New Zealand, Cooper A67. (*c*=middle of uropod 3 from unknown specimen, appendage loose in collection).

with small spine becoming progressively larger with each instar; telson weakly crested, apices broad, with 8-9 irregular serrations, some of them bifidations, 1 small spine in notch space, lateral margins of each lobe with about 5-6 medium spines in tandem; cuticle of posterior body segments smooth or faintly spiculate.

MALE (about 4.2 mm, not strongly developed). — Eyes enlarged, setular tufts on ventral margin of article 1 on antenna 1, dorsal margins on articles 4-5 of antenna 2, article 2 of antenna 1 and article 4 of antenna 2 elongate, article 5 of antenna 2 short relative to article 4, flagella elongate; gnathopod 1 like female but article 5 of gnathopod 2 elongate, thus article 6 of gnathopod 2 only 0.76 times as long as article 5, each oblique row on hand face with 7 setae, posterior margins with 5 and 4 setae each (gnathopods 1 and 2 respectively), anterior facial setae, distal to proximal, formula: 2-2-1 on gnathopod 1, 3-3 gnathopod 2; article 2 of pereopod 3 slightly more slender than in female; uropod 3 with only wire-seta in accessory distal position on peduncle, besides main distal spine; spines on urosome slightly smaller than in female.

REMARKS. — Material of this species has been reexamined since the description was made by J. L. Barnard (in press), resulting in these additional characteristics: the facial setae on the outer plate of maxilla 2 and the development of 2 apical spines on the peduncle of uropod 3 occurs in fully adult specimens, 5.5 to 6.3 mm long, but the second spine occurs only as a seta in specimens smaller than 4.5 mm. In Barnard (in press), I interpreted Sheard's (1938) figure of the mandible as lacking spines, believing he had illustrated the 2 branches of the lacinia mobilis, but I now conclude he

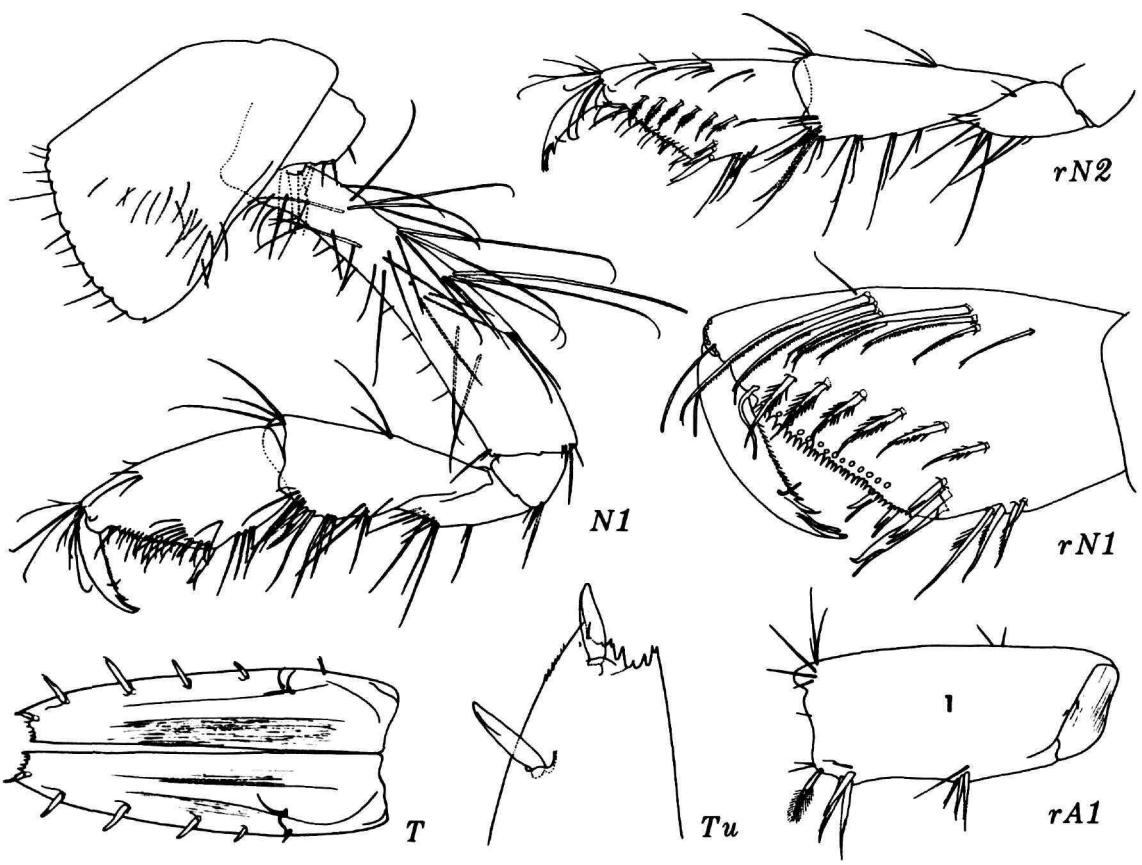


FIGURE 68.—*Paradexamine pacifica* (Thomson).

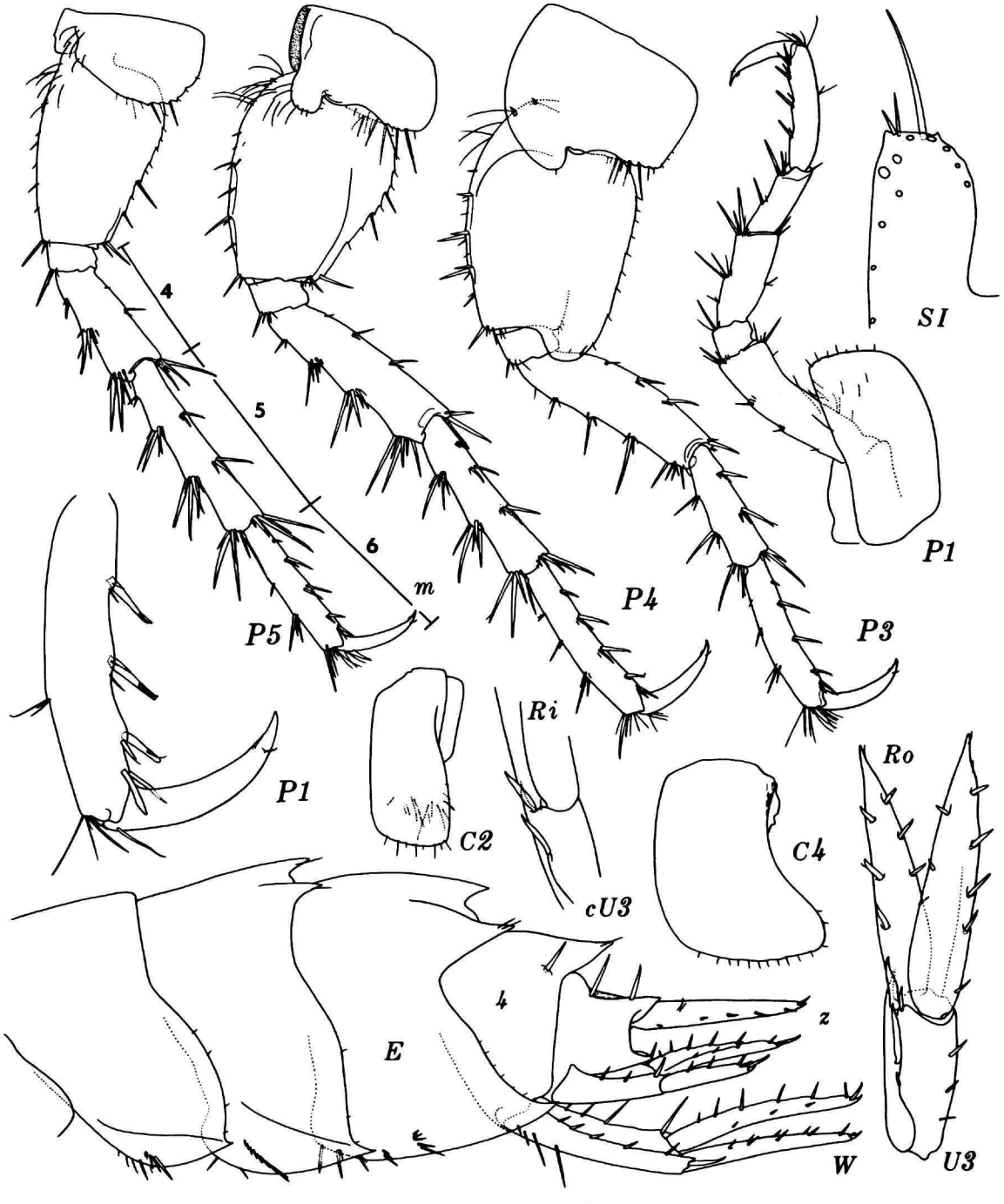


FIGURE 69.—*Paradexamine pacifica* (Thomson).

showed the 2 spines arcing together. Other discrepancies continue to be bothersome, such as the excessively high number of serrations Sheard shows on the telson, the missing apicolateral spines (he shows truly lateral spines only), and the absence of cones on the lower lip. But in general my specimens fit his depiction in the following parts: inner plate of maxilla 1, general shape of maxilla 2, dorsal tooth formula, mandibular lobes of the lower lip, palp of maxilla 1, a few points of the antennae.

Uropod 3 of this species generally falls off after preservation with the result that the largest uropod 3 illustrated herein comes from an unknown specimen. Since uropod 3 occasionally remains with specimens smaller than 4.5 mm, the paired spine position, one of the pair represented by a seta, has been correlated only on the smaller specimens.

MATERIAL. — Same as in J. L. Barnard (in press).

DISTRIBUTION. — New Zealand, sublittoral.

### *Paradexamine quarallia*, new species

FIGURES 70–72

DESCRIPTION (of female). — Lateral cephalic lobe rounded, protruding, head with moderate anteroventral definition, rostrum medium to small, blunt to slightly sharp; article 1 of antenna 1 with 1 middle spine, about 2 apical setae on normally rounded apicoventral corner, article 2 about 1.1 times as long as article 1, apically simple and with 1 midventral spine in very weak notch, flagellum about 1.6 times as long as peduncle; flagellum of antenna 2 nearly reaching end of antenna 1 (when both flexed), about 9-articulate; mandibles with large spines, 2 right, 3 left, both molars heavily triturative, bearing ragged and ordinary setae; outer lobe of lower lip with 4 or 5 large cones, mandibular lobes blunt; palp of maxilla 1 thin, shortened, reaching only 70 percent along outer plate, apex truncate with 2 setae, inner plate of normal size, naked; outer plate of maxilla 2 broader than inner but both appressed, inner subrectangular, outer slightly curved mesiad, inner reaching only 75 percent along outer; inner plate of maxilliped obsolescent, bearing 1-2 small apical or subapical spines, outer plate enlarged, palp falling short of outer plate apex; coxa 1 expanded near distal third, with 3 weak anterior setae, lower oblique margin well setose, coxa 2 apically subtruncate, bearing weak medial seta in position of spine on several other species, coxae 1-4 scarcely serrate, coxa 3 not prolonged, coxae 5-6 weakly spinose ventrally; gnathopod 1 with article 6 about 1.15 times as long as article 5, on gnathopod 2 about equal to article 5, gnathopods of medium size, palms oblique, dactyls shorter than palms, medial faces of hands with 4 and 3 medial setae in oblique rows, proximal setae simple, distal large and pectinate, anterior faces with 1 row of setae, dactyls bearing only inner tooth, palms regularly and minutely serrate in tight pattern; pereopods 1-5 of regular stoutness, with numerous blunt spines, pereopods 1-4 with tendency toward expanded, almost prehensile sixth articles, ratio of articles 4-7 on pereopods 1-2 about 15:15:19:11; article 2 of pereopod 3 of normal breadth, posteroventral lobe well developed; article 2 of pereopod 4 broadly pyriform, lobe well developed, posterior margin sparsely setose; article 2 of pereopod 5 subquadrate, posterior margin serrate, posteroventral area with large lobe bearing weak spines, article 5 slightly elongate, ratio of articles 4-7 about 18:26:21:11; pleonal epimera 1-2 with lateral ridge and small sharp or blunt posteroventral tooth, epimeron 3 with posterior margin straight, tooth obsolescent, posterior margins smooth, epimeron 1 with 1 long, 1 short spinule, epimeron 2 with 1 spinule, 3 with 1 spinule; pereonite 7 smooth, pleonites 1 and 2 with weak but sharp dorsal tooth, pleonite 3 with weak blunt tooth, pleonites 1-3 with side teeth blunt, pleonite 4 with quadrate dorsal tooth, sharp lateral tooth, lateral teeth forming subdorsal ridges, pleonite 4 with 1 spine on subdorsal ridge and pleonites 5-6 (fused) with 2 dorsolateral spines on each side; dorsal margin of peduncle on uropod 1 with fairly even spination, with tendency to gap distally; rami of uropod 3 missing in all but one female and that female bearing 1 seta on inner ramus; apices of telsonic lobes of medium breadth, each bearing weak main notch laterally and medium spine, with 3-4 sharp medial teeth and 1 weak lateral tooth, lateral margin of each lobe with 4-6 medium spines; cuticle of posterior segments weakly and finely spiculate.

MALE (Slack-Smith 1, 3.2 mm, not strongly developed). — Pleonite 1 lacking side tooth, dorsal tooth obsolescent; epimera 1-2 slightly broader than

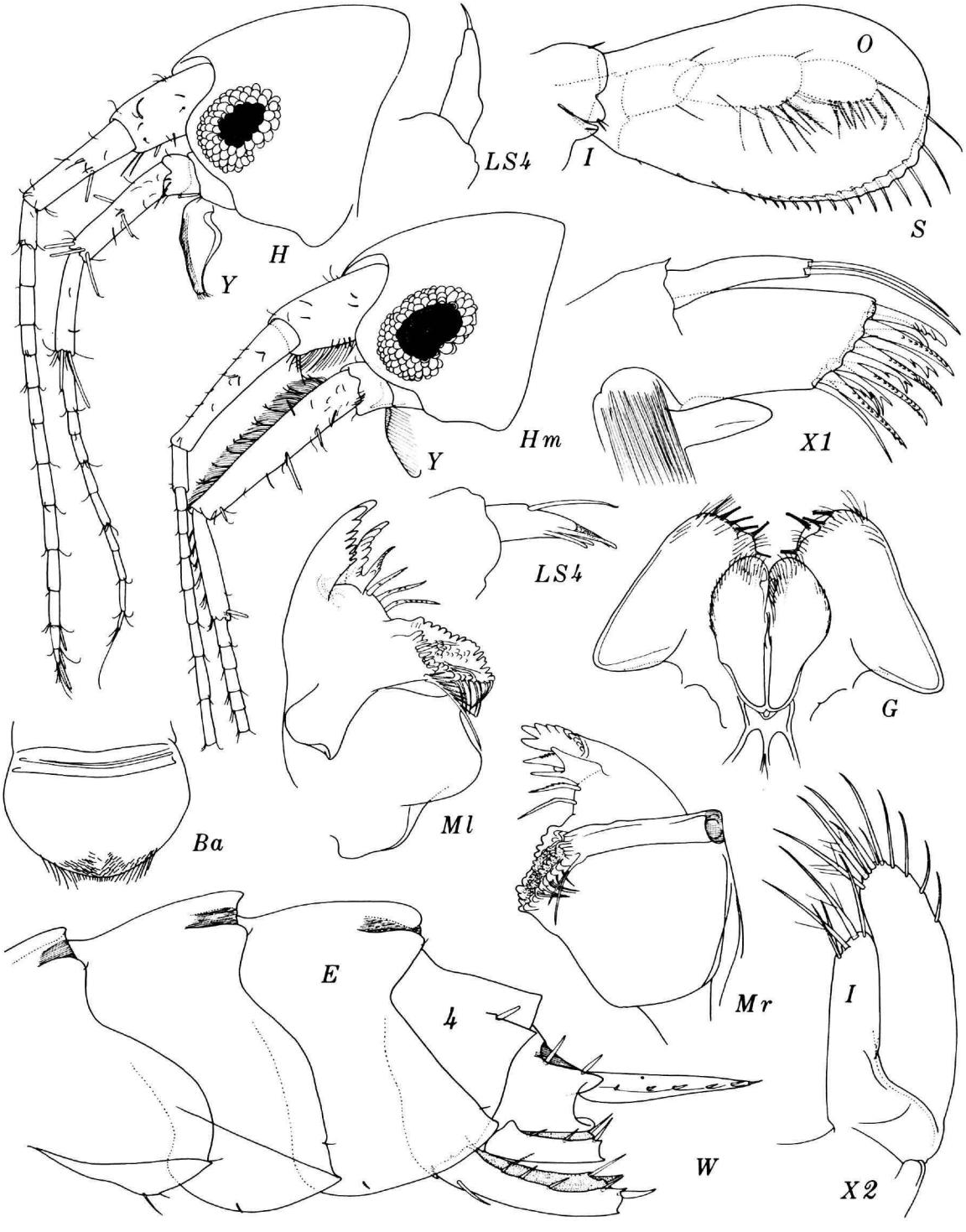


FIGURE 70.—*Paradexamine quarallia*, new species.

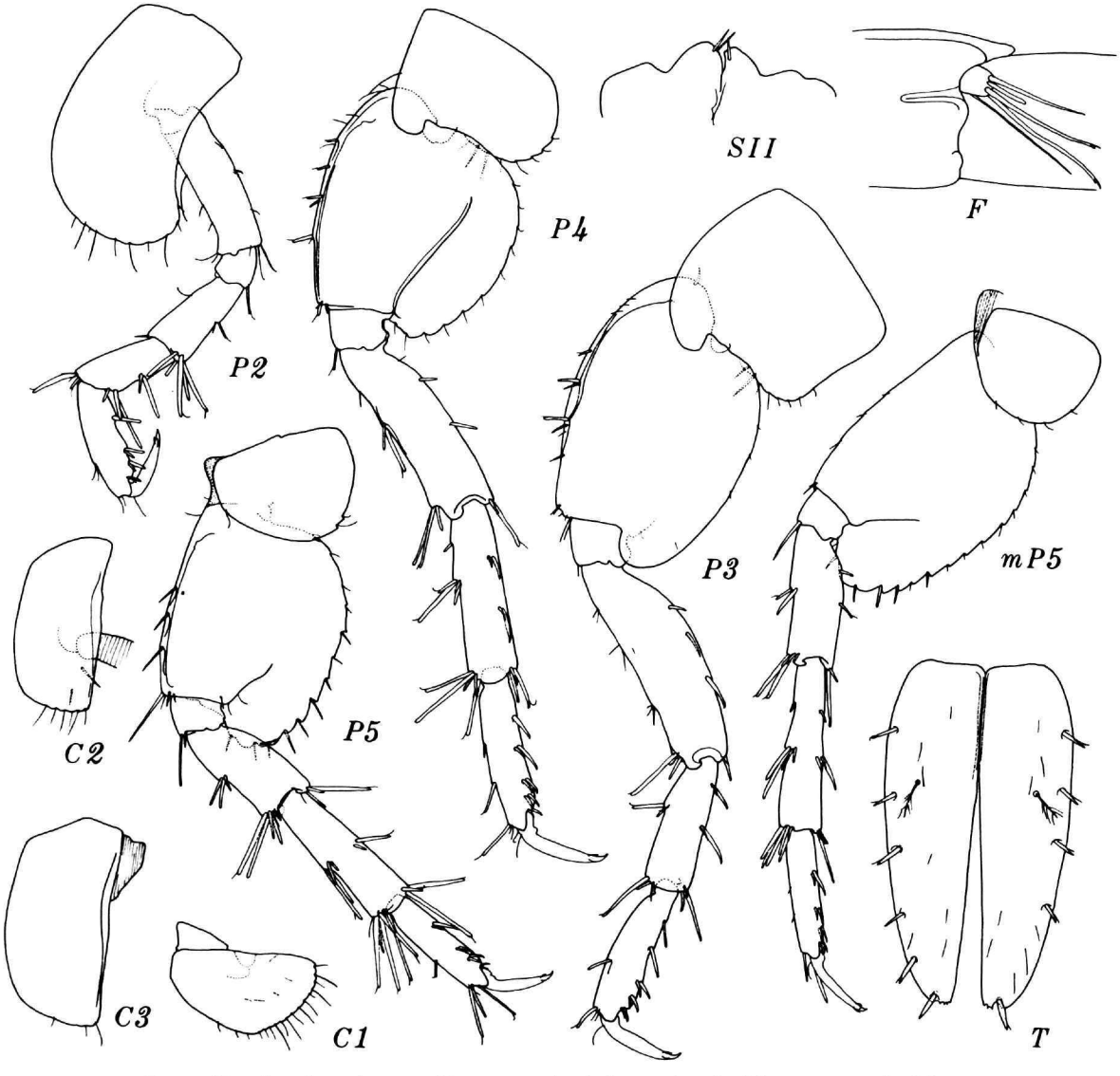


FIGURE 71.—*Paradexamine quarallia*, new species, holotype, female, 2.9 mm; *m*=male, 3.2 mm; both from Slack-Smith 1.

in female (anterior to posterior) and flatter ventrally, epimeron 1 with 1 long, 2 short setae, epimeron 2 with 2 spines ventrally, epimeron 3 with 3 spines ventrally; ventrolateral (basal) spine of uropod 1 half as long as shown for female herein; eyes enlarged; antennae elongate and generally typical of males of this genus, flagellum 1.4 times as long as peduncle on both antennae 1 and 2; lobe on article 2 of pereopods 1-2 better developed than in female and articles 4-5 more elongate, ratio of articles 4-7 about 22:29:21:12; article 2 of pereopod 3 slightly narrower than in female; article 5 on gnathopods 1-2 slightly elongate, about 1.05 times as long as article 6 on gnathopod 1, medial

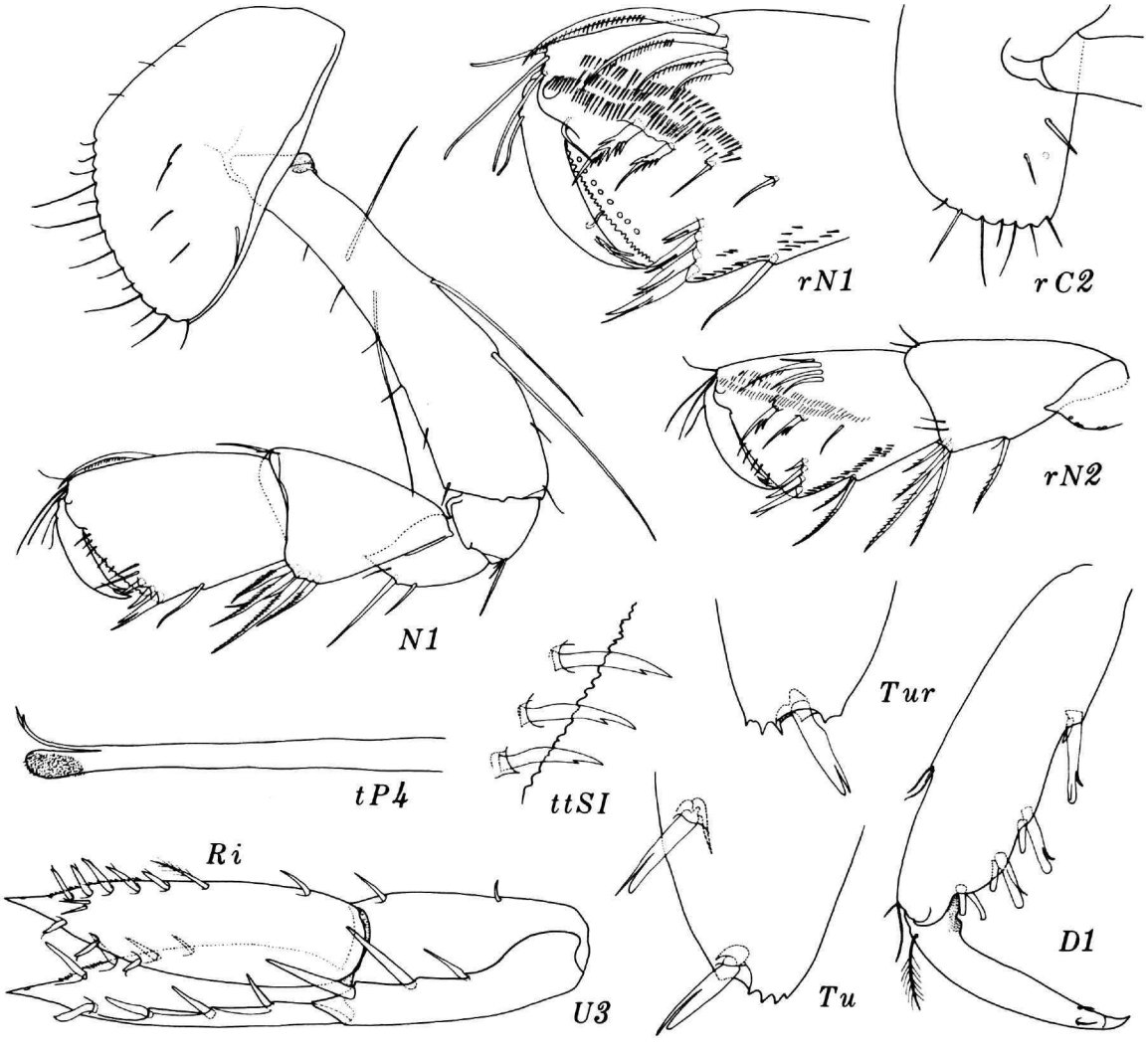


FIGURE 72.—*Paradexamine quarallia*, new species.

faces of hands with 3 serrate spines and 1 simple spine on gnathopod 1, anteriorly with 5 large setae, with 3 serrate and 2 simple spines on gnathopod 2, anteriorly with 5 and 1 large setae in sets; following similar to female: coxa 1, accessory flagellum, maxillae, maxilliped, mandibles, lower lip; telson with only 2 weak medial cusps, and basal giant seta positions bearing 1 seta on one lobe, 2 on other; uropod 3 missing.

MALE (VicFish 62, 3.3 mm). – Differing from Slack-Smith male in better development of telsonic serrations, each medial lobe with either 4 or 5 serrations. Males develop the dorsal tooth on pleonite 1 very late in life (size), and few males in the present collections have that tooth.

ABERRATION. – One specimen from VicFish 109 has the dorsal tooth on pleonite 4 formed into a rounded keel.

JUVENILES. – Specimens range from 1.02 to 3.75 mm, juveniles in these collections generally being less than 2.2 mm long; smallest well-preserved juvenile 1.2 mm; side teeth on pleonites 3-4 rudimen-

tary, absent on pleonites 1-2, dorsal tooth of pleonite 2 sharp, rudimentary on pleonite 3, absent on pleonite 1; uropod 1 bearing large basolateral spine as in adult; pereopods distinctly subprehensile like adult, spine on article 2 of antenna 1 absent, article 2 shorter than article 1, article 3 more than three-fourths as long as article 2, first flagellar article nearly as long as article 1, flagellum with 5 articles, flagellum of antenna 2 with 3 articles; lobe on article 2 of pereopod 5 scarcely developed but 2 large spines present, 1 ventral, 1 posterior.

REMARKS. – Rami of uropods 1-2 not illustrated owing to shrinkage in alcohol; on uropod 1 the outer ramus is 87 percent as long as the inner; on uropod 2 the outer ramus is 67 percent as long as the inner.

HOLOTYPE. – WAM, female, 2.9 mm.

TYPE-LOCALITY. – Slack-Smith 1, Cheyne Beach, east of Albany, Western Australia, intertidal, on weedy rocks, 4 December 1968.

RELATIONSHIP. – Similarities in head, mandibles, lower lip, maxillae, maxilliped, gnathopods, telson, and pereopod 5 suggest a relationship of this species to *P. windarra,* but *P. quarallia* differs from *P. windarra* in the blunt teeth of the metasome, the vestigial tooth and smooth margins of epimeron 3, the essential lack of a gap in the spination of the peduncle on uropod 1, the weakly developed notch on article 2 of antenna 1, the smallness of medial setal-spines of coxae 1-2, the expanded coxa 1 with poor development of anterior setae, the weakly prehensile pereopods, the well-developed posteroventral lobe of article 2 on pereopod 4, the broadness of article 2 on pereopod 3, and the distinctions in the formulae and morphology of the facial setae on the hands of the gnathopods (see Figure 72*N1*).

*Paradexamine quarallia* differs from *P. narluke* (male known only) in the blunt pleonal teeth, the well-developed lobe on pereopod 5, and the weak tooth on epimeron 3.

*Paradexamine ronggi* has a short flagellum on female antenna 2, almost chelate gnathopods with poor setation, a smaller outer plate and a larger inner plate of the maxilliped, an unexpanded coxa 1, no lobe on article 2 of pereopods 4 and 5, sharp spines on pereopods 1-5, and sharp teeth on the metasome and epimera.

MATERIAL. – Slack-Smith 1 (19); JLB Australia 13 (1); VicFish 1-105, 20 samples (53).

DISTRIBUTION. – Warm-temperate Australia, intertidal and bays.

### *Paradexamine ronggi,* new species

FIGURES 73–74

DESCRIPTION (of female, based mainly on 3.25 mm female). – Lateral cephalic lobe rounded, poorly protruding, head with distinct anteroventral definition; rostrum medium and sharp; article 1 of antenna 1 with ventral setae thin and mainly terminal, article 2 about 1.2 times as long as article 1, no tooth present distally, flagellum about 85 percent as long as peduncle; flagellum of antenna 2 with 3-4 articles, about as long as article 4 of peduncle; mandibles with large spines, left with 4, right with 2; molars nearly smooth, weak, with ragged setae and few ordinary setae; outer lobe of lower lip with 1 long apical cone and 2 short cones on medial margin, or with only 1 or no medial cones (female, 3.1 mm), apical cone very weak and translucent in 2.4 mm female; mandibular lobes blunt; palp of maxilla 1 of medium breadth or thin, shortened, reaching only 75 percent along outer plate, apex with 2 setae and weakly rounded cusp (or 3 setae and 1 medial subapical seta in a 2.4 mm female and 2 apical and 1 subapical in a 3.1 mm female), inner plate of normal size and naked; outer plate of maxilla 2 scarcely broader than inner, inner reaching 80 percent along outer; inner plate of maxilliped slender, long, weakly pointed, bearing 2-3 medium-sized apical spines, apex of palp article 3 nearly reaching apex of outer plate; distal half of coxa 1 weakly tapering, anterior margin setose, coxae 1-4 serrate ventrally, coxae 5-6 with spinose ventral margins, coxa 3 with moderately prolonged posteroventral extension, coxae 1-3 lacking spines on middle of posterior margin; gnathopod 1 with article 6 about 1.3 times as long as 5, on gnathopod 2 about 1.15 times, gnathopods small, poorly spinose, almost mitten-shaped, palms convexly transverse, dactyls fitting palms, medial faces of hands with 2 simple setae and 1 anterior row, dactyls unserrate except for main tooth, palms weakly serrate; pereopods 1-5 of normal stoutness, rarely with a blunt spine among mainly sharp spines, second articles of pereopods 1-2 somewhat short and apically thickened, ratio

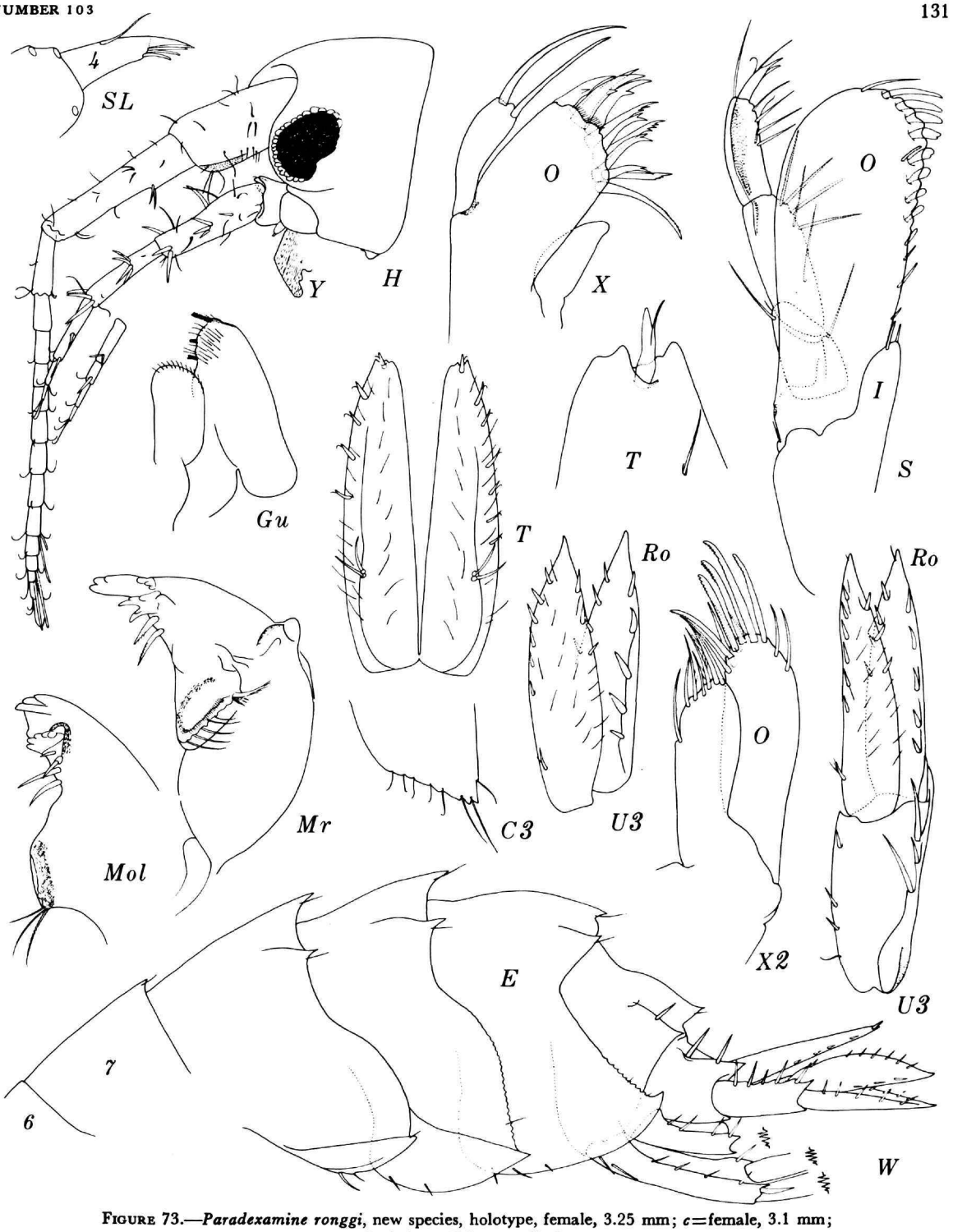


FIGURE 73.—*Paradexamine ronggi*, new species, holotype, female, 3.25 mm; *c*=female, 3.1 mm; both from JLB Australia 8.

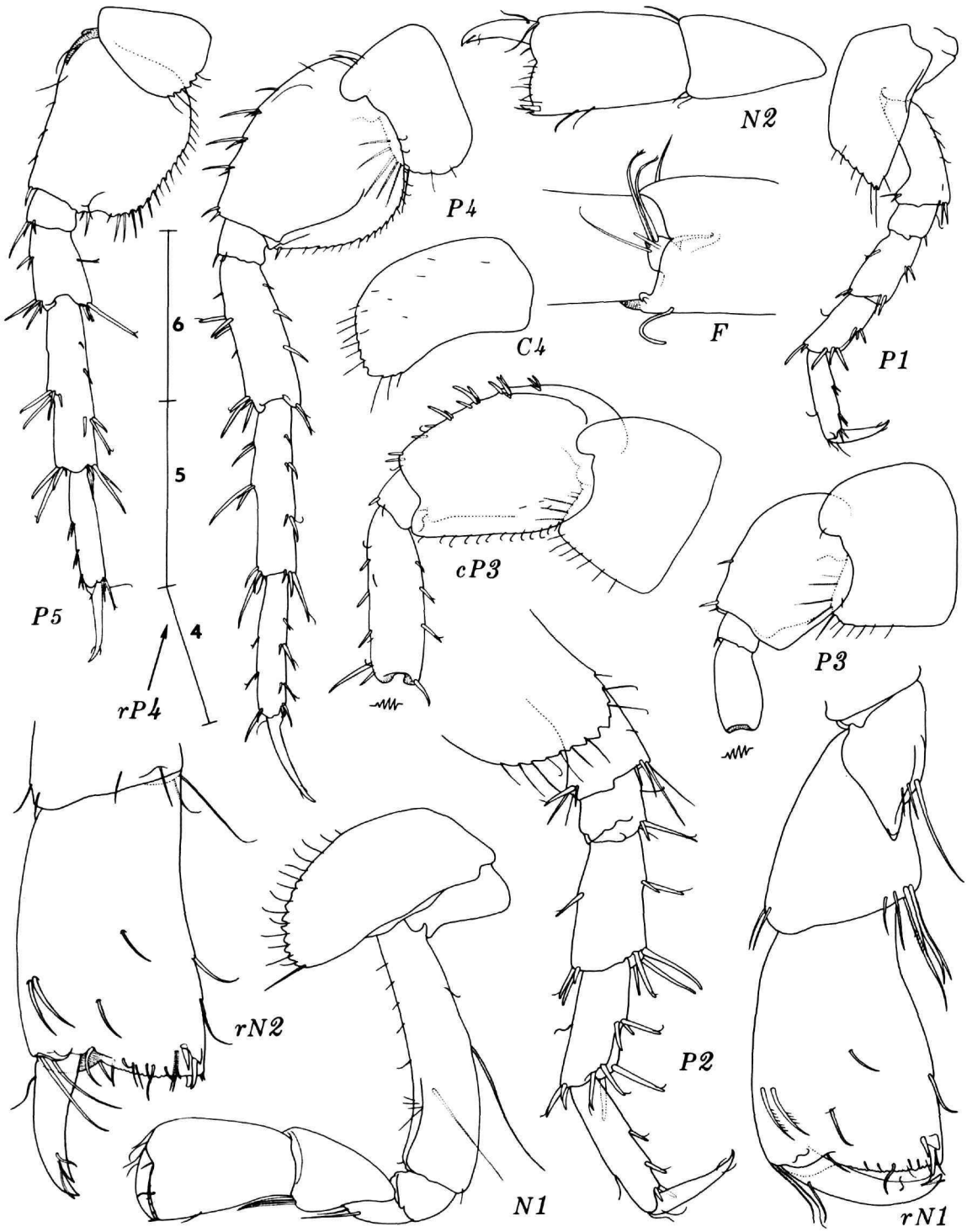


FIGURE 74.—*Paradexamine ronggi*, new species.

of articles 4 - 7 about 10:9:11:7; pereopod 3 highly variable, aberrant on 3.25 mm female (regenerating one side, missing on other side), article 2 subpyriform and with posteroventral lobe and remainder of appendage generally thin as pereopod 4, but in 2.4 mm female article 2 subquadrate, lacking posteroventral lobe, remainder of appendage thicker than on pereopod 4, article 2 generally with more blunt spines than elsewhere on pereopods 1-5; article 2 of pereopod 4 broadly pyriform, large (elongate in 2.4 mm female) posterior margin with closely set setules, article 5 of pereopod 5 rectopyriform, posterior margin serrate and heavily spinose posteroventrally, article 5 elongate, ratio of articles 4, 5, 6 about 6:13:9; pleonal epimera 1-2 with lateral ridge and medium-sized posteroventral tooth, epimeron 3 also with tooth, posterior margins of epimera weakly or moderately serrate, serrations weakest on epimeron 1, epimera each with 2-3 ventral setal spines; pereonite 7 with small, sharp dorsal tooth, pleonites 1-4 each with 3 sharp teeth, lateral teeth forming subdorsal ridges, pleonite 4 with 1 spine on subdorsal ridge and pleonites 5-6 (fused) with 2 dorsolateral spines on each side; rami of uropod 3 spinose only; apices of telsonic lobes narrow, each bearing notch with spine, each medial projection obscurely bifid, lateral margin of each lobe with about 4-6 small spines; cuticle of posterior body segments smooth (lacking papillae or villi seen in *P. goomai*). Male unknown.

HOLOTYPE. — WAM, female, 3.25 mm.

TYPE-LOCALITY. — JLB Australia 8, 3 miles northeast of Dunsborough, near Cape Naturaliste, Western Australia, wash of sponges and tunicates on pilings of old jetty, 2 September 1968.

REMARKS. — The diversity in pereopod 3 of the two specimens at hand is disturbing. The mandibular lobe on the lower lip is illustrated in its flattened condition, whereas the other specimen at hand has the lobe pointed and slightly upturned from a direct anterior or posterior view; the lobe, when flattened, becomes obtusely quadrate. The rami of uropods 1-2 generally are like those figured for *P. goomai*, but, more precisely, they are like those figured by Stebbing (1910a) for *P. flindersi;* on these specimens the rami are strongly curled and could not be straightened sufficiently for illustration.

These specimens have definite affinities with *P. flindersi* in the remarkable similarity of gnathopods, the short antenna 2 and short palp of maxilla 1, and generally in the dorsal tooth formula, the head, telson, mandibles, and maxillipeds, but a large number of small discrepancies between these specimens from Western Australia and the materials studied by Stebbing from eastern Australia suggest subspecific or specific identity for the western Australian material; hence, a specific name is established, but, because of differences between the 3.1 and 3.25 mm specimens, one must suggest the possibility that 2 cryptosibling species occur in Western Australia, in which case both must be named as full species.

*Paradexamine ronggi* differs from *P. flindersi* in the following characters: (1) article 2 of antenna 1 has no distal tooth; (2) the flagellum of antenna 2 is definitely 3 + - articulate; (3) the inner plate of maxilla 2 is elongate; (4) coxa 1 is more strongly beveled and narrower distally; (5) gnathopod 1 has the palm more protuberant; (6) article 4 of pereopods 3 and 4 is definitely shorter than 5 (in *P. flindersi* article 4 is very elongate); (7) article 2 of pereopod 5 is narrower; (8) the apices of the telson are narrower; (9) no tooth occurs on pereonite 6 in definitely adult specimens.

MATERIAL. — JLB Australia 8 (2 females, 3.25 and 3.10 mm).

DISTRIBUTION.—Southwestern Australia, intertidal.

### *Paradexamine thadalee*, new species

FIGURES 75–77

DESCRIPTION (of female). — Lateral cephalic lobe rounded anteriorly, head with weak anteroventral definition at base of antenna 2; rostrum short, blunt; article 1 of antenna 1 with ventral spines thin and arranged in 2 groups of 1-2 each, article 2 about 1.45 times as long as article 1, apically simple and with set of spines ventroproximally, flagellum slightly more than 1.2 times as long as peduncle; flagellum of antenna 2 about 1.2 times as long as peduncle, multiarticulate; mandibles bearing 2 large spines on right, 3 large on left, molar strongly ridged, ragged seta each side, regular setae both sides but larger on right, accessory bulge weak, sharp; outer lobe of lower lip bearing 1 me-

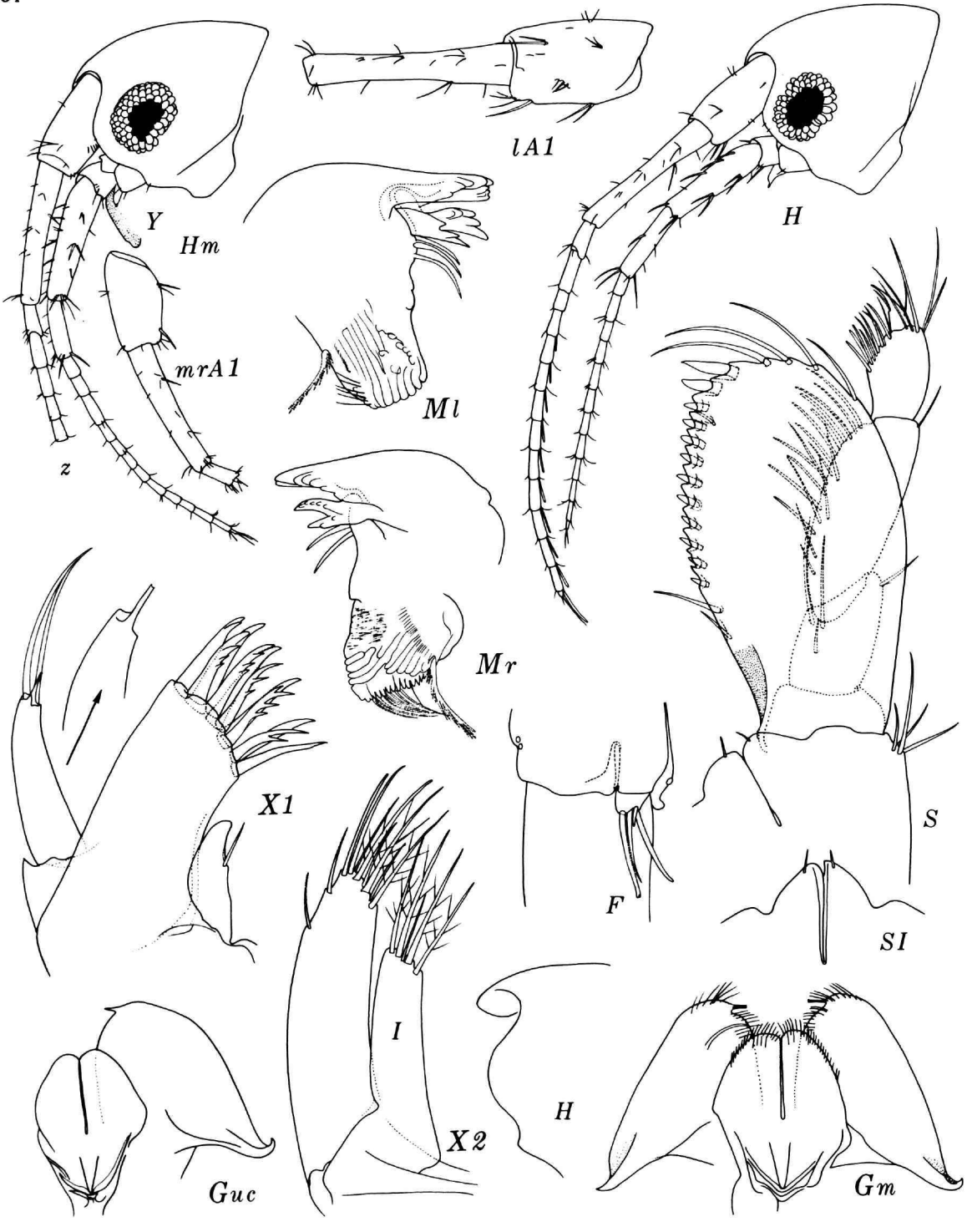


FIGURE 75.—*Paradexamine thadalee*, new species.

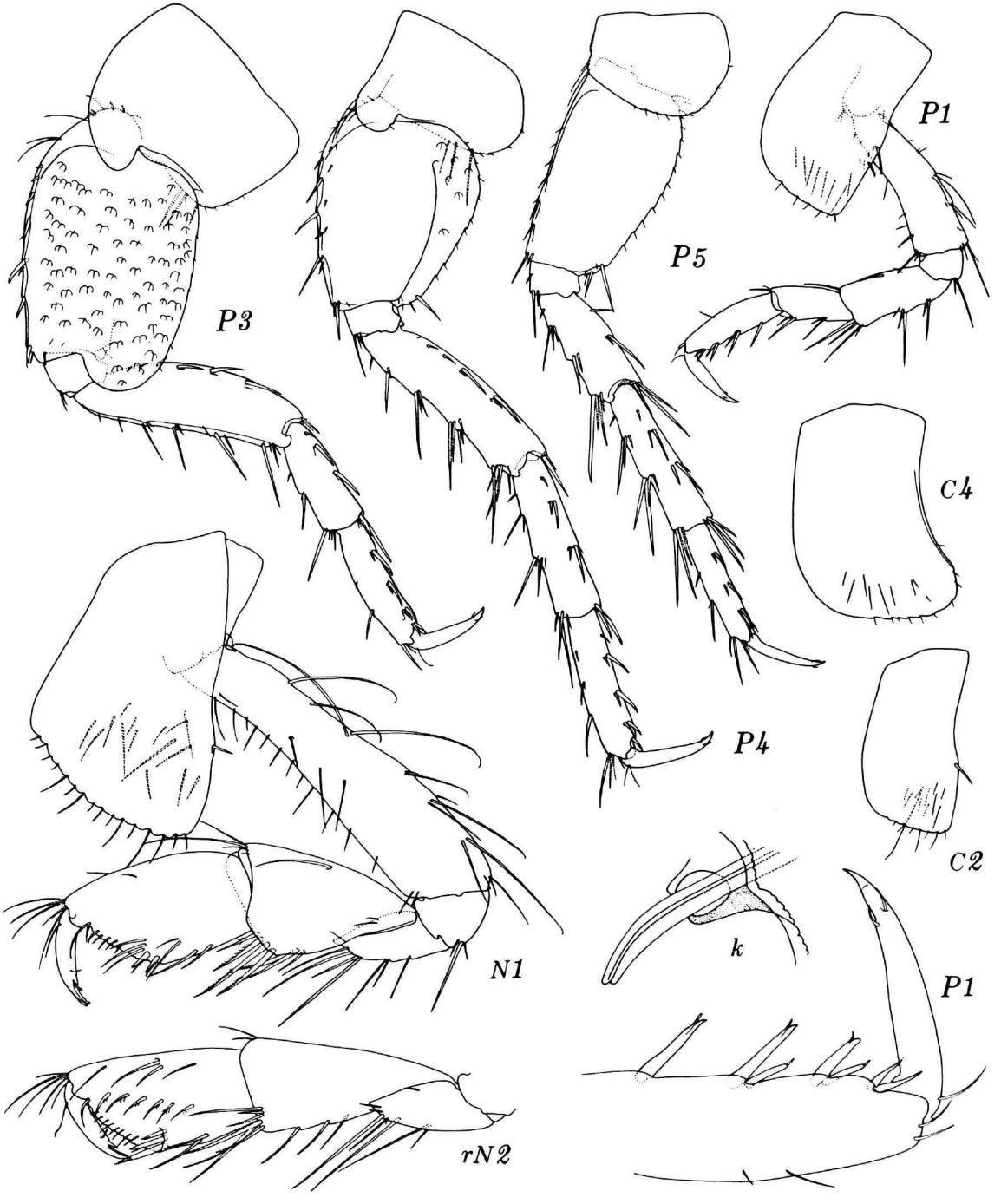


FIGURE 76.—*Paradexamine thadalee*, new species.

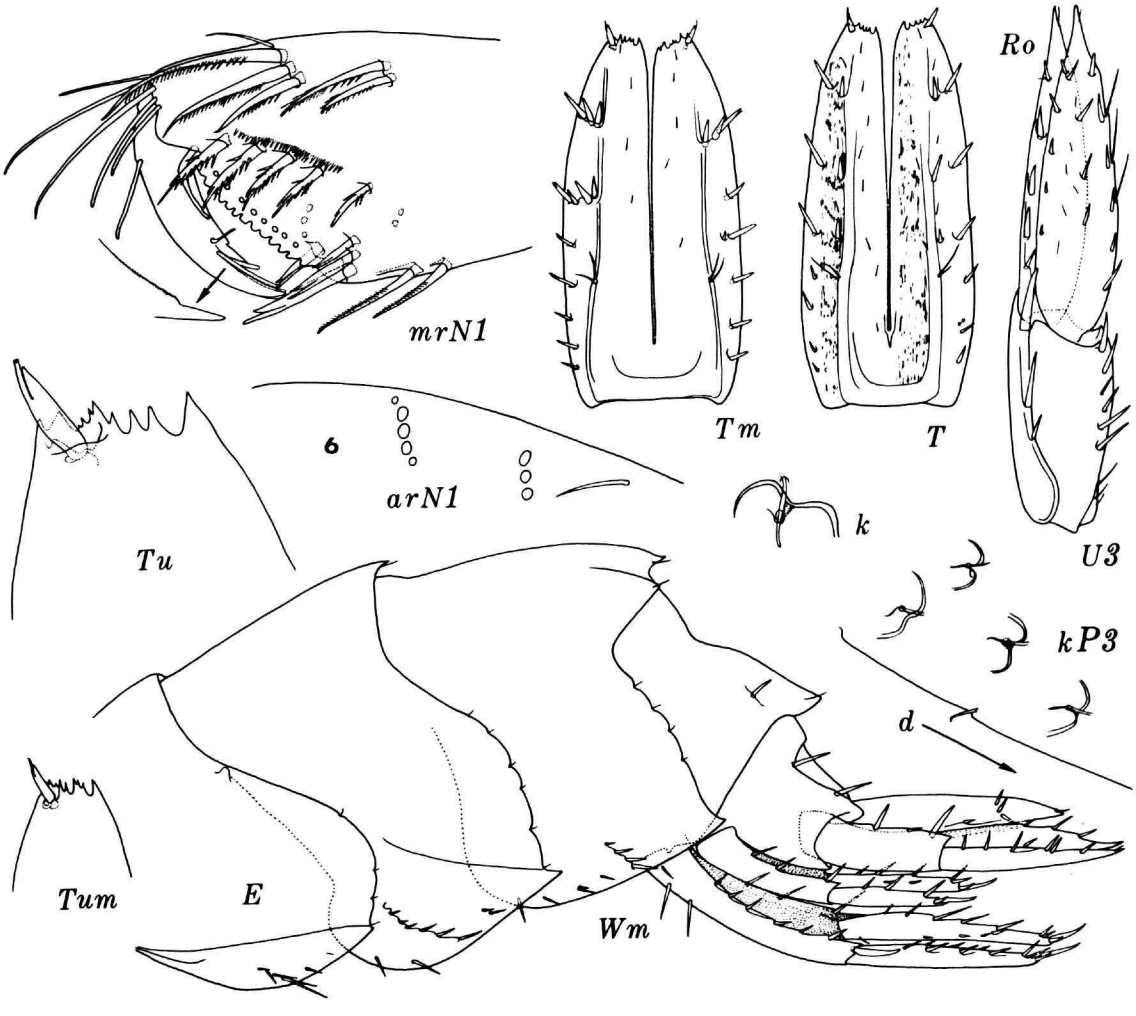


FIGURE 77.—*Paradexamine thadalee*, new species, holotype, female, 3.75 mm; *m*=male, 3.25 mm; *c*=female, 4.0 mm; all from Slack-Smith 1. (*k*=cuticular pit, arrow pointing dorsally; pits omitted on coxae of pereopods 3-5.)

dium cone, mandibular lobes thin, apically upturned; palp of maxilla 1 shorter than outer plate, thin, bearing 2 apical setae and 1 apical cone (both sides), inner plate attentuate apically, bearing 1 seta on medial edge; inner plate of maxilla 2 narrower than outer, both appressed, inner with apex slightly oblique, outer weakly curved, inner reaching 70 percent along outer; inner plate of maxilliped small, bearing 1 apical spine, outer plate of ordinary size, spines small, simple, palp of medium robustness, slightly exceeding outer plate; coxa 1 expanded apically, naked anteriorly, setose ventrally, scarcely scalloped, bearing thin posterior spines, coxae 2-3 rectangular, poorly setose and serrate, coxa 2 bearing 1, coxa 3 bearing 2 small posterior spines, coxae 5-6 with thin posteroventral spines; gnathopod 1 with article 6 about 0.93 times as long as article 5, on gnathopod 2 about 0.80 times, gnathopods of ordinary stoutness, palm oblique, medial faces of hands with 6 pectinate setae, anterior setae in 2 and 3 rows respectively on gnathopods 1-2, dactyls bearing extremely minute

pectinations proximal to inner tooth (pectinations scarcely visible under oil immersion), palms regularly castellate; pereopods 1-5 thin, with sharp spines, ratio of articles 4-7 on pereopods 1-2 about 18:13:18:13; article 2 of pereopod 3 of ordinary stoutness, posteroventral lobe broad and deep; article 2 of pereopod 4 weakly pyriform, posteroventral lobe obsolete but spinose; article 2 of pereopod 5 thinly rectopyriform, posterior margin weakly serrate, posteroventral corner spinose, ratio of articles 4-7 about 21:29:23:15; pleonal epimera 1-2 with lateral ridge, tiny sharp tooth on epimeron 1, medium sharp on epimeron 2, epimeron 3 with small thick tooth, posterior margins of epimera with weak, setulose notches, epimeron 1 with facial row of 5 spines and 1 other spine and 3 tiny spinules in tandem, epimeron 2 with facial row of 6-7 spines, pair of facial posteriorward and 2 spines in tandem anteriorly, epimeron 3 with middle facial row of 4 spines and 4 anterior spines in tandem (rarely paired); pleonite 1 dorsally smooth, pleonite 2 with sharp dorsal tooth, no laterals, pleonite 3 with sharp dorsal, slightly blunted lateral on both sides, pleonite 4 with large, sharp, recumbent dorsal, no laterals, lateral spine on weak ridge, pleonites 5-6 (fused) with 2 dorsolateral spines on each side; dorsal margin of peduncle on uropod 1 evenly spinose or with weak gap between spines 2-3 distally; inner ramus of uropod 3 with several setae; telson with long high crest on each lobe, apices broad, with about 6 main serrations and several smaller ones or various bifid- and trifidations, 1 small spine in notch space, lateral margins of each lobe with about 6 medium-to-small spines, 3 distal members forming spine pairs; cuticle of posterior body segments smooth (in normal context) but bearing few slit-pits armed with sensory setule, these pits sparse to absent on urosome and uropods, absent on pereopod 5, scarce on article 2 of pereopod 4 and epimera, but dense on coxae 1-7, article 2 of pereopod 3, and lower ends of posterior pereonites.

MALE (subadult). – Scarcely distinct from female in eyes and antennae, but spines on urosome slightly shorter than in female, main facial spine rows on epimera denser, epimeron 1 with 6, epimeron 2 with 7, epimeron 3 with 6 spines in main row.

MALE (well advanced, VicFish 56, 4.0 mm). – Article 1 of antenna 1 with several ventral setal brushes, article 2 nearly 1.8 times as long as article 1, peduncular articles 4-5 of antenna 2 elongate, ratio of 2:1 in length, upper margin of 4 with setal brushes; eyes slightly enlarged; lower lip like female; setae on left mandibular molar nearly as long as those on right; palp of maxilla 1 slightly shortened, apical cone more elongate than in female; inner plate of maxilla 2 with apex slightly oblique and bearing 7 setae; maxilliped normal; scallops on palms of gnathopods weaker than in female; article 2 of pereopod 5 slightly more widened proximally than in female; uropod 1 with 4 proximolateral spines on peduncle; spines on urosome very small; pleonites 5-6 with strong hump on dorsal midline; formulae of spine groups on epimera 1-3 as follows, rear to front (s=small seta) epimeron 1: 1s-1s-6; epimeron 2: 0-9-1-1; epimeron 3: 5-2-1-1-1. Characters of left mandible, first maxillary palp, and gnathopodal scallops may be correlated geographically, as this male occurs more than halfway across the Australian continent from the type-locality.

JUVENILES (1.55 and 1.59 mm long, JLB 13).– These two are identified with *P. thadalee* because of spine pairs and crests on the telson, the side seta on the inner plate of maxilla 1, and the small rostrum, in contrast to *P. churinga*. Only 2 slit-pits occur on article 2 of pereopod 3, and they are very weak. The mandibles, lower lip, and maxilla 2 fit the adult morphology in terms of taxonomic characters. The apices of the telsonic lobes have either 1 simple notch bearing the terminal spine, or the main notch has 1-3 rudimentary cusps within it. Only the apical side spine position is paired. No dorsal tooth occurs on pleonite 2, the teeth of pleonites 3 and 4 are rudimentary, epimeron 2 has only 1-2 facial spines in the main set, and only 1 spine is in the main set of epimeron 3. The smallest specimen of *P. churinga* at hand is 1.89 mm; it has the dorsal and side teeth of pleonite 2 well developed, the characteristically elongate and attenuate rostrum, and a flat telson.

HOLOTYPE. – WAM, female, 3.75 mm.

TYPE-LOCALITY. – Slack-Smith 1, Cheyne Beach, east of Albany, Western Australia, intertidal, on weedy rocks, 4 December 1968.

RELATIONSHIP. — This species bears immediate resemblance to *P. churinga,* new species, but it was noticed because of the lack of side teeth on pleonite 2, the smallness of the sharp dorsal teeth on pleonites 2-3, and the bluntness of the side tooth on pleonite 3, plus the spinal pairs on the telson and the high crest on each lobe of the telson. The slit-pits of various parts of the body are absent in *P. churinga,* and the rostrum of *P. churinga* is attenuate in comparison to many other members of *Paradexamine. Paradexamine thadalee* also differs from *P. churinga* in the proximity of the first lateral telsonic spine, in the normal pereopodal dactyls, which in *P. churinga* have the armament far distad, and in the poorly setose inner plates of the maxillipeds.

The blunt side tooth of pleonite 3 suggests affinities with *P. quarallia,* but that species has side teeth on pleonites 1, 2, and 4 and lobes on article 2 of pereopods 4-5 among numerous finer differences.

*Paradexamine marlie* and *P. linga* have an ocular tooth, small or absent mandibular spines, and large palp of maxilla 1 plus sharp side teeth on pleonite 2.

The general congruence between *P. thadalee* and *P. dandaloo* occurs in the head, the pleonite 4 formula, the spine formulae of the epimera, the mandibles, the inner plate of maxilla 1, the mandibular lobes of lower lip, the surficial slit-pits, the pereopods, the coxae, and the shape and general setation of the gnathopods, but *P. dandaloo* has some of the dorsal segmental teeth serrate, a large inner plate on the maxilliped, narrow telsonic apices, and no multiple spine positions on the telson.

MATERIAL. — Slack-Smith 1 (3); JLB Australia 13 (2); VicFish 1-105, 9 samples (18).

DISTRIBUTION. — Warm-temperate Australia, intertidal and bays.

### *Paradexamine windarra,* new species

FIGURES 78–80

DESCRIPTION (of female). — Lateral cephalic lobe rounded, protruding, head with distinct anteroventral definition, rostrum short, blunt; article 1 of antenna 1 with 1 middle spine, several apical setae on quadrate projection, article 2 about 1.5 times as long as article 1, apically simple but proximoventrally with strong spinose notch, flagellum about 1.3 times as long as peduncle; flagellum of antenna 2 about 9-articulate, elongate; mandibles with large spines, 2 right, 3 left, molar heavily triturative, ragged setae on both sides, ordinary setae both sides (removed in Figure 78*Ml*), accessory bulges sharp; outer lobe of lower lip with 3 medium-sized cones, 1 hidden behind inner lobe, mandibular lobes medium thick, straight; palp of maxilla 1 thin, shortened, reaching only 75 percent along outer plate, apex with 2 setae and no apparent cone, inner plate large and naked; outer plate of maxilla 2 scarcely broader than inner, inner reaching less than 60 percent along outer; inner plate of maxilliped short, broad, truncate, bearing 2 small apical spines, outer plate with weakly serrate spines, apex of palp article 4 scarcely reaching apex of outer plate, article 4 elongate; coxa 1 weakly tapering distally, setose along anterior margin, coxa 2 apically rounded, bearing large medial spine, spinule, and setule, coxae 1-4 weakly serrate and moderately setose ventrally, coxa 3 not strongly prolonged, coxae 5-6 ventrally spinose; gnathopod 1 with article 6 about 1.35 times as long as 5, on gnathopod 2 about the same, gnathopods of medium size, palms nearly transverse, dactyls fitting palms, medial faces of hands with 5 small setae in oblique row, setae sparsely plumose, anterior faces with 2 rows of setae, dactyls unserrate except for main tooth, palms regularly and minutely serrate in tight pattern; pereopods 1-5 of regular stoutness, with numerous blunt spines, pereopods 1-3 with tendency toward expanded, almost prehensile sixth articles, ratio of articles 4-7 on pereopods 1-2 about 15:17:20:14; article 2 of pereopod 3 long, narrow, with slightly sharpened posterior lobe; article 2 of pereopod 4 broadly pyriform, lobe obsolete, posterior margin sparsely setose; article 2 of pereopod 5 quadropyriform, posterior margin serrate, posteroventral area with large lobe bearing several long spines, article 5 elongate, ratio of articles 4-7 about 15:35:20:15; pleonal epimera 1-2 with lateral ridge and thin medium-sized posteroventral tooth, epimeron 3 also with thicker tooth, posterior margins very weakly serrate or essentially unserrate on epimeron 1, epimera 2-3 each with 2-4 weak ventral spinules, epimeron 1 with long seta and about 4 setules; pereonite 7 with or without dorsal tooth

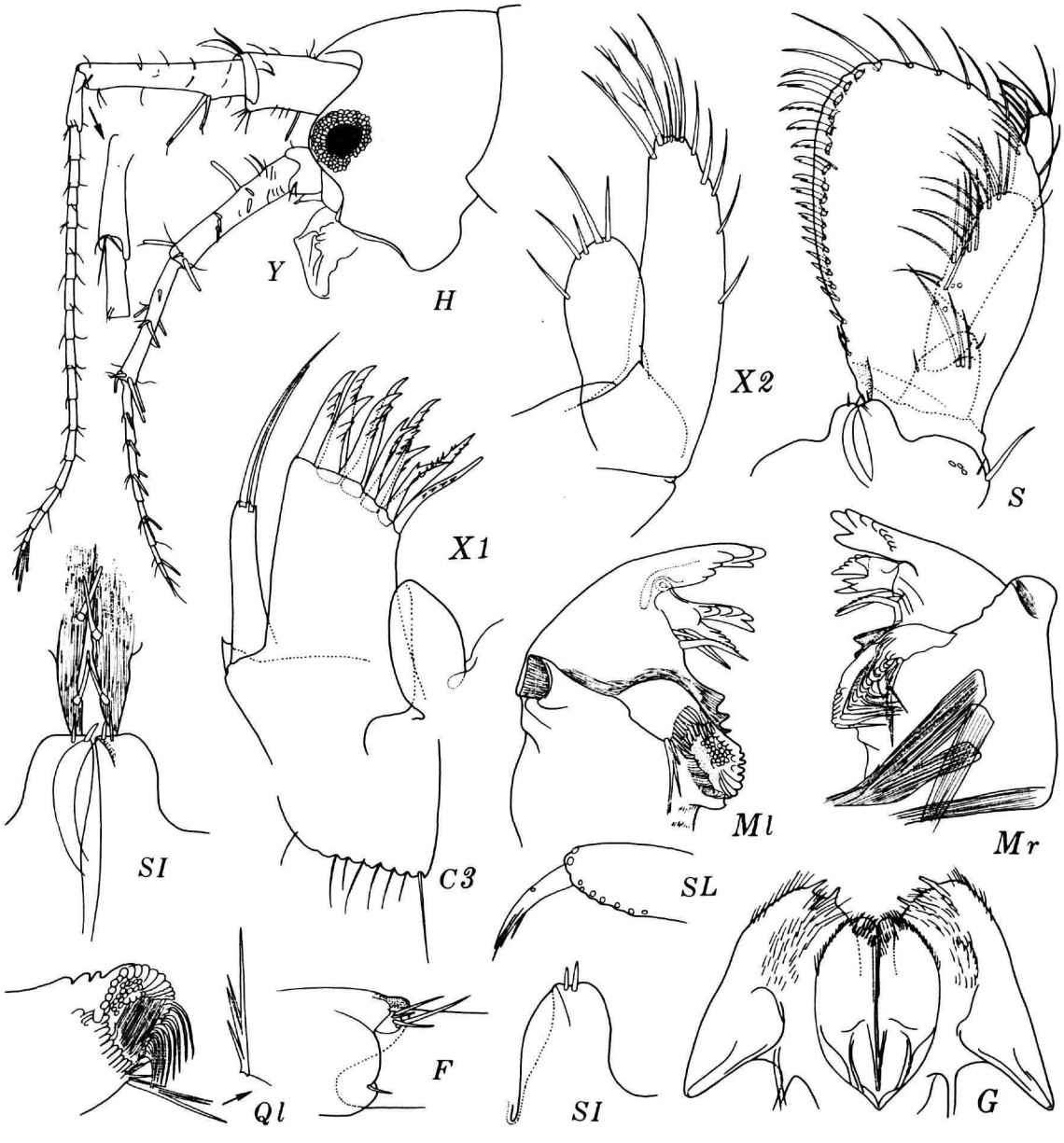


FIGURE 78.—*Paradexamine windarra*, new species, female, 4.4 mm, Slack-Smith 2; *c*=holotype, female, 3.95 mm, Slack-Smith 1. (*nn*=pereonites.)

but occasionally with lateral tooth present without dorsal tooth; pleonites 1-4 each with 3 sharp teeth, lateral teeth forming subdorsal ridges, pleonite 4 with 1 spine on subdorsal ridge and pleonites 5-6 (fused) with 2 dorsolateral spines on each side; dorsal margin of peduncle on uropod 1 with long naked gap between proximal 2 spines and distal spine; rami of uropod 3 spinose and setose; apices of telsonic lobes of medium breadth, each bearing main notch and small spine, with 3 sharp medial

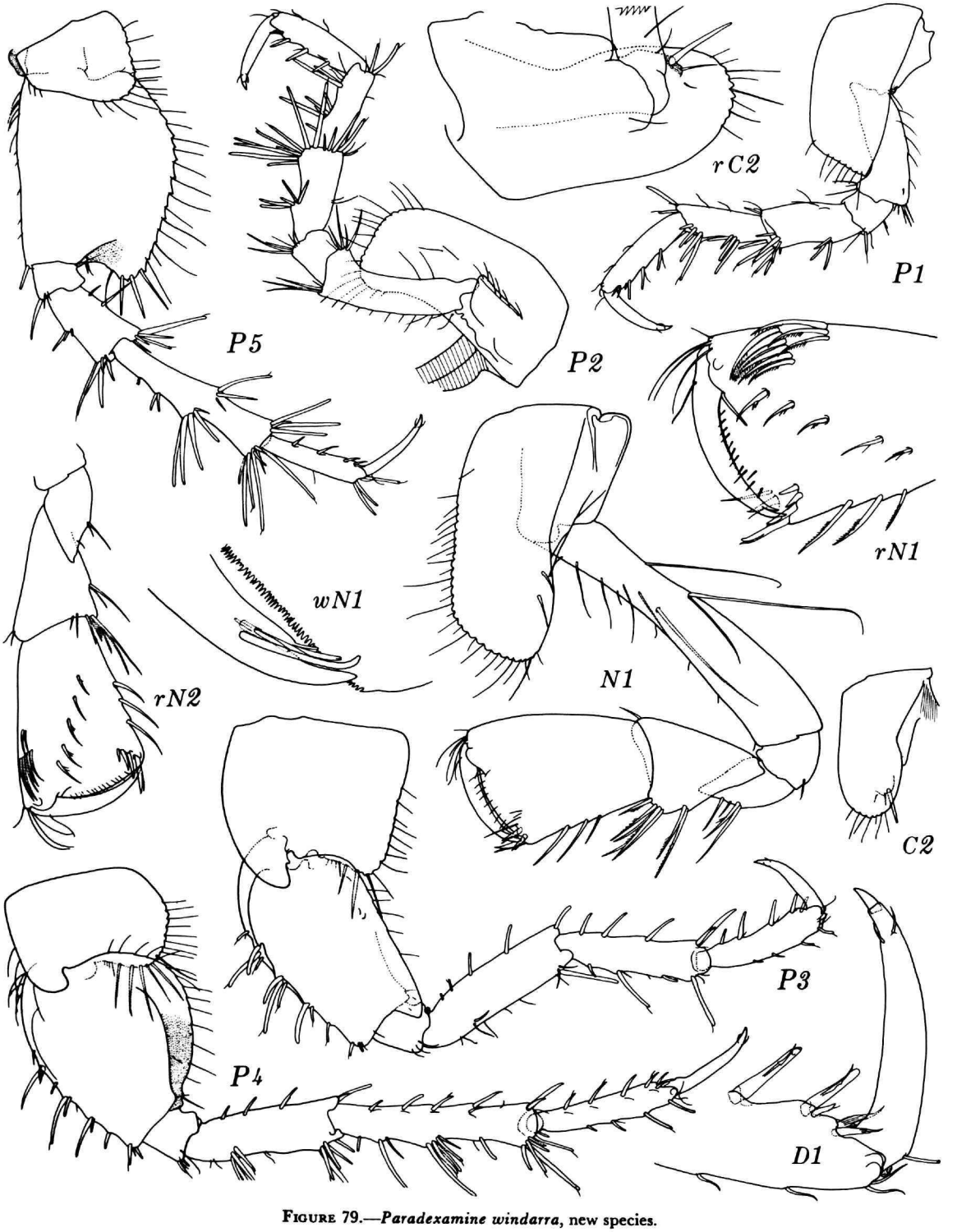


FIGURE 79.—*Paradexamine windarra*, new species.

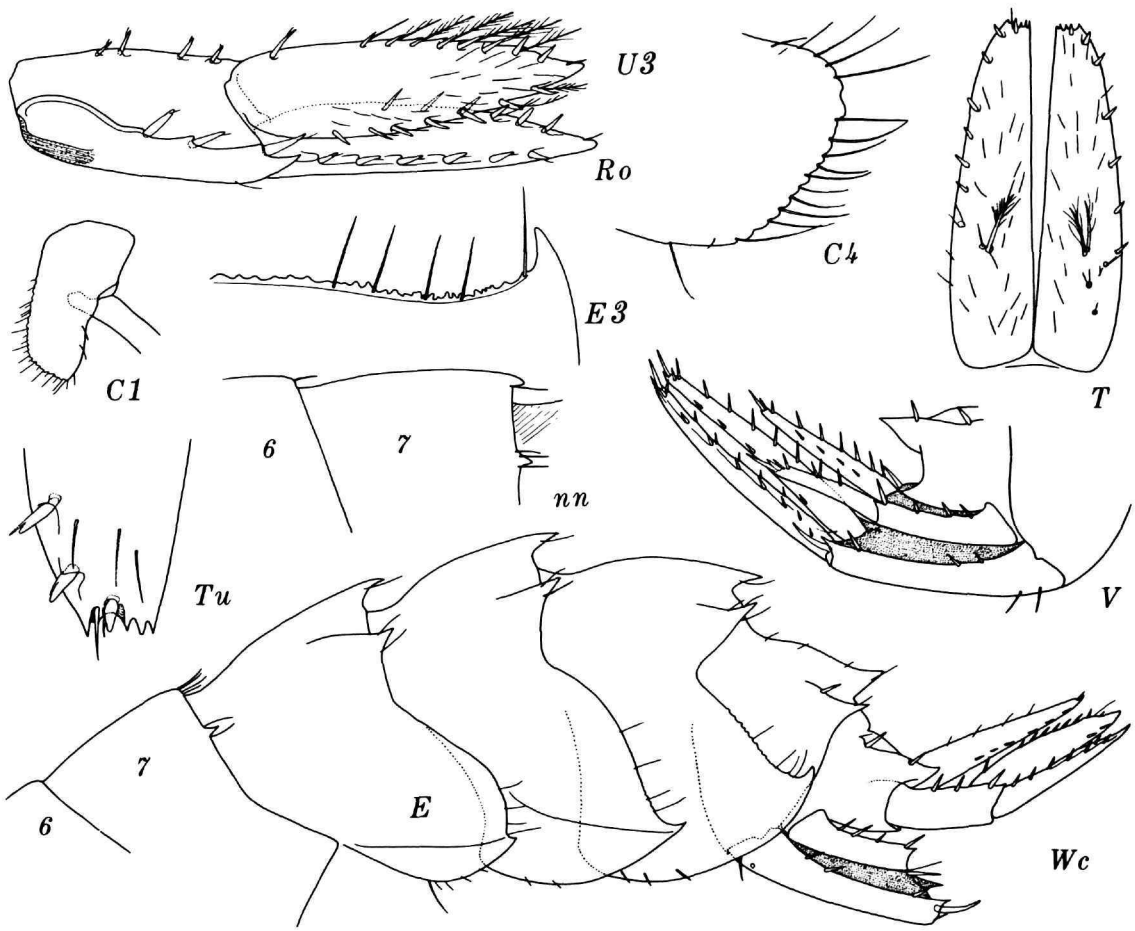


FIGURE 80.—*Paradexamine windarra*, new species.

teeth and 1 large, 1 small lateral tooth, lateral margin of each lobe with 6 small spines; cuticle of posterior body segments finely spiculate. Male unknown.

HOLOTYPE. — WAM, female, 3.95 mm.

TYPE-LOCALITY. — Slack-Smith 1, Cheyne Beach, east of Albany, Western Australia, intertidal, on weedy rocks, 4 December 1968.

REMARKS. — The lobe on article 2 of pereopod 5 characterizes this species, *P. quarallia* (q.v.), and *P. narluke*. *Paradexamine windarra* differs from several species with overall similarities. It differs from *P. frinsdorfi* in the degree of telsonic cuspidation, the short and thin palp of maxilla 1, and the transverse palms of the gnathopods. Since *P. frinsdorfi* is still based mainly on the male, other differential characters known to vary between the sexes are not mentioned in the present context.

*Paradexamine windarra* differs from *P. goomai* in the smaller inner plate of the maxilliped, the less prolonged coxa 3, the more strongly cuspidate telson, the transverse palms of the gnathopods, the high frequency of blunt spines on pereopods, and the elongate article 5 of pereopod 5.

*Paradexamine maunaloa* from Hawaii resembles *P. windarra*, but the latter has many telsonic teeth,

and, on the maxilliped, a definite inner plate that in *P. maunaloa* is obsolete.

From the male of *P. narluke* (female unknown), *P. windarra* differs in the absence of a posteroventral lobe on article 2 of pereopod 4, the nearly transverse palms of the gnathopods, the stouter plates of maxilla 2, the better-developed inner plate of the maxilliped, the anterior setae and nonexpansion of coxa 1, the teeth of pleonite 1, and the frayed locking spines of pereopods 1-2. But *P. windarra* is closely related to *P. narluke* in the bluntness of the spines on pereopods 1-5 and in the generalities on coxa 2, the head, and pleonites 2-6.

*Paradexamine windarra* is closest to neozelanican *P. muriwai,* especially in the spination gap of uropod 1, but *P. windarra* differs from *P. muriwai* in the sharper lobe of article 2 on pereopod 5, the short inner plate of maxilla 2, the more transverse palms and shorter article 5 on the gnathopods, the more pyriform article 2 on pereopod 4, the short palp of maxilla 1, and the absence of posterior spines on coxa 3.

MATERIAL. — Slack-Smith 1 (holotype and one juvenile), 2 (female, 4.4 mm); JLB Australia 13 (1).

DISTRIBUTION.—Southwestern Australia, intertidal.

### Note on *Dexamine Miersii* Haswell, 1885

*Dexamine Miersii* Haswell (1885) is probably a member of *Paradexamine,* but presently its specific identity is unclear. Its type-locality is Thursday Island. It is based obviously on a male because of the long antennae. Haswell's drawing of the pleon lacks teeth, but he notes a pair of teeth on "the third segment of the perion," the latter word of which may be a misprint for "pleon," as he also describes a tooth on "the fourth segment." *Dexamine miersi* is, therefore, not a member of *Syndexamine,* a conclusion positively indicated by the often prehensile pereopods in the latter genus.

### *Syndexamine* Chilton

*Syndexamine* Chilton, 1914:332.

DIAGNOSIS (revised). — Ocular lobe of head occasionally verticalized; accessory flagellum a small cube with 2-4 setules and/or aesthetascs; mandibular molars moderately triturative to completely smooth, with or without ordinary setae and ragged setae, incisors multitoothed or simple, occasionally heavily cornified, rarely without lacinia mobili and spines, palp absent; inner lobes of lower lip distinct, mandibular lobes long to short, blunt to subconical; palp of maxilla 1 uniarticulate; inner lobes of maxilliped small to large, setae large or obsolescent, palp 4-articulate; pereopods simple to slightly prehensile, pereopods 3-5 generally similar to one another; coxae not acuminate or bifid, except rarely coxa 1 slightly upturned; coxa 5 much shorter than coxa 4; only pleonites 5-6 fused together; body lacking any side teeth on segments, pleonite 4 with hump or sharp keel, pleonites sometimes protuberant or keeled.

TYPE-SPECIES. — *Syndexamine carinata* Chilton (1914). New Zealand.

REMARKS. — Four new species of this heretofore montoypic genus are described herein. The diagnosis of *Syndexamine,* therefore, has been greatly broadened. The range of differences among the species approaches that found in *Paradexamine,* and there does not seem to be any point at which a generic distinction can be accorded to the species with extreme character modifications. The type-species itself has an extremely advanced mandible, with loss of nearly all recognizable parts, whereas other species now assigned to this genus have fully normal mandibles bearing toothed incisors, lacinia mobili, regular spines, triturative molars, ordinary setae, and ragged setae. On first sight, a species like *S. wunda,* new species, appears to belong to an entirely different genus from the type-species, but a mandibular stage between that of *S. wunda* and *S. carinata* occurs in *S. wane,* new species.

One may oversimplify *Syndexamine* by stating that it is composed of species like those in *Paradexamine* in which side teeth of the pleon have been lost. The species resemble those in *Guernea,* but pereopods 3-5 are not of the diverse kind found in *Guernea.*

There is a great deal of difference from one species to the next in characters of antennae, head shape, mandible, maxillipeds, pereopods 3-5, uropod 3, different degrees of prehensibility on the pereopods, and wholly different patterns in the cuticle. Some, if not all, of these species, either by the degree of prehensibility or the development of nonskid surfaces on the cuticle, appear to be com-

mensals of sessile organisms (or even of errant organisms, since the origins of all sample materials are not clear).

In the anticipation that several more species of this genus remain to be described in Australia, I have made the following key in the form of equable diagnoses, but even this key is limited to a few of the attributes already known to differ among the several species. The order of advancement is roughly indicated by the position of the species in the key.

There is no orderly progression in these species from primitive to advanced. *Syndexamine runde* has the most ordinary mandible combined with a highly advanced uropod 3. There is probably no evolutionary trend in the cuticle, since apparently *S. nuttoo* has lost the need for a nonskid cuticle owing to the prehensile pereopods. *Syndexamine carinata* has the most advanced mandible, but a similar species, *S. wane,* has a more advanced uropod 3, coxa 1, and gnathopods than *S. carinata.* One could not derive *S. carinata* and *S. wane* from each other in either morphological direction, though this prospect is appealing, since *S. carinata* occurs in New Zealand and *S. wane* in Australia, and one might suppose *S. wane* to be on the line of ancestry of the more isolated species, *S. carinata.* Each, however, has advancements not derivable from the other, though the similarity of mandibular incisor suggests close affinity. On the other hand, the hump on pleonite 4 of *S. carinata* resembles that of *S. nuttoo,* and uropod 3 is similar in the two species, but *S. nuttoo* can not stand very close to *S. carinata's* ancestry because of the reduced inner plates of the maxilliped. Further comparisons seem pointless, as more species of this genus undoubtedly remain to be described.

*Syndexamine wunda* is placed first since it is used as a standard for the other species.

### Diagnoses of Species

1. Mandibular incisor toothed, molar heavily triturative; mandibular lobes of lower lip broad; inner plates of maxilliped well developed and setose; coxa 1 not upturned, with posterior spine; palms of gnathopods oblique; article 2 of pereopod 5 of a broad form; apices of rami on uropod 3 with spines; telson with only apical spines; cuticle with long lines and scattered short crescents; pleonite 4 with erect, subacute process *S. runde*
2. Mandibular incisor toothed, molar weakly triturative, mainly bearing tuberculate hexagons; mandibular lobes of lower lip very thin; inner plates of maxilliped well developed and setose; coxa 1 not upturned, lacking posterior spine; palms of gnathopods oblique; article 2 of pereopod 5 of a broad form; apices of rami on uropod 3 pointed and naked; telson with only apical spines; cuticle with short crescents; pleonite 4 with subrounded dorsal hump ..... *S. wunda*
3. Mandibular incisor toothed, molar weakly ridged and bearing smooth tubercles in cup-shaped circle, mandibular lobes of lower lip broad; inner pates of maxilliped short, subrounded, nearly naked; coxa 1 not upturned, bearing posterior spine; palms of gnathopods oblique; article 2 of pereopod 5 of a broad form; apices on rami of uropod 3 pointed and naked; telson with side spines in addition to apical spines; cuticle with vestigial remnants of polygons; pleonite 4 with saddle-shaped process bearing sharp cusp ..... *S. nuttoo*
4. Mandibular incisor heavily cornified and untoothed, molar nearly smooth, mainly cellular material showing through chitin; mandibular lobes of lower lip broad; inner plates of maxilliped well developed and setose; coxa 1 upturned anteroventrally and lacking posterior spine; palms of gnathopods nearly transverse; article 2 of pereopod 5 extremely thin and linear; apex on inner ramus of uropod 3 bearing spines, outer of complex form; telson with only apical spines; cuticle with extremely heavy scales; pleonite 4 with erect and subacute dorsal hump ..... *S. wane*
5. Mandibular incisor heavily cornified and untoothed, molar smooth and not clearly discernible; mandibular lobes short, broad, and blunt; inner plates of maxilliped well developed and setose; coxa 1 not upturned, apparently lacking posterior spine; palms of gnathopods oblique; article 2 of pereopod 5 of a narrow form; apices on rami of uropod 3 pointed and naked; telson with side spines in addition to apical spines; cuticle unknown; pleonite 4 with saddle-shaped process bearing sharp cusp ..... *S. carinata*

### *Syndexamine wunda,* new species

Figures 81–83

Description.—Antennae reaching subequally in female, but antenna 2 slightly elongate in male, with article 4 longer and anteriorly setulose; article 2 of antenna 1 slightly shorter than article 1; lateral cephalic lobes softly pointed in male, weakly truncate in female, eyes enlarged in male, anteroventral cephalic margin with weak bulge supporting base of antenna 2; upper lip rounded below; right mandible with 2 long thin spines, left with 3 spines; all molars with 1 ragged seta and even row of ordinary setae, except right female mandible bearing only 2 pairs of ordinary

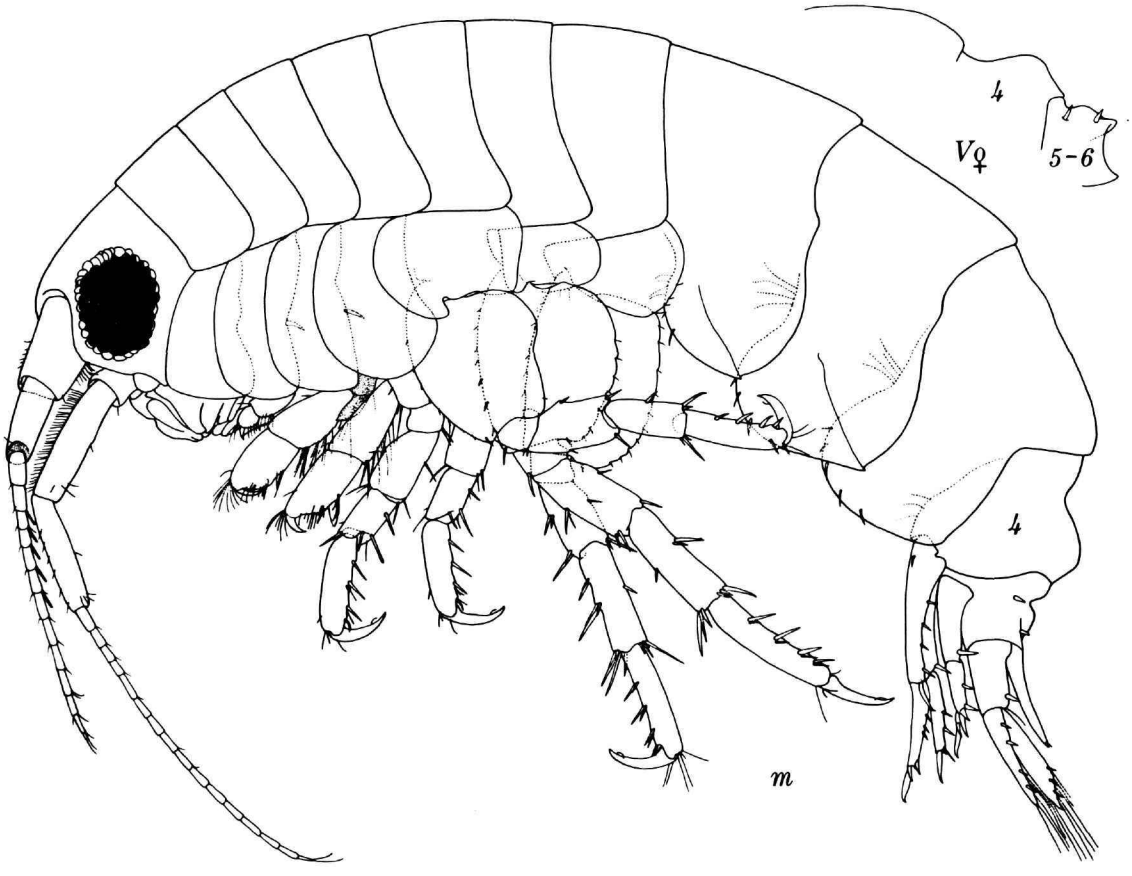


FIGURE 81.—*Syndexamine wunda*, new species, holotype, male, 3.7 mm; *f*=female, 3.2 mm; both from JLB Australia 13.

setae at apex; each outer lobe of lower lip with 1 large cone; inner plate of maxilla 1 with 2 apicomedial setae, outer plate with 11 spines (3 hidden in Figure 82*x1*), apex of palp with attenuate cusp; inner lobe of maxilla 2 half as wide and slightly shorter than outer lobe, with 1 seta on medial margin considerably divorced from next distal seta; palp of maxilliped reaching apex of outer plate, article 4 short but appearing unguiform because of 2 stout distal spines, inner plate with simple spines; coxa 1 distally expanded, lacking posterior spine, coxae 2-3 with 1 posterior spine each; palms of gnathopods weakly oblique, fifth articles slightly longer than sixth; some spines of pereopods 1-2, especially, and anterodistal spines on articles 4-5 of pereopods 3-4 apically blunt and ornamented (Figures 83*tP1*, *tP3*); rami of uropod 2 subequal to each other in length, but inner ramus of uropod 1 reaching only 80 percent along outer ramus; uropod 3 more heavily setose in male than in female; telson broad, apices of medium expansion, and each bearing 1 small spine; pleonal epimera 1-2 with lateral ridge and weak posteroventral cusp, epimeron 3 with weak notch-tooth at posteroventral corner; all cusps stronger in female, pleonites 1-3 not dorsally protuberant, pleonite 4 with medium rounded dorsal hump; cuticle with weak scales, especially sharp on telson and prominent on body, coxae, distal articles of pereopods, peduncles of uropods..

HOLOTYPE.—WAM, male, 3.7 mm.

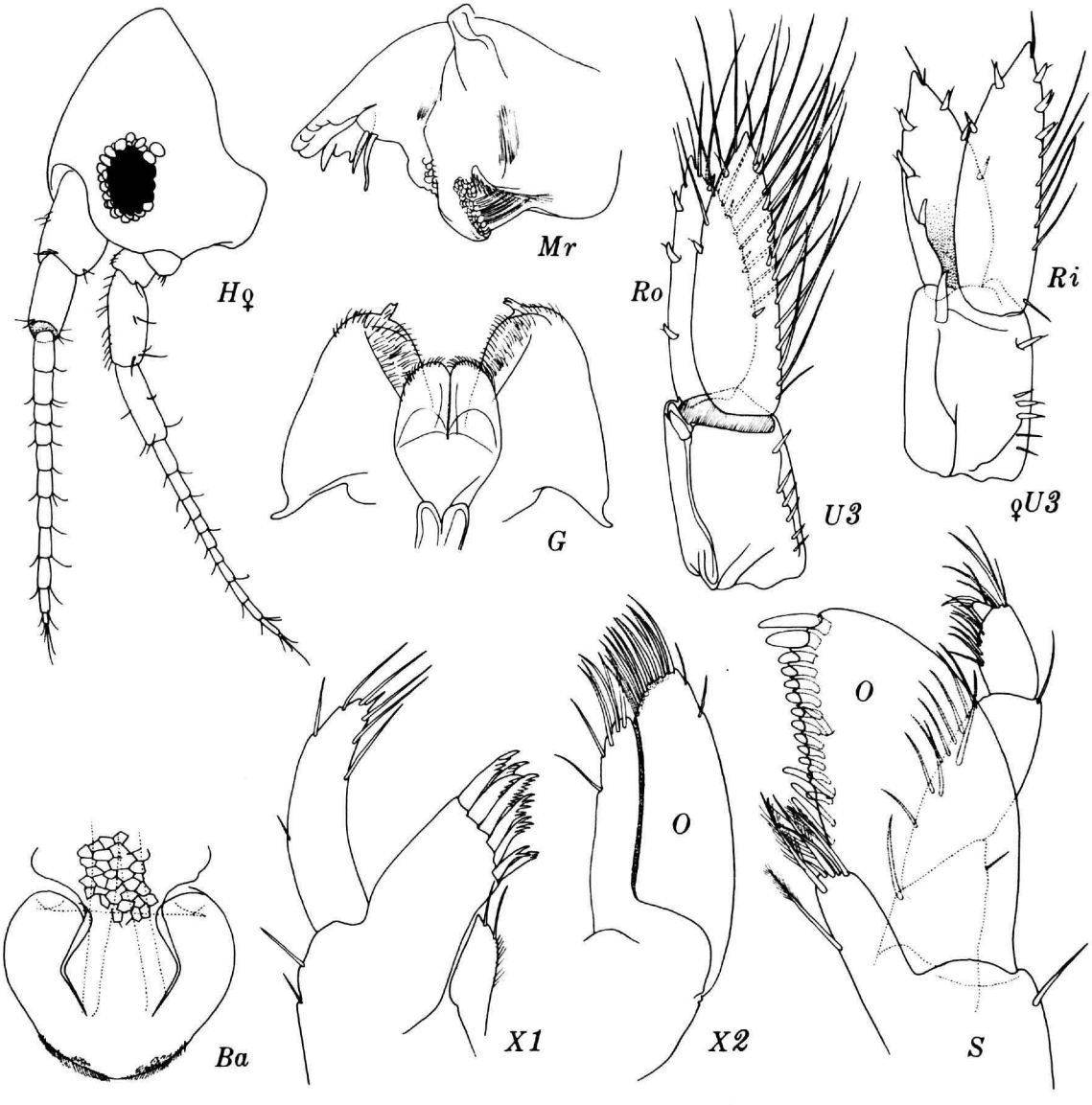


FIGURE 82.—*Syndexamine wunda*, new species.

TYPE-LOCALITY.—JLB Australia 13, Middleton Beach, Albany, Western Australia, intertidal, wash of sandy rocks, coralline algae, 30 September 1968.

MATERIAL.—JLB Australia 5 (8), 11 (7), 12 (6), 13 (34), 14 (5); Slack-Smith 2 (1).

DISTRIBUTION.—Southwestern Australia, intertidal.

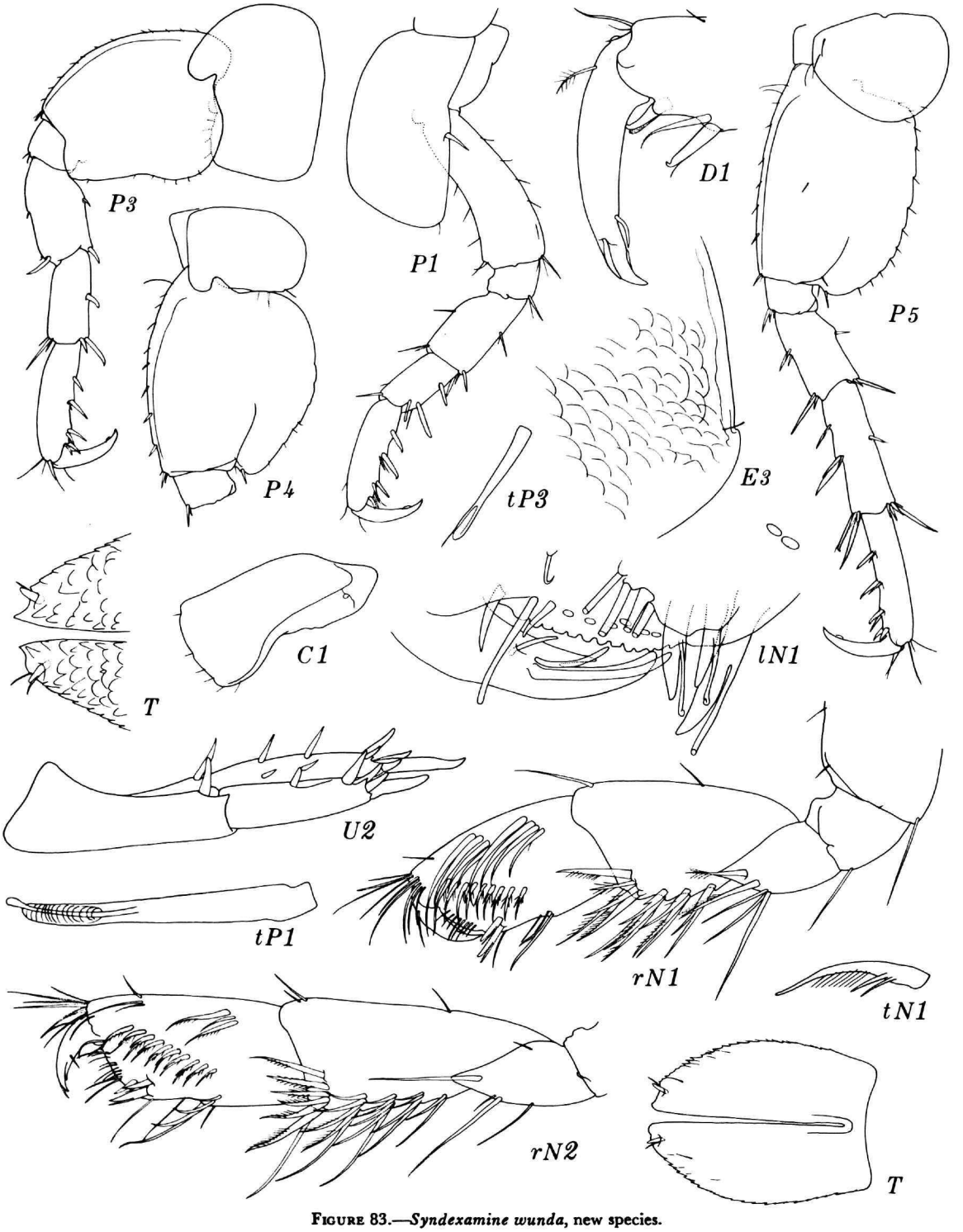


FIGURE 83.—*Syndexamine wunda*, new species.

### *Syndexamine nuttoo*, new species

FIGURES 84–86

DESCRIPTION. (of young male, like the female).—Antenna 1 extending much farther than antenna 2, both pairs of antennae long and thin, article 1 of antenna 1 bearing 2 ventral spines, article 2 scarcely shorter than 1, flagella of medium length; lateral cephalic lobes broad and strongly protuberant, rounded; anteroventral cephalic margin with bulge supporting antenna 2; upper lip rounded below but very broadly so; right mandible with 2 spines, left with 3, each molar with small ragged seta, very small ordinary setae on both mandibles, molars moderately trituative; cones on lower lip obsolescent or absent, mandibular lobes conical, blunt; inner plate of maxilla 1 large, naked, outer plate with 10 spines, apex of palp with 2 setae and cone; inner plate of maxilla 2 very short, bearing several apical setae, no seta strongly divorced from another, lobes broader than in *S. wunda*; maxillipeds with very small mammilliform inner lobes each bearing 1 small apical spinule, spines on outer plate sparse and thin, article 4 of palp especially prominent (in this genus); coxa 1 expanding apically, coxae 1-3 each with small spine posteriorly; gnathopod 2 [sic] like gnathopod 1 of *S. wunda* in general proportions, but gnathopod 1 extremely stout and short; pereopods 1-2 stouter than in *S. wunda*, sixth articles weakly prehensile, spines stout and slightly striate; pereopods 3-5 very stout and short, not appearing prehensile, article 2 of pereopod 4 broadly pyriform, article 2 of pereopod 5 broad with spine at posteroventral corner, unlobed; dactyls of pereopods with main marginal seta free and curved; rami of uropod 1 extending equally, outer ramus of uropod 2 shorter than inner; uropod 3 small, ordinary, outer ramus slightly shorter than inner but rami not as dissimilar as in *S. wane* and lacking apical spines; telson broad, each apex bearing 1 spine and 1 proximolateral spine; pleonal epimera 1-2 with lateral ridge and epimera 1-3 each with medium posteroventral tooth, epimeron 1 with 4-5 side spines in row, epimeron 2 with 3-4 side spines in row and 4-6 ventral spines, epimeron 3 with 6-8 spines (or 1 seta anteriorly); pleonite 3 weakly protuberant dorsally, pleonite 4 with saddle-shaped dorsal process bearing sharp posterior tooth; cuticle nearly smooth everywhere but very weak slits and vestigial remnants of polygons occurring on middle coxae, article 2 of pereopods 3-5 and epimera, occasional setule present.

HOLOTYPE.—NMV, young male, 3.19 mm.

TYPE-LOCALITY.—Port Phillip 60, Victoria area 60-67, 19 January 1958.

REMARKS.—Only three specimens of this species are available; one is broken; the holotype is a male bearing rudimentary penial processes but otherwise looking like a female would be expected to look in this genus; the third and slightly larger specimen is 4.2 mm long and lacks any mark of its sex.

This species is very distinct and is characterized by the stout gnathopod 1, the shape of the dorsal saddle on pleonite 4, the weak uropod 3 lacking apical spines, the cuticular pattern, and especially the short inner plates of maxilla 2 and the maxillipeds.

MATERIAL.—Port Phillip 60 (3).

DISTRIBUTION.—Port Phillip, Victoria.

### *Syndexamine runde*, new species

FIGURES 87–89

DESCRIPTION.—Antennae reaching equally in female, longer than in *S. wunda*, antennae apparently also reaching equally in male and longer than in *S. wunda*, with article 4 elongate and anteriorly setulose, article 1 of female antenna 1 bearing 1-2 ventral spines; article 2 of antenna 1 longer than article 1; lateral cephalic lobes rounded-truncate in both sexes, eyes enlarged in male, anteroventral cephalic margin with weak bulge supporting base of antenna 2; upper lip rounded below; right mandible with 2 spines, left with 3, each molar with 1 ragged seta, no ordinary setae except on male right mandible and largest of females; each outer lobe of lower lip with 1 large cone, mandibular lobes broad and blunt; inner plate of maxilla 1 with 2 apical setae on right side, none on left, or in largest female 2 setae on both sides, outer plate with 11 spines, apex of palp lacking cusp, bearing 1 medial seta in largest females, no lateral setae; inner lobe of maxilla 2 with proximal seta not divorced from next apical seta, lobes broader than in *S. wunda*; maxilliped like that of *S. wunda* but setal distribution of inner plate slightly different (Figure 87*SI*), and distalmost submarginal medial spine (ventral side) paired on outer lobe; coxae 1-3 each bearing large posterior spine; gnathopods like *S. wunda*; pereopods 1-2 grossly similar to those of *S. wunda*, in

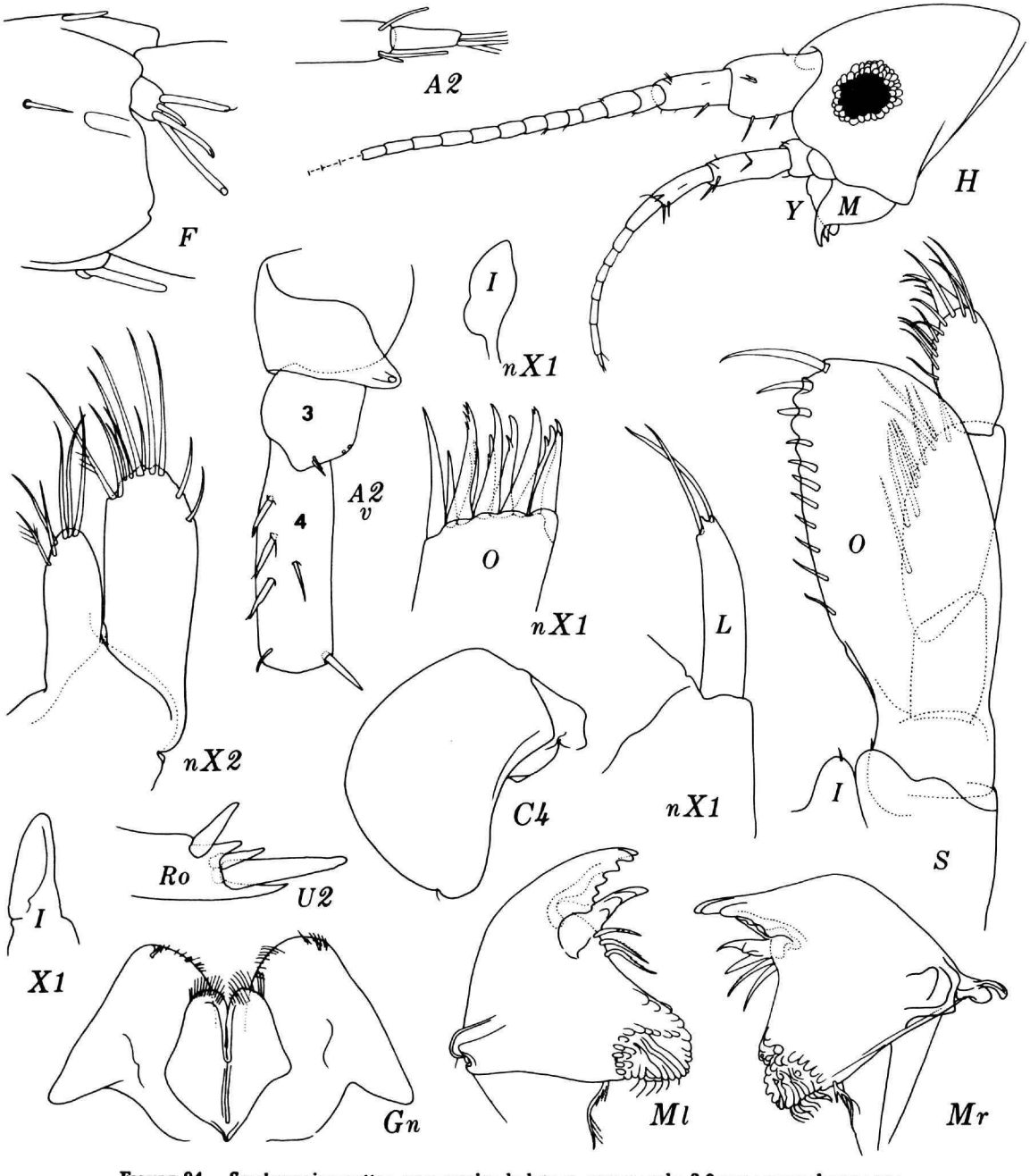


FIGURE 84.—*Syndexamine nuttoo*, new species, holotype, young male, 3.9 mm; *n*=unknown sex, 4.2 mm; both from Port Phillip 60. (*v*=ventral.)

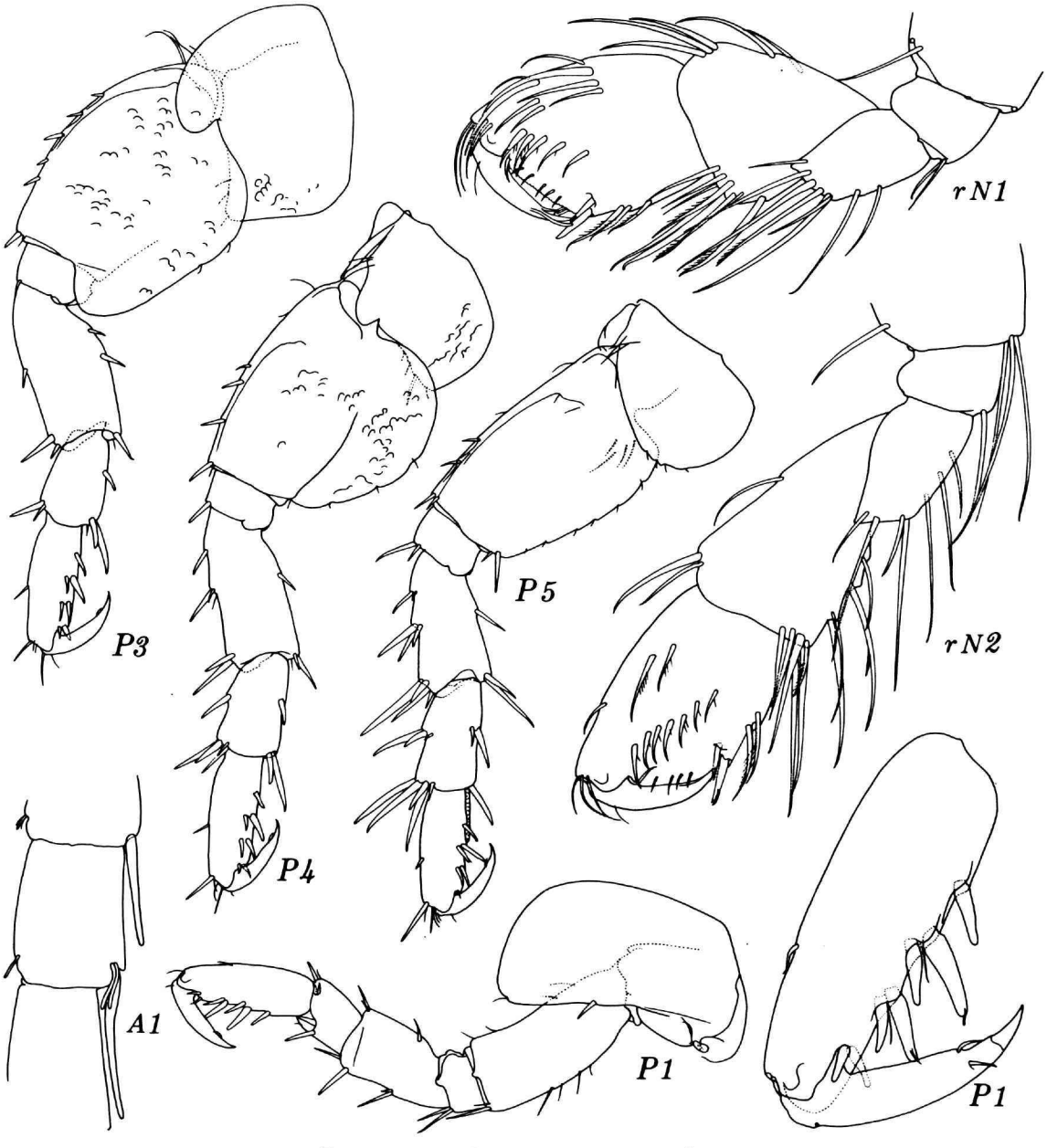


FIGURE 85.—*Syndexamine nuttoo*, new species.

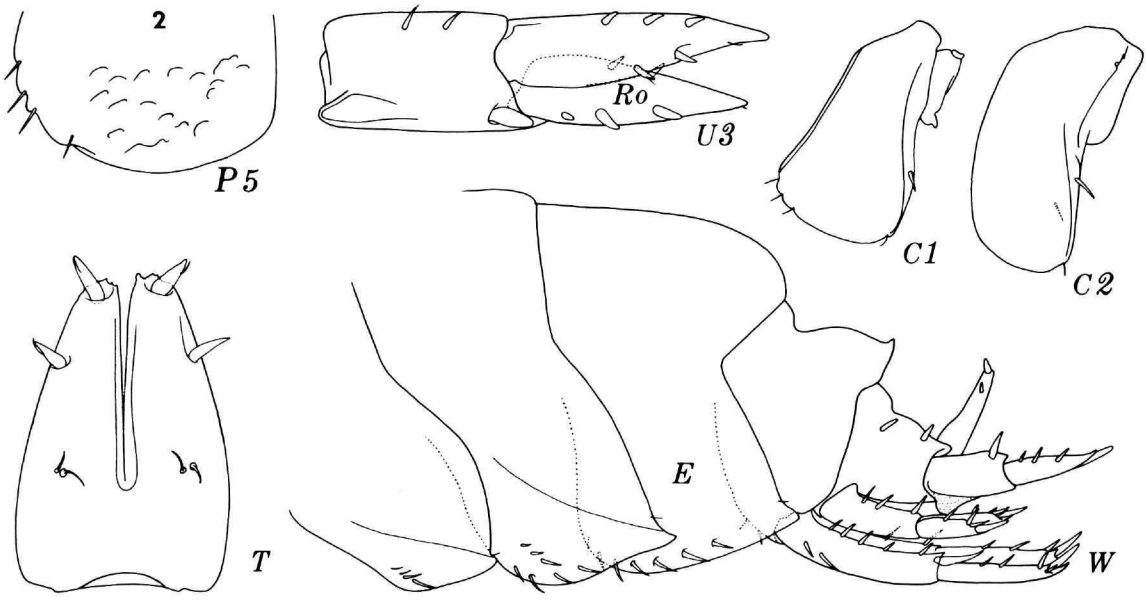


FIGURE 86.—*Syndexamine nuttoo*, new species.

female stout, spines heavy, paired and not gapped, but in male thinner, and posterior margin of article 6 with long gap between sets of main spines; pereopods 3-5 much longer and second articles much thinner than in *S. wunda*, and article 2 of pereopod 5 with several posterior spines; main inner seta on dactyls scarcely free in females; rami of uropod 1 reaching equally, inner ramus of uropod 2 reaching slightly more than outer; uropod 3 with elongate rami bearing many heavy spines apically; outer ramus becoming shorter than inner in adult females; telson narrow, each apex bearing 1 spine; pleonal epimera 1-2 with lateral ridge and weak-to-medium posteroventral tooth, epimeron 2 with pair of side spines, epimeron 3 with weak notch-tooth in male, slightly enlarged tooth in female, young males with intermediate condition; pleonite 3 with weak dorsposterior protuberance, pleonite 4 with acute but partially recumbent dorsal protuberance, better developed and more erect in terminal females; cuticle scaliform, ridges or scales especially sharp and protuberant on telson and prominent on body, coxae, distal articles of pereopods, peduncles of uropods, but on epimera forming long ridges in contrast to *S. wunda*.

HOLOTYPE.—SAM, male, 4.0 mm.

TYPE-LOCALITY.—Shepherd 46, Judith Cove, West Island, South Australia, 15 feet [no date].

RELATIONSHIP.—This species differs from *S. wunda* in many characters, some of which in earlier times might have been valued at the generic level: the shorter palp on maxilla 1, the heavily triturative molars, the absence of plain setae on the molars, and the broad mandibular lobes of the lower lip. Characters of ordinary specific value in *S. runde* are: the more elongate antennae with article 2 of antenna 1 elongate, the absence of an apical cusp on the first maxillary palp, broader lobes of maxilla 2, posterior spine on coxa 1, thinner posteroventral lobe of coxa 4, taller coxa 5, more elongate pereopods 3-5 with thinner article 2 and larger spines on article 2 of pereopod 5, longer rami of uropod 2, strongly spinose apices on rami of uropod 3, sharp process on pleonite 4, thinner telson, and longer ridges on cuticle of epimera. Otherwise, cuticular ridges (semilunes) are the same on other parts of the body as in *S. wunda*.

VARIATIONS.—The presence or absence of a posterior spine on coxa 1 may be a result of age, as the largest specimen, 5.2 mm, from southeastern Australia lacks this spine, and all three specimens from Western Australia, all about 5.2 mm long, also lack this spine; however, a specimen, 5.1 mm, from the type-locality bears this spine, as do smaller specimens in southeastern Australia. The appearance of a row of ordinary setae on the serrate apical edge of the mandibular

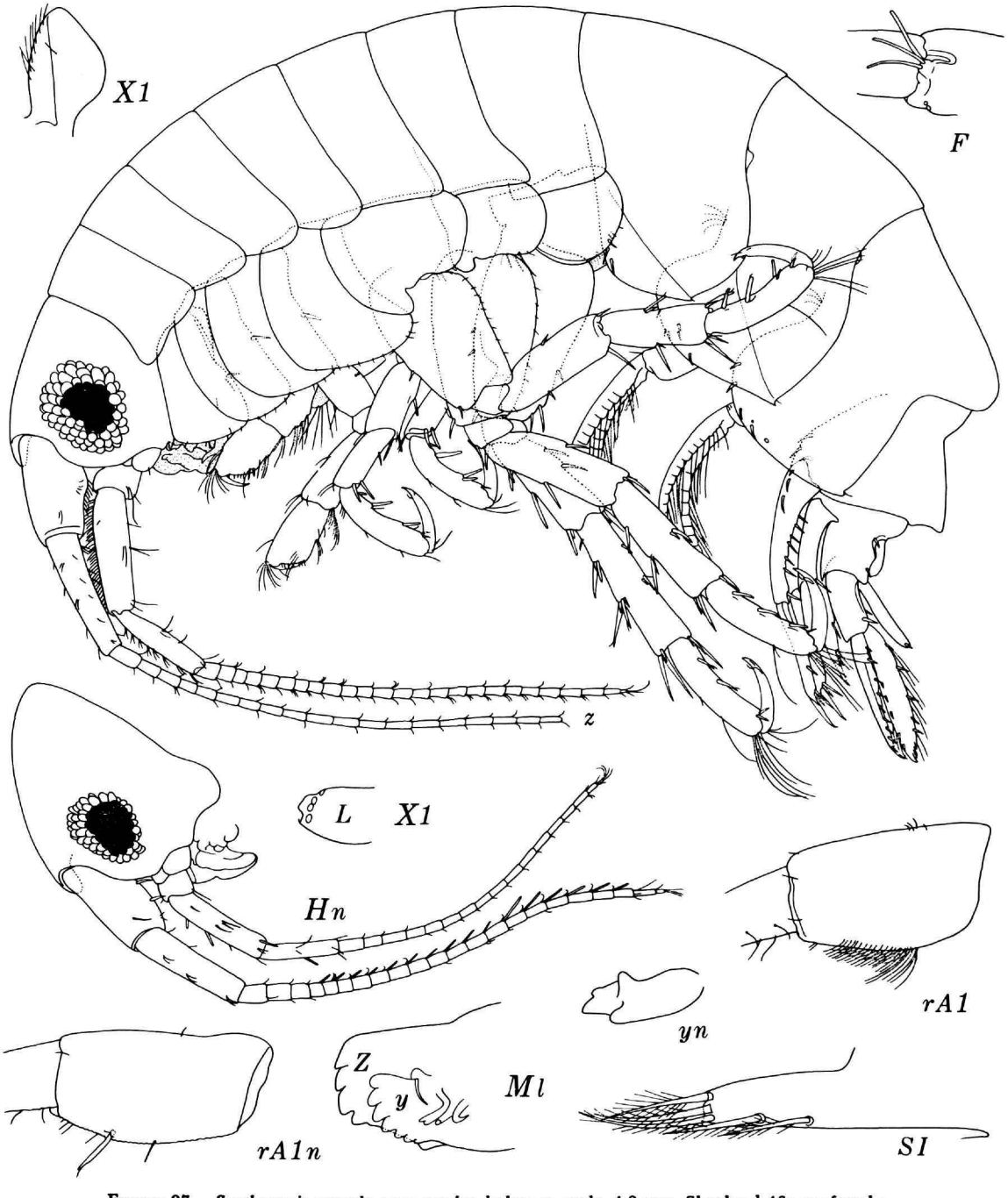


FIGURE 87.—*Syndexamine runde*, new species, holotype, male, 4.0 mm, Shepherd 46; *n*=female, 5.2 mm, Shepherd 46; *w*=female, 5.1 mm, Shepherd 46; *c*=female, 5.9 mm, Shepherd 49.

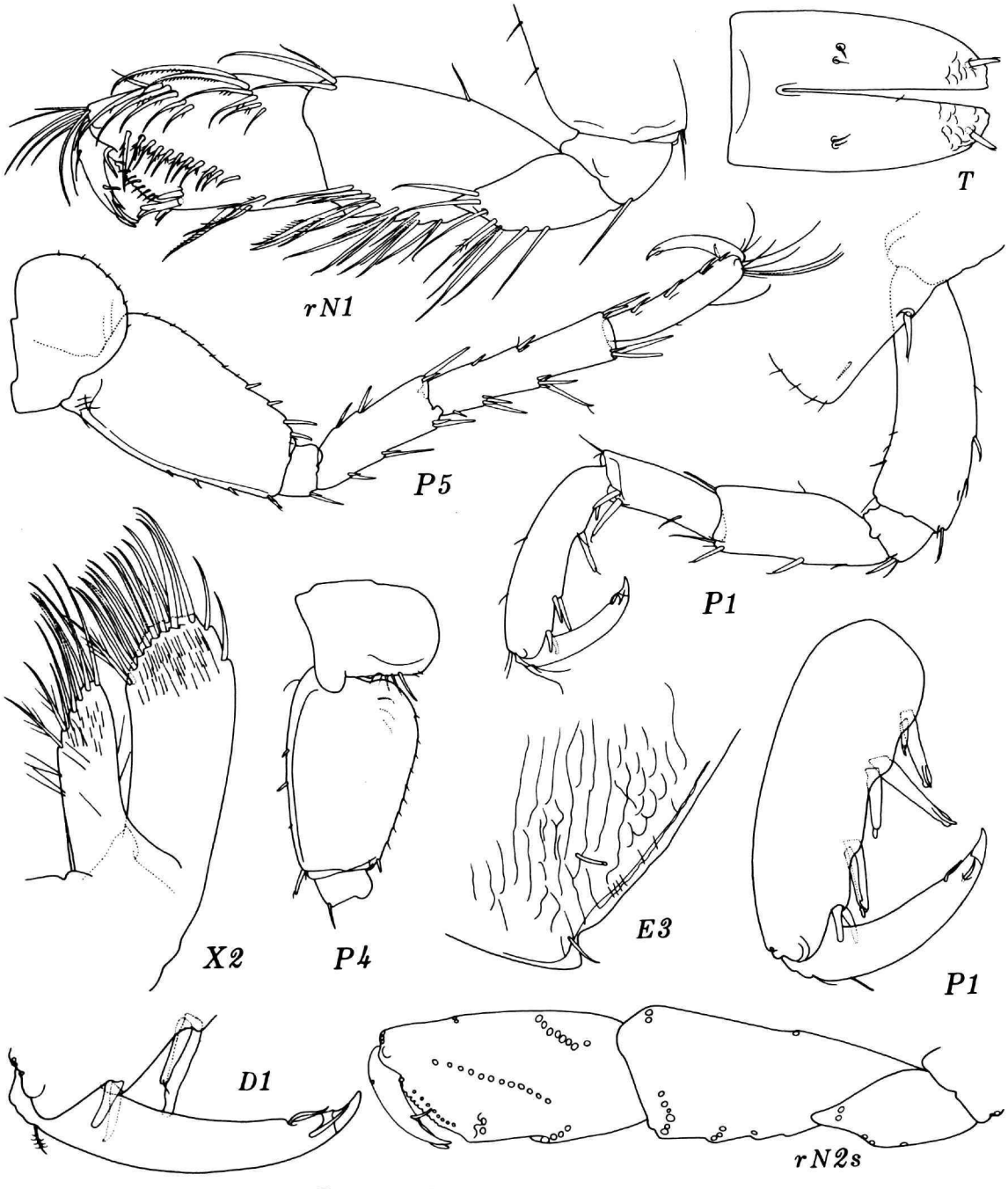


FIGURE 88.—*Syndexamine runde*, new species.

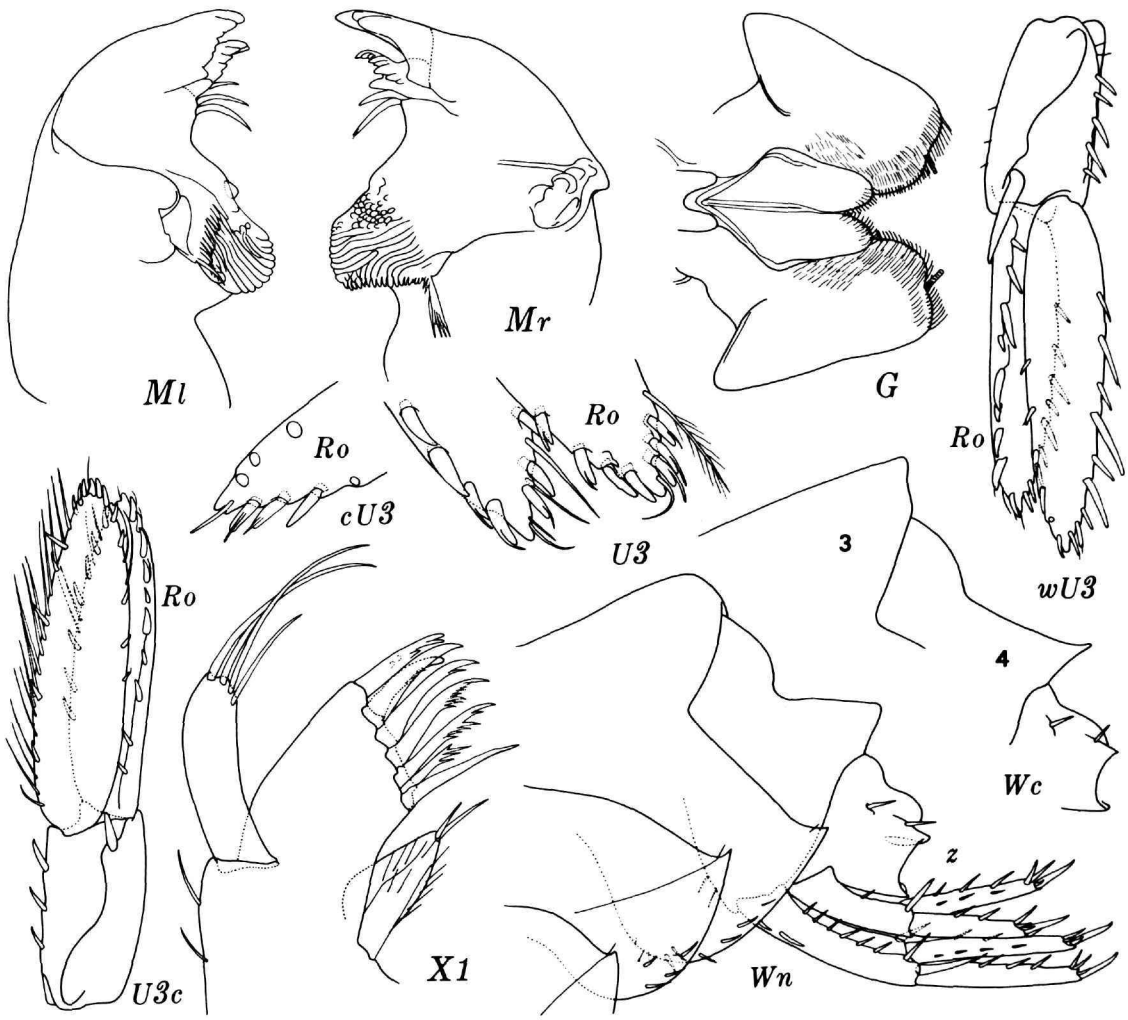


FIGURE 89.—*Syndexamine runde*, new species.

molar also appears in specimens about 5.2 mm long, whereas smaller specimens, including the 5.1 mm female noted above, lack these setae on the right molar, though the 5.1 mm female has 1 of these setae on the left mandible. These setae are in addition to the single ragged seta always present on both molars. Two stiff setae on the inner plate of maxilla 1 also appear in terminal females and males, and they may occur on only one of the maxillae, right or left, but these are absent in juveniles. The western specimens do not differ materially from those in the southeast, though they have lost their eyes in the preservative (the eyes probably have shrunk toward the middle of the head).

The largest specimen at hand, a female, 5.9 mm, from Shepherd 49, has the dorsal process of pleonite 4 highly pointed (Figure 89*Wc*). Hatched juveniles have pleonite 4 weakly rounded dorsally.

MATERIAL.—Shepherd 30 (3), 46 (5), 49 (1), 52 (10); WAM, Garden Island, diving, (3); Slack-Smith 2 (3).

DISTRIBUTION.—Warm-temperate Australia, sublittoral.

***Syndexamine* species (cf. *S. runde*)**

FIGURES 90–92

DESCRIPTION.—Male unknown; antenna 1 extending farther than antenna 2 in female and longer than in *S. wunda*, article 1 bearing 2 ventral spines; article 2 of antenna 1 equal to article 1 in length; lateral cephalic lobes rounded-truncate, anteroventral cephalic margin with strong bulge supporting base of antenna 2; upper lip rounded below; right mandible probably with 2 spines (1 occluded by precipitate in unique specimen), left with 1 visible, other 2 probably broken off, each molar with 1 ragged seta and numerous ordinary setae, longer on right mandible,

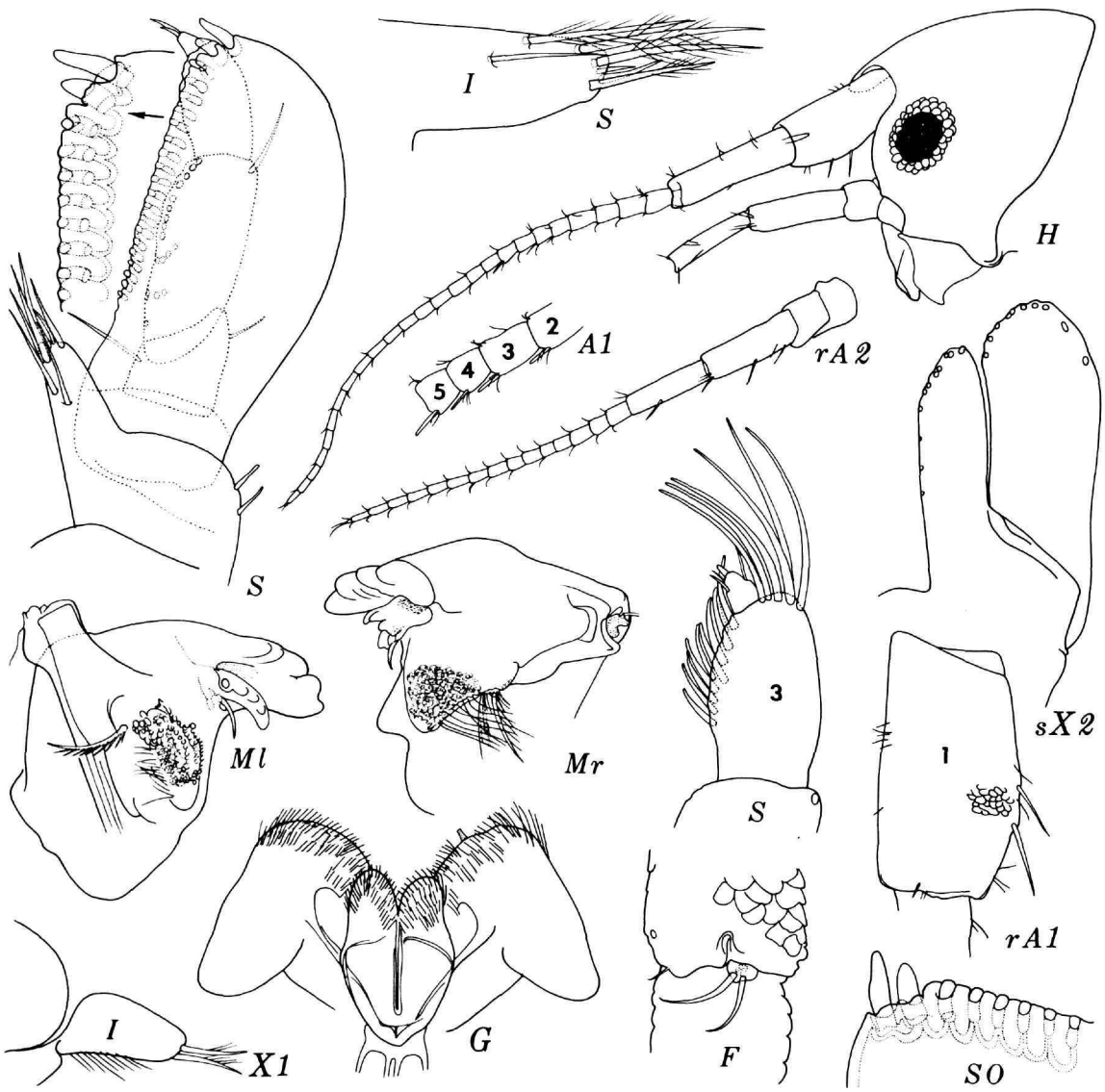


FIGURE 90.—*Syndexamine* species (cf. *S. runde*), female, 5.7 mm, Shepherd 15.

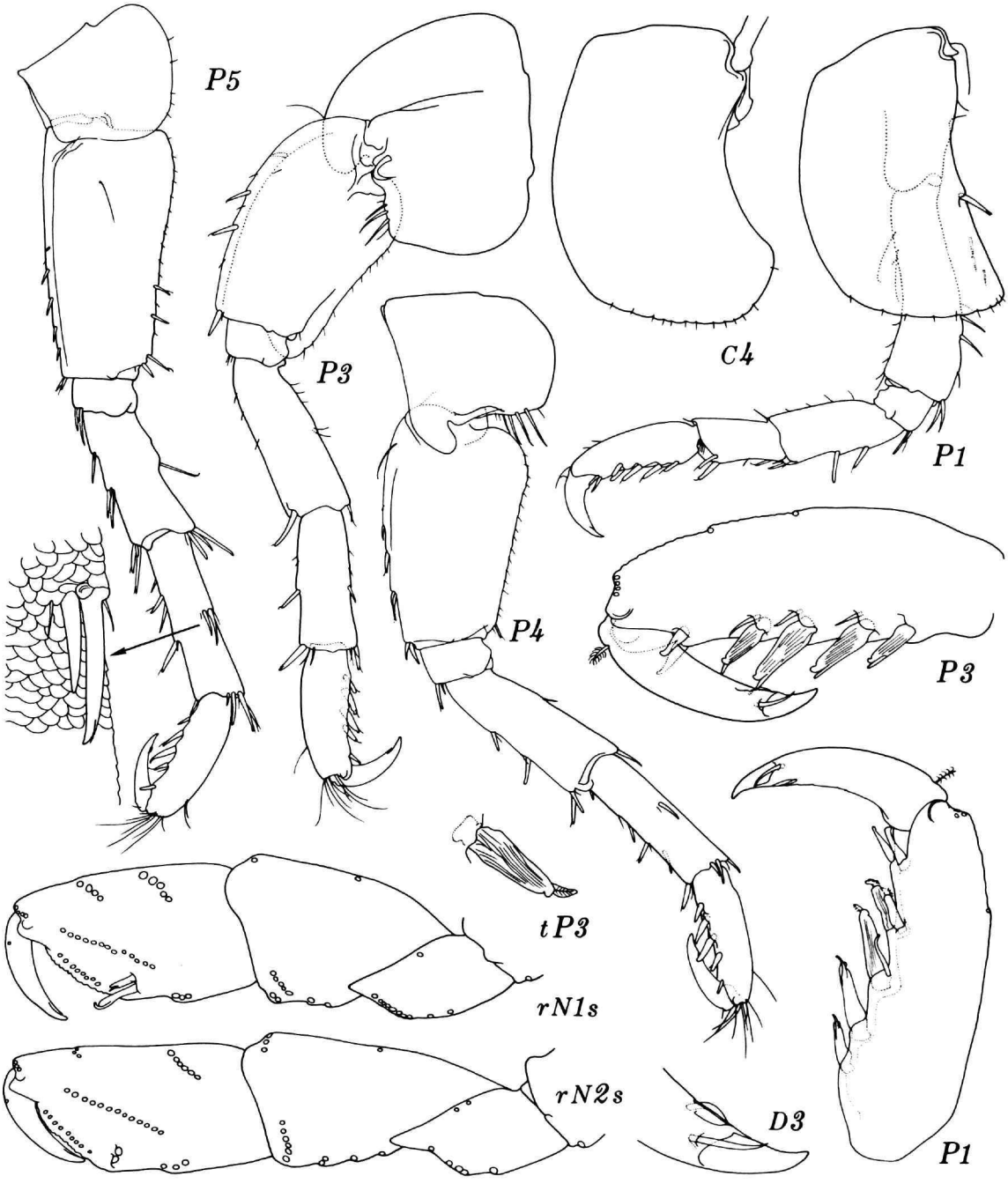


FIGURE 91.—*Syndexamine* species (cf. *S. runde*).

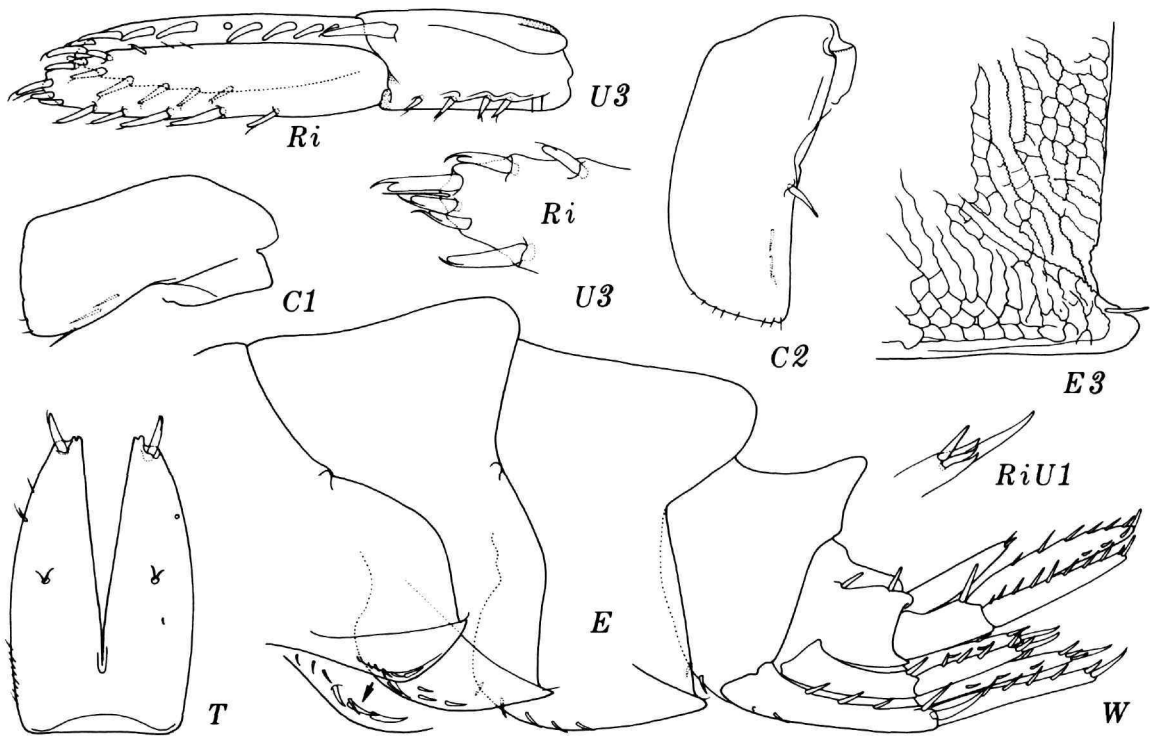


FIGURE 92.—*Syndexamine* species (cf. *S. runde*).

molars very poorly triturative; each outer lobe of lower lip with 1 cone, mandibular lobes broad and blunt; inner plate of maxilla 1 with 2 apical setae on both sides, outer plate with 11 spines, apex of palp lacking cone, bearing 3 apical setae only; inner plate of maxilla 2 with 3 medial setules, first proximal main seta near apex not divorced from next distally, lobes broader than in *S. wunda*; maxilliped like that of *S. wunda* but setal distribution on inner plate different (Figure 90*SI*) and medial spines on inner plate scarcely emerging from matrix and no extra facial spines present; coxae 2-3 each with strong posterior spine, coxa 1 with 3 small posteromedial spines, 1 projecting free posteriorly; gnathopods like *S. wunda*; pereopods 1-2 like *S. wunda* but posterior spines of article 6 much thicker and therefore more closely crowded, lending prehensile appearance, spines heavily striate; pereopods 3-5 much longer and thinner than in *S. wunda*, second articles especially narrow and rectangular, article 2 of pereopod 5 with several posterior spines; pereopods 3-5 also with prehensile appearance; dactyls of pereopods with main marginal seta not fully free from dactylar margin; rami of uropods 1-2 reaching subequally on each appendage; uropod 3 with elongate rami bearing many heavy spines, several spines apically, outer ramus shorter than inner; telson narrow, each apex bearing 1 spine; pleonal epimera 1-3 with lateral ridge and medium posteroventral tooth on each; epimeron 2 with pair of side spines at ventral margin and 1 facial seta dorsal to that; both pleonites 2-3 strongly protuberant, posterodistally, pleonite 4 with large, vertically erect protuberance; cuticle with very heavy scales like those of fish and reptiles, very sharp over most of the area and often bearing ragged edges, forming both long ridges and numerous cells (polygons) on epimeron 3.

REMARKS.—This specimen is probably a very advanced female of *S. runde*, but one cannot be certain in light of the unusual prehensile condition in *S. wane*.

This advanced female differs from the mature but

less advanced females in the reduction or loss of one of the members in the pairs of spines on article 6 of pereopods 1-5, and the heavy thickening of the remaining or dominant spine, with a frill developing on the trigger of those spines. In addition, the majority of spines on the outer plate of the maxilliped is almost wholly immersed in matrix, and epimeron 3 has a definite ridge, although some females of *S. runde* have the rudiments of this ridge. The 5.2 mm figured female of *S. runde* has an abberant half on the maxillipeds in which these spines on the outer plate are partially immersed. The cuticle of the advanced specimen is more strongly scaled than in *S. runde*. Since one would expect advanced specimens to maintain and to add subapical setae, rather than to lose them, the absence of subapical setae on the palp of maxilla 1 is one character suggesting a specific difference between this advanced specimen and *S. runde*.

ILLUSTRATIONS.—In the view of the head, antenna 2 has been flattened in the offset; scales are shown on several appendages, but only a few here and there in order not to obscure other details; the right lacinia mobilis and one spine are occluded with precipitate; the right molarial ragged seta has been restored from its broken and partially hanging state; apices of both maxillipedal palps have been restored, perhaps erroneously.

MATERIAL.—Female, 5.7 mm, Shepherd 15.

DISTRIBUTION.—South Australia, sublittoral.

### *Syndexamine wane*, new species

FIGURES 93–95

DESCRIPTION (of female).—Antenna 1 extending much farther than antenna 2, both pairs of antennae short, antenna 1 thick, article 1 bearing 1 large, 1 small ventral spine, article 2 scarcely shorter than 1, flagella of antennae very short; lateral cephalic lobes broad and slightly incised, anteroventral cephalic margin with strong bulge supporting base of antenna 2; upper lip rounded below; mandibles very thick, incisors untoothed, right mandible with 2 spines (one broken off in Figure 95*Mr*), left with 3, each molar with ragged seta, short ordinary setae on right, 1-2 vestigial setae on left, molars scarcely triturative; each outer lobe of lower lip with large cone, mandibular lobes short, broad, blunt; inner plate of maxilla 1 with 1 medioapical seta, outer plate with 11 spines, apex of palp with 2-3 cones, bearing apical and subapical setae; inner plate of maxilla 2 with numerous medial setules, first proximal main seta not divorced from next distally, lobes broader than in *S. wunda*; maxilliped like that of *S. wunda* but spines of outer plate stouter; no coxa with posterior spine, coxa 1 with concave anterior margin and upturned anteroventral corner, bearing weak posteromedial setal-spine on face; gnathopod 1 like that of *S. wunda*, but palm of gnathopod 2 nearly transverse; pereopods 1-2 stouter than in *S. wunda*, spines shorter and stouter and heavily striate, article 6 appearing subprehensile; pereopods 3-5 with article 2 very thin and rectangular, but otherwise pereopods shorter and distally stouter than in *S. wunda*, and with prehensile appearance, article 2 of pereopods 4-5 with small ala near posteroproximal end, 5 with spines near posterodistal end; dactyls of pereopods with main marginal seta free but recumbant; rami of uropods 1-2 reaching subequally on each appendage; uropod 3 with elongate rami bearing many heavy spines, several spines apically, outer ramus shorter and narrower than inner, latter expanded; telson narrow, each apex bearing 1 spine; pleonal epimera 1-3 with lateral ridge and medium posteroventral tooth on each, epimeron 2 with pair of side spines above 3 spines on ventral margin; pleonite 3 protuberant dorsally, pleonite 4 with large, vertically erect protuberance; cuticle smooth.

ELABORATION OF FEMALE.—Because this species appears so different from other Australian species of the genus, further notes are appended here: body heavily calcified, brittle, and resembling that of heavily calcified species of *Atylus*; antenna 2 with 3 heavy spines on lateroventral margin of article 4, one midmedial spine, article 5 with distolateral spine, distomedial spine and 2 midmedial spines; eyes scarcely showing through heavily calcified head; coxa 2 especially thin and tapering, coxa 6 especially small; aesthestascs of antenna 1 especially well developed, setae on flagella appearing as cylinders with circular tips almost formed like lips; cones on apex of maxilla 1 palp webbed; gnathopodal dactyls lacking distal accessory flat setules, bearing incision-tooth on inner margin, palms weakly and finely wavy; 5 oblique mediofacial rows of setae on female; on gnathopod 2, 4 poorly developed widely spaced setae; 3 anterior rows on gnathopod 1; on gnathopod 2, from distal to proximal, row of 2, large gap, then rows of 4, 4, and 1 setae; formulae of posterior spines on article 6 of pereopods 1-2 from distal to proximal (locking spines omitted,

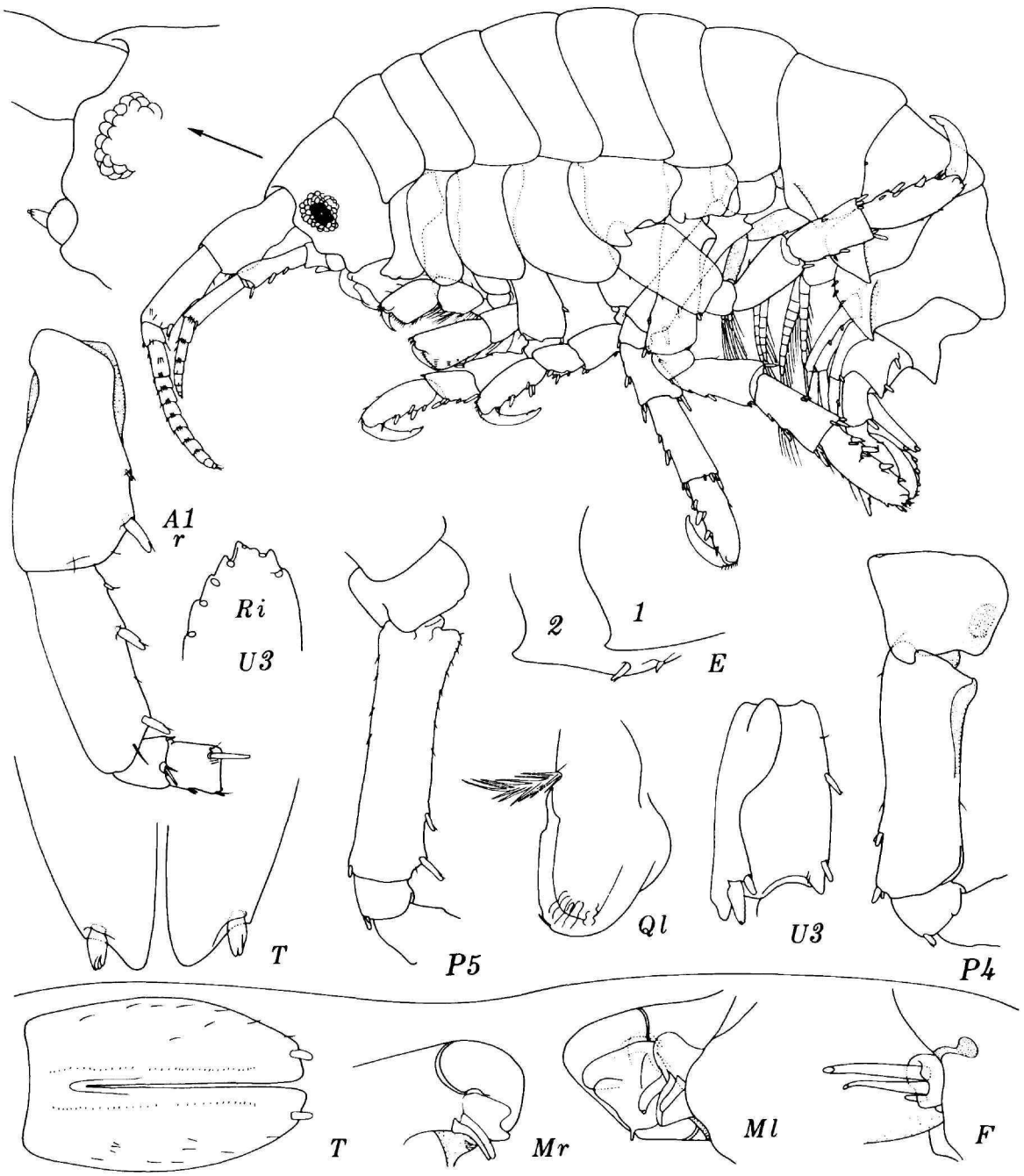


FIGURE 93.—*Syndexamine wane*, new species, upper=female, 3.5 mm, Shepherd 8; lower=holotype, male, 3.9 mm, Shepherd 15.

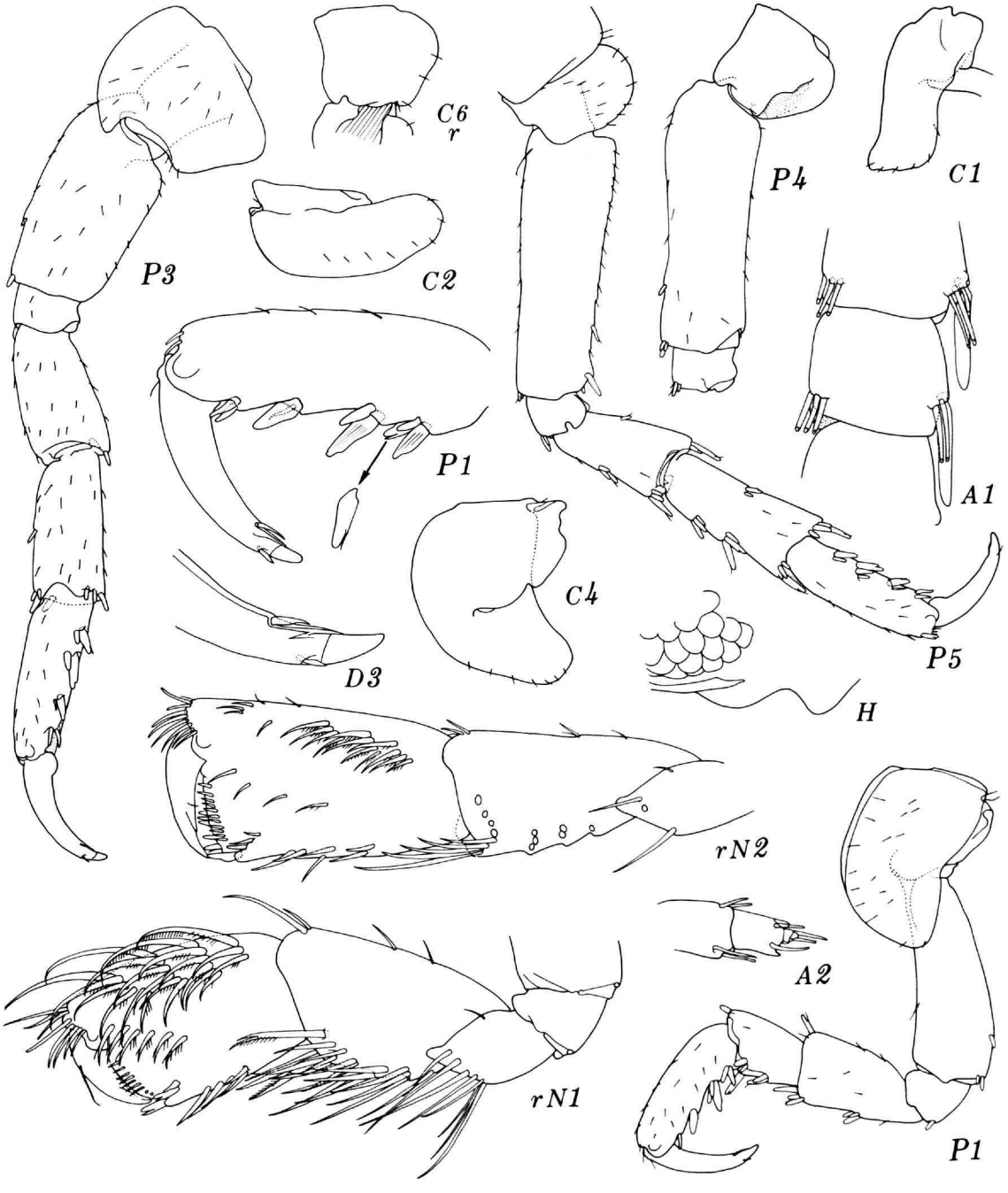


FIGURE 94.—*Syndexamine wane*, new species, holotype, male, 3.9 mm, Shepherd 15.

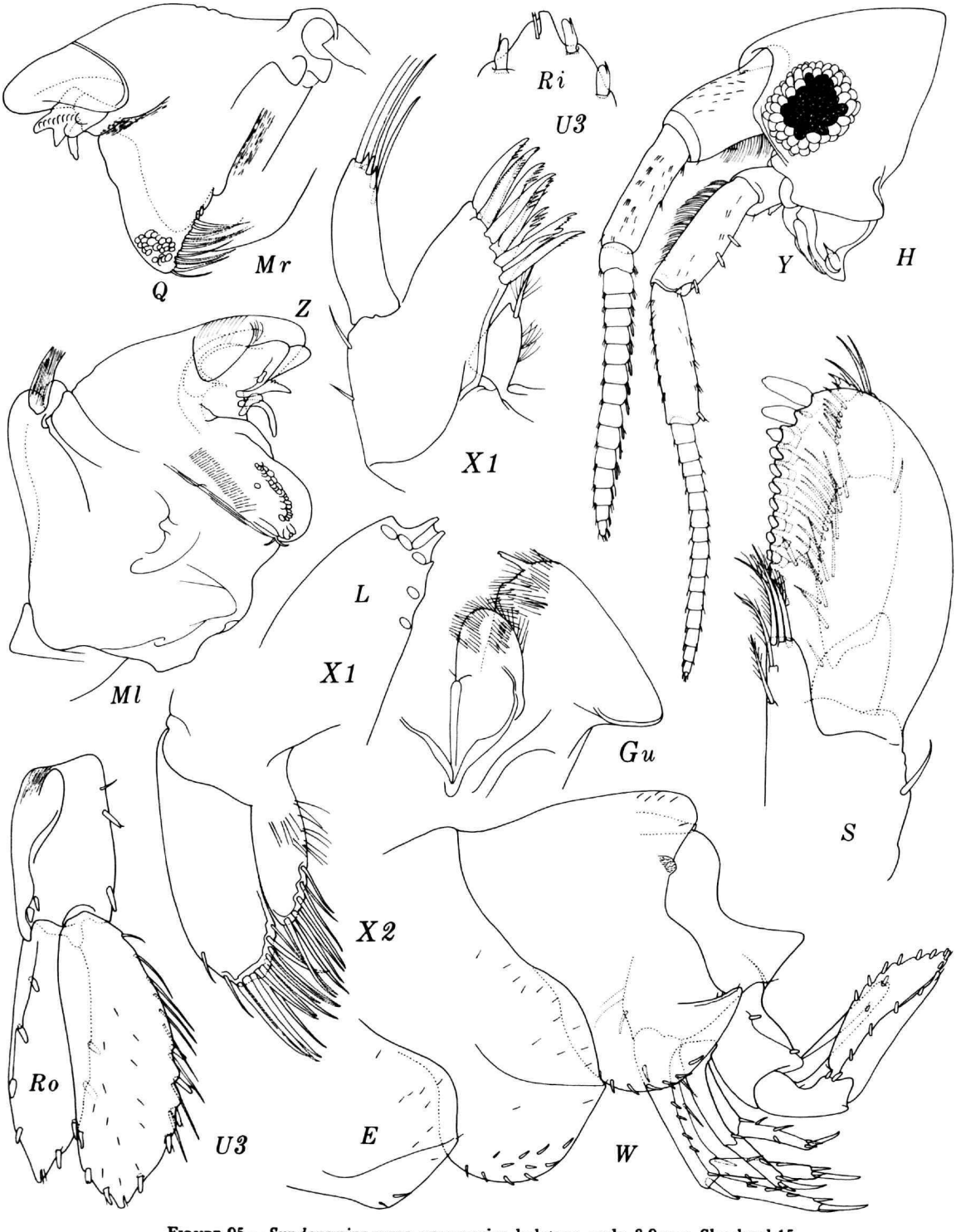


FIGURE 95.—*Syndexamine wane*, new species, holotype, male, 3.9 mm, Shepherd 15.

T=tiny, M=medium, G=giant): pereopod 1: TG, MG, M; pereopod 2: TG, MGM; formulae of epimeral spines, epimeron 1: 2 short setae, epimeron 2: 3 ventral spines and 2 side spines, epimeron 3: 3 spines; telson lacking dorsal denticles found in male.

MALE.—Body less calcified than in female, eyes enlarged, easily visible; antennae elongate, extending equally, flagellum of antenna 2 multiarticulate, heavy setular groups present on article 1 of antenna 1 and article 4 of antenna 2; cephocular lobe overriding flange at anteroventral corner of head; oblique mediofacial setal rows on gnathopods 1-2 composed of 6 and 4 setae respectively, 4 anterior setal rows on gnathopod 1, rows on gnathopod 2 composed of 3,1,4,4,4 setae; spine formula on article 6 (same symbols as for female): pereopod 1: TG, MG, MGG; pereopod 2: TG, MG, MG; article 2 of pereopods 4-5 not as strongly alate as in female; distal spine pair on peduncle of uropod 3 composed of very small spines; dorsal face of telson bearing long row of denticles on each side of cleft; epimeron 1 with 2 spines, epimeron 2 with 6 ventral spines and 5 side spines, epimeron 3 with 7 spines.

ILLUSTRATIONS.—Antennae 1-2 as attached to the head of the female (Figure 93, upper) have been untwisted and drawn flat. Ragged setae on mandibles of male (Figures 93*Ml, Mr*) have not been drawn; they were missing on the mandibles but presumed to be present; triggers on the large spines are largely broken off.

HOLOTYPE.—SAM, male, 3.9 mm.

TYPE-LOCALITY.—Shepherd 15, Pearson Islands, South Australia, 8 meters, 2/11 $m^2$, horizontal face in algae, January 1969.

RELATIONSHIP.—This species forms the main link between the type-species of *Syndexamine* from New Zealand and the other Australian species described in this study. Without this link, I would have placed *S. wunda* and *S. runde* in a new genus, as the differences between the type-species, *S. carinata*, and the others appear to have generic value in the Dexaminidae. These generic differences are not as strong as I formerly believed, however, because of the variability I have encountered as a result of this study, in the genus *Paradexamine* and the submergence of *Dexaminoides* in that genus. If *S. wunda* is considered the extreme opposite of *S. carinata*, then the generic differences would be cited as (1) the heavily cornified mandible of *S. carinata*, lacking teeth on the incisor and apparently lacking spines, and (2) the very obtuse mandibular lobes of the lower lip. These differences are strongly lessened by the condition of the mandible and lower lip of *S. wane*: the mandible is heavily cornified and lacks teeth on the incisor, but, unlike *S. carinata*, it still bears lacinia mobili, spines, and a recognizable molar. The mandibular lobes of the lower lip are slightly more pointed and protruding than in *S. carinata*.

*Syndexamine carinata* further differs from *S. wane* in the dorsal keel of pleonites 1-3 and the longer flagella on the antennae of the female (the male is unknown, though I am only assuming that Chilton's drawings represent the female). The prehensibility of pereopods 3-5 is not as strong in *S. carinata* as it is in *S. wane*, though pereopods 1-2 appear similar; coxa 1 has the extended anteroventral corner seen in *S. wane*, plus weak alae on pereopods 4-5, but the telson has lateral spines, and uropod 3 is more ordinary than in *S. wane*.

MATERIAL.—Shepherd 8 (1), 9 (2), 15 (1), 18 (1), 49 (1).

DISTRIBUTION.—South Australia, sublittoral.

## PROPHLIANTINAE

### *Prophlias* Nicholls

*Prophlias* Nicholls, 1939:312–313.

DIAGNOSIS.—Urosomites 1-3 together fused, but weak sclerotic ridge marking joint between urosomites 1 and 2; antenna 2 of female flabellate and short, flagellum composed of 2 or fewer articles; article 5 of pereopod 5 normally rectangular (not enveloping article 6 as in *Haustoriopsis* Schellenberg, 1938); palp of maxilla 1 uniarticulate.

DESCRIPTION.—Accessory flagellum a vestigial nonarticulate boss bearing 1 seta; peduncle of antenna 2 flabellate, article 4 much broader than 5, but article 5 flabellate in female, slender in male, flagellum essentially 1-articulate in female, multiarticulate in male; epistome unproduced; upper lip widely truncate below; mandible lacking palp, incisor simple, lacinia mobilis present on both sides, spine row absent, molars weakly triturative but lacking setae; inner lobes of lower lip free and fleshy; palp of maxilla 1 uniarticulate and large; inner plate of maxilla 2 much shorter than outer and bearing 1 apical spine and 1-2 medial

spines; inner plate of maxilliped small, bearing 1 long seta, outer plate large, palp 4-articulate; coxae not acuminate or bifid; gnathopods slender, small, article 3 of gnathopod 2 elongate; coxa 5 very large, with as much or more surface area than coxae 1-4 combined; inner ramus of uropod 1 about half as long as outer, inner ramus of uropod 2 more slender and slightly shorter than outer; telson of medium length, deeply cleft; body lacking side teeth; urosomite 1 scarcely humped, urosomites 2-3 with medium hump forming posterodorsal limit of urosome.

TYPE-SPECIES.—*Prophlias anomalus* Nicholls.

REMARKS.—The names of this genus and subfamily are misnomers in the sense that their affinities are with the Dexaminidae and only very remotely with the Phliantidae, despite many similarities. *Prophlias* is an advanced prophlian in which urosomite 1 has become solidly coalesced with the rest of the urosome and the female antenna 2 has been grossly reduced in segments, which have become flabellate. Coxa 5 is also more enlarged than in other dexaminids. Phliantidae are characterized by a uniramous or aramous uropod 3, splayed coxae, with coxa 4 large and coxa 5 small, bearing simple or parachelate gnathopods, an obsolescent palp on maxilla 1, and a complete cephalic envelopment of articles 1-2 of antenna 2.

### *Prophlias anomalus* Nicholls

FIGURES 96–97

*Prophlias anomalus* Nicholls, 1939:314–316, figs. 1–2.

DESCRIPTION.—Pereon of female much thicker dorsoventrally than in male, whereas male metasome much larger than in female, female and juveniles with strong dorsal humps on body segments, male with flatter tops and subangular posterodorsal extensions, especially on pereonites 5-6 and pleonites 1-3; cuticle very rough with appearance of plastic foam, large polygonal shallow pits appearing on major coxae, bases of pereopods 3-5, epimera 1-3, sides of urosome, pits becoming smaller and more irregular in other places, pereonites 1-7 laterally swollen, head with ocular bulge; eye much enlarged in male; ommatidia hidden by surficial rugosities, pigment brown black, irregular; head of female with angular lappet anteroventral to eye, whereas that margin angularly rounded in male; female second antennae so grossly rugose as to defy normal observation of articulations, antennae closely appressed side to side so as to appear coalesced to each other from anterior view, but otherwise antennae separable upon dissection; flagella of male antenna 2 in all preserved specimens available (7 males) tucked into brood space medial to coxae; coxae 1-4 with vertical bulges on lateral faces, bulges poorly developed in males, coxa 5 with similar bulge near anterior edge in both sexes; each lobe of lower lip with cone in female; cones, if present on male lower lip, invisible under oil-immersion technique; inner plate of maxilla 1 lacking setae (contrary to Nicholls' statement; however, he had specimens as large as 3 mm long), outer plate with 8 spines; inner plate of maxilla 1 with apical portion constricted; some setae on gnathopods with truncate apices appearing hollow and bearing longitudinal raphus (but these setae difficult to observe because of small size under oil immersion); locking spines of pereopods apically curved slightly, dactyl with weak distal slit (or articulation), inner setule, outer setule; pleonites 5-6 (fused) with large dorsal hump; flagellar articles of male antenna 2 with apical cusps; brood-lamellar setae of female apically simple; pleopods of male much stouter than in female. Largest specimen 1.9 mm, smallest 0.9 mm long. Body dull pink in formaldehyde, but males with rusty red on anterior margins of head, antennae, coxae 1-4, pink fading in alcohol rapidly, but red of males retained for at least two weeks.

REMARKS.—Nicholls considered that female antenna 2 lacked a flagellum; he illustrated the gland cone adjacent to an anterior segment that I believe represents article 3 in analogy to other amphipods and in homology to male antenna 2. Nicholls did not have males. By then recounting segments, one finds the female actually bearing a sixth article on antenna 2 that would represent a vestigial flagellum. The gland cone thus appears to be attached to an article 2 that appears only medially and is masked laterally by article 3. This is common in many other amphipods.

Nicholls had specimens as long as 3 mm, but my largest is 1.9 mm. He found a seta on the inner plate of maxilla 1 and a marginal spine on one ramus of uropod 3 not present in my specimens at hand. Penial processes on males and brood lamellae on females confirm the sexes of the material.

The drawings in toto of male and female that are given here contain only the highlights of the cuticle. On the female, pereonites 1-7 have lateral bulges and conical swellings progressing dorsad, forming, thus,

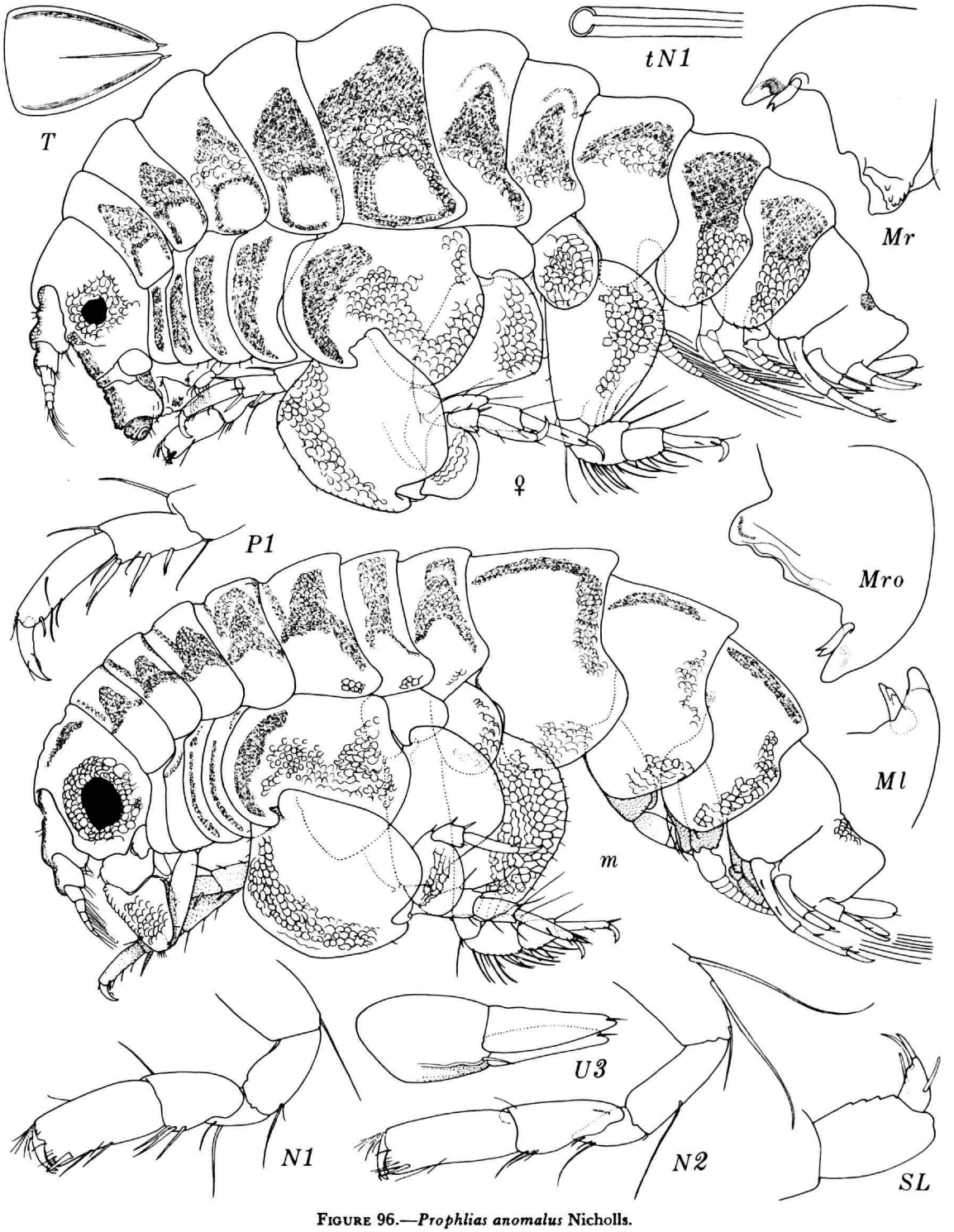


FIGURE 96.—*Prophlias anomalus* Nicholls.

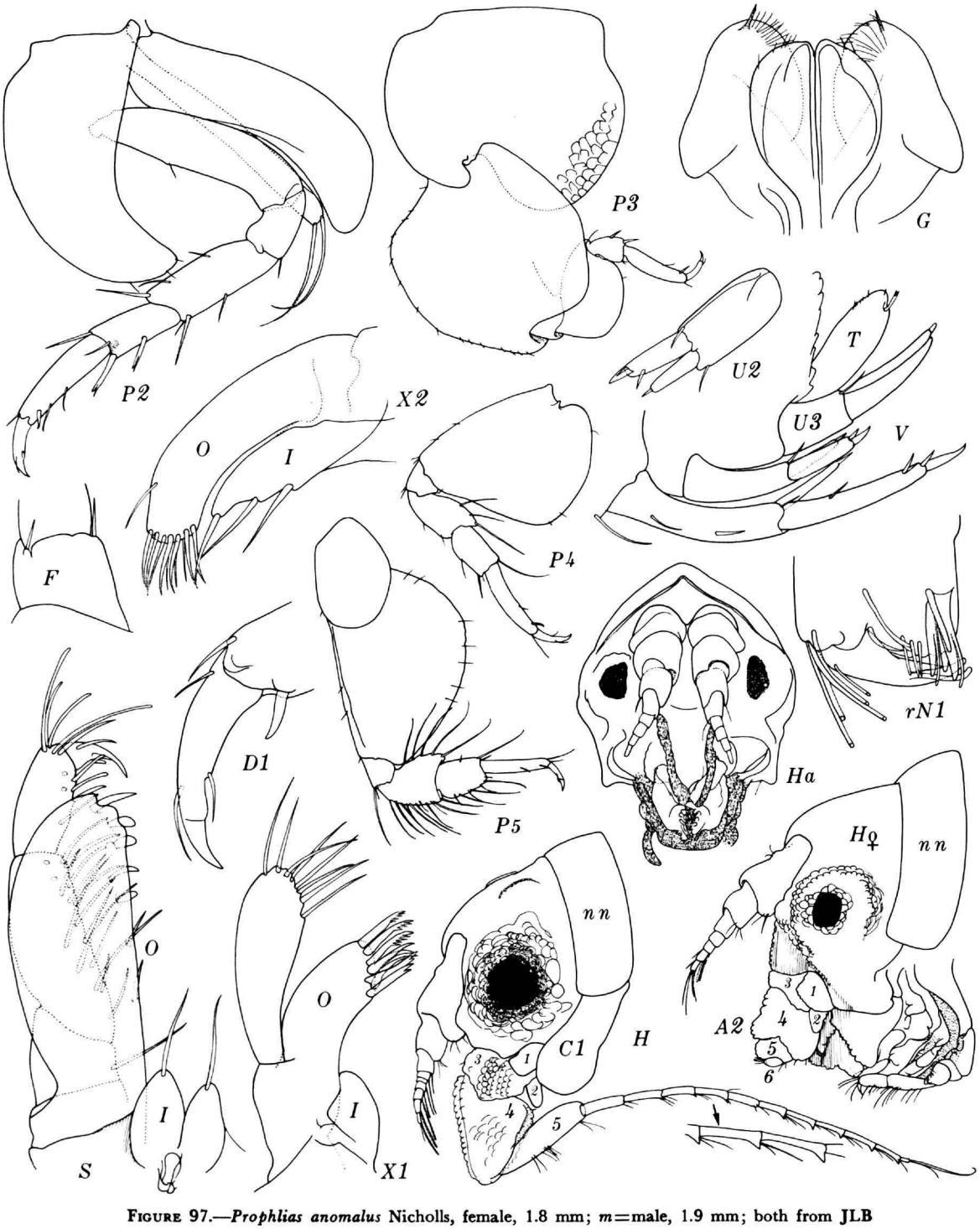


FIGURE 97.—*Prophlias anomalus* Nicholls, female, 1.8 mm; *m*=male, 1.9 mm; both from JLB Australia 13. (Body texture formed of highlights only; male antenna 2 tucked into "brood space.")

reverse highlights seen by transmitted light; the polygonal structures of coxa 6, the urosome, and epimeron 1 have been omitted for clarity, while only the largest polygons of coxae 5 and 7, the head, and pereopods 3-5 have been included. Polygons of male pereopod 4 and the urosome have been omitted.

MATERIAL.—JLB Australia 12 (5), 13 (12).

DISTRIBUTION.—Southwestern Australia, intertidal.

## *Guernea* Chevreux

*Guernea* Chevreux.—J. L. Barnard 1970b:169–171 [with synonymy].

DIAGNOSIS.—Urosomites 2-3 together fused but distinct from urosomite 1; antenna 2 of female normally stenodious and flagellum about 3-articulate or more; article 5 of pereopod 5 normally rectangular (not enveloping article 6 as in *Haustoriopsis* Schellenberg); palp of maxilla 1 usually biarticulate but rarely uniarticulate.

DESCRIPTION.—Accessory flagellum a vestigial setulose cube or absent; antenna 2 slender and cylindrical in both sexes; epistome unproduced; upper lip rounded below or tending to become truncate; mandible lacking palp, incisor toothed or simple, lacinia mobilis usually present both sides, spine row present or absent, molars weakly triturative to smooth, bearing ordinary setae and a ragged seta each, or not; inner lobes of lower lip free and fleshy; palp of maxilla 1 usually biarticulate, but occasionally uniarticulate; inner plate of maxilla 2 generally shorter than outer and well setose apically; inner plates of maxilliped vestigial to large, setae large or obsolescent, outer plates large, palp 4-articulate; coxae not acuminate nor bifid; gnathopods medium to slender, small, article 3 of gnathopod 2 not elongate; coxa 5 large, surface area nearly as great as coxae 1-4 together; inner rami of uropods 1-2 variable in size; telson of medium length or elongate, deeply cleft; body lacking side teeth but urosomites 2-3 (fused) often with weak lateral crests, urosomite 1 with 1 dorsal hump, tooth, or keel.

TYPE-SPECIES.—*Helleria coalita* Norman.

REMARKS.—This genus now includes *Dexamonica* J. L. Barnard and *Prinassus* Hansen (see J. L. Barnard, 1970b), and it is divisible into 2 subgenera, *Guernea* sensu stricto and *Prinassus*. The species described from Australia belong with *Guernea*, as *Prinassus* contains northern species with a retrorse dorsal hump on pleonite 4 in the female and a high keel in the male.

## *Guernea endota*, new species

FIGURES 98–100

DIAGNOSIS (of female; male unknown).—Accessory flagellum well developed, antenna 2 unlobed; mandibular incisor with 2-4 teeth, 1 spine in spine row, molar with several setae; inner lobes of lower lip well developed and distinctly separate, weakly appressed; palp of maxilla 1 exceeding apex of outer plate, uniarticulate; inner plate of maxilla 2 reaching about 90 percent along outer plate, much thinner than outer plate and bearing 3 apicomedial and 2 medial setae; inner plate of maxilliped of medium development, palp slightly exceeding outer plate; gnathopods 1-2 equally broad; posterior lobe of coxa 5 scarcely longer than anterior lobe; anterior lobe of coxa 6 of medium size; anterior setae on article 2 of pereopod 3 sparse and shorter than article 3, article 6 not elongate; pereopod 5 with large dactyl; inner rami of uropods 1-2 subequal in length to outer rami; peduncle of uropod 2 with 2 dorsal spines; telson 1.7 times as long as broad; epimeron 3 with weak posteroventral notch and sharp tooth; urosomite 1 with strong dorsal hump, urosomites 2-3 (fused) low and elongate, forming stairstep, each dorsolateral ridge with about 5 spines in adult, ridges weakly serrate, medial depression between ridges covered with long setae; cuticle of body and coxae strongly polygonal.

DESCRIPTION.—Eyes with dark magenta cores in alcohol; upper lip normally rounded below; palp of maxilla 1 with distal cone, 2 apical and 1 subapical setae; base of gnathopod 1 article 2 normally S-shaped; gnathopods 1-2 with 5 medial prickle spines on hands, palms weakly scalloped, dactyls with only large inner tooth; posterior margin of article 2 on pereopod 5 minutely and irregularly serrate; apical spine of telsonic lobe surrounded by alae; uropod 1 with 5 long ventrolateral setae; urosomite 1 ventrally naked.

HOLOTYPE.—WAM, female, 3.0 mm.

TYPE-LOCALITY.—Slack-Smith 1, Cheyne Beach, east of Albany, Western Australia, intertidal, weedy rocks, 4 December 1968.

RELATIONSHIP.—This species differs from any known member of *Guernea*, *Dexamonica*, and *Prinassus* in the spiny and setose urosome and in the odd

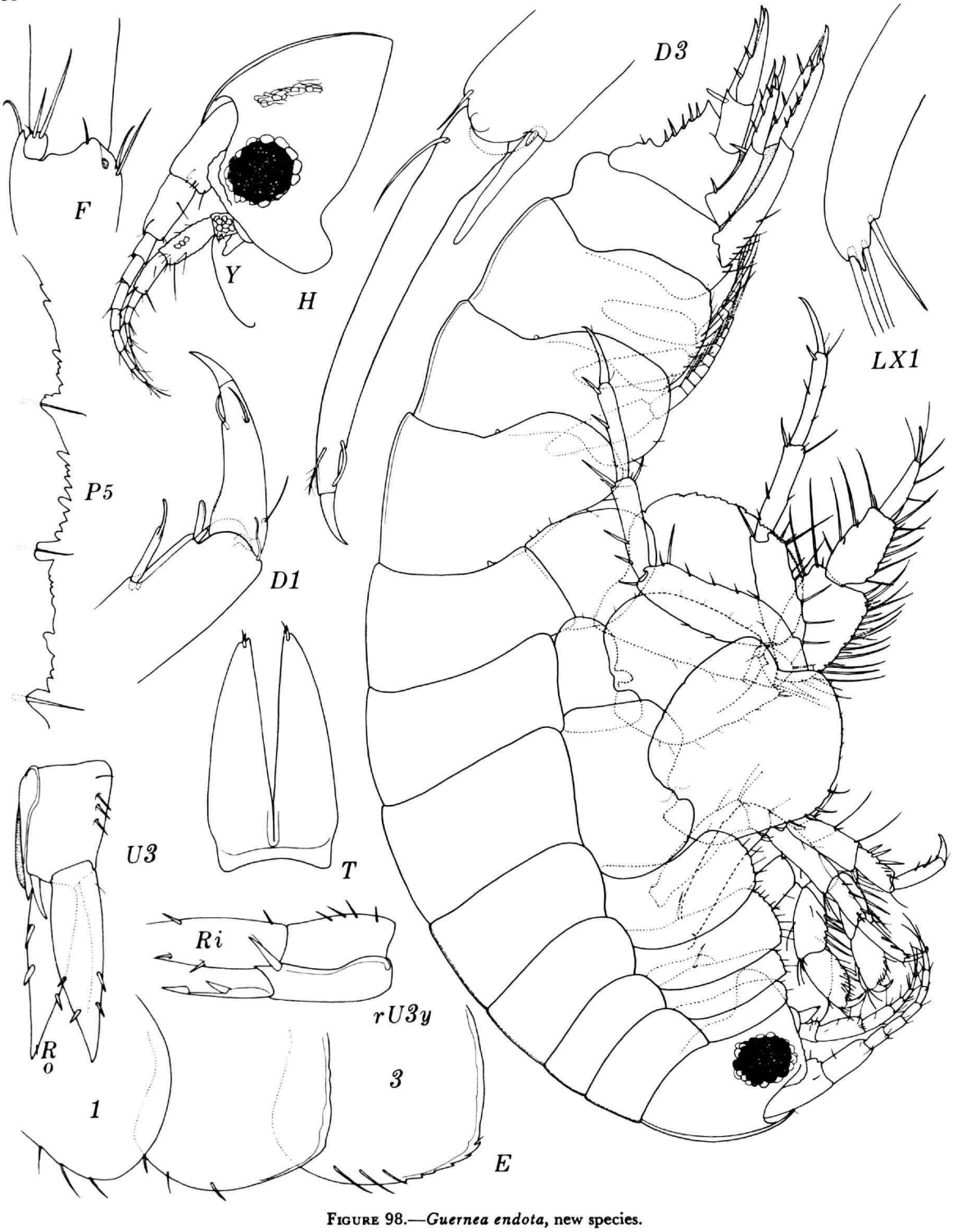


FIGURE 98.—*Guernea endota*, new species.

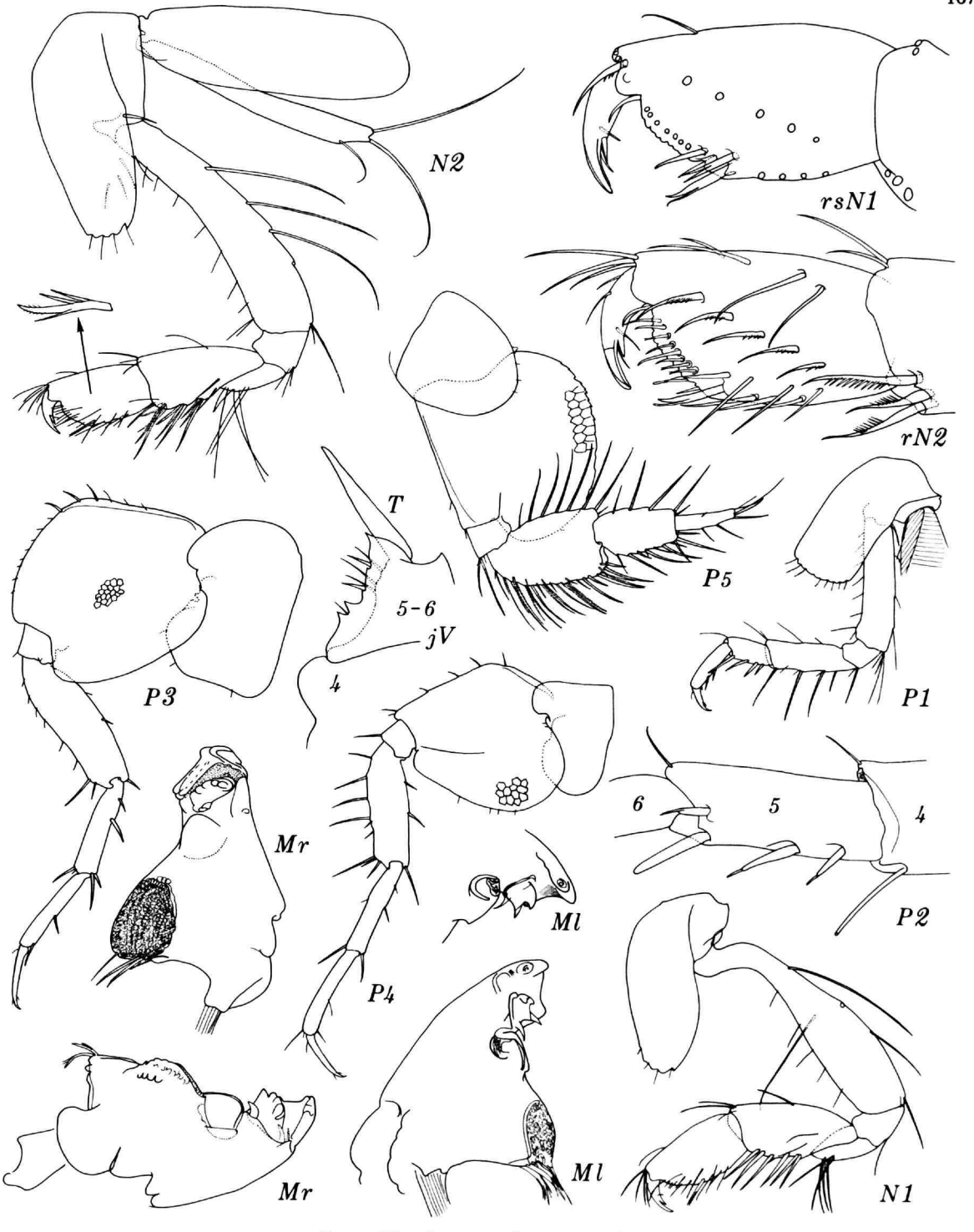


FIGURE 99.—*Guernea endota*, new species.

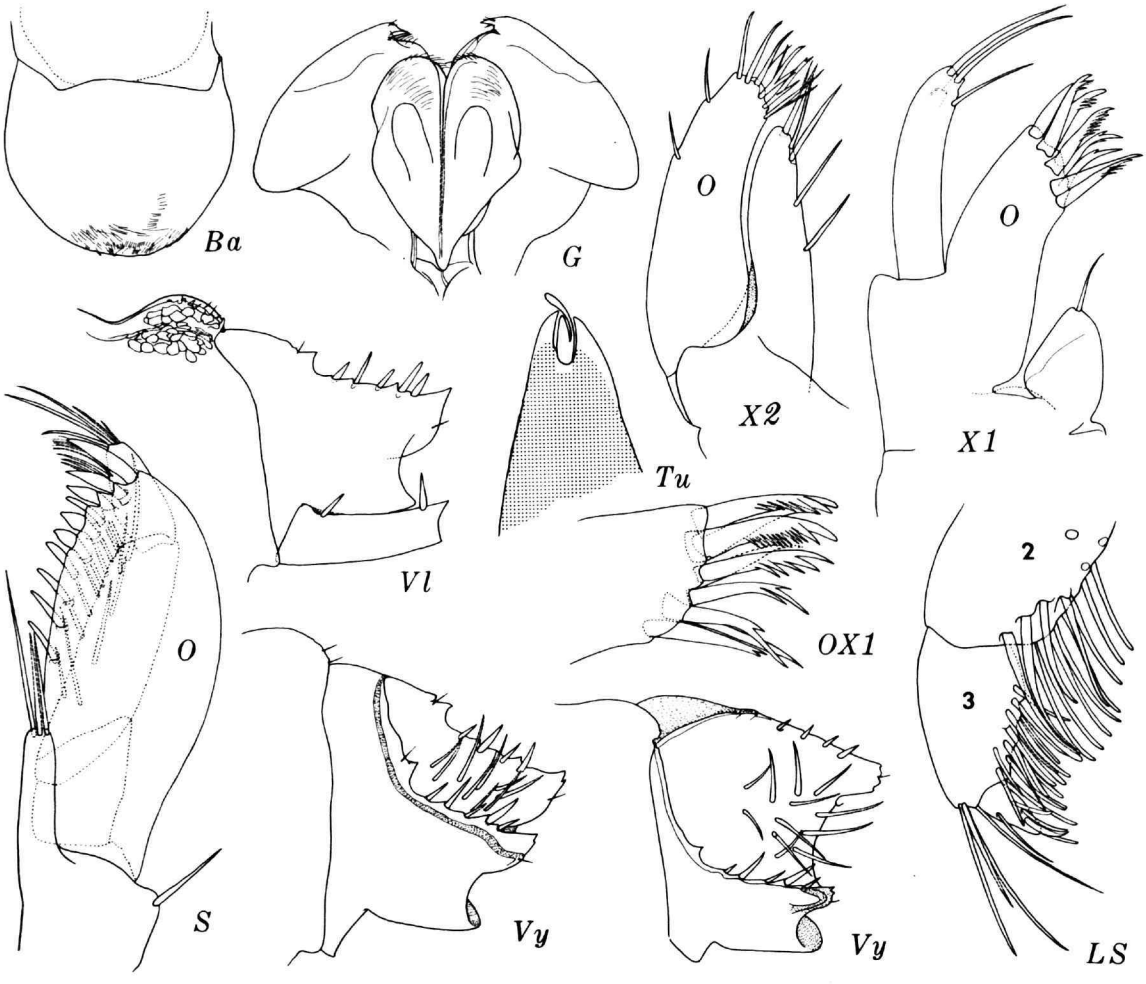


FIGURE 100.—*Guernea endota*, new species, holotype, female, 3.0 mm; *j*=juvenile, 1.6 mm; both from Slack-Smith 1.

telsonic apices, both characters of which give *G. endota* the appearance of a distinct genus.

Other characters in *G. endota* differing from 4 other known species of *Guernea* in the southern hemisphere (the 3 herein plus *G. timaru* J. L. Barnard, in press, from New Zealand) are the fairly high dorsal hump of urosomite 1 and the plumosity (prickles) on the spines of the hands on gnathopods 1-2 (found on *G. unchalka* only, on setae near the dorsal margin of the hand).

MATERIAL.—The type-locality (3).

DISTRIBUTION.—Southwestern Australia, intertidal.

### *Guernea gelane*, new species

FIGURES 101–103

DIAGNOSIS.—Accessory flagellum absent in female, present in male; antenna 2 unlobed; mandibular incisor with 2-3 teeth, spine row absent, molar without setae; inner lobes of lower lip large, fleshy, and separate; palp of maxilla 1 exceeding end of outer plate, article 1 only 60 percent as long as article 2; inner plate of maxilla 2 much narrower than, and reaching less than 60 percent along, outer plate, bearing 2 apical setae; inner plate of maxilliped of medium de-

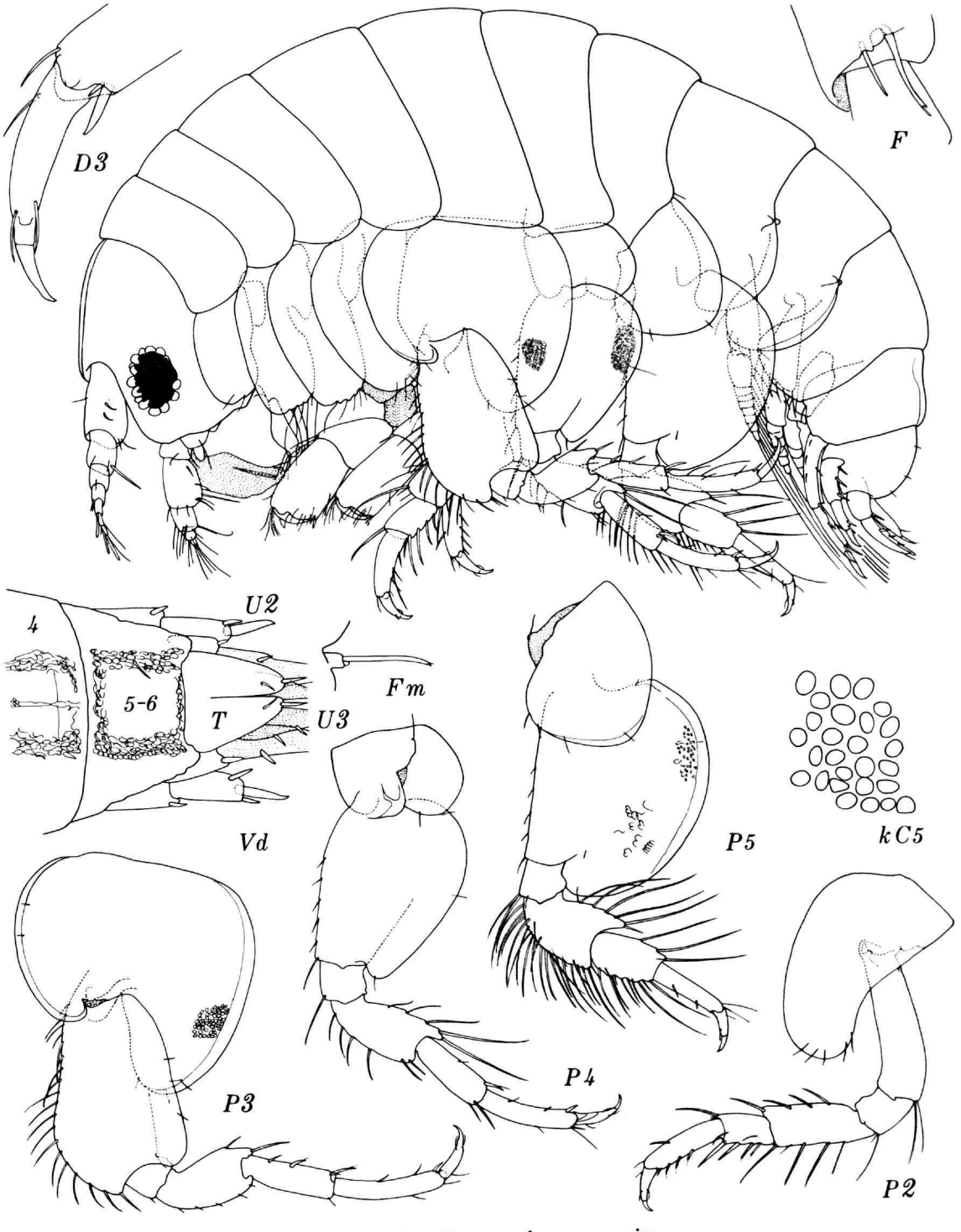


FIGURE 101.—*Guernea gelane*, new species.

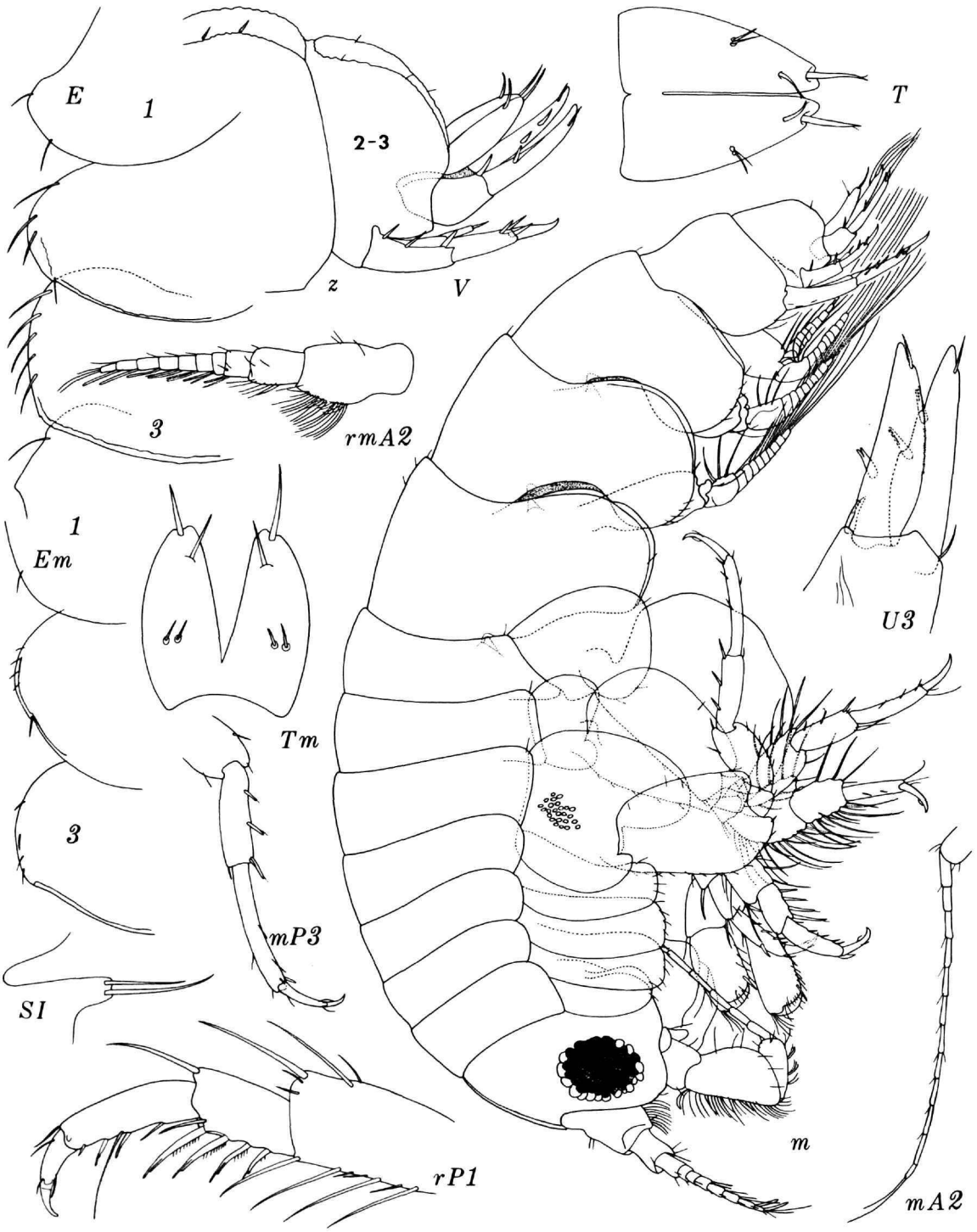


FIGURE 102.—*Guernea gelane*, new species.

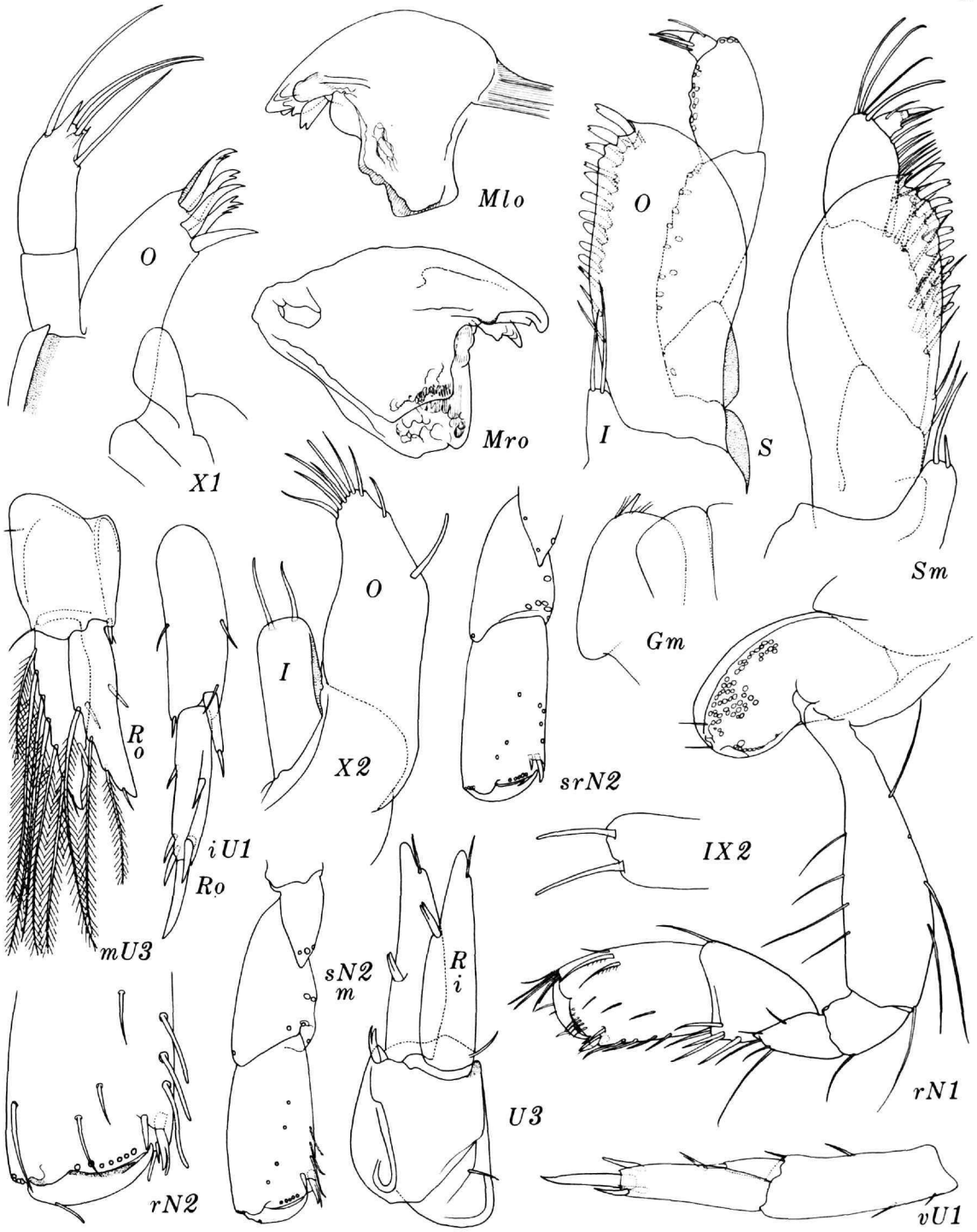


FIGURE 103.—*Guernea gelane*, new species, holotype, female, 1.9 mm; *m*=male, 1.9 mm; both from Merimbula A. (Accessory flagellum of female [*F*] on Figure 101 is absent.)

velopment, palp strongly exceeding outer plate; gnathopod 1 slightly broader than gnathopod 2; coxa 5 with very large tapering posterior lobe, anterior lobe on coxa 6 rudimentary; anterior setae of article 2 on pereopod 3 strongly developed only in female, article 6 elongate, pereopod 5 with large dactyl; inner ramus of uropods 1-2 strongly shortened; peduncle of uropod 2 with 2-3 dorsal spines; telson only 1.1 times as long as broad; epimeron 3 with posteroventral corner essentially smooth; urosomite 1 with double dorsal crest in female, single weak crest in male, urosomites 2-3 (fused) of medium height, almost evenly rounded to posterior slope, bearing only 1-3 weak lateral setules on each crest; body, coxae, and bases of pereopods covered with finely alveolar sculpture, finer on female than on male.

DESCRIPTION.—Eyes with deep purple cores in alcohol; female antenna 1 lacking setal brush of male; upper lip normally rounded below; palp of maxilla 1 with 1 apical cone in female, 2 in male, and 4-5 setae, 1-2 setae apicomedial; inner plate of maxilla 2 more strongly truncate in female than in male; base of gnathopod 1 article 2 normally S-shaped (for prophliantins), male and female gnathopods 1-2 similar to each other, but article 5 of male gnathopods elongate, medial faces of hands with 3-4 simple setae, palms smooth, dactyls bearing only 1 large inner tooth; uropod 1 with several very weak ventrolateral peduncular setae; urosomite 1 with 0-2 ventral setae removed from corner; urosomite 2 of male (fused to 3) bearing row of ragged scales above base of uropod 2, absent in female. Smallest specimen available 1.0 mm.

HOLOTYPE.—AM, female, 1.9 mm.

TYPE-LOCALITY.—Merimbula A, New South Wales, intertidal, weedy rock pools, collected by Margaret Drummond, 6 February 1969.

REMARKS.—Like other prophliantins, male antenna 2 has a swollen peduncle, and the long flagellum is tucked into the brood chamber; relative to coxa 5, the anterior body segments are smaller and the metasomal segments larger than in the female, and the pleonal epimera have distinct configurations from those of the female (see Figures 98–108 for various species of *Guernea* not mentioned in text). The male of *G. gelane* has coxae 1-4, 6-7 and pereopods 1-2, 4-5 similar to those illustrated for the female. The posterior lobe on coxa 5 is relatively narrower and longer than in the female.

This species has numerous characters that differ from *G. melape*, new species, some of which are not mentioned in the diagnoses and descriptions because I am not certain if they will prove to be diagnostic. One of the most interesting of these may have no identificatory value in juveniles lacking any ventral setae on urosomite 1 anterior to uropod 2; juveniles of *G. gelane* have no such setae, but adults of *G. gelane* have 1-2 (2 generally in males only) setae on the ventral part of the urosomite anterior to the juncture of uropod 2; in *G. melape* a single seta occurs in adults at the juncture of uropod 1. *Guernea melape* has 1-2 long basopeduncular setae on uropod 1, whereas *G. gelane* has very small setae in that position, pointing posteriorly instead of ventrally, and in one male of *G. gelane* 4 setae occur from base to apex of the peduncle, but they remain short. Another attribute of dubious value is the stout article 4 of antenna 2 in females of *G. gelane*. The posteroventral protrusion on the head in adults but not in juveniles of *G. gelane* bends mesiad with the result that it does not appear so well defined as in *G. melape*. The posteroventral corners of pleonal epimera 1-2 of *G. gelane*, in contrast to *G. melape*, have essentially no notches. Urosomite 1 in females of *G. gelane* has 2 weak dorsal crests, whereas both sexes of *G. melape* and the males of *G. gelane* have only 1 weak crest.

The strong characters distinguishing *G. gelane* from *G. melape* are numerous, but most are difficult to observe in undissected specimens. The two species are very similar in general body shape, but differences that were first noticed are the absence of a pair of dorsal spines on urosomites 2-3 and the less angular and shorter profile of those segments, with a weaker protrusion near uropod 3. The character of urosomal spines is not absolute because one specimen of *G. melape* has been found lacking those spines. In females of *G. gelane*, article 2 of pereopod 3 is strongly setose anteriorly, but this condition is easily overlooked because the appendage is often twisted and those setae, often clogged with dirt, are not easily clarified. The cuticular texture of the two species is absolutely distinct, *G. melape* having large polygon pits with very little flat surface between each of the polygons, and *G. gelane* having very fine rounded pits with much flat surface between each pit. In *G. gelane* this texture appears alveolar (like bubbles). In *G. melape*, article 2 of pereopods 3-5 has the polygons very strongly developed, whereas in *G. gelane* the alveolar

froth is poorly developed on those pereopodal articles.

The inner rami of uropods 1-2 of *G. gelane* are so strongly shortened that, on many specimens, inner rami appear absent from the lateral view, but, if the outer ramus is cleared, the inner can be seen. The mandibular molar of *G. gelane* has no simple setae, no main ragged seta as seen in *G. melape*, and no spine row. The mandible of *G. gelane* is generally more rugged and similar to that of the genus *Syndexamine* than that of *Guernea*. The inner plate of maxilla 2 in *G. gelane* is shorter, more truncate, and less setose than in *G. melape*; the outer ramus is broader and has a larger seta on a larger notch. Finally, the telson of *G. gelane* is much shorter and broader than it is in *G. melape*. The odd, as yet enigmatic, scales on the urosome of male *G. gelane* appear also to be characteristic. In general, the male and female of *G. gelane* appear to have more differences than do the two sexes in *G. melape*.

The smallest specimen of *G. gelane* at hand is 1.0 mm long. The main characters distinguishing juveniles remain those that distinguish females: the setose pereopod 3, the cuticular texture, the urosome, and the short inner rami of the uropods (easily seen on juveniles, which are more translucent than adults).

*Guernea gelane* differs from *G. coalita* (Norman) in the setose pereopod 3 of the female, the absence of a dorsal notch on urosomite 3, the short inner plate of maxilla 2, and the long dactyl of pereopod 5.

*Guernea petalocera* Ruffo (1959) has, among many characters that differ from *G. gelane*, no setae on article 2 of the female pereopod 3, has a lobe on article 4 of antenna 2, and has equally developed rami of uropod 2.

*Guernea gelane* has several characters in common with *G. timaru* J. L. Barnard (in press) from New Zealand, among them characteristics of maxilla 1, maxilla 2, pleonal epimera, cuticle, mandibles, urosomites 2-3, telson, and, to some extent, setosity of pereopod 3. *Guernea gelane* differs from *G. timaru*, which is known from only one female, in the much narrower article 2 of pereopod 3, the more strongly tapering article 2 of pereopod 4, the longer posterior lobe of coxa 5, the greater expansion of coxa 4 at mark 33, the short rami of uropods 1-2, the larger inner plate of the maxilliped, and the stronger development of article 4 on the maxillipedal palp.

MATERIAL.—The type-locality (11).

DISTRIBUTION.—Southeastern Australia, intertidal.

## *Guernea melape*, new species

FIGURES 104–106

DIAGNOSIS.—Accessory flagellum present in both sexes; antenna 2 unlobed; mandibular incisor with 2-3 teeth, 1 spine in spine row, molar with several setae; inner lobes of lower lip small and tightly appressed; palp of maxilla 1 exceeding apex of outer plate, article 1 equalling 2 in length in male, right palp of female occasionally 1-articulate; inner plate of maxilla 2 reaching 65 percent along outer plate, much thinner than inner plate and bearing 3 apical setae and 1 medial seta; inner plate of maxilliped of medium development, palp strongly exceeding outer plate; gnathopods 1-2 equally broad; posterior lobe on coxa 5 long and tapering, anterior lobe on coxa 6 rudimentary; anterior setae on article 2 of pereopod 3 sparse and extremely weak, article 6 scarcely elongate; pereopod 5 with large dactyl; inner ramus of uropods 1-2 as long as outer, peduncle of uropod 2 with 2-3 dorsal spines; telson nearly 1.6 times as long as broad; epimeron 3 with weak posteroventral notch and rounded tooth in both sexes; urosomite 1 faintly crested; urosomites 2-3 (fused) tall and with posterodorsal slope of about 45 degrees, bearing 1 heavy spine on each lateral crest; cuticle of body and coxae strongly polygonal.

DESCRIPTION.—Eyes with deep purple cores in alcohol; upper lip normally rounded below; male ocular lobe with slight anterior flange; female antenna 1 lacking ventral setal brush of male; palp of maxilla 1 with distal cone and 2 long setae; base of gnathopod 1 normally S-shaped; medial face of hands on gnathopods 1-2 with 2-3 simple setae in the setal row, gnathopods of both sexes similar to one another, palms weakly scalloped, dactyls bearing only large inner tooth; dactyl of pereopod 3 similar to that of pereopod 1; smallest specimen available, 1.3 mm, also bearing 2 spines on urosomites 2-3; uropod 1 with 1-2 long ventrolateral peduncular setae; urosomite 1 with 1 seta at corner near attachment of uropod 1.

NOTE.—Both mandibular molars have a main ragged seta; it is omitted on the drawing herein of the left female molar (Figure 106*Ml*), perhaps having been overlooked.

VARIATIONS.—A female, 1.70 mm, from JLB Australia 4 differs from the figured female holotype in the absence of spines on urosomites 2-3, but generally this specimen is more spinose than the larger holotype. It

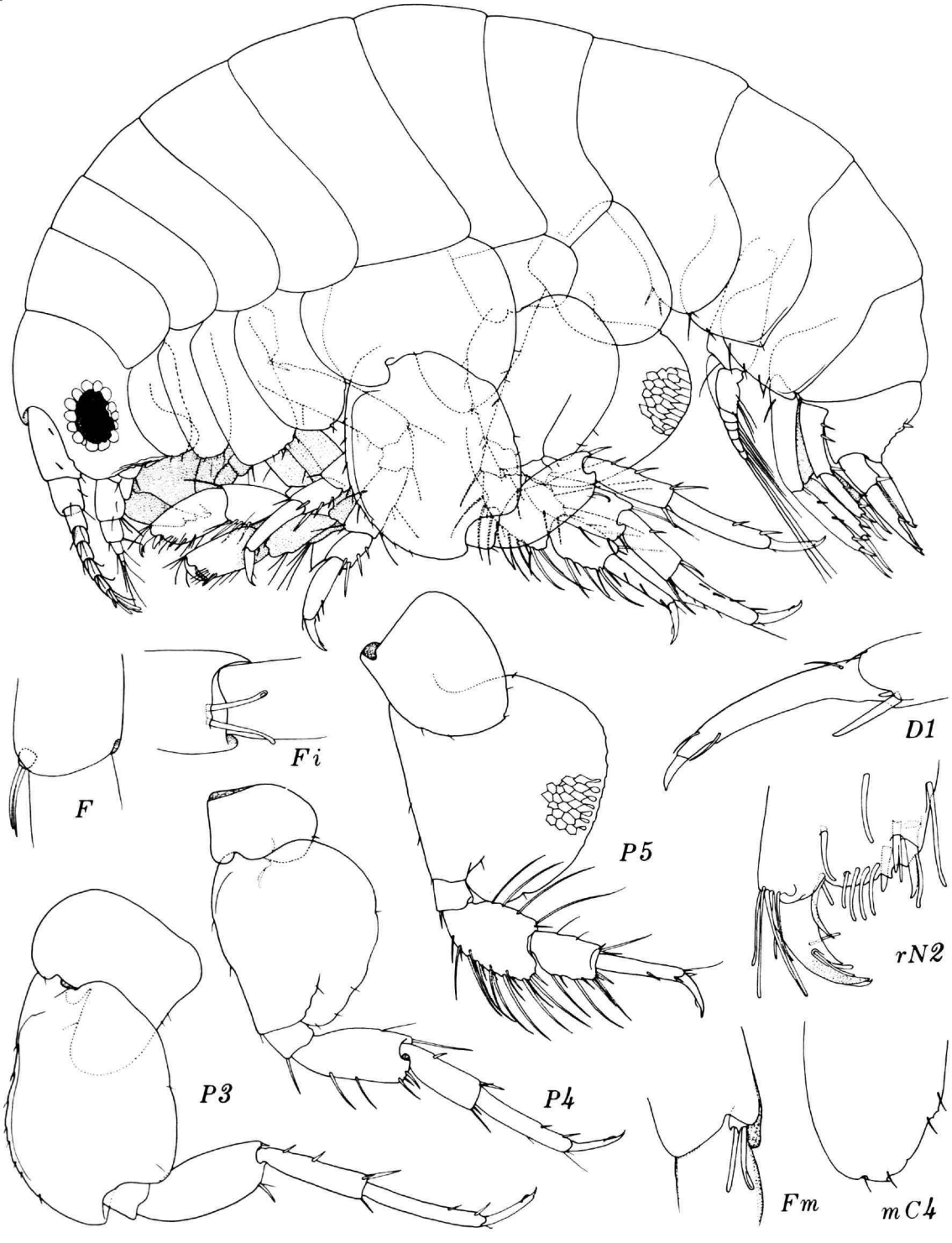


FIGURE 104.—*Guernea melape*, new species.

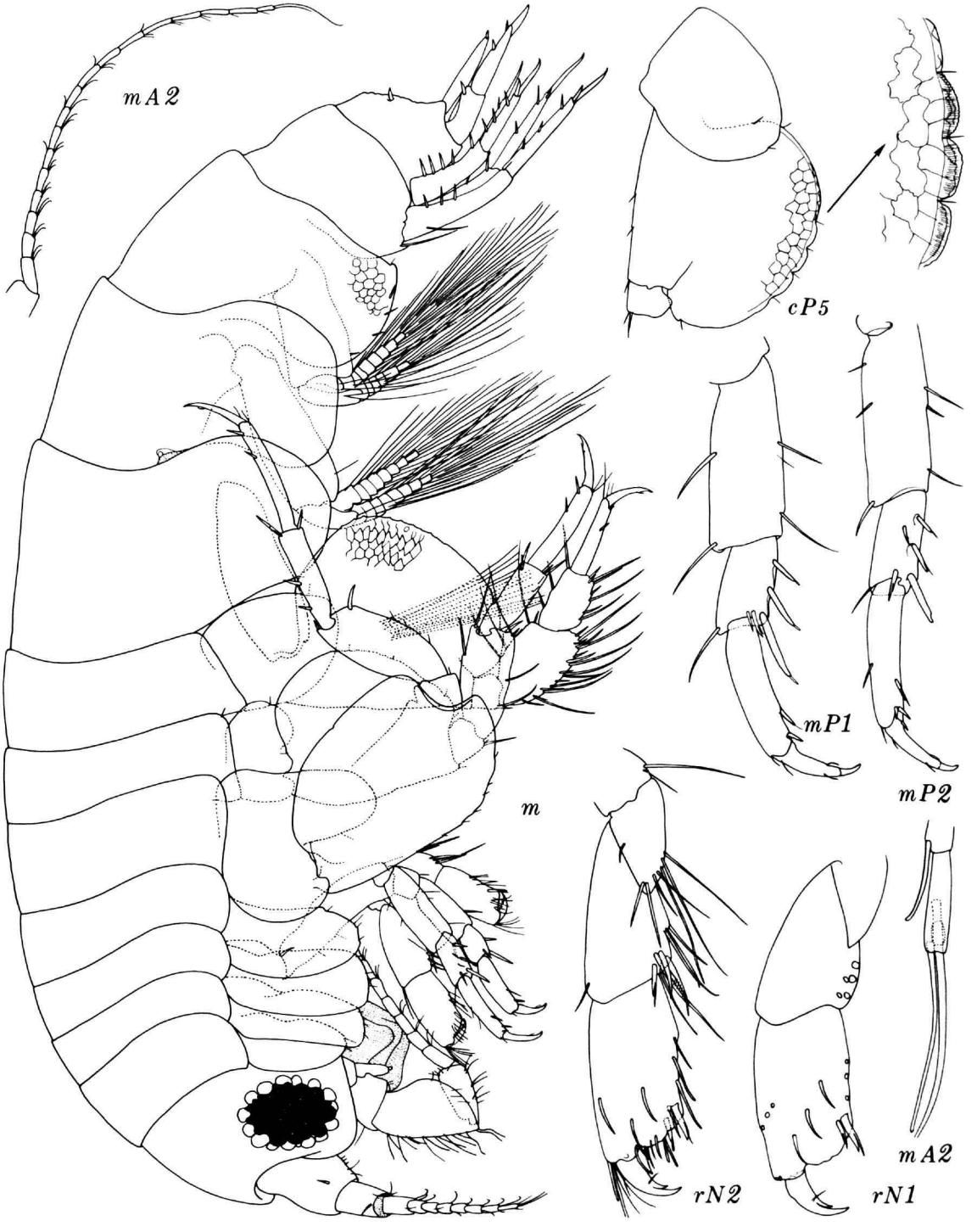


FIGURE 105.—*Guernea melape*, new species.

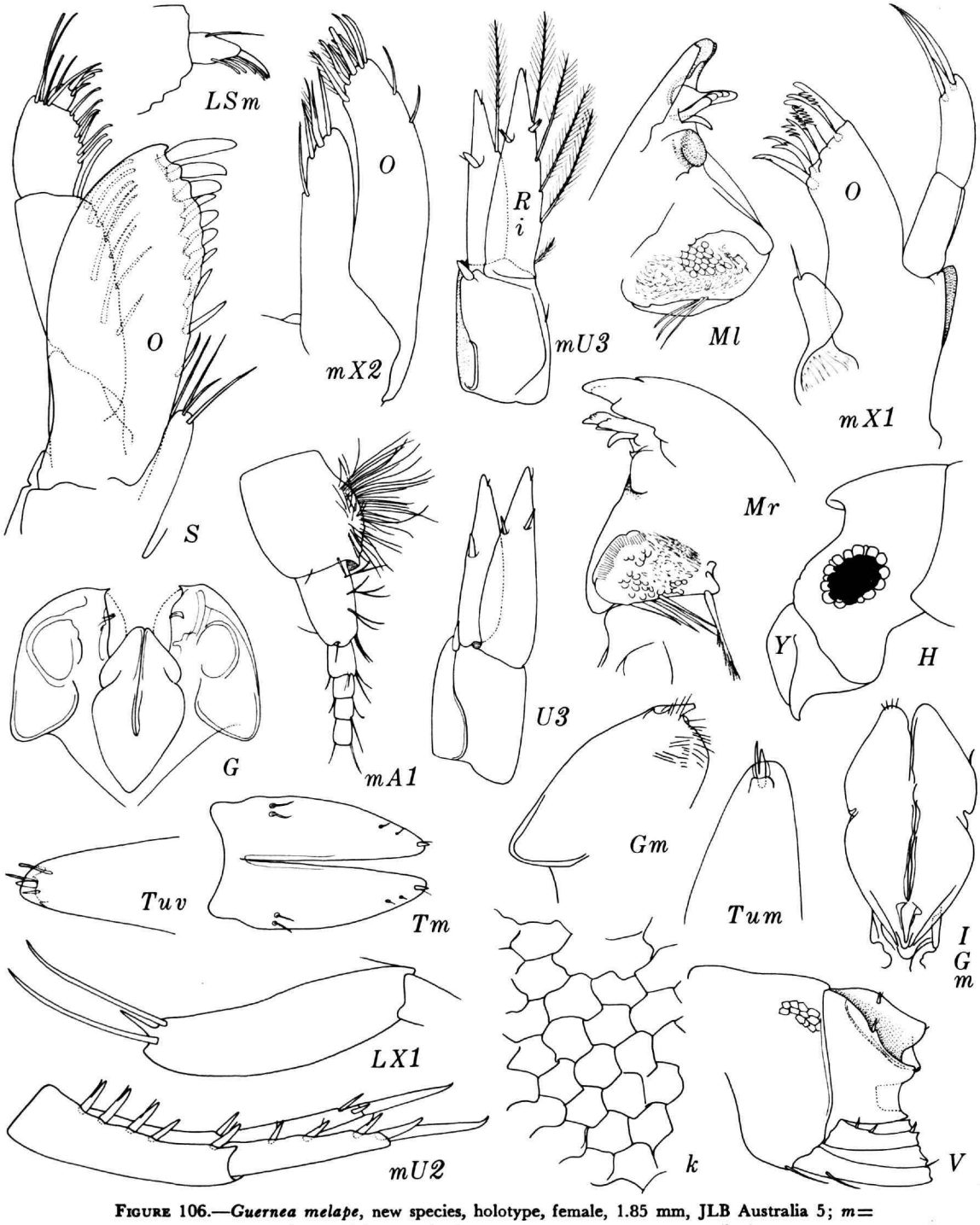


FIGURE 106.—*Guernea melape*, new species, holotype, female, 1.85 mm, JLB Australia 5; *m*= male, 2.0 mm, JLB Australia 5; *c*=female, 1.7 mm, JLB Australia 4.

resembles *G. gelane* only in urosomites 2-3. The sixth articles of pereopods 1-2 have 2 posterior spines plus the locking spine, and the fifth articles have 4 main posterior spines; the hands of gnathopods 1-2 have 3 and 4 main medial setae; the outer plate of maxilla 1 has 9 spines and both palps are biarticulate; the inner plate of maxilla 2 has 4 terminal and 2 medial setae; the peduncle of uropod 1 has 1 distal and 1 marginal spine, the outer ramus of uropod 3 has 2 lateral spines in tandem; pleonal epimeron 2 has a distinct tooth like that of epimeron 3; urosomite 1 has a slight crest and article 2 of pereopod 5 is slightly narrowed basally and scalloped posteriorly.

Another female, 1.72 mm, from JLB Australia 4 has 2 spines on urosomites 2-3, but uropod 1 has 2 ventral peduncular setae, uropod 2 has 1 distal and 1 marginal spine on the peduncle, epimeron 2 has a tooth, the outer ramus of uropod 3 has only 1 lateral spine, and article 6 of pereopods 1-2 has 1 posterior spine plus the locking spine, and article 5 has 3 main posterior spines.

A female-like specimen, 1.2 mm, from Slack-Smith 1 has 1 seta on the anterior sweep of the ventral margin of urosomite 1 somewhat similar to that found ventrally and more posteriorly on *G. gelane*; this specimen also has a thick article 4 of antenna 2, but otherwise the cuticle, uropods 1-2, urosomites 2-3, and pereopod 3 are like those characteristic of *G. melape* and not *G. gelane*.

Male and female specimens from Merimbula, New South Wales, have been compared minutely with typical specimens and correspond specifically. Adult females from Merimbula have 4 and 3 medial setae instead of 3 and 2, on the hands of gnathopods 1-2 respectively.

HOLOTYPE.—WAM, female, 1.85 mm.

TYPE-LOCALITY.—JLB Australia 5, west of Bunker Bay, Cape Naturaliste, Western Australia, intertidal, wash of algae and rocks, 2 September 1968.

RELATIONSHIP.—*Guernea coalita* (Norman) (see Chevreux and Fage, 1925) has article 1 of the first maxillary palp slightly longer than article 2, the left lacinia mobilis is untoothed, urosomites 2-3 are less beveled than in *G. melape*, the posterior lobe of coxa 5 is much weaker, and the dactyl of pereopod 5 is vestigial.

*Guernea petalocera* Ruffo (1959) has enlarged inner lobes on the lower lip, has article 4 of antenna 2 elongate, bearing a dorsal lobe that overrides article 5, has a very short article 1 on the first maxillary palp, and has gnathopod 1 stouter than gnathopod 2.

*Guernea* (?) *timaru* J. L. Barnard (in press), of which only the female is known, has a small inner plate on the maxilliped, has poorly toothed lacinia mobili and incisors of the mandibles, the length ratio of articles 1-2 of the first maxillary palp is 9:16, maxilla 2 has a strong bevelment on the lateral margin of the outer plate, and it has a strongly shortened inner plate.

*Prinassus nordenskioldi* Hansen (see J. L. Barnard, 1970b) and *Dexamonica reduncans* J. L. Barnard (1970b) have dorsal processes on one or more posterior body segments.

MATERIAL.—JLB Australia 3 (1), 4 (3), 5 (6), 12 (2); Slack-Smith 1 (2); Merimbula A (7).

DISTRIBUTION.—Warm-temperate Australia, intertidal.

### *Guernea unchalka*, new species

FIGURES 107–108

DIAGNOSIS (of female; male unknown).—Accessory flagellum well developed; antenna 2 unlobed; mandibular incisor with 2-3 teeth, 1 spine in spine row, molar with 1 ragged seta on right side only, socket or nodule on left; inner lobes of lower lip large, fleshy and separate; palp of maxilla 1 reaching apex of outer plate, article 1 about 80 percent as long as article 2 on right palp, but left palp without articulation separating articles 1-2; inner plate of maxilla 2 reaching more than 80 percent along outer plate, much thinner than outer plate and bearing 3 apical and 2 medial setae; inner plate of maxilliped of medium development, palp not exceeding outer plate; gnathopods 1-2 equally broad; long posterior lobe on coxa 5 extraordinarily broad, coxa 6 with exceptionally elongate anterior lobe; anterior setae on article 2 of pereopod 3 sparse and weakly developed, not longer than article 3, article 6 not elongate; pereopod 5 with large dactyl; inner ramus of uropods 1-2 scarcely shortened, peduncle of uropod 2 with 2 dorsal spines; telson slightly more than 1.3 times as long as broad; epimeron 3 with weak notch and rounded tooth at posteroventral corner; urosomite 1 with faint trace of medial crest; urosomites 2-3 (fused) tall, and with posterodorsal slope of about 45 degrees, bearing only 1-2 weak setules on each lateral crest; body and coxae covered with extremely fine pits separated from each other by space approximately as wide as their diameters.

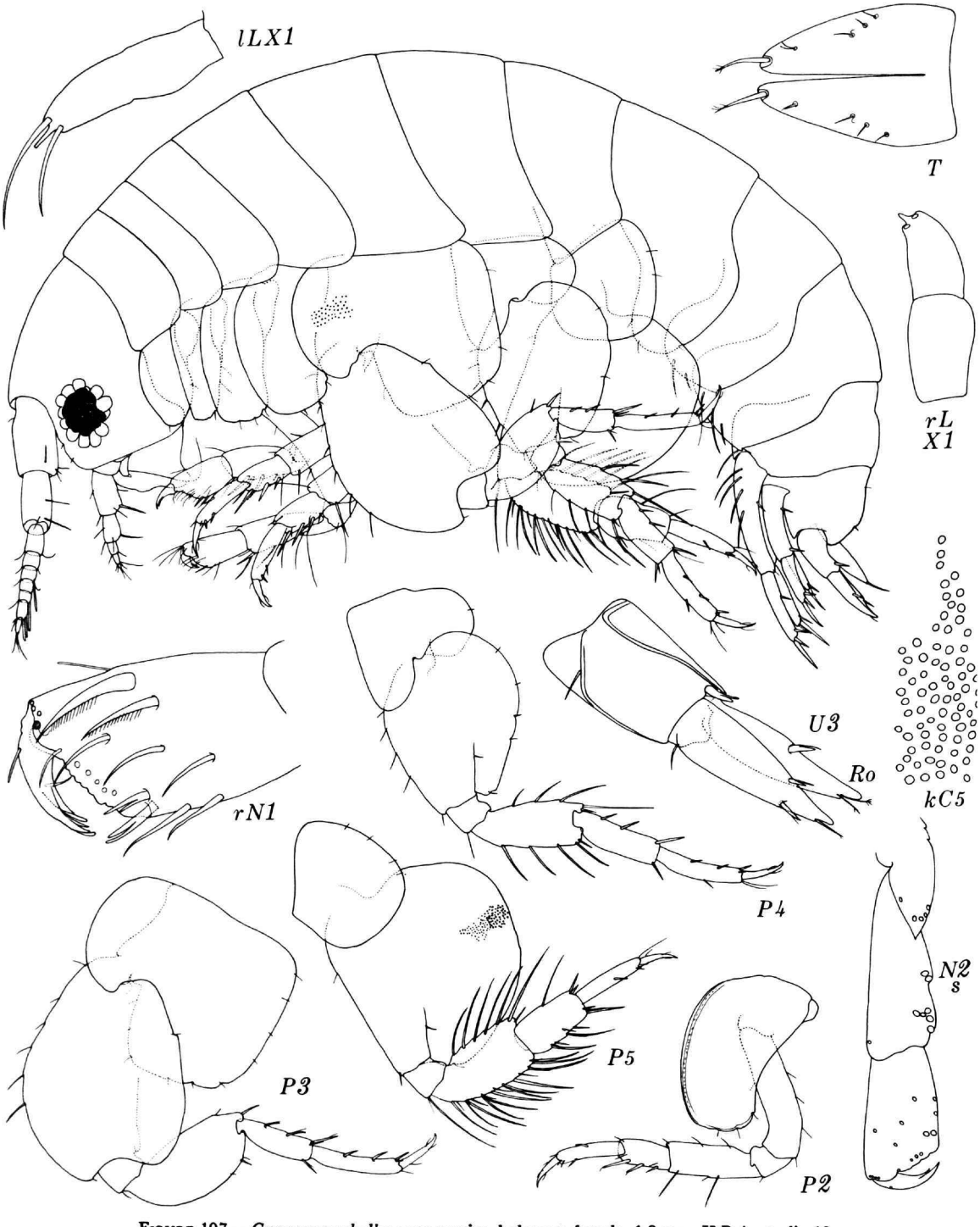


FIGURE 107.—*Guernea unchalka*, new species, holotype, female, 1.8 mm, JLB Australia 12.

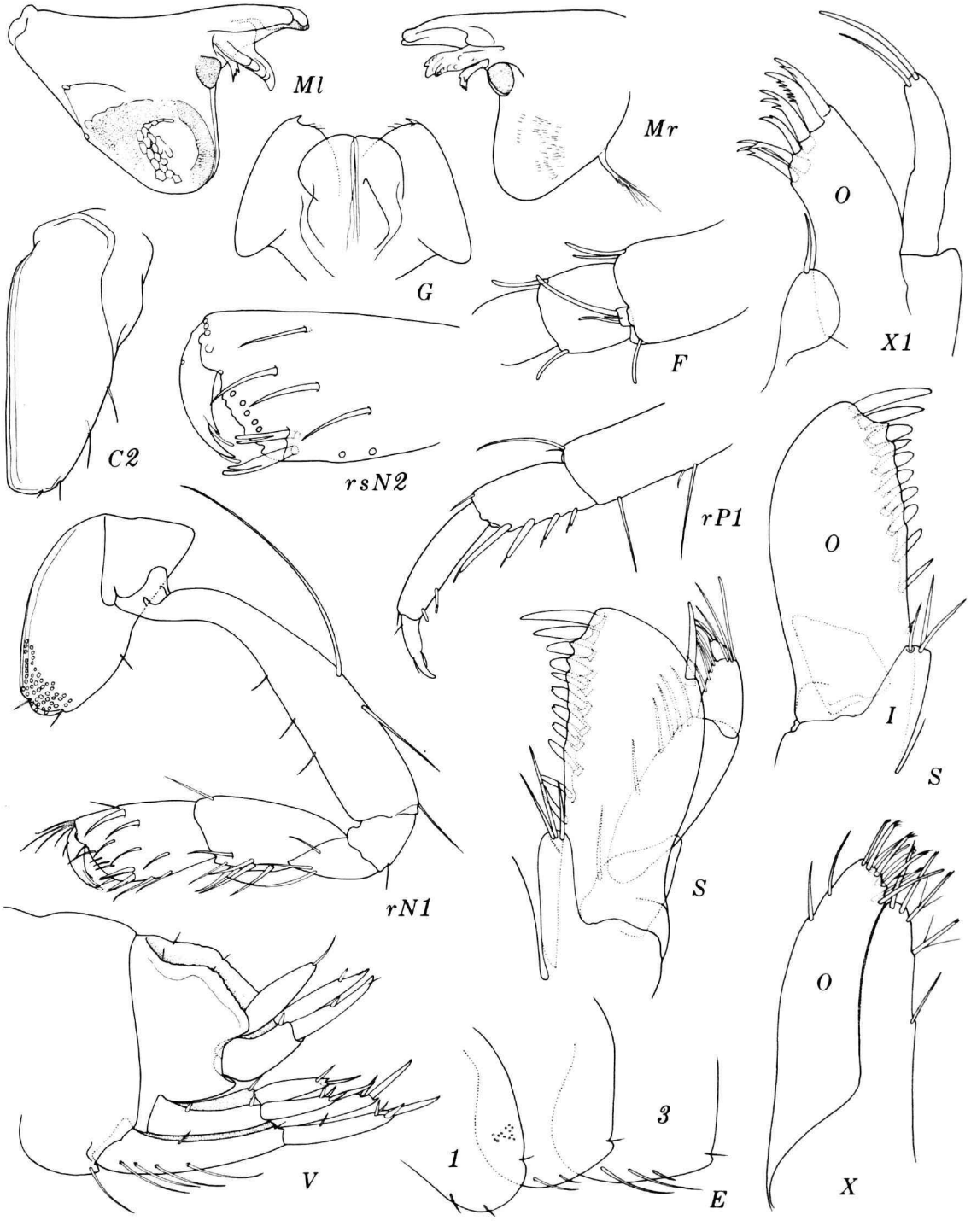


FIGURE 108.—*Guernea unchalka*, new species.

DESCRIPTION.—Eyes with deep purple cores in alcohol; upper lip slightly truncate below and possibly with weak notch; palp of maxilla 1 with 1 apical cone, short on right, long on left, with 2 apical setae (cone not showing in normal magnification and thus not drawn in whole view in Figure 108), outer plate with 9 spines (some hidden in Figure 108*X1;* base of gnathopod 1 normally S-shaped; medial faces of hands on gnathopods with 3 simple setae (in normal oblique line), palms slightly scalloped, dactyls bearing only large inner tooth; coxa 2 exceptionally thin; dactyls of pereopods as figured for pereopod 3 of *G. gelane*, new species; outer plate of maxilliped on one side with large lateral spines, absent on other member and on specimen 2; uropod 1 with 4 long ventrolateral peduncular setae; urosomite 1 with 1 seta at corner near attachment of uropod 1.

HOLOTYPE.—WAM, female, 1.8 mm.

TYPE-LOCALITY.—JLB Australia 12, Middleton Beach, Albany, Western Australia, intertidal, wash of sandy coralline algae, 30 September 1968.

RELATIONSHIP.—Like *Guernea gelane*, this species has affinities with the New Zealand *G.* (?) *timaru* J. L. Barnard (in press), but it is distinguished immediately from either species by the elongate anterior lobe of coxa 6, the very quadrate posterior lobe of coxa 5, the extremely well-developed accessory flagellum of the female, the short maxillipedal palp with the main projecting tooth on the outer plate of the maxilliped occurring proximal to the terminal spine instead of distalward, and the elongate inner plate of maxilla 2. *Guernea timaru* lacks a spine on the mandible, has an offset notch on the corner of epimeron 3, and a small inner plate on the maxilliped, but *G. unchalka* has small cuticular pits unlike the polygons of *G. melape*. *Guernea gelane* remains closer to *G. timaru*, however, than does *G. unchalka*, because of the characters of maxilla 2, epimera, accessory flagellum, coxae 5-6, mandible (lack of molarial setae), and maxillipedal palp.

*Guernea melape* has a polygonal cuticular structure, urosomal spines, and a long maxillipedal palp, but, like *G. unchalka*, it has a long, well-setose inner plate on maxilla 2, a poorly setose palp on maxilla 1, a seta at the corner of urosomite 1 where uropod 1 joins the body, 1 (or more?) long seta on the peduncle of uropod 1, with the result that the number of characters of *G. unchalka* shared by *G. gelane* and *G. melape* is well balanced.

MATERIAL.—The type-locality (2).

DISTRIBUTION.—Southwestern Australia, intertidal.

## EOPHLIANTIDAE

### *Bircenna* Chilton

### *Bircenna ignea* Nicholls

FIGURES 109–110

*Bircenna ignea* Nicholls, 1939:329–333, figs. 9, 10.

REMARKS.—This species differs from *B. fulva* Chilton (see J. L. Barnard, in press), the type-species of the genus from New Zealand, in the shorter, stouter body, the larger pereonite 1, the smaller coxa 1, the elongate article 1 of the 3-articulate flagellum on antenna 2, the much larger ventral cradle on pereonite 1, the absence of distal chelae on the gnathopods, and the equal length of the rami to each other on uropods 1-2.

*Bircenna ignea* differs from *B. nichollsi* Sheard (1939) in the thinner body, the larger pereopods, the larger cradle of pereonite 1 and the segment itself, the equality of length of article 1 on both rami of pleopod 3, the presence of more than 1 articulated spine and seta on uropod 3, and the smaller unbilobed coxa 1.

Nicholls is in error about the urosome of *Bircenna*; all segments are freely articulate. Nicholls and Sheard appear to have confused as a molar the process of the mandible used to articulate with the upper lip epistome. If any molar is present, it is represented, like the first maxillary palp, only by chitinous folds or lines in the normal position.

The ventral cradle holds a ventral callus on the base of the maxillipeds; in the specimen illustrated herein (Figure 109), the cradle has been rotated posteriorward.

The eyes have a core of black pigment surrounded by ommatidia shaped like maize kernals; body color in formaldehyde deep pink ("fiery red" according to Nicholls, who possibly described one in a living state), maintaining pink for 2-4 weeks or more in alcohol; body covered with flecks of shiny glint.

The specimen figured herein has no penial processes, but it has the large head and stout antennae figured by Nicholls for the male. Nicholls records specimens

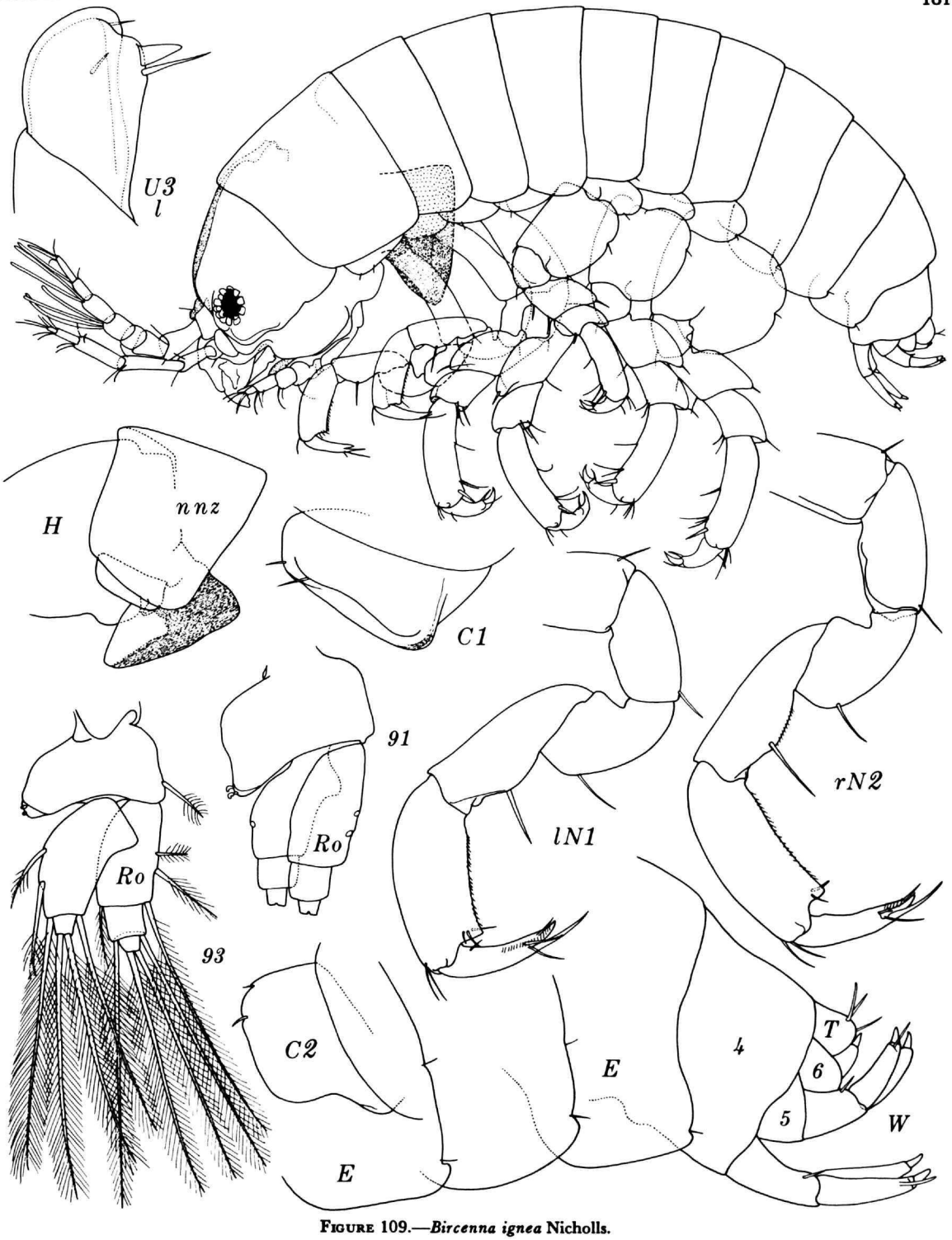


FIGURE 109.—*Bircenna ignea* Nicholls.

1.5-2.0 mm long; most of the specimens at hand are between 1.2 and 1.5 mm, with one specimen 1.9 mm long and one about 0.8 mm long.

Coxa 1 in individuals 1.5 mm long is not bilobate, but in the 1.9 mm individual and in Nicholls' drawing, coxa 1 is weakly bilobate. The coxae are longer than they appear in lateral drawings of the body, and coxae 1 and 2 are shown here from the side with the bulging lateral surface of the pereonites flattened. Preservative apparently also draws the coxae upward behind the lateral surface of the pereonites.

MATERIAL.—JLB Australia 4 (18), 5 (3), 14 (1).

DISTRIBUTION.—Southwestern Australia, intertidal.

## EUSIRIDAE

The family Eusiridae is used provisionally to contain genera formerly included in the Calliopiidae, Eusiridae, and Pontogeneiidae.

### *Pontogeneia*, Boeck and Its Allies

FIGURE 111

At least two flocks of species have been wrongly placed in *Pontogeneia*. They appear to be sufficiently distinct for generic recognition, which is elaborated below. *Paramoera* Miers is defined more tightly than

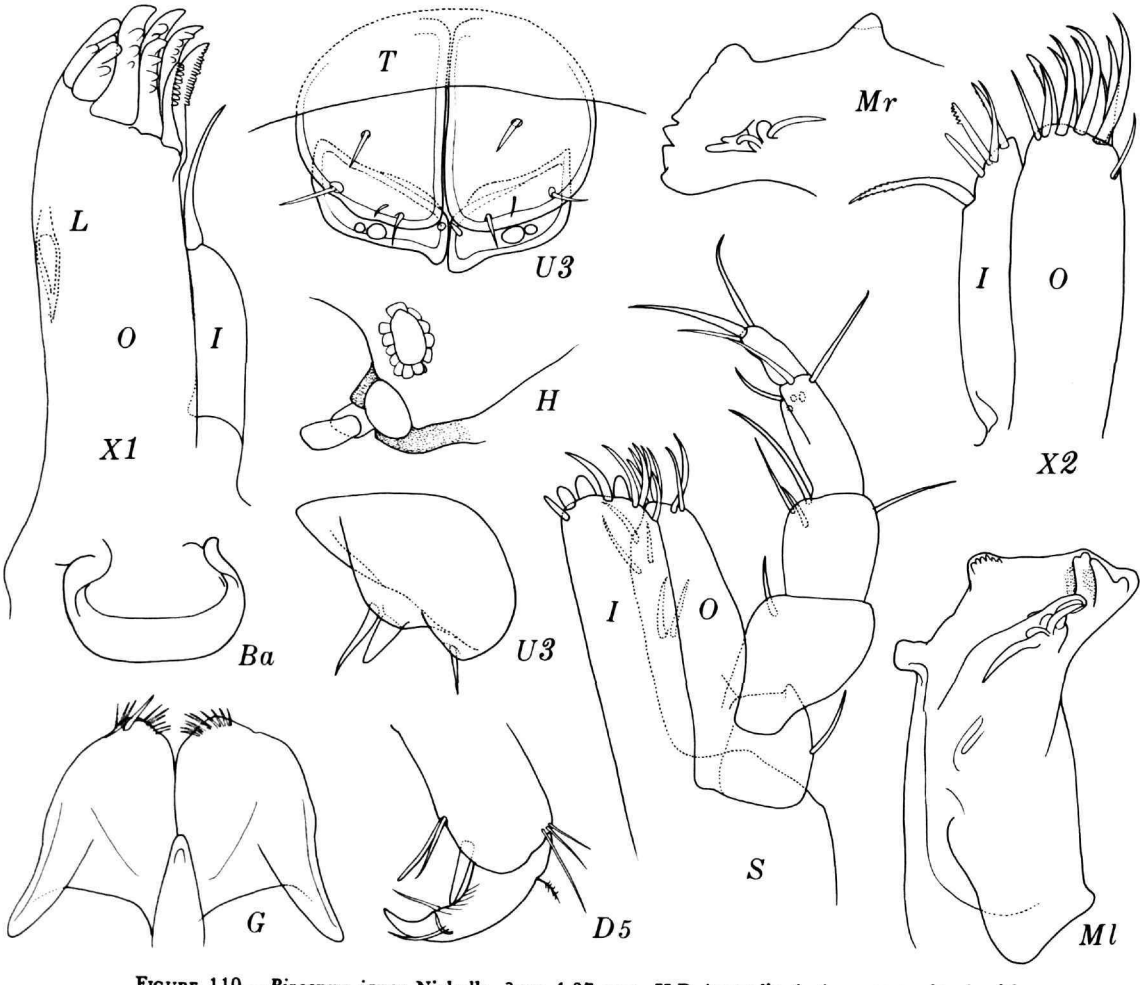


FIGURE 110.—*Bircenna ignea* Nicholls, ?sex, 1.37 mm, JLB Australia 4. (*cc*=pereonite 1 with ventral cradle.)

it is in the earlier literature. The consequence of these more stringent arrangements suggests a completely different biogeographic aspect than heretofore recognized. *Pontogeneia* is restricted to a few species in the high northern hemisphere; a partner genus, *Accedomoera* J. L. Barnard (1964a), has already been described in the high northern hemisphere. *Paramoera* has species in both northern and southern hemispheres, while new names are proposed for the species in the southern hemisphere that heretofore have been placed in *Pontogeneia*. One of these southern genera has representatives in low latitudes of the northern hemisphere.

The presence or absence of an accessory flagellum has no obligatory generic consequence in the group of genera being discussed since obvious pairs of siblings in two very different flocks of species may or may not have this appendage; therefore, *Paramoera* and *Pontogeneia* themselves are not distinguishable on this character alone, nor are *Pontogeneia* and *Accedomoera*. Other characters have now been found to be more significant.

A model (Figure 111) is presented to visualize relationships among pontogeneiid-calliopiid genera as previously known in the literature. These genera represent a group I call the pontogeneiids as defined stringently in Figure 111. Attributes of the lower lip, maxilla 1, maxilla 2, the accessory flagellum, and the telson are utilized in the model to distinguish among the 37 or more species groups. During the course of checking many of the species in each of the genera against the diagram, which is based on the type-species of each genus, I found anomalous species that seem to qualify as genera themselves.

The main sequence of the model is adjusted to the condition of maxilla 2: whether a well-developed oblique submarginal row of setae is present on the face of the inner plate (primitive?), or whether some modification occurs as in the upper parts of the figure. Only one seta may remain in the submarginal row in the first of the derived groups, while the remainder of the groups has no submarginal setae. In those, the inner margin may have setae evenly developed or have a few setae highly enlarged or have the setae crowded closely together toward the apex.

I am aware that the relationships among groups of species in this pontogeneiid-calliopiid section of the suborder are far more complicated than this simplification intends to show. There is undoubtedly no straight-line relationship as indicated by the progress of maxilla 2, and there are indications to be found in the literature that various pontogeneiids and calliopiids came independently from several basic stocks in the Gammaridae. My main purpose in this diagram is to show (1) how the Australian and Tethyan members of *Pontogeneia* stand apart from the type-species of *Pontogeneia*, (2) how far the description of two genera is justified in light of other known genera, and (3) how the characteristics of these genera, though minor, can be magnified in view of the known diversity of genera in this group.

Various genera in the complex of Eusiridae-Calliopiidae-Pontogeneiidae have been omitted from this scheme (check this list against J. L. Barnard, 1969a); they lie outside the model by the definition of Figure 111, but some of the positive characters they possess do not necessarily exclude them from a close relationship to foci inside this model. I have eliminated them for the sake of simplicity.

In the following abbreviated discussion many genera or incipient genera are not touched upon mainly because I am fairly certain that numerous species remain to be described and various species named in earlier times are very poorly known. Much redescription is required. Other complications include the relationships of such genera as *Paracalliope* Stebbing (see J. L. Barnard, in press), *Amphoediceros* Fearn-Wannan (1968), and *Metaleptamphopus* Chevreux (1912), which have the appearance of incipient oedicerotids. The first two genera have elongate pereopod 5 but cannot be placed in the Oedicerotodae because the peduncle of uropod 3 is not elongate; the third genus has the elongate peduncle of uropod 3 but does not have the elongate pereopod 5. Their status cannot be explored until some order has been restored to the pontogeneiid genera.

Taxonomists often arrange gammaridean amphipods according to the presence or absence of an attribute, and they usually consider that the loss of an attribute represents an evolutionary advance. Thus, I chose as a hypothetical ancestor in Figure 111 (R= primitive) a scheme in which all characters occurred in positive degree: lower lip bearing inner lobes, accessory flagellum present, telson bearing large terminal spine(s) on each lobe, inner plate of maxilla 2 bearing a well-developed submarginal oblique row of setae, and the inner plate of maxilla 1 fully setose along the inner edge. No known pontogeneiid has been found

with all of these positive attributes. Only one of the genera, *Paramoera*, elaborated from this ancestor, retains the large apical telsonic spines, and I have redefined this genus to include only species bearing those spines, thus rejecting some species and transferring several species of *Pontogeneia* into *Paramoera*. Since the presence or absence of an accessory flagellum has been disregarded and so many other characters are unknown for various species now included in *Paramoera*, further subdivisions may be necessary. *Paramoera* differs from the ancestor in the absence of inner lobes on the lower lip.

One now follows the left side of Figure 111 to see relationships among genera bearing inner lobes on the lower lip. These small fleshy lobes are often disregarded in amphipod taxonomy, though in Eusiridae, Pontogeneiidae, and Calliopiidae they have been widely used as generic characters. There is as yet no evidence for or against their value as phyletic indicators. By the criteria used here, some genera on the left of Figure 111 are congeners of those on the right if lower lips are disregarded. For instance, a *Pontogeneiella* without inner lobes would be shifted to the right into *Bovallia*. One may see that *Pontogeneia*, *Pontogeneiella*, *Prostebbingia*, and the freshwater Australian *Paramoera fontanus* are all closely similar to one another. *Prostebbingia* is unusual because antenna 1 is longer than 2, *P. fontanus* bears an accessory flagellum and setose telson, and *Pontogeneia* has reduced setae on the inner plate of maxilla 1. These are not strong generic characters.

The next step upward contains *Accedomoera*, a genus originally described as a partner of *Pontogeneia* but bearing an accessory flagellum. This is not now apparently so important a distinction as the fact that the submarginal setal row of the inner plate on maxilla 1 is reduced to 1 seta. Above this come genera with no submarginal setae on maxilla 2, but the inner margin is still fully setose. The freshwater Australia *Pseudomoera* has a setose telson, and *Atylopsis* has a poorly cleft telson. The final increment concerns *Pontogeneioides*, characterized by a poorly cleft telson and a concentration of the setae on the inner plate of maxilla 2 toward the distal end. To some extent, this anticipates the extreme condition in *Eusiroides*.

On the right side of Figure 111 are genera without inner lobes on the lower lip. Only *Bovallia* belongs in the primitive group with a fully developed submarginal setal row on maxilla 2 and non-elongate gnathopods. Above that are two enigmatic taxa, *Pseudopontogeneia* Oldevig, poorly described, and *Pontogeneia bartschi* Shoemaker, the latter possibly characterized by 1 submarginal seta on maxilla 2. *Pontogeneia bartschi* does not fit in the next group above because it combines double anthurial calceoli with a short rostrum and it would in any case be excludable by this oddity.

The next group above concerns the species with which I am most familiar and those involved in the present study. The inner plate of maxilla 2 has no submarginal setae but it does have 2, rarely 3 or 1, enlarged medial setae. In the context of other marine groups, this is a highly recognizable distinction. Furthermore, the species included in this group are divisible into two subgroups. The most characteristic (and most familiar to me) of these groups is the one I propose calling *Tethygeneia*, composed of species heretofore called *Pontogeneia*, but which have a long, somewhat linguiform rostrum and which bear fairly simple, swollen calceoli shaped somewhat like an anthurium. The

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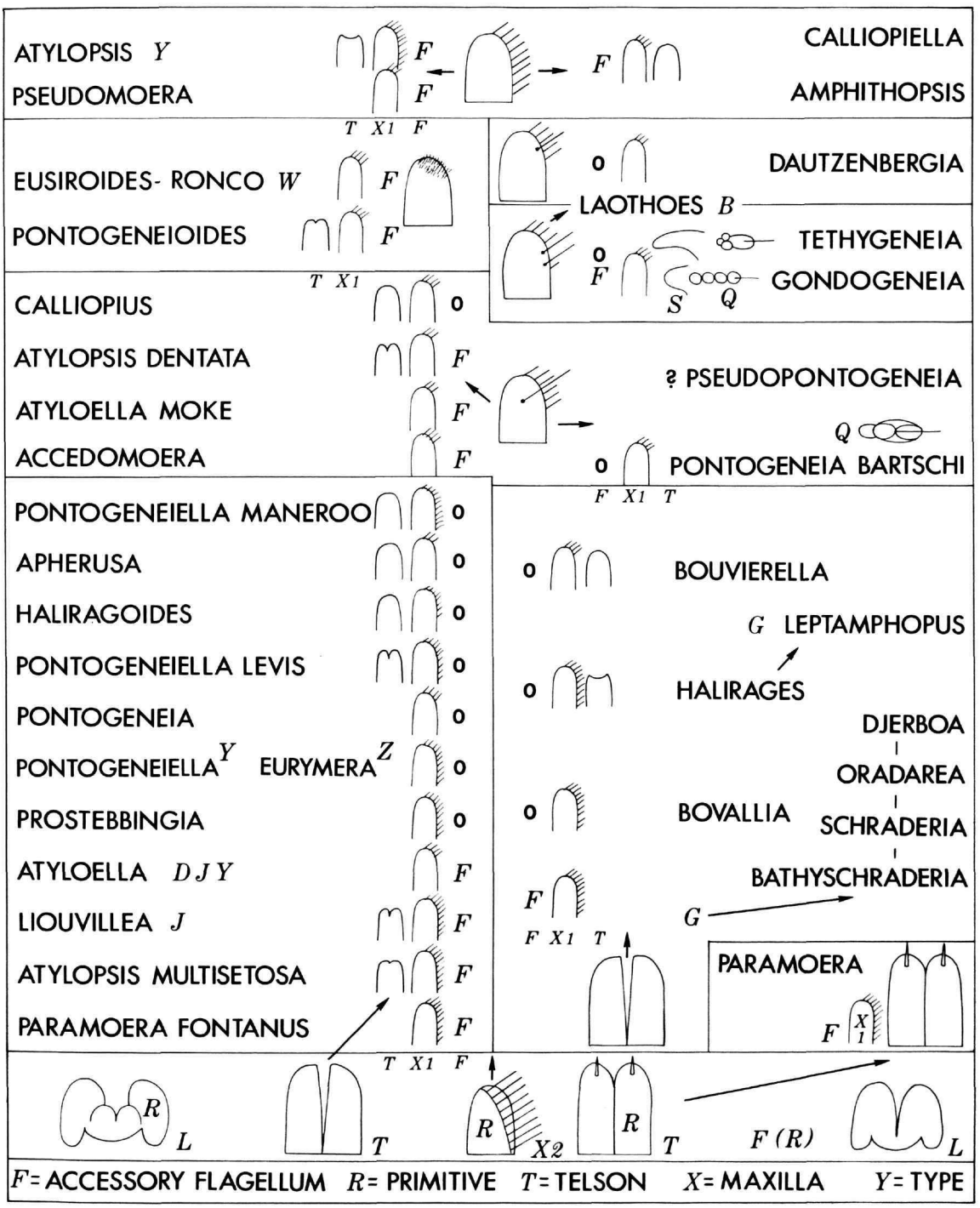
FIGURE 111.—Interrelationships of some genera related to *Pontogeneia* Boeck. Diagnosis below represents framework for elaboration of *Pontogeneia*, *Pontogeneiella*, *Paramoera*, *Accedomoera*, *Gondogeneia*, and *Tethygeneia* (exceptions in parentheses apply to symbols on figure, but the foregoing genera follow the diagnosis by ignoring the exceptions):

Body not umbonate (except *Z*), and laterally compressed, head not sharply attenuate at posteroventral corner (except *D*), epistome rounded (except *J*), accessory flagellum 1-articulate or absent (fused to peduncle), upper lip rounded below (except some species in *W*), mandibular molar triturative, outer lobes of lower lip not widely gaping, palp of maxilla 1 normal (except *B*), gnathopods not eusirid, articles 5-6 not elongate (except *G*), subchelate, lacking giant spines in tandem on palm (except *W*), pereopods not fossorial, 5 not highly elongate, articles 4-6 shorter than 1.5 times as long as article 2, peduncle of uropod 3 not elongate.

Diagnosis eliminates the following genera: *Amphoediceros* Fearn-Wannan, *Chosroes* Stebbing, *Cleippides* Boeck, *Harpinioides* Stebbing, *Metaleptamphopus* Chevreux, *Regalia* K. H. Barnard, *Sancho* Stebbing, *Stenopleura* Stebbing, *Stenopleuroides* Birstein and Vinogradov, *Cleonardo* Stebbing, *Cleonardopsis* K. H. Barnard, *Eusirella* Chevreux, *Eusirogenes* Stebbing, *Eusiropsis* Stebbing, *Eusirus* Kroyer, *Harcledo* J. L. Barnard, *Harpinioidella* Schellenberg, *Meteusiroides* Pirlot, *Paracalliope* Stebbing, *Pareusirogenes* Birstein and Vinogradov, *Rhachotropis* Smith, *Rozinante* Stebbing, *Zaramilla* Stebbing.

See J. L. Barnard (1958, 1969a) for authors of, and references to, names. (Other symbols: *L*=lower lip, *Q*=calceolus, *S*=rostrum.)


ATYLOPSIS Y
PSEUDOMOERA
CALLIOPIELLA
AMPHITHOPSIS
T X1 F
EUSIROIDES- RONCO W
PONTOGENEIOIDES
DAUTZENBERGIA
LAOTHOES B
TETHYGENEIA
GONDOGENEIA
T X1
CALLIOPIUS
ATYLOPSIS DENTATA
ATYLOELLA MOKE
ACCEDOMOERA
? PSEUDOPONTOGENEIA
PONTOGENEIA BARTSCHI
F X1 T
PONTOGENEIELLA MANEROO
APHERUSA
HALIRAGOIDES
PONTOGENEIELLA LEVIS
PONTOGENEIA
PONTOGENEIELLA Y EURYMERA Z
PROSTEBBINGIA
ATYLOELLA D J Y
LIOUVILLEA J
ATYLOPSIS MULTISETOSA
PARAMOERA FONTANUS
BOUVIERELLA
LEPTAMPHOPUS
HALIRAGES
DJERBOA
ORADAREA
BOVALLIA
SCHRADERIA
BATHYSCHRADERIA
F X1 T
PARAMOERA
F (R)
F= ACCESSORY FLAGELLUM R= PRIMITIVE T= TELSON X= MAXILLA Y= TYPE

other group is less tangible except for the fact that the rostrum is otherwise than in *Tethygeneia*; furthermore, some of the species are known to bear calceoli composed of 3 or 4 equal parts, somewhat like a series of shallow dishes. I propose the generic name *Gondogeneia* for these.

The name *Tethygeneia* implies a Tethyan distribution, the warm-temperate waters of both hemispheres, whereas *Gondogeneia* is apparently confined to southern waters.

There remain many enigmas in this proposed classification, as males of several species in *Tethygeneia* and *Gondogeneia* apparently do not develop calceoli; as a result, their recognition is based on rostra. Owing to undescribed characters, various species in the literature are not firmly assigned to the several genera. Possibly other species groups worthy of generic or subgeneric ranking lie undetected even within those I have examined. The identity of various species of *Paramoera* is so confounded presently that I cannot properly evaluate variables within that genus.

Brief diagnoses of *Paramoera, Pontogeneia, Pontogeneiella, Tethygeneia, Gondogeneia,* and *Accedomoera* are presented in the following sections; to these diagnoses one must add the characters of Figure 111. The remaining genera are left for observation in that figure, as no contribution to their taxonomy is made herein. Species of the genera are listed within each diagnosis, those with question marks being presently non-confirmable.

NOTE ON CALCEOLI.—These have not been studied with histological techniques, as such a study appears to be a long-term project of its own, requiring the assemblage of a wide variety of materials from this flock of genera. Three main kinds of calceoli are apparent in *Tethygeneia, Gondogeneia,* and *Pontogeneia bartschi,* members of which have been examined cursorily for this feature. The calceoli of *Gondogeneia* appear to be composed of 3 tympana (like radar reflectors) and a fourth anthurial or linguiform piece. In *Tethygeneia* the 3 tympana, if all are indeed present, are small and dominated by the terminal anthurial piece. In *Pontogeneia bartschi* at least 1 small basal tympanum seems to be present on some of the calceoli, but the dominant structure appears to be 1 large tympanum with a central setule, the tympanum on some calceoli appearing to be composed of 2 leaves, sometimes quadrate, opposite each other, but so melded as to appear as one.

### *Paramoera* Miers

*Paramoera* Miers.—J. L. Barnard 1969a:227.

Lower lip lacking inner lobes; telson cleft, bearing 1-2 large spines on each apex; maxilla 2 bearing strong submarginal oblique row of setae on inner plate; accessory flagellum present (or absent); setae on inner plate of maxilla 1 occupying most of medial margin; rostrum short and blunt.

LIST OF SPECIES.—Same as J. L. Barnard (1958) with following additions:

*brevirostrata* Bulycheva (1952), probable synonym of *P. japonica* (Tattersall)
*mokyevskii* (Gurjanova, 1952)
*carlottensis* (Bousfield, 1958)
*columbiana* (Bousfield, 1958)
*capensis* (Bousfield, 1958)

REJECTED SPECIES.—*fontanus* Sayce (1902a), genus unknown.

### *Pontogeneia* Boeck

*Pontogeneia* Boeck.—J. L. Barnard 1969a:228.

Lower lip bearing small inner lobes; telson cleft, lacking large spines on apices (though "spines" have indeed been reported for the type-species, *P. inermis,* by Oldevig, 1959); maxilla 2 bearing weakly submarginal oblique row of setae on inner plate; accessory flagellum absent; setae on inner plate of maxilla 1 confined mainly toward apex; rostrum short and blunt.

LIST OF SPECIES.—
*inermis* (Kroyer), type-species (Sars, 1895)
*?makarovi* Gurjanova (1951)
*?kondakovi* Gurjanova (1951)

REJECTED SPECIES.—All those now contained in *Tethygeneia* and *Gondogeneia. Pontogeneia chosroides* Nicholls (1938) probably should be relegated to a new genus.

### *Accedomoera* J. L. Barnard

*Accedomoera* J. L. Barnard, 1964a:59.

Lower lip bearing small inner lobes; telson cleft, lacking large spines on apices; maxilla 2 bearing weakly submarginal seta on inner plate, possibly representing vestige of ordinary row; accessory flagellum present; setae on inner plate of maxilla 1 confined mainly toward apex; rostrum short and blunt.

LIST OF SPECIES.—
*tricuspidata* (Gurjanova, 1951) type-species
*melanophthalma* (Gurjanova, 1951)
*vagor* J. L. Barnard (1969b)

REJECTED SPECIES.—*Accedomoera mokyevskii* (Gurjanova, 1952) is removed to *Paramoera*.

## *Pontogeneiella* Schellenberg

*Pontogeneiella* Schellenberg.—J. L. Barnard 1969a:228.

DIAGNOSIS (of type-species).—Lower lip with inner lobes; telson lacking large spines on apices; maxilla 2 bearing strong submarginal oblique row of setae on inner plate; accessory flagellum absent; setae on inner plate of maxilla 1 occupying most of medial margin; telson cleft (outer ramus of uropod 3 shorter than inner).

LIST OF NORMAL SPECIES.—
*brevicornis* (Chevreux, 1906), type-species
*longicornis* (Chevreux, 1906)

LIST OF ABNORMAL SPECIES.—Telson poorly cleft, outer ramus of uropod 3 as long as inner:
*levis* (Thomson) (see J. L. Barnard, in press)

Telson entire, outer ramus of uropod 3 short:
*maneroo*, new species

## *Pontogeneiella maneroo*, new species

FIGURES 112–114

DIAGNOSIS (including characters of generic value).—Rostrum of medium length, thick, but almost becoming acute apically; eye of medium size, composed of large ommatidia, with weak core of purple pigment; lateral cephalic lobe obtusely and softly rounded, defined below by rounded excavation, anteroventral corner of head rounded; antenna 1 about 60 percent length of body, antenna 2 only 85 percent as long as antenna 1, peduncles short, accessory flagellum absent but marked by setose bulge on inner margin of article 3 of peduncle on antenna 1, articles of flagella on either antenna even or nearly so, on middle of antenna 1 flagellum with alternate articles bearing 1 aesthetasc; epistome rounded in front, upper lip rounded below from anterior view; mandibular molar small but columnar and slightly cup shaped apically, heavily triturative, and each molar bearing medium ragged seta, left lacinia mobilis normal and serrate, right composed of 2 spines basally fused, 1 spine bearing weak cusp, right spine row with 2 main spines, left with 3 main spines; palp articles 2-3 subequal to each other in length, article 1 naked, article 2 bearing 1-2 setae, article 3 with 1 medium apical spine and 1 stout apical spine, inner edge with about 7 spines on distal half, 1 basofacial seta, article 3 scarcely falcate; lower lip with inner lobes clearly outlined but thin and tightly appressed to outer lobes, mandibular lobes unevenly rounded and smooth; inner plate of maxilla 1 fully lined on medial margin, with about 9 large setae and 1 giant apical seta, outer plate with 9 spines, some with very long serrations, palp 2-articulate, article 2 elongate, right apex with teeth, left with articulate spines; inner plate of maxilla 2 with strongly submarginal oblique row of about 6 setae, plus setae on medial margin; inner plate of maxilliped with 2 apicomedial spines, 1 simple, 1 plumose, then small lateral gap and another smooth spine, palp ordinary; coxae 1-4 ordinary, posterior lobes of coxae 5 and 6 weakly to strongly larger than anterior lobes; gnathopods small, first slightly larger than second, fifth articles with scarcely produced long flat posterior margins bearing heavy spines, hands 1.3 and 1.15 times as long as article 5 respectively on gnathopods 1-2, hands rectangular, palms ordinarily oblique, dactyls with about 3 recumbant serrations on inner edge, pereopods 1-2 slender, locking spines paired and bearing 4 other setae in group, locking spines on pereopods 1-2 hooked but straight or slightly curved on pereopods 3-5, dactyls of all pereopods similar, bearing large inner protrusion slightly thicker than nail, plus sharp seta proximal to protrusion and facial seta, plus about 5 accessory setules on outer marginal faces (3 outer, 2 inner on pereopods 1-2, reversed on pereopods 3-5); see Figure 113*P* for proportions of pereopods, not diagnostic as not highly distinct from other species in genus; uropods 1-2 reaching equally, and slightly surpassing, uropod 3; outer rami of uropods 1-3 shortened, uropod 3 with inner row of heavy spines on peduncle, outer ramus with about 3 dorsal spines, inner ramus with about 4 spines on inner edge, 2 on outer, no setae; telson linguiform, entire, slightly longer than peduncle of uropod 3, bearing setules dorsally, and slight apical trifoliation marked with 2 setules; no dorsal teeth; pleonal epimera 1-2 softly rounded behind but becoming flat near weakly produced posteroventral corners, epimeron 3 softly rounded behind, posteroventral corner bearing weak cusp, epimera 1-2 with lateral ridge, ventral margins with 1, 1, and 3 spines respectively. Female about 3.3 mm long.

MALE (about 2.2 mm long).—Like female, but gnathopods slightly larger and difference in size between gnathopods 1 and 2 slightly more exaggerated. Possibly terminal males not yet found.

FORMULA OF AESTHETASCS (on antenna 1 of female, no bulges, no calceoli).—1-1-1-0-1-0-1-0-1-0-1-0-1-0-1-0-1-0-1-0-1-0-(half-sized aesthetasc)-0-0-0-0-0-(terminus).

HATCHED JUVENILE.—Recognizable as this species by dactyls of pereopods, size approximately 0.80 mm long.

HOLOTYPE.—WAM, female, 3.4 mm.

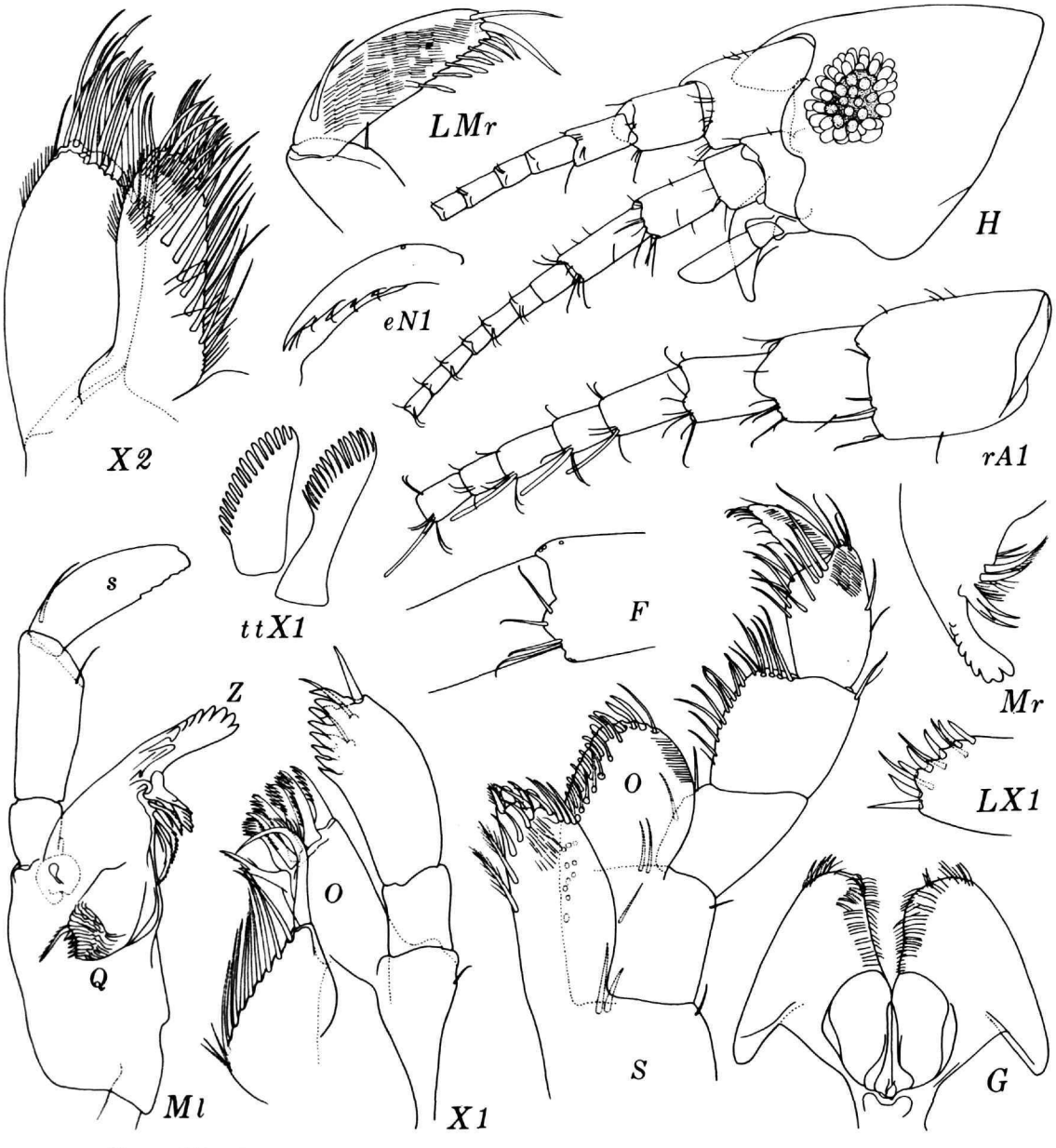



FIGURE 112.—*Pontogeneiella maneroo*, new species, holotype, female, 3.4 mm; *b*=female, 3.2 mm; *n*=male, 2.2 mm; all from JLB Australia 3.

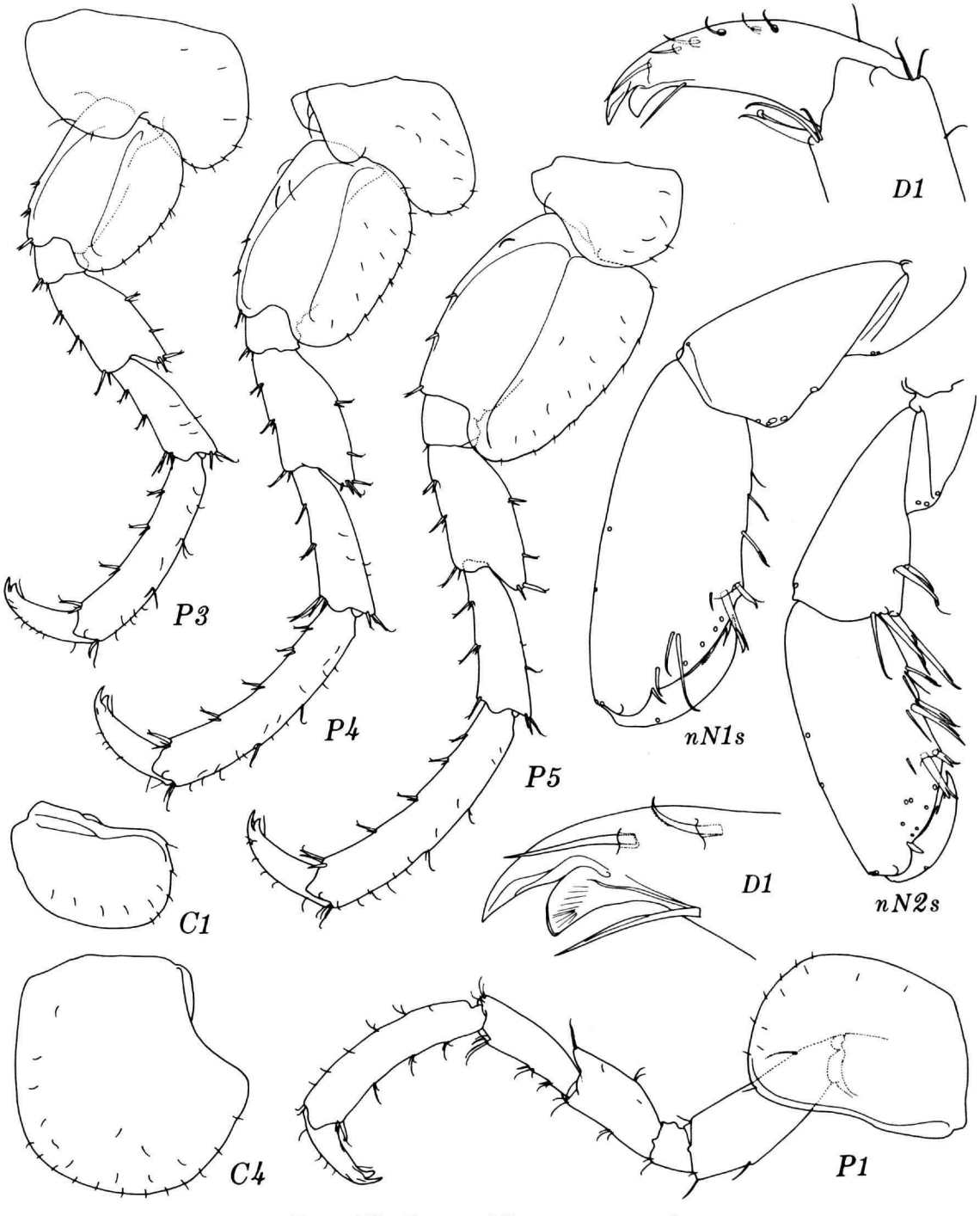



FIGURE 113.—*Pontogeneiella maneroo*, new species.

TYPE-LOCALITY.—JLB Australia 3, Sugarloaf Rock, Cape Naturaliste, Western Australia, intertidal, wash of common seaweeds, 1 September 1968.

REMARKS.—This species seems closest to the concept of *Pontogeneiella* of any genus named in Figure 111, mainly because of the condition of maxillae 1-2, the fused accessory flagellum, and the short outer ramus of uropod 3, and, except for the latter character it seems closest to *P. levis* (Thomson) (see J.L. Barnard, in press). But *P. maneroo* also has affinities with *Atylopsis* Stebbing in the telson and uropod 3, especially to *A. dentata* Stebbing (1888). *Pontogeneiella maneroo* differs from the generic concept of *Atylopsis*, however, in the absence of an accessory flagellum, in the fully developed submarginal row of setae in maxilla 2 (poor in *Atylopsis*, except *A. multisetosa* Schellenberg, 1926), and in the fully setose inner plate of maxilla 1 (also positive in *A. multisetosa*). According to the diagram of Figure 111, the three Antarctic species of *Atylopsis* all appear to be in different genera. *Pontogeneiella maneroo* is quite close to *Atylopsis multisetosa* Schellenberg (1926), but it lacks an accessory flagellum and has unequal rami on uropod 3.

*Pontogeneiella maneroo* differs from *P. levis* by the absence of posterior spines on coxae 1-2, the unpaired ventral spines on the epimera, the presence of only 1 basofacial seta on article 3 of the mandibular palp (6 in *P. levis*), the uncleft telson, the short outer ramus of uropod 3, the stouter rostrum, the larger and fewer ommatidia of the eyes, and the absence of an incision defining the lateral cephalic lobe. The pereopodal dactyls of *P. levis* are unknown.

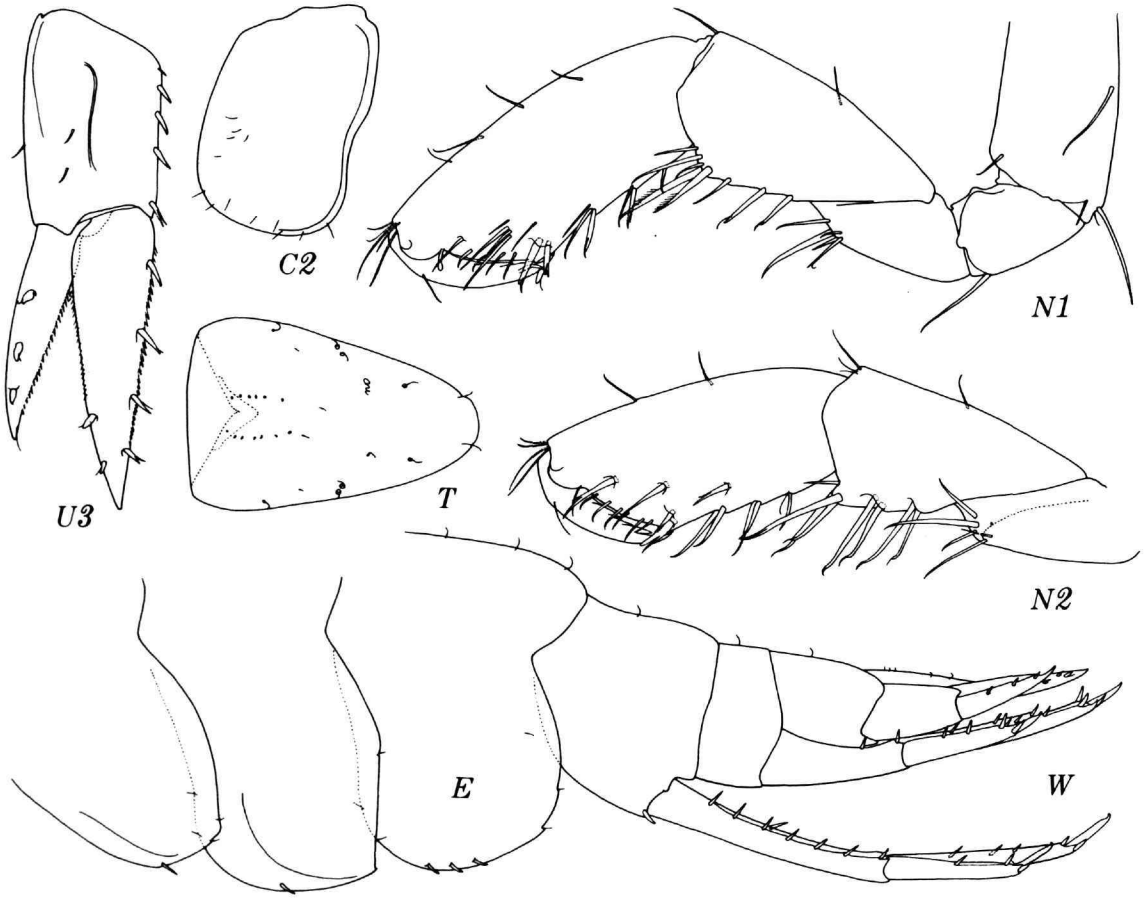



FIGURE 114.—*Pontogeneiella maneroo*, new species.

*Pontogeneiella maneroo* differs from *P. brevicornis* Chevreux (1906) in the absence of spines on coxa 2, the uncleft telson, the special pereopodal dactyls, and the absence of setae on the outer margin of palp article 2 on maxilla 1. From *P. longicornis* Chevreux (1906), *P. maneroo* differs in the uncleft telson and the special dactyls of the pereopods.

*Pontogeneiella maneroo* differs from *Pontogeneioides* Nicholls (1938), in the fact that the differently shaped inner lobes on the lower lip do not cause a gape and in the unincised telson, the fully setose inner plates of maxillae, the absence of an accessory flagellum, and the short outer ramus of uropod 3.

*Pontogeneiella maneroo* is very close to *Prostebbingia* Schellenberg (see *Stebbingia gracilis* of Chevreux, 1912), but antenna 1 of *P. maneroo* is shorter than antenna 2 and the telson is uncleft.

From *Liouvillea* (see Chevreux, 1912), *P. maneroo* differs in the unproduced epistome, the absence of an accessory flagellum, and the 1-articulate outer ramus of uropod 3 in the adult. The similar *Atyloella* Schellenberg (see *Atylopsis magellanica* Stebbing, 1888) has a poorly setose inner plate of maxilla 1, an accessory flagellum (fide Schellenberg, 1929), an attenuate anteroventral cephalic corner, and a cleft telson. *Atyloella moke* J. L. Barnard (in press) from New Zealand, however, is closer to *P. maneroo* in the head, but also it has a cleft telson, a flabellate lacinia mobilis on the right mandible, a long accessory flagellum, a single giant seta on the inner plate of maxilla 2, a tooth on article 4 of gnathopods 1-2, a slightly enlarged gnathopod 2, only 2 setae on a truncate apex of maxilla 1, and only vestigial ragged setae on the mandibular molars. The right lacinia mobilis of *A. moke* suggests it lies in a species group distinct from *A. magellanica*, the type-species.

*Pontogeneiella maneroo* is very close to the generic concept of *Calliopius* Liljeborg, but it differs in the relatively slender hands of the gnathopods and in the full setosity of maxillae 1-2. *Apherusa* Walker is another taxon close to *P. maneroo*, but it has a short uropod 2 and lacks a fully setose maxilla 1. *Halirages* Boeck has a short uropod 2 and lacks inner lobes on the lower lip. *Haliragoides* Sars has short uropods 1-2 and a complexly notched telson.

*Pontogeneiella maneroo* thus confounds the generic classification in this group of eusirid-pontogeneiid-calliopiids, but *P. levis*, *Atyloella moke*, *Atylopsis dentata*, *A. multisetosa*, *Paramoera fontanus*, and *Pontogeneia bartschi* also apparently lack generic homes.

MATERIAL.—Slack-Smith 2 (18); JLB Australia 3 (21), 14 (19); Shepherd 31 (1).

DISTRIBUTION.—Southwestern Australia and South Australia, intertidal.

## *Gondogeneia*, new genus

TYPE-SPECIES.—*Atylus microdeuteropus* Haswell (1880a).

DIAGNOSIS.—Lower lip lacking inner lobes; telson cleft, lacking large spines on apices; maxilla 2 bearing no submarginal setae but typically bearing 2-3 enlarged mediomarginal setae on inner plate plus occasional small setae between them; accessory flagellum present or absent, usually article 3 of peduncle on antenna 1 bearing lump indicating fused accessory flagellum; setae on inner plate of maxilla 1 confined mainly toward apex; rostrum short and blunt.

ADDITIONAL CHARACTER (not known for many genera in this complex and not necessarily occurring in all species of *Gondogeneia*).—Males bearing complex calceoli composed of 3 or 4 saucers in tandem.

Some species of this genus have gnathopod 1 significantly enlarged.

LIST OF SPECIES.—

*microdeuteropa* (Haswell, 1880a), type-species
*danai* (Thomson) (see J. L. Barnard, in press)
species (part of *P. danai* identified by J. L. Barnard, in press)
*rotorua* (J. L. Barnard, in press)
*antarctica* (Chevreux, 1906)
*simplex* (Dana, 1853)
*subantarctica* (Stephensen, 1938)
*bidentata* (Stephensen, 1927)
*tasmaniae* (Thomson, 1893)
?*georgiana* (Pfeffer, 1888)
?*gracilicauda* (Schellenberg, 1931)
?*macrodon* (Schellenberg, 1931)
?*ushuaiae* (Schellenberg, 1931)
?*tristanensis* (K. H. Barnard, 1932)

A key to the species of *Gondogeneia* and *Tethygeneia* follows the description of the latter new genus.

## *Gondogeneia microdeuteropa* (Haswell)

FIGURES 115–117

*Atylus microdeuteropus* Haswell, 1880a:102, pl. 6: fig. 3; 1882:244.

NOMENCLATURE.—This species is definitely not *Atylus austrinus* Bate (1862), as that species has very differently shaped gnathopods, including a transverse

palm on gnathopod 1 and an elongate, rather slender hand on gnathopod 2, with gnathopod 2 being longer than 1.

Though it bears a superficial resemblance to *Atyloides australis* (Miers) of Stebbing (1888), there are numerous differences, one of them at least of generic magnitude: the strong apical spine and incision on each lobe of the telson. One can only presume that Stebbing has correctly identified Miers' (1875) *Paramoera australis* and the species at hand is definitely not Miers' species because the epimera are not serrate.

This species differs from *Atylus danai* [=*dania*] Thomson (1879) in the absence of a notch and spine on the posteroventral rounded margin of epimeron 3, in the short article 2 of the mandibular palp bearing many setae in the main setal group, and in the presence of a spine on article 1 of the mandibular palp.

*Atylus simplex* Dana (1853) from Hermit Island, Cape Horn, has been a receptacle for many species, but its status remains unclear; the only clue to its distinction appears to be the sharp corners of article 2 on pereopods 3-5, and, though this may be an artifact, Dana's drawings often are fairly accurate on those pereopods (for instance, they are apparently diagnostic in *Parelasmopus*).

By these eliminations, the earliest name available for the Australian member of the *Pontogeneia simplex* group appears to be *Atylus microdeuteropus* Haswell.

ORIGINAL MATERIAL OF THIS SPECIES.—*Atylus microdeuteropus,* Port Jackson, New South Wales, Australian Museum, Catalog P 3444 (registered in 1912), 30 specimens. Ten specimens of this lot were borrowed from the Australian Museum, courtesy of Miss Elizabeth C Pope. No specimens labeled as types are extant; presumably, these specimens were identified by Haswell. One of the ten specimens is a species of *Hyale*,

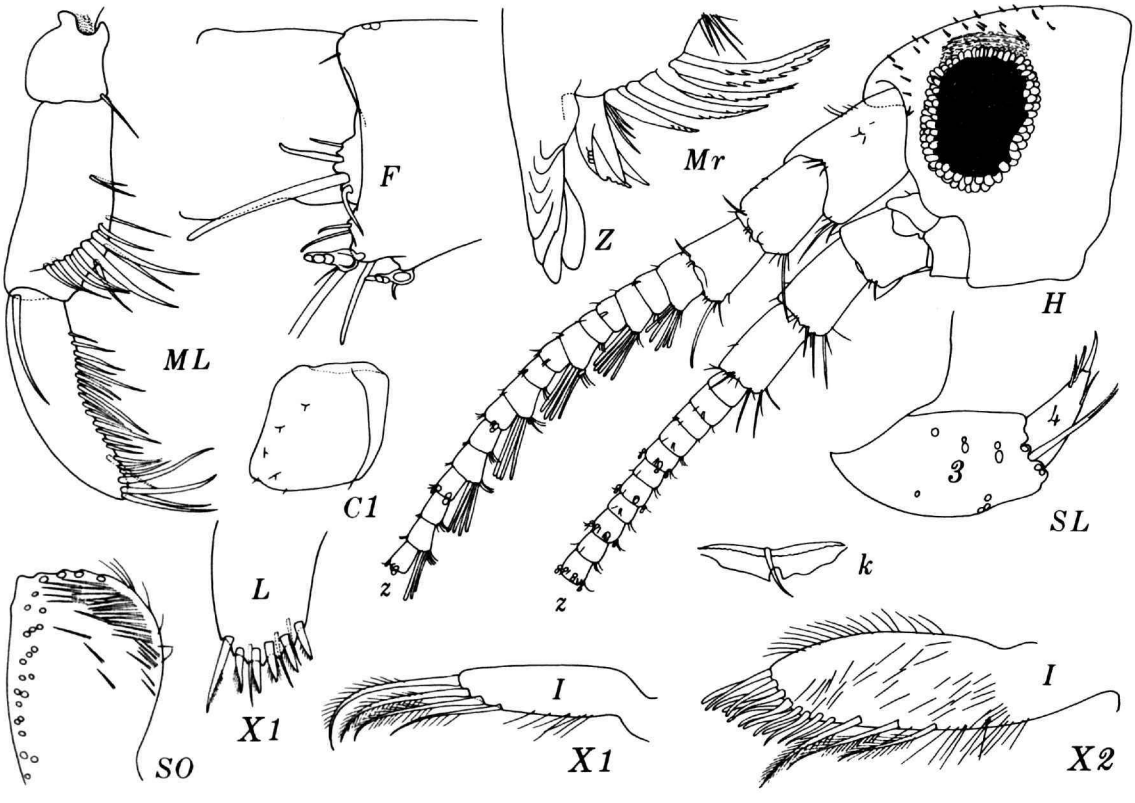



FIGURE 115.—*Gondogeneia microdeuteropa* (Haswell), male, 3.6 mm, JLB Australia 4; *n*= male, 3.7 mm, JLB Australia 4; *w*=female, 3.8 mm, Merimbula A.

but the other nine correspond to the identification of *A. microdeuteropus* made from fresh specimens and presented in the figures and description herein. Only a few apices of pereopods are present on the nine specimens, and only one pair of antennae is present. One young male, 3.7 mm long, and one ovigerous female, 5.3 mm, were studied intensively and compared with fresh specimens. Agreement is good on generalities and most minor points or most highly microscopic points.

The following troublesome points are listed: No calceolus has been clearly observed, as the only male

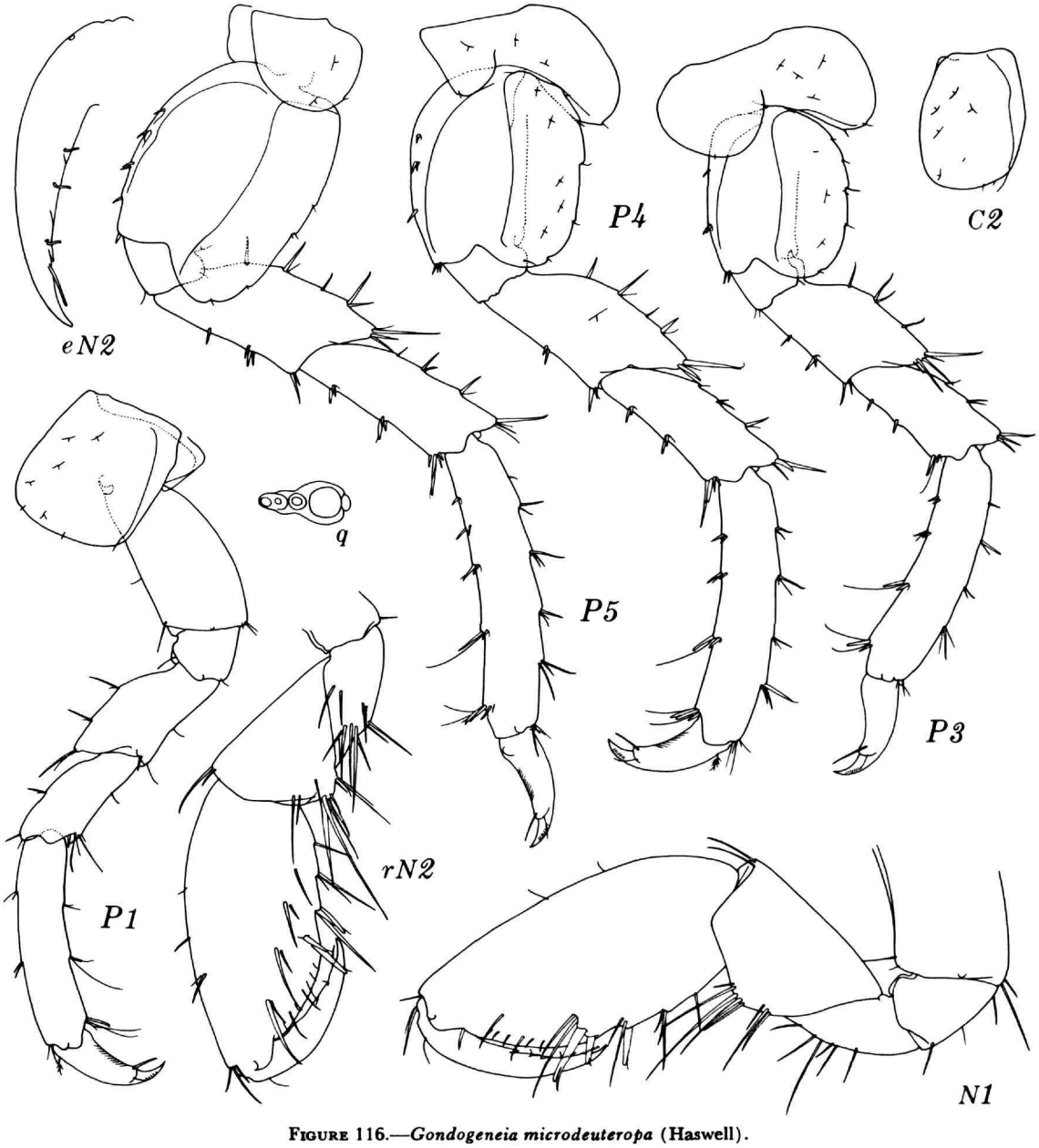



FIGURE 116.—*Gondogeneia microdeuteropa* (Haswell).

with antennae is very young. This male bears only 1 extant calceolus on article 3 of the peduncle of antenna 1, and that calceolus cannot be well resolved. The locking spines on pereopods 1-2 of the male are scarcely striate and scarcely hooked, but the female has typical locking spines, hooked on pereopods 1-2 and straight on pereopods 3-5. Two or 3 ridge-slits have definitely been found on the female (pereopods 3-5), but they appear rarer than in the fresh material. The outer ramus of unropod 1 has 1 dorsal spine on both male and female. The distal protrusion on the pereopodal dactyls is weaker than in fresh material.

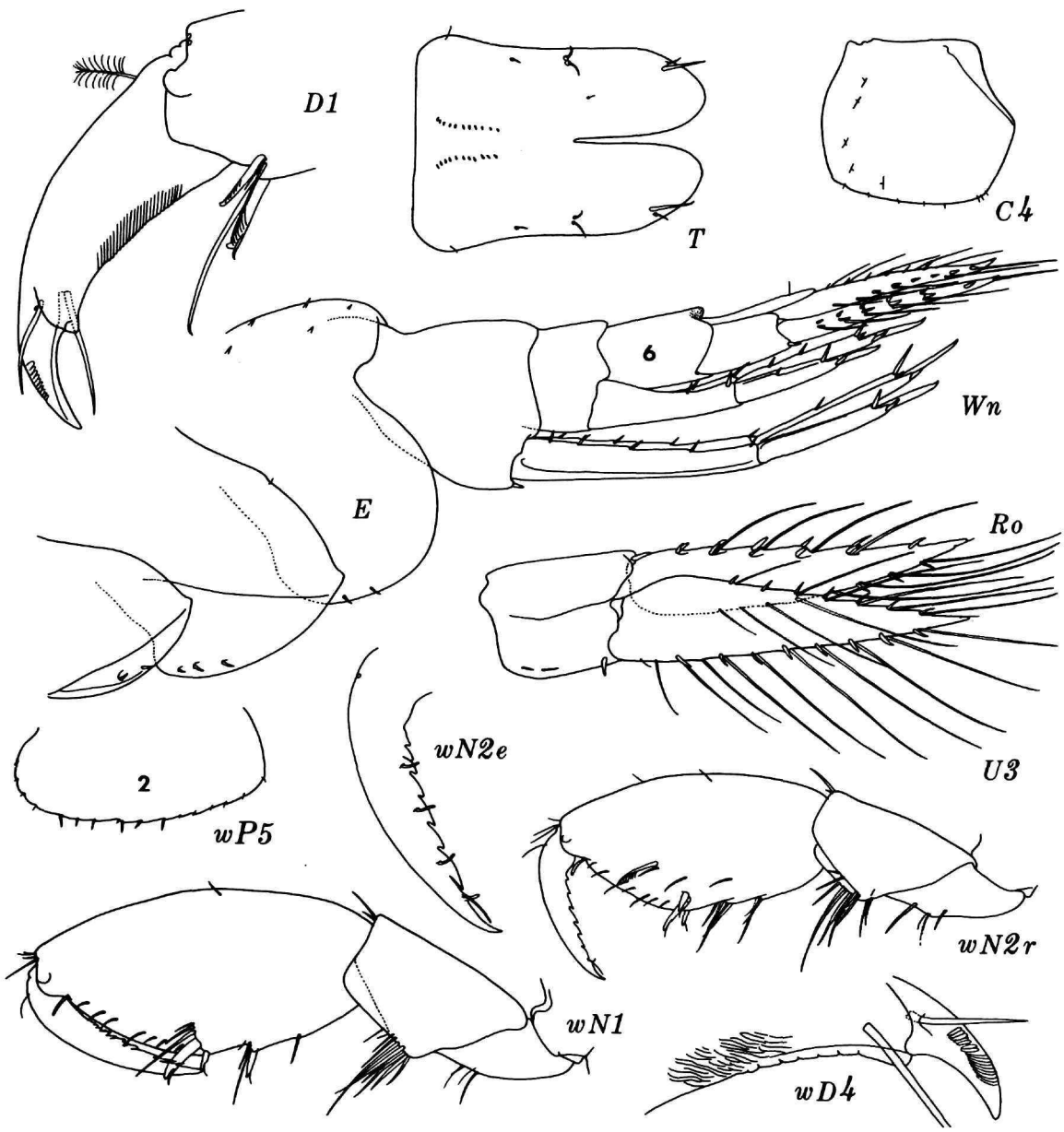



FIGURE 117.—*Gondogeneia microdeuteropa* (Haswell).

There is good agreement in the Haswell material on head, rostrum, eyes, gnathopods, epimera, mouthparts, uropods, and telson (the latter somewhat narrow and basomedial denticles not resolved), with the result that I am reasonably certain these specimens and the fresh material from Merimbula are conspecific. No lectotype has been selected, as the material is not specifically cited from Clark Island.

DESCRIPTION (of female, Merimbula, New South Wales, eastern Australia).—Rostrum thick, short, rounded apically, lateral cephalic lobe not distinct from dorsal part of head but marked below by strong quadrate invagination, anteroventral corner quadrate; antenna 2 half as long as body, antenna 1 about two-thirds as long as antenna 2; eye large, purple core surrounded by 2-3 layers of clear ommatidia in alcohol; flagellum of antenna 1 about twice as long as peduncle, but flagellum of antenna 2 about 2.6 times as long as peduncle of antenna 2, flagellum of antenna 1 alternately thick and thin in middle of flagellum, with every fourth article thickened and bulging and bearing 3-5 aesthestascs, calceoli present on various articles including articles 2-3 of peduncle, calceoli of the 4-saucer kind; articles of flagellum on antenna 2 even but bearing calceoli; accessory flagellum very short and broad, articulate, bearing 1 very long seta and 3 short ones; mandibular molars triturative, each with long ragged seta, spine row on right with about 6-7 weakly ragged spines, fuzz otherwise sparse, left with 7 spines, left lacinia mobilis ordinarily serrate, right composed of 2 basally fused spines with weak cusp (instead of membrane); mandibular palp article 3 weakly falcate and about 1.15 times as long as article 2 (which is therefore short), article 1 bearing spine, article 2 with broadly spread group of about 7 spines in row plus 3 marginals and another proximo-submarginal spine (1 each face), article 3 with 1 basofacial spine, 2 apical spines, but next 2 spines equal to each other in length and scarcely longer than apicals, then about 13-16 uneven spines on margin; lower lip lacking inner lobes, mandibular lobes subtruncate and apically smooth; inner plate of maxilla 1 bearing 4 setae, apicalmost not abnormally enlarged; inner plate of maxilla 2 apically and subapically fringed with small setae, midmedial margin with 3 enlarged setae in tandem; inner plate of maxilliped with apicolateral spine separated from 2 medioapical spines by gap and hollow (slightly less exaggerated than in figure of *T. elanora*), article 2 of maxillipedal palp not especially broad, outer plate with facial setules irregularly arranged but mostly in 1 lateral row, article 3 of palp without protuberance seen in *T. elanora* group of species; coxae 1-3 lacking posterior setules, coxa 4 very broad and short, posterodorsal excavation weak, corner softly rounded; article 2 of gnathopods 1-2 scarcely setose posteroventrally, gnathopod 1 much larger than gnathopod 2, hands of gnathopods ovatorectangular, palms oblique-convex, article 5 approximately 60 percent as long as article 6, triangular, but in elongate fashion and with weak posterior lobe, dactyls deeply serrate; locking spines of pereopods 1-5 composed of 2 stout spines with weak corkscrew striations and hooked tips, plus other thin setae and setules accompanying spines, dactyls bearing weak facial striations on mid-inner margin plus weak-to-medium castelloserrations on edge, dactyl with distal bulge marking insertion of main large sharp seta, then nail constricted, facial seta also present and nail with scallop-striations along outer margin of face; coxae 5-6 fairly shallow compared with *T. elanora* group, lobes on coxa 5 subequal, but posterior lobe of coxa 6 long and linguiform; article 2 of pereopods 3-4 relatively short and broad compared with remaining length of appendage, evenly ovate, each bearing posteriorly about 10-12 notches armed unevenly with stout short spinule, seta, or setule, article 2 on pereopod 5 more elongate and bearing about 17 posterior notches with various-sized spine-setae, anterofacial spines on article 2 of pereopods 3-5 poorly developed and medial setae absent; pleonal epimera 1-2 each with small soft posteroventral tooth and 2-3 ventrofacial spines in tandem, epimeron 3 broadly and evenly rounded posteroventrally, with 2 spines in tandem on ventral margin; no dorsal teeth; pleonite 6 with denticle row; uropod 3 with stout spine on peduncle at mediodorsal corner, another at lateroventral corner, plus 3 more smaller medial spinules in tandem, outer ramus with pairs of spines along outer margin; telson flat, cleft slightly less than halfway, bearing pair of medium-sized spine setae on apicolateral margin of each lobe plus other setules more proximally (see Figure 117*T*), apices rounded, smooth; cuticle bearing sparse pit-ridges especially on dorsal margin of urosome.

MALE (Merimbula).—Very similar to female, but outer ramus of uropod 1 bearing 1 dorsal spine, while ramus in female bearing 2 dorsal spines; main seta of accessory flagellum much smaller than in female; spinules on medial margin of peduncle somewhat bet-

ter developed than in female; number and size of armaments on posterior margin of article 2 on pereopods 3-5 similar to western form described below.

EXAMPLES OF FORMULAE FOR CALCEOLI (ventral=V, middle=M, dorsal=D, bulges=B, aesthetascs=numbers on antennae given below).—Female (Merimbula): Antenna 1, right side from medial aspect, article 2 of peduncle with 3 calceoli in tandem, article 3 with 2 pairs; flagellum formula: 5B:0VMD:0:4B:0VMD:0:0VMMD:5BV:0MMD:0:0VMMD:3BV:0MD:0:0VMMD:3BV:0MD:0:0VMD:4BV:0MD:0:BV:0D:0:0 (terminus). Antenna 2, right medial: V:V:V:VMMD:V:VMMD:V:VMMMD:VMMD:V:VMMD:V:VMMD:VMMD:V:VMMD:V:VMMD:VMMD:0:VMMD:0: VMMD:0:VMMD:0:VMMD:VMD:0:V:0:0:0:0:0:0:0:0(terminus).

Male (Merimbula, young), antenna 1, right medial, calceoli absent on peduncle: 5B:0:6B:0:0:5B:0D:0:5B:0:0:4B:0:0:3B:0:0:5B:0:4B:0:0:3B:0:0:0:0 (terminus). Antenna 1, left medial (calceoli absent on peduncle): 6B:0:4B:0:0:5B:0:0:5B:0:0:5B:0:5B:0:5B:0:(tiny B):B:0 (terminus). Antenna 2, left medial: 0:0:D:0:0:VD:0:0:0 (and 23 more zeros (terminus)).

MATERIAL FROM WESTERN AUSTRALIA.—Pit ridges better developed and especially apparent on head and more frequent on coxae and article 2 of pereopods 3-5 than in eastern material (Merimbula); only 2 narrow articles between each bulged article on flagellum of antenna 1 (instead of 3 as in eastern material); right lacinia mobilis with extended serrate membrane (instead of small cusp); fifth articles of gnathopods slightly less elongate, posterior lobes more even and less skewed toward proximal end of appendage; dactyls of gnathopods very weakly serrate; dactyls of pereopods less strongly castellate; posterior margins of article 2 on pereopods 3-5 with much fewer serrations, about 3-5 instead of 10-17, generally only one of pereopods 3-5 with spine, others with smaller setae; outer ramus of uropod 1 lacking dorsal spine; medial armaments of uropod 3 peduncle much weaker, spines thus thinner and fewer; distalmost armaments on telson much stronger than in eastern specimens; spine on article 3 of pereopods 3-5 much better developed than in eastern specimens.

Adults between 3.3 and 3.7 mm in length from both eastern and western sides have been compared in these analyses, but females from the western side are unknown and fully terminal males from the eastern side are unknown.

EXAMPLES OF FORMULAE FOR CALCEOLI, BULGES, AND AESTHETASCS ON ANTENNAE OF A MALE (Western Australia).—Peduncular article 2 of antenna 1 with 1-2 calceoli, article 3 with 2 calceoli. Right antenna 1 medial, flagellum: (3-7B):0:6BV:0MD:0:7BV:0MD:0:2BV:0:0:0BV:0VD:0:3BV:0VD:0V:0BV:0:0:0(terminus). Left antenna 1 medial, flagellum: 8B:0:7B:0MD:0:7BV:0MD:0:5BV:0VMD:0:5BV:0VMD:0:3BV:0VD:0V:2BV:0V:0:0:0 (terminus). Antenna 2, right medial, flagellum, no aesthetascs: 0:V:VMMD:V:V:VMMD:V:VMMD:V:VMMD:V:VMMD:V:VMMD:V:VMMD:V:VMMD:V:VMD:0:0:0:0:0:0:0 (terminus). Left medial: 0:V:V:V:VMMD:V:VMMD:V:VMMD:V:VMMD:V:VMMD:V:VMD:V:VMD:V:VD:0:0:0:0:0:0:0: (terminus).

DISCUSSION.—Though I can find more distinctions between the eastern and western specimens of *G. microdeuteropa* than I can between *G. danai* from New Zealand and *G. microdeuteropa* from Australia, these distinctions between eastern and western materials seem to be more of a quantitative than of a qualitative character. My material from Australia is actually sparse, as it occurs in only two samples over two thousand miles apart, emphasizing that the species has scarcely been explored morphologically yet. The small differences that can now be demonstrated between *G. danai* and *G. microdeuteropa,* plus differences that can be vaguely detected in the literature of other species in the *G. simplex* conglomerate, suggest that Schellenberg (1931) may have unjustly lumped together a variety of taxa in the southern hemisphere, though he did rightly recognize the strong similarities of these taxa. There is little sense in trying to unravel the problem until specimens from each of the many prominent locales in the southern hemisphere can be examined in detail together.

The distinctions of this species from *G. antarctica* (Chevreux, 1906) are difficult to determine, as several characters of possible value have not been stated for that species, though Chevreux's description is among the best of any Antarctic species in the genus. The long article 2 of the mandibular palp in *G. antarctica* is a clue to the probable distinction of the species. The following attributes are unknown in *G. antarctica*: dactyls of the pereopods, locking spines of pereopods 1-2, spines on the epimera and uropod 3,

antennal calceoli, basofacial seta on article 3 of the mandibular palp, spine on article 1 of mandibular palp (apparently absent in *G. antarctica*), and cuticle.

*Gondogeneia microdeuteropa* differs from *G. subantarctica* (Stephensen) (see his *P. antarctica* of 1927) in the deeper anteroventral excavation on the head and the equality of gnathopodal size in both sexes, but attributes such as the mandibular palp and the gnathopodal dactyls are undescribed in *G. subantarctica*. The western Australian members of *G. microdeuteropa* especially resemble *G. subantarctica* in the few serrations and setules on the posterior margins of article 2 on pereopods 3-5.

*Atyloides tasmaniae* Thomson (1893) appears to belong to *Gondogeneia* by virtue of its short rostrum, its lack of an accessory flagellum, the shape of the maxillipedal palp, and the setation on maxillae 1-2, but the inner lobes of the lower lip are not known. *Gondogeneia tasmaniae* differs from *G. microdeuteropa* in the heavier setosity of article 1 on the mandibular palp, the narrower article 3 of the mandibular palp, the narrower and shorter article 6 of gnathopod 1, and the heavier setosity of the gnathopods.

I have compared this species minutely with specimens of *G. danai* (Thomson) (see J. L. Barnard, in press), as there are several items I did not describe for *G. danai* that represent good distinctions. *Gondogeneia danai* differs from *G. microdeuteropa* especially in the presence of a notch armed with a spine at the posteroventral position on epimeron 3 (though this is absent in the small juveniles of *G. danai*); no spine is present on article 1 of the mandibular palp; article 2 is elongate, bears about 4 apicofacial setae tightly grouped and about 4 slender setae in tandem on the medial margin; article 3 is strongly falcate, has 1 basofacial seta and, otherwise, the armament is like *G. microdeuteropa*; uropod 3 does not differ from that of *G. microdeuteropa* because spines on the outer ramus occur as doublets, rarely triplets; pit-ridges are very scarce; the dactyls of the gnathopods are smooth, even smoother than those of the western population of *G. microdeuteropa;* the spine seen on article 3 of pereopods 3-5 in *G. microdeuteropa* is very thin and feeble in *G. danai*; a juvenile of *G. danai* has a biarticulate outer ramus of uropod 3, has 2 single spines in tandem on the outer margin of the outer ramus, the accessory flagellum is somewhat barrel shaped, the inner plate of maxilla 1 has 3 setae, the inner plate of maxilla 2 has only 2 setae, and all of the epimera are rounded and lack spines.

The condition of the accessory flagellum in the 2.4 mm male of Figure 42 in J. L. Barnard (in press) suggests that it represents a species distinct from *G. danai*, though at the time I studied the problem I considered it as a phenotypic condition; however, the plethora of cryptic species found in the *T. elanora* complex presented herein suggests that the New Zealand material requires further study on this point. When I reexamined it recently, I also found a third species in the *G. danai* material characterized by a small tooth on epimeron 3, but only juveniles were present and it could not be elucidated.

*Gondogeneia rotorua* (J. L. Barnard, in press, from New Zealand) has also been reexamined because it is even closer to *G. microdeuteropa* in epimeron 3 than is *G. danai*. The New Zealand species has 2 spines on the outer ramus of uropod 1 in adults, 1 spine on the outer ramus of uropod 2, doublets of spines on the outer margin of the outer ramus of uropod 3, it bears pit-ridges very scarcely, has slightly developed posterior spines on article 2 of pereopods 3-5 and a well-developed spine on article 3 of pereopods 3-5, but it differs from *G. microdeuteropa* in the elongate article 2 of the mandibular palp, the absence of a spine on article 1 of the palp, a weakness of the main distal spine-seta group on the telson (even compared with the eastern Australian section of *G. microdeuteropa*), the cusp on the inner plate of maxilla 1, the presence of only 2 setae on that plate, and the distinction between the sizes of gnathopods in males and females.

MATERIAL.—Merimbula A (100+); Merimbula B (100+); JLB Australia 4 (3), 6 (2), 13 (1).

DISTRIBUTION.—Warm-temperate Australia, intertidal.

### *Tethygeneia*, new genus

TYPE-SPECIES.—*Tethygeneia waminda*, new species.

DIAGNOSIS.—Lower lip lacking inner lobes; telson cleft, lacking large spines on apices; maxilla 2 bearing no submarginal setae but typically bearing 2 enlarged mediomarginal setae on inner plate plus occasional small setae between them (atypically bearing full row of regular setae; cf. *T. rostrata* (Gurjanova)); accessory flagellum present or absent, usually article 3 of peduncle on antenna 1 bearing lump indicating fused accessory flagellum; setae on inner plate of maxilla 1

confined mainly toward apex; rostrum long and linguiform.

ADDITIONAL CHARACTER (not known for many genera in this complex, and not necessarily occurring in all species of *Tethygeneia*).—Males bearing anthurial calceoli on antennae 1-2.

LIST OF SPECIES.—
*waminda*, new species, type-species
*elanora*, new species
*nalgo*, new species
*tulkara*, new species
*megalophthalma* (Haswell), see herein
*longleyi* (Shoemaker, 1933)
*minuta* (Chevreux, 1908)
*minuta* of (J. L. Barnard, 1959)
*nasa* (J. L. Barnård, 1969c)
*quinsana* (J. L. Barnard, 1964b)
*pacifica* (Schellenberg, 1938)
?*rostrata* (Gurjanova, 1951), but maxilla 2 aberrant
?*intermedia* (Gurjanova, 1938, 1951)
?*ivanovi* (Gurjanova, 1951)
?*andrijaschovi* (Gurjanova, 1951)
?*arenaria* (Bulycheva, 1952), but telson and maxilla 2 aberrant

## Key to Species of *Gondogeneia* and *Tethygeneia* from Australia

1. Pereopods 1-2 with pair of stout locking spines ..... 2
   Pereopods 1-2 with setae in place of locking spines ..... 3
2. Gnathopod 1 larger than 2, cuticle with pit-crescents (epimera), pereopodal dactyls with striations and castelliform slits, uropod 3 with stout spine(s) on peduncle, rostrum short and blunt ..... ***G. microdeuteropa***
   Gnathopod 1 not larger than 2, cuticle lacking crescents, pereopodal dactyls with smooth inner edge, uropod 3 lacking stout spine on peduncle, rostrum long, linguiform ..... ***T. tulkara***
3. Accessory flagellum longer than broad, uropod 3 with 1 or more stout spines on peduncle, epimeron 2 with facial spines in adults, pereopod 5 with stout spines posterior to anterofacial ridge in adults (cuticle with pit-crescents) ..... ***T. waminda***
   Accessory flagellum very short or absent, broader than long, uropod 3 lacking stout spines on peduncle, epimeron 2 lacking facial spines in adults, pereopod 5 with no spines on article 2 posterior to anterofacial ridge (cuticle variable) ..... 4
4. Accessory flagellum completely fused to article 3 of peduncle, hands of gnathopods in adults with stout spines on posterior margins (cuticle with pit-crescents) ..... ***T. megalophthalma***
   Accessory flagellum articulate, gnathopods in adults lacking stout posterior spines (cuticle variable) ..... 5
5. Cuticle lacking pit-crescents, dactyls of pereopods 3-5 lacking pectinations but minutely castelliform in terminal adults ..... ***T. elanora***
   Cuticle (epimera) bearing pit-crescents, dactyls of pereopods 3-5 bearing strong pectinations on inner edges ..... ***T. nalgo***

### *Tethygeneia megalophthalma* (Haswell)

FIGURE 118

*Atylus megalophthalmus* Haswell, 1880a: 102–103, pl. 6: fig. 4.

DESCRIPTION (of male, based on one specimen).—Rostrum large, long, down-curved, slightly expanded apically and blunt, lateral cephalic lobe broad, shallow, quadriform, defined below by weak but sharp incision, anteroventral margin bulbous, rounded; antenna 2 about three-fourths as long as body, antenna 1 only three-fourths as long as antenna 2; eye large, purple core surrounded by 1-2 layers of clear ommatidia in alcohol; flagella of antenna 1-2 each about 4.5 times as long as their own peduncles, flagella thin; accessory flagellum completely fused to article 3 of peduncle but with same trapezoidal form seen in *T. elanora*; middle of primary flagellum on antenna 1 with alternate articles slightly swollen and each bearing 2, occasionally 3, aesthetascs; articles of flagellum of antenna 2 even; calceoli absent; mandibular molars triturative, each with ragged seta, spine row on right with 3 main ragged spines and small fourth toward molar, left with 4 main spines and fifth toward molar, left lacinia mobilis serrate and clearly distinct, right composed of 2 serrate spines, 1 toward molar bearing large unserrate membrane weakly falcate; mandibular palp with article 2 about twice as broad as article 3, latter slightly falcate and nearly 4 times as long as broad, but only about 68 percent as long as article 2, bearing 2 apical spines of medium size, third larger, fourth medium, then about 9 smaller proximal spines

and 1 basofacial seta, article 2 with about 7 spines on distal half and proximomarginal seta, article 1 naked; lower lip lacking inner lobes, mandibular lobes subtruncate and apically fringed; inner plate of maxilla 1 bearing 1 giant apical seta and 3-4 smaller medial setae on distal half; inner plate of maxilla 2 apically and subapically fringed with small setae, midmedial margin with 2 enlarged setae in tandem; inner plate of maxilliped with apicolateral spine separated from 2 medioapical spines by gap and hollow, outer plate

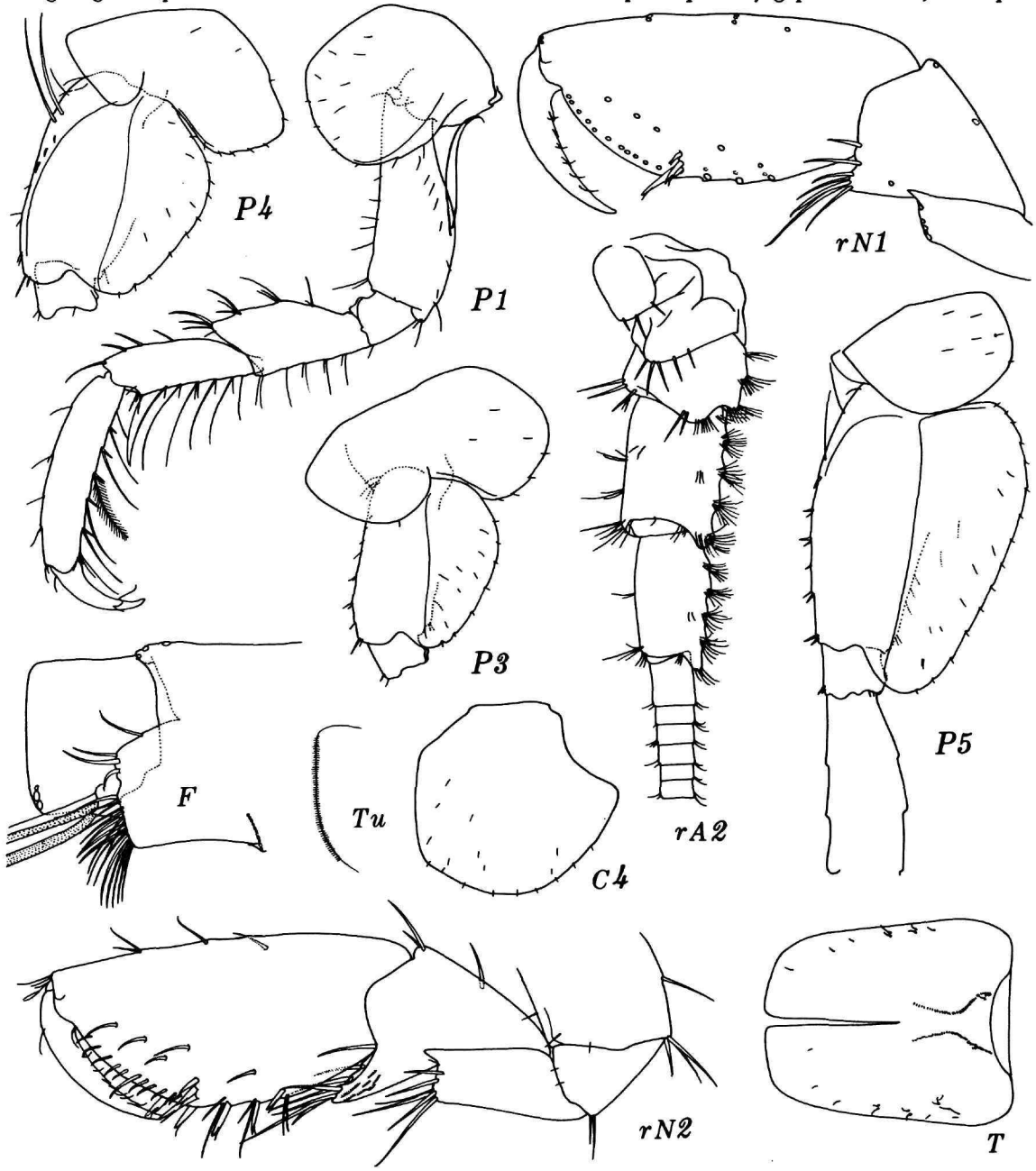



FIGURE 118.—*Tethygeneia megalophthalma* (Haswell), male, 6.2 mm, Merimbula A.

with facial setules mainly in 1 lateral row, a few scattered toward apex, article 2 of maxillipedal palp especially broad; coxae 2-3 lacking posterior setules, posterior lobe of coxa 4 softly rounded; article 2 of gnathopods 1-2 scarcely setose posteroventrally, hands of gnathopods long, ovatorectangular, posterior margins with stout spines, palms evenly oblique and slightly convex, article 5 of gnathopods 1-2 about 55 percent the length of article 6, posterior margin of article 5 on gnathopod 1 evenly triangulate and protruding, on gnathopod 2 produced to long lobe guarding posteroproximal portion of hand; locking spines of pereopods 1-2 really thin flexible setae, up to 4 in number and posterior setae of article 6 plumose, dactyls each with distal constriction, nail, long sharp inner seta and short sharp facial seta guarding constriction, inner margin of dactyl smooth; pair of locking spines on pereopods 3-5 normally stiff and slightly thickened, each with subterminal setular trigger, spines joined by 2 setae-setules; coxa 5 with posterior lobe slightly larger than anterior, coxa 6 with large quadriform posterior lobe; article 2 of pereopods 3-5 broadly expanded, articles 3-7 slender, facial spines on article 2 of pereopods 4-5 absent or weakly developed anterior to anterofacial ridge; epimeron 1 softly rounded behind, with 1-2 weak acclivities on broad posteroventral margin, ventral margins of epimera lined with spines in sets of singles; no dorsal teeth; uropod 3 lacking any stout peduncular spine; pleonite 6 with row of tiny denticles anterodistal to base of uropod 3; telson flat, cleft more than halfway, apices broad, blunt, fringed, lateral margins of lobes with several paired sets and singles of setules; cuticle on epimera covered with crescent-pits, slits on posterodorsal part of body raised as ridges or scales.

Flagellar formula of antenna 1 (See *T. elanora* for symbols).—Left medial, (2-2):2:3:3:0:2:0:2:0:3:0:2:0:2:0:3:0:2:0:2:0:2:0:3:0:2:0:2:0:1:0:0:(and 9 more zeros)(terminus). Right medial: (3-2):2:4:0:2:0:2:0:3:0:2:0:2:0:3:0:2:0:0:0:2:0:1:0:2:0:2:0:2:0:1:0:0(and 5 more zeros) (broken).

Illustrations.—The following parts are similar to illustrations (Figures 119–121) given for *T. elanora*, new species: head, antenna 1, lower lip, mandibles, maxillae 1-2, maxilliped, coxae 1-2, pereopodal dactyls, uropods 1-3, epimera 1, 2 (5 spines), 3 (6 spines), pleonite 6, and the serrations present on article 6 of pereopods 3-5.

Remarks.—This specimen is the only one found in collections examined from the New South Wales coast that resembles *A. megalophthalma* sufficiently to identify it with Haswell's species. The lobes on the fifth articles of the gnathopods are the main clue out of Haswell's sparse description and figures. The lobes protrude somewhat more than in other species discussed herein. This species differs from *T. elanora* in the presence of cuticular crescents, the fused accessory flagellum, and the presence of stout spines on the posterior margins of the hands on the gnathopods. It differs from *T. nalgo* in the fused accessory flagellum and the absence of pectinations on the dactyls of pereopods 3-5. *Tethygeneia waminda* has a large accessory flagellum and peduncular spines on uropod 3. *Tethygeneia tulkara* has an articulate accessory flagellum, stout locking spines on pereopods 1-2, and no cuticular pits.

*Gondogeneia microdeuteropa* has gnathopod 1 enlarged, a short rostrum, stout locking spines on pereopods 1-2, striate and castellate pereopodal dactyls, and scattered setules on the outer plate of the maxilliped.

Material.—Merimbula, A (male, 6.2 mm).

Distribution.—New South Wales, intertidal.

### *Tethygeneia elanora*, new species

Figures 119–121

Description (of female).—Rostrum large, long, curved down, apically blunt, lateral cephalic lobe broad, shallow, quadriform, defined below by weak but sharp incision, anteroventral margin bulbous, rounded; antenna 2 slightly more than half as long as body, antenna 1 only three-fourths as long as antenna 2; eye of medium size, purple core surrounded by 1-2 layers of clear ommatidia in alcohol; flagella of antennae 1-2 each 3 times as long as their own peduncles, flagella thin; accessory flagellum articulate, broader than long, sharply trapezoidal; middle of primary flagellum on antenna 1 with alternate articles slightly swollen or offset and each swollen article bearing 2 aesthetascs; articles of flagellum on antenna 2 even; mandibular molars triturative, each with ragged seta, spine row on right side with 3 main ragged spines, fourth rudimentary spine toward molar, left side with 3 main spines, smaller fourth toward molar, detached thinner fifth spine toward lacinia mobilis, left lacinia mobilis serrate and clearly distinct, right lacinia mobilis appearing composed

of 3 parts, as 2 spines and 1 serrate membrane; mandibular palp with article 2 about twice as broad as article 3, latter slightly falcate and nearly 4 times as long as broad, but only 65 percent as long as article 2, bearing 2 apical spines of medium size, third spine larger, then about 9 smaller proximal spines, and 1 basofacial seta, article 2 with about 10 spines on distal half; lower lip lacking inner lobes, mandibular lobes subtruncate and apically fringed; inner plate of maxilla 1 bearing 1 giant apical seta and 4 smaller medial setae on distal half; inner plate of maxilla 2 apically and subapically fringed with

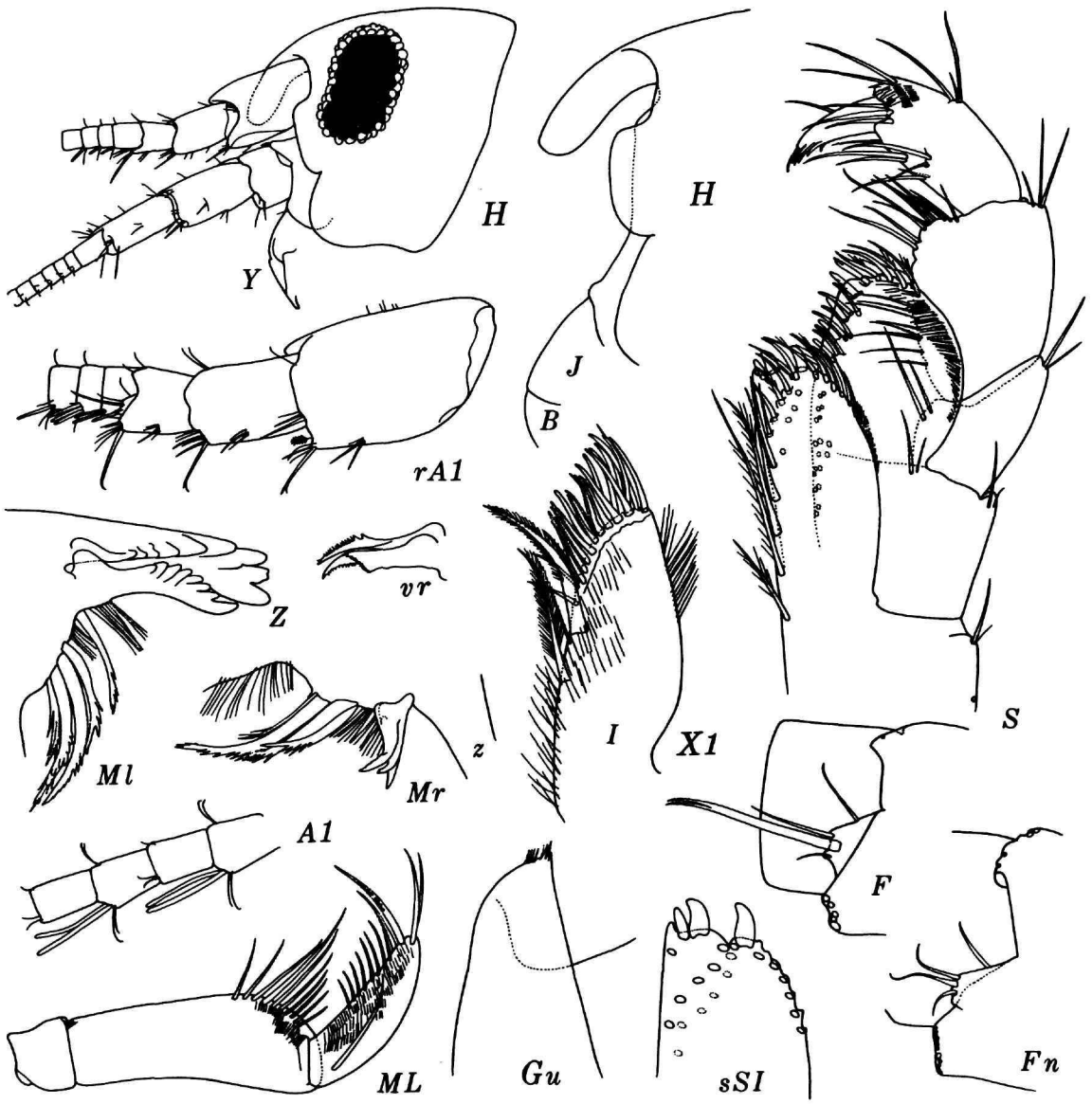



FIGURE 119.—*Tethygeneia elanora*, new genus, new species, female, 7.6 mm, JLB Australia 2; *n*=male, 6.5 mm, JLB Australia 2; *w*=male, 6.0 mm, JLB Australia 2; *b*=male, 5.2 mm, JLB Australia 14. (*v*=lacinia mobilis.)

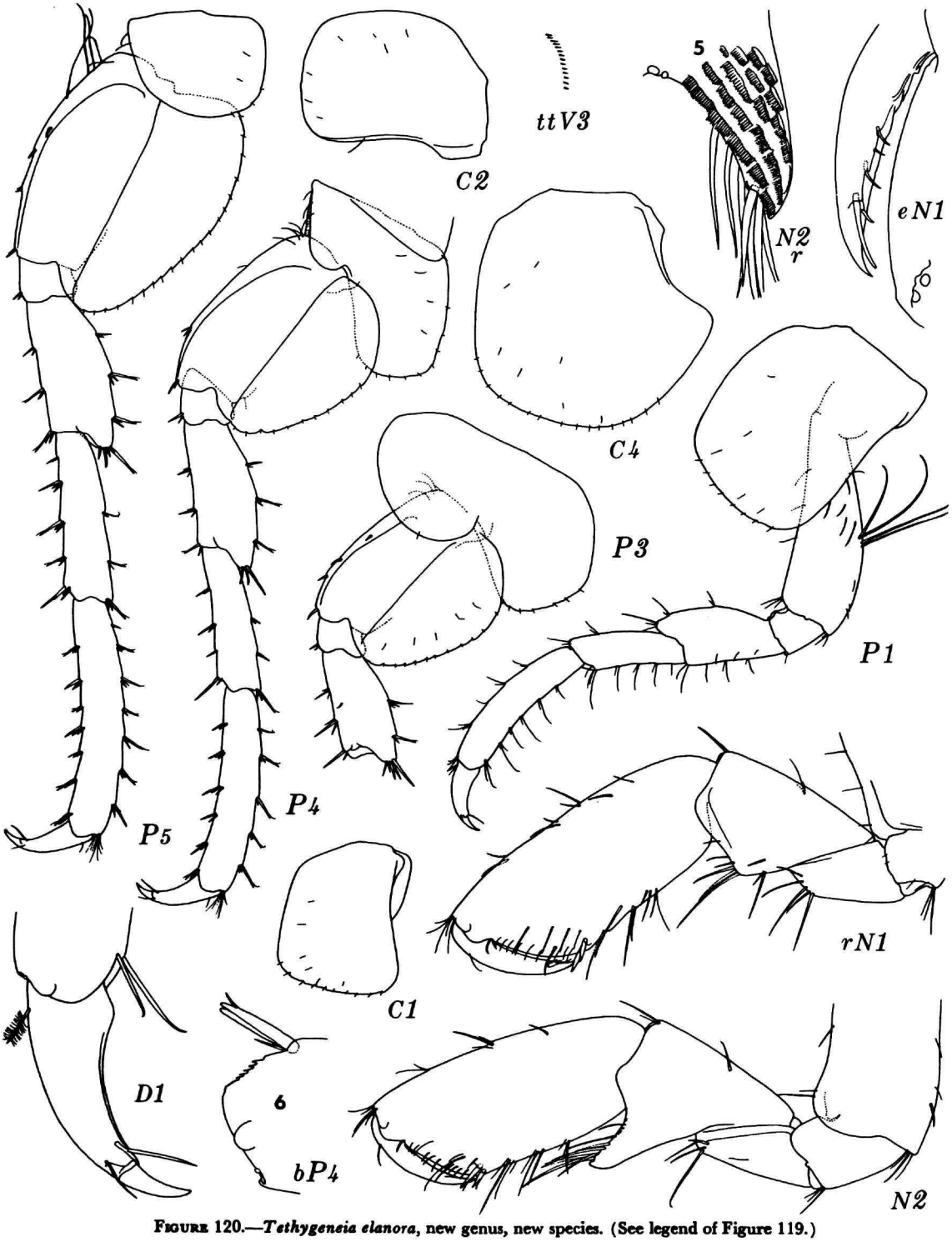



FIGURE 120.—*Tethygeneia elanora*, new genus, new species. (See legend of Figure 119.)

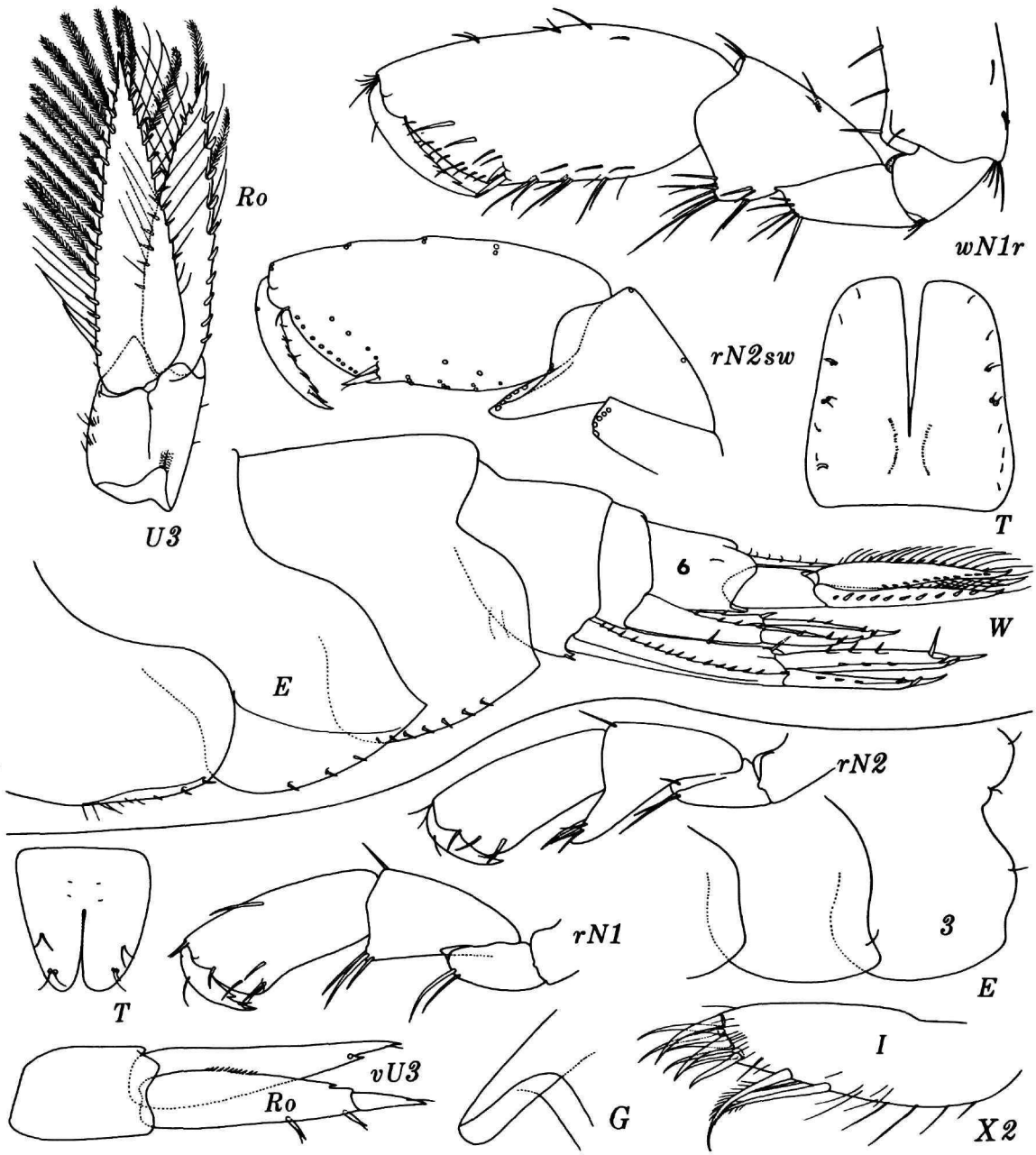



FIGURE 121.—*Tethygeneia elanora*, new genus, new species, lower=juvenile, 1.3 mm, JLB Australia 13. (See legend of Figure 119; *v*=ventral, this figure only.)

small setae, midmedial margin with 2 enlarged setae in tandem; inner plate of maxilliped with 1 apicolateral spine separated from 2 medioapical spines by gap and hollow, outer plate with facial setules in 1 even row, article 2 of maxillipedal palp especially broad; coxae 2-3 each with 1-2 posterior setules, posterior lobe of coxa 4 softly rounded; article 2 of gnathopods 1-2 scarcely setose posteroventrally, hands of gnathopods long, thin and rectangular, palms evenly oblique, article 5 of gnathopod 1 about 60 percent length of article 6, about 65 percent on gnathopod 2, posterior margin of article 5 on gnathopod 1 triangulate but softly, on gnathopod 2 produced to long lobe guarding posterior proximal third of hand; locking spines of pereopods 1-2 really thin flexible setae, dactyls each with distal constriction, nail, long sharp inner seta, and shorter sharp facial seta guarding constriction, inner margin of dactyl usually smooth but in enlarged adults occasionally bearing extremely faint, broadly spaced notches resembling incipient castellations; pair of locking spines of pereopods 3-5 normally stiff and slightly thickened, each with subterminal setular trigger, spines often joined by third or fourth member in form of tiny setules, outer apical margin of article 6 at base of dactyl sharply serrate only on pereopods 3-5; coxa 5 evenly lobate, coxa 6 with large quadriform posterior lobe; article 2 of pereopods 3-5 broadly expanded, articles 3-7 slender, article 2 on pereopod 5 lacking facial seta posterior to main ridge; epimeron 1 softly rounded behind, with or without very weak declivity at posteroventral corner, epimeron 2 with sharp shallow tooth and protruding posteromiddle margin, epimeron 3 similar but protrusion deeper and tooth smaller, ventral margins of epimera lined with spines in sets of singles; no dorsal teeth; uropod 3 lacking any stout peduncular spine; pleonite 6 with row of tiny denticles anterodorsal to base of uropod 3; telson flat, broad, cleft more than halfway, apices broad, blunt, smooth, lateral margins of lobes with 2 pairs of setular sets, occasionally third near base, plus other single setules in tandem (see Figure 121*T*, upper); cuticle generally clear of setules but rare setule present, crescents absent.

MALE.—Like female but antennae more elongate and no male yet discovered bearing calceoli; eyes slightly larger than in female; accessory flagellum with main elongate spine found in female reduced to size similar to other setae; antennal peduncles developing groups of setules as in *T. waminda*, formula for aesthetascs and swollen articles generally similar to female; gnathopods enlarged, less elongate, hands broader than in female; posterior setae on article 6 of pereopods 1-2 becoming strongly plumose and elongate, locking setae increasing to 6.

JUVENILES (about 1.3 mm minimum length examined).—Generally like adult female except as follows: flagellum of antenna 1 bearing only 4 articles, articles 2 and 3 each with 1 aesthetasc; accessory flagellum normal; antenna 2 also short, spines and setae everywhere far less abundant; for example, inner plate of maxilla 1 bearing only 1 apical seta and 2 medials, mandibular palp article 3 bearing main spine, 2 apicals and 1 proximal to main, article 2 bearing only 1 spine, right mandible with only 2 main spines, no rudimentary, and lacinia mobilis clearly composed of 2 similar spines partially fused at base, left mandible with 3 spines, ragged seta of molars very short; gnathopods very thin, plain, dactyls overlapping palms (see Figure 121*N*, lower); pleonal epimera plain, lacking ventral spines (see Figure 121*E*, lower); outer ramus of uropod 3 clearly biarticulate, this articulation disappearing or becoming very dim in adults; telson with main pairs of setules occurring highly distad in comparison with adult (see Figure 121*T*, lower).

EXAMPLES OF FLAGELLAR FORMULAE (of males and females).—Female antenna 1 flagellum, segments alternately swollen and bearing aesthetascs in middle, but all proximal segments with aesthetascs and basalmost segment with 2 sets; in following formula, numbers = presence of aesthetascs and, after first few segments, also swollen articles; parentheses = more than 1 set of aesthetascs on a segment: (1-3):2:2:2:2:0:2:0:2(continuing to segment 25; then, as follows, starting with segment 26)2:0:1:0:0:0:0(terminus), swellings diminishing distally.

MALE, NORMAL.—(2-2) :2:2:2:0:2:0 (continuing; then, commencing segment 36 as) B:0:B:0:0:0:0:0:0(terminus). Alternate: 2:2:2:2:2:2:0:2:0:2:0, etc.

NOTE.—Occasional specimens of both *T. elanora* and *T. waminda* have serrations on the inner distal margin near the base of the dactyl on pereopods 3-5.

HOLOTYPE.—WAM, female, 6.8 mm.

TYPE-LOCALITY.—JLB Australia 13, Middleton Beach, Albany, Western Australia, intertidal, wash of sandy rocks, coralline algae, 30 September 1968.

RELATIONSHIP.—The presence of an accessory flagellum and, to a degree, the setosity of the inner plates

of maxillae 1-2 suggest that this species belongs in *Paramoera*, but the structure of the flagellum of antenna 1, the shape and ornamentation of the telson, and the failure of a submarginal row of setae to be developed on the inner plate of maxilla 2 suggest this species is properly placed in *Tethygeneia*, where it constitutes the most primitive member yet known. The absence of inner lobes on the lower lip seems definitely to remove this species from *Pontogeneiella* Schellenberg.

The elongate rostrum is the best clue at present to suggest relationships, because members of southern "*Pontogeneia*" and *Paramoera* are otherwise so confused in the southern hemisphere that it is difficult to suggest relationships by ignoring the rostrum and comparing other characters.

An accessory flagellum in *Gondogeneia danai* (Thomson) was found by J. L. Barnard (in press), and one is absent apparently in the *Pontogeneia magellanica* of Chevreux (1906), a species that otherwise is a member of *Paramoera*. Variability in the presence or absence of swollen segments and calceoli occurs throughout *Paramoera* and southern "*Pontogeneia*" and does not appear correlated with other characters of generic value. It appears that *Paramoera* remains well defined by the submarginal setal row on the inner plate of maxilla 2 and the presence of long and fairly thick apical spines on the telson, whereas most species of "*Pontogeneia*," especially those in the southern hemisphere or low latitudes of the Pacific Ocean, now called *Tethygeneia* and *Gondogeneia*, have no apical spines on the telson and no submarginal row of setae on maxilla 2.

This species is apparently not *Atylus megalophthalmus* Haswell (1880a), as article 5 of gnathopod 1 in adults does not have a pointed posterior lobe and the hands of both pairs of gnathopods are more elongate and rectangular than in *A. megalophthalmus* (see *Tethygeneia megalophthalma*). Haswell shows the lobe on article 5 of gnathopod 1 as longer than on gnathopod 2, the reverse of *T. elanora*.

MATERIAL.—JLB Australia 2 (31), 3 (14), 6 (1), 5 (2), 10 (9), 11 (9), 13 (24), 14 (1).

DISTRIBUTION.—Southwestern Australia, intertidal.

### *Tethygeneia nalgo*, new species

FIGURE 122

DESCRIPTION (of female).—Rostrum large, long, curved down slightly, apically blunt but thinner than in *T. elanora*, new species; lateral cephalic lobe broad, shallow, quadriform, defined below by weak but sharp incision, anteroventral margin bulbous, rounded; antenna 2 unknown in adult female (broken), antenna 1 about as in *T. elanora*; eye of medium size, purple core surrounded by 1-2 layers of clear ommatidia in alcohol; flagella of antennae 1-2 apically broken, thin; accessory flagellum articulate, broader than long, extremely short and attached under oblique edge of article 3 so as to appear as triangular and, in some specimens, appearing scarcely articulate; middle of primary flagellum on antenna 1 with alternate articles slightly swollen or offset and each swollen article bearing 1 aesthetasc; articles of flagellum on antenna 2 unknown; mandibular molars triturative, each with ragged seta, spine row on right with 3 main ragged spines, much smaller fourth spine toward molar, occasionally fifth small spine between large spines 1-2; left mandible with 3 main ragged spines, with detached weak spine toward lacinia mobilis (better developed in male), very weak spine between main spines 1-2 (better in male), (and male with medium fourth spine toward molar), left lacinia mobilis serrate and clearly distinct, right appearing composed of 3 parts, 2 spines, and 1 smooth membrane with weak falcation; mandibular palp approximately like *T. elanora*, article 3 with about 7 (9 in male) spines in the group of small members, 1 basofacial (2 in male) setae, article 2 with 5 (6 in male) setae; lower lip lacking inner lobes, mandibular lobes subtruncate and apically fringed (like *T. elanora*); inner plate of maxilla bearing 1 giant apical seta and 4 (5 in male) smaller medial setae on distal half (article 1 of right palp with 1 outer seta, 1 on left side, but 2 on male left side, setae not present in *T. elanora* and *T. waminda*); inner plate of maxilla 2 apically and subapically fringed with small setae, midmedial margin with 2 enlarged setae in tandem; inner plate of maxilliped with apicolateral spine separated from 2 medioapical spines by gap and hollow (like figure of *T. elanora*), article 2 of maxillipedal palp of medium breadth, outer plate with facial setules arranged in lines along lateral margin; coxae 1-3 lacking posterior setules, posterior lobe of coxa 4 softly rounded; article 2 of gnathopods 1-2 scarcely setose posteroventrally, hands of gnathopods slightly less elongate than in *T. elanora*, rectangular to slightly expanded apically, palms evenly oblique, article 5 of gnathopod 1

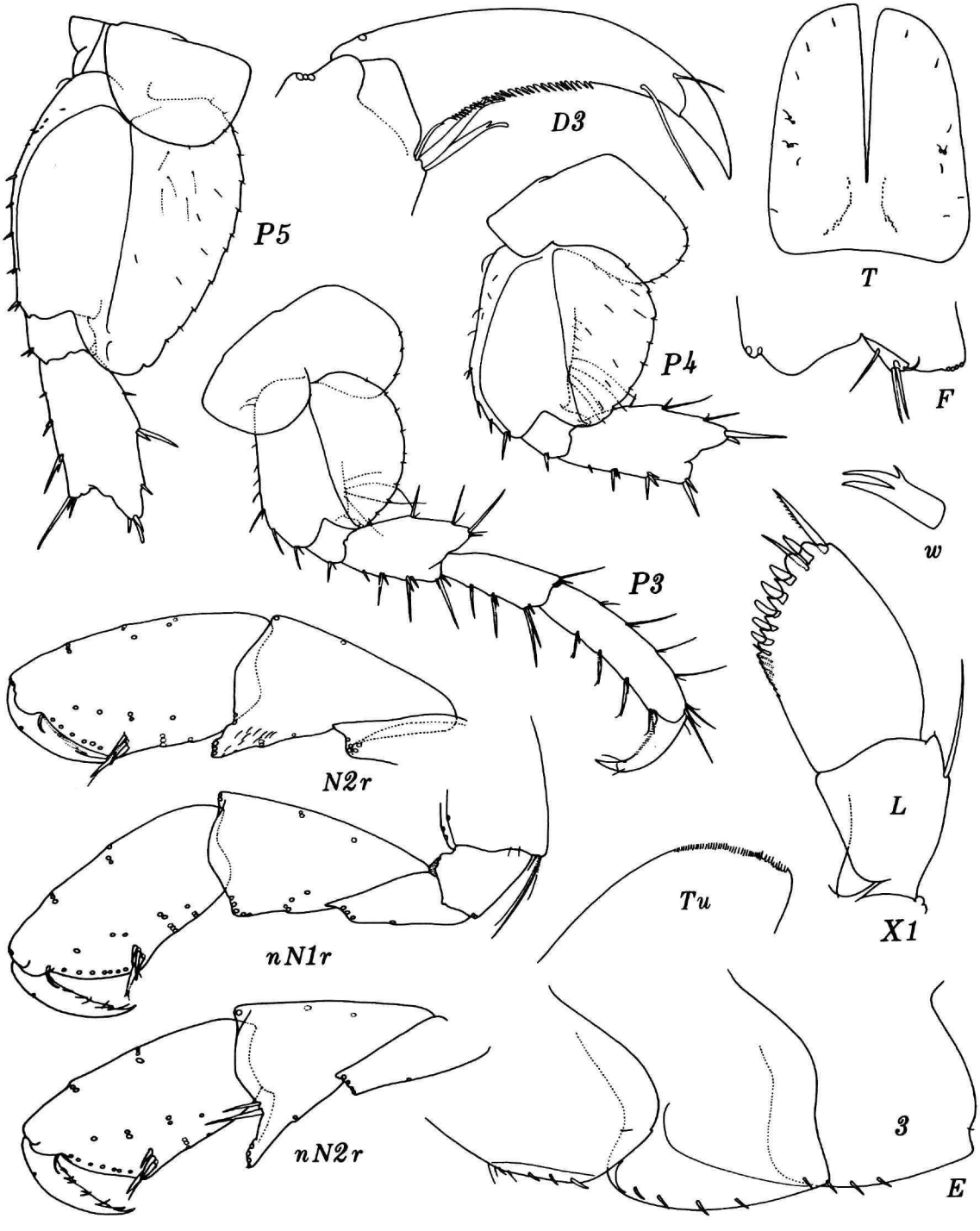



FIGURE 122.—*Tethygeneia nalgo*, new species, holotype, male, 6.1 mm, JLB Australia 13; *n*= female, 5.5 mm, JLB Australia 2. (*w*=lacinia mobilis from a juvenile.)

about 90 percent the length of article 6, but only 83 percent on gnathopod 2, posterior margin of article 5 on gnathopod 1 truncate but weakly triangulate distally, on gnathopod 2 produced to medium lobe slightly guarding posterior proximal third of hand (female lacking combs of setae on lobe of gnathopod 2 seen in *T. elanora* and *T. waminda*, but male bearing these); locking spines of pereopods 1-2 really thin flexible setae, dactyls each with distal constriction, nail, medium sharp inner seta and shorter facial seta guarding constriction, inner margin of dactyl smooth, locking setae up to 4 or 5; locking spines of pereopods 3-5 normally stiff and slightly thickened, each with subterminal setular trigger, spines often joined by third to fourth members in form of setules or spines, outer apical margin at base of dactyl smooth, dactyls of pereopods 3-5 like pereopods 1-2 but inner margin strongly pectinate; coxae 5-6 with elongate posterior quadriform lobe; article 2 of pereopods 3-5 broadly expanded, articles 3-7 slender, article 2 of pereopod 5 with extremely weak facial row of setules anterior to main facial ridge, also present on pereopod 4; (special character: setae on medial facial vertical line especially long and confined tightly to ventral half of line, about 4-5 setae present and occurring only on pereopods 4-5); epimeron 1 grossly and softly rounded behind but with weak acclivity forming posteroventral tooth, epimeron 2 with softly rounded shallow protrusion, epimeron 3 similar, ventral margins of epimera lined with several spines, all singles and in tandem, no facial spines; no dorsal teeth; uropod 3 with no stout peduncular spine; pleonite 6 with tiny row of denticles anterodorsal to base of uropod 3; telson flat, broad, cleft more than halfway, apices broad, beveled but generally truncate, fringed, lateral margins of lobes with pairs and singles of setules; cuticle bearing crescents, especially prevalent on epimera, telson, article 2 of pereopods 3-5, coxae, plus scattered setules on coxae 1-4 especially.

MALE.—Like female except as follows: accessory flagellum bearing same 3 apical setae but middlemost not elongate as in female (female similar to *T. elanora*); antennal peduncles developing groups of setules and calceoli on ventral margin of antenna 1, dorsal margin of antenna 2, calceoli occurring on alternate articles of flagellum of antenna 1 (in its middle—see formula below), articles alternating in breadth as on female, but calceoli not occurring on narrow articles, so zigzag pattern absent; antenna 2 unknown; lobe on article 5 of gnathopod 2 stouter and seemingly shorter than in female, hands of gnathopods also stouter, gnathopods scarcely larger than in female; posterior setae on article 6 of pereopods 1-2 becoming elongate and plumose.

JUVENILE (1.5 mm).—Corollary to adult in accessory flagellum, locking setae of pereopods 1-2, pectinations of dactyls on pereopods 3-5, but cuticular crescents absent; flagellum of antenna 1 bearing 5 articles, with 1 aesthetasc on article 4; accessory flagellum and rostrum like adult; eyes small; lacinia mobilis on right mandible with accessory membrane poorly formed, represented by side cusp on main spine-fork (see Figure 122*w*), left lacinia mobilis normal and bearing 7 teeth; right mandible with 3 clear spines, scarcely ragged and fuzz only between lacinia mobilis and first spine; left mandible with 4 clear spines; molarial seta very short; mandibular palp article 2 with 1 spine, article 3 lacking basofacial seta, apex with 2 terminal, 1 large and 1 small, spines (total 4); lower lip (fringed) and maxilla 2 like adult, but latter less setose although bearing characteristic 2 enlarged medial setae; inner plate of maxilla 1 bearing only 3 setae, outer plate with 9 spines, article 1 of palp naked; maxilliped like adult, but outer plate with only 2 main spines and bearing normal setular row on lateral margin; gnathopods feebly ornamented but recognizable as in adult owing to lobations of fifth articles; pereopods 1-2 each with 2 locking setae, no other posterior ornaments on article 6; dactyls of pereopods 3-5 normal to adult; only epimeron 1 bearing 1 ventral spine; no cuticular crescents; uropod 3 without clear demarcation as to article 2 on outer ramus seen in juvenile of *T. elanora*; coxae 2-3 with facioposterior ridge as in adult.

EXAMPLES OF FLAGELLAR FORMULAE (of male and female; see *T. elanora* for symbols).—Female antenna 1: (1-1):1:0:1:0 (until article 26, then continue) 0:1:0:0:0:0(terminus). Male antenna 1 flagellum, bearing aesthetascs (denoted by number) and calceolus (denoted by C; articles with aesthetascs and calceoli also bulging): 1:1:2:1:1C:1C:1C:0:1C: 0:1C:0:1C:0:1C:0:1C:0:1C:0:1C: 0:1:0:1:0:1:0:1:0:1:0:1: 0:1:0:1:0:0:0:0:0(terminus).

ILLUSTRATIONS.—Only a few illustrations of this species have been thought necessary because of resemblances to *T. elanora* and *T. waminda* in so many attributes.

Since the only adults with unbroken antenna 2 are

young males, the relationships of the length and presence of calceoli in terminal males and the length in adult females are unknown.

HOLOTYPE.—WAM, male, 6.1 mm.

TYPE-LOCALITY.—JLB Australia 13, Middleton Beach, Albany, Western Australia, intertidal, wash of sandy rocks, coralline algae, 30 September 1968.

RELATIONSHIP.—This species differs from *T. elanora* mainly in the presence of cuticular crescents in specimens exceeding 3.0 mm (but not in juveniles 1.5 mm long) and in the dactylar pectinations of pereopods 3-5. The presence of several long setae on the medial ridge of article 2 on pereopods 4-5 is also characteristic, the first distinction I noted in separating the specimens of this species from *T. elanora*. The dactylar pectinations on pereopods 3-5 are less noticeable, as they must be observed at very high power and the distal parts of those appendages are often missing. The observation of cuticular crescents also has required special care, but, once comparison is made between species bearing and lacking these crescents, one may come to recognize the subtly distinct frosted appearance of *T. nalgo* cuticle under reasonably lower power and proper light angles.

The sparsity of material in this species leaves unanswered several basic taxonomic questions. Among the most important is whether or not the presence of only 1 aesthetasc on each swollen article of the first antennal flagella in both males and females marks a legitimate distinction between *T. nalgo* and *T. elanora,* which in adults, has 2 aesthestacs on each swollen segment. Since no male of *T. elanora* has yet been discovered with calceoli, the presence of calceoli in some adult males of *T. nalgo* suggests a further difference.

The short, if not partitioned, faciolateral ridge (the one in the middle) on article 2 of pereopod 5 (Figure 122*P5*) apparently is abnormal, as other specimens have the ridge continuing normally to the ventral terminus of the article.

*Tethygeneia nalgo* differs from *T. waminda* in the short accessory flagellum, the lack of peduncular spine on uropod 3, the dactylar pectinations of pereopods 3-5, the absence of facial spines on epimeron 2, the singularity of the ventral epimeral spines, the even row of setules on the outer plate of the maxilliped, and (probably) the presence of only 1 aesthetasc on swollen segments of the first antennal flagellum. *Tethygeneia nalgo* stands between *T. waminda* and *T. elanora* in the weakly developed anterofacial spines (setae and setules) on article 2 of pereopod 5.

MATERIAL.—JLB Australia 2 (9), 6 (3), 8 (1), 13 (1).

DISTRIBUTION.—Southwestern Australia, intertidal.

### *Tethygeneia tulkara,* new species

FIGURE 123

DESCRIPTION (of female).—Rostrum large, long, curved down, apically blunt, lateral cephalic lobe broad, shallow, quadriform, defined below by weak but sharp incision, anteroventral margin bulbous, rounded; antenna 2 about half as long as body, antenna 1 only about 60 percent as long as antenna 2; eye of medium size, purple core surrounded by 1-2 layers of clear ommatidia in alcohol; flagellum of antenna 1 twice as long as peduncle but flagellum of antenna 2 thrice as long as its peduncle, flagella thin; accessory flagellum articulate, broader than long, sharply trapezoidal; middle of primary flagellum on antenna 1 with alternate articles slightly swollen and bearing 1 or 2 aesthetascs; articles of flagellum on antenna 2 even; mandibular molars triturative, each with ragged seta, spine row on right with 3 main spines, a fourth smaller spine toward molar (in male 2 main spines, a third smaller spine toward molar, a fourth even thinner spine between 1 and 2), left with 4 main spines, pair of smaller spines between 1-2, and 1 smaller spine between 2 and 3 (male, 4 main spines, pair of smaller spines between 1-2 and 2 smaller spines past spine 4 toward molar), left lacinia mobilis serrate and clearly distinct, right composed of 2 serrate spines, 1 bearing cusp and appearing as membrane; mandibular palp with article 2 about twice as broad as 3, latter falcate and only 55 percent as long as 2, bearing 2 apical spines, 2 slightly larger, then 3 more proximal spines, no basofacial seta, article 2 with about 5 spines near apex; lower lip lacking inner lobes, mandibular lobes subtruncate and apically fringed; inner plate of maxilla 1 bearing 1 giant apical seta and 3 smaller medial setae on distal half; inner plate of maxilla 2 apically and subapically fringed with small setae, midmedial margin with 2 enlarged setae in tandem; inner plate of maxilliped with apicolateral spine separated from 2 medioapical spines by gap and hollow (medialmost spine much smaller than in *T. elanora*), outer plate with facial setules in 1 row and a few scattered, article 2

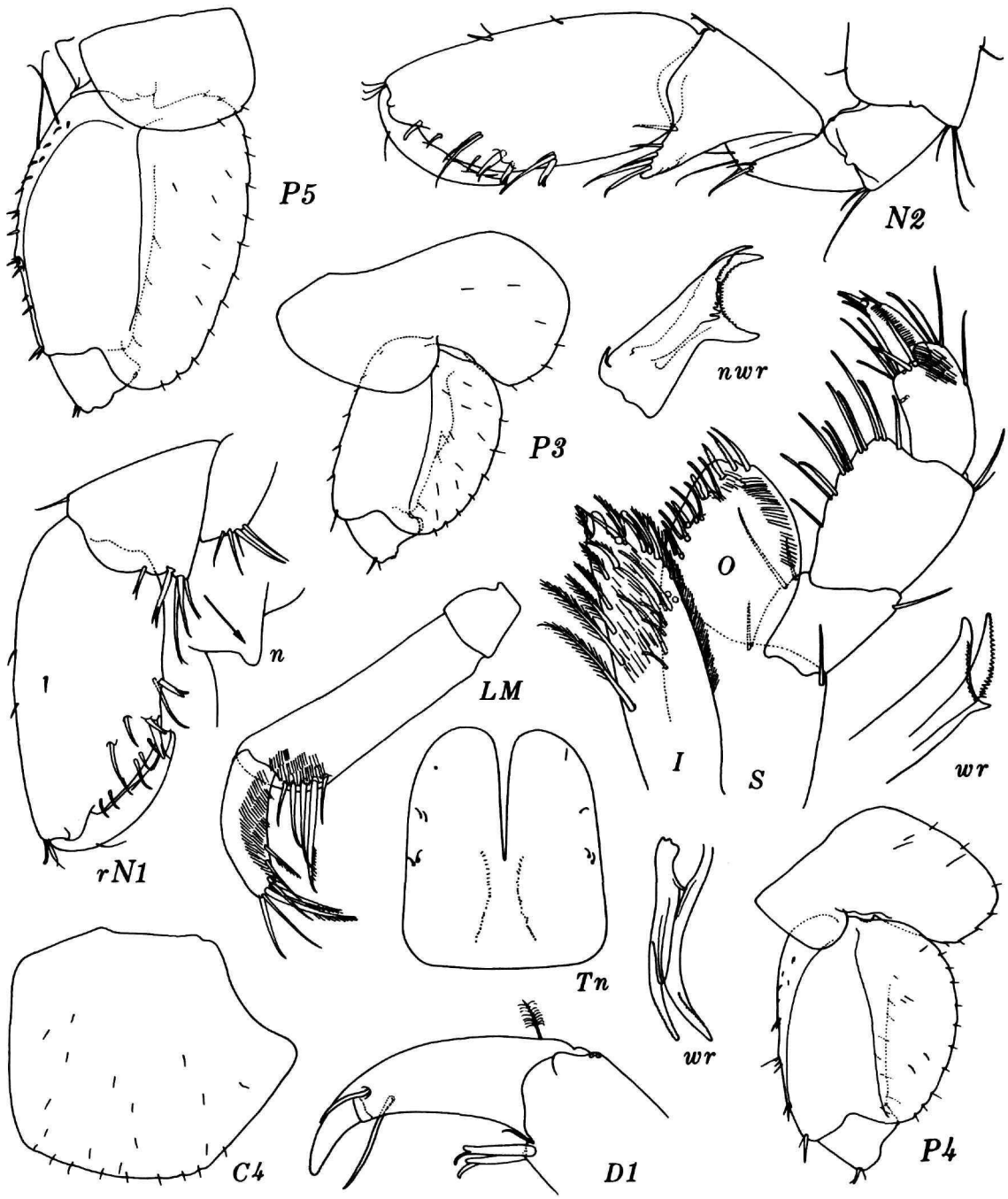



FIGURE 123.—*Tethygeneia tulkara*, new species, holotype, female, 4.5 mm, JLB Australia 3; *n*=male, 4.6 mm, JLB Australia 14. (*w*=lacina mobilis.)

of maxillipedal palp especially broad; coxae 1-4 lacking posterior setules, posterior lobe of coxa 4 softly rounded (coxae 1-4 more shallow than in *T. elanora* and lobe of coxa 4 thus somewhat extended); article 2 of gnathopods 1-2 scarcely setose posteroventrally, hands of gnathopods long, thin, subrectangular, palms evenly oblique, article 5 of gnathopod 1 about 55 percent the length of article 6, about 50 percent on gnathopod 2, posterior margin of article 5 on gnathopod 1 narrowly triangulate but softly, on gnathopod 2 produced to long lobe guarding posterior proximal third of hand (differing from *T. elanora* in presence of posterior spine on hand instead of seta, comb rows on article 5 of gnathopod 2 sparse); locking spines of pereopods 1-2 composed of 2 heavy spines slightly truncate apically (with triggers) and 2 short setae, dactyls each with distal constriction, nail, long sharp seta, and shorter sharp facial seta guarding constriction, inner margin of dactyl smooth; locking spines of pereopods 3-5 similar; article 6 apically smooth on pereopods 3-5; coxa 5 almost evenly lobate, coxa 6 with large quadriform posterior lobe; article 2 of pereopods 3-5 broadly expanded, articles 4-7 slender, article 2 on pereopod 5 bearing facial setules-spinules only anterior to main anterofacial ridge; epimeron 1 softly rounded behind, with weak declivity at posteroventral corner, epimeron 2 with sharp shallow tooth and protruding posteromiddle margin, epimeron 3 similar but protrusion deeper and tooth smaller, ventral margins of epimera lined with spines in sets of singles (epimeron 1 with 5 spines, 2 with 4, 3 with 5); no dorsal teeth; uropod 3 lacking any stout peduncular spine; pleonite 6 with row of tiny denticles anterodorsal to base of uropod 3 (and pleonites 1-5 with pair of dorsal longitudinal rows of these); telson flat, broad, cleft more than halfway, apices slightly rounded, broad, smooth, lateral margins of lobes with 2 pairs of partial sets of setules; cuticle with rare setule.

MALE.—Like female but antennae more elongate and no male yet discovered bearing calceoli; eyes slightly larger than in female; accessory flagellum with main elongate spine reduced to size similar to other setae; antennal peduncles developing groups of setules; formula for aesthetascs and swollen articles generally similar to female; gnathopods slightly enlarged, hands slightly more elongate and ovate than in female and lobes on article 5 of both gnathopods slightly more protuberant; posterior setae of article 6 on pereopods 1-2 not plumose (no terminal male apparently found); epimeron 1 bearing only 2 ventral spines.

EXAMPLES OF FLAGELLAR FORMULAE (of males and females; see symbols in *T. elanora*).—Flagellum of female antenna 1: (1-2):2:3:0:2:0:2:0:1:0:1:0:1:0:1:0:0:0:0 (terminus). Male, left: 2:2:2:0:2:0:2:0:2:0:2:0:2:0:3:0:0:0: (broken); right:2:3:3:0:2:0:2:0:2:0:2:0 (broken).

ILLUSTRATIONS.—The strong similarity of most attributes of this species to *T. elanora* has obviated repeating most of the drawings.

HOLOTYPE.—WAM, female, 4.5 mm.

TYPE-LOCALITY.—JLB Australia 3, Sugarloaf Rock, Cape Naturaliste, Western Australia, intertidal, wash of common seaweeds, 1 September 1968.

RELATIONSHIP.—This species differs from the three species *T. elanora, T. nalgo,* and *T. waminda* in the presence of stout spines in the locking set on pereopods 1-2. Though *T. tulkara* may be distinguished from *T. nalgo* and *T. waminda* by the plain cuticle, I have not found any other character to distinguish *T. waminda* and *T. tulkara* except the locking spines on pereopods 1-2; specimens missing the apices of these pereopods have remained unidentified if the cuticle is unpitted.

*Tethygeneia tulkara* bears a gradational resemblance to *G. microdeuteropa* (Haswell) because of the stout locking spines on pereopods 1-2, but, otherwise, it differs by the smaller, more even gnathopods 1-2, the long rostrum, the smooth cuticle, and the fairly simple flagella and pereopodal dactyls. Juveniles of the two species are difficult to separate grossly without checking the rostrum and gnathopods, but the eyes of *G. microdeuteropa* are much more densely pigmented and more circular than those of *T. tulkara,* and this appears to be a possible way to separate large quantities of specimens rapidly.

MATERIAL.—JLB Australia 3 (17), 5 (14), 6 (3), 11 (13), 13 (18), 14 (9).

DISTRIBUTION.—Southwestern Australia, intertidal.

### *Tethygeneia waminda,* new species

FIGURES 124–126

DESCRIPTION (of female).—Rostrum large, long, curved down slightly, apically blunt but thinner than in *T. elanora,* new species, lateral cephalic lobe broad, shallow, quadriform, defined below by weak but sharp

incision, anteroventral margin bulbous, rounded; antenna 2 about half as long as body, antenna 1 about seven-eighths as long as antenna 2; eye of medium size, purple core surrounded by 1-2 layers of clear ommatidia in alcohol; flagella of antennae 1-2 each nearly 3 times as long as its own peduncle, flagella thin; accessory flagellum articulate, longer than broad; middle of primary flagellum on antenna 1 with alternate articles slightly swollen or offset, and each swollen article bearing 2, rarely 3, aesthetascs;

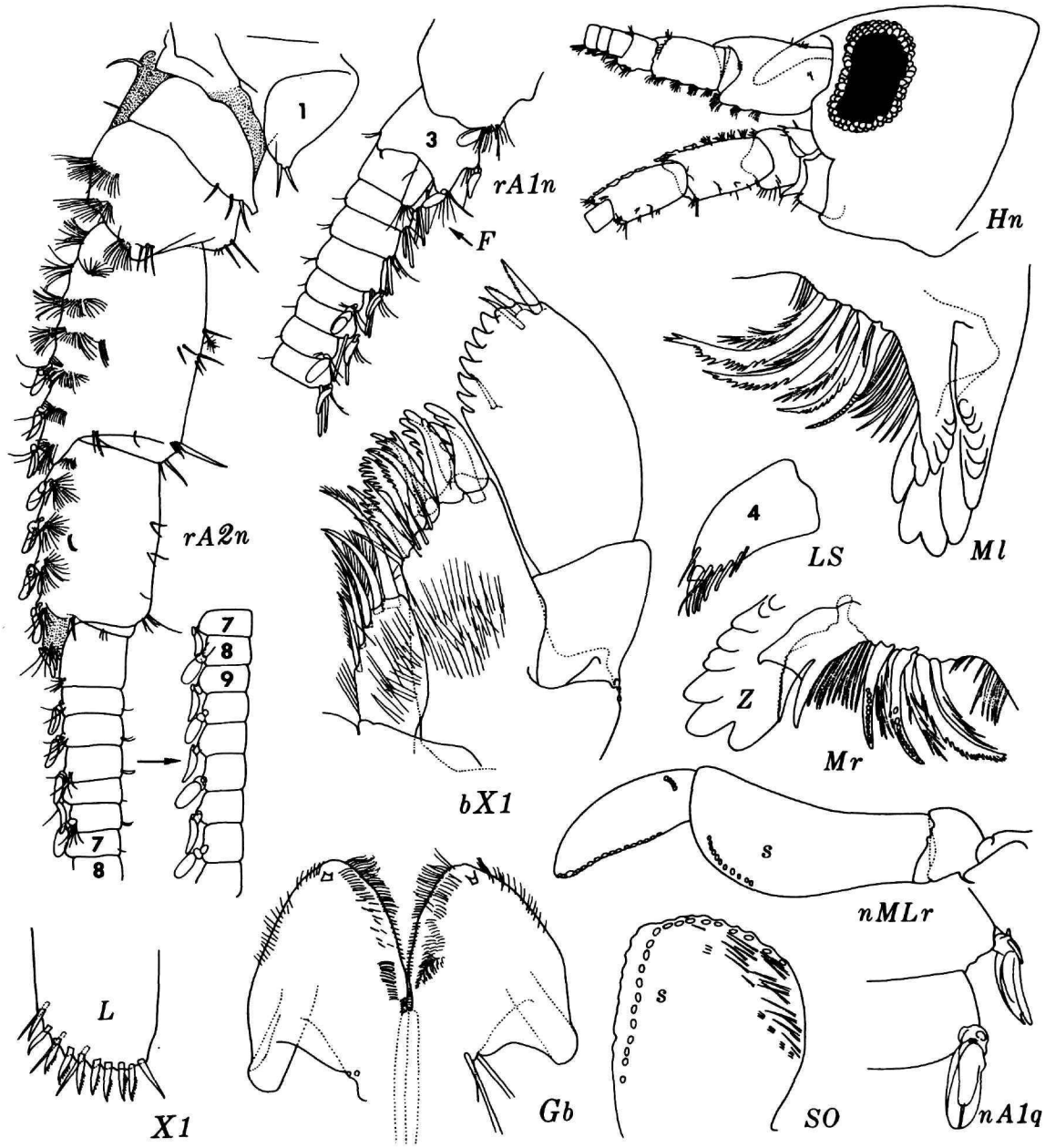



FIGURE 124.—*Tethygeneia waminda*, new species, holotype, female, 6.6 mm; *b*=female, 5.8 mm; *n*=male, 7.2 mm; *w*=male, 7.6 mm; all from JLB Australia 14.

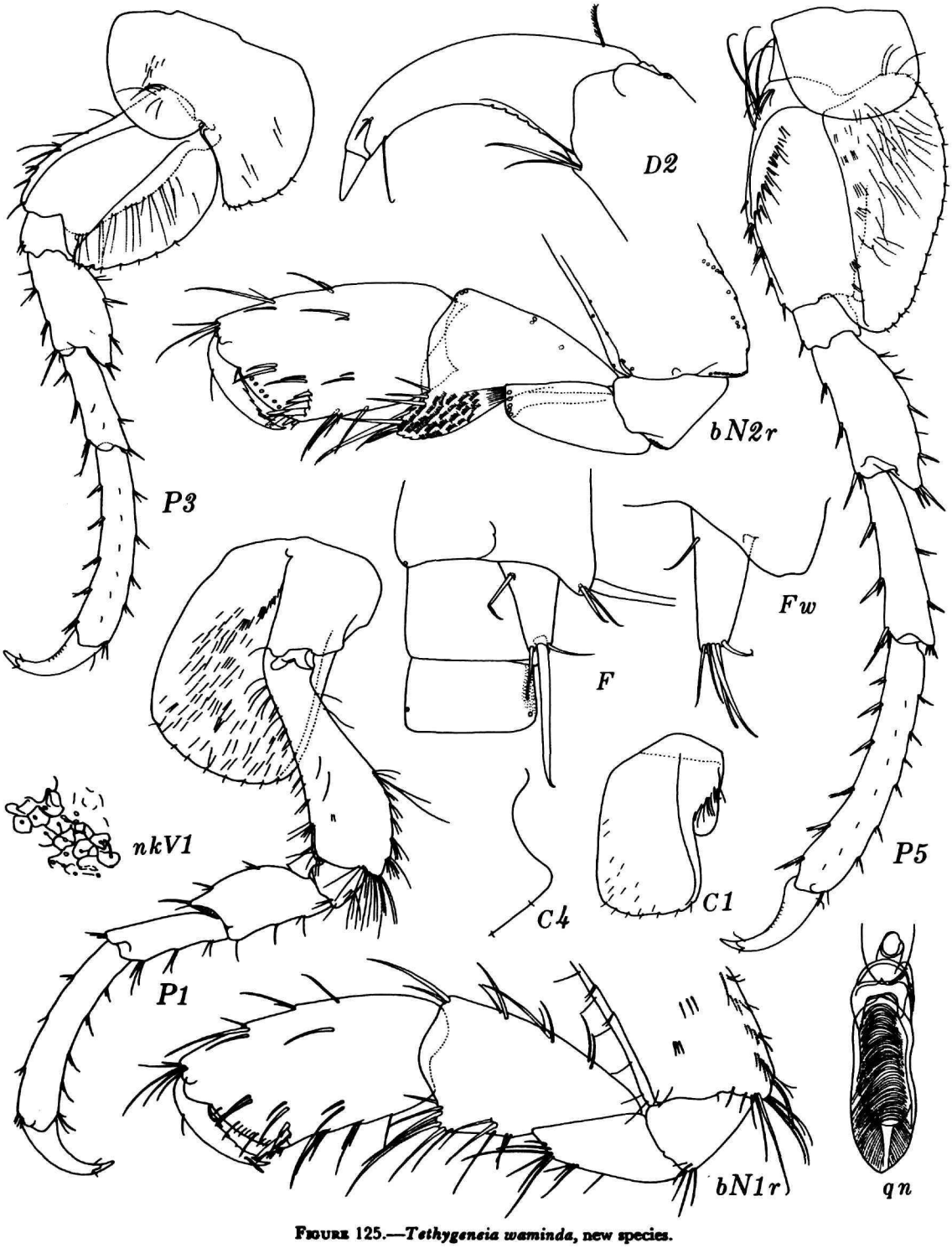



FIGURE 125.—*Tethygeneia waminda*, new species.

articles of flagellum of antenna 2 even; mandibular molars triturative, each with ragged seta, spine row on right with 3 main ragged spines, 2 slightly smaller plumose spines, 1 between 2 and 3 and 1 past 3 toward molar, left side with 4 ragged spines and 3 plumose spines, 1 between 2 and 3, 1 between 3 and 4 and 1 toward molar past 4, left lacinia mobilis serrate and clearly distinct, right appearing composed of 3 parts, 2 spines and 1 smooth membrane bearing falcations; mandibular palp approximately like *T. elanora,* article 3 bearing 2 apical spines of medium size, third spine larger, then about 10 smaller proximal spines and 3-4 basofacial setae, article 2 with about 9 spines on distal half; lower lip lacking inner lobes, mandibular lobes subtruncate and apically smooth or occasionally with very weak fringe; inner plate of

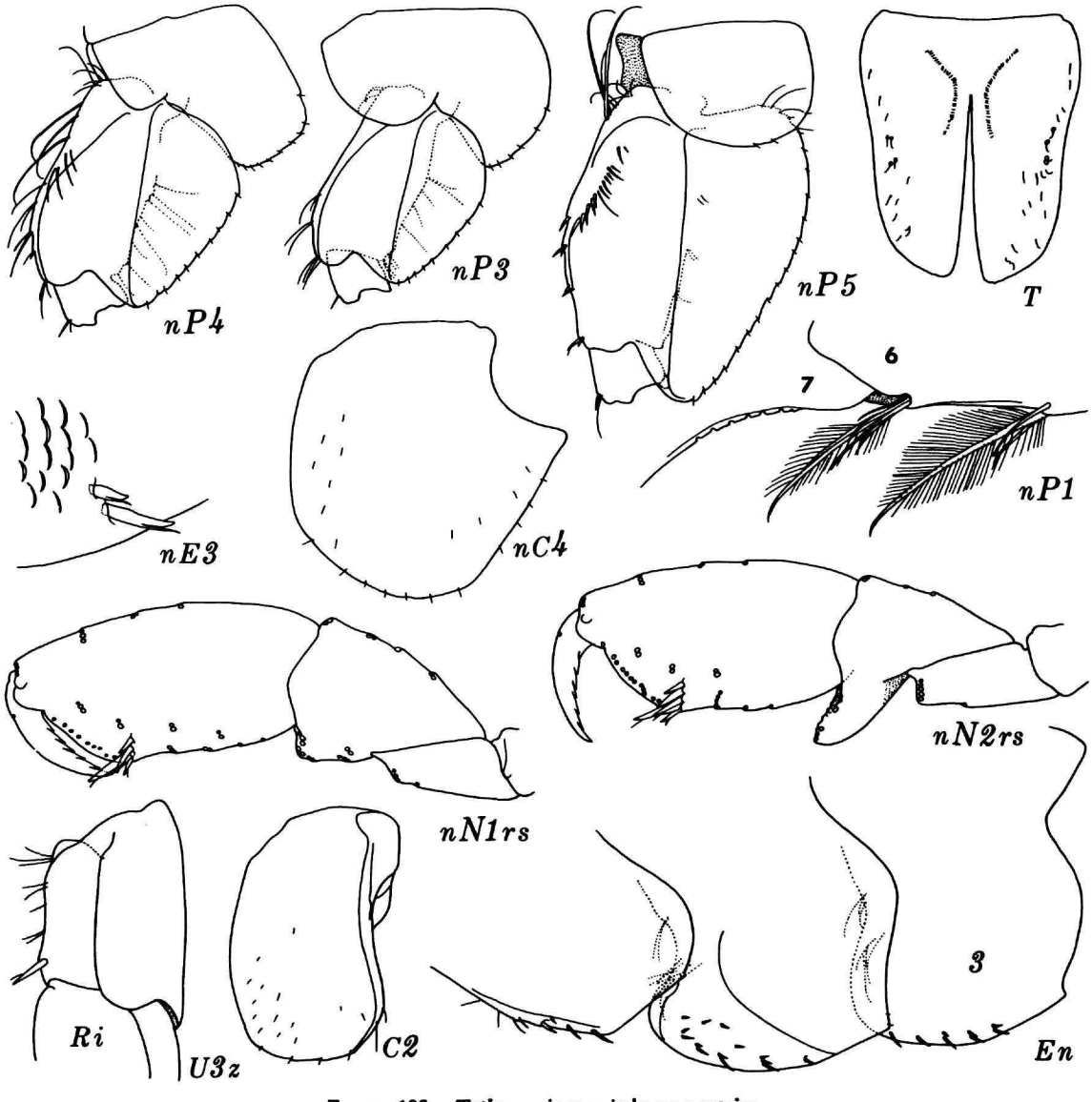



FIGURE 126.—*Tethygeneia waminda,* new species.

maxilla 1 bearing 1 giant apical seta and 4 smaller medial setae on distal half; inner plate of maxilla 2 apically and subapically fringed with small setae, mid-medial margin with 2 enlarged setae in tandem; inner plate of maxilliped with apicolateral spine separated from 2 medioapical spines by gap and hollow (cf. Figure 119*S* of *T. elanora*), article 2 of maxillipedal palp not especially broad, outer plate with facial setules irregularly arranged; coxae 1-3 lacking posterior setules, posterior lobe of coxa 4 softly rounded; article 2 of gnathopods 1-2 heavily setose posteroventrally, hands of gnathopods less elongate than in *T. elanora*, rectangular, palms evenly oblique, article 5 of gnathopods 1-2 about 80 percent the length of article 6, posterior margin of article 5 on gnathopod 1 truncate but weakly triangulate distally, on gnathopod 2 produced to medium lobe slightly guarding posterior proximal third of hand; locking spines of pereopods 1-2 really thin flexible setae; dactyls each with distal constriction, nail, medium sharp inner seta, and shorter facial seta guarding constriction; inner margin of dactyl smooth or in large adults occasionally bearing faint, broadly spaced notches resembling incipient castellations, locking setae increasing in number up to 4 or 5; locking spines of pereopods 3-5 normally stiff and slightly thickened, each with subterminal setular trigger, spines often joined by third to fourth members in form of setules, outer apical margin of article 6 at base of dactyl smooth; coxae 5-6 with elongate posterior quadriform lobe; article 2 of pereopods 3-5 broadly expanded, articles 3-7 slender, article 2 of pereopod 5 bearing facial row of setae and spines posterior to main anterior facial ridge, row anterior to ridge on pereopod 4; epimeron 1 grossly and softly rounded behind but with weak tooth (declivity) forming posteroventral tooth, epimeron 2 with sharp shallow tooth and protruding posteromiddle margin, epimeron 3 similar but protrusion deeper and tooth slightly better defined, ventral margins of epimera lined with pairs (rarely triads) of spines and face of epimeron 2 with facial spines in pairs and singles; no dorsal teeth; uropod 3 with 1 stout peduncular spine, pleonite 6 with row of tiny denticles anterodorsal to base of uropod 3; telson flat, broad, cleft more than halfway, apices broad, somewhat beveled but generally truncate, smooth lateral margins of lobes with pairs of setular sets and other setules; cuticle bearing crescents, especially prevalent on epimera, telson, article 2 of pereopods 3-5, coxae, plus frequent setules on coxae 1-4 especially.

MALE.—Like female except as follows: eyes slightly larger; accessory flagellum bearing about 5 medium-sized apical setae (not like female, bearing 1 very large and stout seta and 2 regular setae); antennal peduncles developing groups of setules on ventral margin of antenna 1 and dorsal margin of antenna 2 and anthurial calceoli on articles 4-5 of antenna 2, calceoli occurring on all articles (except few terminal) of antenna 1 flagellum, articles alternating in breadth as on female and calceoli occurring in zigzag pattern as result; alternate articles of flagellum on antenna 2 slightly swollen and calceoli occurring on all except distal articles, alternating between a recumbent position and a slightly erect position on basal half or more of flagellum; mandibular palp article 2 slightly more swollen than in female; lobes on article 5 of gnathopods 1-2 slightly more protuberant than on female and gnathopods enlarged; posterior setae on article 6 of pereopods 1-2 becoming strongly plumose and elongate.

JUVENILE (smallest, 2.9 mm).—Differing from adults in absence of facial spines on epimeron 2, presence of only single spines in tandem on ventral margins of epimera, poorly developed facial rows of setae on article 2 of pereopods 4-5 (about 2 setae); otherwise important taxonomic characters such as accessory flagellum, spine on peduncle of uropod 3, and thin locking spines of pereopods 1-2 as in adult.

EXAMPLES OF FLAGELLAR FORMULAE (of males and female; see *T. elanora* for symbols).—Female antenna 1: (1-2):1:3:2:0:2:0:2:0:2:0:3:0:2:0:2:0:2:0:2:0:3:0:2:0:2:0:2:0:0 (bulge continues) :0:0B:0:0 (terminus).

Male antenna 1 flagellum bearing aethestascs (number), a calceolus (C), and a bulge (B): (1-2):2:2:2CB:C:2CB:C:2CB:(continuing to segment 23, then commencing, as follows, on segment 24)2CB:C(B):2CB:C(B):2CB:0:2CB:0:2CB:0:1CB:0:0:0:0:0:0 (terminus).

Male antenna 2 flagellum bearing calceoli either recumbent (P) or slightly erect (E) with some segments bulging: 0:E:E:E:PB:E:PB:E:PB (continuing to segment 22, then commencing with segment 23 as follows) PB:E(slightly erect, continuing alternately to segment 34, then commencing with segment 35) PB:E:0:E:0:E:0:0:0:0:0:0:0:0(terminus).

HOLOTYPE.—WAM, female, 6.6 mm.

TYPE-LOCALITY.—JLB Australia 4, Sugarloaf Rock, Cape Naturaliste, Western Australia, intertidal, wash of algae, mainly green *Caulerpa* species, 1 September 1968.

RELATIONSHIP.—This species grossly resembles *T. elanora* so closely that microscopic examination is required to distinguish the species. In adults (or in specimens larger than 3.0 mm) the main differences appear to be the following: In *T. waminda,* epimeron 2 bears facial spines, and the ventral epimeral spines occur in pairs; the accessory flagellum is elongate; cuticular crescents occur on the epimera, coxae, and article 2 of pereopods 3-5, but these are often hard to see and may actually be absent on some specimens (unless there is a cryptic species, possibly phenotype, mixed into my identification of *T. waminda*); the peduncle of uropod 3 bears a large and conspicuous terminal spine; article 2 of pereopods 4-5 has a facial setal row. Minor characters include differences in the spine rows of mandibles (see descriptions), the ornamental formulae on antennae, the irregularly scattered setules on face of outer plate of maxilliped, the heavy posteroventral setosity of article 2 on gnathopods 1-2, the essentially smooth apices of the mandibular lobes on the lower lip, the slightly longer telson and longer denticular rows on its basal face, the slightly thinner rostrum, the larger posterior lobe on coxa 5 in the female, the slightly better developed lacinia mobilis membrane, unserrate but bearing a falcation, the presence of more than 1 basofacial seta on article 3 of the mandibular palp, and the slight differences in the shape of the gnathopods.

MATERIAL.—JLB Australia 14 (17).

DISTRIBUTION.—Southwestern Australia, intertidal.

## GAMMARIDAE

### *Ceradocus* Costa

*Ceradocus* Costa.—Stebbing 1906:430.—Sheard 1939:277.—J. L. Barnard 1969a:239.

REMARKS.—Sheard's study of the genus in Australia has been difficult to use in routine identification of the four previously known species because of the following problems: (1) Sheard's key, partially based on lateral "hairs" of the telson is apparently erroneous in this regard. He saw only one hair (plumose setule) on the midlateral margin of all four species, but I have examined three of those species and find a pair of those setules in every specimen dissected (about 15 specimens of three species). (2) He also utilized in the key the number of telsonic spines on each lobe, but this varies in certain species; for instance, *C. rubromaculatus* has only 2 spines on each lobe in all stages, but juveniles of *C. serratus* and *C. ramsayi* also have as few as 2 spines. (3) The "even" dentation of pleonites 4-5 is difficult to utilize because adolescents and occasional adults of *C. serratus* and various specimens of *C. ramsayi* do not have the middle tooth of pleonites 4 and 5 enlarged; and a new species, described herein, also has uneven dentation on pleonite 4, the uneveness being interpretive because of the wide middle gap between the 2 lateral pairs of teeth. (4) The lengths of articles 1 and 3 on the mandibular palp are difficult to measure precisely and are not highly useful in specific determinations when other characters are so readily observed. (5) For pleonal epimera, Sheard utilized terms of "barely serrate" and "well toothed" but figures were either not included to substantiate these characters, or those that were included are confusing.

The material at hand has been readily divided into four species, *C. sellickensis* Sheard not having been found. That species is like *C. rubromaculatus* in epimera and pleonal teeth, and perhaps in gland cone (vaguely in Sheard's Figure 1*c*), but it has more than 2 spines on each lobe of the telson and nearly transverse gnathopodal palms in both sexes.

Since juveniles of *C. rubromaculatus* have never been adequately reported, my remarks herein concern specimens 8 mm or larger in all four species. Juveniles of *C. serratus* as small as 4 mm, however, fit the adolescent diagnosis of that species, but they might be difficult to distinguish from juveniles of *C. rubromaculatus* if the former prove to lack the characters of epimera, gland cone, and pleonal teeth.

Though specimens of material at hand show some constant characters among species, these do not check out well with Sheard's analysis of specimens from New South Wales, and so these characters are not used in the following key. For example, my specimens of *C. ramsayi* all have a long gland cone, whereas my specimens of *C. serratus* have the shortened form. Sheard shows *C. ramsayi* with the shortened gland cone. All species at hand have a distomedial tooth on article 1 of antenna 1 and a distolateral tooth on article 3 of antenna 2, though these are poorly developed in some specimens of *C. serratus*. A large inner

tooth occurs on article 2 of antenna 2 in resemblance to the gland cone occurring on the ventral side of article 2. These characters are generally ignored by Sheard.

The definitive tooth of epimera 1-2 is defined herein as that tooth closest to the terminus of the lateral ridge; in the species at hand that tooth is generally small and has 1 or more enlarged teeth above it and generally 1 or more smaller teeth on the ventral margin anterior to it.

The anteriorly extended lateral ridge of the Port Phillip phenotype of *C. serratus* is distinctive but unknown in specimens otherwise reported in the literature. The blunt posteroventral extension of article 2 on pereopod 4 of my specimens of *C. ramsayi* is unknown in the literature. This is unusual, as the condition of that projection usually follows the sharpness of pereopod 5 in other species such as *C. rubromaculatus* and *C. serratus*.

In each of the species identified herein the 2 main dactylar setae on pereopods 1-5 are composed of 1 outer simple seta and 1 inner seta apically and subapically divided into 2-3 branches; the facial seta is simple.

My analysis of *Ceradocus* is undoubtedly oversimplified, as I have ignored one or two variant specimens appearing to represent the variations in palmar slope and armament of gnathopod 2 figured by Haswell (1885, pl. 15: figs. 5–12). Various phenotypes or species may be represented by these morphs, but the material at hand is inadequate for any further elaboration.

### Key to Species of *Ceradocus* in Australia

(Adults 8+ mm long)

1. Pleonal epimera 1-2 bearing only 1-2 (rarely 3) large or small teeth above definitive tooth. 2
   Pleonal epimera 1-2 bearing 5 or more large or small teeth or waves above definitive tooth . 3
2. Palm of gnathopod 2, whether hand large or small, very oblique, apico-conical extension of telsonic lobe reaching more than halfway along longest spine ..... *C. serratus*
   Palm of gnathopod 2, whether hand large or small, nearly transverse, apico-conical extension of telsonic lobe reaching scarcely one-third along longest spine ..... *C. ramsayi*
3. Pleonite 4 with broad dorsal midline gape, rarely bearing midline rudimentary tooth, gape bounded by pair (or more) of large teeth on each side ..... *C. dooliba*
   Pleonite 4 with teeth at midline, no conspicuous medial gape ..... 4
4. Palm of gnathopod 2 nearly transverse, each lobe of telson with more than 2 apical spines ..... *C. sellickensis*
   Palm of gnathopod 2 normally oblique, each lobe of telson with only 2 apical spines. *C. rubromaculatus*

### *Ceradocus dooliba*, new species

FIGURE 127

DIAGNOSIS.—In alcohol, eyes lacking black pigment; slit of lateral cephalic lobe deep, edges fully appressed, anteroventral corner below slit with small blunt tooth; antenna 1 with 3-4 ventral spines on article 1; simple gland cone of antenna 2 failing slightly to reach full length along article 3 of peduncle; peduncle of antenna 2 reaching fully along article 2 on peduncle of antenna 1; article 3 of mandibular palp about one-half to two-thirds as long as article 1; coxa 1 with lateral ridge highly posteriad (like *C. ramsayi*), article 4 of gnathopods 1-2 with sharp posteroventral tooth; male gnathopod 2 with simple, oblique, convex palm defined by a weak cusp; posteroventral corner of article 2 on pereopods 3-5 with sharp process but slightly less sharp than in *C. serratus*; telson with strongly attenuate apices each bearing 3-4 spines, 1 of those spines very elongate and nearly half as long as telson, plus 1 distal feathered seta and 2 basolateral feathered setae; pleonites 1-3 dorsally serrate evenly; pleonite 4 dorsally toothed unevenly, axial line with vestigial tooth, each dorsolateral margin with pair or triad of large teeth, pleonite 5 with midline free of teeth and each dorsolateral margin with pair of large teeth; pleonal epimeron 1 in young specimens (cf. 9.0 mm) with sharp posteroventral tooth, 1 ventral notch, and a few notches above main tooth; epimeron 2 with 2 ventral notches, 1 posterior notch but no sharp tooth; both epimera 1-2 with lateral ridge; adults (15.0 mm+) with epimeron 1 bearing 1 ven-

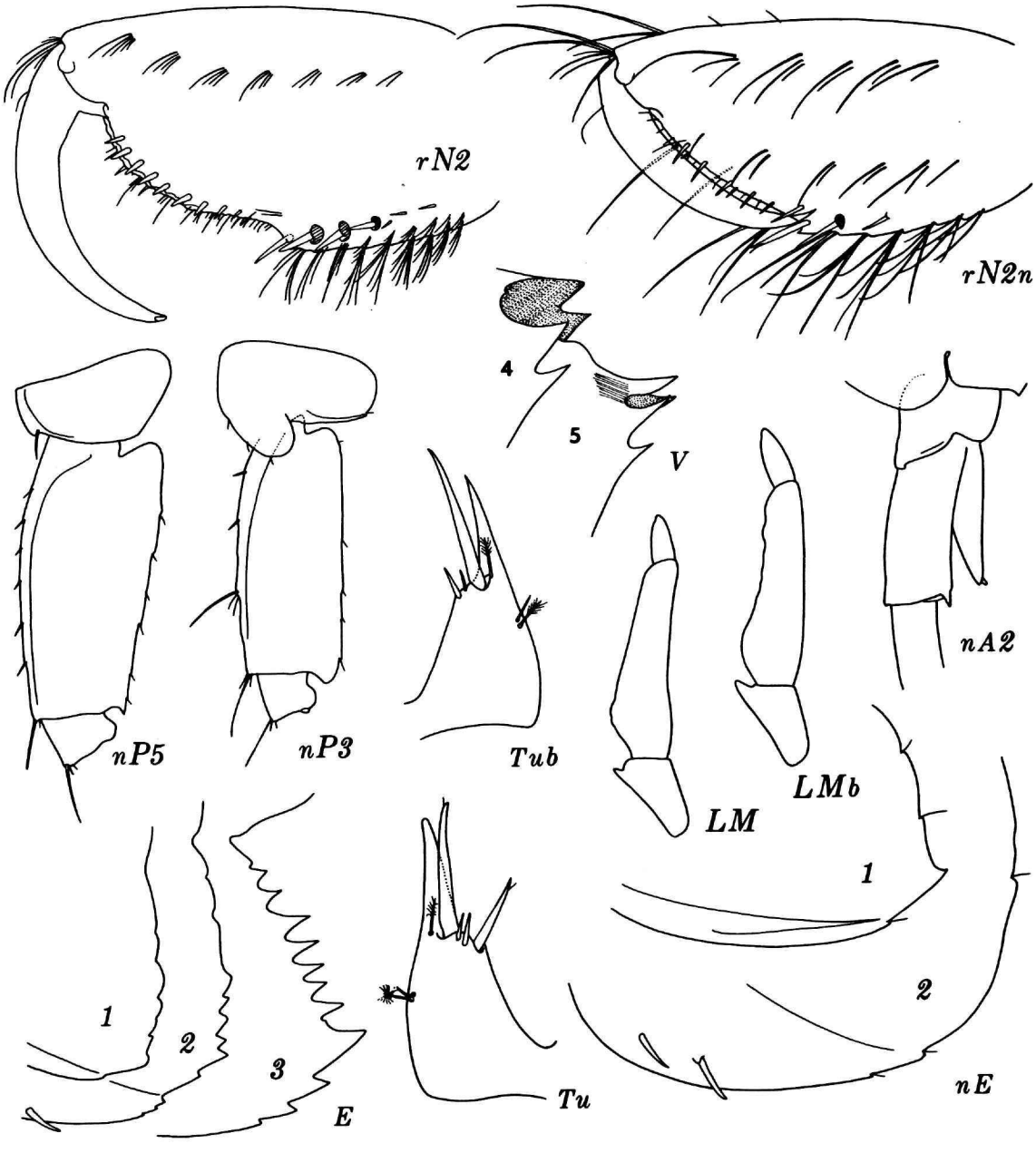



FIGURE 127.—*Ceradocus dooliba*, new species, male, 23.0 mm, Port Phillip 56; *b*=juvenile, 11.3 mm, Port Phillip 56; *n*=unknown sex, 9.0 mm, Port Phillip 86.

tral notch and weak posteroventral nob and several waves and notches above corner, epimeron 2 with weak notches on ventral margin and teeth and waves of medium size on posterior margin above corner; epimeron 3 in all stages above 9.0 mm with deep posterior teeth and about 3 teeth on ventral margin.

HOLOTYPE.—NMV, female, 20.3 mm.

TYPE-LOCALITY.—Port Phillip 56, Capel Sound, area 68, 25 June 1961.

REMARKS.—The following paragraphs are presented in the understanding that I am uncertain of my identification herein of *C. serratus* Sheard, and, therefore, *C. dooliba* must be discussed in reference to Sheard's (1939) analysis of Australian *Ceradocus*.

There is little doubt that *C. dooliba* does not represent *C. serratus* as depicted by Sheard, because the former differs from the latter in the slightly sharper corners on article 2 of pereopod 5 (though Sheard shows variation in these), in the shorter article 3 of the mandibular palp (an unsatisfactory specific character in *Ceradocus*), in the enlarged teeth of epimeron 2, and in the vestigial-to-absent teeth in the dorsal midline of pleonites 4-5.

*Ceradocus rubromaculatus* is stated by Sheard to have 2 telsonic spines on each lobe; *C. sellickensis* and *C. serratus*, 4 each on each lobe; some specimens of *C. dooliba* have only 3, and young females of *C. serratus* (identified herein) have only 2 like *C. rubromaculatus*. The number of spines, therefore, appears to be an uncertain character difference.

In *C. rubromaculatus* and *C. serratus*, Sheard has not clearly indicated the tooth pattern on pleonites 4-5, which is significantly distinctive on *C. dooliba* (if I have properly identified the former two species by other means). One must pursue, by a process of elimination, the identification of *C. dooliba* out of Sheard's analyses of the other species; it differs from *C. rubromaculatus* on the weakness of serrations on pleonal epimera 1-2, plus the presence of more than 2 spines on each telsonic lobe (adults only are present); it has the same telsonic spine formula as *C. sellickensis*, but that species has a notably distinct gnathopod 2 with the palm being nearly transverse; there are strong similarities in epimera, however; the neozelanican *C. chiltoni* has palmar sculpture on male gnathopod 2, and apparently it has evenly distributed dentation on pleonites 4-5; *C. ramsayi* has a significantly enlarged mediodorsal tooth on pleonites 4-5; hence, the material at hand more closely resembles *C. serratus*. Sheard's description (no figures) of epimera 1-2 in the latter weakly conform only to the youthful stages of the material at hand.

One turns, in the following paragraphs, to comparisons based not so much on Sheard's work but on the material at hand.

If the Port Phillip phenotype of *C. serratus* is indeed a portion of that species, then *C. dooliba* differs from *C. serratus* in the development of distinct tooth-waves consistently on epimeron 2 above the main posteroventral corner, in the lateral ridge of coxa 1 occurring highly posteriad, and in the ventral gape between the dorsal teeth on pleonites 4-5; thus, in *C. serratus* a midline tooth is always present, whereas in *C. dooliba* a middle tooth is absent on pleonite 5 and only a rudiment occurs on pleonite 4.

Some specimens of *C. rubromaculatus* have a middle tooth on pleonite 5 and others have the gaped situation of *C. dooliba*. The presence of weak though distinct tooth waves on epimeron 2 of *C. dooliba* suggests it has strong affinities with *C. rubromaculatus*. *Ceradocus dooliba* also resembles *C. rubromaculatus* in the normal posteriad position of the lateral ridge on coxa 1, in contrast to the condition in the Port Phillip phenotype of *C. serratus*. *Ceradocus dooliba* differs from *C. rubromaculatus* mainly in the weak teeth of epimera 1-2, the slightly shortened gland cone, the failure of that gland cone to develop a large apical accessory cusp, the strong middle gape lacking any but 1 rudimentary tooth on pleonite 4, and the presence of more than 2 spines on each lobe of the telson. Whether some previous records of *C. serratus* and *C. rubromaculatus* represent this species is unknown.

MATERIAL.—Port Phillip 4 (3), 56 (11), 80 (2), 86 (11), 88 (4), 89 (3); JLB Australia 4 (1 ?juvenile).

DISTRIBUTION.—Warm-temperate Australia, mainly sublittoral in bays.

### *Ceradocus ramsayi* (Haswell)

FIGURE 128

*Melita (?) Ramsayi* Haswell, 1880b:264–265, pl. 10: fig. 1.
*Maera rubromaculata*.—Stebbing 1888:1008–1014, pls. 95A, 96B [not Stimpson].
*Ceradocus (Denticeradocus) ramsayi*.—Sheard 1939:283–285, fig. 3 [with references].

DIAGNOSIS.—In alcohol, eyes lacking black pigment; slit of lateral cephalic lobe deep, edges fully

appressed, anteroventral corner below slit with small sharp tooth; antenna 1 with 4-5 ventral spines on article 1, distalmost spines each paired with 1 or more setae; gland cone of antenna 2 simple, reaching or exceeding apex of article 3 of peduncle; peduncle of antenna 2 well exceeding peduncle of antenna 1; article 3 of mandibular palp about two-thirds as long as article 1; coxa 1 with lateral ridge highly posteriad; article 4 of gnathopods 1-2 with sharp posteroventral tooth; gnathopod 2 alike in both sexes, highly unequal

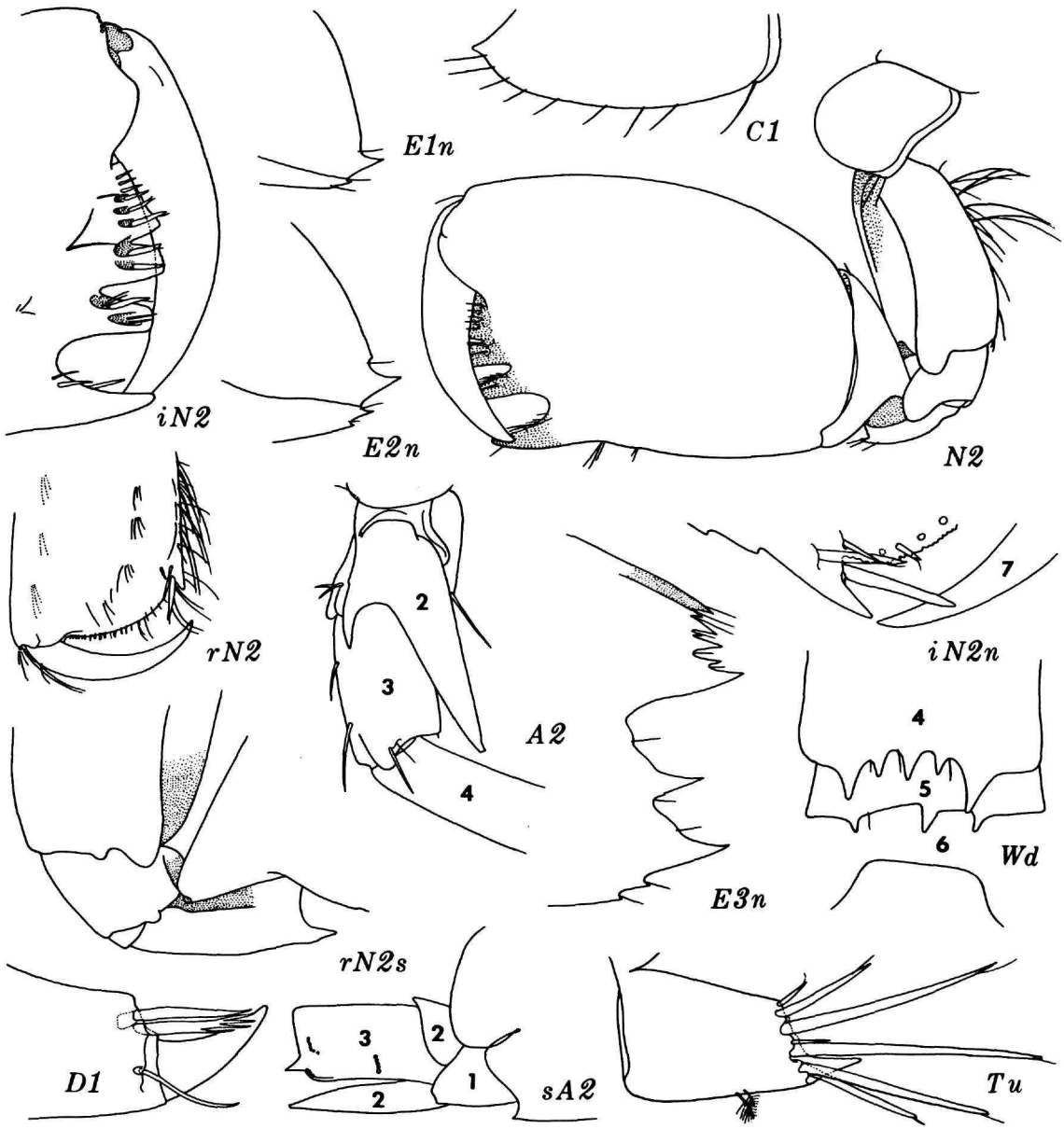



FIGURE 128.—*Ceradocus ramsayi* (Haswell), female, 9.3 mm; *n*=male, 8.5 mm; both from BAU 2.

on left and right sides (either side not consistently enlarged), smaller gnathopod 2 with subtransverse, simple, convex palm defined by tooth, large gnathopod with subtransverse, convex palm bearing elongate defining tooth and 0-2 other palmar sinuses dividing off 1-3 other truncate teeth not reaching quite as far as defining tooth, articles 2-3 with large anterodistal lobes on both faces; posteroventral corner of article 2 on pereopods 3-4 with blunt projection, very sharp and long but not attenuate on pereopod 5; telson with weakly attenuate apices, each bearing 4-7 spines, generally 2-4 spines elongate, 1 apicolateral feathered seta (hidden in Figure 128*Tu*), and 2 basolateral feathered setae; pleonites 1-3 dorsally serrate evenly or lateralmost tooth on pleonite 3 enlarged, pleonite 4 generally with 5 dorsal teeth, each lateral tooth slightly to strongly enlarged, tooth on midline slightly smaller than extreme laterals but larger than laterals next contiguous; dorsal teeth of pleonite 5 variable, either (a) with 1 midline tooth slightly enlarged and 1 tooth on either side of it, or (b) with 4 teeth altogether, middle pair enlarged and embracing midline gap; thus, from side view in either case (a, b), and including pleonite 4, specimens appearing to have enlarged middle tooth as stated by Sheard; pleonal epimera 1-2 each with small definitive tooth, 1 large tooth above and 0–1 tiny tooth below; epimeron 3 with 2-4 large posterior teeth and 1-2 small posteroventral teeth: epimera 1-2 with lateral ridge.

Remarks.—Numerous specimens from Banner BAU-2 have epimeron 3 bearing only 2 large posterior teeth but other specimens have 4 like those described by Sheard (1939); he did not mention whether males and females of his specimens had identical gnathopods as they do in these materials. The lobes of articles 2-3 on the small gnathopod and in juveniles are small to absent, especially being obsolescent on article 3. The male from Burraneer Bay in collections from the Sydney Museum has the dorsal teeth of pleonite 4 arranged in coronate fashion like those of adults in the Port Phillip population of *C. serratus*; this tendency is especially apparent in the individuals at hand from western Australia.

Material.—Banner BAU 2 (2), 3 (1); WAM Bunbury (1); Australian Museum, Sydney, Catalog P 15921, Shiprock, Burraneer Bay, Port Hacking, collected by A. Healey, 19 November 1967 (1 male).

Distribution.—Warm-temperate Australia, littoral and sublittoral.

## *Ceradocus rubromaculatus* (Stimpson)

Figure 129

*Gammarus rubromaculatus* Stimpson, 1855:394.
*Moera rubromaculata.*—Haswell 1880b:267–268, pl. 10: fig. 4.
*Ceradocus (Denticeradocus) rubromaculatus.*—Sheard 1939: 280–283, fig. 2.

Diagnosis (8+ mm).—In alcohol, eyes lacking black pigment; slit of lateral cephalic lobe deep, edges fully appressed, anteroventral corner below slit with small sharp tooth; antenna 1 with 3-4 ventral spines on article 1; gland cone of antenna 2 reaching or exceeding apex of article 3 of peduncle and bearing small-to-large accessory cusp; peduncle of antenna 2 well exceeding peduncle of antenna 1; article 3 of mandibular palp two-thirds as long as, or subequal to, article 1; coxa 1 with lateral ridge highly posteriad (like *C. ramsayi*); article 4 of gnathopods 1-2 with sharp posteroventral tooth; male gnathopod 2 with oblique convex palm, usually smooth and defined by weak cusp, but specimens from Western Australia bearing deep distal notch separating off distal tooth; posteroventral corner of article 2 on pereopods 3-5 with sharp process; telson with moderately attenuate apices each bearing 2-4 spines, generally only 2 spines highly elongate, plus 1 distal feathered seta and 2 basolateral feathered setae; pleonites 1-3 dorsally serrate evenly or some lateral teeth on pleonite 3 enlarged; pleonite 4 dorsally toothed evenly, middle tooth not larger than any other lateral tooth, but occasionally slightly larger than contiguous laterals; pleonite 5 with 3, 4, or up to 8 or 9 teeth, variable, occasionally with rudimentary to fully developed midline tooth, latter not larger than some laterals, often with midline tooth missing, thus appearing to have middle gap, this condition especially prevalent in specimens bearing only 4 teeth total, some lateral teeth becoming highly enlarged; pleonal epimera 1-3 grossly serrate posteriorly and slightly below, with at least 5 large teeth above small definitive tooth, epimera 1-2 with lateral ridge.

Remarks.—Sheard (1939) wrote that *C. rubromaculatus* never develops palmar ornaments on gnathopod 2, but specimens from Western Australia often have a palmar notch separating off a distal tooth as figured herein. The accessory cusp on the gland cone is often very small, but occasionally extraordinarily large and reverted. Unlike *C. serratus* and *C. dooliba* described herein, the presence or absence of a midline

tooth on pleonite 5 is inconsistent in *C. rubromaculatus*.

The presence of more than 2 spines on each lobe of the telson is especially characteristic of specimens from Western Australia; they have 2 long and 2 short spines.

MATERIAL.—Port Phillip 12 (2), 38 (1), 67 (3), 87 (1), 89 (2); WAM, Favourite Islands (1); WAM, Cottesloe, July 1926, determined by C. Chilton (2); WAM, Garden Island, beam trawl (1); WAM, Cockburn Sound 31 (1); Banner BAU 2 (1).

DISTRIBUTION.—Warm-temperate Australia, littoral and sublittoral.

### *Ceradocus serratus* (Bate)

FIGURES 130–131

*Megamoera serrata* Bate, 1862:226, pl. 39: fig. 5.

*Moera spinosa* Haswell 1880b:268, pl. 10: fig. 5.—Haswell 1885:105, figs. 5–12 [part].

*Ceradocus (Denticeradocus) serrata*.—Sheard 1939:285–288, figs. 4, 5*a-m* [with references].

This material from Port Phillip Bay apparently represents the form described by Sheard (1939) and found in Western Port, a short distance from Port Phillip.

DIAGNOSIS (of bay form).—In alcohol, eyes lacking black pigment; slit of lateral cephalic lobe deep, edges fully appressed, anteroventral corner below slit with small sharp tooth; antenna 1 with 3 ventral spines on article 1; simple gland cone of antenna 2 reaching 60 percent along article 3 of peduncle; antenna 2 reaching only 67 percent along article 2 of peduncle on antenna 1; article 3 of mandibular palp as long as article 1; lateral ridge on coxa 2 placed somewhat anteriad; article 4 of gnathopods 1-2 with sharp posteroventral tooth; female gnathopod 2 with simple,

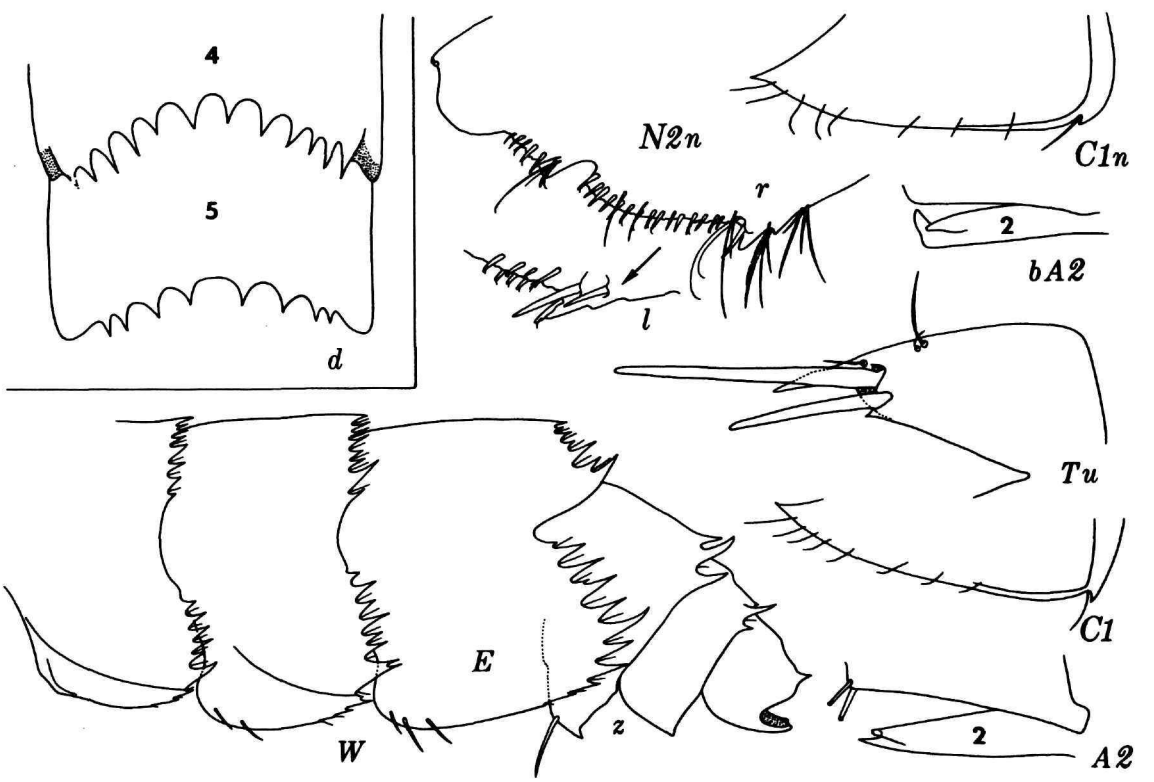



FIGURE 129.—*Ceradocus rubromaculatus* (Stimpson), female, 12.3 mm, Port Phillip 89; *b*= male, 11.2 mm, Port Phillip 38; *n*=male, 11.0 mm, WAM 31. *Ceradocus* species, male, 13.3 mm, Port Hacking (*d*=dorsal pleonites).

oblique palm defined by weak cusp; male gnathopod 2 with variable gnathopod 2, left occasionally small and like female, or enlarged and bearing large falconiform process near base of dactyl, process defined by sinus, remainder of palm with straight oblique margin and not defined, right gnathopod 2 either larger or smaller than left, bearing 1 weak notch and rudimentary falconiform process or process slightly enlarged and joined by second subquadrate process also defined by sinus; posteroventral corner of article 2 on pereopods 3-5 with sharp process; telson of adolescent female with strongly attenuate apices each bearing 2 spines, 1 spine nearly as long as telson, plus 1 distal feathered seta and 2 basolateral feathered setae, adolescent male telson with apices much less attenuate and apical spines very short, adults with 4-5 spines on each lobe; pleonites 1-3 dorsally serrate evenly; in adolescents pleonite 4 dorsally bearing 6 teeth subequal in length to each other, occasionally lateralmost tooth slightly elongate, middle of dorsal edge with teeth evenly spaced, pleonite 5 always with middle tooth, with 6 small teeth of even size and even distri-

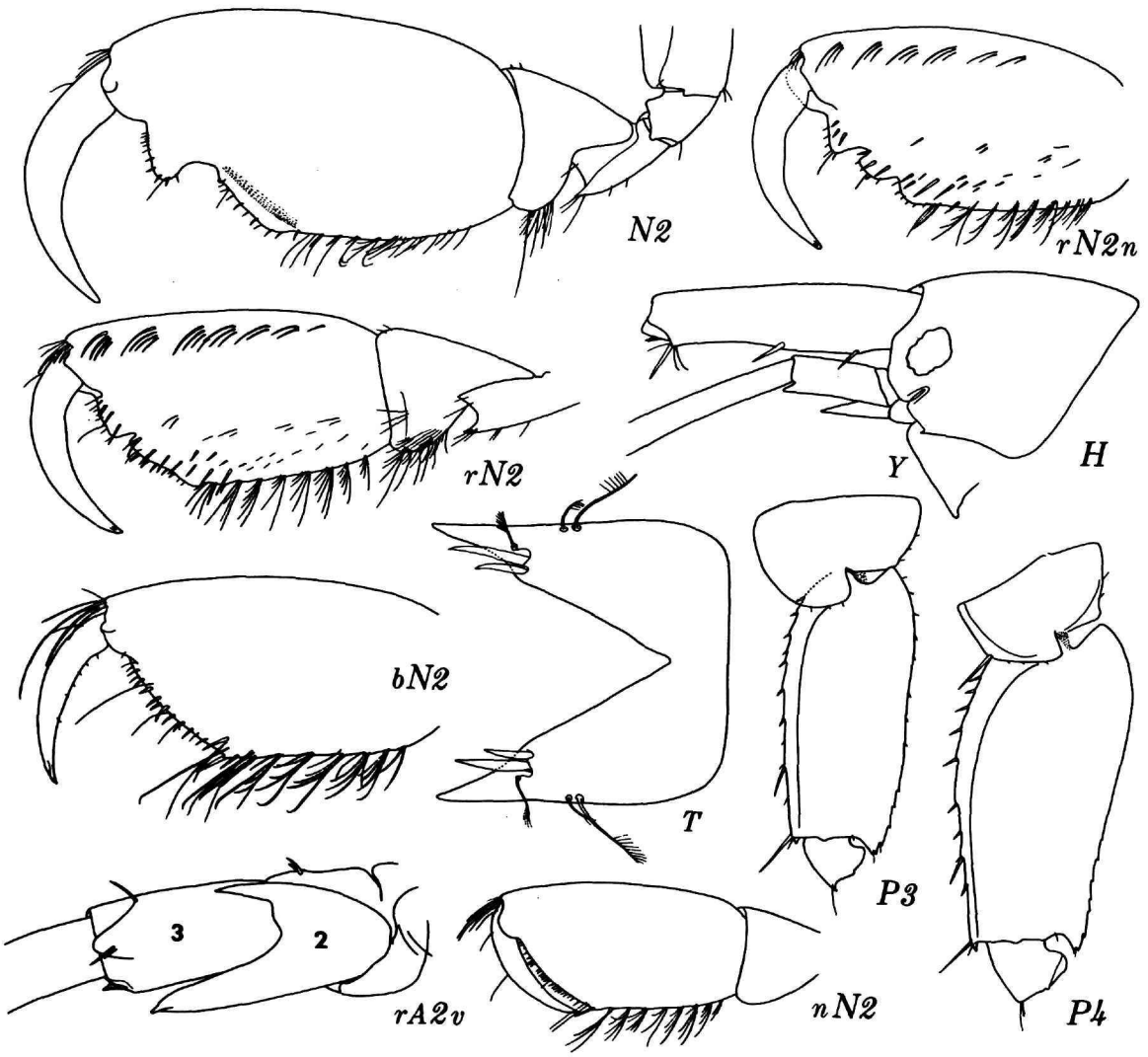



FIGURE 130.—*Ceradocus serratus* (Bate), male, 10.4 mm, Port Phillip 88; *b*=female, 9.0 mm, Port Phillip 88; *n*=male, 8.2 mm, Port Phillip 88; *v*=male, 15.4 mm, Port Phillip 16.

bution or middle tooth enlarged. Adults with 9 dorsal teeth on pleonite 4 arranged coronately, middle tooth sometimes enlarged, pleonite 5 with 1 large tooth in middle and 2 laterals each side; pleonal epimera 1-2 with small, sharp definitive posteroventral tooth, small notch on ventral margin below main tooth and 2 small-to-medium teeth above definitive tooth, both epimera with lateral ridge, epimeron 2 with or without weak waves above main tooth, epimeron 3 grossly serrate on posterior margin and with 2-3 gross serrations on posterior part of ventral margin.

RELATIONSHIP.—The even distribution of teeth on

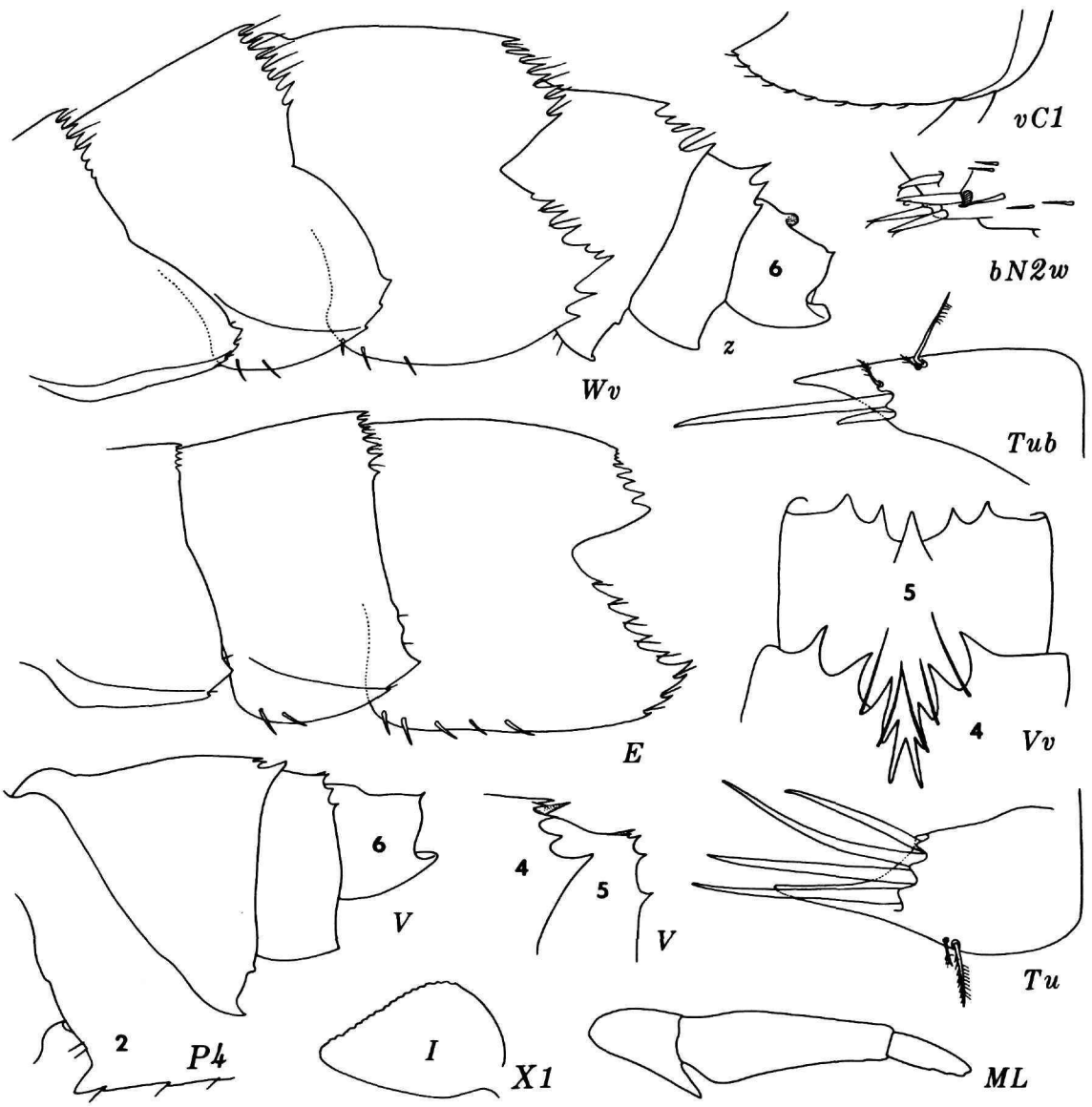



FIGURE 131.—*Ceradocus serratus* (Bate).

pleonites 4-5, the presence of a strong sharp tooth on epimeron 2, the shortened gland cone, the shortened peduncle of antenna 2, and the long article 3 of the mandibular palp distinguish this species from *C. dooliba*. That species might be considered in the category of a cryptic or sibling partner of *C. serratus* and may heretofore have been identified as juveniles of *C. serratus*. Sexual characters of males and females appear at least as early as a body length of 8.2 mm, but no juveniles smaller than that size are in the collections. Males of *C. dooliba* do not develop penial processes until a body length of about 11.0 mm is reached; no specimens of *C. dooliba* smaller than about 9.0 mm are available. Specimens of both species with body lengths of 9-11 mm have been compared to determine whether *C. dooliba* simply represents a transformation of *C. serratus* to adult stages; both species may be distinguished in those body sizes, but there is only negative evidence that one does not transform into the other. No intergrades have been found in mandibular palp, gland cone, epimeron 2, and pleonites 4-5, but the female of *C. serratus* in contrast to the male has a telson characteristic of *C. dooliba*. Uropod 1 of both species has a basolateral spine and a large distolateral spine on the peduncle. The heads are nearly identical, the small tooth of *C. dooliba* being slightly more blunt. Gnathopod 1 and pereopods 1-2 are similar in both species.

MATERIAL.—Port Phillip 16 (5), 48 (1), 56 (1), 88 (5).

DISTRIBUTION.—Southeastern Australia, littoral and sublittoral.

### *Ceradocus* species

FIGURE 129 (part)

MATERIAL.—Australian Museum, Sydney, Catalog P 15921, Shiprock, Burraneer Bay, Port Hacking, collected by A. Healy, 19 November 1967 (male, 13.3 mm).

This specimen has pleonal epimera like *C. rubromaculatus*, an oblique palm on gnathopod 2, telsonic lobes with 3 and 4 spines each, and a simple gland cone. The oblique palm on gnathopod 2 removes this specimen from *C. sellickensis*, but in other respects it bears characters of that species. The simple gland cone and more than 2 spines on each telsonic lobe remove the specimen from *C. rubromaculatus*.

## *Maera* Leach

### POSSIBLE REVIVAL OF *Linguimaera* PIRLOT AS A SUBGENUS OF *Maera* LEACH

*Linguimaera* Pirlot (1936), established to represent *L. othonides* (Walker), was characterized solely by the enlarged sagittal lobe of the upper lip. Schellenberg (1938:49) implied the synonymy of *Linguimaera* and *Maera* by his statement "die Keinerlei systematische Bedeutung besitzt."

There is one other character of *Linguimaera* that seems to have some importance as the mark of a species flock, the notch on the cephalic cheek, which does not occur in the type-species of *Maera, M. grossimana* (Montagu). The presence of the cheek notch in combination with carinae on pleonite 4 is utilized herein to distinguish the new genus *Mallacoota* from *Maera*; however, in *Melita*, another genus of Gammaridae, the presence or absence of a cheek notch has been accorded only specific value. There may be some purpose in studying the members of *Melita* that have lost the cheek notch in order to determine whether they have other characters in common, which might cause them to be assembled as a subgenus. The problem of the cheek notch is prevalent in the genera *Eriopisa, Eriopisella,* and *Nuuanu* (see J. L. Barnard, 1970a). The genus *Ceradocus* is also characterized by the presence of a cheek notch, and some of the species of *Maera* bearing the cheek notch have a strong external resemblance to members of *Ceradocus*. This is especially true of *Maera mastersi* because of the many posterior teeth on epimeron 3 and the pair of teeth on epimeron 2. *Maera mastersi*, however, differs from the five known species of *Ceradocus* from Australia in the absence of a cusp on article 1 of the mandibular palp, the elongate article 3 of the mandibular palp, the absence of dorsal serrations on the pleonites, and the characters heretofore used mainly to distinguish *Ceradocus* from *Maera*: the absence of strong medial setae on the inner plates of maxillae 1-2. The species of *Ceradocus* examined by me also have a large inner tooth on article 2 of antenna 1 not occurring in *M. mastersi*.

Whether the Australian *M. mastersi* signals any significant relationship between the *Linguimaera* section of *Maera* and the genus *Ceradocus* is a question to ponder. Unfortunately, the only species of the section fairly well described is *M. mastersi*, and it is not the type of *Linguimaera*. Perhaps the *Linguimaera* section and *Ceradocus* are merely convergent in gnath-

opods, epimera, and cephalic notch, but there is also a general resemblance in the telson between *Maera* in general and *Ceradocus*, although the species of *Ceradocus* generally have the telson in the extreme condition of extended apices and elongate spines. A second example of character convergence—and one complicating the free use as a unique generic character of the cuspidate article 1 on the mandibular palp of *Ceradocus*—is the New Zealand species *Maera tepuni* J. L. Barnard (in press). That species is a typical *Maera* in the absence of a cephalic notch (though a weak indication of one is present), the poorly setose maxillae, and, most importantly, the completely ordinary telson with broad lobes and weak spines, similar to some members of *Maera* and *Elasmopus*. But *Maera tepuni* has a cuspidate article 1 on the mandibular palp like the genus *Ceradocus*.

The final complication reducing the value of the cheek notch is the fact that the type-species, *Ceradocus orchestiipes* Costa, from the North Atlantic Ocean, lacks the cheek notch. All other species of *Ceradocus* from the North Atlantic Ocean or from the high circumboreal waters apparently also lack the cheek notch. Kunkel's two species from Bermuda, *C. colei* and *C. parkeri*, are unknown for this character. Thus, *C. orchestiipes* Costa, *C. torelli* (Goës), *C. baffini* Stephensen, and *C. sheardi* Shoemaker lack the notch. All of the Pacific Ocean and Indian Ocean species, including those from the low North Pacific in California and Hawaii, bear the cheek notch. Hence, the presence or absence of a cheek notch can be shown to occur in *Maera*, *Ceradocus*, and *Melita*. It therefore, appears to have no full generic value in this context, though it may signify relationships among flocks of species within those genera and thus have significance at subgeneric level. So far, it has geographic significance in *Ceradocus*, but not in *Melita* and *Maera*.

The many characteristically deep serrations on epimeron 3 and the 2 each on epimera 1-2 of *M. mastersi* also may have some significance in finding relationships among various species in the *Linguimaera* section of *Maera*. Unfortunately, this character is not well explored among the various species presumed to belong to *Linguimaera*, but it occurs in the material identified as *M. othonides* by Pirlot (1936), *M. othonopsis* Schellenberg (1938), and in the material identified as *M. hamigera* by J. L. Barnard (1965). Serraations, however, both below and above the main posteroventral tooth on epimeron 3, also occur in various ordinary species of *Maera* such as *M. othonis* (Milne Edwards) from the North Atlantic Ocean, *M. serrata* Schellenberg from the tropical Pacific, and *M. tepuni* J. L. Barnard (in press) from New Zealand. Serrations or extra teeth on epimera 2-3, however, appear to be confined to some of the species with a cephalic notch herein placed in *Linguimaera*.

The revival of *Linguimaera* cannot be made legitimately until the question of Pirlot's identification of *M. othonides* Walker is clarified. Since Pirlot cited Walker's species as the type of *Linguimaera* and since there is some question whether or not Pirlot had Walker's species in hand, there remains a possibility that the validity of *Linguimaera* would have to be considered by the International Committee on Zoological Nomenclature under Article 70a of the *Code*.

Regardless of name, the concept that the taxa listed below represent a species flock with interconnected ancestry seems presently worth investigation. Some of the apparent taxa in the group are poorly described and may require establishment of new names. Except in the limited statement below, it is not worthwhile now discussing why the various identifications appear as distinct species.

The list of species and presumed species in the *Linguimaera* section of *Maera* are as follows:

*?Maera othonides* Walker (1904)
*Linguimaera othonides* of Pirlot (1936)
*?Maera othonides* of Chilton (1921b)
*?Maera othonides* of K. H. Barnard (1935)
*Maera mastersi* (Haswell)
*?Maera hamigera* (Haswell)
*Maera hamigera* of J. L. Barnard (1965)
*?Maera boeckii* (Haswell)
*?Elasmopus boeckii* of K. H. Barnard (1916)
*?Elasmopus laevis* K. H. Barnard (1916)
*Maera bruzelii* Stebbing (1888)
*Maera* species A of J. L. Barnard (1970a)
*Maera othonopsis* Schellenberg (1938)

Note on identification of *M. othonides* Walker (1904). The original description and figures were very slim. One is required to examine illustrations of *M. othonis* (Milne Edwards) from Europe to make assumptions on characters Walker did not describe. Walker wrote that article 3 of the mandibular palp was "considerably" shorter than article 2. Pirlot (1936) noted that article 3 is "beaucoup plus court" than the second. Nayar (1959) has identified as *M. othonides* a very unique species in the Gammaridae, because it combines the palp article 3 shortness of

*Ceradocus* (but the absence or only faint indictation of a cusp on article 1) with the maxillae of the genus *Maera* and a telson apparently either badly squashed or with some medial fusion of the lobes. Gnathopod 2 of Nayar's specimens is grossly enlarged, whereas in Pirlot's material it is small, thin, and rectangular, and one infers the small gnathopod from Walker's original description. Nayar's specimens also have dorsal pleonal denticulation typical of *Ceradocus*. His specimens presumably should be placed in a new genus, but whether his or those of Pirlot belong with Walker's species is highly questionable.

### *Maera mastersi* (Haswell)

FIGURE 132

*Megamoera Mastersii* Haswell, 1880b:265–266, pl. 11: fig. 1.
*Megamoera thomsoni* Miers, 1884:318–319, pl. 34: fig. B.
*Maera mastersii*.—Stebbing 1906:439.
*Maera mastersi*.—Sheard 1936b:177–179, fig. 3.—J. L. Barnard, in press [New Zealand material].

REMARKS.—These specimens either differ from those figured by Sheard (1936b, Sellick Beach, South Australia), or else Sheard overlooked and underemphasized these characteristics: gnathopod 1, arti-

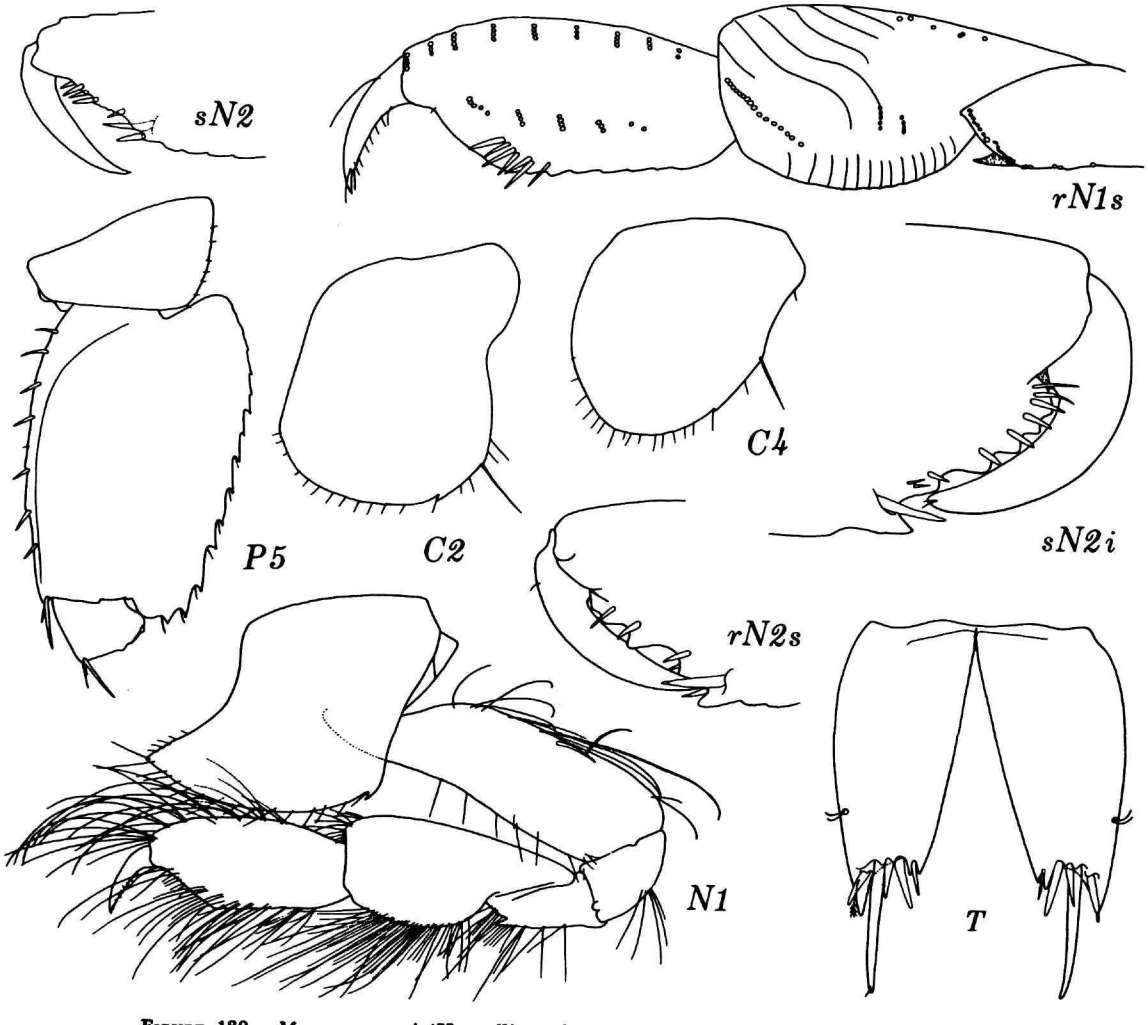



FIGURE 132.—*Maera mastersi* (Haswell), male, 12.1 mm; *n*=male, 11.8 mm; both from Port Phillip 83.

cle 4, bears a sharp cusp; articles 5 and 6 of gnathopod 1 are disproportionate in the sense that article 6 is attached asymmetrically to article 5 and is much thinner than 5; coxae 1-2 have a sharp posteroventral cusp, coxae 3-4 have a weak cusp, and coxa 4 is broadened and has a stout seta on the midposterior, highly oblique margin. All of these characters represent differences from the New Zealand specimens. The adult telson of Port Phillip specimens is far more spinose than that in Sheard's drawing, but it differs from the New Zealand telson only in the absence of a subterminal medial spine on each lobe. The various morphs of gnathopod 2 in Port Phillip specimens do not have the uneveness of tooth distribution seen in New Zealand material. Posterior teeth on article 2 of pereopods 3-5 are far larger than those in New Zealand material, cusps on pleonal epimera 1-2 are smaller, and New Zealand specimens have a distinct cusp on pereopodal dactyls at the base of the main setule not occurring on Australian specimens. Since these differences have subspecific value, the New Zealand material probably should be relegated to subspecific status, but my New Zealand material (J. L. Barnard, in press) is sparse, and I hesitate coining a name until more New Zealand specimens can be examined and more specimens from the Australian eastern coast can be studied. The specimens from Western Australia fit the remarks made for the materials from Victoria. The enlarged gnathopod 2 occurs on either right or left sides.

MATERIAL.—Port Phillip 10 (4), 26 (2), 40 (1), 47 (6), 83 (10), 88 (1); WAM, Bunbury (2); WAM, Favourite Islands (1); WAM, Point Peron, 1929 (2).

DISTRIBUTION.—Warm-temperate Australia, mostly sublittoral.

### *Maera viridis* Haswell

FIGURES 133–135

*Moera viridis* Haswell, 1880c:333–334, pl. 21: fig. 2.
*Elasmopus viridis*.—Stebbing 1906:445; 1910a:683.—?Chevreux 1908:482.
*Maera viridis*.—Chilton 1916: 362–365, figs. 3, 4; 1921a:73.
*Maera inaequipes*.—Hale 1929:214–215, fig. 212 [not Costa].

NOMENCLATURE.—This species bore the name "*M. inaequipes* (Costa)" for a period of time; Hale cited it as such; and J. L. Barnard (1962), in a key to *Maera*, grouped it and several other species under the name. J. L. Barnard (in press) discussed the species of *Maera* with a transverse palm on gnathopod 2 under the name "*Maera incerta* Chilton." They are best known as the *quadrimana* complex after a typical species belonging to the group. There are about 10 different kinds of material from around the world in the literature belonging to this complex, and most of these have a name available. None of these species is the Mediterranean *M. inaequipes*, which has an oblique palm on gnathopod 2. Each has some small difference from another, in many cases the difference occurring on the male gnathopod 2. They may be races of a common stem, or they may be distinct species. I favor presently retaining a name for each, because Hawaii, for example, has two species of the complex, which indicates, by means of sympatric occurrence, that the various other elements of the complex, though allopatric, also may be good species rather than geographic races.

MORPHOLOGY.—In addition to the figures presenting the morphology of *M. viridis*, the following attributes are characteristic: the left mandible has 7 spines and the right has 6 in the spine row; the inner plate of maxilla 1 bears 2 large apical setae and 1-2 small subapical members in addition to the normal hairs on the medial margin; the inner plate of maxilla 2 has 1 or 2 slightly disjunct apicomedial setae; the lower lip has 5-6 tiny cones in tandem, forming a compact group on the apicomedial margin of each outer lobe; these are scarcely distinct from setae.

RELATIONSHIPS.—*Maera incerta* Chilton and *M. viridis* Haswell were maintained as distinct species by J. L. Barnard (in press). In the brief diagnoses of the species, he pointed out characters of the telson in *M. incerta* as unique to this group of *Maera*, but these same characters are found to be typical of *M. viridis* in contradistinction to the original description of the species. *Maera incerta* and *M. viridis* both have apically bifid lobes and 1 disjunct lateral spine. But comparison of New Zealand and Australian specimens, now possible, shows that the two species differ in other characters: *M. incerta* has only 1 accessory tooth on the tooth on the dactyls of the pereopods, whereas *M. viridis* has 3; the anteroventral cephalic tooth of *M. incerta* is much longer and thinner than that in *M. viridis*, and it is slightly twisted axially in contradistinction to *M. viridis*.

*Maera viridis* resembles *Maera* species from California (see J. L. Barnard, 1959, cited as *M. inaequipes*), but it differs in the absence of stout spines

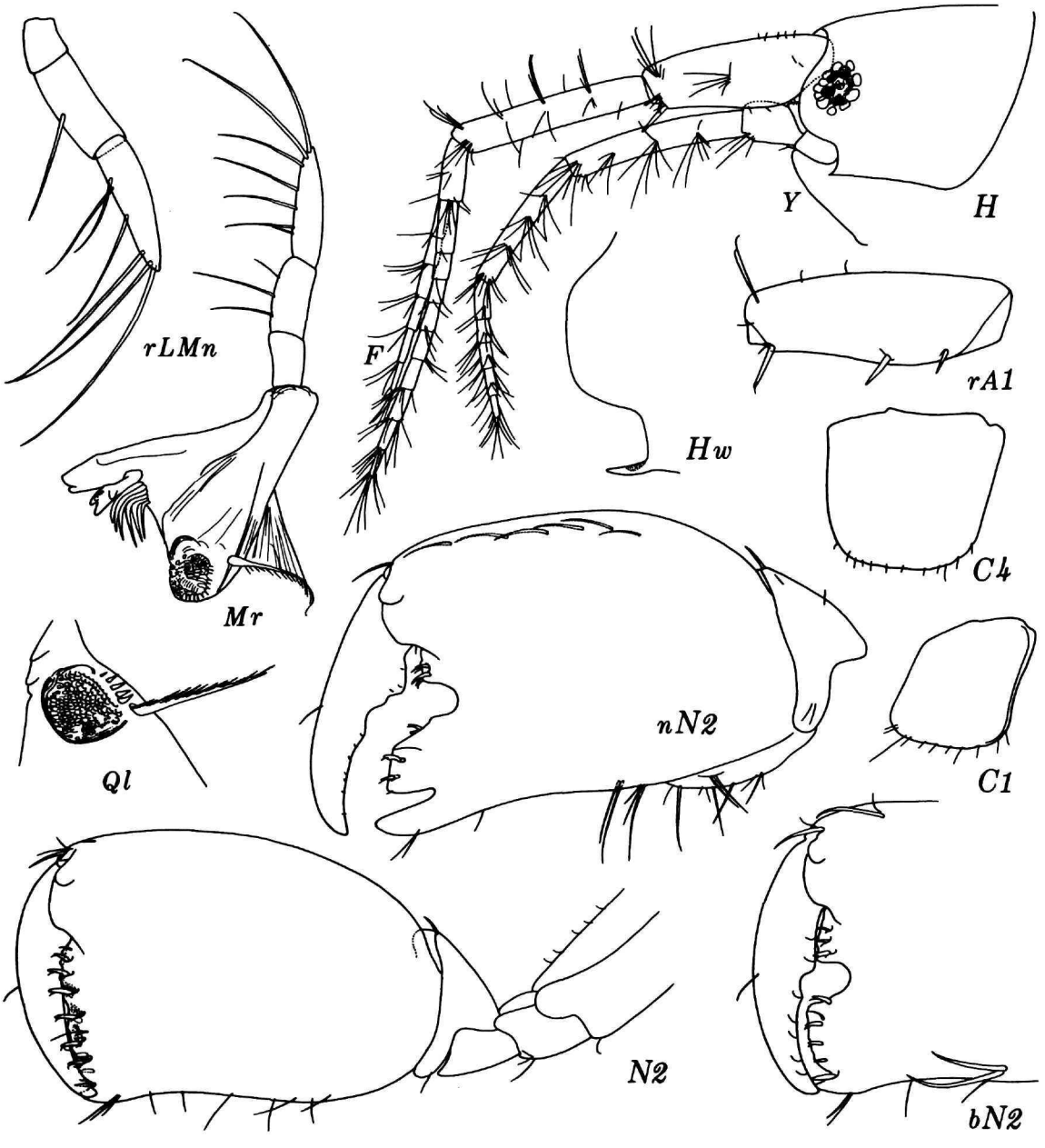



FIGURE 133.—*Maera viridis* Haswell, female, 4.4 mm, JLB Australia 13; *b*=male, 3.1 mm, JLB Australia 10; *n*=male, 5.1 mm, Slack-Smith 5. *Maera incerta* Chilton, male, JLB New Zealand 5 (*Hw*=head).

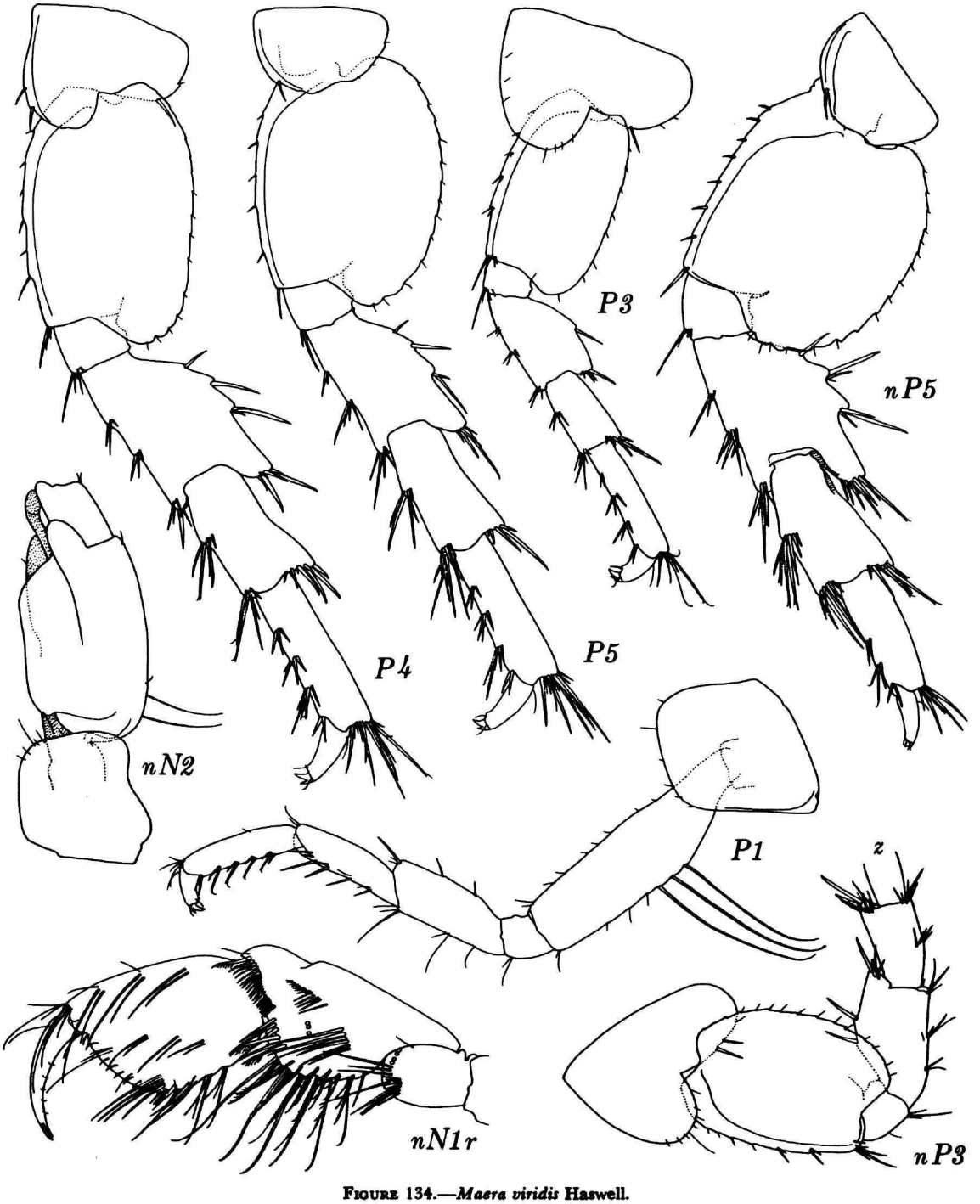



FIGURE 134.—*Maera viridis* Haswell.

on article 2 of male gnathopod 2 (in *M. viridis* the margin bears weak setae), in the terminal development of an extra incision and the chelate projection of the palm on gnathopod 2, in the enlarged spines on article 1 of antenna 1, and in the form of the telson: the apices distinctly bifid, sparsely spined, and bearing a suggestion of a lateral acclivity containing an extra spine.

There may be a distinct species involved in Chilton's (1916) record of *M. viridis* from Lord Howe Island, as male gnathopod 2 is very much like that of *M. pacifica* Schellenberg.

The amount of material available is insufficient to determine whether the full development of a male-like gnathopod 2 in an ovigerous female from Shepard 29 (South Australia, 6.9 mm long) is a consistent occurrence in this species or not. This in itself may be a good specific character, as other species of the complex have the female gnathopod 2 generally bearing a smooth palm.

MATERIAL.—Shepherd 8 (2), 13 (1), 29 (2), 30 (2), 31 (1), 49 (1), 52 (1), 54 (1); Slack-Smith 5 (1); JLB Australia 10 (5), 11 (1), 13 (9); Port Phillip 60 (?2).

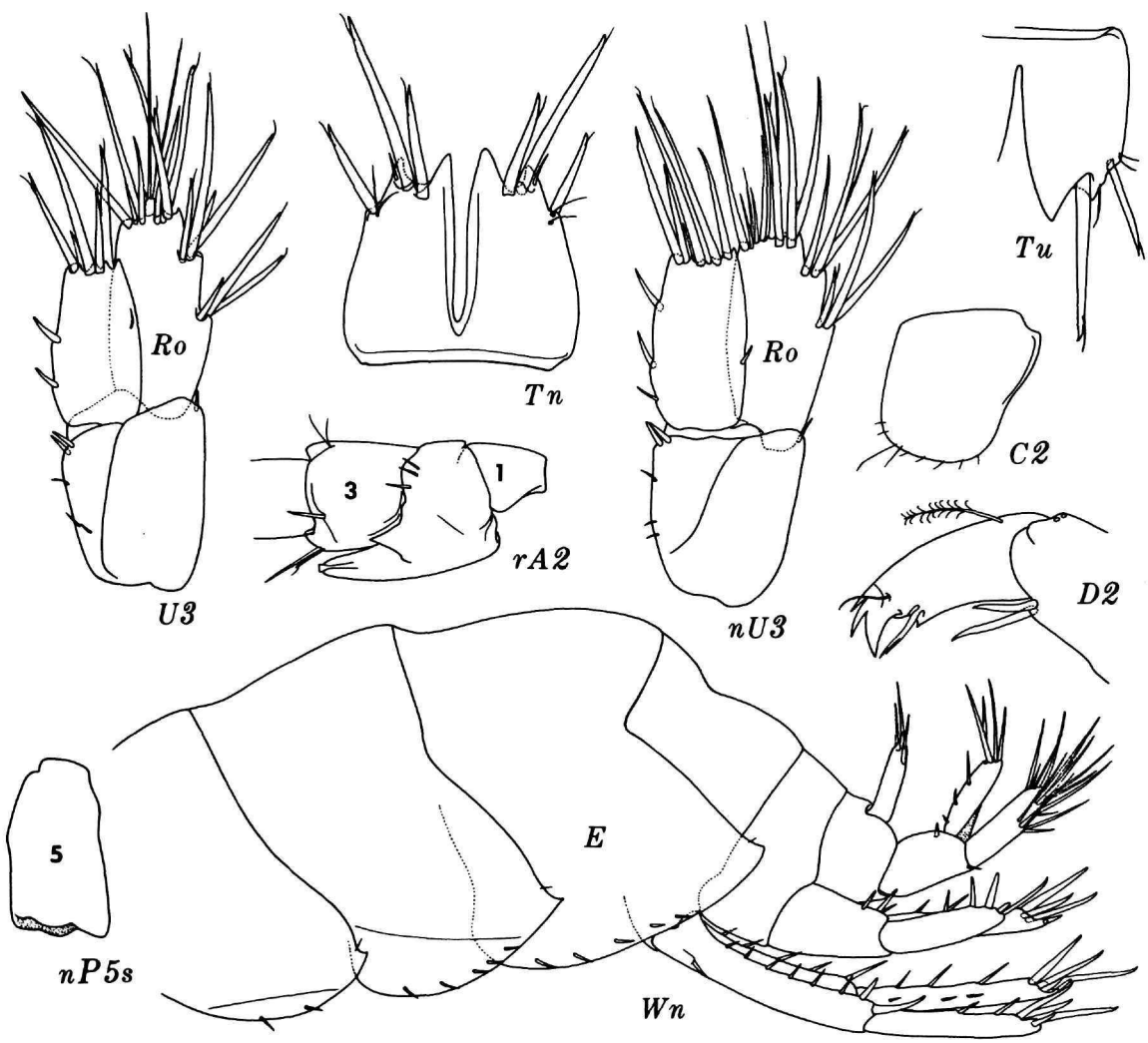



FIGURE 135.—*Maera viridis* Haswell.

DISTRIBUTION.—Warm-temperate Australia, littoral and sublittoral.

### *Melita* Leach

### *Melita matilda*, new species

FIGURES 136, 137 (part)

DESCRIPTION.—General morphology like that of *Melita awa* J. L. Barnard (in press) from New Zealand; following illustrations or description therefore not replicated; urosome, uropods 1-3, pleonal epimera 1-2, lower lip, body of mandible, maxillae 1-2, maxilliped, articles 1-5 of gnathopod 1, and pereopods 1-2; anteroventral cephalic notch evenly quadrate; eyes black, ovatocirculate; accessory flagellum about 5-articulate; length ratio of articles 2-3 of mandibular palp 15:17, article 3 with 2-4 distal setae and 0-1 seta on middle margin, article 2 with 1-5 setae; maxillipedal palp article 3 with truncate distal margin; gnathopod 1 alike in both sexes, hand distally expanded, palm transverse, convex, dactyl fitting palm and not basally swollen; female gnathopod 2 like that of *M. awa*, but process on article 4 sharper and spines defining palm longer; male gnathopod 2 with sharp process on article 4, hand broadest in middle, palm oblique, bearing 2 weak invaginations in middle, 1 armed with lateral spine, medial face of hand with deep hollow of small area near palm, defined posteriorly by 2 large spines, anteriorly by subconical cusp, dactyl swollen at base, basolaterally with tuberosity, overriding palm onto face of hand; coxae 1-4 shorter than in *M. awa* and bearing elongate setae; female coxa 6 like that of male; article 2 of pereopods 3-5 subrectangular, article 2 of pereopod 5 scarcely broader than in pereopod 4, posteroventral corners of article 2 subquadrate, pereopods 3-5 with long setae on articles 4-6 and on article 2 of pereopod 3, dactyls as figured; pleonal epimera 1-3 with lateral ridge, 1-2 with small posteroventral tooth, 3 with large tooth, 2-3 with anteroventral spine in male, only 3 with spine in female, all epimera with 2 weak serrations on posteroventral margin near tooth; pleonite 5 with 1 weak dorsal cusp on each side, each cusp with large spine; uropods 1-3 like *M. awa*, but uropod 3 lacking ridge on peduncle joining spine bundle; telsonic apices sharp, bearing lateral group of 2 spines, medial group of 2-3 spines. Name represents type-locality as noun in apposition.

HOLOTYPE.—WAM, male, 8.9 mm.

TYPE-LOCALITY.—RLB Australia 19, Matilda Bay, Swan River, Western Australia, in dead clam, collected by Robert L. Barnard, 24 July 1968.

RELATIONSHIP.—The closest known affinities of this species lie with the estuarine *Melita awa* from New Zealand. The special resemblance occurs in the ornament of pleonite 5, the general morphology of the head and gnathopods, and the pleonal epimera 1-2. *Melita matilda* differs from *M. awa* in: (1) the large tooth of epimeron 3; (2) the smaller and deeper pocket on the hand of male gnathopod 2, with basally swollen dactyl; (3) the absence of a hump on the hand of male gnathopod 1; (4) the thinner article 2 of pereopod 5; (5) the absence of a deep anterior hook on female coxa 6; (6) the elongate setae of the pereopods and antennae; (7) the short coxae and their long setae; (8) the lateral ridge of epimeron 3; (9) absence of peduncular ridge on uropod 3; (10) slightly different striation pattern on pereopodal dactyls (see Figure 136*D5*); (11) spines and setae on peduncle and base of outer ramus on uropod 3 about twice as long as those on *M. awa*; (12) sharper cusp on article 4 of male and female gnathopod 2; and (13) article 3 of mandibular palp longer than article 2.

The dactyl of male gnathopod 2 (Figure 137*N2*) in terminal adults is turned so that its anterior margin points medially; it has been slightly flattened in the drawings. Hands of juvenile males have the medial gnathopodal pocket appearing similar to that of adults.

See *Melita oba*, to follow, for further comparisons.

MATERIAL.—Type-locality (16); JLB Australia 1 (25); Prince, Swan Basin (18).

DISTRIBUTION.—Swan River, Western Australia, in salt water.

### *Melita oba*, new species

FIGURE 137 (part), 138

DESCRIPTION.—The general morphology is like that of *Melita awa* J. L. Barnard (in press) from New Zealand; illustrations and descriptions of the following, therefore, are not replicated: urosome, uropods 1-3, lower lip, body of mandible, maxillae 1-2, maxilliped, articles 2-3 of gnathopod 1, and pereopods 1-2. Following is the new description: anteroventral cep-

halic notch almost evenly quadrate; eyes black, ovato-circular; accessory flagellum 4-5 articulate; length ratio of articles 2-3 of mandibular palp 9:10 in female, 7:10 in male; article 3 with 2 distal setae and 2-4 other setae, article 2 with 2-3 setae; maxillipedal palp article 3 with small distal process; gnathopod 1 similar in both sexes but male palm more oblique and dactyl longer; female dactyl with extra small setae besides main setal-tooth, gnathopod 1 slender, hand evenly wide at both ends, palm oblique or subtransverse but deeply convex, defined by 1 (male) or 3 (female) submarginal spines on inner face, male

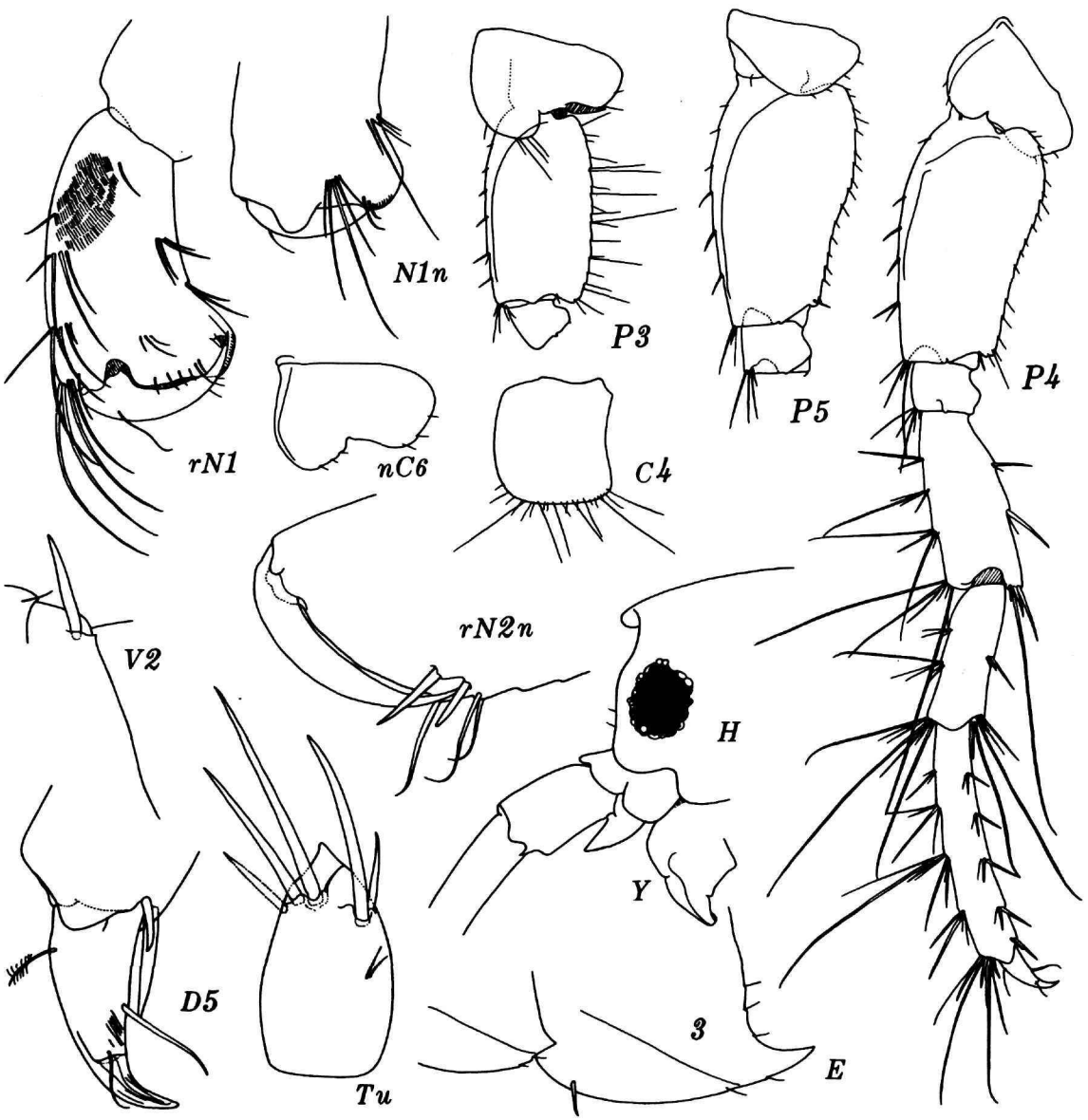



FIGURE 136.—*Melita matilda*, new species, male, 9.0 mm, Matilda Bay; *n*=female, 5.0 mm, JLB Australia 1.

hand with small posterior cusp far proximal from tapering end of dactyl, fitting palm, not grossly swollen basally, bearing deep hemilunar slit near mark 65; female gnathopod 2 like that of *M. awa* but article 4 without sharp process; male gnathopod 2 with sharp process on article 4, hand not strongly broadened in middle, palm oblique, bearing low subquadrate process distally and several spines on medial face of hand near base of dactyl, medial face otherwise without sculpture except for weak hemilunar line distally, strongly setose, lacking channel, dactyl subclavate, slightly overriding palm onto face of hand; coxae 1 and 4 distally expanded, male coxa 6 with rounded anterior lobe, female with broadly truncate anterior lobe, coxae poorly setose; article 2 of pereopods 3-5 ovate and subovate, article 2 of pereopod 5 broader than on pereopod 4, all with well-rounded posteroventral lobes; pereopodal dactyls with accessory cusp on outer side of apex, pereopod 5 with 2 accessory cusps (male), with chopped off setule near

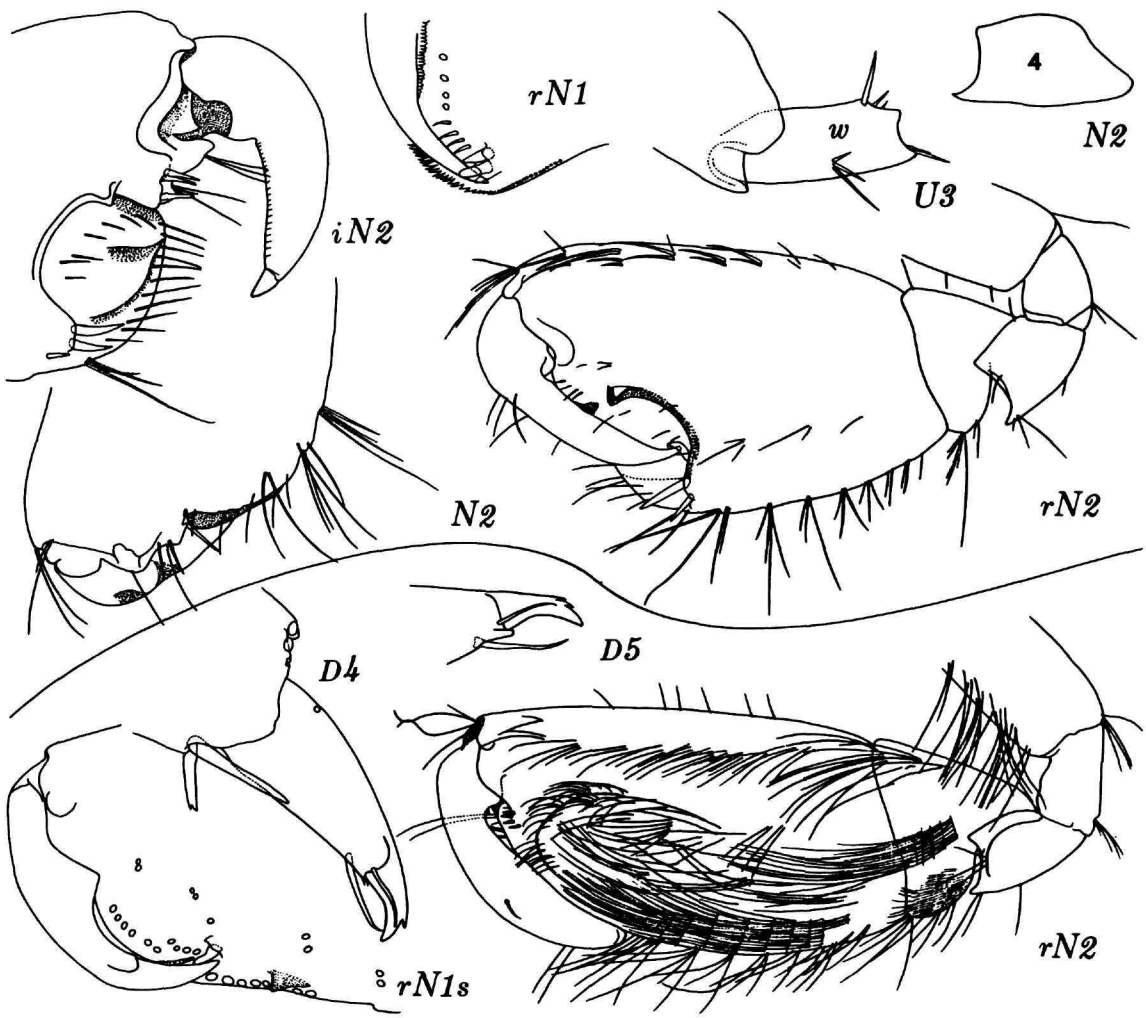



FIGURE 137.—Upper: *Melita matilda*, new species (see legend of Figure 136; *w*=peduncle). Lower: *Metita oba*, new species, holotype, male, 7.2 mm; *n*=female, 5.5 mm; both from JLB Australia 5.

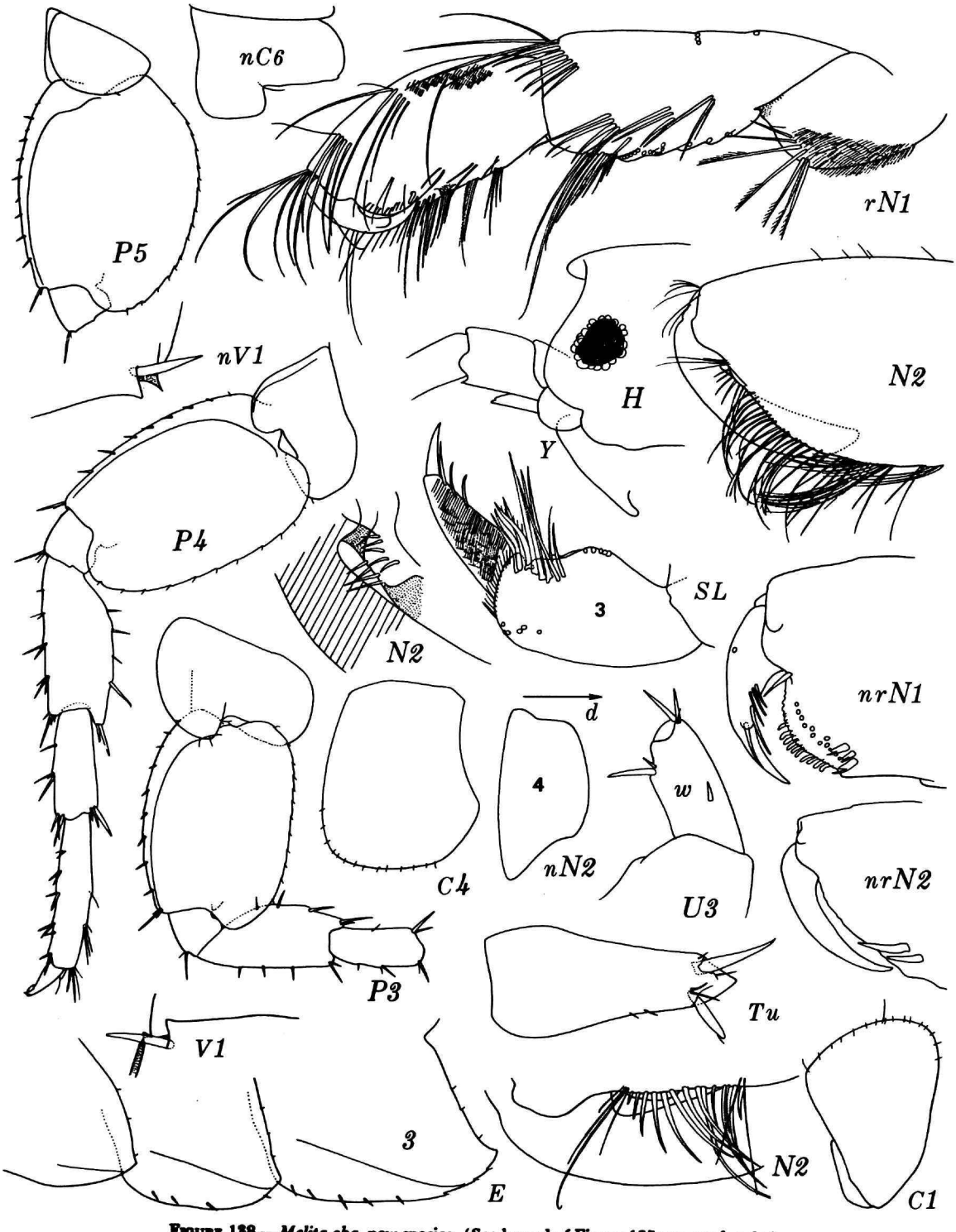



FIGURE 138.—*Melita oba*, new species. (See legend of Figure 137; *w*=peduncle.)

slit constriction and thick unchopped setule proximal to slit; pleonal epimera 1-3 with lateral ridge, 1-2 with obsolescent posteroventral cusp, 3 with medium tooth, posterior margins very weakly notched, epimera 2-3 with line of small ventral spines, 3 with several posteroventral serrations; pleonite 5 with pair of small, sharp posterolateral cusps on each side, each pair of cusps embracing 1 spine; uropods 1-3 like *M. awa* but ridge on peduncle of uropod 3 weak or absent; telson elongate, apices blunt but coniform, each bearing pair of short spines.

HOLOTYPE.—WAM, male, 7.2 mm.

TYPE-LOCALITY.—JLB Australia 5, west of Bunker Bay, Cape Naturaliste, Western Australia, intertidal, wash of algae and rocks, 2 September 1968.

RELATIONSHIP—This species, like *M. matilda*, resembles *M. awa*, and more so than *M. matilda*, in characters of head, pleonite 4, epimera, pereopods 3-5, and gnathopod 2, but far less so in telson, gnathopod 1, and maxillipedal palp.

*Melita oba* differs from *M. awa* and *M. matilda* in the expanded coxa 4 and coxa 1, in the process of maxillipedal palp article 3, in the rounded lobes and regularly ovate article 2 of pereopods 3-5, and in the elongate, narrow telsonic lobes bearing only 2 spines each.

*Melita oba* differs additionally from *M. matilda* in the presence of 2 cusps on each side of pleonite 4 (instead of 1), in the weak cusps of the pereopodal dactyls, in the small tooth of pleonal epimeron 3, in the simplified male hand of gnathopod 2, in the absence of a sharp tooth on article 4 of female gnathopod 2, and in the more oblique palm of gnathopod 1.

In the adult male one of the locking spines of pereopods 3-5 is apically bifid.

MATERIAL.—Slack-Smith 1 (14); JLB Australia 2 (2), 4 (1), 5 (17), 6 (5), 11 (2).

DISTRIBUTION.—Southwestern Australia, littoral and sublittoral.

### *Melita zeylanica* Stebbing

*Melita zeylanica* Stebbing, 1904:22–24, pl. 5.

### *Melita zeylanica kauerti*, new subspecies

FIGURES 139–141

DIAGNOSIS (of male).—Head with deep lateral slit below subnasiform lateral lobe; eyes subcircular, retaining brownish purple pigment in alcohol; flagellum of antenna 2 about 1.25 times as long as article 5; coxa 1 not anteroventrally produced; article 6 of gnathopod 1 not distally expanded, palm short and transverse, bearing 1 stout facial spine, then excavate for reception of dactylar bulge, dactyl distally unguiform and bearing accessory setal spine; gnathopod 2 usually of equal size on both sides, occasionally one side with small appendage similar to that of female, articles 2-3 unlobed, article 4 with weak posterodistal cusp, article 5 with setose medium posterior lobe, article 6 elongate, expanding distally, dactyl overriding face of hand, palm rounding on to posterior margin of hand evenly, spinulose throughout, medial face of hand with axial channel bearing rows of setae, anteriorly defined by ridge lacking spines, pereopodal dactyls not abruptly constricted but bearing regular large marginal seta and smaller facial setule at base of nail, locking spines simple; pereopods 3-5 of regular form but relatively short and thick, article 4 on pereopods 1-2 only 0.3 times as broad as long, 0.4 times on pereopods 3-5, dactyls thick; outer ramus of uropod 3 lacking article 2, inner ramus with 4 apical spines; telson with rounded or truncate apices, lobes gaping, each lobe with 2 medial spines, 1 mediodorsal spine, 1 lateral spine, no basolaterals; pleonal epimera 1-3 with very small posteroventral tooth, a few very fine serrations on posterior margin; only urosomite 2 with 3-4 dorsolateral spinules on each side and 1 cusp.

DESCRIPTION.—Ventral margin of article 1 on antenna 1 with 1 basal, 1 apical spine, 1-2 sets of setae between spines, length ratio of articles 1-3 and flagellum about 43:51:16:163; accessory flagellum 3-4 articulate; gland cone large, article 3 of antenna 2 with apicolateral lobe and small apicoventral tooth, ratio of articles 4-5 and flagellum about 100:100:125; upper lip rounded below; length ratio of articles 1-3 of mandibular palp about 14:64:55, article 3 setose apically and marginally, right and left molars each with stout pectinate seta, shorter on left, lacinia mobilis present on both sides; lower lip as illustrated (Figure 139*G*); inner plates of maxillae 1-2 lined medially with setae, none submarginal; article 3 of maxillipedal palp with setose medial lobe and apical lobe overriding base of dactyl; coxa 4 deeply excavate posterodorsally; uropods 1 and 3 each with basolateral ridge and spine.

FEMALE.—Very similar to male except dactyl of gnathopod 1 not as strongly swollen basally, gnathopod 2 small, bearing only scattered setae on medial face of hand and 2 large locking spines, dactyl overriding face only slightly; coxa 6 with large, fleshy hooklike anterior lobe; main spines of telson 50-75 percent longer than those of male, 1 apicolateral setule in female as long as longest spine in male.

HOLOTYPE.—WAM, male, 8.0 mm.

TYPE-LOCALITY.—Middle Swan Bridge, Swan River, Western Australia, collected by Jane Prince, University of Western Australia, 4 March 1969.

REMARKS.—These Australian specimens differ so little from Stebbing's (1904) portrayal of the Ceylonese *M. zeylanica*, as compared with the minor but significant differences I have seen in the Hawaiian

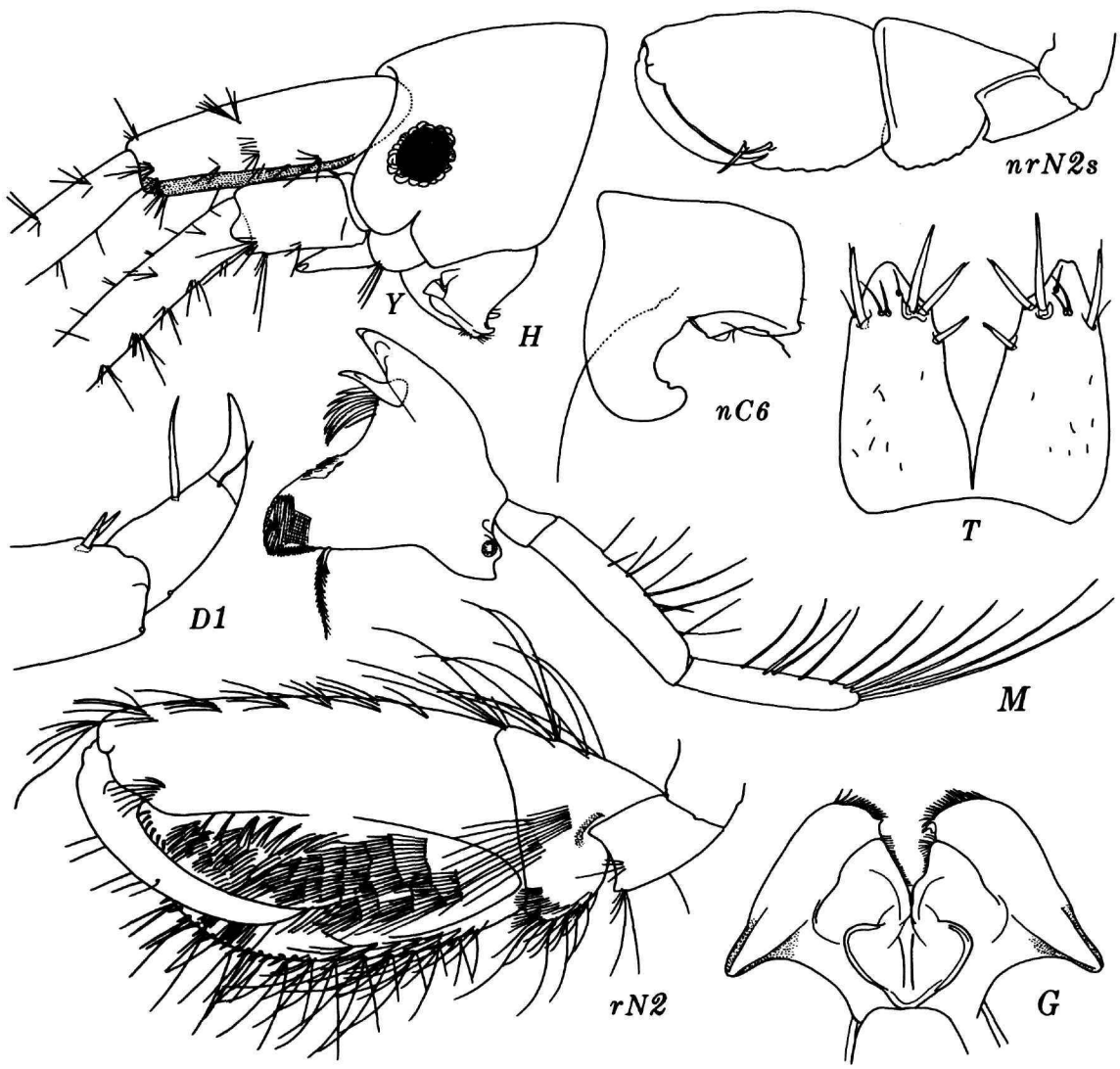



FIGURE 139.—*Melita zeylanica kauerti*, new subspecies, holotype, male, 8.0 mm, Middle Swan Bridge; *n*=female, 7.5 mm, Lucky Bay.

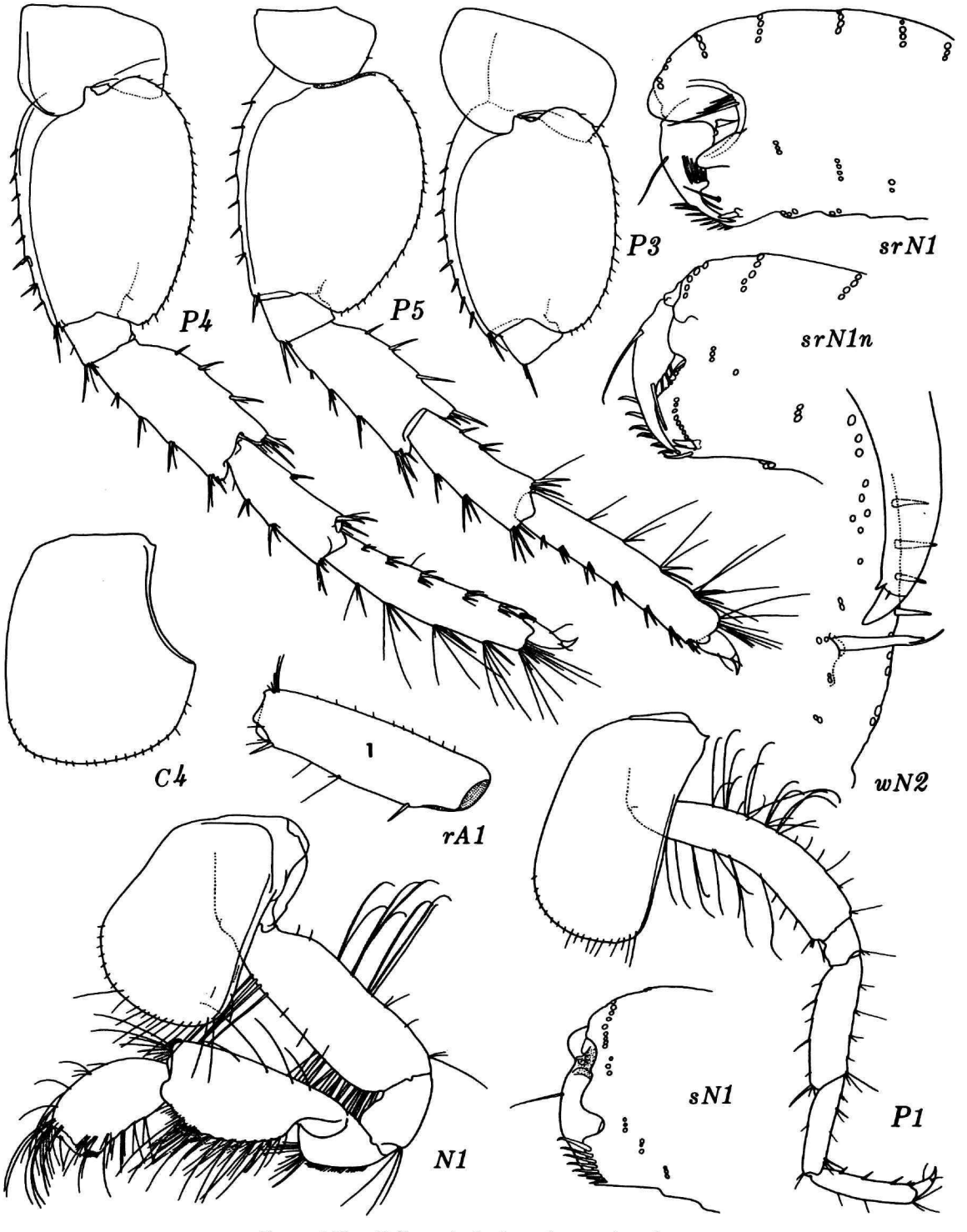



FIGURE 140.—*Melita zeylanica kauerti*, new subspecies.

*M. pahuwai* J. L. Barnard (1970a) and the New Zealand *M. inaequistylis* (Dana) (see J. L. Barnard, in press), that I cannot justify establishing a new species for these specimens. There are two small differences, however, and possibly others that are not evident because of several minor details unknown about the Ceylonese population. The Australian material has thinner fourth articles of pereopods 1-5 than do the Ceylonese specimens, but Stebbing stated that the described pereopods fit only males and I am not certain that terminal males are present in the Swan River collections. The anterior process on coxa 6 of the female of the Australian specimens is much larger than that on the female of *M. z. zeylanica*. The inner ramus of uropod 3 has 4 terminal spines compared to 1 in Ceylonese specimens. Stebbing did not

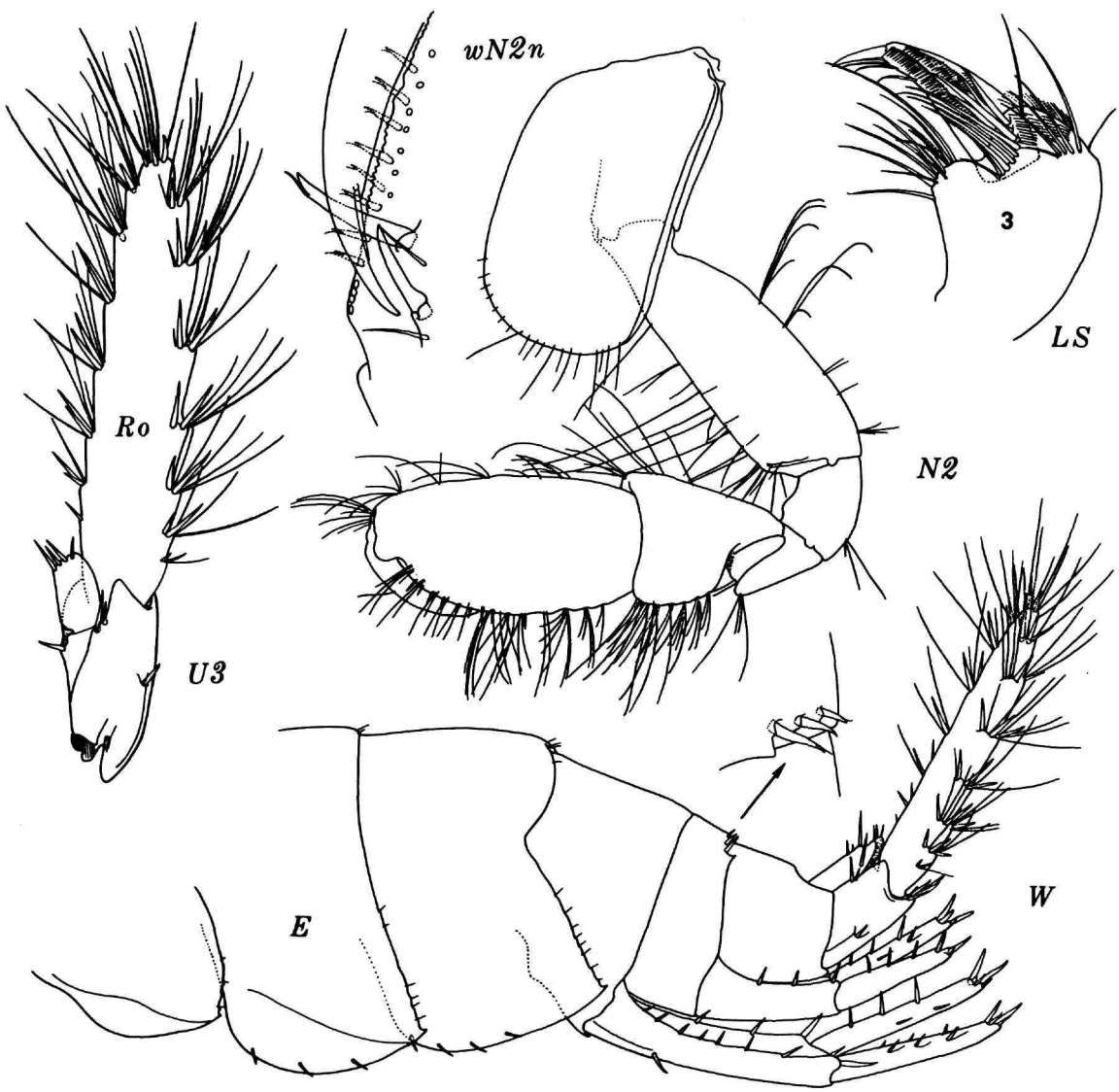



FIGURE 141.—*Melita zeylanica kauerti*, new subspecies.

report a slit on the head, but he may have overlooked it. He shows no ventral spines or setae on article 1 of antenna 1, and his drawing of the telson is poorly detailed, but it is approximate to that illustrated herein (Figure 139*T*).

As an example of the kinds of differences attributing specific distinction, one may cite how the material at hand differs from *M. pahuwai*: the medial face of the hand on male gnathopod 2 has spines on the anterior ridge, gnathopod 1 has only 1 (instead of 3) facial spines on the hand, the palmar spines of female gnathopod 2 are shorter but the facial spines longer; there are no basolateral spines on the telson; coxa 4 is deeply excavate; article 4 of pereopods 1-2 is thinner and more elongate; there are 3 instead of 2 spines on each side of pleonite 5.

MATERIAL.—Prince, Lucky Bay (7); Prince, Middle Swan Bridge (7); WAM, Denmark, Wilason Inlet (24).

DISTRIBUTION.—Southwestern Australia, in estuaries.

## The Generic Problem in the Bicarinate Species of *Maera, Elasmopus,* and *Parelasmopus*

These carinate species have 2 longitudinal dorsal carinae on pleonite 4. If the bicarinate species of *Parelasmopus* Stebbing constitute a good genus, then the bicarinate species attributed to *Maera* and closely related to *Parelasmopus* appear also to constitute a good genus; or if the definition of *Parelasmopus* were widened, the bicarinate species could be transferred to that genus. In early days the carinate species of *Maera* were placed in a catchall genus *Megamoera,* which later became an unofficial synonym of *Elasmopus,* but the designated type-species of *Megamoera,* belonging to *Melita,* reduces *Megamoera* to synonymy with *Melita.* Stebbing (1906) placed the carinate maeras in *Elasmopus* because at that time he distinguished *Maera* and *Elasmopus* on the robustness of pereopods 3-5, even though he noted that most species of *Elasmopus* differ from *Maera* in the falcate article 3 of the mandibular palp. Then in 1938 Schellenberg redefined *Maera* and *Elasmopus* with the result that all species of *Elasmopus* with an unfalcate article 3 of the mandibular palp were transferred to *Maera,* including the carinate maeras. When Stebbing (1888) erected *Parelasmopus,* he distinguished it from *Elasmopus* in the short article 2 of the mandibular palp, but he did not relate it to *Maera* in terms of its straight article 3.

The carinate maeras superficially look like many species of *Elasmopus,* and not *Maera,* in the presence of a strong cephalic cheek notch, in the falcate process of article 3 on the maxillipedal palp common to many elasmopuses, and in the short rami of uropod 3, though a few species of *Maera,* like *M. hamigera* and *M. mastersi,* either have the cheek notch, or others, like *M. pacifica,* have short rami on uropod 3. Those with the cheek notch also have epimera characteristically serrate like various species in the genus *Ceradocus,* thus suggesting they are evolutes of *Ceradocus* with characters convergent toward *Maera.*

The relationship between the carinate *Maera-Elasmopus* flock and the flock of species in *Parelasmopus* is very clear, as Australian phenotype A of *M. subcarinata* has a mandibular palp definitely intergradational to the palp in *Parelasmopus.* The carinate maeras lack the posteroventral teeth on epimeron 3 of *Parelasmopus* and seem to form as cohesive a flock of species as the parelasmopuses. These should be segregated generically, which requires redefinition of *Maera, Elasmopus,* and *Parelasmopus* and the establishment of two new genera, *Mallacoota* and *Ifalukia,* as there do not seem to be names available for the carinate maeras and the odd species from Ifaluk Atoll (see J. L. Barnard, 1965). The distinctions among the genera are noted in the brief diagnoses below but formal diagnoses of the new genera follow later.

*Maera* LEACH, SENSU STRICTO.—Head lacking notch on cheek though often with tooth or broad excavation; mandibular palp 3-articulate, article 2 never shorter than article 1, article 3 straight and not setiferopectinate; pleonite 4 lacking pair of dorsal carinae; rami of uropod 3 usually longer than peduncle; epimeron 3 not serrate on lower margin posteriorly.

*Elasmopus* COSTA.—Head with notch on cheek; mandibular palp 3-articulate, article 2 never shorter than article 1, latter very short, article 3 long, falcate, and setiferopectinate; pleonite 4 lacking pair of dorsal carinae; rami of uropod 3 equal in length to peduncle; epimeron 3 not serrate on lower margin posteriorly.

*Mallacoota,* NEW GENUS.—Head with notch on cheek; mandibular palp absent, 1-articulate or 3-articulate, article 2 never shorter than article 1, arti-

cle 3 straight, not setiferopectinate; pleonite 4 with pair of dorsal carinae; rami of uropod 3 as short as peduncle; epimeron 3 not serrate on lower margin posteriorly. Type-species: *Megamoera diemenensis* Haswell (1880b), from Tasmania.

*Parelasmopus* STEBBING.—Head with notch on cheek; mandibular palp 3-articulate, article 2 much shorter than article 1, article 3 straight, not setiferopectinate; pleonite 4 with pair of dorsal carinae; rami of uropod 3 as short as peduncle; epimeron 3 serrate on lower margin posteriorly.

*Ifalukia*, NEW GENUS.—Head with notch on cheek; mandibular palp 3-articulate, article 2 shorter than article 1, article 3 straight, not setiferopectinate; rami of uropod 3 slightly longer than peduncle; pleonite 4 lacking dorsal carinae; epimeron 3 not serrate on lower margin posteriorly. Type-species: *Parelasmopus resacus* J. L. Barnard (1965), from Ifaluk, Micronesia.

## The Bicarinate Species of *Mallacoota* and *Parelasmopus*

Six species of *Mallacoota* and *Parelasmopus* have been found in Australian collections. They are characterized by the presence of 2 longitudinal, sharp dorsal carinae on pleonite 4. At least 11 phenotypes are involved in these six species, some of which can be seen only in terminal males. My taxonomic assessment is probably rudimentary, but heretofore in Australian waters only three of the phenotypes were apparent from the literature, so that the recognition of two new cryptosibling species with four phases, two other new species, plus the other phases of previously described species, is a step forward. Whether or not some of these phases represent distinct species or hybrids is a problem that needs to be clarified further by the study of juveniles recently hatched from a known parent.

*Mallacoota diemenensis* (Haswell) so far has not been found outside of the Bass Strait region and South Australia, and it has a simple nomenclatural history. On the other hand, *M. subcarinata* (Haswell) has been found more widely distributed in Australia, and it has been reported from New Zealand and the Indian Ocean under several names. The following discussion of *M. subcarinata* suggests that the New Zealand materials identified with *M. subcarinata* can be given at least a subspecific appellation, of which *Maera petriei* Thomson is available. Since the Indian Ocean materials remain poorly described, the connection of Australian populations to Ceylon cannot be clarified.

Chilton (1915) treated the history of *M. subcarinata*, but he based his reanalysis of the species on New Zealand specimens. Stebbing (1888) was the first to synonymize the New Zealand species with *M. subcarinata*, but he was influenced by Chilton in correspondence.

One of the most disturbing problems involving *M. subcarinata* is the fact that Victorian-South Australian collections contain a great many specimens of two presumably new species (*M. carteta* and *M. marilla*) that have 4 phases between them. Whether these species were overlooked by Chilton and Haswell, or confused with *M. subcarinata*, or are indeed a narrowly distributed complex not occurring in New South Wales, where Chilton and Haswell collected and studied, is unknown. Furthermore, if a narrow distribution is possible for *M. carteta* and *M. marilla*, one may hypothesize that these 2 species and other phases of the carinate complex may represent hybrids between *M. subcarinata* and *M. diemenensis* in a restricted part of Australia. If so, these hybrids are extraordinarily abundant.

This proposition, low in probability though it may be, has been evaluated continuously as specimens of this complex have been identified, but the consistency with which the main phases of this complex (*M. subcarinata* sensu lato, *M. diemenensis* sensu lato, *M. marilla*, and *M. carteta*) can be recognized and sorted has solidified my opinion that the latter two are good species.

Since the typical phenotype (P) of *M. marilla* outwardly resembles *M. subcarinata*, I had to examine the types of the latter in the Australian Museum to determine that they have a large 3-articulate mandibular palp. *Mallacoota marilla* differs in the reduction of the palp to 1 short article. The palp is not grossly visible like that of *M. subcarinata*, but this is essentially the only qualitative difference between typical *M. marilla* and *M. subcarinata*. *Mallacoota carteta* is grossly distinct from either *M. subcarinata* or *M. marilla* in the development of a dorsal tooth on pleonites 1-2, but, like *M. marilla*, the mandibular palp is reduced to a small article. There would be little question that *M. carteta* is a species distinct from *M. marilla* if *M. subcarinata* and *M. marilla*

each did not have 2 phenotypes based on notches of coxae or on setose and nonsetose second gnathopods of the male. To rank *M. carteta* as a good species requires one to evaluate the presence of dorsal teeth of pleonites 1-2 at specific level while counting the phases of terminal male gnathopod 2 as simply an expression of phenotypy. In this case the gnathopodal phases of *M. marilla* P and *M. carteta* C are congruent, each having a setose (S) and a nonsetose phase, whereas *M. subcarinata* has 3 kinds of only setose phases and *M. diemenensis* has only 1 gnathopodal phase, always setose. This suggests that *M. marilla* and *M. carteta* are closer to each other than, together, they are to either *M. subcarinata* or *M. diemenensis*. The dorsal teeth of *M. carteta* are consistent, and they occur in juveniles as small as 3.0 mm. Unfortunately, no recently hatched juveniles are available; presumably these are in a size range of 1.0-1.5 mm.

Since the reduction of mandibular palp in marine Gammaridae is a rare situation and not heretofore found in the *Maera-Elasmopus* group of more than 75 species, this condition in *Mallacoota* was at first thought to be an aberrancy, either an ordinary phenotype or possibly a hybrid. The discovery of *M. carteta* implemented the belief that hybrids between *M. diemenensis* and *M. subcarinata* were present, because *M. carteta* has teeth on pleonites 1-2. But the teeth in *M. diemenensis* are paired, whereas they are single in *M. carteta*. While the latter species is uncommon in the collections at hand, *M. marilla* is as abundant as, if not more so than, either *M. subcarinata* or *M. diemenensis*; thus, neither can be dismissed as insignificant aberrations.

I have not equated the naming of my Australian forms with Chilton's system of "forms 1 and 2" in *M. subcarinata* from New Zealand because there is a remote possibility that cryptosiblings are present in New Zealand as they are in Australia. My phenotype B of *M. subcarinata* is essentially like form 1 of Chilton as represented in terminal stages, my form D is similar to the youthful stage of Chilton's form 1, and presumably my form A would represent a stage between early and late form 1. Chilton's form 2, characterized by sparse setae on male gnathopod 2, has not been found in my study, but it is instead found as the nonsetose forms of *M. marilla* and *M. carteta*. Possibly Chilton's form 2 thus represents a neozelanican species with reduced mandibular palp like *M. marilla* and must be checked for that character.

Chilton's thesis that his early and late form 1 represent growth stages, and thus cannot be called phenotypes by my system, is probably correct, but the incongruence in body size with gnathopodal development in my material suggests a further complexity, and this is reinforced by the gnathopodal phenotypes found in *M. marilla* and *M. carteta*. What appears to be the terminal stage (my phenotype B or Chilton's terminal form 1) does not necessarily occur on the males with largest body sizes, as some males with my phenotype A and Chilton's form 1 in early stages have larger bodies than phenotype B. The same is relatively true of my form D (setose but palm mainly toothless). I suggest that the sequence from phenotype D to A to B is a growth sequence under normal logic but that morphological maturation of the gnathopods is delayed or interrupted in relation to body growth owing to environmental circumstances such as season of hatching.

In *M. marilla* and *M. carteta*, to the contrary, the gnathopodal phenotypes are more clear cut, as male gnathopod 2 in terminal stages exists either as a setose or nonsetose member (and these have other differences in teeth and dactyl). Chilton's form 2 of *M. subcarinata* comprises the nonsetose alternative seen in *M. marilla* but not yet found in Australian *M. subcarinata*. By the standards of taxonomic practice, these nonsetose phenotypes also have the appearance of distinct species in *Maera* and *Elasmopus*, where structures of male gnathopod 2 are crucial to specific identification. A judgment on them as phenotypes or as indicators of distinct species is therefore difficult to make until complexes of this sort can be studied in other parts of the world.

### Key to Bicarinate Species of *Ifalukia*, *Mallacoota*, and *Parelasmophus*

1. Mandible with vestigial 1-articulate palp ..... 2
   Mandible with large 3-articulate palp ..... 5
2. Pleonites 1-2 each with 1 middorsal tooth ..... 3
   Pleonites 1-2 dorsally smooth ..... 4

## Key to Bicarinate Species of *Ifalukia, Mallacoota,* and *Parelasmopus* (cont'd)

3. Male gnathopod 2 heavily setose on medial face of hand..... ***M. carteta*** (phenotype C-S)
   Male gnathopod 2 poorly setose on medial face of hand..... ***M. carteta*** (phenotype C-C)
4. Male gnathopod 2 heavily setose on medial face of hand..... ***M. marilla*** (phenotype P-S)
   Male gnathopod 2 poorly setose on medial face of hand..... ***M. marilla*** (phenotype P-C)
5. Article 2 on mandibular palp distinctly shorter than article 1; latter elongate and equal to, or much longer than, article 3; epimeron 3 serrate ventroposteriorly (=*Parelasmopus, sensu stricto*) ..... 6
   Article 2 of mandibular palp equal to, or longer than, article 1; latter with length variable; epimeron 3 unserrate..... 11
6. Article 2 of pereopods 3-5 grossly serrate (coxae 1-3, or 4, with point)..... 7
   Article 2 of pereopods 3-5 normally (minutely) serrate (only coxae 1-2 rarely with point). 8
7. Pereonite 7 with pair of dorsal teeth (palm of male gnathopod 2 very oblique)..... ***P. echo***
   Pereonite 7 smooth (palm of male gnathopod 2 unknown in original).
   ***P. suluensis*** and ***P. albidus*** of Schellenberg, 1938
8. Pereonite 7 with pair of dorsal teeth..... 9
   Pereonite 7 smooth dorsally..... 10
9. Palm of male gnathopod 2 nearly transverse, coxa 1 with small anteroventral point, pereopods 3-5 with long setae ..... ***P. setiger*** and ***P. ?suensis****
   Palm of male gnathopod 2 oblique, coxa 1 lacking point, possibly pereopods 3-5 lacking elongate setae..... ***P. suluensis**** of Stebbing (1888)
10. Pleonites 1-2 and 4 with dorsal teeth, palm of male gnathopod 2 nearly transverse..... ***P. albidus*** (Dana) and ***P. ya***
    No pleonites with dorsal teeth, palm of male gnathopod 2 oblique..... ***I. resaca***†
11. Pleonites 1-2 (occasionally 3) each with 2 posterolateral teeth, 1 tooth each side, article 2 of pereopod 5 posteriorly crenuloserrate..... ***M. diemenensis***
    Pleonites 1-3 lacking teeth, article 2 of pereopod 5 normally serrate..... 12
12. Mandibular palp article 3 longer than article 2..... 13
    Mandibular palp article 3 shorter than article 2..... 17
13. Coxa 1 lacking posteroventral notch, facial lobes of articles 2-3 on male gnathopod 2 enlarged (article 1 of antenna 1 lacking middistal cusp, palp article 1 of mandible shorter than article 2 and often less than half as long as article 2)..... 14
    Coxa 1 bearing posteroventral notch, facial lobes of articles 2-3 on male gnathopod 2 small ..... 15
14. Mandibular palp article 3 with more than 2 setae, article 2 with several setae, article 1 varying from less than, to more than, half as long as article 2, male gnathopod 2 with tooth defining palm near apex of dactyl, latter adze shaped or not..... ***M. subcarinata***
    (phenotype B, like *M. persetosus* and terminal form 1 of Chilton, 1915)
    Mandibular palp article 3 with only 2 apical setae, article 2 naked, article 1 about two-thirds as long as article 2, male gnathopod 2 palm with several teeth but none defining apex of dactyl, latter simple..... ***M. insignis*** (?=*sokotrae*)
15a. Palm of male gnathopod 2 with 1-2 defining teeth, middle of palm with spinose tooth besides distal spinose truncation, dactyl simple, article 1 of mandibular palp large, broad, as long as article 2 (latter naked, article 3 with only 2 apical setae), middistal margin of article 1 on antenna 1 with sharp cusp..... ***M. subcarinata*** (phenotype A)
15b. Palm of male gnathopod 2 lacking defining tooth, *hand poorly setose, article 2 highly thickened,* dactyl simple, articles 1 and 2 of mandibular palp both relatively short and subequal to each other, thin (article 3 with 2 apical setae, article 2 naked), middistal margin of article 1 on antenna 1 *apparently* with cusp..... ***M. latibrachium***
15c. Palm of male gnathopod 2 lacking defining tooth except for facial ridge, boss, or space clear of setae, palm with pair of distal processes, 1 of which is spinose, article 1 of mandibular palp normal, thus shorter than article 2 (latter naked, article 3 with only 2 apical setae), middistal margin of article 1 on antenna 1 lacking cusp..... 16
16. Hand of male gnathopod 2 heavily setose medially..... ***M. subcarinata*** (phenotype D)
    Hand of male gnathopod 2 poorly setose..... ***M. odontoplax***

**Key to Bicarinate Species of *Ifalukia, Mallacoota,* and *Parelasmopus* (cont'd)**

17. Article 3 of mandibular palp longer than article 1 but shorter than article 2, article 3 bearing only 2 apical setae, article 1 not elongate, flagellum of antenna 2 about 7+ articulate..... ***M. subcarinata*** (forms A and B of Pirlot, 1936)
Article 3 of mandibular palp shorter than either articles 1 or 2 and bearing 2 apical and 1 subterminal setae, article 1 elongate, flagellum of antenna 2 about 3-articulate.
***M. subcarinata*** (form C of Pirlot, 1936)

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* The species *suensis* and *suluersis* are properly spelled here.
†*Ifalukia resaca* is a derived form lacking dorsal carinae on pleonite 4.

### *Ifalukia,* new genus

DIAGNOSIS.—Gammaridae generally like *Elasmopus* Costa and *Parelasmopus* Stebbing, with antenna 1 longer than antenna 2, accessory flagellum exceeding 1 article (but barely); head with notch on cheek; mandibular molar triturative, spine row normal, incisor and lacinia mobili on both sides (but molar seta unclear), palp 3-articulate, article 2 shorter than 1, article 3 straight, short, bearing 2 apical setae, not setiferopectinate; (lower lip, maxilla 1, maxilla 2, maxilliped not described in detail, but inner plates of maxillae lacking basomedial setae and palp article 3 of maxilliped bearing fuzzy falcate process); gnathopod 2 larger than 1, enlarged, and both pairs subchelate in regular gammarid fashion; pereopods of ordinary form and none highly elongate; (basolateral spine on uropod 1 unknown), uropod 3 with broad, flat rami slightly exceeding length of peduncle; telson cleft deeply but not to base; pleonites all dorsally smooth; epimeron 3 unserrate ventrally near posterior end.

TYPE-SPECIES.—*Parelasmopus resacus* J. L. Barnard (1965).

REMARKS.—Like *Ronco* J. L. Barnard and *Beaudettia* J. L. Barnard, also from Micronesia, this genus is represented by one species that does not fit the ordinary mold of a related genus, *Parelasmopus. Ifalukia* has the mandibular palp of *Parelasmopus,* but it lacks the dorsal carinae and epimeral teeth. It therefore approximates the genus *Maera,* but it has a head notch unlike typical members of *Maera* (the atypical members of *Maera* may belong in yet another genus distinct from *Ifalukia*). It differs from *Elasmopus* in the unfalcate article 3 of the mandibular palp.

### *Mallacoota,* new genus

DIAGNOSIS.—Gammaridae generally like *Elasmopus* Costa, with antenna 1 longer than antenna 2, with accessory flagellum exceeding 1 article; head with notch on cheek; mandibular molar weakly triturative, bearing ragged seta, normal spine row, incisor and lacinia mobili on both sides; palp either absent, 1-articulate, or 3-articulate; but if article 3 present, never falcate nor setiferopectinate; article 2 never shorter than 1 but article 1 occasionally as long as article 2; lower lip with sharp mandibular lobes, well-defined inner lobes completely separate from outer lobes even basally; inner plate of maxilla 1 mainly with apical setae, though occasionally with subterminal seta or setules, palp 2-articulate, article 1 slightly elongate, article 2 apically spinose; inner plate of maxilla 2 terminally setose, with setae reaching proximally along beveled apex perhaps one-third of the length, but medial margin naked of ordinary setae though occasionally bearing hairs; inner and outer plates of maxilliped of ordinary condition, palp article 3 with fuzzy falcate process; gnathopod 2 larger than 1, enlarged, and both pairs subchelate in regular gammarid fashion; pereopods of ordinary form, pereopods 4-5 generally together longer than pereopod 3 but never highly elongate; uropod 1 bearing basolateral spine on peduncle, uropod 3 with rami broad, flat, short, subequal in length to peduncle; telson cleft deeply but not necessarily to base; pleonite 4 bearing 2 sharp dorsal longitudinal carinae side by side; epimeron 3 not serrate ventrally near posterior end.

TYPE-SPECIES.—*Megamoera diemenensis* Haswell (1880b).

REMARKS.—The type-species is selected not only because it is the earliest described of the Australian species of this genus but also because I am most certain of its identification in my present material. I am unclear as to the polymorphy of *Mallacoota subcarinata* (Haswell) and which phenotype is represented by the type-material. *Mallacoota suensis* Haswell probably belongs to *Parelasmopus,* while the earliest described

species, *Gammarus indicus* Dana (1853), remains unclarified; Pirlot (1936) considered it to be the senior synonym of *Elascopus insignis* Chevreux (1901). Though forms of *M. subcarinata* occur in the tropics and *E. insignis* is widely tropical, Australia appears to be the distributional heart of *Mallacoota*.

The taxonomy of this genus is discussed elsewhere and is elaborated in the key to *Mallacoota*, which includes *Parelasmopus* and *Ifalukia*. The key to these three genera precedes the account of *Ifalukia*. *Mallacoota* comprises *M. diemenensis* (Haswell), *M. subcarinata* (Haswell), *M. insignis* (Chevreux), *M. odontoplax* (Pirlot), *M. carteta*, new species, and *M. marilla*, new species. *Elasmopus persetosus* Stebbing (1888) and *Moera petriei* Thomson (1882) are considered synonymous of *M. subcarinata*, but the key demonstrates how various phenotypes of *M. subcarinata* can be distinguished, and there is a possibility that these are good species; therefore, the names *petriei* and *persetosus* may be revived. *Mallacoota marilla* and *M. carteta* also have 2 phenotypes each, which in themselves suggest that four species may be involved in the complex. I have not found any gross phenotypy in *M. diemenensis* or *M. insignis* equivalent to that found in the other so-called species; for example, the specimens of *M. insignis* from Hawaii (see J. L. Barnard, 1970a) are very similar to those described by Chevreux from the Seychelles Islands, but the examination of *M. diemenensis* from Australia is not extensive. *Megamoera suensis* Haswell apparently belongs with *Parelasmopus*; the later identification of that species by Haswell (1885) is completely erroneous and probably the material is a species of *Ceradocus*. *Gammarus asper* Dana (1852, 1855) may be a carinate *Maera* or possibly a member of *Ceradocus*. Form 2 of *Elasmopus subcarinatus* described by Chilton (1915) is not placed in the key, as the conditions of coxa 1 and the mandibular palp are unknown.

In my key (1962) to *Maera*, I made *M. odontoplax* a synonym of *M. latibrachium*, but in the key herein they are kept separate. In that same paper, I made *M. sokotrae* a synonym of *M. subcarinata*, but herein it keys both to *M. insignis* and *M. subcarinata* phenotype A, if, in the first approximation one considers the male of *M. sokotrae* to be immature and possibly to be lacking both the normal coxal notch and the facial lobes of articles 2-3 on gnathopod 2. The telson of *M. sokotrae* appears unusual in having the spines attached to an unexcavate distal edge on either side.

### *Mallacoota diemenensis* (Haswell)

FIGURES 142–143

*Megamoera diemenensis* Haswell, 1880b:266–267, pl. 11: fig. 3; 1882:259.

*Elasmopus diemenensis*.—Stebbing 1906:442.—Chilton 1921a:74–76, fig. 10a-c.

?*Elasmopus subcarinatus*.—Tattersall 1922:9–10 [not Haswell].

DIAGNOSIS.—Head with deep anteroventral notch slightly gaping and lobe ventral to notch thin and not reaching tangent of ocular lobe; article 1 of antenna 1 with 5 ventral spines in line; accessory flagellum 5-articulate; eyes black; mandibular palp article 1 with weak distal cusp, article 3 thin, with 2 apical setae; mandibular molar weak with basal hump (like *M. subcarinata*); each outer lobe of lower lip with 2 cones, 1 large, 1 small; inner plate of maxilla 1 with 2 long apical setae, 2 short apical setules and 6 setules on side, palp with spines and setae both terminal on quadrate apex and nearly halfway along medial margin; inner plate of maxilla 2 with 4 stout long setae evenly spaced on distal half of inner margin; palp article 3 of maxilliped with subfalciform apical process; coxa 1 weakly extended forward, anterior margin scarcely concave, posteroventral corners of coxae 1-2 with weak notch; article 4 of gnathopod 2 with strong tooth in both sexes, female gnathopod remarkably slender, male hand elongate, strongly setose on posterior half of medial margin, palm undefined, distal portion with wavy serrations, dactyl curved, weakly serrate near base on inner margin; pereopodal dactyls with distal constriction marked with 3 setules, locking spines simple; article 2 of pereopod 5 with posteroventral edge nearly horizontal, that margin and posterior margin armed with castelloserrations, these serrations not distinctly castellate on pereopod 4 and of normal degree on pereopod 3; rami of uropod 3 averaging 1.5 times as long as peduncle, outer ramus held in position so as to appear slightly shorter than inner; telson with strongly gaping bifid apices armed with 2 long spines and 1 short spine; pleonites 1-4 posteriorly bearing 2 dorsal teeth side by side, pleonite 4 with teeth continued forward as carinae, pleonite 3 with middorsal carina, carina obsolescent on pleonites 1-2; epimera 1-2 each with lateral ridge and weak posteroventral tooth, epimeron 3 with large posteriorly extended sharp tooth, epimera 2 and 3 with 1 and 2 ventral spines each. Males and females about 17 and 16 mm long.

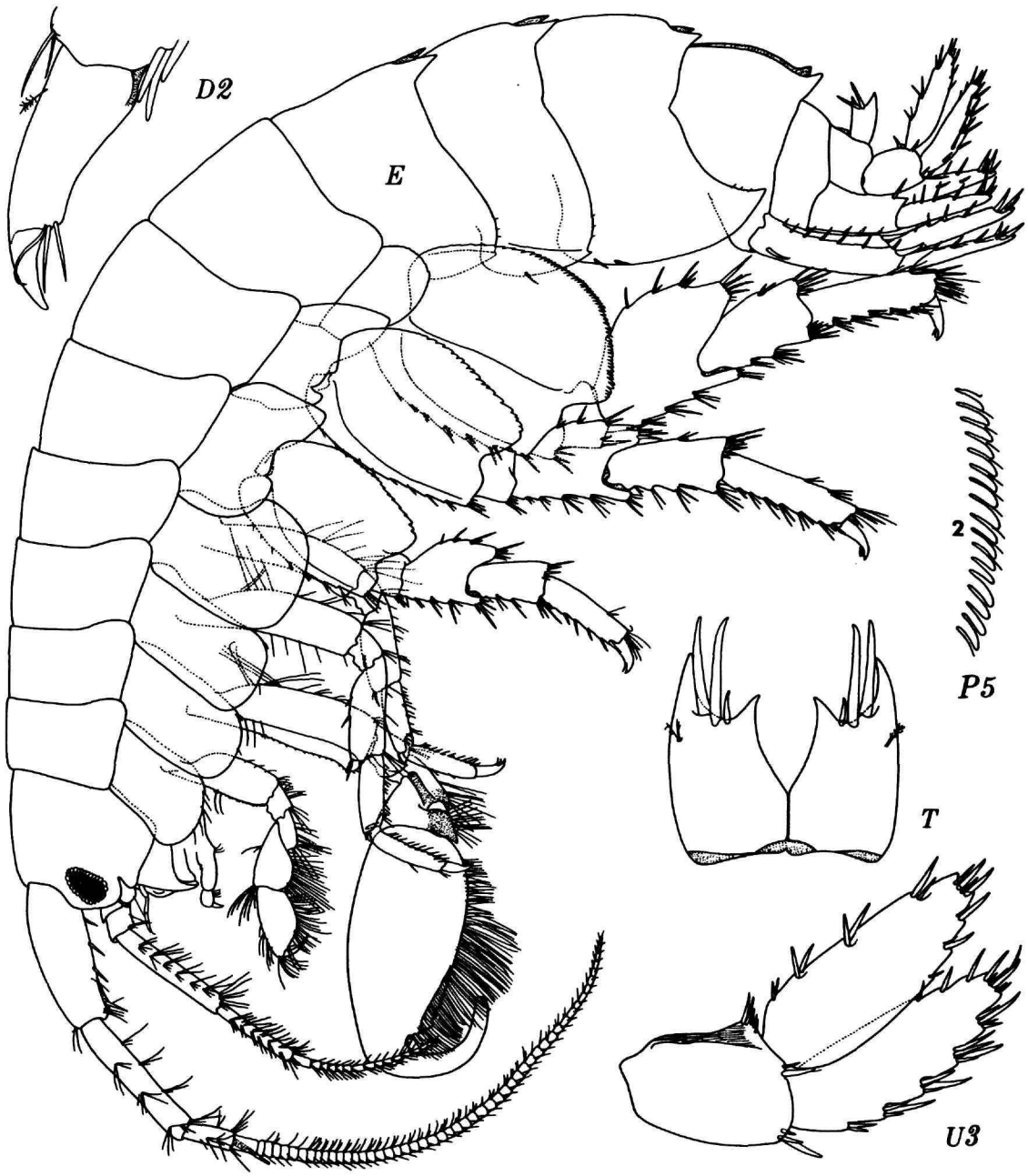


FIGURE 142.—*Mallacoota diemenensis* (Haswell), male, 17.0 mm, Port Phillip 64; *n*=female, 16.0 mm, Port Phillip 18; *c*=small male, Port Phillip 18.

REMARKS.—The specimen from Shepherd 36 has the dorsal teeth of pleonite 3 obsolescent, has only a single, weak dorsal carina on that segment, and has a deep triangular incision above the posteroventral tooth on the right pleonal epimeron 3.

Tattersall's identification of *E. subcarinatus* noted that article 2 of pereopod 5 is deeply castelloserrate, which may indicate that he had, instead, *M. diemenensis* from the Abrolhos Islands (off Western Australia). An occasional specimen of *M. subcarinata,* however, has been found with very rudimentary castelloserrations, so some gene flow between the two species may be apparent. Oddly, if Tattersall had *M. diemenensis,* he did not notice the dorsal teeth pairs on pleonites 1-2.

MATERIAL.—Port Phillip 7 (2), 18 (5), 25 (6), 30 (2), 59 (1), 64 (1), 76 (1), 83 (1); Shepherd 23 (2), 24 (2), 26 (1), 36 (1), 46 (2), 54 (2).

DISTRIBUTION.—Cooler part of southeastern Australia and Tasmania, littoral and sublittoral.

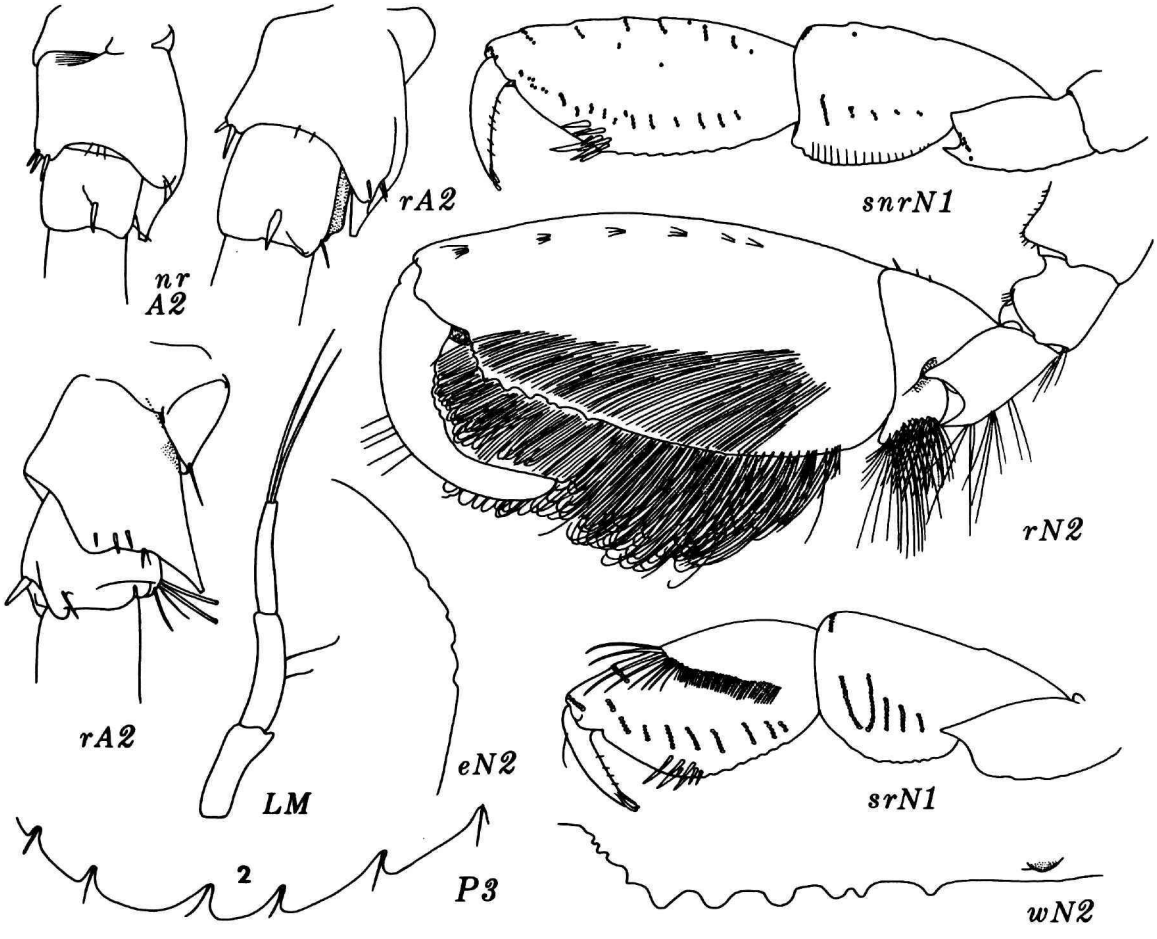


FIGURE 143.—*Mallacoota diemenensis* (Haswell).

## *Mallacoota subcarinata* (Haswell)

FIGURES 144–145

*Megamoera sub-carinata* Haswell, 1880b:335, pl. 21: fig. 4.—Chilton 1885:1039.

?*Moera petriei* Thomson, 1882:236–237, pl. 18: fig. 3.—Chilton 1883:82, pl. 2: fig. 4; 1885:1039.

?*Moera subcarinata*.—Chilton 1885:1039.—Thomson 1889:261.

?*Moera sub-carinata*.—Chilton 1884:230–231.—Thomson and Chilton 1886:146.

?*Elasmopus subcarinatus*.—Stebbing 1888:1019–1025.—Chilton 1892:261.—Walker 1904:275, pl. 5: fig. 34.—Stebbing 1906:441–442.—Walker 1909:335.—Stebbing 1910a:602, 643; 1910b:457–458.—Thomson 1913:243.—Chilton 1915:321–326, figs. 1–6; 1921a:76.—Stephensen 1931:11.—K. H. Barnard 1935:286.—Pirlot 1936:317–326, figs. 136–145.—K. H. Barnard 1937:160–161.

?*Elasmopus persetosus* Stebbing 1888:1019, pl. 98.

?*Maera subcarinata*.—K. H. Barnard 1940:460.—Nayar 1967:149.

DIAGNOSIS (of phenotype A).—Head with deep anteroventral notch slightly gaping and lobe ventral to notch thin and not reaching tangent of ocular lobe; article 1 of antenna 1 with 3-5 ventral spines in line and middistal cusp; accessory flagellum 3-4 articulate; eyes black; mandibular palp in adolescence with thin

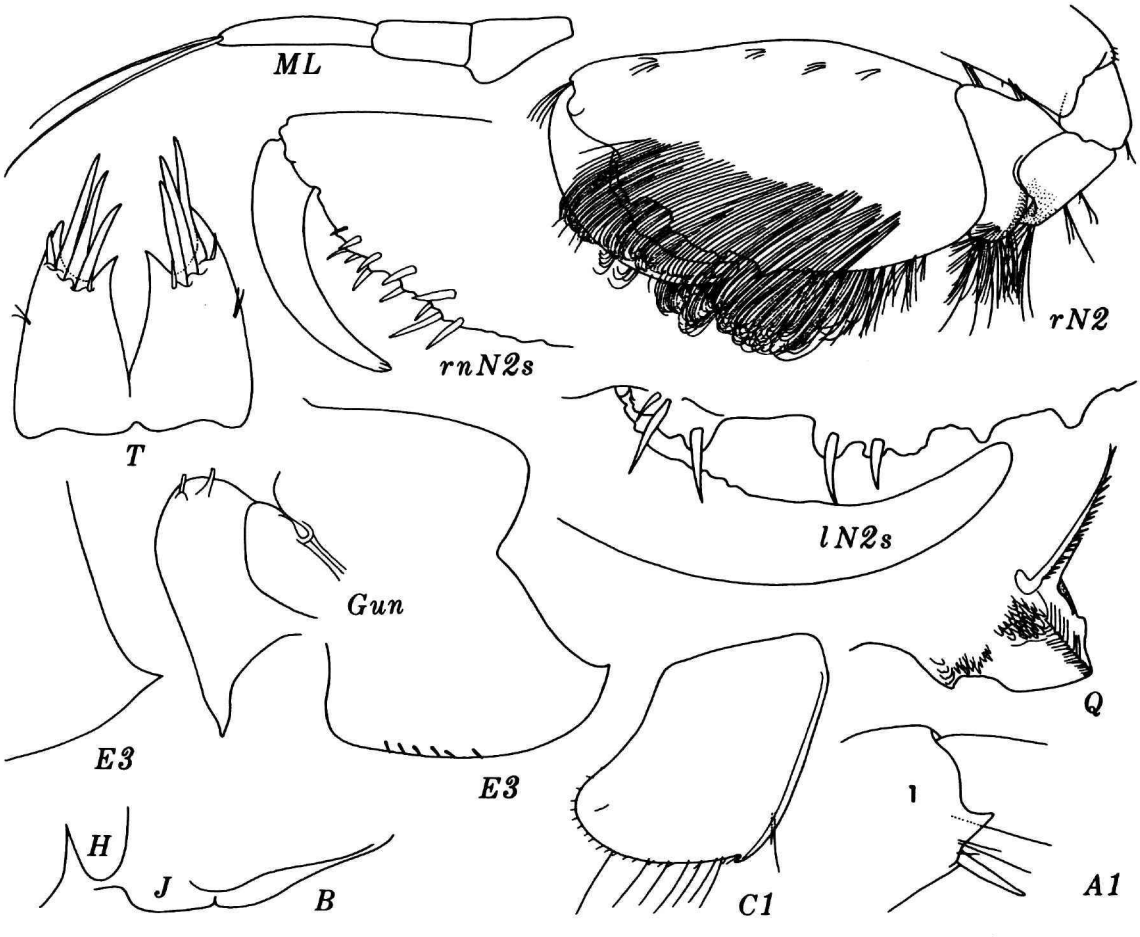


FIGURE 144.—*Mallacoota subcarinata* (Haswell), phenotype A, male, 11.8 mm; ♀=female, 8.9 mm; both from Port Phillip 50.

article 1 lacking distal cusp and articles 2-3 of normal proportions, with article 3 bearing 3 subterminal setae and 2 terminal setae, in adults (both sexes) article 1 becoming apically tumid, or in some females only developing weak cusp, article 2 becoming relatively much shorter than article 3, latter with only 2 apical setae; mandibular molar with weak basal hump; each outer lobe of lower lip with 1 medial cone and 1-2 apical cones; inner plate of maxilla 1 (adult) with 5 long plumose apical setae and 5 setules on side, palp apically tapering and bearing spines and setae terminally and halfway along medial margin; inner plate of maxilla 2 bearing only medial setules (hairs); palp article 3 of maxilliped with subfalciform apical process; coxa 1 normally extended forward, anterior margin moderately excavate, posteroventral corners of coxae 1-3 with strong notch in adults (present in juveniles), article 4 of gnathopod 2 with strong tooth in both sexes, female gnathopod 2 of normal dimensions (see "Remarks"), male hand elongate, strongly setose on posterior half of medial margin, palm defined by 1-2 small cusps, distal portion with low spinose, castelliform teeth, dactyl curved, simple or weakly serrate near base on inner margin; pereopodal dactyls with distal constriction marked with 3 setules, locking spines simple; article 2 of pereopod 5 with regularly rounded posteroventral lobe and weak posterior serrations; base of uropod 1 with lateral spine; rami of uropod 3 about 1.4 times as long as peduncle, rami equal to each other in length; adult telson with strongly gaping bifid apices armed with 3 long and 2 very short spines, adolescents with much less gape and shorter wings, with 1 long spine reduced in length and smallest spines occasionally represented by spinule or seta, or absent; pleonites 1-3 dorsally smooth; pleonite 4 dorsally bicarinate (as in *M. diemenensis*); pleonal epimera 1-2 each with lateral ridge and weak posteroventral tooth, epimeron 3 with small (adoles-

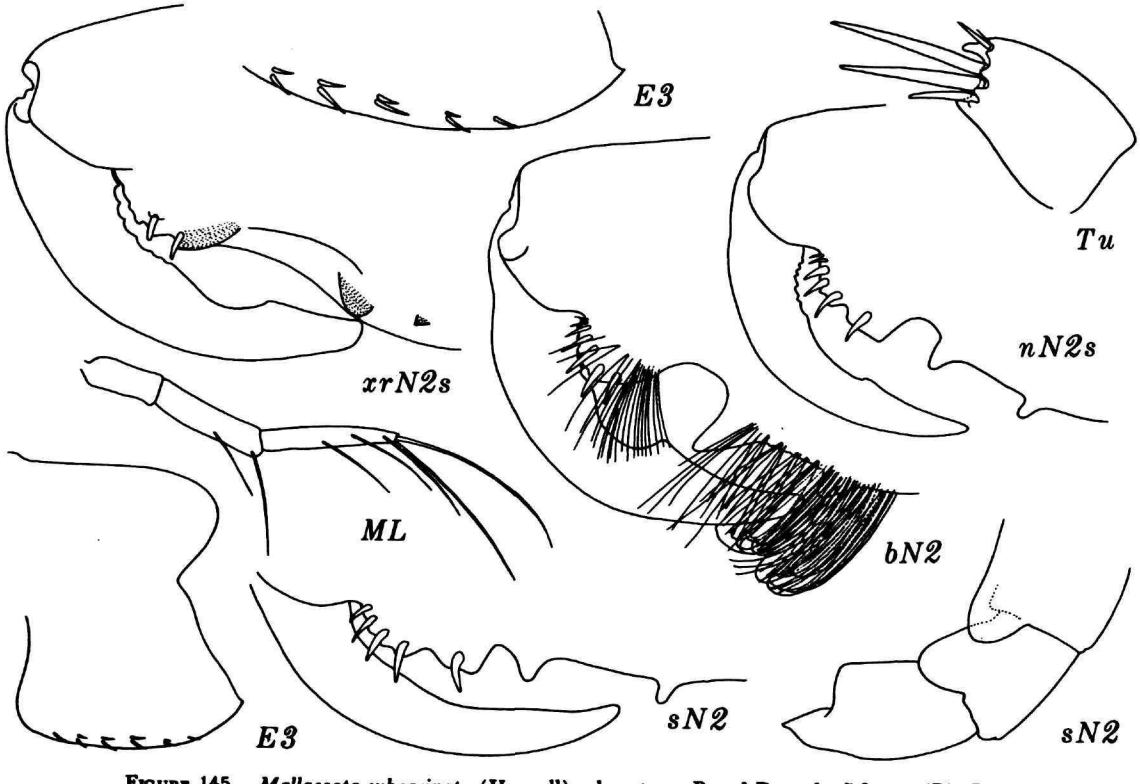


FIGURE 145.—*Mallacoota subcarinata* (Haswell), phenotypes B and D, male, 7.0 mm (B), Port Phillip 87; *b*=male, 8.7 mm (B), WAM, Cottesloe; *n*=male, aberrant (B), Shepherd 36; *x*=male, 10.2 mm (D), Shepherd 23.

cent) to medium-sized posteroventral tooth, epimera 2-3 with many ventral spines set in single row, but occasional adolescent male with spines set in pairs. Males about 7–12 mm long, females about 7–10 mm long.

PHENOTYPE B.—Like phenotype A, but coxae 1-3 lacking notches in both sexes; male gnathopod 2 in juvenile with palm rudimentarily similar to adult of phenotype A, bearing 1 spine on middle process, in adult male palm with large invagination between distal spinose process and strong simple cusp, palm defined by 1 cusp, dactyl apically acquiring form of adze; male developing 2 or 3 spines in each position on ventrofacial margins of pleonal epimera 2-3; articles 2-3 of male gnathapod 2 with large anterofacial lobes, medial and lateral.

PHENOTYPE D.—Like phenotype A, but cusp absent on article 1 of antenna 1, distal process of palm on male gnathapod 2 small, bulbous, bearing only 2 spines, middle of palm without process, weakly excavate, weak semifacial lobe at apex of dactyl and very weak cusp proximal to dactyl on face of hand, dactyl adze shaped; lobes of articles 2-3 of gnathopod 2 weak as in phenotype A; medial face of hand of male gnathopod 2 very setose like phenotypes A and B (not shown in Figure 145*xrN2s*); coxae 1-3 each with posteroventral notch.

REMARKS.—Parts not illustrated herein correspond to those figured by J. L. Barnard (in press); these include the head, maxillipedal palp, gnathopod 1, female gnathopod 2, pereopods 1-5, including coxae 3-7, pleonal epimera 1-2, urosome, uropods 1-3 (except that uropod 1 has a basolateral spine).

The largest female at hand, 8.9 mm long (Port Phillip 50, phenotype A), has the palm of the left gnathopod 2 smooth, but the palm of right gnathopod 2 has a weak sculpture (Figure 144*rnN2s*).

Adolescents have an unmodified distal margin on article 1 of antenna 1, but adults have a sharp tooth on the posteromedial surface (Figure 144*A1*).

MATERIAL.—Noted as phenotypes A, B, and D; Port Phillip 4 (1A), 50 (6A), 60 (2A), 63 (1A), 83 (3A), 87 (1A, 4B); Shepherd 22 (2D), 23 (9D), 34 (38), 36 (2B), 37 (1B); WAM, Point Peron, seaweed washings (1B); WAM, Rottnest, 18 fms (1B); WAM, Cottesloe, determined by C. Chilton, July 1926 (4B).

DISTRIBUTION.—Warm-temperate Australia, littoral and sublittoral; ?New Zealand; South Africa; Indonesia; subantarctica.

### *Mallacoota marilla*, new species

FIGURES 146–147 (part)

With this species occurring in two phenotypes, a setose and nonsetose phase, the main diagnosis is based on the most commonly occurring phenotype; the other is diagnosed in sequel.

DIAGNOSIS (of phenotype PP)—Head with deep anteroventral notch slightly gaping and lobe ventral to notch thin and not reaching tangent of ocular lobe; article 1 of antenna 1 with 3-5 ventral spines in line but distal spine forming member of group of 2-5 spines; accessory flagellum 2-3 articulate; eyes black; mandibular palp vestigial, 1-articulate, with 2 apical setae; mandibular molar with weak basal hump; each outer lobe of lower lip with medial cone and 1 apical cone, these cones about twice as long as in *M. subcarinata*; inner plate of maxilla 1 with 3-4 apical setae and 5 spinules on side, palp apically tapering and bearing spines and setae terminally and halfway along medial margin; inner plate of maxilla 2 medially smooth; palp article 3 of maxilliped with subfalciform apical process; coxa 1 normally extended forward, anterior margin moderately excavate; posteroventral corners of coxae 1-3 lacking notch; article 4 of gnathopod 2 in both sexes with very weak tooth, female gnathopod 2 of normal dimensions, male hand elongate, nearly barren of setae, palm defined by weak nodule on medial margin of deep hollow, outer limb bearing strong subcircular cusp, anterodistal end of palm forming low spinose humps, dactyl curved, with strong apical adze; article 3 with sharp anterolateral lobe unlike *M. subcarinata*; pereopodal dactyls with distal constriction marked with 3 setules, locking spines simple; article 2 of pereopod 5 with regularly rounded posteroventral lobe and weak posterior serrations; uropod 1 with basolateral spine; rami of uropod 3 about 1.4 times as long as peduncle, rami equal to each other in length but outer often appearing slightly shorter like *M. diemenensis;* telson with weakly gaping apices like adolescent male of *M. subcarinata* and bearing 3 apical spines on each lobe, spines all medium in length, or 2 long and 1 medium; lateral edge of spine group with setule (not to be confused with 2 setules on each side in middle of each lobe); pleonites 1-3 dorsally simple, pleonite 4 dorsally bicarinate; pleonal epimera 1-2 each with lateral ridge and weak posteroventral tooth, epimera 2-3 with many ventral spines set in groups of 1, usually 2, but rarely 3 or 4

in each set, epimeron 3 with small posteroventral tooth set on posteriorly projecting part of epimeron as in *M. subcarinata*. Males about 7–12 mm long, females 7–11 mm long.

PHENOTYPE PS.—Setose phase, male gnathopod 2 with palm more oblique than in PP, medial face of hand extremely setose on posterior half (lower half), concealing weak longitudinal hollow defined proxi-

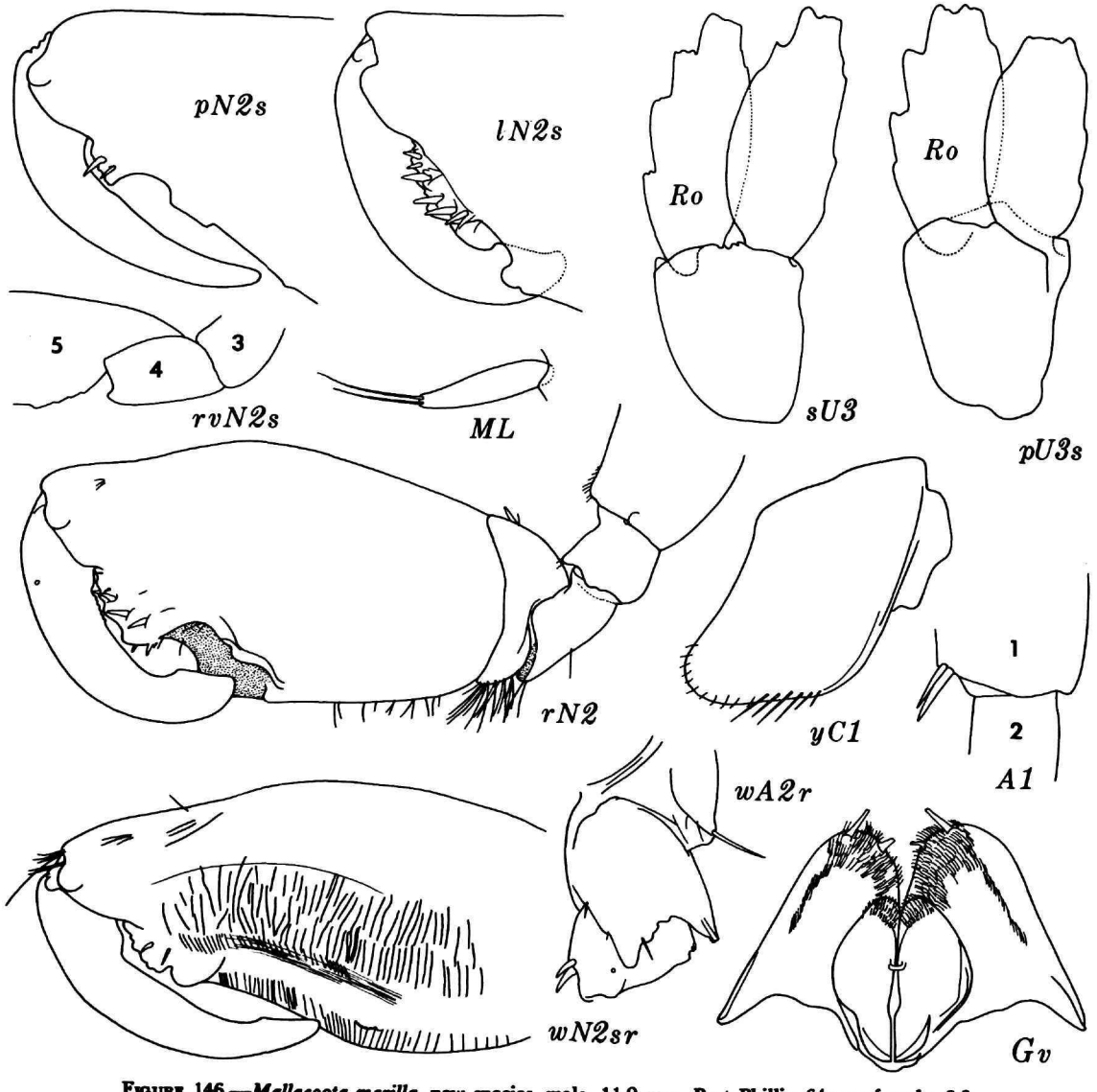


FIGURE 146.—*Mallacoota marilla*, new species, male, 11.0 mm, Port Phillip 64; *v*=female, 8.0 mm, Port Phillip 87; *y*=holotype, male, 7.4 mm, Port Phillip 87; *w*=male, 10.3 mm, phenotype S, WAM, Point Peron; *p*=male, 6.8 mm, Shepherd 40. (Vertical lines on *wN2sr* = rows of setae.)

mally by weak ridge, distal subcircular cusp on palm highly bulbous, dactyl curved but elongate, adze shaped like PP, posterior lobe of article 5 heavily setose medially, article 2 of dimensions similar to PP. Male 10.3 mm. In the drawing of this gnathopod, the medial setae have been removed from the posterior half of the hand and represented by lines vaguely defining the rows of setae.

PRESUMED ADOLESCENT MALE.—Gnathopod 2 untransformed, generally resembling that of adolescent male of *M. subcarinata*, very heavily setose on posterior margin and medioposterior face of hand, palmar area highly variable, defining cusp obsolescent or absent, process in midpalmar area either very low and very broad (Figure 146*pN2s*), low and narrow or absent, in several specimens that area of midpalm deeply and evenly excavate, distal process varying in length from 2 to 4 spine areas, midlateral process of article 3 rudimentarily conical.

JUVENILES.—Posterior margin of pleonal epimeron 3 not posteriorly extended, margin nearly vertical, posteroventral tooth obsolescent; ventral spines on

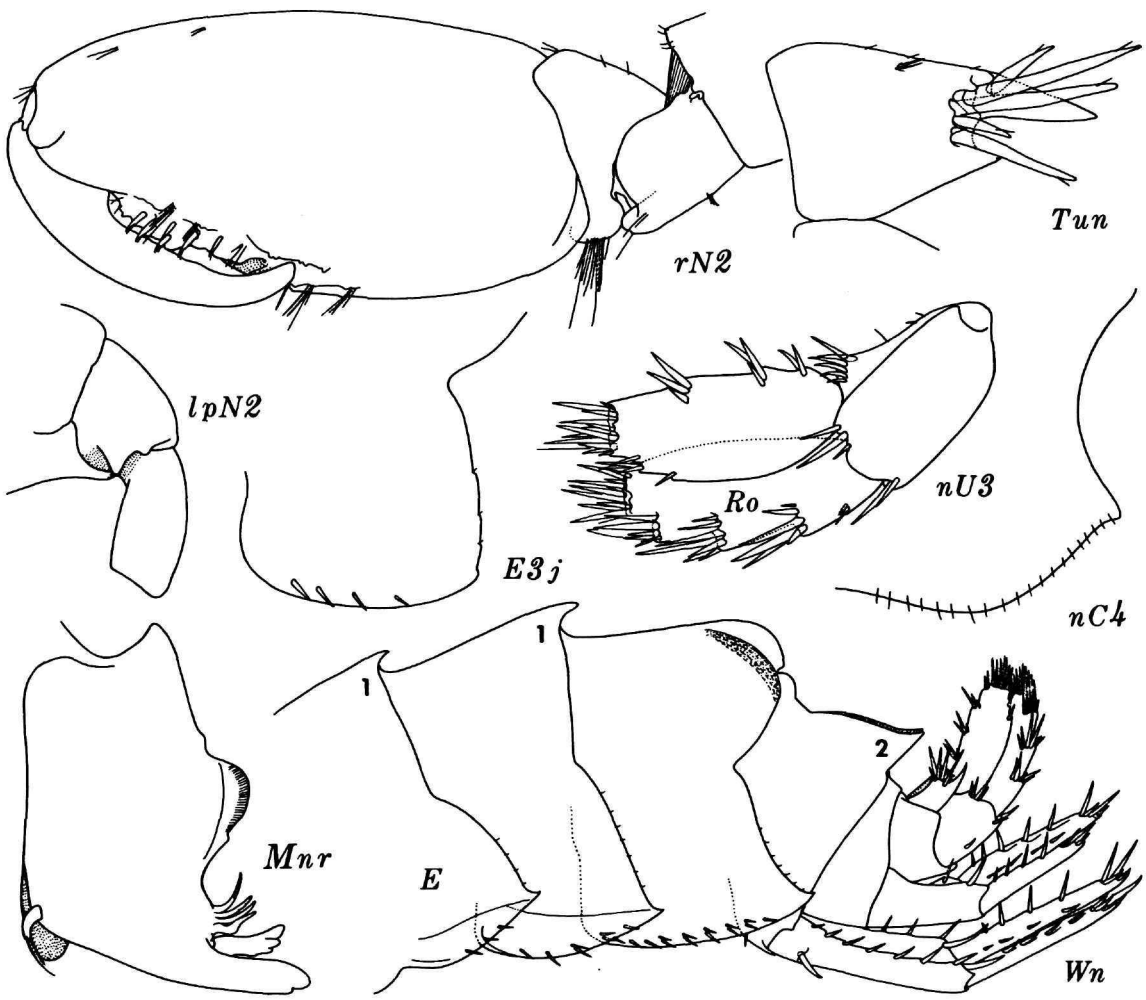


FIGURE 147.—*Mallacoota carteta*, new species, holotype, male, 8.8 mm, Slack-Smith 2; *n*= female, 10.8 mm, Shepherd 33. *Mallacoota marilla*, new species, *p*=male, 6.8 mm, Shepherd 40; *j*=juvenile, 6.2 mm, Shepherd 48.

epimera set as single members; adolescent males recognizable at body length of 5 to 7 mm, with gnathopodal enlargement commencing and epimeron 3 commencing posteroventral extension; juvenile 2.5 mm long bearing only 1 distal spine on article 1 of antenna 1 but mandibular palp 1-articulate like that of adult.

OTHER VARIATIONS.—Slight thickening of article 6 of pereopods 4-5 in occasional specimens; urosome slightly more robust in occasional specimens (usually represented by all specimens in a sample), especially measurable in uropod 3 (Figure 146*sU3*, 146*pU3s*), having rami relatively broader and shorter in relation to peduncle; inner ramus of uropod 3 rarely shortened, and robustness of uropod 3 not correlated with shortening of inner ramus.

One female from JLB Australia 5 lacks a palp on the right mandible; the telson of West Australian specimens has up to 5 spines on each lobe.

HOLOTYPE.—NMV, male, 7.4 mm (phenotype PP).

TYPE-LOCALITY.—Port Phillip 87, Victoria, area 59, Pope's Eye Annulus.

RELATIONSHIP.—This species is apparently a cryptic and sibling species with affinities to *M. subcarinata*, but there remains the possibility that the specimens represent hybrids between *M. subcarinata* and *M. diemenensis* or that the specimens represent phenotypes of either of those species. The degeneration of the mandibular palp, the occurrence of *M. carteta* (below), and the occurrence of a unicarinate specimen of *M. diemenensis* (q.v.) are the only clues suggesting that the specimens might be hybrids; the following factors suggest the opposite: the high frequency of occurrence of the specimens (they are more numerous than either of the earlier described species in these collections), the lack of any intergradation in the degenerate mandibular palp, the presence of 2 or more distal spines on article 1 of antenna 1 being consistent in adults and juveniles between 4 and 12 mm (but not in a juvenile 2.5 mm), the small process on article 4 of gnathopod 2, the enlarged cones on the lower lip, and the consistently obsolescent defining tooth of the untransformed male gnathopod 2.

Several characters typical of this species occur very rarely or only in certain stages of *M. subcarinata*: Coxal teeth are often absent in adolescent males of *M. subcarinata*; in adult males of phenotype B, the presence of pairs or triads of epimeral spines also occurs only in adolescent males of *M. subcarinata* or in few adults of phenotype B; males with transformed gnathopod 2 (nonsetose) have not been found in *M. subcarinata*, but the materials are insuffiiciently abundant to make any conclusions; the development of a terminal adze on the dactyl of male gnathopod 2 occurs rarely in *M. subcarinata*; the telson is usually like adolescent males of *M. subcarinata* with the gape and wings of moderate extent and length.

MATERIAL.—Port Phillip 64 (1), 87 (2); Shepherd 8 (2), 9 (6), 11 (6), 13 (7), 22 (7) 23 (2), 24 (1), 27 (1), 30 (7), 31 (21), 32 (9), 33 (1), 38 (2), 40 (10), 42 (4), 46 (12), 48 (6), 52 (5), 54 (4), 55 (4), 76 (4); Slack-Smith 2 (7); JLB Australia 2 (1), 3 (4), 5 (26), 12 (4), 13 (9), 14 (6); WAM, Bunbury (1); WAM, Rottnest, 18 fms (3); WAM, Point Peron, 1946 (3 samples) (59).

DISTRIBUTION.—Warm-temperate Australia, littoral and sublittoral.

ILLUSTRATIONS.—Legends for Figures 146 and 147 of *M. marilla* and *M. carteta* are abbreviated, but the details are presented here. Two phenotypes of each species occur, but since females and juveniles cannot be judged for setose phases as yet, S phenotypes apply only to males: *M. carteta*, male, 8.8 mm, phenotype CC, Slack-Smith 2; female, 10.8 mm, C, Shepherd 33; *M. marilla*, male, 6.8 mm, PS, Shepherd 40; male (juvenile), 6.2 mm, P, Shepherd 48; male, 11.0 mm, PP, Port Phillip 64; male, 10.3 mm, PS, WAM, Point Peron; female, 8.0 mm, P, Port Phillip 87; male, 7.4 mm, PP, Port Phillip 87.

### *Mallacoota carteta*, new species

FIGURE 147 (part)

DIAGNOSIS (of female phenotype CC).—Differing from *M. marilla* in presence of single middorsal posterior tooth on each of pleonites 1-2, with strong, rounded middorsal carina on pleonite 3; apex of posteroventral lobe on coxa 4 with slight extension; epimeron 3 with enlarged posteroventral tooth; rami of uropod 3 slightly broadened but equal in relative length to *M. marilla*; telson with lateral wing of apex enormously extended. Females up to 11.0 mm long; juvenile 3.0 mm also known and bearing typical teeth.

MALE OF PHENOTYPE CC.—Gnathopod 2 scarcely setose, palm very oblique, ill defined, bearing weak spinose humps and facial ridge locking dactyl, nodulate, dactyl long, weakly curved, apically simple; teeth

of pleonites 1-2 very thick; lateral wings of telson not as highly elongate as in other phenotypes or in female of phenotype C.

MALE OF PHENOTYPE CS.—Gnathopod 2 highly setose medially as in PS of *M. marilla*; dactyl simple. Male is juvenile, 4.5 mm; adult unknown; possibly this phase transforms into adult CC.

HOLOTYPE.—WAM, male, 8.8 mm.

TYPE-LOCALITY.—Slack-Smith 2, Cheyne Beach, east of Albany, Western Australia, intertidal, weedy rocks, 6 December 1968.

REMARKS.—The extraordinary morphology of *M. carteta* is enigmatic. The mandibular palp and spines on article 1 of antenna 1 conform to *M. marilla* and not to *M. subcarinata* and *M. diemenensis*. To some extent, the dorsal sculpture of pleonites 1-3 is a conceptual intergrade between *M. subcarinata* and *M. diemenensis*, a clue suggesting that *M. carteta* is a hybrid between the two species. In terms of mandibular palp and antenna 1, this logic could then be extended to *M. marilla*.

The degeneration of a mandibular palp in these circumstances is extraordinary; that is to say, this character change is usually a mark of generic or familial magnitude, and it has not been previously reported as a change possibly marking a phenotype, hybrid, or a sibling species of a family or genus in which mandibular palps are a fundamentally 3-articulate development. A species of Phliantidae, *Iphinotus typicus* (Thomson) from New Zealand, apparently has phenotypes with alternatively 3 or 4 maxillipedal palp articles (J. L. Barnard, in press), but that family has several genera distinguished among themselves with variations of that sort, whereas marine Gammaridae do not.

MATERIAL.—Shepherd 8 (1), 11 (3), 13 (3), 22 (10), 23 (3), 26 (1), 30 (15), 33 (3), 34 (4), 48 (3), 49 (2), 52 (2); Slack-Smith 2 (5); Port Phillip 59 (1).

DISTRIBUTION.—Warm-temperate Australia, intertidal and sublittoral.

## *Parelasmopus* Stebbing

### THE PROBLEM OF SPECIES IN THIS GENUS

The following names have been established for species in *Parelasmopus*: *Gammarus suluensis* Dana (see 1853); *G. albidus* Dana (see 1853); *Parelasmopus setiger* Chevreux (1901); *P. resacus* J. L. Barnard (1965). Stebbing (1888) identified and described a species as *P. suluensis*, which has been used as a model comparator ever since. Only the female of *G. suluensis* was described by Dana in 1853, but his weakly developed figures clearly show Stebbing's material to be distinct in the presence of a pair of dorsal teeth on pereonite 7 and in the weakly serrate article 2 of pereopods 3-5. Dana showed *G. suluensis* to be lacking teeth on pereonite 7, but he distinguished them on the pleonites successfully; he also showed a heavily serrate article 2 of pereopods 3-5, which appears very real directly beside a similar species now believed to be in the same genus, *G. albidus*. Dana drew the latter with a smooth article 2 of pereopods 3-5, implying, at the least, that they were so poorly serrate that, with his enlarging lens, the serrations appeared minimal.

Chevreux (1901) differentiated his *P. setiger* from Stebbing's (1888) view of *P. suluensis* in a number of characters, one of which seems today to be of importance: the strong anteroventral tooth on coxa 1 in *P. setiger*. In addition, the oblique palm of gnathopod 2 and the apparent absence of long setae on pereopods 3-5 seem to differentiate Stebbing's material from *P. setiger*. (Stebbing's specimen lacked articles 5-7 of the pereopods, so that the degree of setosity is not fully clear except on article 4). Whether the difference between 4 telsonic spines on each lobe in *P. setiger* and 2 spines in Stebbing's material is valid is difficult to determine until similar instars can be compared. Chevreux also noted that Stebbing in *P. setiger* drew rounded lateral cephalic lobes that are truncate. *Parelasmopus setiger* also is characterized by long dorsal body setae, but I have specimens on hand, otherwise congruous to *P. setiger*, with these setae either absent or very sparse, though elongate. Other differences mentioned by Chevreux are difficult now to evaluate.

Walker (1904) had specimens that he believed mixed together characters of Stebbing's *P. suluensis* and Chevreux's *P. setiger*, and he started a trend to synoymizing *P. suluensis* and *P. setiger*, followed later by Stebbing, K. H. Barnard, Stephensen, and Pirlot among others with the result that by 1936 the two species definitely had been synonymized. But in 1938 Schellenberg rediscovered the fact that Dana also had described another *Parelasmopus*, *G. albidus*. Unfortunately, I believe he attributed the wrong material to that species, as did Stebbing (1888), who apparently also attributed wrong material to *P. suluensis*.

It now appears that major specific characters in the genus include at least the following: (1) whether dorsal teeth are present or absent on pereonite 7 in adults; (2) whether the palm of male gnathpod 2 is nearly transverse or definitely and strongly oblique; (3) whether article 2 of pereopods 3-5 is grossly or weakly serrate; (4) whether coxa 1 (and 2, 3, and 4) has an extended, sharp anteroventral tooth; and (5) whether pereopods 3-5 have extremely long setae or not. If variations in these characters can be demonstrated to represent only demes or morphs, one must then synonymize all of these species.

Character 5 may be of little value, as I have found specimens of *P. setiger* without dorsal setae of any extent, and thus by extension I consider the possibility that setose and nonsetose forms of pereopods may occur. Since 1904, however, characters 1-4 have not been consistently handled in identifying specimens of *Parelasmopus,* although an occasional reference to what has since become a single species, *P. suluensis,* has sufficient information to suggest a proper identification. Until the tropical Indo-Pacific specimens of *Parelasmopus* can be studied thoroughly, it seems wise to separate the various species originally described and any other identification not fitting the original material of each name. This is presented in the key to *Ifalukia, Mallacoota,* and *Parelasmopus,* wherein *Parelasmopus resacus* is removed to a new genus, *Ifalukia.*

Among the various references to *P. suluensis* and *P. albidus,* one may find some clues to a different identification than that proposed by the identifier:

Walker's (1904) *P. suluensis* appears to be *P. setiger.*

Walker's (1905) *P. suluensis* also may be *P. setiger.*

Chilton's (1922) *P. suluensis* is definitely *P. setiger* in the dorsally nonsetose phase.

Stephensen's (1931) *P. suluensis* may be *P. albidus.*

K. H. Barnard's (1935) *P. suluensis* is generally similar to Stebbing's (1888) version of *P. suluensis* except that pereopods 3-5 have long setae. It is thus the most disturbing material so far reported, and it suggests that the systematic problem in *Parelasmopus* is compounded by the presence of many undescribed species or undescribed phenotypes of a common stem.

Schellenberg's (1938) *P. albidus* may be Dana's *P. suluensis.*

Schellenberg's (1938) *P. suluensis* is enigmatic.

Identifications of *P. suluensis* by Spandl (1924), Pillai (1957), and Nayar (1967) all suggest the presence of additional species or morphs in the genus.

Identifications of *P. suluensis* in the following papers did not include any significant morphological notes: Chevreux (1908), Walker (1909), Stebbing (1922), Pirlot (1936), K. H. Barnard (1940), Ruffo (1959).

I have reexamined my (1965) identification of *P. albidus* from Micronesia and find that the one juvenile specimen fits the key (herein) to *P. albidus,* but it does not fit Schellenberg's (1938) material of *P. albidus* because the serrations on article 2 of pereopod 3 are of the weak and not the strong alternative. The specimen has a weakly developed gnathopod 2, no teeth on pereonite 7, a sharp anteroventral cusp on only coxae 1-2. Articles 5-7 of pereopods 3-5 are missing, but article 4 has a few of the medium-long spine setae (about 60 percent as long as article 4) that are not considered to be the long kind of flexible setae seen in *P. setiger.* The peduncle of antenna 2 fails strongly in reaching the end of the peduncle of antenna 1. Except for antenna 2, this specimen thus fits the original description of *P. albidus* more strongly than anything since reported in the literature.

A key to the species of *Ifalukia, Mallacoota,* and *Parelasmopus* precedes the description of *Ifalukia.*

### *Parelasmopus setiger* Chevreux

FIGURE 152 (part)

*?Megamoera suensis* Haswell, 1880c:335–336, pl. 21: fig. 5.
*Megamoera suensis.*—Miers 1884:317–318.
*Megamoera haswelli* Miers, 1884:318 [name in text].
Not *Megamoera suensis.*—Haswell 1885:103–104, pl. 15: figs. 1–4 [= *Maera hamigera* (Haswell) fide Stebbing, 1906, but see Stebbing, 1910a:600].
*Elasmopus suensis.*—Stebbing, 1906:442–443.
*Parelasmopus setiger* Chevreux, 1901:412–418, figs. 32–39.
*Parelasmopus suluensis.*—Chilton 1922:7–8, fig. 3 [not Dana].
*?Parelasmopus suluensis.*—Walker 1904:278, pl. 6: fig. 3 [?not Dana].

REMARKS.—The material at hand adequately fits Chevreux's excellent description and figures except for the weakly developed, to absent, dorsal body setation, apparently also characterististic of Chilton's material from northwestern Australia. Two stages of the palm of male gnathopod 2 are illustrated herein, and the deep serrations of coxa 1 are shown, as these were not pointed out by Chevreux but can be dimly seen in his drawing of the body. These serrations, 2-3 teeth, occur on coxae 1 and 2 and weakly on coxa 3. Coxae 1-2 have the sharp anteroventral point, but coxa 3 has only a bare indication of such. The weak development of dorsal setation is not here considered a mark of more than

phenotypy. Epimeron 3 is not like that drawn by Chevreux, but it is like that drawn herein for *Parelasmopus ya,* bearing 2-3 teeth ventral to the main posterior tooth. Chevreux showed these teeth as approximately equal in size and on the same tangent, which may be a legitimate specific difference.

Generally, these specimens look like *P. ya,* but they have 2 dorsal teeth on pereonite 7, a longer tooth on epimeron 2 (like the drawing of Chevreux), less densely setose articles 4-5 of the peduncle of antenna 2 (like Chevreux), antenna 1 with only 2 ventral spines, 1 distal spine at approximately mark 40, and the wings of the telsonic lobes short (as shown by Chevreux). The dorsolateral prolongations on pleonite 3 are variable: in BPI 26 (Banner Samples) the prolongations are softly rounded, but in BAU 27 (idem) they form the sharp right angles shown by Chevreux.

There seems little doubt that Miers (1884) had specimens of this species, like the material in hand, as his description adequately covers my material. But the original description of *Megamoera suensis* by Haswell is too sparse for positive identification. Haswell's name would take priority over that of Chevreux. Miers proposed the name *M. haswelli* to cover his material of *M. suensis* if it proved distinct from that of Haswell, and so the name *setiger* appears definitely to be a junior synonym.

One problem with Haswell's description of *Megamoera suensis* is his statement that mesial teeth occur on peronite 7 and pleonites 1-2, indicating a single dorsal tooth; he also compares *M. suensis* with *M. subcarinata* (now in *Mallacoota*). To some extent, the dorsal teeth of *M. suensis* fit *Mallacoota carteta,* but the transverse palm of gnathopod 2 and the tropical location of the species at Torres Strait suggest that *M. suensis,* in this context, belongs to *Parelasmopus.*

MATERIAL.—Banner BAU 27 (7), BPI 26 (2) (Philippine Islands).

DISTRIBUTION.—Tropical Australia, Indonesia, and northern Indian Ocean; littoral and sublittoral.

### *Parelasmopus echo,* new species

FIGURES 148–149

DIAGNOSIS.—Head with deep anteroventral notch slightly gaping, and lobe ventral to notch thick but sharp and extending nearly to tangent of ocular lobe; article 1 of antenna 1 with 2 ventral spines in tandem, distal spine in group of setae; accessory flagellum 4-articulate; eyes deep reddish purple in alcohol (long term storage); mandibular palp long, 3-articulate, article 1 immensely elongate and broad and about 1.5 times as long as article 3, article 2 less than half as long as article 3, latter with 2 apical setae; mandibular molar with weak basal hump; each outer lobe of lower lip with 1 long apical cone, 1 medium medial cone, otherwise as shown herein for *Mallacoota subcarinata* (Figure 144*Gun*) inner plate of maxilla 1 with 2 apical setae, 1 subterminal medial seta, 3 spinules on side (and other subterminal setae not on main flat face), palp apically tapering and bearing spines and setae terminally and about one-third along medial margin; inner plate of maxilla 2 medially smooth but terminal setae extending one-third along oblique apicomedial margin; palp article 3 of maxilliped with subfalciform apical process (larger than in *P. ya,* new species); coxa 1 extended forward weakly and ending in sharp point, coxae 2-4 also with small anteroventral point, posteroventral corners of coxae 1-4 very weakly serrate; article 4 of gnathopod 2 in both sexes with small tooth, female gnathopod 2 with hand highly elongate, male hand long and broad, subrectangular but palm strongly oblique, distinct from posterior margin, irregularly spinose and bearing long shallow hollow in middle, medial face with submarginal hump holding apex of dactyl, latter weakly curved, simple, medial face of hand poorly setose; pereopodal dactyls with strong distal constriction marked by slight protrusion and 3 setules, locking spines simple; article 2 of pereopods 3-5 with sharp posteroventral lobe armed with large sharp teeth, these teeth also extending along posterior margin of article 2; uropod 1 with basolateral spine; rami of uropod 3 about 1.4 times as long as peduncle, held so that apex of outer ramus not extending as far as inner; telson with strongly gaping bifid apices armed with 4 short and 4 long spines; pleonites 1, 2, 4, and pereonite 7 bearing 2 dorsal teeth side by side, pleonite 4 with teeth continued forward as carinae, pleonite 3 with similar but weaker teeth, no middorsal carina; pleonal epimera 1-2 each with lateral ridge, subtruncate posterior margins and each posteroventral corner with very thin sharp tooth, epimeron 3 with upswept weakly extended posterior tooth, with ventral margin deeply serrate below, epimera 1-3 with 1, 3, and 5 ventral spines in tandem groups respectively. Terminal males and females about 13-14 mm long.

DESCRIPTION.—Body of mandible not figured and similar to that of *P. ya,* new species, but molars slight-

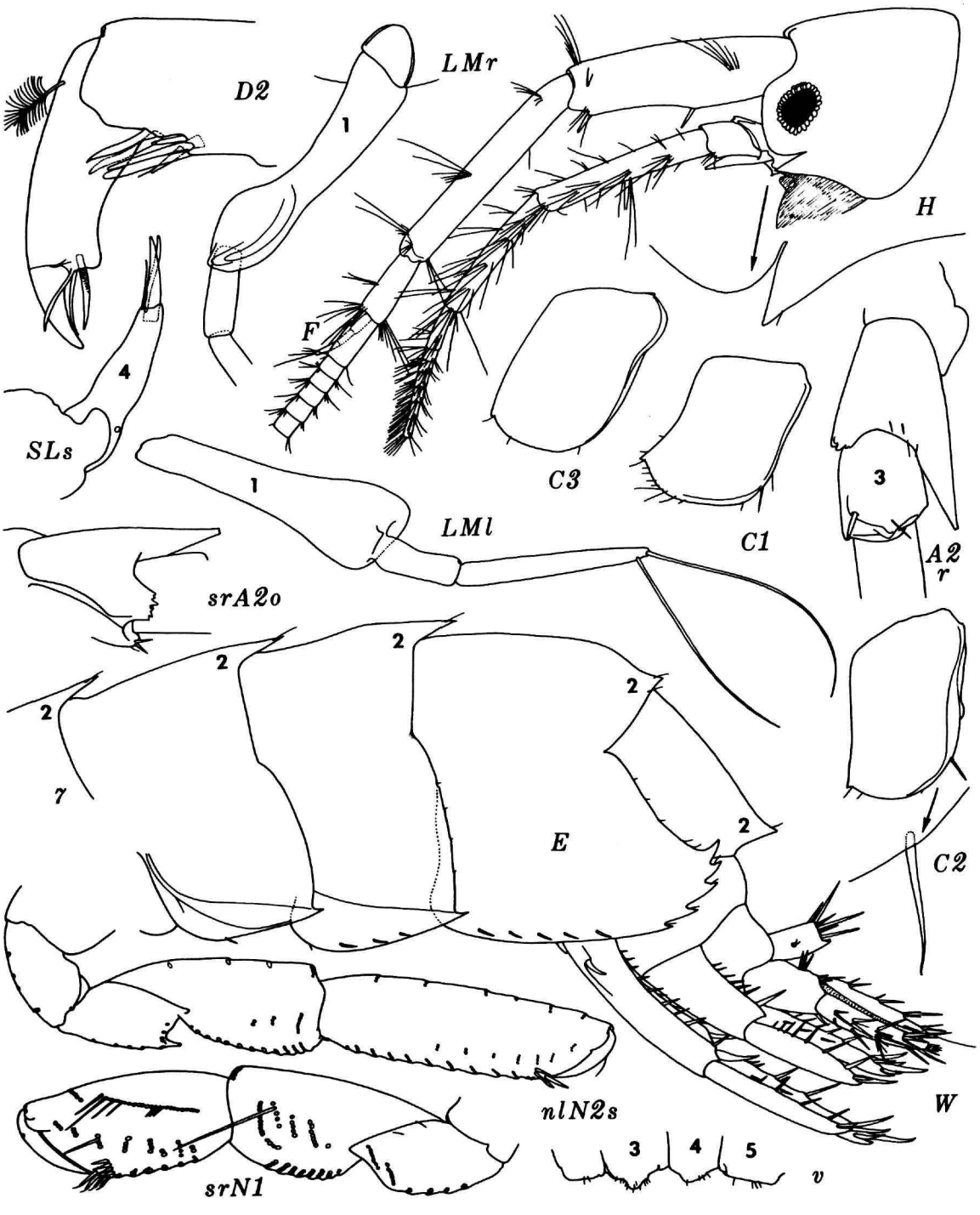


FIGURE 148.—*Parelasmopus echo*, new species, holotype, male, 14.0 mm; *n*=female, 13.2 mm; both from Bunbury. (*v*=venters of pereonites.)

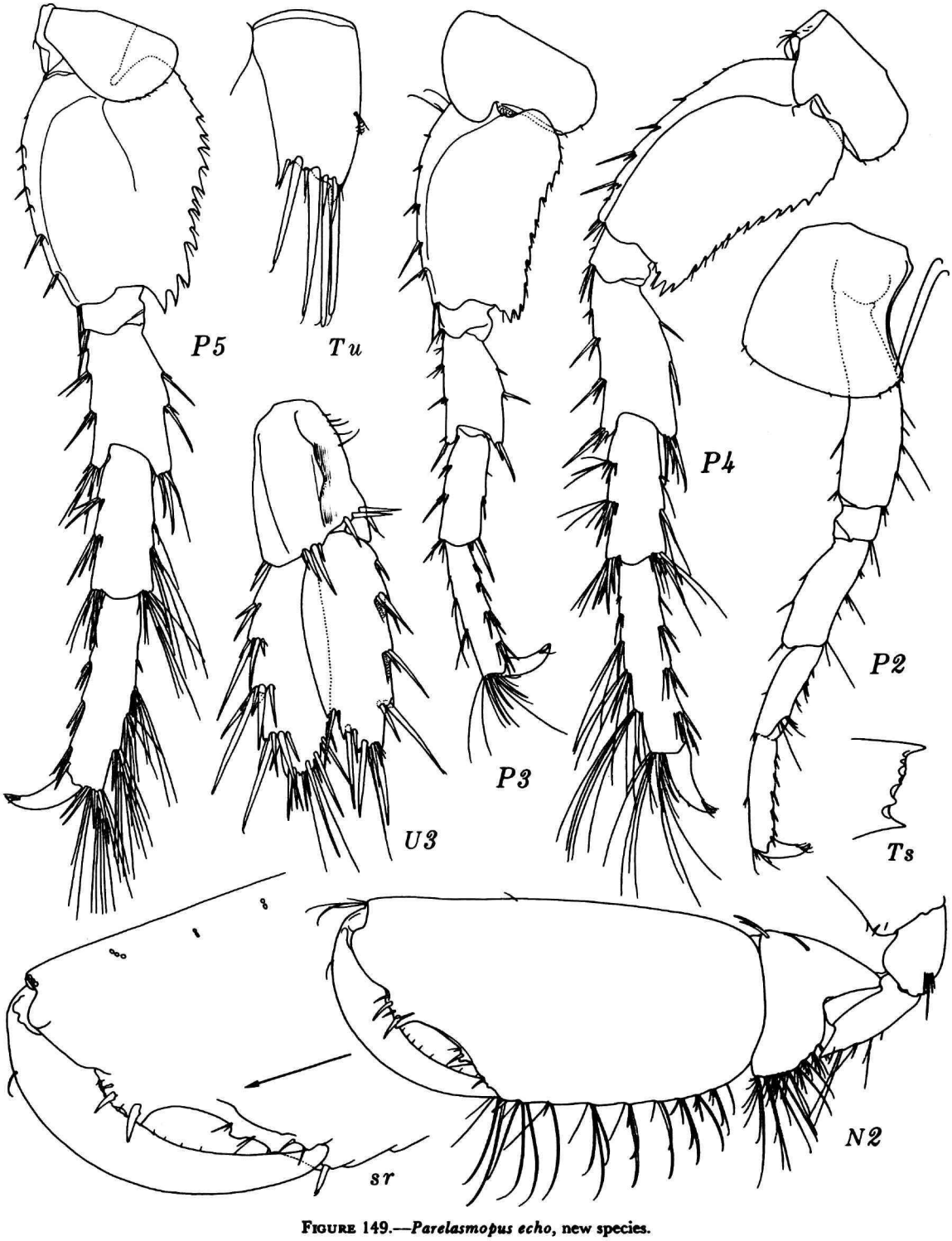


FIGURE 149.—*Parelasmopus echo*, new species.

ly more digitate and ridged on rims, left ragged seta three-fourths as long as that on right (in contrast to *P. ya*), female coxae 1-4 more strongly serrate posteroventrally than in male (more like *P. ya*).

HOLOTYPE.—WAM, male, 14.0 mm.

TYPE-LOCALITY.—WAM, 7 miles southwest of Bunbury, Western Australia, 11 fathoms, FRV *Lancelin*, 13 April 1963.

RELATIONSHIP.—*Parelasmopus echo*, like *P. ya*, resembles *Mallacoota diemenensis* (Haswell) because of the dorsal pairs of teeth, but, *P. echo* differs from *M. diemenensis* in the sharp tooth of the cephalic cheek, the disproportionate articles of the mandibular palp, the narrow posterior lobe of coxa 4, the distinct palm and poorly setose hand of male gnathopod 2, the elongate hand of female gnathopod 2, the long setae and large teeth of pereopods 3-5, the narrower article 4 of pereopods 3-5, the more heavily constricted dactyls of the pereopods bearing slight protrusions, the longer and more numerous telsonic spines, the ventral serrations of epimeron 3, the points on coxae 1-4, and the presence of teeth on pereonite 7.

*Parelasmopus echo* differs from *P. ya* in the poorly developed coxal setae and the development of coxal points, the much larger article 1 of the mandibular palp, the larger falcate process on article 3 of the maxillipedal palp, the more elongate article 6 of female gnathopod 2, the more oblique palm of male gnathopod 2 bearing a much wider hollow, the large tooth-serrations of pereopods 3-5, the longer cheek tooth on the head, the thinner tooth on epimera 1-2, and the presence of teeth on pereonite 7.

The sterna of pereonites 3-4 in the male of *P. echo* have weak humps (Figure 148*v*), slightly better developed than in *P. ya*.

MATERIAL.—The type-locality (3).

DISTRIBUTION.—Southwestern Australia, sublittoral.

### *Parelasmopus ya*, new species

FIGURES 150–152 (part)

DIAGNOSIS.—Head with deep anteroventral notch slightly gaping and lobe ventral to notch thick but sharp apically and not reaching tangent of ocular lobe; article 1 of antenna 1 with about 3-5 ventral spines in tandem, distal spine in group of setae; accessory flagellum 2-4 articulate; eyes deep purple-magenta in alcohol (long term storage); mandibular palp long, 3-articulate, article 1 elongate and broad, nearly as long as article 3, article 2 less than half as long as other articles, article 3 with 2 apical setae; mandibular molar with weak basal hump; each outer lobe of lower lip with 1 medial cone and 1 apical cone, medial cone small, otherwise as shown herein for *Mallacoota subcarinata* (Figure 144*Gun*); inner plate of maxilla 1 with 3 apical setae and 0-1 spinule on side, palp apically tapering and bearing spines and setae terminally and nearly halfway along medial margin; inner plate of maxilla 2 medially smooth but terminal setae extending one-third along oblique apicomedial margin; palp article 3 of maxilliped with subfalciform apical process; coxa 1 extended forward weakly, posteroventral corners of coxae 1-3 with several notches; article 4 of gnathopod 2 in both sexes with small tooth, female gnathopod 2 with hand elongate, male hand long and broad, subrectangular, palm evenly oblique, distinct from posterior margin, spinose and bearing small hollow in middle, medial face with submarginal hump holding apex of dactyl, latter weakly curved, simple, medial face of hand poorly setose; pereopodal dactyls with strong distal constriction marked by slight protrusion and 3 setules, locking spines simple; article 2 of pereopod 5 with slightly sharpened posteroventral lobe, posterior margin with regular serrations; uropod 1 with basolateral spine; rami of uropod 3 about 1.33 times as long as peduncle when held so that apices extend flush with each other; telson with strongly gaping bifid apices armed with 2-4 long and 2-4 short spines, occasionally with as many as 9 spines on each lobe; pleonites 1-2 and 4 posteriorly bearing 2 dorsal teeth side by side, pleonite 4 with teeth continued forward as carinae, pleonite 3 with rudimentary side bulges and weak posterior middorsal carina; pleonal epimera 1-2 each with lateral ridge, each with subtruncate posterior margins and each posteroventral corner with small sharp tooth; in male, epimeron 2 forming thick bifid protrusion at corner, epimeron 3 with weakly extended medium-sized sharp posteroventral corner with ventral margin below serrate, each epimeron with 2-4 ventral spines in tandem. Terminal males and females about 11-12 mm long.

HOLOTYPE.—WAM, male, 12.3 mm.

TYPE-LOCALITY.—Cockburn 93, Cockburn Sound, Western Australia (near Perth), Marine Naturalists' Club, 22 December 1959.

RELATIONSHIP.—This species cannot be differentiated from *P. albidus* (Dana) except that the small

figures of Dana show his species with a palm of male gnathopod 2 generally similar to that of young males of *P. setiger* Chevreux (Figure 152*N2*), the palm being slightly excavate for a long distance, whereas the palm on *P. ya* has a narrow notch. There seems to be no way to clarify Dana's species except by collecting in the type-locality of *P. albidus*, Tongatabu.

Specific differences of this species from *P. setiger* Chevreux are listed under the latter.

The key to this genus further develops the distinc-

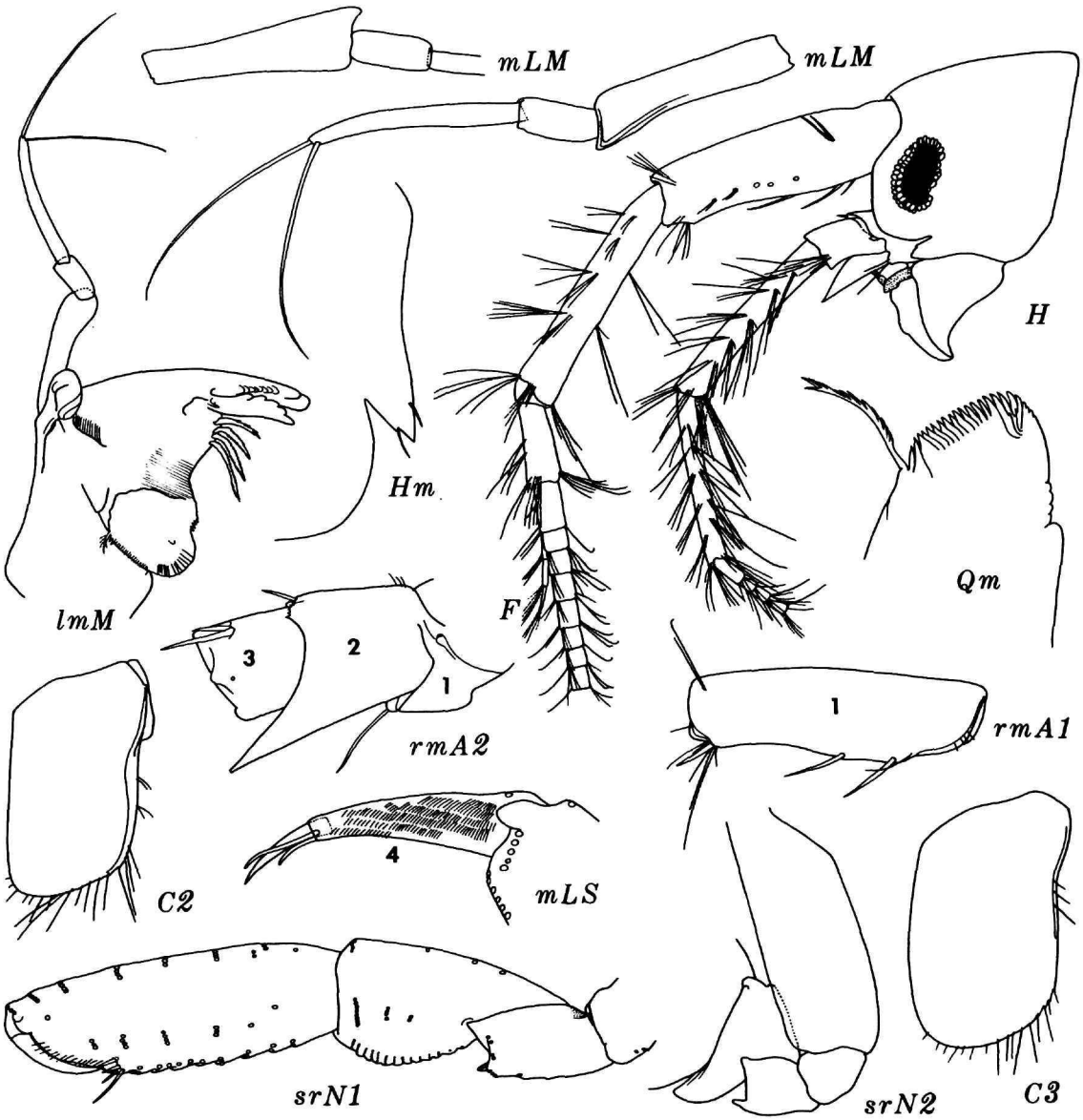


FIGURE 150.—*Parelasmopus ya*, new species, female, 12.3 mm; *m*=holotype, male, 13.1 mm; both from WAM 93.

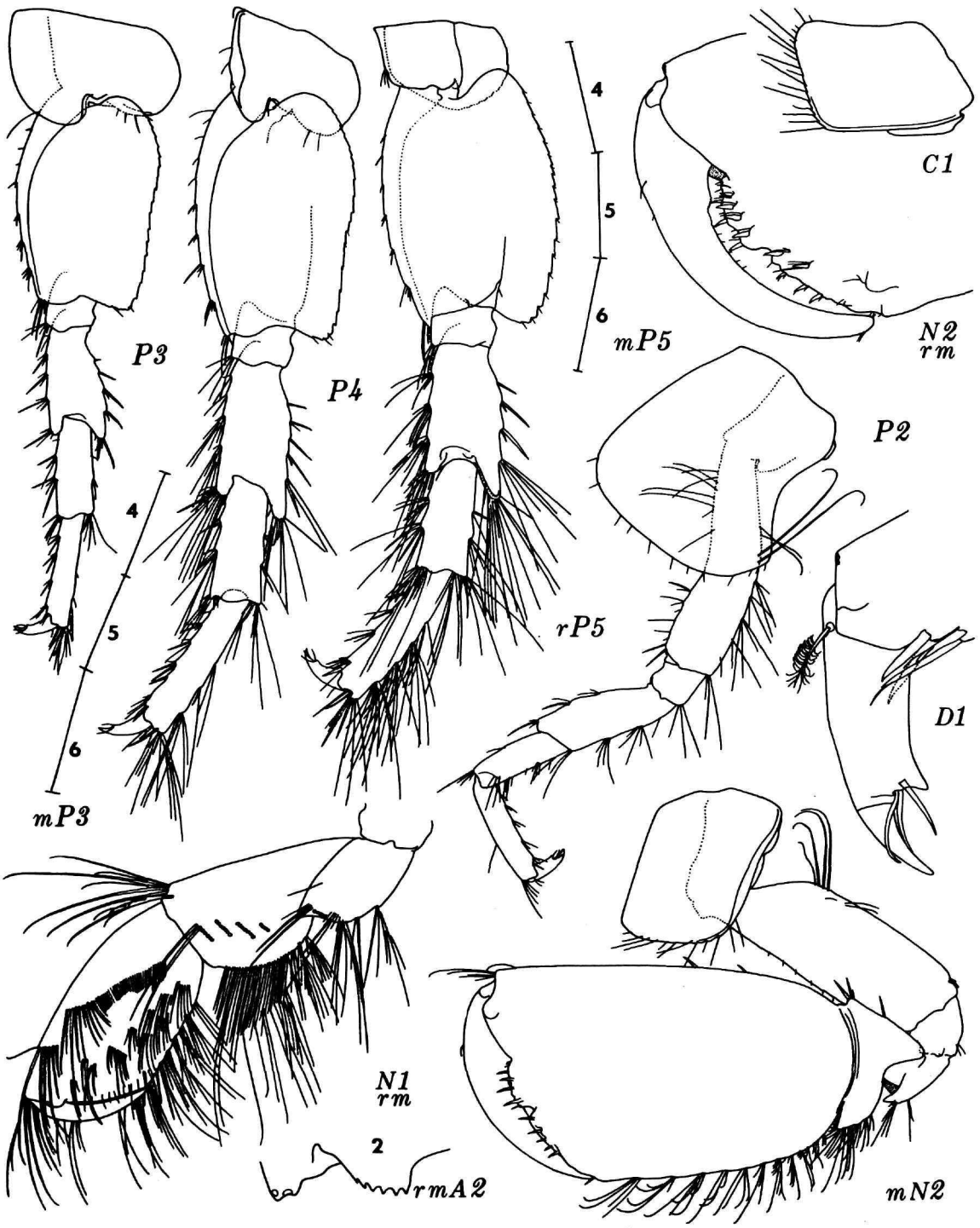


FIGURE 151.—*Parelasmopus ya*, new species. (See legend of Figure 150.)

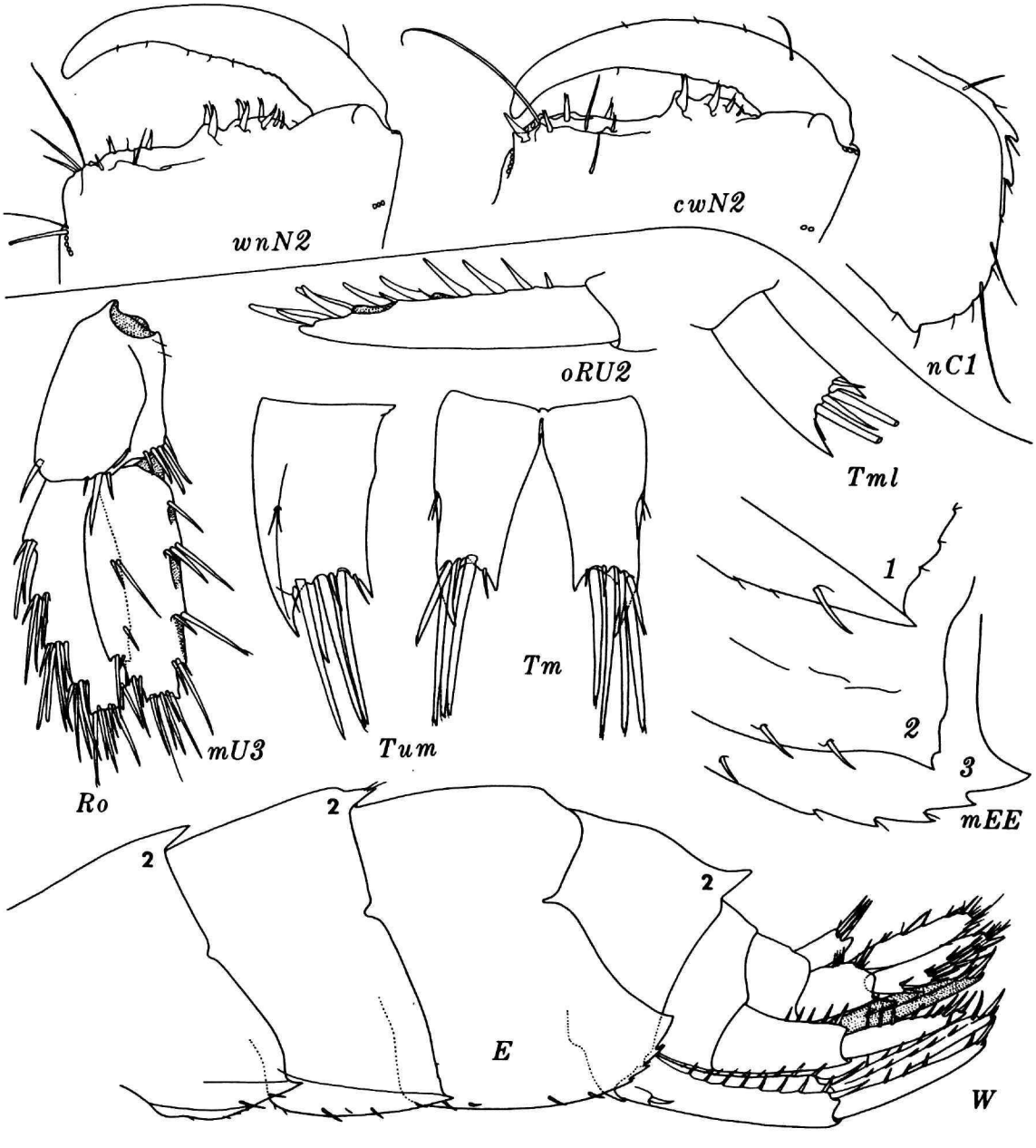


FIGURE 152.—Lower: *Parelasmopus ya*, new species (see legend of Figure 150). Upper: *Parelasmopus setiger* Chevreux, *n*=male, 7.6 mm, BPI 26; *c*=male, 6.6 mm, BAU 27.

tions of this species. Since there is very little stability in the nomenclature—or in the study of the stability of characters such as pereopodal setae and serrations, dorsal teeth, slope of gnathopodal palms, and coxal teeth—there is little point in developing the relationships of this species until the tropical Indo-Pacific situation is clarified.

MATERIAL.—WAM, Cockburn Sound: Cockburn 28 (1), Cockburn 93 (2), 2 miles west of Naval Base (1); WAM, Favourite Islands, Jurien Bay, (8) 16-18 September 1964.

DISTRIBUTION.—Southwestern Australia, sublittoral.

## LEUCOTHOIDAE

### *Paraleucothoe* Stebbing, 1899b

To the generic diagnosis of this genus composed by Stebbing (1906) should be added the fact that the lower lip has distinct and articulate inner lobes that can be removed cleanly from the outer lobes. *Paraleucothoe* thus differs from *Leucothoe* Leach in the large outer plates of the maxilliped, the presence of free inner lobes on the lower lip, the presence of only 1 article in the first maxillary palp, and the slightly elongate pereonite 1, but coxa 1 is broader than coxa 2 only in the male; in the female it is not only narrower but often shorter than coxa 2.

### *Paraleucothoe novaehollandiae* (Haswell)

FIGURES 153–155

*Leucothoë novae-hollandiae* Haswell, 1880c:329–330, pl. 20: fig. 2.—Miers 1884:314.
*Paraleucothoe novaehollandiae.*—Stebbing 1906:169–170.—Chilton 1922:6–7, fig. 2.
*Leucothoë brevidigitata* Miers, 1884:313–314, pl. 39: fig. A.

Very little can be added to Stebbing's (1906) appraisal of this species except to point out, as above, that the lower lip has inner lobes. Juveniles as small as 3 mm have a point on pleonal epimeron 2 and 1 posterior notch on epimeron 3. The anterior cephalic keel in juveniles is nearly contiguous with the epistome, but as the individuals pass 10 mm in length (up to 21 mm in length) a space appears between the keel and epistome and grows wider with increased age. No male over 16.1 mm in length occurs in the collections at hand, whereas females reach nearly 22 mm.

Juveniles about 6.0 mm long from Western Australia have the dactyl of the maxilliped regularly curved, apically sharp, bearing an immersed or fused apical nail and a regular comb of setules as found in species of *Leucothoe*. Maxilla 1 has 5 large spines on the outer plate and 2 small spines on the outer margin hidden from view by the large spines when the maxilla is placed buccal side up on the slide. The inner plate is slightly pointed apically. On maxilla 2 the setae are relatively larger than in adults, the inner plate bearing 2 subapical and 1 basal setae, the outer plate bearing 2 apical setae. Because the dactyl of gnathopod 1 is relatively larger in juveniles than in adults, *L. brevidigitata* can be shown to be a young stage of *P. novaehollandiae*. *Leucothoe flindersi* Stebbing (1888) is distinct.

MATERIAL.—Australian Museum, Sydney, New South Wales, Catalog P 15915, off Cronulla, near Sydney, 80 feet, commensal in *Pyura spinifer* (determined by E.C.P.), collected by U.R.G. (7), 17 March 1968; AM, P 15916, Glaisher Point, Cronulla, 20 feet, on *Pyura spinifer* (determined by E.C.P.), collected by U.R.G. (5), 9 September 1965; AM, P 15917, Sydney area, in *Pyura* species, collected by N. Coleman (7), 26 February 1968; AM, P 15918, off Bare Island, La Perouse, near Sydney, commensal in *Pyura pachydermatina*, collected by A. Healy (1), 26 February 1963; AM, P 15919, Cronulla, commensal in branchial sac of *Pyura stolonifera*, collected by R. de Preaux (1), 12 February 1962; Victorian Fisheries, two samples from Jiguma, New South Wales, from pharynx of *Pyura stolonifera*, collected by M. Drummond (31), 4-8 February 1971; Port Phillip 47 (1), 53 (1), 81 (5); Western Port, Victoria, VicFish, 8 samples (11); JLB Australia 8 (5); WAM, northeast Garden Island, on old boom piles (1), 14 March 1959; WAM, Cockburn 92, Marine Group Naturalists Club (2), 10 October 1958.

DISTRIBUTION.—Australia, from northeast at Thursday Island, south to Victoria, west to Perth, north to Cape Jaubert, 0-5 fathoms.

## LYSIANASSIDAE

### *Amaryllis* Haswell

### *Amaryllis macrophthalma* Haswell

FIGURES 156–158

*Amaryllis macrophthalmus* Haswell, 1880b:253–254, pl. 8: fig. 3.—?Stebbing 1888:706–709, pl. 29.—Thomson 1902: 463.—Chilton 1906:267.

*Amaryllis macrophthalma.*—Stebbing 1906:24; 1908:67–69. —?Walker 1909:327 [questioned by K. H. Barnard, 1932]. —Stebbing 1910a:569–570; 1910b:448.—Chilton 1912: 463–464.—K. H. Barnard 1916:114–116.—Chilton 1921a: 55.—Schellenberg 1926:243; 1931:10–11.—K. H. Barnard 1932:34.

*Amaryllis brevicornis* Haswell, 1880b:254.
*Glycerina affinis* Chilton, 1885:1036–1037, pl. 47: figs. 1*a*, *b*.

Heretofore, Australian specimens of this species have not been figured minutely. Presumably the identification of this species from South Africa, to which most

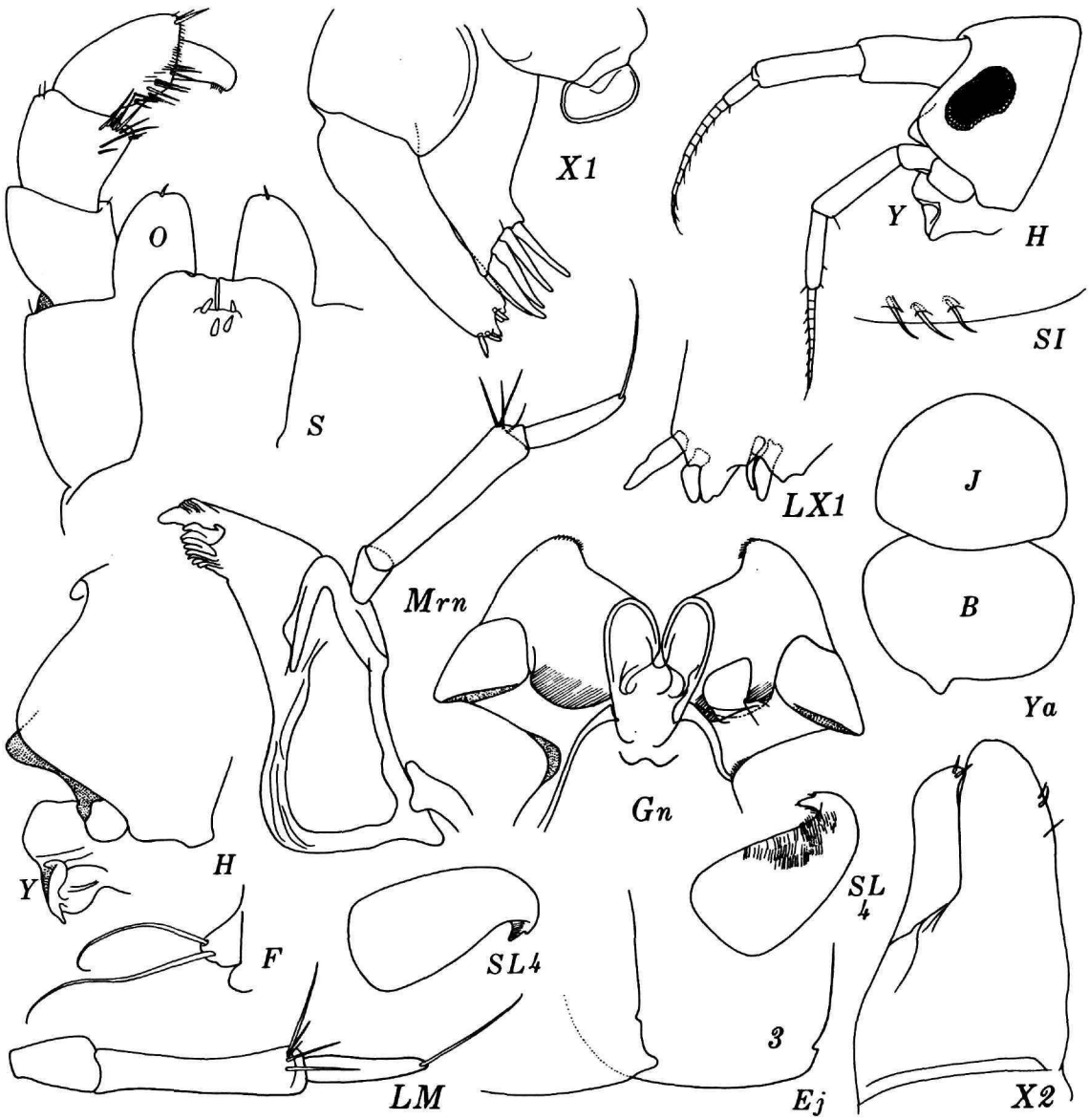


FIGURE 153.—*Paraleucothoe novaehollandiae* (Haswell), female, 21.4 mm, AM P15918; *n*= male, 16.1 mm, AM P15915; *j*=juvenile, 7.8 mm, AM P15917.

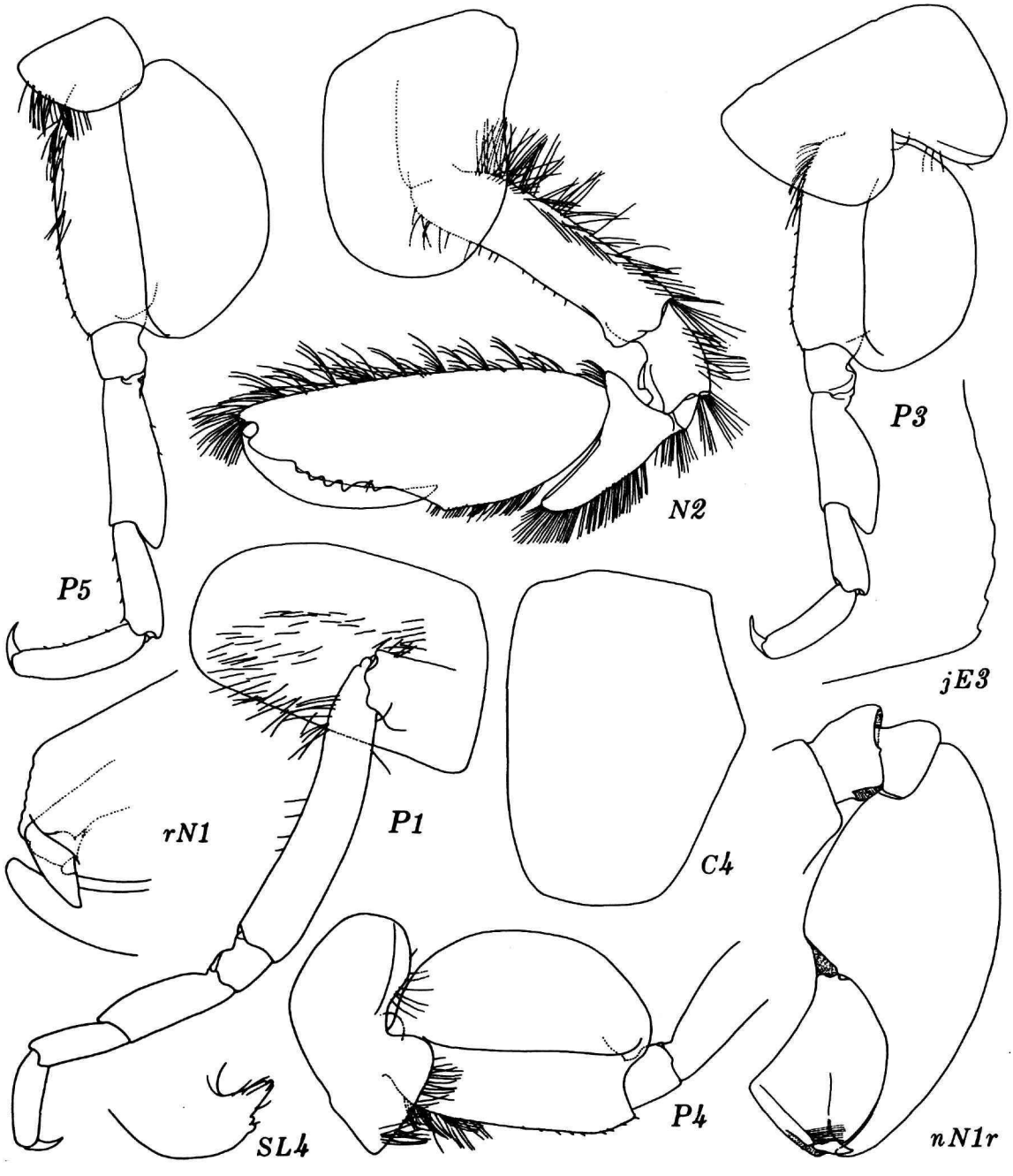


FIGURE 154.—*Pareleucothoe novaehollandiae* (Haswell).

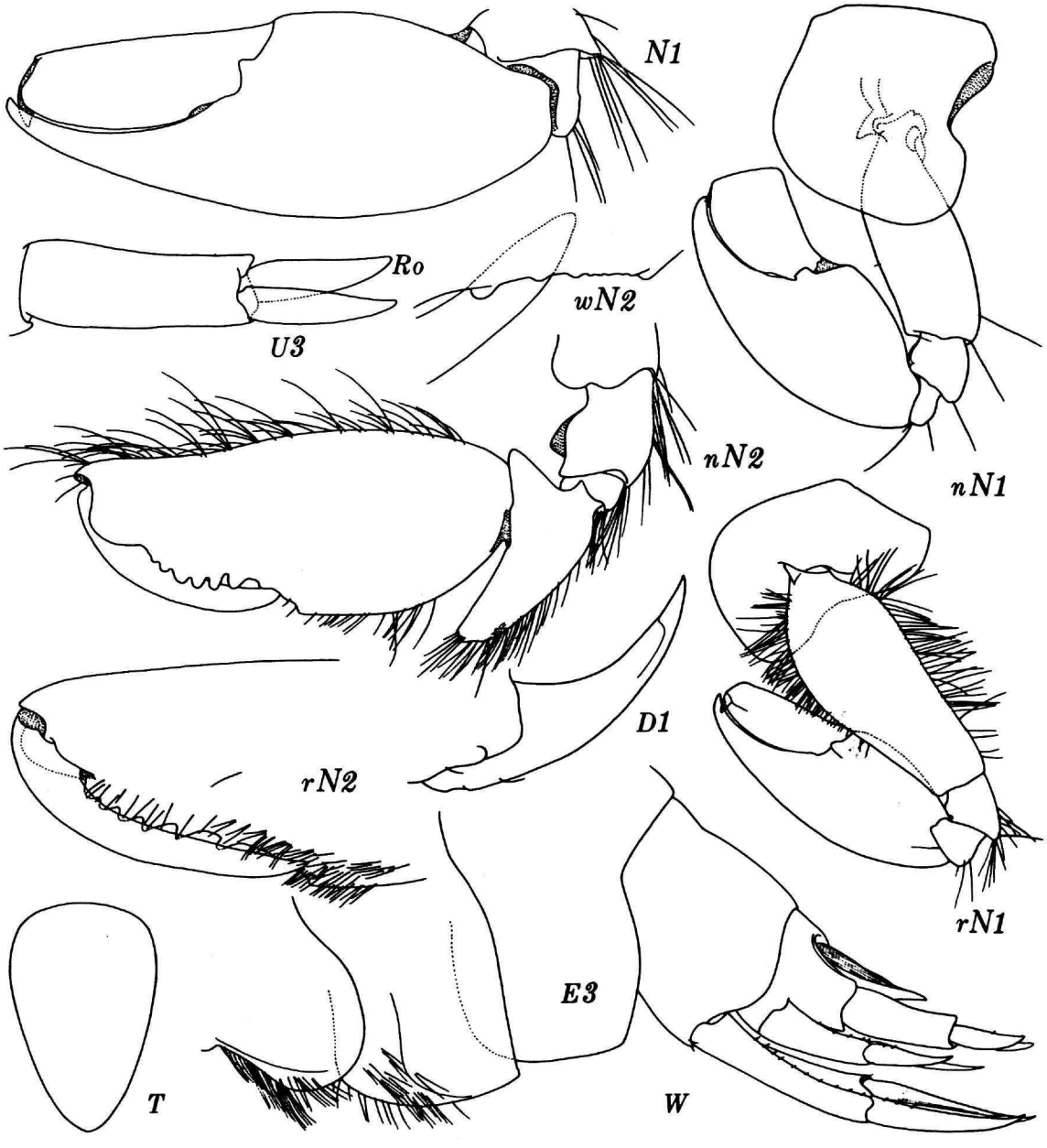


FIGURE 155.—*Paraleucothoe novaehollandiae* (Haswell).

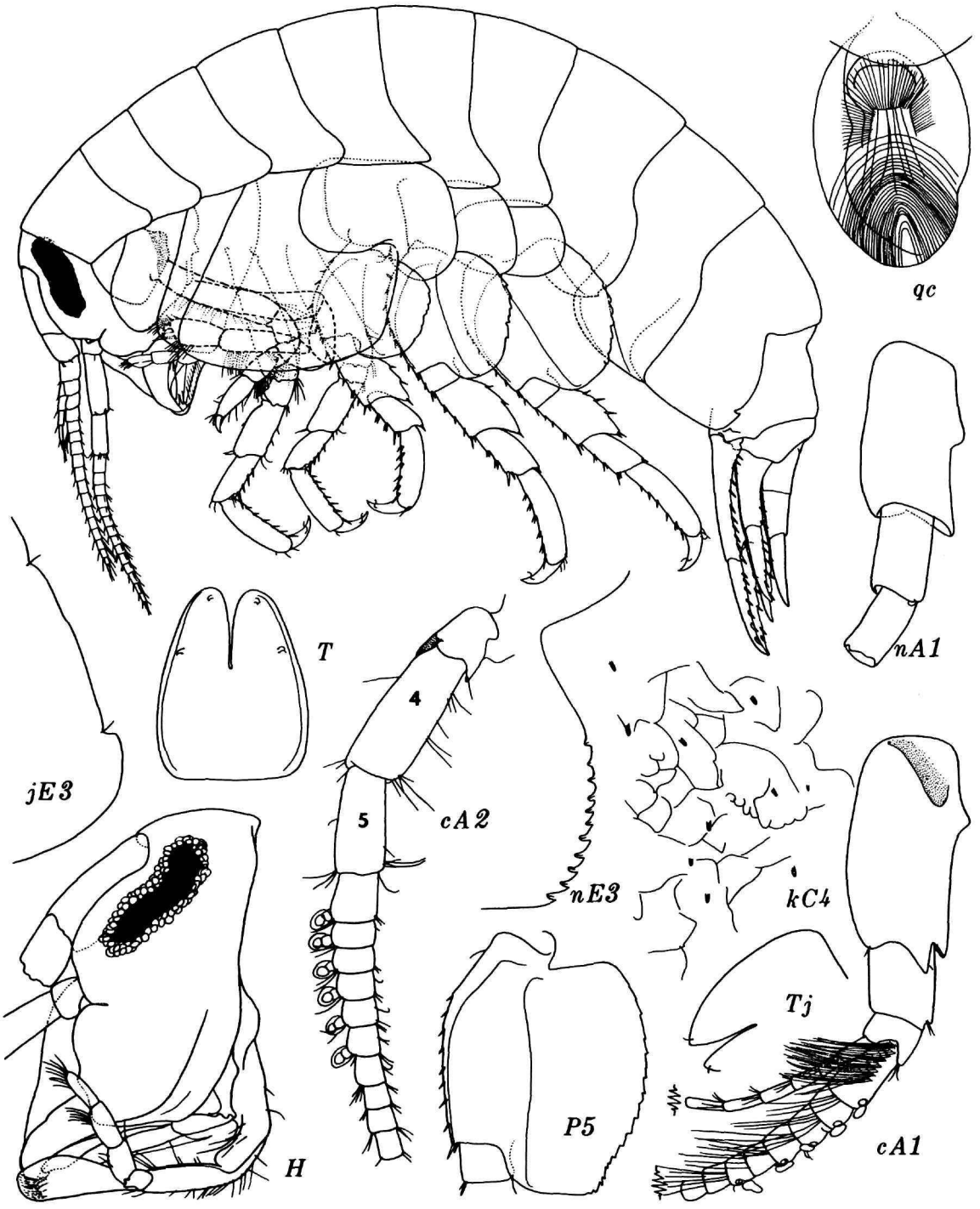


FIGURE 156.—*Amaryllis macrophthalma* Haswell, female, 8.5 mm, Shepherd 33; *c*=male, 15.0 mm, Port Phillip 86; *n*=female, 14.8 mm, Port Phillip 25; *j*=juvenile, Port Phillip 6.

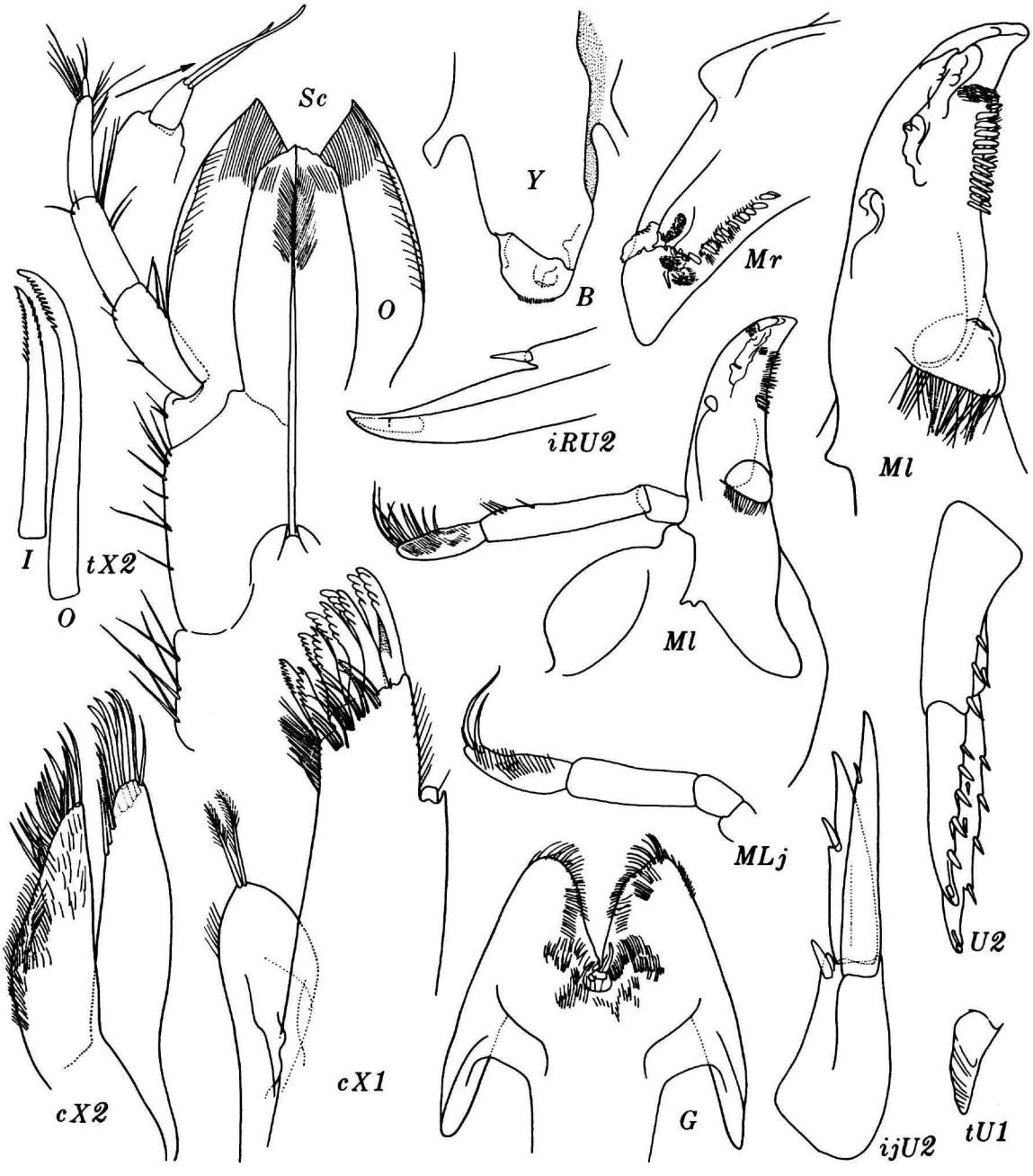


FIGURE 157.—*Amaryllis macrophthalma* Haswell.

references in the 1900s refer, has been made on the basis of Stebbing's (1888) excellent drawings of a juvenile from Patagonia.

The smallest Australian juveniles at hand are about 2.0 mm long and compare with the Patagonian specimen (approximately 5.0 mm) in several characters that are not typical of adults. Juveniles differ from adults in the narrower coxa 4, which, in juveniles, has a height-width ratio of 171:140 and, in adults, 150:140. Article 4 of pereopod 3 is broad in juveniles, with a ratio of 20:34 on article 2; in adults, 9:34. Article 4 of pereopod 3 nearly covers the posterior margin of article 5 in juveniles, but it is much shorter in adults. Mandibular palp article 3 of juveniles is short and slightly falcate in contrast to adults.

The Patagonian juvenile differs from any stage of the Australian specimens (2–21 mm) in the apical notches on the telsonic lobes, the presence of an apical spine on the outer ramus of uropod 3, and the placement of the posteroventral notch on pleonal epimeron

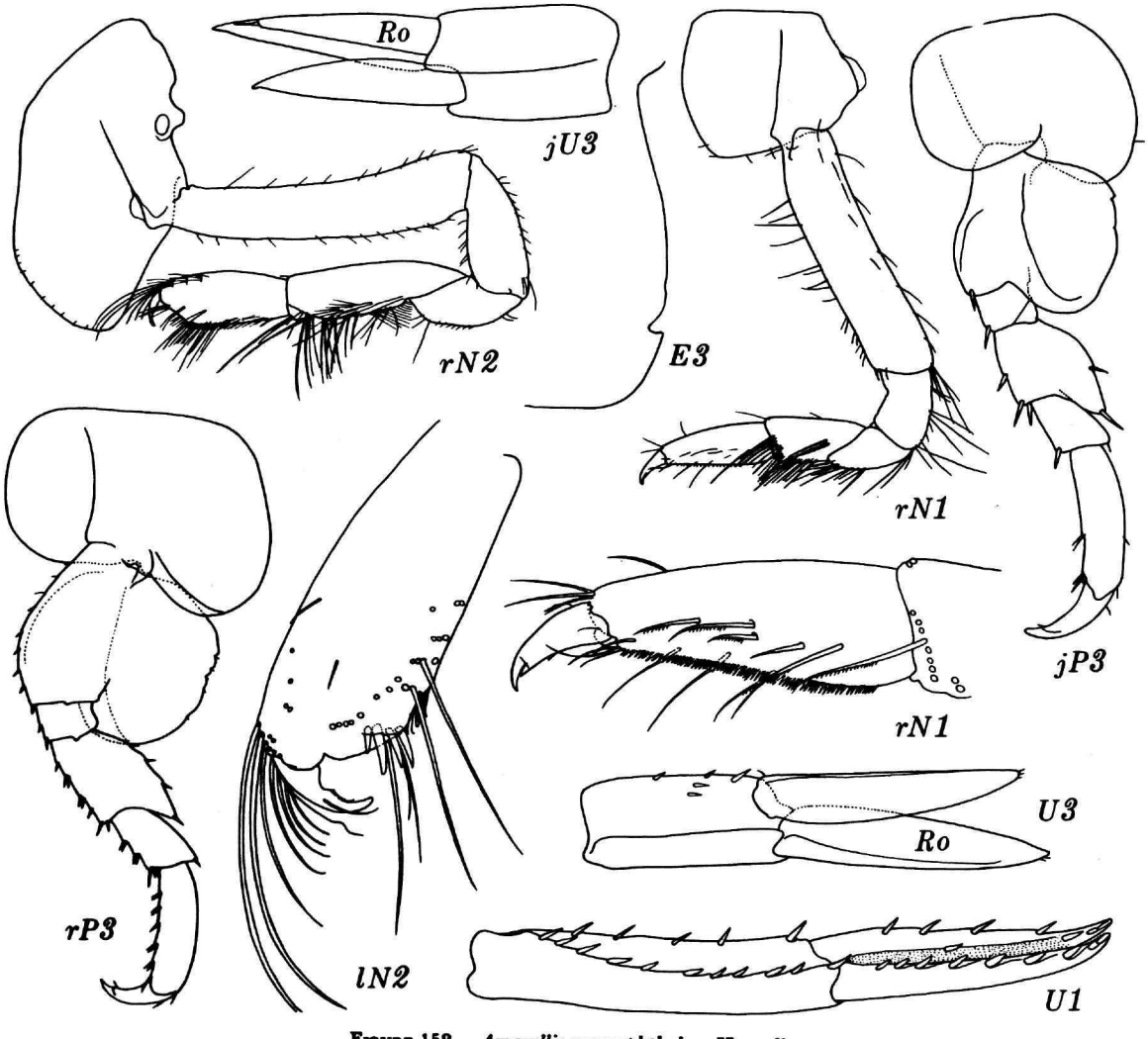


FIGURE 158.—*Amaryllis macrophthalma* Haswell.

3 directly at the lower corner, not well above it. The latter character seems to be a significant indication that Patagonian and South African specimens represent a distinct species or subspecies.

Adults have article 2 of pereopods 3-5 becoming progressively more truncate ventrally with increase in body size.

An aberrant group of specimens from Port Phillip 25 is characterized by a series of deep posterior serrations on pleonal epimeron 3, serrations that replicate the single serration typical of other specimens. In view of the congruence of other characters of the specimens in Port Phillip 25 and in view of coxal and pereopodal differences that characterize the only other known species of *Amaryllis*, I am not attributing any nomenclatural distinction to the variation in the specimens in hand. This variation reduces the significance of the epimeral difference in the Patagonian juvenile.

K. H. Barnard (1916) appears to have confused the meaning of Stebbing (1908), who described long setae on articles 4 and 5 of pereopods 1-2 in males. Barnard changed this meaning to apply to articles 5 and 6 of gnathopods 1 and 2. No well-developed male is present in the many specimens at hand. Two males with a few calceoli on antennae 1-2 are present, but they lack setae on uropod 3 and pereopods 1-2.

Though the mouthparts of *Amaryllis* are not strongly styliform, the mouthpart group does present a subconical appearance from lateral view. When flattened, maxilla 1 consistently breaks on the outer lobe about halfway down the outer margin to form an artifact that appears as a rudimentary palp.

The cuticle bears irregular and weak lines, which form a mosaic with scattered spinules, that are almost completely immersed in the skin.

MATERIAL.—Port Phillip, 24 stations (100); Shepherd 22 (3), 23 (2), 33 (2), 37 (1), 47 (2); JLB Australia 4 (1); Slack-Smith 2 (2); WAM, jetty piles, Fremantle (2), October 1912; WAM, Lancelin Island, on deck from craypots and sponges, collected by J. Shea (1), February 1956; northeast of Garden Island, on old boom piles, collected by P.B. Lenhard (2), 14 March 1959.

DISTRIBUTION.—Warm-temperate Australia, littoral and sublittoral; Tasmania; New Zealand; cold-temperate South America and Falkland Islands; South Africa; sublittoral upward to 100 fms.

## *Parawaldeckia* Stebbing

### *Parawaldeckia dilkera*, new species

FIGURE 159

DESCRIPTION (of female).—Eye elongate-oval, deep brown-black in alcohol; lateral cephalic lobes evenly triangular; prebuccal mass deeply produced, rounded; upper lip formed of small, narrow, asymmetrical lobe hanging from epistome, posterior margin with setulose hump; article 3 of mandibular palp about 50 percent as long as article 2, bearing 3 apical setae, article 2 with 4 short setal spines apically, article 1 about 35 percent as long as article 2; apex of palp on maxilla 1 blunt and bearing 4 apical teeth and 1 subapical tooth, inner plate with 2 short setae; coxa 1 strongly expanded and slightly extended anteroventrally; posterior margin of hand on gnathopod 1 lacking serrations but bearing 5 strong spines, dactyl with inner tooth obsolescent; palm of male gnathopod 2 protuberant, dactyl attached in middle of hand apex, hand wider than distal third of article 5 but about 1.7 times as long as broad; pereopods 1-5 with small spines on active margins of article 6, dactyls with weak slits and vestigial accessory setule-tooth; article 4 of pereopods 1-2 twice as broad as articles 5-6; article 4 of pereopods 3-5 broadly expanded, on pereopod 5 its process reaching halfway along article 5, see Figures 159*P1,2,3*, for details of shapes of articles, article 2 of pereopod 5 not beveled, ventral margin weakly truncate; pleonal epimeron 1 with anteroventral protrusion softly rounded, epimera 2-3 softly quadrate posteroventrally; pleonite 4 nearly straight dorsally; inner ramus of uropod 2 with 1 spine in normal-sized notch; peduncle of uropod 3 moderately expanded, half as broad as long, inner ramus about 35 percent as long (including basal immersed portions), outer ramus with article 2 clearly articulate; depth of incision of telson about 10 percent of length, each apex armed with 2 stout spines, each lateral margin with pair of plumose setules, edges of telson not greatly rolled dorsally.

HOLOTYPE.—WAM, female-like, 3.9 mm, unique.

TYPE-LOCALITY.—JLB Australia 5, west of Bunker Bay, Cape Naturaliste, Western Australia, intertidal, wash of algae and rocks, 2 September 1968.

REMARKS.—This species has the following characters in common with *P. yamba*, new species, the illustrations of which (Figures 161-163) serve for this species: upper lip, body of mandible, lower lip, outer

plate of maxilla 1, maxilla 2, maxilliped (except for outer plate being narrowed: see Figures 159*SO*, 161*S*), pereopods 1-2 and 4, pleonal epimera, uropods 1-2. Antenna 2 has a length similar to that of *P. stebbingi*, and thus it is longer than in the *P. yamba* female. Coxa 7 has the posterior lobe slightly narrower and better rounded than in *P. yamba*. *Parawaldeckia dilkera* differs from *P. yamba* in the shallower telsonic emargination, the lack of bevelment on pereopod 5, and significantly in the lack of serrations on gnathapod 1 and the multiserrate apex of the palp on maxilla 1.

MATERIAL.—The holotype.

DISTRIBUTION.—Southwesern Australia, intertidal.

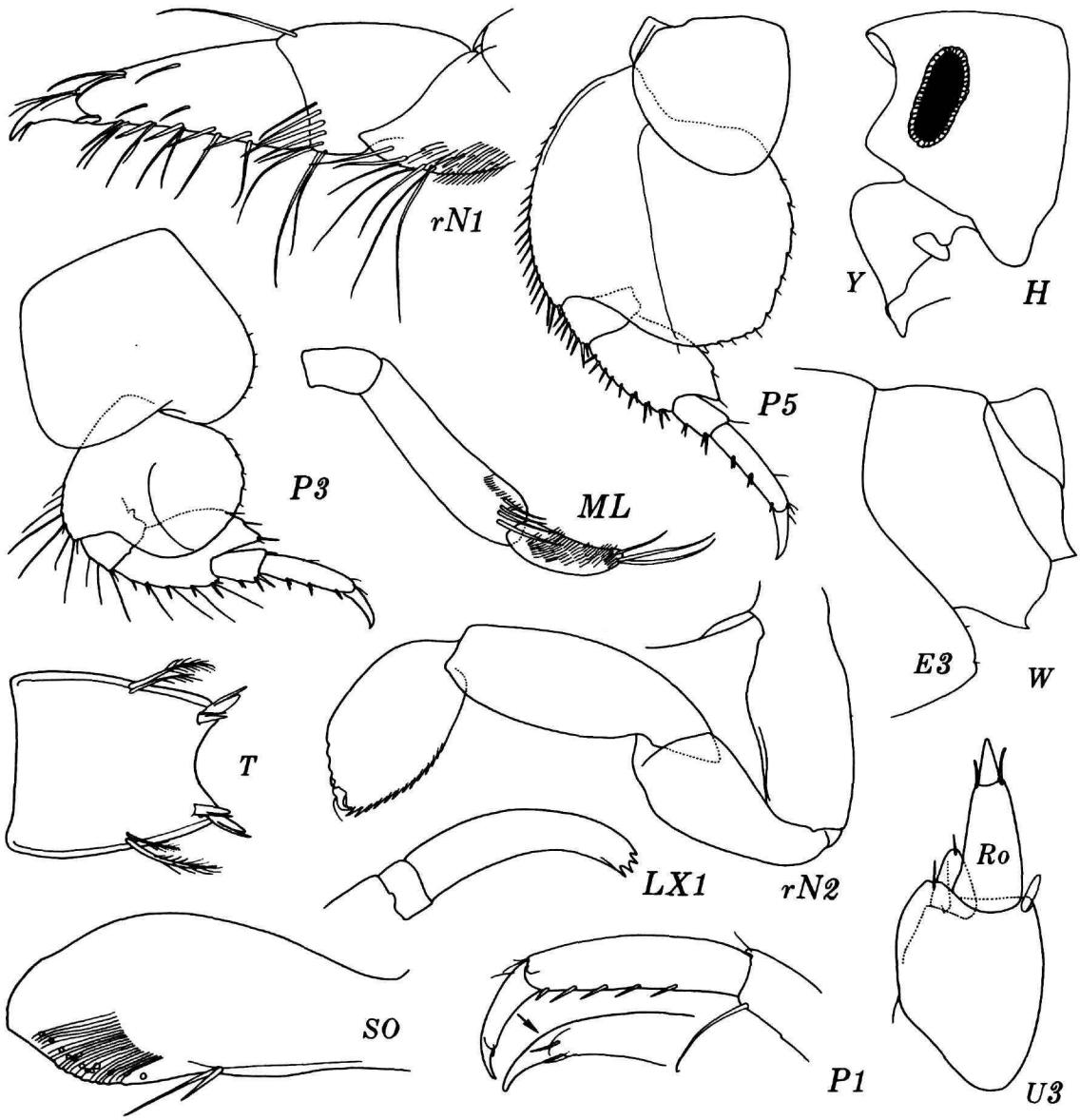


FIGURE 159.—*Parawaldeckia dilkera*, new species, holotype, female-like, 3.9 mm, JLB Australia 5.

### *Parawaldeckia stebbingi* (Thomson)

FIGURE 160

*Lysianax stebbingi* Thomson, 1893:63–65, pl. 3: figs. 9–18, pl. 5: figs. 9–10.
*Socarnoides stebbingi.*—Stebbing 1906:47–48.
*Nannonyx kidderi.*—Chilton 1921a:41–42, fig. 3 [not Smith].

NOMENCLATURE.—Chilton (1921a) has compared a male of this species from Tasmania with the type-specimen from Pirate's Bay, Tasmania, Chilton's figure of the telson is like that of the specimens identified herein, but Chilton was not able to see the telson of the type from a dorsal view. Since neither Thomson nor Chilton have indicated the condition of pereopod 5, there remains a question as to the proper nomenclature of the specimens at hand. This species and the following new species differ primarily in telson and pereopod 5.

DESCRIPTION (of female).—Eye elongate-oval, deep brown in alcohol; lateral cephalic lobes unevenly triangular and sharper than in *P. yamba*; prebuccal mass deeply produced, rounded, and weakly more pointed than in *P. yamba*; upper lip formed of small, narrow, slightly asymmetrical lobe hanging from epistome, posterior margin with scarcely setulose hump; article 3 of mandibular palp about 55 percent as long as article 2, bearing 2 apical setae, article 2 with 5 medium setae apically, article 1 about 60 percent as long as article 2; apex of palp on maxilla 1 sharp, inner plate with 2 short setae; coxa 1 strongly expanded and slightly extended anteroventrally; posterior margin of hand on gnathopod 1 with 5-6 medium-sized serrations, dactyl bearing distal accessory tooth, otherwise simple; palm of gnathopod 2 protuberant, dactyl attached in middle of hand apex, hand wider than distal third of article 5 but 1.7 times as long as broad; pereopods 1-5 with medium-sized spines on active margins of article 6, dactyls with weak slit and vestigial setule-tooth; article 4 of pereopods 1-2 twice as broad as articles 5-6; article 4 of pereopods 3-5 broadly expand-

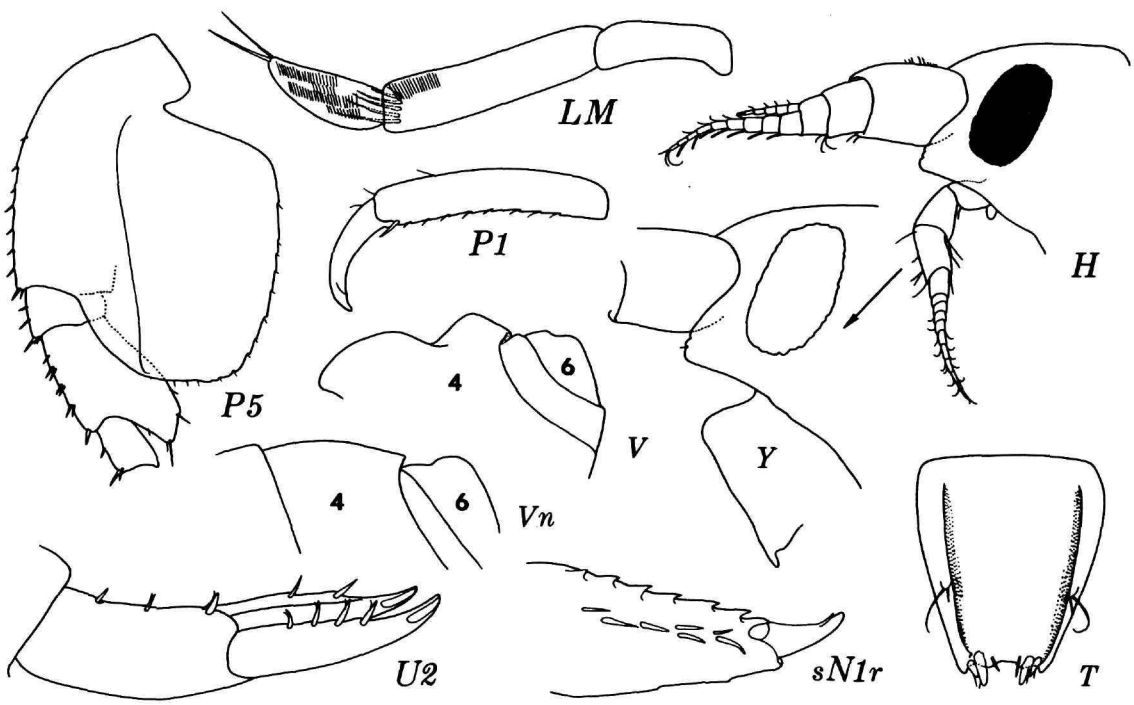


FIGURE 160.—*Parawaldeckia stebbingi* (Thomson), female-like, 6.9 mm; *n*=juvenile, 2.5 mm; both from Port Phillip 6.

ed, on pereopod 5 process of this article reaching two-thirds along 5, article 5 shorter than in *P. yamba* (see Figure 162*P* for other details of shapes); article 2 of pereopod 5 with softly quadrate unbeveled posteroventral corner; pleonal epimeron 1 with anteroventral protrusion softly rounded, epimera 2-3 softly quadrate posteroventrally; pleonite 4 with tent-shaped dorsal mound behind dorsal saddle; inner ramus of uropod 2 with 2 spines set in 2 notches of medium depth; peduncle of uropod 3 moderately expanded, half as broad as long, inner ramus about 35 percent as long as outer (including basal immersed portions), outer ramus with article 2 clearly articulate; telsonic apex nearly truncate, scarcely concave, each lateral apex with 2 stout spines and weak setule toward medial on each side, each lateral margin with notch at mark 60, each notch with 1 long and 1 short, thin plumose setule, telson with lateral margins rolled dorsally in rim far stronger than in *P. yamba*.

FIGURED SPECIMEN.—Sex unknown, female-like, 6.9 mm.

REMARKS.—This species differs from *P. yamba* in the unbeveled posteroventral corner of article 2 on pereopod 5, the nonincised telson with deeply rolled lateral rims, the longer antenna 2 in the female (variable in *P. yamba*) or a stouter antenna 2, the longer article 1 of the mandibular palp, the presence of 2 spines on the inner ramus of uropod 2 in adults comparable in size to *P. yamba*, the larger locking spine of the pereopods, and the sharper, less symmetrical lateral cephalic lobes. Juveniles of this species have the dorsal margin of pleonite 4 evenly convex with a slight posterodorsal attenuation overriding pleonite 5.

Drawings of the following parts have not been made for *P. stebbingi* because they compare so closely to those (Figures 161-163) drawn for *P. yamba* (except in numerical details mentioned in the description): mandibular body, upper lip, lower lip, maxillae 1-2, maxilliped, gnathopods 1-2, coxae, pereopods 1-4, pleonal epimera, and uropods 1 and 3.

MATERIAL.—Port Phillip 6 (23); JLB Australia 10 (1).

DISTRIBUTION.—Warm-temperate Australia, mainly sublittoral in bays.

### *Parawaldeckia yamba*, new species

FIGURES 161–163

DESCRIPTION (of female from South Australia).—Eye elongate-oval, deep brown in alcohol; lateral cephalic lobes evenly triangular; prebuccal mass deeply produced, rounded; upper lip formed of small, narrow asymmetrical lobe hanging from epistome, posterior margin with setulose hump; article 3 of mandibular palp about 55 percent as long as article 2, bearing 3 apical setae, article 2 with 3 short setal spines apically; article 1 about 50 percent as long as article 2; apex of palp on maxilla 1 sharp, inner plate with 1 short seta; coxa 1 strongly expanded and slightly extended anteroventrally; posterior margin of hand on gnathopod 1 with 5 medium-sized serrations, dactyl bearing distal accessory tooth, otherwise simple; palm of gnathopod 2 protuberant, dactyl attached in middle of hand apex, hand wider than distal third of article 5 but 1.7 times as long as broad; pereopods 1-5 with very small spines on active margins of article 6, dactyls with weak slit and vestigial accessory setule-tooth; article 4 of pereopods 1-2 twice as broad as articles 5-6; article 4 of pereopods 3-5 broadly expanded on pereopod 5, its process reaching less than halfway along 5 (see Figures 162*P3–5* for details of shapes of articles), article 2 of pereopod 5 posteroventrally beveled; pleonal epimeron 1 with anteroventral protrusion softly rounded, epimera 2-3 softly quadrate posteroventrally; pleonite 4 with low dorsal mound behind dorsal saddle; inner ramus of uropod 2 with 1 spine in normal-sized notch; peduncle of uropod 3 moderately expanded, half as broad as long, inner ramus about 35 percent as long as outer (including basal immersed portions), outer ramus with article 2 clearly articulate; depth of medial incision on telson about 20 percent of length, each apex armed with 1-2 large and 1-2 small spines, each lateral margin with notch near middle bearing 2 fat plumose setules, each apex with subterminal plumose setule or spinule.

Adult males differing from females in the elongate antenna 2, the shorter cephalic lobe with small mammilliform projection, the more broadly rounded epistome projecting less, the hand of gnathopod 1 bearing only 4 posterior serrations, the flatter dorsal margin of pleonite 4, the different epimeral shapes (Figure 163*En*), the reduction of spines on uropod 2 to 1 spine on the outer ramus and no spines on the inner, the grossly setose uropod 3, and the longer, narrower telson. This male, 5.2 mm, and others are far better developed than the 7.0 mm male of adolescent description below.

ADOLESCENT MALE (from Western Australia).—Antenna 2 elongate, about half as long as body, eyes

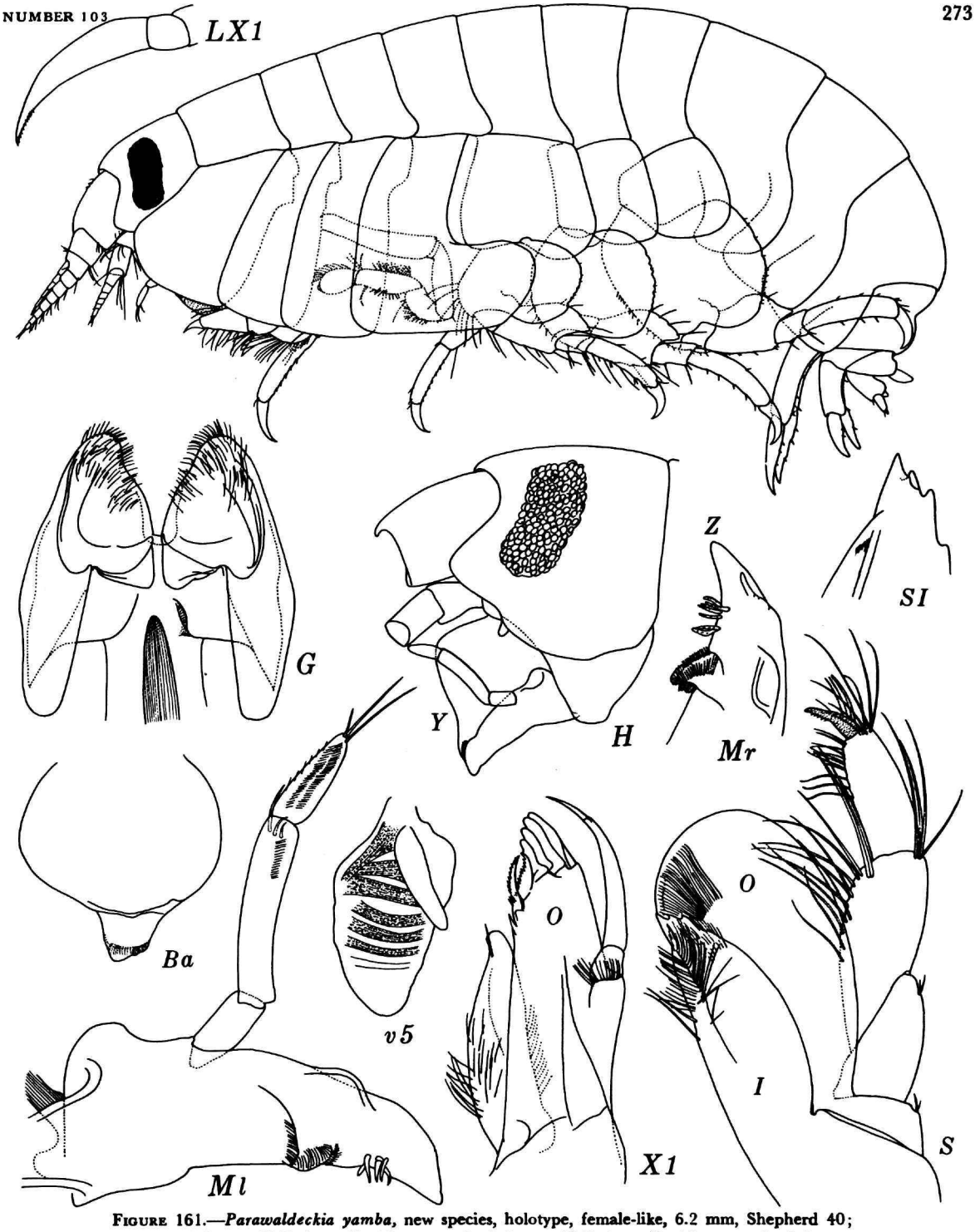


FIGURE 161.—*Parawaldeckia yamba*, new species, holotype, female-like, 6.2 mm, Shepherd 40; *b*=male, 7.0 mm, JLB Australia 10; *w*=male, 7.0 mm, JLB Australia 10; *n*=male, 5.2 mm, JLB Australia 13. (*v*=gill.))

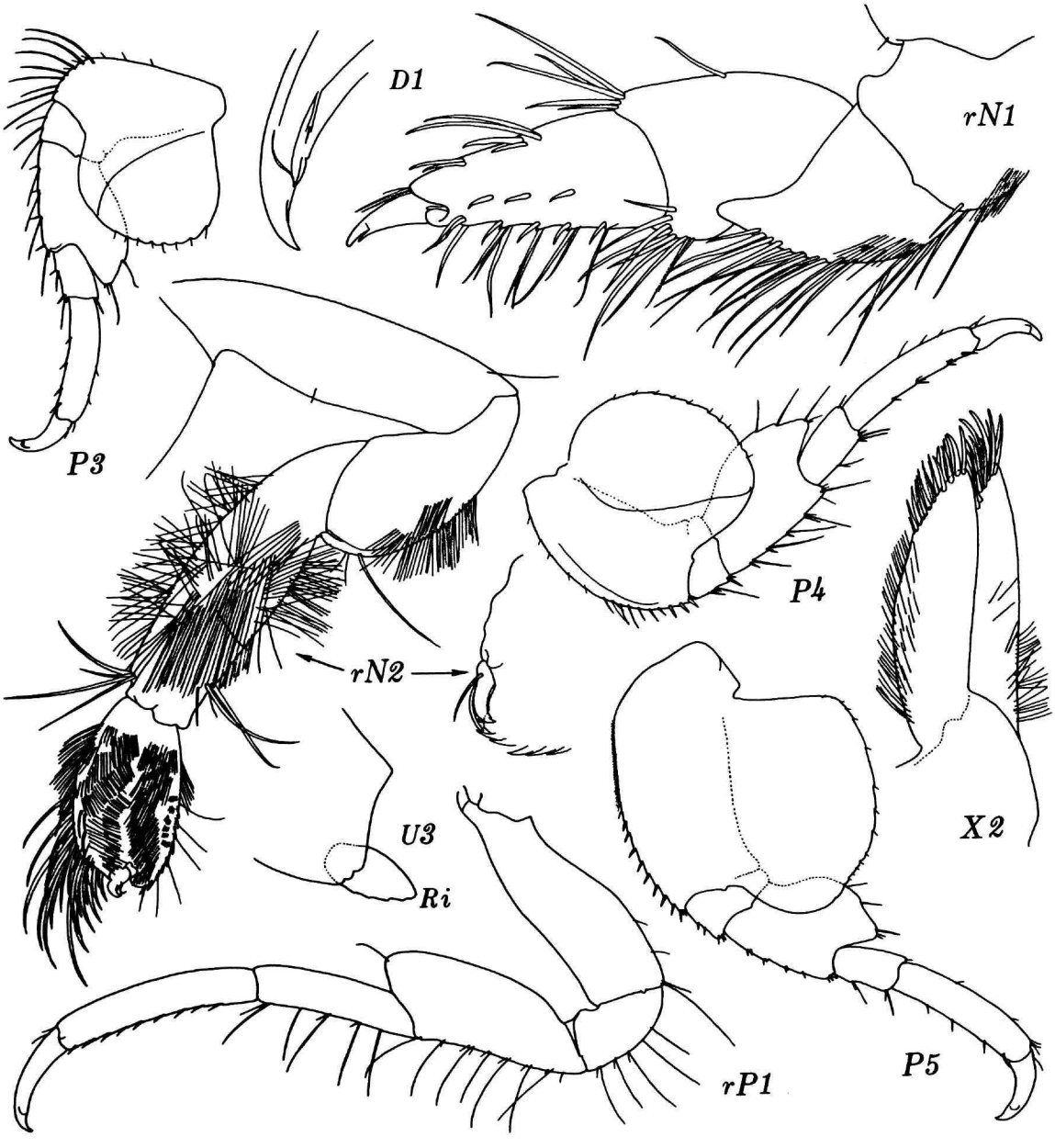


FIGURE 162.—*Parawaldeckia yamba*, new species.

scarcely larger than those of female; inner ramus of uropod 3 conical, 70 percent as long as outer; dorsal hump of pleonite 4 slightly flatter than in female.

FEMALE AND MALE (from Southwestern Australia). —Uropod 2 with only 1 spine on outer ramus and none on inner ramus.

HOLOTYPE.—SAM, sex unknown, 6.2 mm.

TYPE-LOCALITY.—Shepherd 40, D-282, Point Gilliam, West Island, South Australia, 0-4 feet, among corallines, *Asparagopsis armata,* and *Halopteris* species, 27 May 1967.

RELATIONSHIP.—The incised telson distinguishes this species from the type, *P. thomsoni* (Stebbing, 1906); the latter also has an upturned acute postero-ventral corner of epimeron 3.

This species differs from Stephensen's (1927) identification of *P. kidderi* from the Auckland and Campbell islands by the presence of spines on the telson.

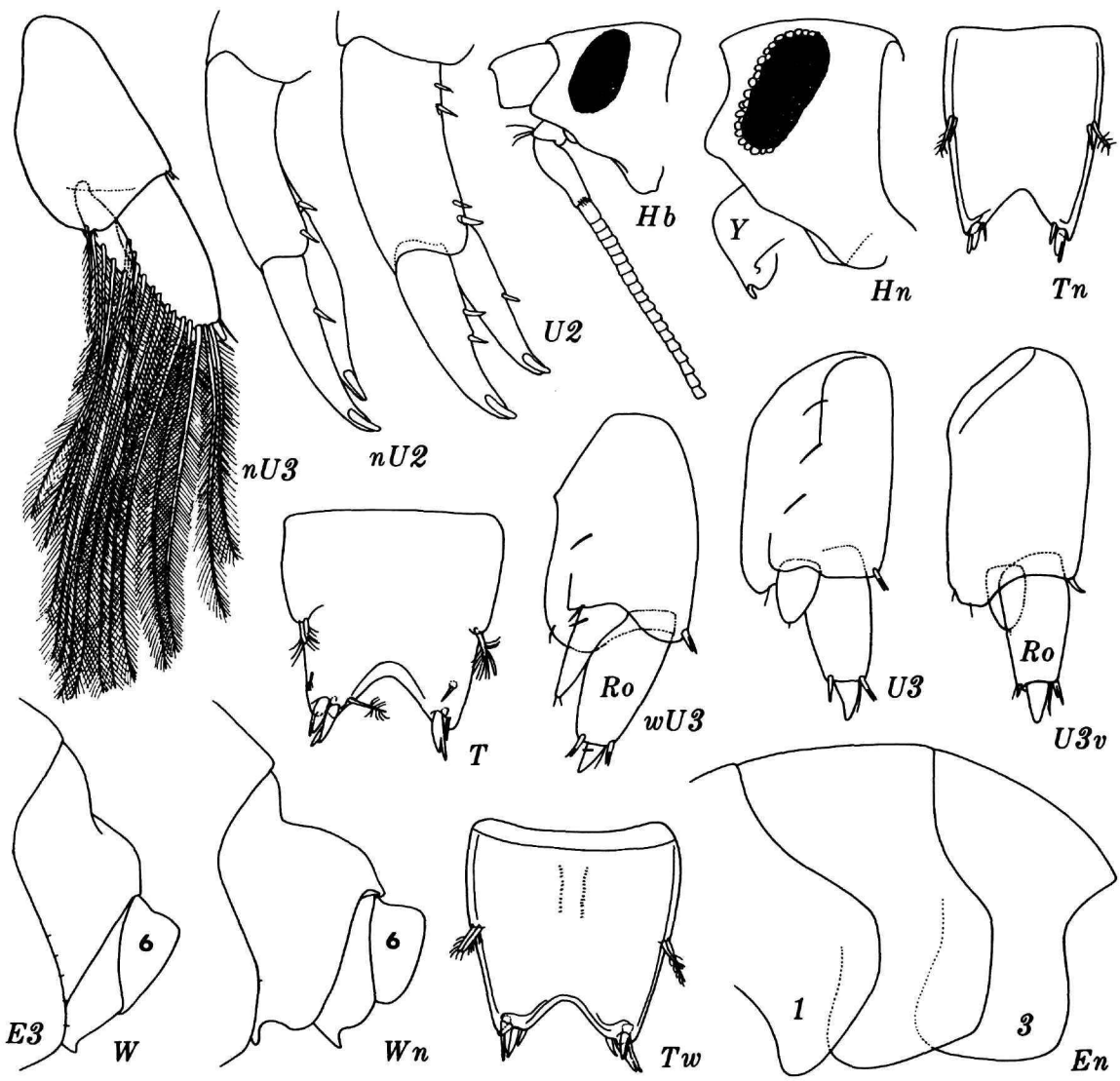


FIGURE 163.—*Parawaldeckia yamba,* new species.

Stephensen's synonymy of *P. kidderi* is erroneous, as Stebbing's (1888) *Socarnoides kergueleni* is not in *Parawaldeckia* and Monod's (1926) identification appears to be correctly *Nannonyx kidderi*, but the latter species belongs with a distinct, perhaps undescribed, genus (see J. L. Barnard, 1969a).

The material figured herein is of the female-like morphology, the antennae being short, but the specimen lacks brood plates.

MATERIAL.—Shepherd 40 (2), 46 (1); JLB Australia 4 (1), 10 (2), 12 (17), 13 (20).

DISTRIBUTION.—Warm-temperate Australia, littoral and sublittoral.

### *Tryphosella* Bonnier

### *Tryphosella orana*, new species

FIGURES 164–165

DIAGNOSIS.—Lateral cephalic lobes apically rounded but strongly projecting and ventrally undercut in male, less strongly so in female; ommatidia lacking, but side of head with hourglass-shaped stain of bright red in formaldehyde, disappearing in alcohol; article 5 of antenna 2 slightly (male) to strongly (female) shorter than article 4; flagellum of antenna 2 on male elongate and tucked into broodspace; epistome broadly rounded and strongly produced; mandibular incisor with weak lateral notch and cusp; inner plate of maxilla 1 with 2 apical setae; inner plate of maxilla 2 with proximalmost seta discontiguous from adjacent setae; palm of gnathopod 1 subtransverse, dactyl with large inner tooth; palm of gnathopod 2 not distinctly chelate; pereopods 1-5 with pair of large weakly striate, slightly curved locking spines; process on article 4 of pereopods 3-5 produced nearly halfway along article 5; coxa 5 laterally smooth (no crest); pleonal epimeron 3 softly quadrate posteroventrally; pleonite 4 with massive process dorsally flat, process slightly overextending posterior segments; peduncle of uropod 1 with smooth gap between basal spines and terminal spine; outer rami of uropods 1-2 with enlarged striate subdistal spine and suture, inner ramus of uropod 2 with small subdistal striate spine on weak notch; inner ramus of uropod 3 scarcely exceeding article 1 of outer ramus, article 2 of outer ramus about half as long as article 1; uropod 3 of male strongly setose; telson long, narrow, each apex with weak notch and spine, lateral margins of each lobe with 2 spines in tandem at approximately marks 33 and 67.

Mouthparts generally like *T. nana* of Sars (1895, pl. 27: fig. 1) (=*T. sarsi* Bonnier), especially lower lip, maxilliped, mandible, maxilla 1, but spines on outer plate of maxilla 1 very stout (Figure 165*vOX1*), mandibular incisor with weak lateral notch and cusp, each mandible with 3 spines in spine row, left with small lacinia mobilis; maxilla 2 illustrated (Figure 165*X2*).

Gills plaited on both faces; those of pereonites 6-7 with 2 accessory lobes each.

HOLOTYPE.—WAM, male, 4.2 mm.

TYPE-LOCALITY. –JLB Australia 13, Middleton Beach, Albany, Western Australia, intertidal wash of sandy rocks, coralline algae, 30 September 1968.

RELATIONSHIP.—This species has affinities with Australian *T. camela* (Stebbing, 1910a), but the dorsal crest of pleonite 4 is lower and flatter in *T. orana*, the stenopodous portions of pereopods 3-5 are elongate, the rami of uropod 2 have spines, the inner ramus of uropod 3 is slightly longer, and coxa 1 is less attenuate.

The relationship to *T. miersi* (Stebbing, 1888) appears even closer, but the crest of pleonite 4 of *T. orana* is slightly larger, the palm of gnathopod 1 is more strongly transverse, article 2 of pereopod 5 does not taper distally, article 5 of antenna 2 is shorter than article 4 in both sexes, palp article 3 of the mandible is much shorter, and the pereopods have large locking spines. These spines are not noted in *T. camela* (Stebbing).

MATERIAL.—JLB Australia 13 (2).

DISTRIBUTION.—Southwestern Australia, intertidal.

## NIHOTUNGIDAE, new family

DIAGNOSIS.—Uropod 3 uniramous, ramus biarticulate, as in Stenothoidae; telson short and entire; accessory flagellum obsolescent; body with aspect of cyproidin amphilochids or certain stenothoids, coxa 4 very large, posteriorly excavate and posterodorsally extended, coxa 1 of normal dimensions though smaller than coxa 4, but coxae 2 and 3 much smaller than 1; inner plates of maxillipeds styliform, outer plates very large, palp at least 3-articulate; gnathopods simple and very feeble; article 2 of pereopods 3-5 slender; urosomites free; mandible styliform and bearing 3-articulate palp; palp of maxilla 1 forming long blade.

TYPE-GENUS.—*Nihotunga*, new genus.

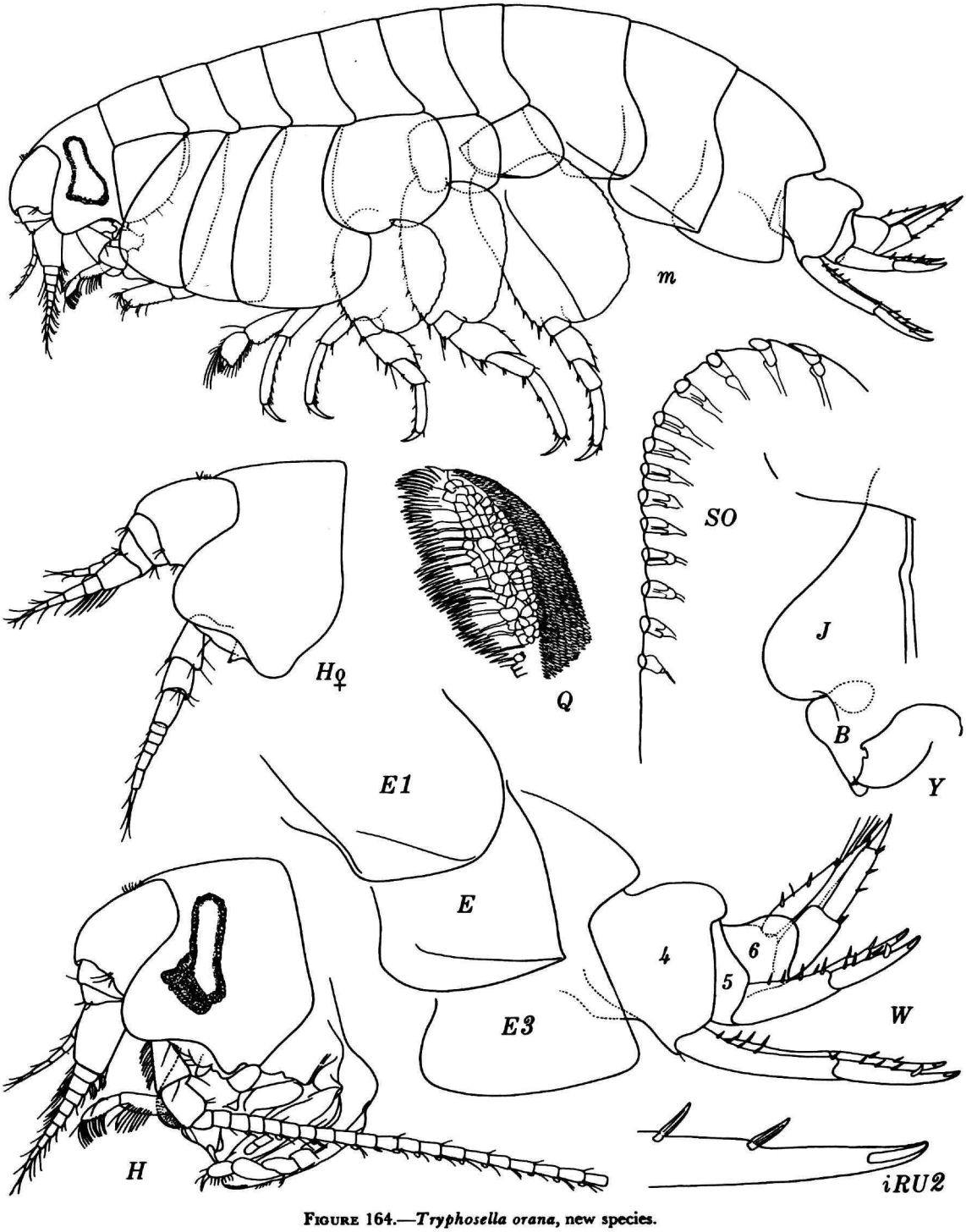


FIGURE 164.—*Tryphosella orana*, new species.

***Nihotunga*, new genus**

DIAGNOSIS.—With the characters of the family.

DESCRIPTION.—Head with lateral lobes broadly extended forward, rostrum very small, attachment of antenna 1 deeply recessed dorsally, antennae short, accessory flagellum absent; epistome unproduced, upper lip very broad and slightly incised; mandible styliform, molar absent, lacinia mobilis long and rodlike, palp long and naked, article 2 shorter than others; lower lip unknown; palp and outer plate of maxilla 1 similar to each other, palp uniarticulate, inner plate naked and attached in position overriding outer plates, appendage with long, slightly to strongly geniculate lateral blade with capability of being extended far outside buccal mass, but lacking any visible internal

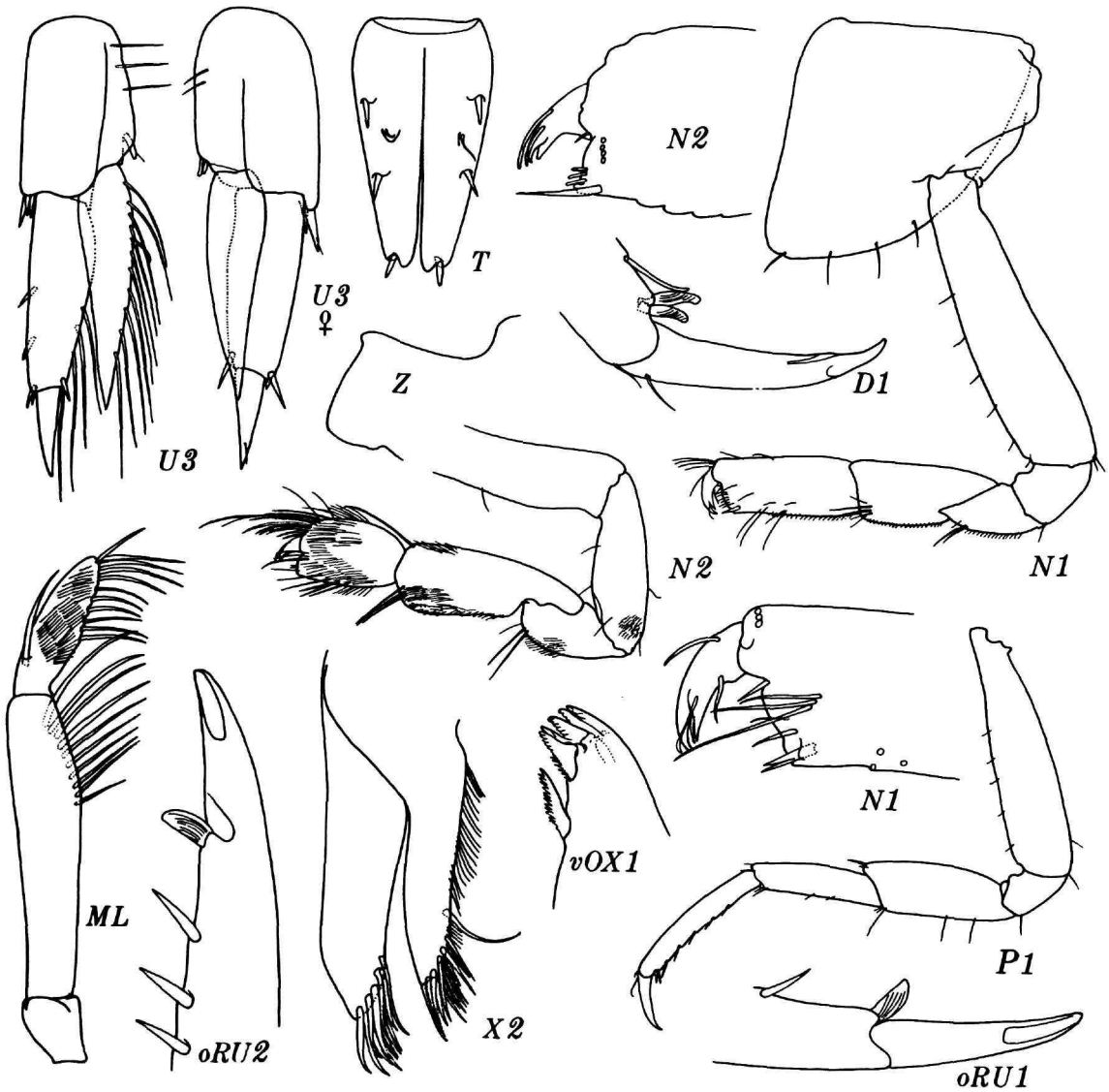


FIGURE 165.—*Tryphosella orana*, new species, holotype, male, 4.2 mm; *f*=female, 3.2 mm; both from JLB Australia 13.

muscles, possibly used as epistomal wiper or as piercing stylet; maxilla 2 with subequal lobes, inner bearing distal bifidation probably composed of 2 setae completely coalesced with plate, outer plate with several articulate setae, plates similar to each other; maxilliped with styliform inner plates bearing apical spine, outer lobes long and broad, poorly ornamented, palp 3-articulate and curving around outer plates, article 2 with distoventral process, article 3 nonunguiform and apically spinulose; coxa 1 large, coxae 2-3 smaller, coxa 4 very large, with long, deep posterior lobe and posterodorsal excavation fitting visible coxa 5, coxa 4 partially covering coxae 1-3 but not coxae 6-7; gnathopods 1-2 simple, articles 6-7 of gnathopod 2 scarcely different from pereopods 1-2, but article 4 of normal shortness, article 5 with weak posterodistal broadening, gnathopod 1 with distal locking spines and subterminal "palmar" spine, article 4 with weak posterodistal broadening; pereopods 3-4 with linearly narrowed article 2, pereopod 5 with proximally broadened but distally narrowed article 2; urosomites all free and dorsally palpable; uropods 1-2 biramous; uropod 3 uniramous, ramus short and apparently bearing strong distal spine (?not article 2); telson short, covering urosomite 3 dorsally, entire, apically rounded, pleopods normally biramous.

TYPE-SPECIES.—*Nihotunga iluka,* new species.

### *Nihotunga iluka,* new species

FIGURES 166–167

DIAGNOSIS.—Main eyes with 5 conspicuous red anterior ommatidia in tandem; inner plate of maxilliped with 2 apical spines; coxa 2 about 1.2 times longer

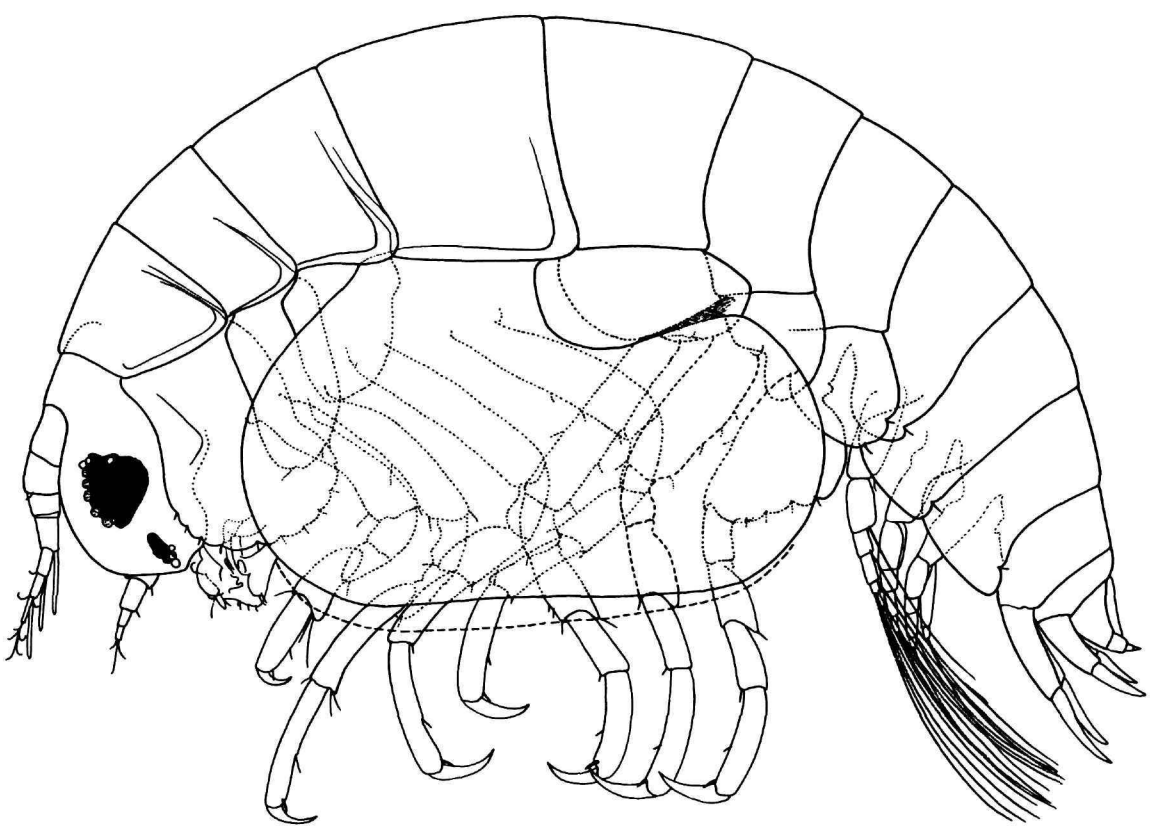

FIGURE 166.—*Nihotunga iluka,* new species, female, ovigerous, 1.50 mm; *c*=female, 1.45 mm; both from JLB Australia 5. (*Mtz*=lacinia mobilis bent on purpose.)

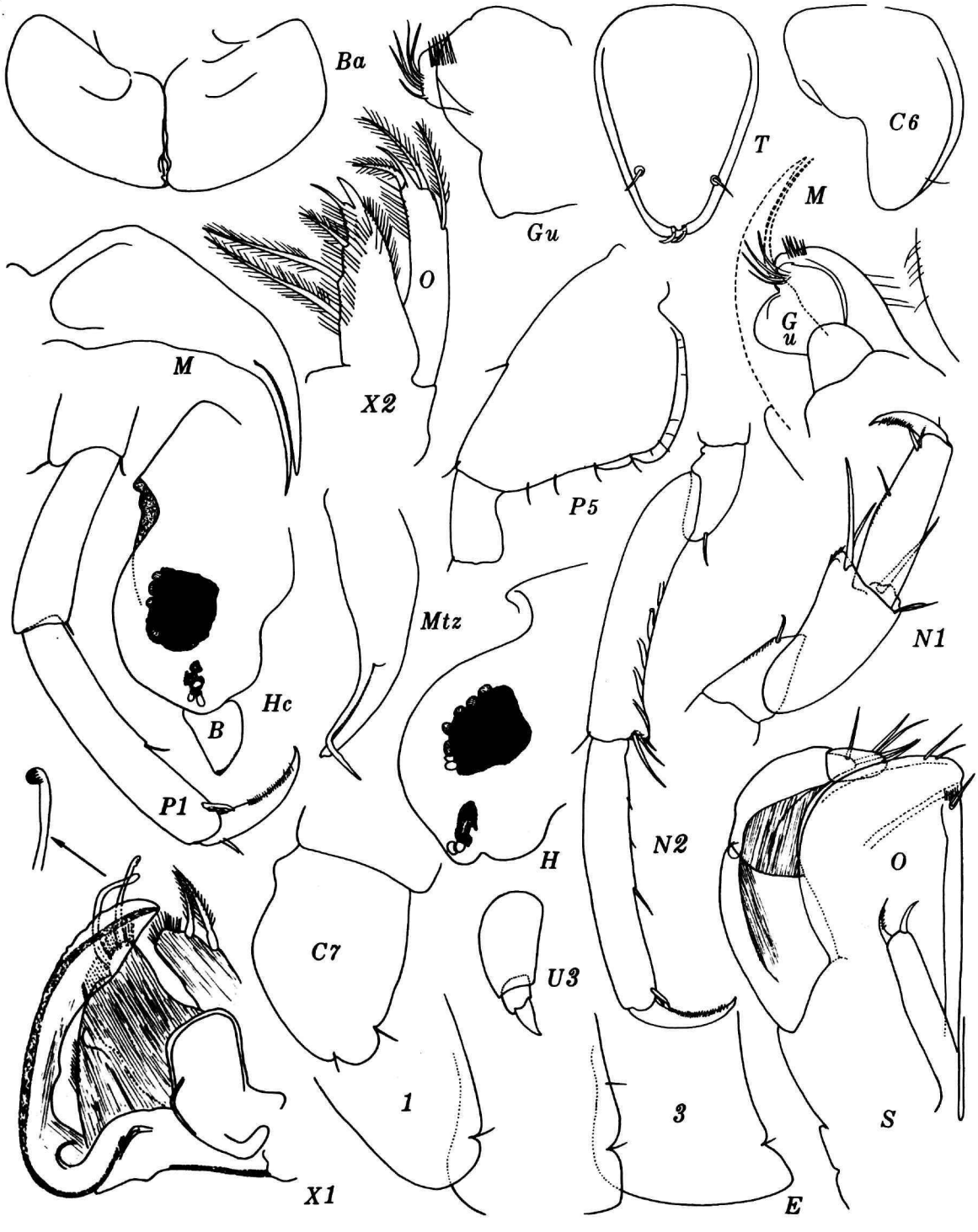


FIGURE 167.—*Nihotunga iluka*, new species.

than coxa 3; posterior lobe of coxa 6 twice as long as anterior lobe; dactyls of pereopods and gnathopods with comb row of pectinations; middle of article 2 on pereopod 5 about 70 percent as broad as long.

HOLOTYPE.—WAM, ?sex, 1.0 mm.

TYPE-LOCALITY.—JLB Australia 5, west of Bunker Bay, Cape Naturaliste, Western Australia, intertidal, wash of algae and rocks, 2 September 1968.

RELATIONSHIP.—This species differs in only a few characters from the New Zealand *N. noa* J. L. Barnard (in press) which has an odd pattern of anterior ommatidia in the eyes, starting dorsally with 2 red, 2 clear, 1 red, 1 white, and finally 1 white ommatidium projecting strongly in front, in contrast to *N. iluka,* wherein 5 red anterior ommatidia occur in tandem, with one specimen having 2 white ommatidia anteroventrally and one with 2 anterodorsally. The pattern in *N. iluka* is less regular. Indeed, the accessory set of ventral eyes might have been overlooked if *N. iluka* had been the first species of the genus to be described, because the lower eyes have very weak pigment and a few ommatidia of poor definition in comparison to *N. noa.*

The body pigment of *N. iluka* in 2-day formaldehyde is irregularly blotchy, being composed of dark gray, brown, and deep burgundy; the eyes are dark brown but not distinctly black as in *N. noa,* and in alcohol the fluoroscein-like changes seen in *N. noa* are weak; perhaps this feature is related to diet.

The anterior margin of coxa 4 is more broadly rounded in *N. iluka* than it is in *N. noa.* The total length of that coxa is drawn in a flattened condition as an offset line in the illustration of the body (Figure 166). Coxae 2 and 3 in *N. noa* are of equal length, pereopod 5 has a much narrower article 2, coxa 6 has a shorter posterior lobe, the dactyls of gnathopods and pereopods lack a comb-row, and the inner plate of the maxilliped has only 1 apical spine.

Specimens of *N. iluka* at hand range in length between 0.92 and 1.5 mm. To avoid damage, I have not examined the holotype for its sex. No eggs are apparent in it.

The lower lip, not studied in *N. noa,* appears to be composed of 2 widely separate lobes with no indication of mandibular lobes nor a clear indication of inner lobes. The apices bearing 2 patches of setules and the 2 main lobes appear almost as if they are attached to pedunculate bases and thus widely separate. The upper lip of *N. iluka* is composed of 2 alate lobes curling slightly around the front of the head and separated by a medial sclerotic line, in contrast to the interpretation of the upper lip of *N. noa* that was more conventional. The upper and lower lips of both species need further study, but sufficient material of *N. iluka* in good condition remains to be collected.

MATERIAL.—JLB Australia 5 (5), 10 (2), 11 (1), 12 (3), 13 (1).

DISTRIBUTION.—Southwestern Australia, intertidal.

## OCHLESIDAE

### *Ochlesis* Stebbing

### *Ochlesis eridunda,* new species

FIGURES 168–169

DESCRIPTION (of male).—Body moderately compressed, scarcely carinate dorsally, pleonite 3 with large, erect tooth, pleonite 2 occasionally with smaller process; head short, telescoped into pereonite 1, latter weakly extended over head; rostrum thin and sharp, lateral cephalic lobe much more obtuse than rostrum and bluntly quadrate at anteroventral corner; eye moruliform and densely packed with numerous ommatidia, posterodorsal corner of eye cut by anterior margin of pereonite 1; antenna 1 cylindrical, lacking any teeth, article 1 longer than 2, article 3 very short but subequal in width to article 2; accessory flagellum absent; primary flagellum 4-articulate, with article 1 longer than article 2 of peduncle, flagellum armed witn large aesthetascs; antenna 2 shorter and thinner than antenna 1 but not strongly disproportionate, lacking cusps, flagellum 3-articulate, including tiny terminal article, article 1 about as long as article 5 of peduncle; gland cone small but conical; epistomal portion of prebuccal complex with weak keel, upper lip with attenuate apex; styliform mandibles with simple pointed apex from lateral view, left with strong, serrate lacinia mobilis, right with obsolescent sharp scale, molar small, weakly cup shaped, scarcely trituative, palp article 2 slightly longer than 3, article 1 much shorter than either, article 3 with 3 short apical setae and linear comb-row; lower lip slender, apices simple and sharp, inner lobes apparent; maxilla 1 with small inner plate, outer plate styliform, apex with about 3 tooth ridges, 2-3 reverted cusps and 2-3 hooks, palp tiny, uniarticulate, bearing 1 long seta; maxilla 2 with slender, unequal but strongly setose lobes; inner

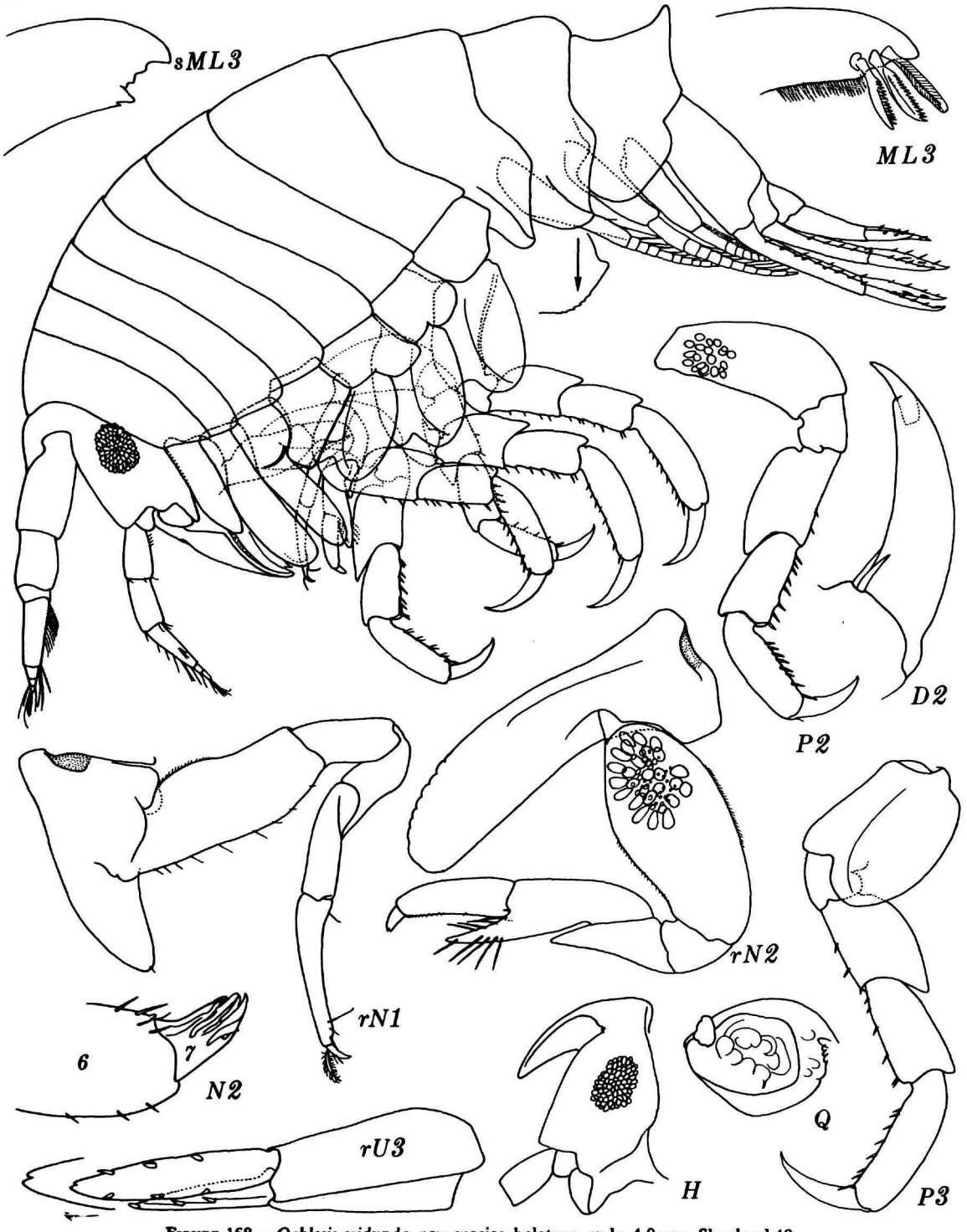


FIGURE 168.—*Ochlesis eridunda*, new species, holotype, male, 4.9 mm, Shepherd 40.

plates of maxillipeds each with pair of distolateral spine setae on lateral bevelment beside subacute apex and several setae on midmargin; outer plates slightly rolled apicolaterally, distal ends with a few deeply immersed setules; coxae 1-2 scarcely sinuous proximally, coxa 3 not basally produced and with weak posterobasal hump; coxa 4 very short, broadly truncate obliquely, with adz-shaped anterior process and proximal excavation fitting coxa 3, coxae 5-6 with truncate anterior margins and subquadrate posterior

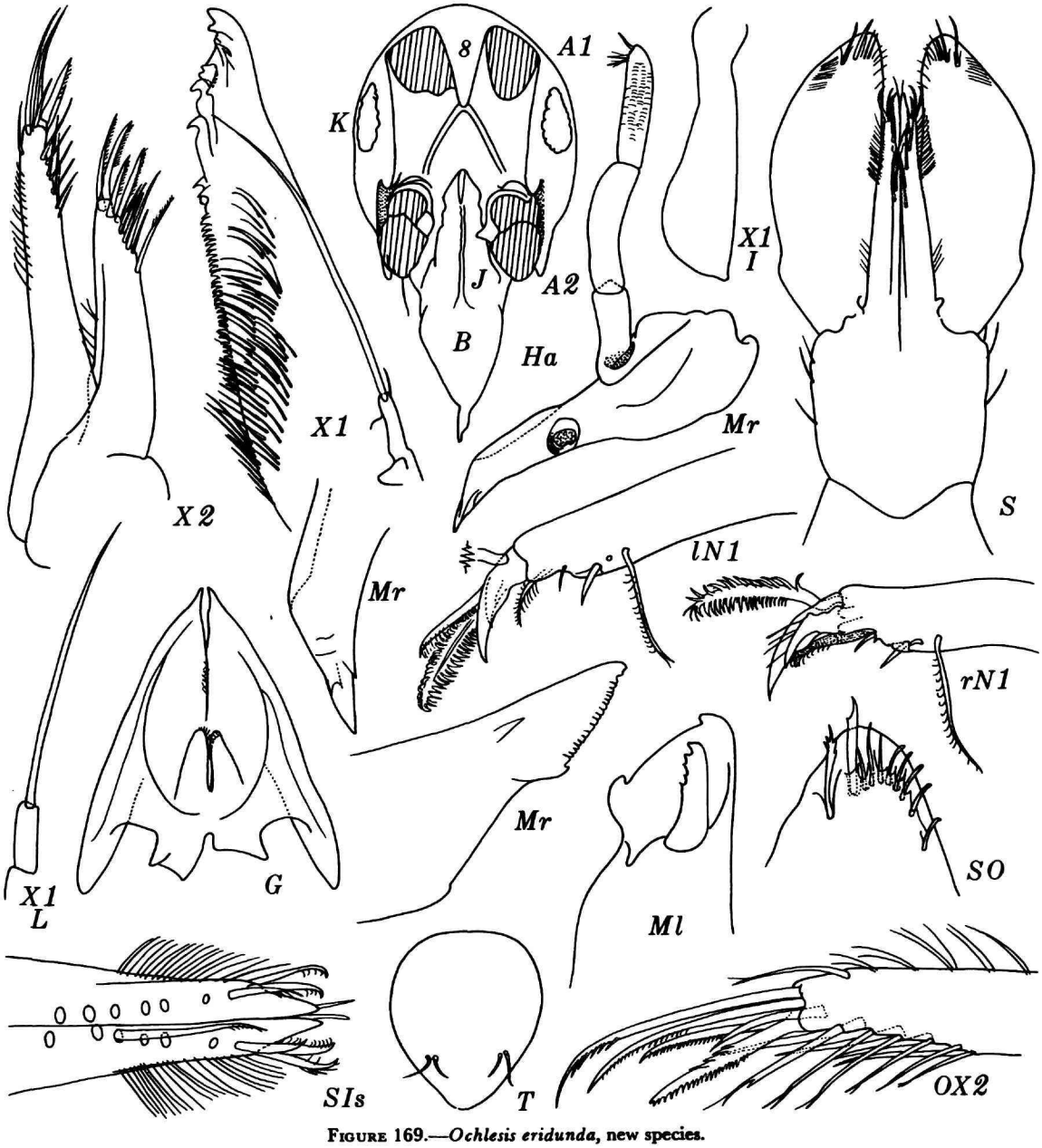


FIGURE 169.—*Ochlesis eridunda*, new species.

lobe longer than anterior lobe, coxa 7 with posteroventral bevelment slightly concave; gnathopod 1 with article 2 basally inflated, articles 3-4 subequally elongate but fairly stout in comparison to other species of genus, articles 5-6 elongate but article 6 longer than 5, article 6 with weak, oblique palm defined by stout spine, with 1 feather seta proximal to spine, 1 feather seta at dactylar base, dactyl with 3 anterior strap-shaped feather setae and rudimentary fourth; gnathopod 2 with swollen article 2 bearing basal stellar gland, article 3 short, article 4 obliquely jointed to article 5 and distoventrally extended and subacute, article 5 carpochelate along article 6, setose, article 6 shorter than 5, simple, dactyl stout, rigid, subconiform; pereopods 1-2 with stellar gland in article 2, with long anterodistal process on article 4 extending less than halfway along article 5, dactyls simple but bearing cornified distal nail, article 6 with many distal spinules; articles 3-7 of pereopods 3-5 similar to pereopods 1-2, second articles evenly expanded and posteriorly smooth; pleonal epimera 1-2 with midposterior margins slightly concave, posteroventral corners slightly protruding, epimeron 3 with short convex posterior margin and rounded corner; outer rami of uropods 2-3 shortened; telson ovatocircular, with weak ventral keel.

FEMALE.—Apart from presence of brood plates no apparent difference from male, except that all definite females at hand bearing deep triangular posterior excavation on coxa 4, largest specimen a female 8.1 mm long (brood plates vestigial), others exceeding 4.0 mm in length, generally recognizable females between 4.8 and 6.2 mm in length (parabolic); poorly excavate coxa 4 confined to males and juveniles between 3.7 and 4.5 mm long (smallest specimen 3.7).

VARIATIONS.—Coxa 4 (see "Female" above); dorsal process of pleonite 3 highly variable, not apparently associated with size (above 3.7 mm), varying from high rhombic (Figure 168) to quadratorhombic to transverse-rhombic, pleonite 2 often bearing similar but smaller rhombic process or rounded lobe; pereopod 5 occasionally with extreme rounded protrusion on article 2 at posterodorsal corner, protrusion weak in most specimens, absent in small specimens and males.

HOLOTYPE.—SAM, male, 4.9 mm.

TYPE-LOCALITY.—Shepherd 40, D-282, Point Gillian, West Island, South Australia, 0-4 feet, among corallines, *Asparagopsis armata*, and *Halopteris* species, 27 May 1967.

RELATIONSHIP.—This species differs from *O. innocens* Stebbing (1910a), its sympatriot from Port Hacking and Wata Mooli, in the absence of teeth on the antennae and pleonal epimeron 3, the shorter article 2 of antenna 1, the better developed flagella of the antennae, the broader and more even expansion of article 2 on pereopods 3-5, the more circular telson, the even rami of uropod 1, and the shorter more strongly truncate coxa 4.

The absence of teeth on the antennae and on epimeron 3 suggest the close affinities of *O. eridunda* with *O. levetzowi* Schellenberg (1953) from southwest Africa. But *O. eridunda* differs from that species in the absence of basal processes on coxae 2-5, the evenly expanded article 2 of pereopods 3-5, and the large size of the dorsal tooth on pleonite 3.

MATERIAL.—Shepherd 1 (5), 4 (1), 5 (2), 6 (1), 8 (3), 18 (1), 22 (2), 30 (1), 40 (1), 46 (1).

DISTRIBUTION.—South Australia, sublittoral.

### *Ochlesis meraldi*, new species

FIGURES 170–172

DESCRIPTION.—Body moderately compressed, doubly carinate or bearing dorsal plaques and otherwise complexly ornamented (see below), pereonites 1-4, 7 and pleonites 1-2 especially protuberant; head short, telescoped into pereonite 1, latter extended over head; rostrum very thick, sharp, lateral cephalic lobe obtusely tripartite (one interpretation), anterior margin thus excavate and ventral margin bearing deep notch; eye moruliform but ommatidia sparse, posterodorsal half of eye hidden under pereonite 1 but showing through thin cuticle; antenna 1 stoutly cylindrical, articles 1-2 with humps, article 3 mostly telescoped into article 2 and much narrower than 2; accessory flagellum absent; primary flagellum with 1 very large article and 1 very small article but with simulated articles bearing aesthestascs and setules placed around distoventral margin of article 1 of flagellum; antenna 2 shorter and thinner than antenna 1 and strongly disproportionate, lacking cusps, flagellum 2-articulate, article 2 telescoped into 1, latter also shorter than article 5 of peduncle; gland cone small but subconical; epistomal portion of prebuccal complex with weak keel, upper lip with attenuate apex; styliform man-

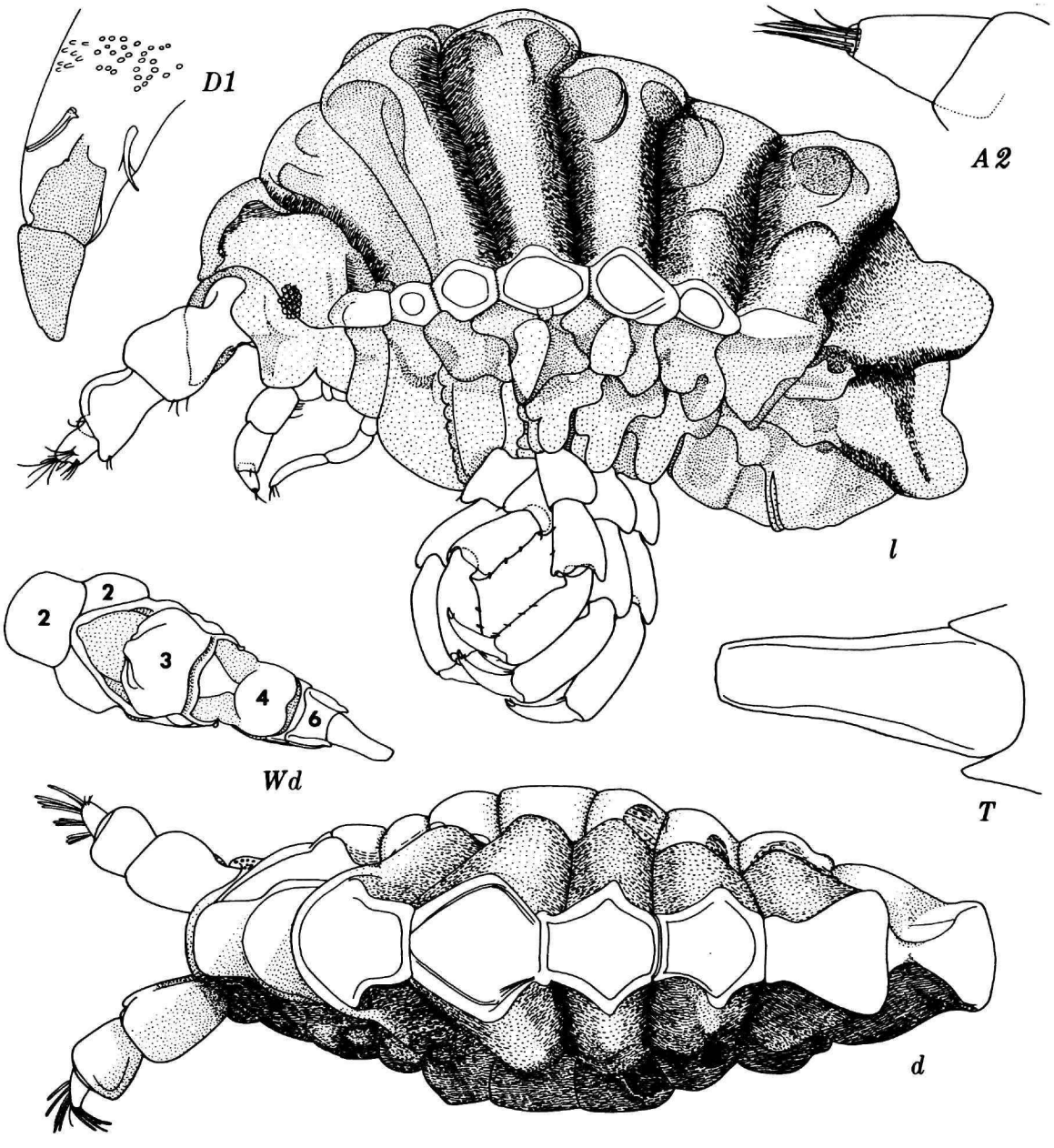


FIGURE 170.—*Ochlesis meraldi*, new species, holotype, female, 4.0 mm, Shepherd 22. (*d*=dorsal).

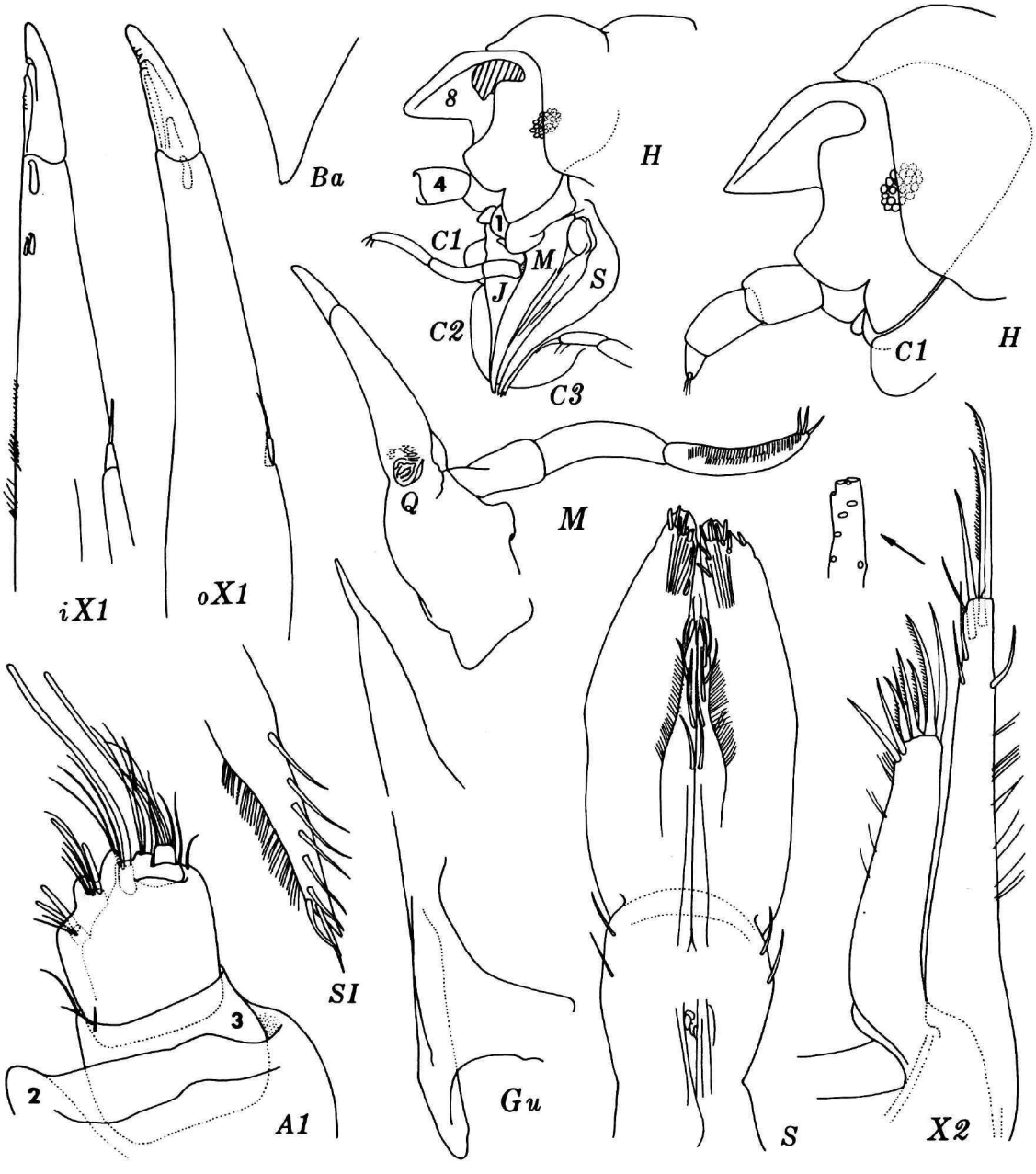


FIGURE 171.—*Ochlesis meraldi*, new species.

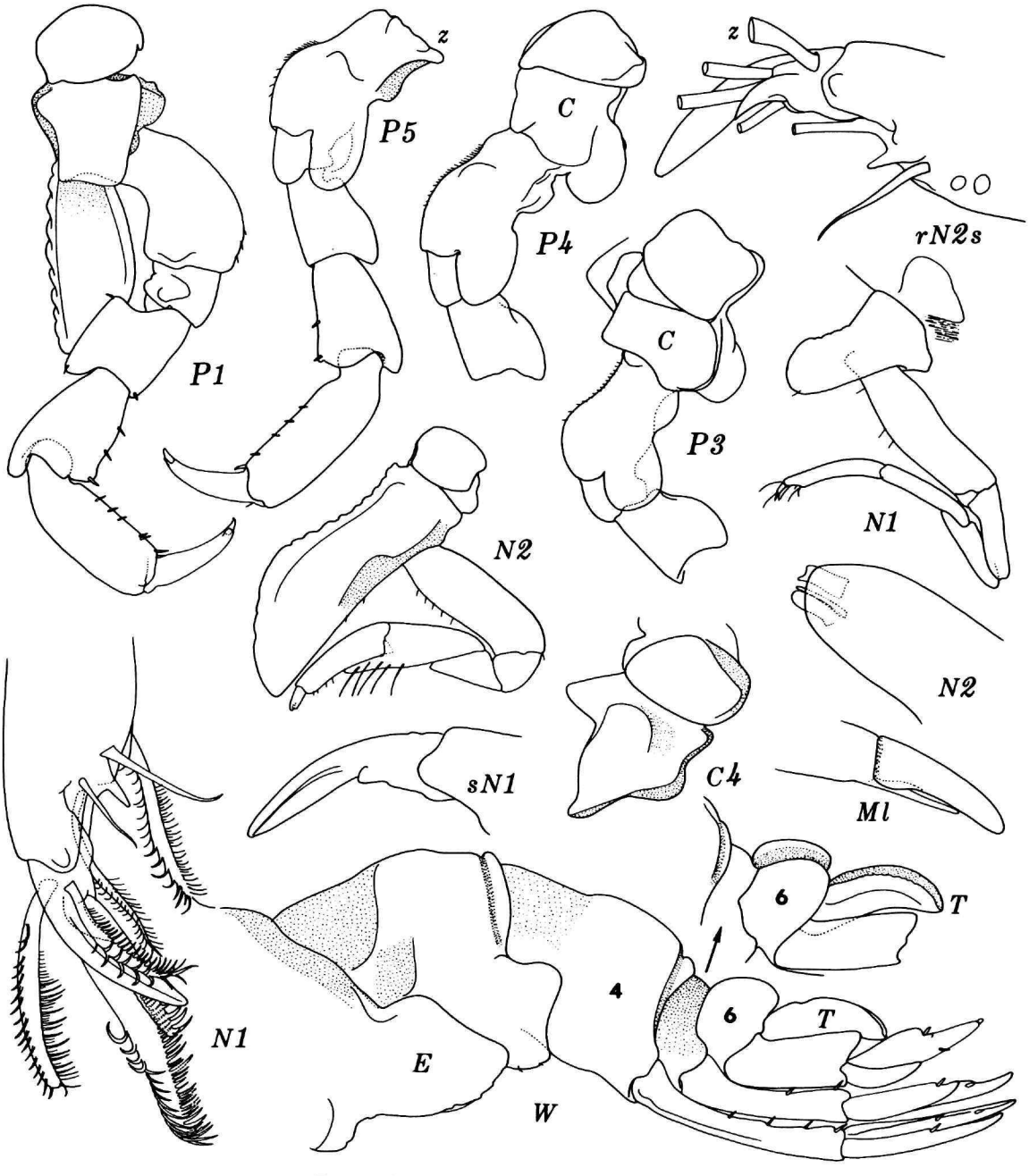


FIGURE 172.—*Ochlesis meraldi*, new species.

dibles with simple pointed apex from lateral view, left with cylindrical lacinia mobilis (?apically broken), right with no lacinia mobilis except for weak keel paralleling incisor, molar small, weakly cup shaped, scarcely triturative, palp article 2 slightly shorter than 3, article 1 shorter than either, article 3 with 3 short apical setae and linear comb row; lower lip slender, apices simple, grossly sharp but minutely truncate; inner lobes, if present, destroyed during dissection; maxilla 1 with inner plate, if present, also destroyed during dissection, outer plate styliform, apex with 2 or 3 tooth ridges distad from definite suture, then inner face with 3 weak spines proximal to suture, palp tiny, uniarticulate, bearing 1 short seta; maxilla 2 with slender, unequal but strongly setose lobes; inner plates of maxillipeds each with pair of distolateral spine setae on lateral bevelment beside subacute apex and several setae on midmargin; outer plates slightly rolled apicolaterally, distal ends with a few deeply immersed spinules, plates much longer and narrower than in *O. eridunda*; coxae 1-3 scarcely sinous posteriorly, bearing basolateral humps; coxa 4 very short, somewhat bifid, with anterior and ventral projections and lateral hump, not fitting coxa 3, coxa 5 with large midlateral hump resembling hump on pereonite, 6 with weak humps, 7 coalesced to pereonite, coxae 5-7 long; gnathopod 1 with article 2 evenly inflated its full length, articles 3-4 subequally elongate, thin, articles 5 and 6 equal, long and slender, article 6 with weak, oblique palm defined by stout spine coalesced with article 6, with 1 simple seta and 1 feather seta proximal to spine, 1 feather seta at dactylar base, dactyl with 3 anterior and 1 posterior strap-shaped feather setae; gnathopod 2 with unswollen article 2 and no gland, article 3 short, article 4 obliquely jointed to article 5 and distoventrally extended and subacute, article 5 carpochelate along article 6, setose, article 6 equal to main part of 5 in length, dactyl stout, rigid, subconiform; pereopods 1-2 lacking gland, with stout and short article 4 bearing basal hump, distal end not strongly extending along article 5, dactyls simple, bearing distal cornified nail, article 6 slightly broader than ordinary, with posterior spines, some paired, some alternating lateral and medial; articles 3-5 grossly similar to those on pereopods 1-2, but article 4 not so grossly humped, second articles narrow; grotesque, basally bent, with long posteroventral lobes; pleonal epimera 1-3 with upper hump, then slightly concave margin and rounded-attenuate posteroventral corner; outer rami of uropods 1-3 progressively shorter than inner rami; telson grossly linguiform and lateral margins upturned to form central trough.

Additional description.—Nothing like this species of *Ochlesis* has ever been reported: body dull pink in alcohol, very chalky, mostly opaque, except pereonite 1 near head; all pereonites and pleonites 1-2 broadly flattened on top, forming diamond-shaped plaques, especially on pereonites 3-6, with slightly upturned lateral rims appearing as translucent ridges from lateral view; each pereonite with rounded lateral column except pereonites 1-2 with relatively flat and depressed sides; pleonites 3-4 dorsally rounded side to side and posterodorsally bearing frenulum; pereonites above coxae bearing lateral diamond-shaped plaques tightly pressed against one another but fully separate from each other; pleonite 5 very short and somewhat overridden by pleonites 4 and 6; pleonite 6 with pair of strong dorsolateral crests to some extent matching crests of telson; coxae 2-3 with wavy anterior margins; pereopod 1 overriding coxa 3 laterally because coxae bent closely together from side to side and brood space between coxae anterior to coxa 3 filled with mouthparts and gnathopods.

Relationship.—This species differs so grossly in its body ornaments from other species of *Ochlesis* that one wonders whether it does not deserve separate generic status. Although the telson of O. *meraldi* is extraordinary, the mouthparts, gnathopods, generalities in coxae, pereopods, and uropods, however, correspond to those of other species of *Ochlesis*.

Holotype.—SAM, female, 4.0 mm (parabolic). Unique.

Type-locality.—Shepherd 22, Pearson Islands, South Australia, Station A, 35 m, in algae, 7 January 1969.

Material.—The holotype.

Distribution.—South Australia, sublittoral.

## PHLIANTIDAE

### *Gabophlias*, new genus

Diagnosis.—Body low, anterior coxae splayed, pereonite 1 with weak anterior hump larger than any hump on pereonites 2-5; rostrum weak; mandible with stylocylindrioid molar; lower lip with inner lobes, if present, forming small single plate; maxilla 1 lacking

palp, inner plate bluntly triangular; plates of maxilla 2 separate; palp of maxilliped 4-articulate; gnathopods and pereopods subprehensile, bearing spinose protrusion at base of article 6, inner ramus of pleopod 3 very short, less than one-third as long as outer ramus, peduncle produced medially; uropods 1-2 each with 2 rami; uropod 3 with 1 ramus.

TYPE-SPECIES.—*Gabophlias olono,* new species.

RELATIONSHIP.—This genus fits the general diagnosis of *Quasimodia* in most characters, but it differs in the lower body altitude, the splayed coxae, and the subprehensile gnathopods and pereopods. *Gabophlias* thus looks superficially like an ordinary phliantid in contrast to *Quasimodia,* which is so tall. *Gabophlias* differs from *Palinnotus* Stebbing in the short inner ramus of pleopod 3, the presence of a ramus on uropod 3, the presence of a fourth article on the maxillipedal palp, and the subprehensile pereopods. *Gabophlias* is perhaps even closer to *Iphiplateia* Stebbing, also from Australia, but it differs in the presence of a ramus on uropod 3 and in the subprehensile pereopods and gnathopods. As more phliantids are discovered, these two generic differences may not hold together. Consistency in presence or absence of a ramus on uropod 3, however, is beginning to take shape, as there are now four species in *Quasimodia* and four in *Palinnotus* demonstrating this consistency.

### *Gabophlias olono,* new species

FIGURES 173–175

DIAGNOSIS.—With the characters of the genus.

DESCRIPTION.—Body covered sparsely with cuticular tubes, as in *Quasimodia,* and occasional craters; upper lip rounded below and weakly denticulate on posteroventral face; spines on mouthparts heavily accreted with precipitate (hence, analyses open to defects); mandibular molar also accreted, no spine present but possibly broken off, ordinary spine row accreted, apparently 3 or 4 very short spines in that row; lower lip like that illustrated herein for *Quasimodia enna* (Figure 184*G*); coxae highly splayed, illustration of sideview herein (Figure 173*l*) with coxae slightly bent ventrad, ventral margins of anterior coxae nearly aimed directly at viewer in normal aspect, legs on dorsal and lateral views drawn in natural aspect; gnathopods and pereopods apically similar to one another, sixth article bearing spinose protrusion near proximal end, thus appearing prehensile, spines of those protrusions various, 2 on gnathopods 1-2, 3 on pereopod 1 (1 hidden), 4 on pereopods 2, 3, 5, and 5 on pereopod 4; right gnathopod 1 on holotype (unique) aberrant, lacking medial prickle spines on hand, present on medial face of gnathopod 1; medioproximal margin of inner ramus of pleopod 1 naked.

Unique male (holotype) bearing characters found typical of males in *Quasimodia*; equally extending uropods 1-2 with thick rami and thick peduncle of uropod 2, ramus of uropod 3 shorter than peduncle, lateral faces of pleonite 4 with ridge.

HOLOTYPE.—SAM, male, 4.5 mm. Unique.

TYPE-LOCALITY.—Shepherd 31, D-238, Judith Cove, West Island, 0-3 feet, among coralline matting, 5 November 1966.

DISTRIBUTION.—South Australia, sublittoral.

### *Palinnotus* Stebbing

*Palinnotus* Stebbing, 1900:16.—J. L. Barnard 1969a:411; 1970a:226–227.

DIAGNOSIS.—Body low, anterior coxae splayed; pereonite 1 with pair of weak anterior humps, other pereonites usually with 1 hump of similar size; rostrum weak; mandible with spiniform molar; inner lobes of lower lip coalesced into single plate; palp of maxilla 1 distinct, flabellate or spiniform, inner plate triangular; plates of maxilla 2 separate; palp of maxilliped 3-articulate; gnathopods and pereopods simple; inner ramus of pleopod 3 about two-thirds as long as outer, peduncle produced medially; uropods 1-2 each with pair of rami in female, but uropod 2 in male with only 1 ramus; uropod 3 composed only of peduncle.

TYPE-SPECIES.—*Pereionotus thomsoni* Stebbing, 1899a.

REMARKS.—The four species of this genus are very similar to each other. The following key attempts to distinguish them. *Palinnotus natalensis* K. H. Barnard (1940), from South Africa, and of Pillai (1954), from India, seems to be the most distinctive of the four with its nasiform posterior lobe on article 2 of pereopod 5. K. H. Barnard found this characteristic occurring only in the largest specimen(s) whereas juveniles had article 2 like that in *P. thomsoni* (Stebbing 1899a:417), the type-species from Australia. *Palinnotus holmesi* Gurjanova (1938), from the Japan Sea, is very close to *P. thomsoni* also, but the dorsal humps of the midpereon are undeveloped. *Palinnotus alaniphilias* J. L. Barnard (1970a), from Hawaii, differs

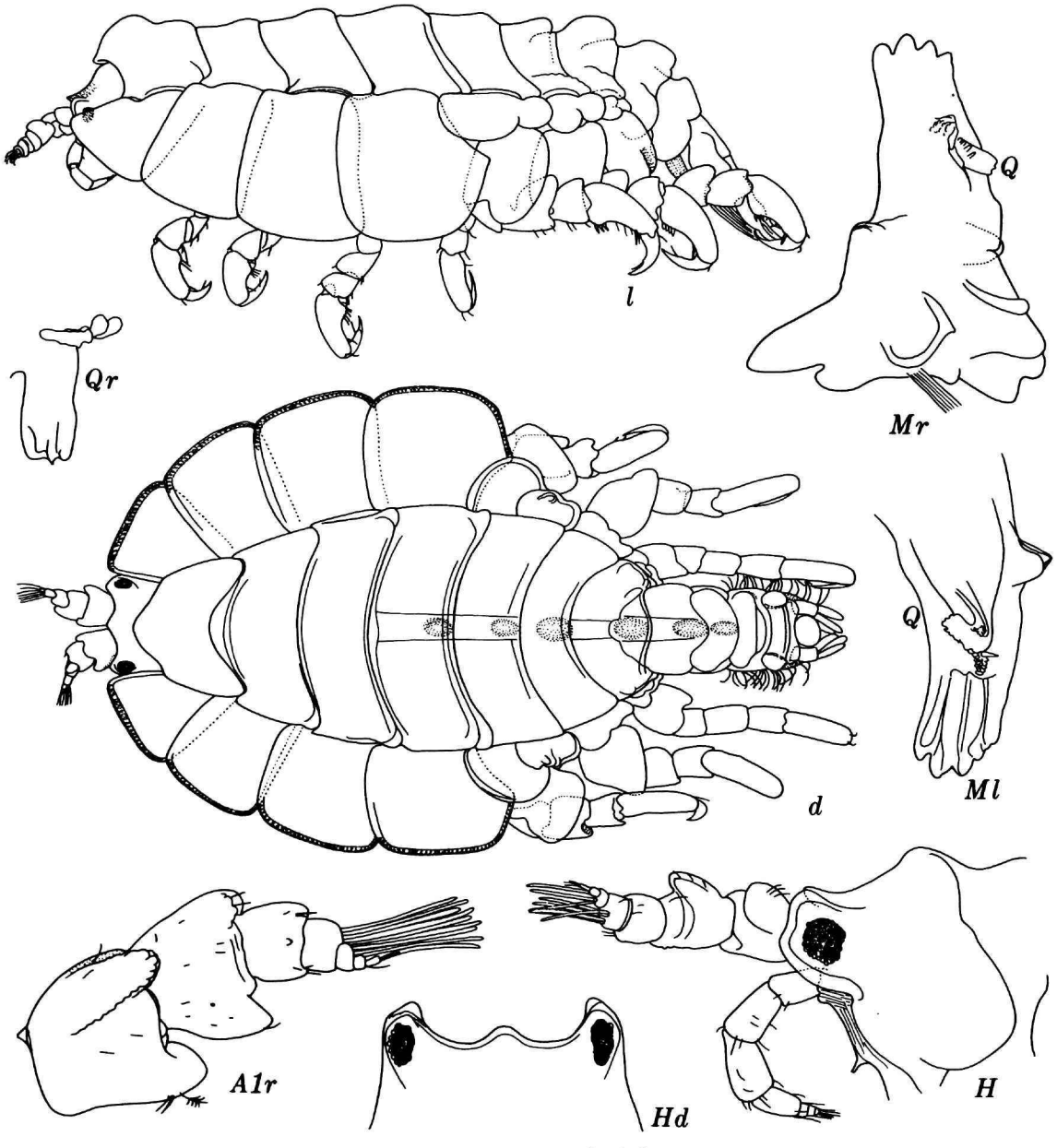


FIGURE 173.—*Gabophlias olono*, new genus, new species, holotype, male, 4.5 mm, Shepherd 31.

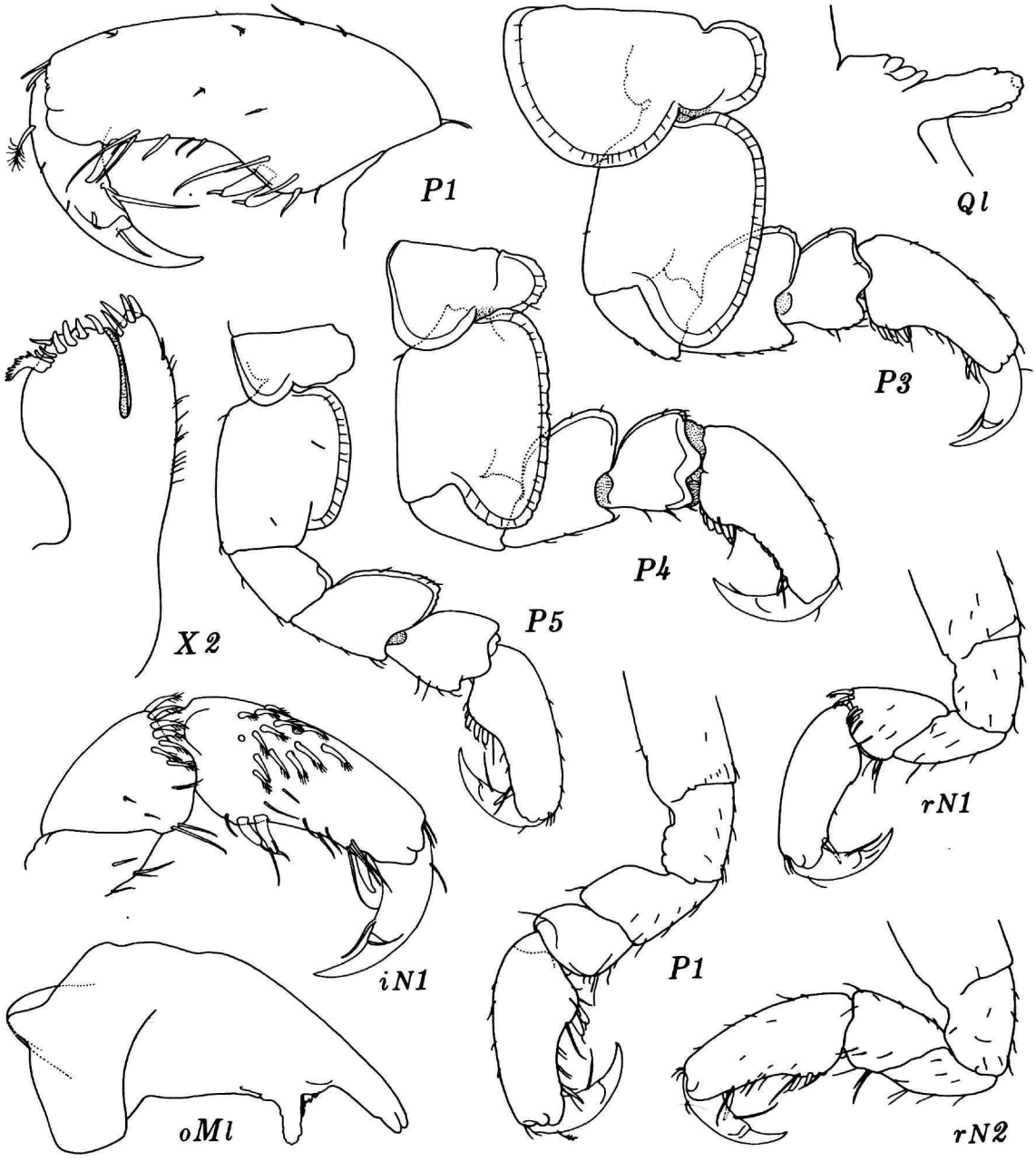


FIGURE 174.—*Gabophlias olono*, new genus, new species.

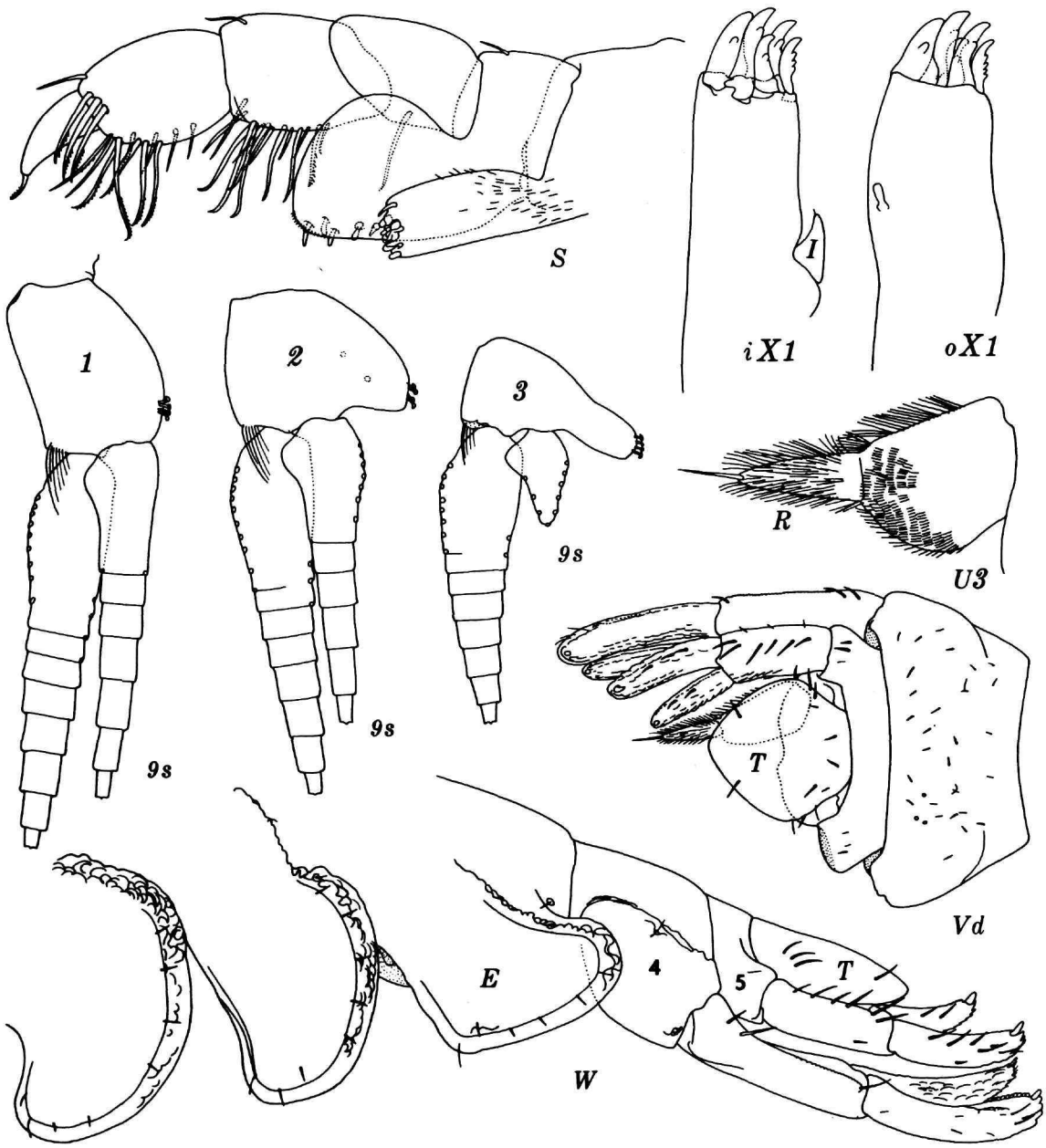


FIGURE 175.—*Gabophlias olono*, new genus, new species.

from *P. thomsoni* and *P. holmesi* in the absence of a distal constriction on article 2 of pereopod 5. So few specimens of this genus have been studied that no conclusions can be made on variability. The four specimens at hand do not vary in article 2 of pereopod 5 nor in the dorsal humps.

RELATIONSHIP TO *Pereionotus* BATE AND WESTWOOD.—I doubt that *Palinnotus* is distinct from *Pereionotus*. Now that the male of *Palinnotus thomsoni* has been discovered (herein) and proves to have male uropod 2 like that of *Pereionotus testudo* (Montagu) from the northeastern Atlantic Ocean, there is little left to differentiate the two genera except a few small points of questionable generic value. These may result from omissions, oversights, and misinterpretations.

Stebbing (1899a, 1900) appears to have erred slightly in the original description of *Palinnotus thomsoni* and the subsequent diagnosis of *Palinnotus*, perhaps relying on drawings of Della Valle (1893). One might suspect that two species are involved in European identifications of *Pereionotus testudo*, because the maxillipedal palp of Della Valle's drawing and that of Chevreux and Fage (1925) are vastly different in their sizes and robustness. There are also strong differences in the degree of development of the pleopods of the two sets of illustrations. The crux of the question, however, is that Stebbing (1900) in his diagnosis of *Palinnotus* wrote that the upper lip is not bilobed and that the outer plates of the maxillipeds reach slightly beyond the 3-articulate palp (true in Della Valle, false in Chevreux and Fage). The bilobation is not true of *Palinnotus thomsoni*, the type-species (if I have that species properly identified) nor of others in *Palinnotus*; the condition is minor in both *Pereionotus* (see Della Valle, 1893) and *Palinnotus*. This leaves only two other valuable characters in Stebbing's diagnosis: the fact that pleopod 2 has the peduncle prolonged in *Pereionotus* and not in *Palinnotus*, and the presence of a small palp on maxilla 1 in *Palinnotus* but not in *Pereionotus*. Stebbing may have trusted Della Valle's Plate 31: figure 18 as representing both plepods 2 and 3. I strongly suspect Della Valle has presented two different drawings of pleopod 3, as the lengths and thicknesses of the rami are similar, whereas these proportions usually differ between pleopods 2 and 3 in phliantids, whether the peduncles do or do not. Chevreux and Fage use the character of pleopod 2 in their diagnosis, but they show a drawing only of pleopod 3.

The small palp of maxilla 1 in *Palinnotus*, originally described by Stebbing as a spine, is really a flat, subconical, fleshy appendage in three entities presently described in the literature (*P. holmesi*, *P. alaniphlias*, and my representation herein of *P. thomsoni*) while the palp of *P. natalensis* is not described. This palp is wrinkled and deformed in preservative, and one suspects it may have been overlooked in *Pereionotus testudo* or dismissed as organic dirt or an epizoont.

The differences between *Pereionotus* and *Palinnotus* now seem to hinge on the condition of pleopod 2 peduncle and the palp of maxilla 1. For the problem concerning the maxillipedal palp, wide geographic series of *P. testudo* should also be examined.

UROPOD 2 IN MALE *Palinnotus*.—The first male to be discovered in *Palinnotus* is described following the key. Uropod 2 has 2 short, thick rami, the inner ramus offset from the outer by an extension of the peduncle. One juvenile of *P. thomsoni* also has been examined and has been found to resemble the female in having 1 ramus on uropod 2. I presume, therefore, that males of *Pereionotus* and *Palinnotus* pass through a stage of development in which the inner ramus is essentially created out of "whole cloth." This is an amazing transformation— for a species to recapitulate a ramus lost in the female and not occurring in the juvenile. It appears not to be a case of the female losing the ramus after reaching adulthood. One might use this example in extending the principle of recapitulation to the *Ceina-Quasimodia* problem discussed under *Quasimodia*. In that case, the descent of phliantids from ceinids is beclouded with the presence of a ramus on uropod 3 in the phliantids and not in the ceinids, and with the presence of maxillary palps in certain phliantids but not in the ceinids.

## Key to Species of *Palinnotus* Stebbing

1a. Article 2 of pereopod 5 evenly quadriform ..... ***P. alaniphlias***
b. Article 2 of pereopod 5 with nasiform posterior lobe ..... ***P. natalensis***
c. Article 2 of pereopod 5 with sudden distal constriction below quadriform posterior lobe ..... 2
2. Pereonites 3-7 each with dorsal hump as large as humps on pereonite 1 and pleonite 1. ***P. thomsoni***
Pereonites 3-7 lacking dorsal hump ..... ***P. holmesi***

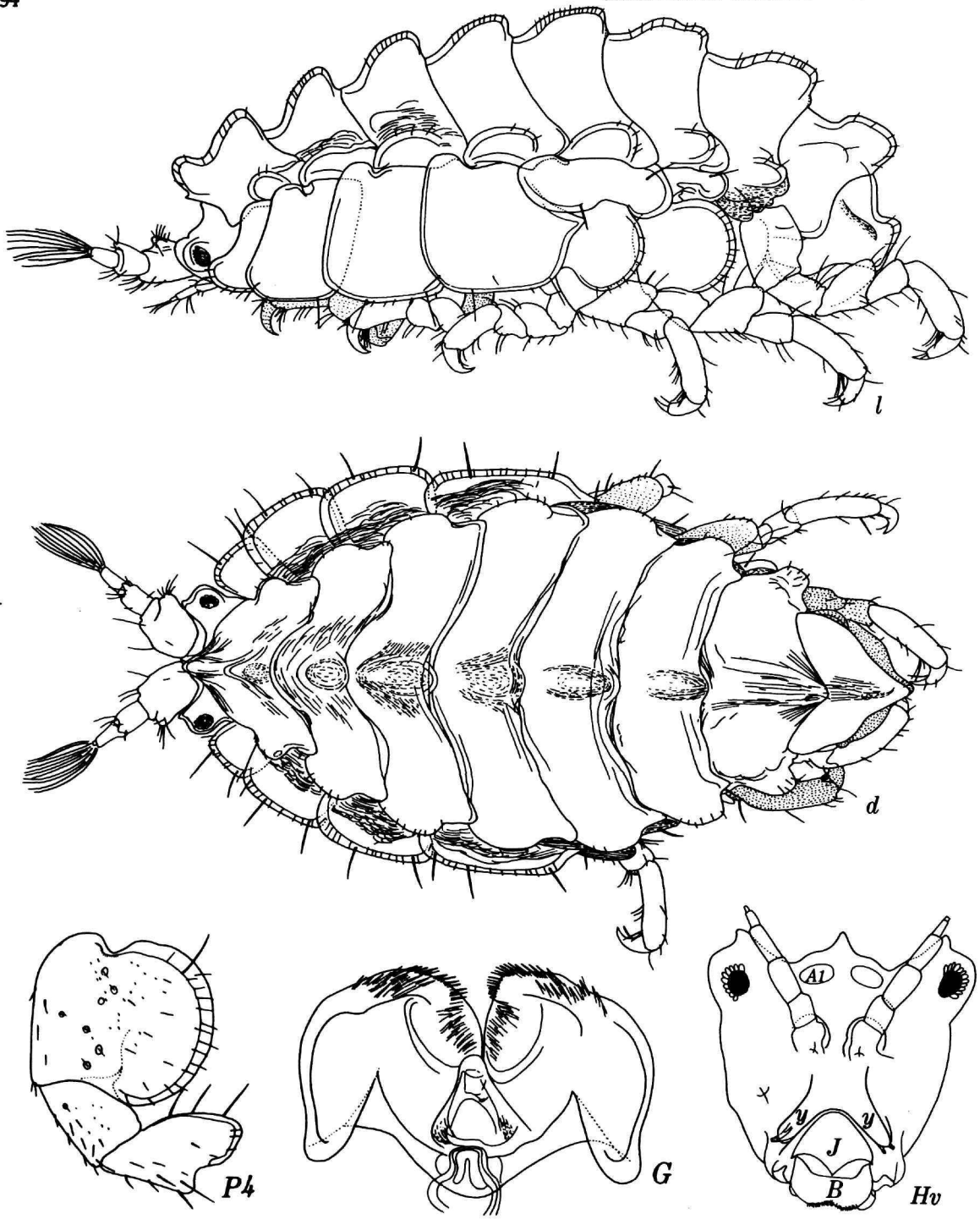


FIGURE 176.—*Palinnotus thomsoni* (Stebbing), female, 4.5 mm; *n*=male, 3.5 mm; both from Slack-Smith 2. (*v*=ventral; *y*=gland cone.)

### *Palinnotus thomsoni* (Stebbing)

FIGURES 176–179

*Pereionotus thomsoni* Stebbing, 1899a:417–418, pl. 35A.

REMARKS.—This species was described from one female collected at Watsons Bay, New South Wales. Several discrepancies occur between the original and my specimens collected in Western Australia. Stebbing described the palp of maxilla 1 as a spine, whereas it is a fleshy coniform or flattened tubular piece. The small size of Stebbing's maxillary drawings suggests he may not have had a high-powered microscope to study the material. Stebbing did not notice or report upon the distinctive medial spination on article 6 of gnathopod 1 that differentiates it from gnathopod 2 and pereopods 1-2. Stebbing equated all of these appendages and wrote that they all have on the inner margin of article 6 a strong spine plus another one near the middle. No conspicuous setules were found on coxae 1-4, in contrast to my specimens, but these may have been worn off; they are mostly broken off in my specimens. Stebbing also differentiated *Palinnotus thomsoni* from *Pereionotus testudo* in the absence of lateral pereonal tubercles in the former. These, however, are present in the specimens at hand and in the other species of *Palinnotus*. Finally, in Plate 35 of Stebbing's work the figure of pereopod 3 has article 4

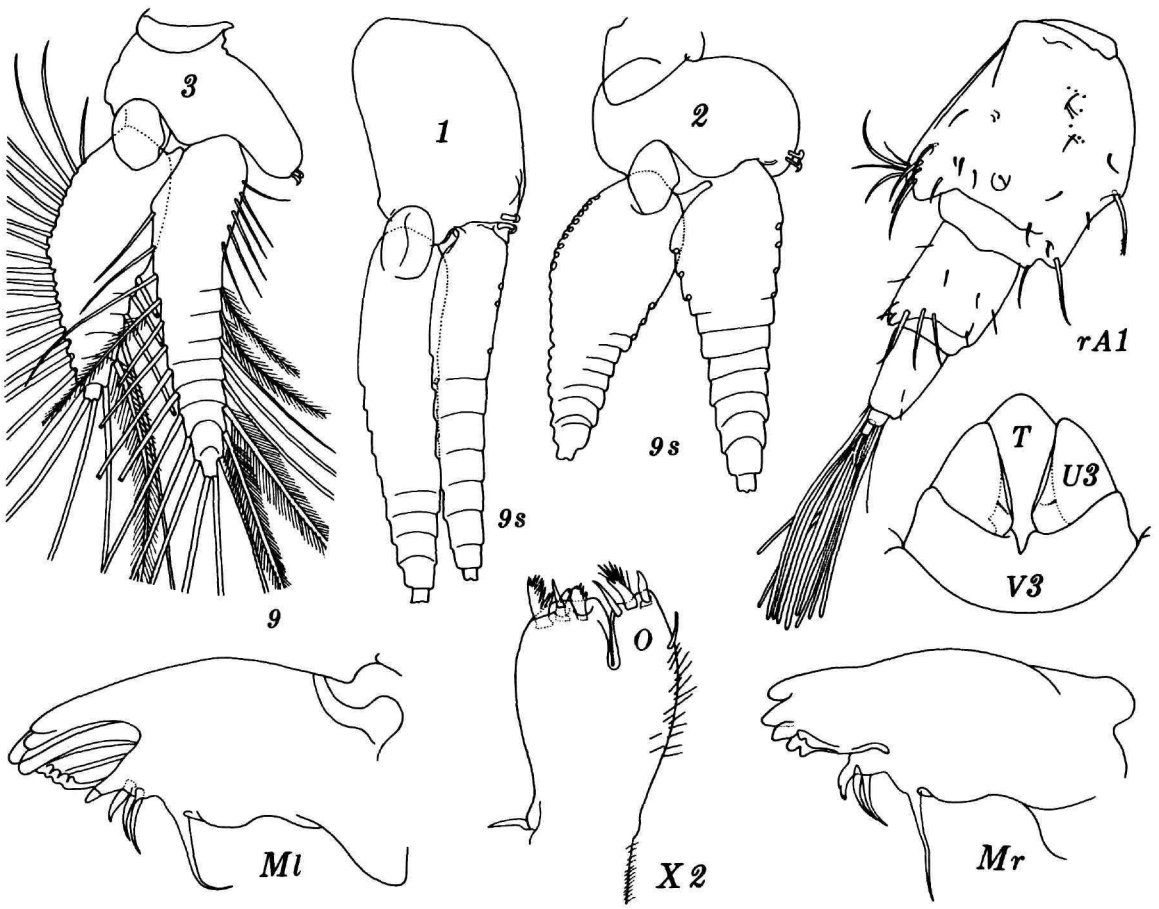


FIGURE 177.—*Palinnotus thomsoni* (Stebbing).

very strougly lobed, unlike present materials. Pillai (1954) has noted considerable variation in *P. natalensis* from India in widths of pereopodal articles.

There remains a question as to whether or not my material belongs with Stebbing's species, but the only clear difference concerns article 4 of pereopod 3. In view of the taxonomic characters already used in this genus to differentiate species, this would suffice to describe a new species, but the variability pointed out by Pillai suggests that the difference may be worthless. There is also a great deal of inquiry required on whether any of the species in this genus deserve separation from the type-species.

MORPHOLOGICAL NOTES.—The body, head, coxae,

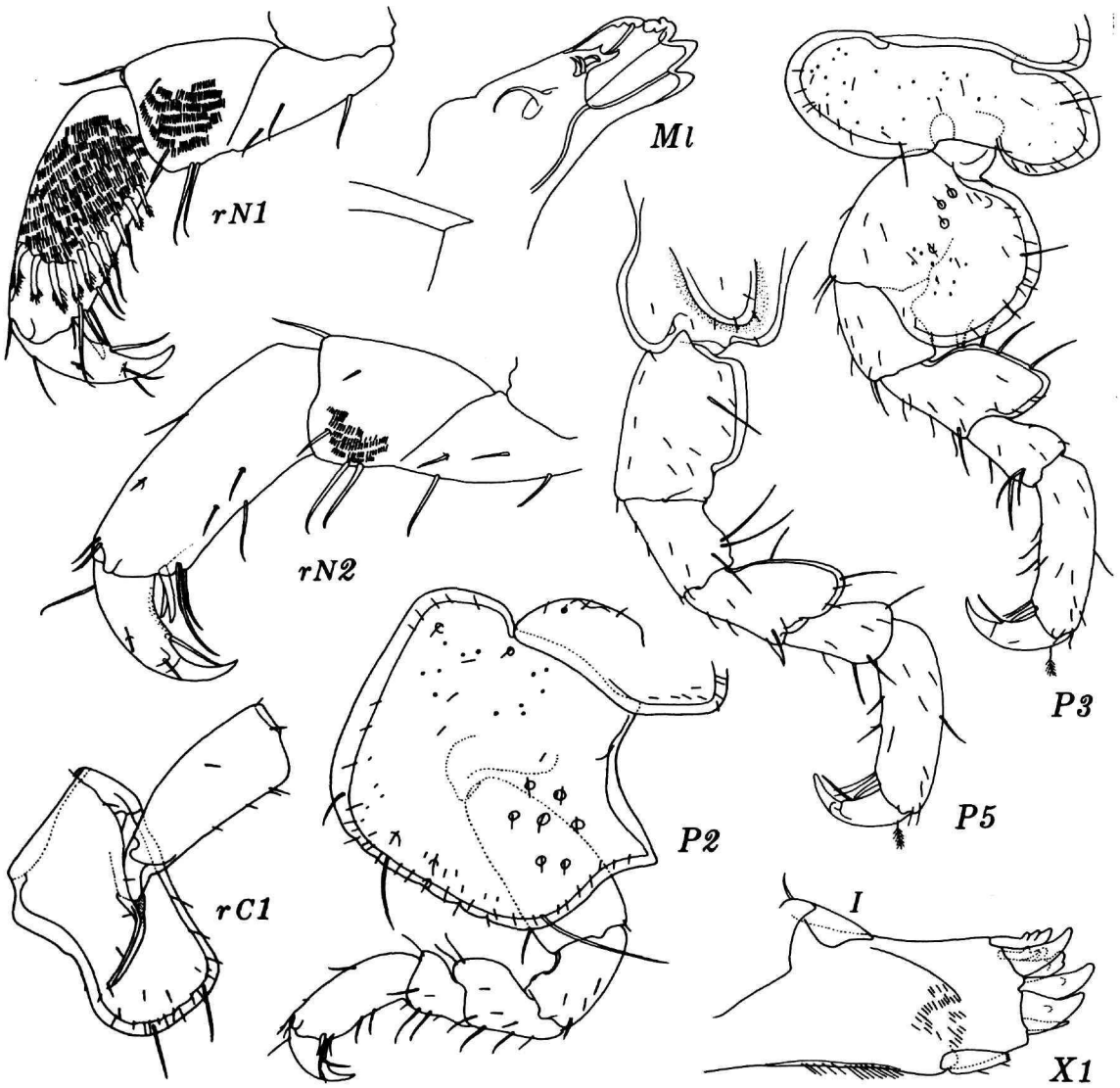


FIGURE 178.—*Palinnotus thomsoni* (Stebbing).

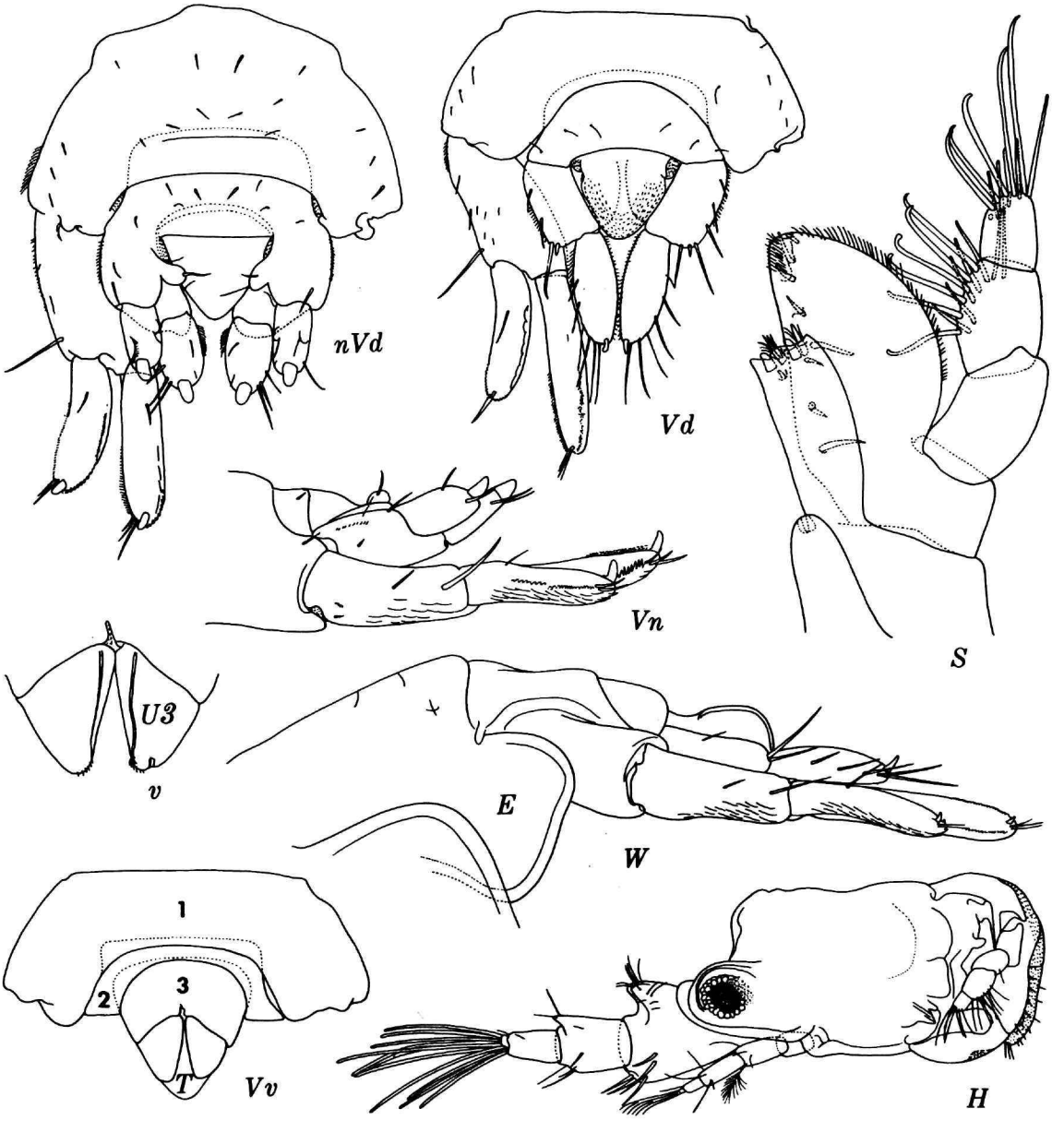


FIGURE 179.—*Palinnotus thomsoni* (Stebbing).

and proximal articles of the pereopods are sparsely covered with shallow pits, each bearing 1 setule, and the cuticle also contains very sparsely scattered, occasionally clustered, tubes, similar to those seen in *Quasimodia* but smaller in dimensions. The drawing of the lower lip (Figure 176*G*) represents an unflattened aspect with the apices of the outer lobes curled toward the observer. Male antenna 1 has not been drawn because it is only slightly stouter than that of the female. Mouthparts of the male correspond almost exactly to those of the female. The dorsolateral side of pleonite 3 in the male is weakly rugose. Since the articulation between uropod 2 and pleonite 5 has not been detected in the male, it is omitted from the dorsal view.

MATERIAL.—Slack-Smith 2 (4).

DISTRIBUTION.—Warm-temperate Australia, littoral.

### *Quasimodia* Sheard

*Quasimodia* Sheard, 1936c:464.

DIAGNOSIS (revised).—Body tall, anterior coxae not definitely splayed, pereonite 1 with large dorsal hump much larger than any hump on pereonites 2-5; rostrum obsolescent; mandible with stylocylindrioid molar; lower lip with inner lobes, if indeed present, forming small single plate; maxilla 1 lacking palp, inner plate foliate, pointed; plates of maxilla 2 separate; palp of maxilliped 4-articulate; gnathopods and pereopods simple; inner ramus of pleopod 3 very short, less than one-third as long as outer ramus, occasionally a vestigial asetose bud, peduncle produced medially; uropods 1-2 each with 2 rami; uropod 3 with 1 ramus.

TYPE-SPECIES.—*Quasimodia womersleyi* Sheard (1936c) (selected by J. L. Barnard, 1969a).

REMARKS.—When I established the family Ceinidae (J. L. Barnard, in press), I was not aware of the remarkable resemblance of *Quasimodia* to *Ceina*, except for the dorsal hump on pereonite 1. *Quasimodia* differs also from certain phliantids in the tallness of the body and the unsplayed coxae, and it bears some rudimentary cuticular pit-craters plus long tubes passing from soft tissue through the cuticle and opening externally. The pits vaguely resemble those in *Ceina*; however, Ceinidae continue to differ from Phliantidae in the relatively free condition of the base of antenna 2, which in the Phliantidae has articles 1 and 2 fully incorporated into the head; and the Ceindae have uropod 3 visible and attached lateral to the telson, whereas, in Phliantidae, uropod 3 is attached ventral to the telson and is hidden from lateral view. Phliantids have anthurial curl-tipped setae on brood lamellae, while marine ceinids have flattened coils in resemblance to the curl of certain egg masses of snails.

An inner plate on maxilla 1 has been found by cutting away maxilla 2 and observing the base of maxilla 1 in situ, then by cutting the proper basal tendons and muscles in order to excise the maxilla in toto. The inner plate is sharply foliate. It projects so far dorsally into the buccal cavity that it lies dorsad to the lower lip, and thus it is easily lost in removing the outer plate, because it is apparently caught and held by the lower lip.

Males of both species of *Quasimodia* found in this study differ from their females in the relatively shorter and thicker urosome, urosomite 1 bearing a tent-shaped lateral ridge on each side and uropods 1 and 2 projecting equally, whereas, in females, uropod 1 far outreaches uropod 2. The peduncle of uropod 2 is thick in the male, antenna 1 is thicker than in the female, with about twice as many terminal aesthetascs. The ramus or uropod 3 is shorter than in the female, articles 4-6 on gnathopods 1-2 and pereopods 1-2 being more elongate, and the telson is smaller.

Mandibular molars apparently have an apical spine, but it is often broken off during dissection. The left view of antenna 1 shown herein (Figures 180, 183) results from twisting the antenna to the left, so that the illustration represents an oblique dorsolateral view.

The anteroventral margins of pereonites 2-4 project anteriorly, and override laterally, the segments in front, in contrast to most other amphipods. Coxa 7 is articulate.

One apparent new species of *Quasimodia* is described below. My interpretation of the taxonomic differences among the four known species, based on my examination of *Q. barnardi*, the new species below, and Sheard's descriptions of the other two species is as follows:

1. Inner ramus of pleopod 3 vestigial, a small bud without setae; inner ramus of uropod 1 less than half as long as outer; ramus of uropod 3 twice as long as peduncle; rami of uropod 2 equal in length; small dorsal humps of pereonite 7 and pleonite 1 projecting evenly..... ..... *Q. womersleyi*
2. Inner ramus of pleopod 3 not vestigial but short and bearing setae; inner ramus of uropod 1 nearly as long as outer; ramus of uropod 3 twice as long as peduncle; inner ramus of uropod 2 perceptibly shorter than outer; small dorsal humps of pereonite 7 and pleonite 1 projecting evenly.....*Q. capricornis*

3. Inner ramus of pleopod 3 not vestigial but short and bearing setae; inner ramus of uropod 1 about half as long as outer; ramus of uropod 3 equal in length to peduncle (but even shorter in male); inner ramus of uropod 2 perceptibly shorter than outer; small dorsal humps of pereonite 7 and pleonite 1 projecting evenly ..... *Q. barnardi*
4. Inner ramus of pleopod 3 not vestigial but short and bearing setae; inner ramus of uropod 1 about half as long as outer; ramus of uropod 3 equal in length to peduncle (but even shorter in male); inner ramus of uropod 2 about two-thirds as long as outer; very large dorsal hump of pereonite 7 far outreaching small hump of pleonite 1..... *Q. enna*, new species

## *Quasimodia barnardi* Sheard

FIGURES 180–182

*Quasimodia barnardi* Sheard, 1936c:468, figs. 5*a-j*, 6*a-d*.

DIAGNOSIS.—Inner ramus of pleopod 3 not vestigial but short and bearing setae; inner ramus of uropod 1 about half as long as outer; ramus of uropod 3 equal in length to peduncle (but even shorter than peduncle in male); inner ramus of uropod 2 perceptibly shorter than outer; pereonite 7 and pleonite 1 with very low humps projecting equally, hump on pereonite 7 with cyphos index (see Bowman and McCain, 1967), of about 27, of pleonite 1 about 62.

MATERIAL.—JLB Australia 5 (female, 4.0 mm), 6 (male, 3.4 mm), 14 (male, 3.0 mm); Slack-Smith 2 (4 specimens, 2.2-3.9 mm); Shepherd 4 (male, 4.0 mm; female, 5.6 mm).

DISTRIBUTION.—Warm temperate Australia, littoral and sublittoral.

## *Quasimodia enna*, new species

FIGURES 183–186

DIAGNOSIS.—Inner ramus of pleopod 3 not vestigial but short and bearing setae; inner ramus of uropod 1 about half as long as outer; ramus of uropod 3 equal in length to peduncle (but even shorter than peduncle in male); inner ramus of uropod 2 about two-thirds as long as outer; very large dorsal hump of pereonite 7 far outreaching small hump of pleonite 1, with a cyphos index (see Bowman and McCain, 1967) varying between 38 and 64, cyphos index of pleonite 1 approximately 16 to 22, but ratio of height between pereonite 7 and pleonite 1 even more distinct than in cyphos index, varying between 3:1 and 8:1; cyphos index of hump on pereonite 1 varying between 86 and 120; pereopods very stout as in *Q. barnardi*.

DESCRIPTION.—The drawings provide most of the description; drawings or enlargements for the following parts have not been made because they are so similar to those figured for *Q. barnardi*: antenna 2, maxillae 1-2, maxilliped, upper lip, and the setae of pleopods and dactyls of pereopods. Both this species and *Q. barnardi* have a facial seta on the dactyls of gnathopods 1-2 and pereopods 1-5; inner plate of maxilla 1 with 4 simple spines and 1 fuzzy spine in female, 7 simple and 2 fuzzy spines in male; maxillipedal palp article 3 with 4 apical setae; inner ramus of female uropod 3 with 2 apical setae, in male with 1 (this is probably not a sexual difference but a growth stage or aberrancy); mandibular molars probably all with 1 thin apical spine (but often broken off); setae on outer plate of male maxilliped much shorter than in female; pereopods 3-5 of male slightly stouter than in female.

MAJOR DISTINCTIONS OF MALE.—Processes of antenna 1 slightly better developed, aesthetascs much more numerous (perhaps twice as abundant); fifth articles of gnathopods with longer and flatter posterior margins; articles 4-6 of pereopods 1-2 relatively more elongate than in female; pleopods proportionally more slender; uropod 1 not exceeding uropod 2, peduncle of uropod 2 stout; uropod 3 with ramus distinctly shorter than peduncle; pleonite 4 with a tent-shaped lateral ridge and dorsocentral tent-shaped hump; urosome relatively smaller than in female, and telson relative to urosome even smaller again. Humps on pereonites 1 and 7 of male much smaller than in female, body of male less bulky than in female, but length of male generally similar. Since only two specimens of this species are known, sexual differences and general variability cannot be firmly stated.

HOLOTYPE.—SAM, female, 4.1 mm.

TYPE-LOCALITY.—Shepherd 52, Pearson Islands, South Australia, station B, 60-80 feet, in algae, 8 January 1969.

REMARKS.—This species looks so different from *Q. barnardi* Sheard in gross view that there is little difficulty in distinguishing the two, but apart from various quantitative characters and subtly different shapes, the microscopic morphology of the two is highly similar. Only the largeness of the humps of pereonite 1—but

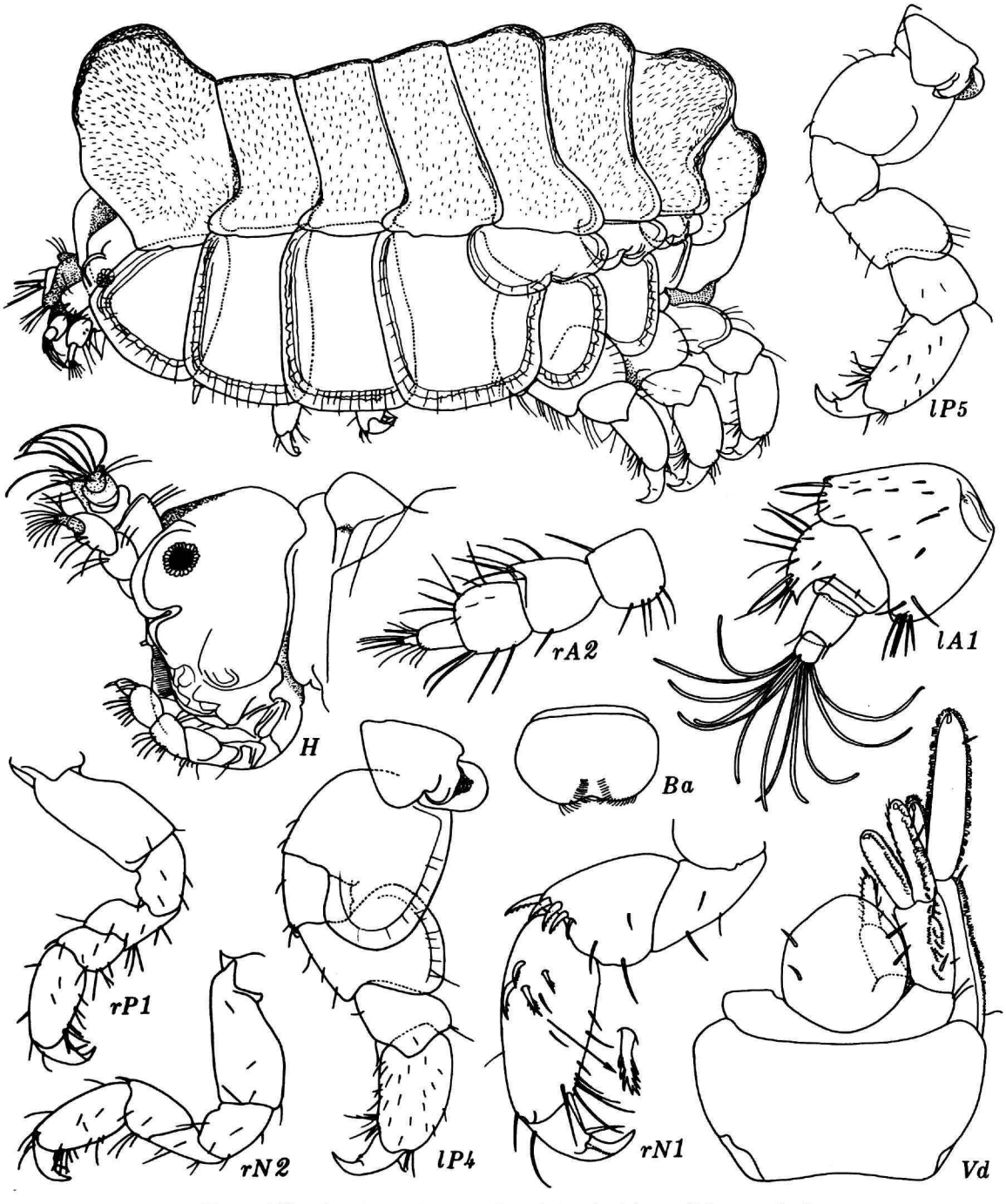


FIGURE 180.—*Quasimodia barnardi* Sheard, female, 4.0 mm, JLB Australia 5.

especially pereonite 7—are grossly diagnostic, although one other microscopic difference is the very large size of the blunt comb teeth on the outer ramus of uropod 1 in *Q. barnardi* and their extraordinary smallness in *Q. enna*. Other differences in proportions and meristic characters can be seen in comparing the drawings given here, but one must remember that only two specimens of the new species and less than a dozen

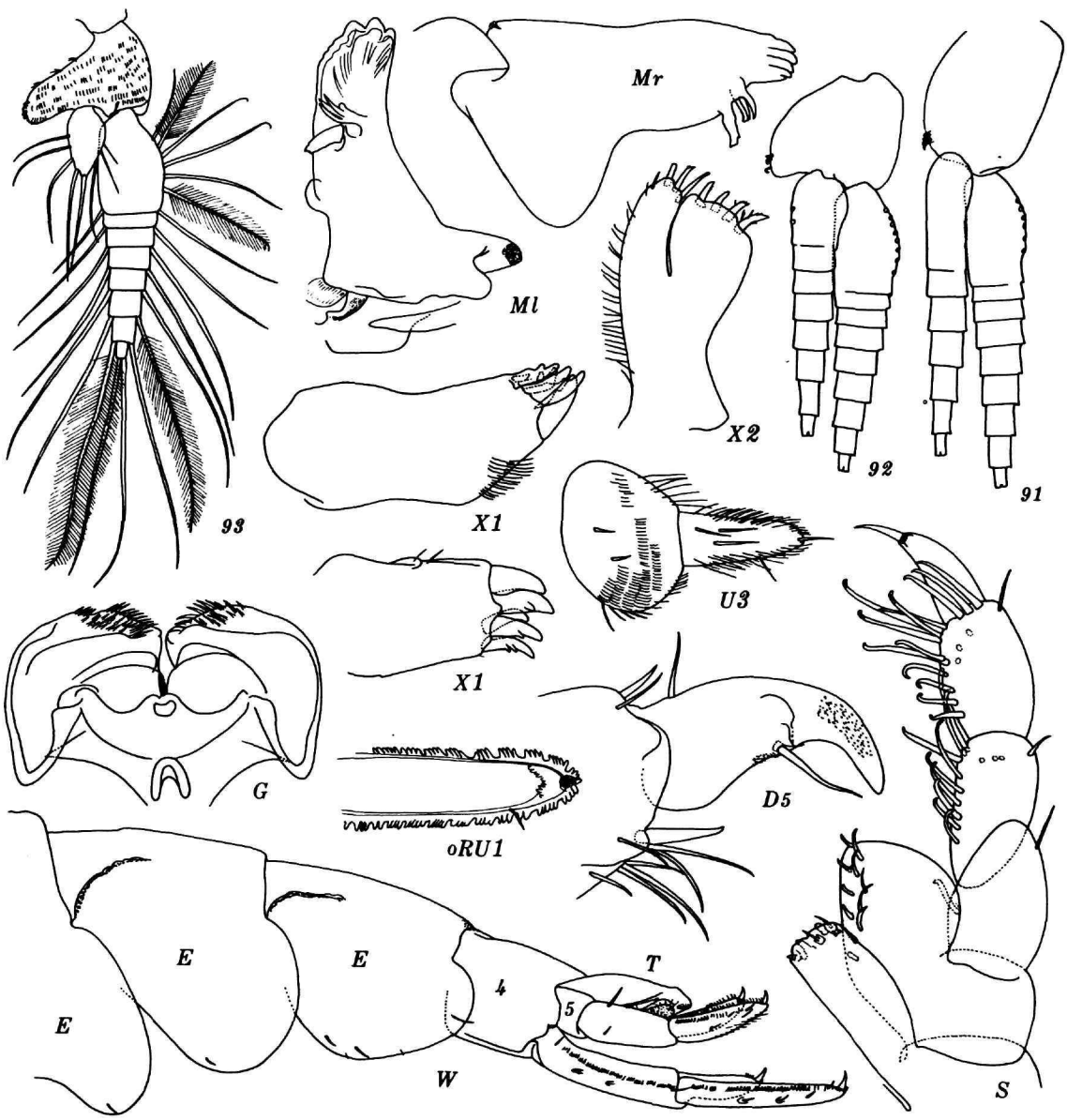


FIGURE 181.—*Quasimodia barnardi* Sheard, female, 4.0 mm, JLB Australia 5.

of *Q. barnardi* have been compared. One hatched juvenile of *Q. barnardi* is available; it has the eophliantid appearance noted by J. L. Barnard (1970a) for *Palinnotus alaniphlias* juveniles, but no stages between hatched juveniles and mature adults have been studied in *Quasimodia* (nor have I seen any in these collections; all specimens appear to be mature adults). Thus, the variability of characters is poorly known.

MATERIAL.—The holotype and a male, 4.3 mm.

DISTRIBUTION.—South Australia, sublittoral.

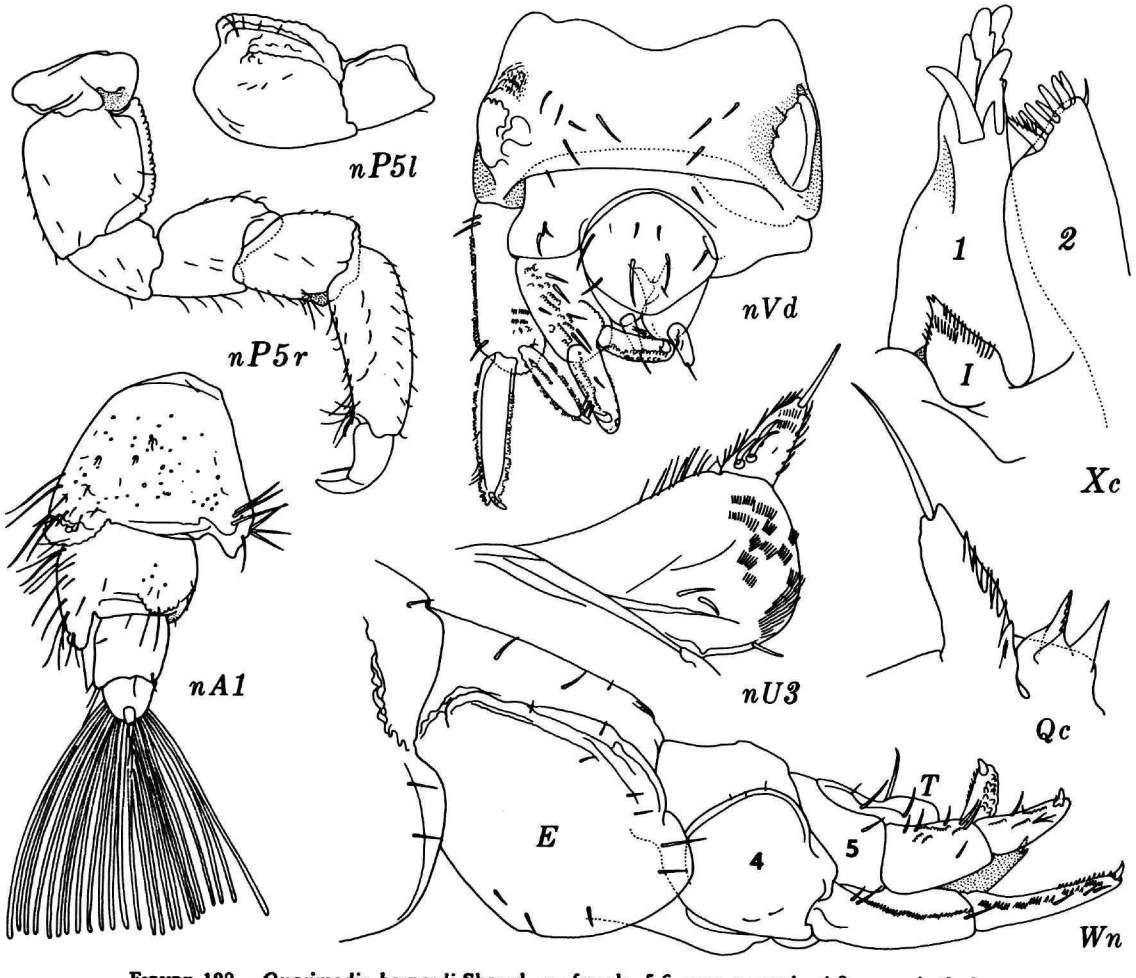


FIGURE 182.—*Quasimodia barnardi* Sheard, *c*=female, 5.6 mm; *n*=male, 4.0 mm; both from Shepherd 4.

## STEGOCEPHALIDAE

### *Andaniotes* Stebbing

*Andaniotes* Stebbing, 1897:30–31; 1906:96.

One further character might be added to the diagnosis of this genus: the coalescence of urosomites 2-3. The character is present at least on the new Australian species that follows, and, because that species has a superficial line running from the peduncular base of uropod 2 dorsoanteriorly like *A. corpulentus* (Thom-

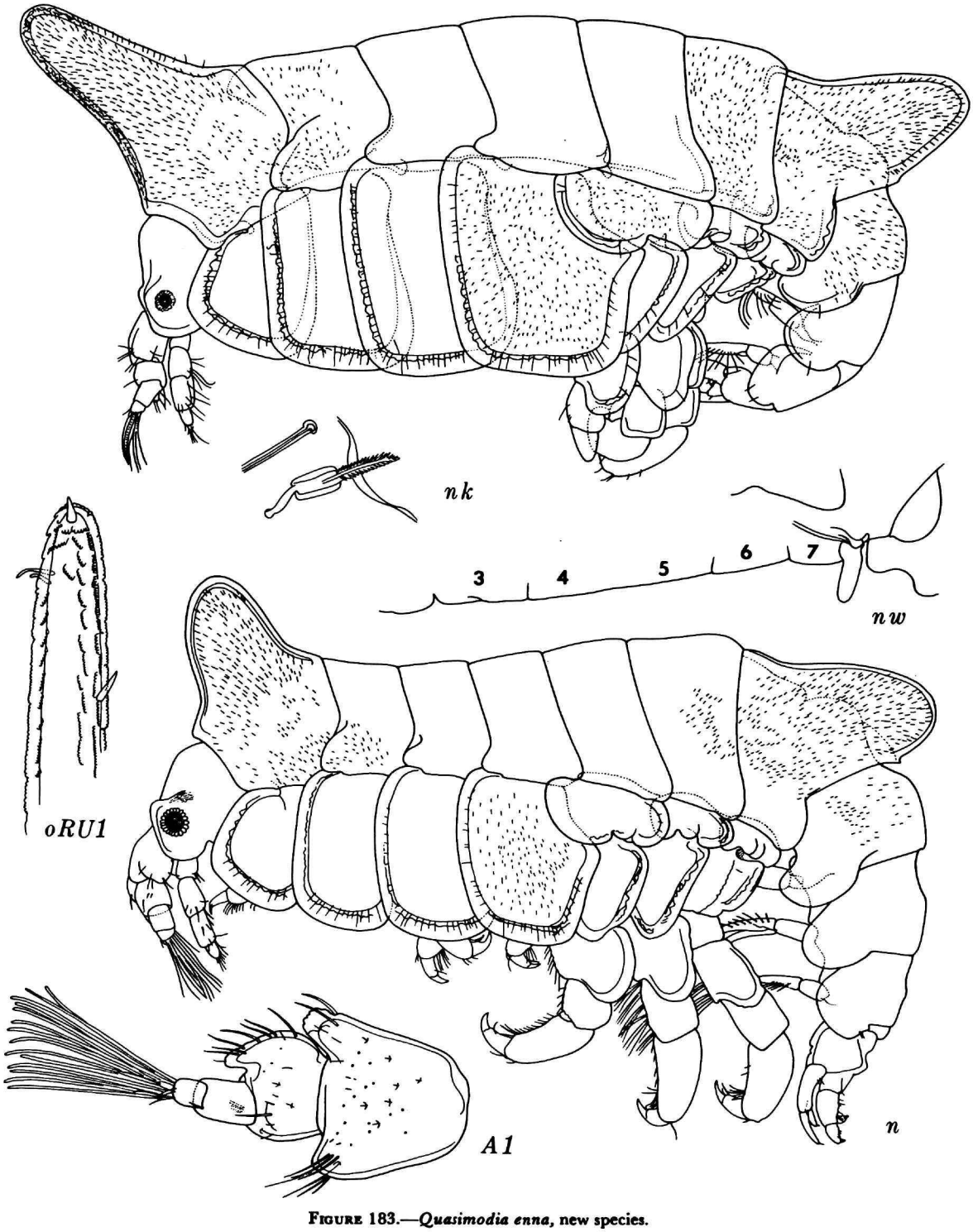


FIGURE 183.—*Quasimodia enna*, new species.

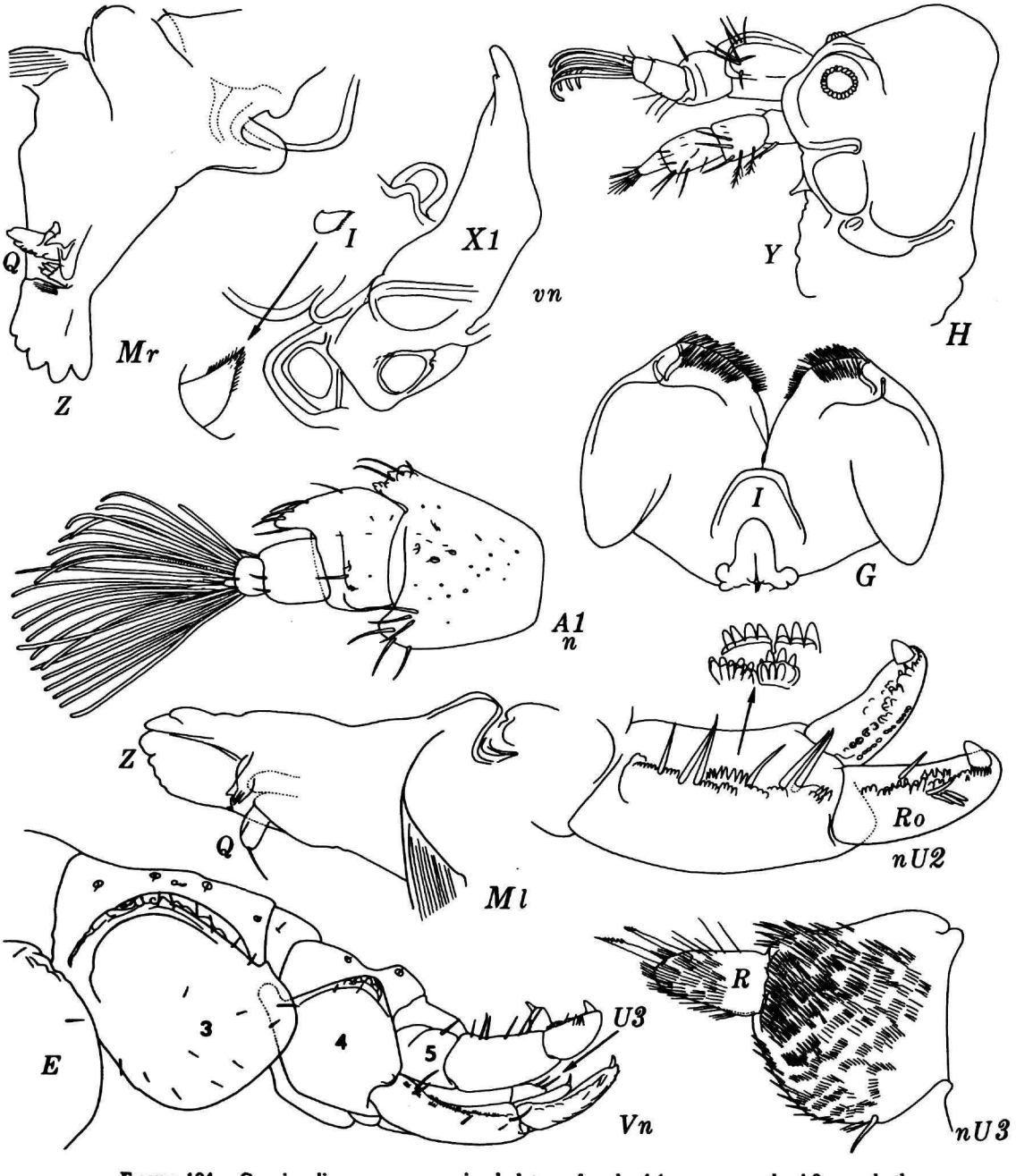


FIGURE 184.—*Quasimodia enna*, new species, holotype, female, 4.1 mm; *n*=male, 4.3 mm; both from Shepherd 52. (*k*=cuticle of pereon; *v*=mouthpart field; *w*=pereon.)

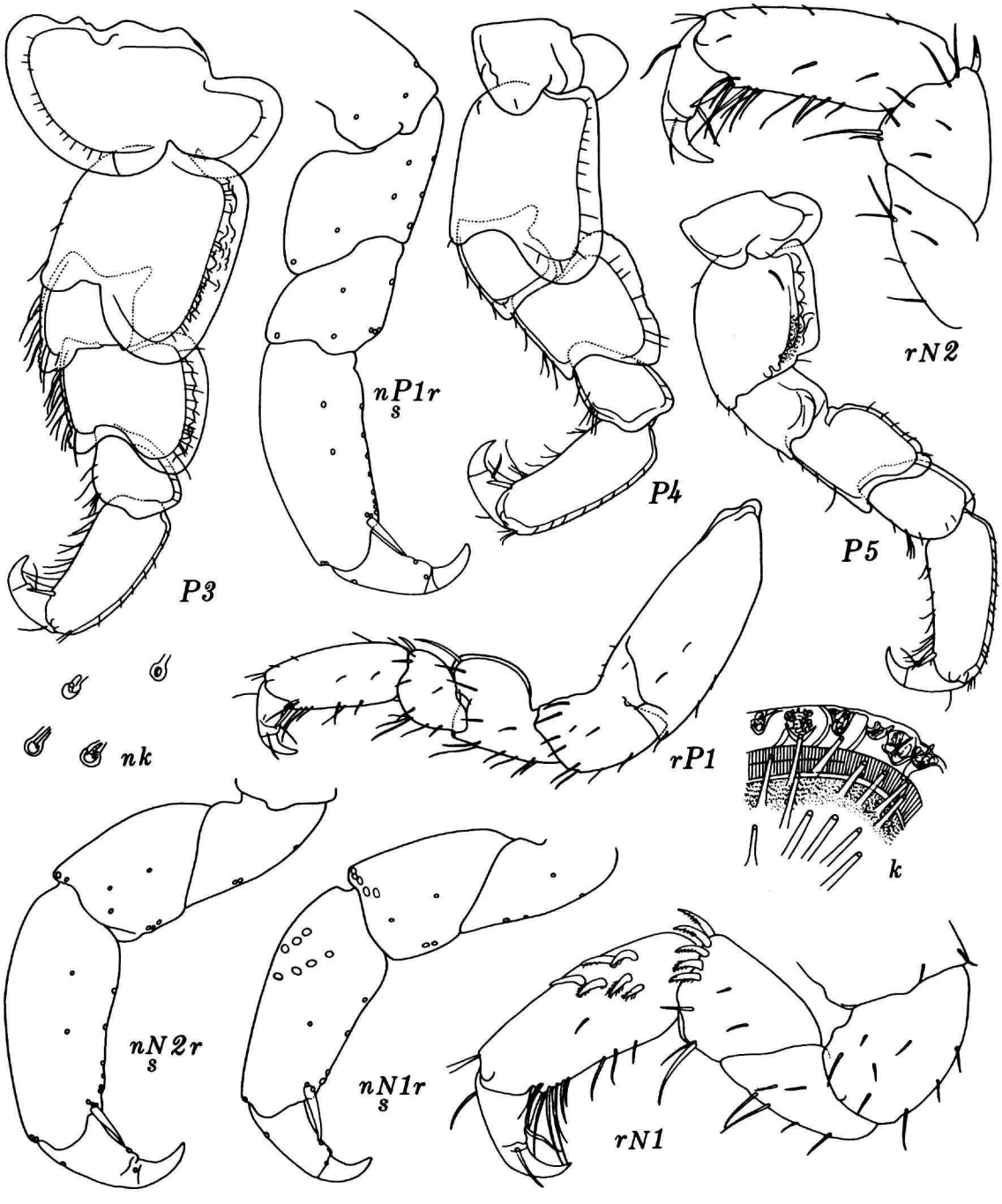


FIGURE 185.—*Quasimodia enna*, new species.

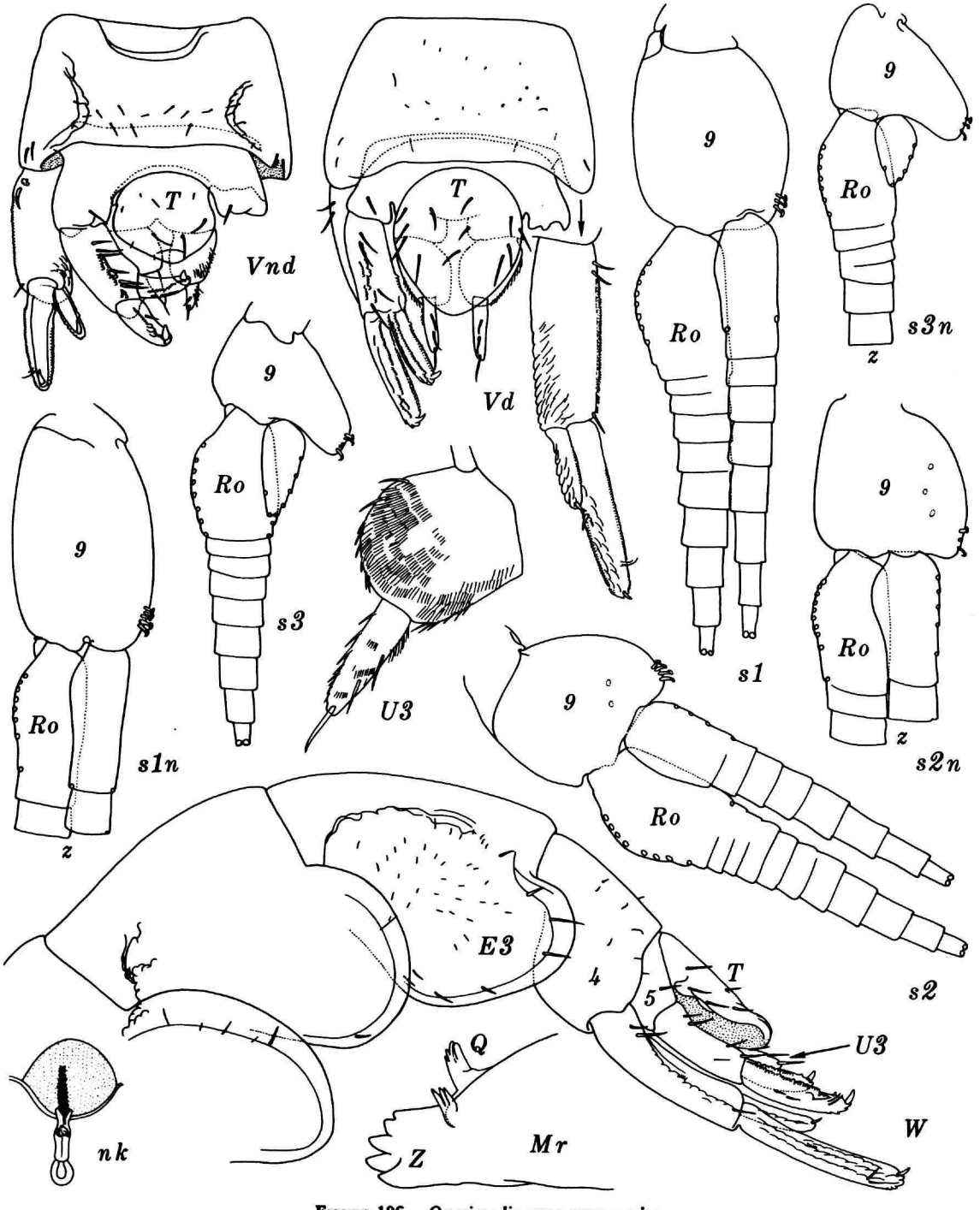


FIGURE 186.—*Quasimodia enna*, new species.

son), the type-species as figured by Stebbing (1888, 1897), one might presume the urosomites also are coalesced in the type-species. The line is simply a weak ridge forming a shadow.

## Key to Species of *Andaniotes*

1. Maxilliped with 3 articles on palp..... ***A. simplex*** K. H. Barnard (1930), New Zealand
   Maxilliped with 4 articles on palp ..... 2
2. Article 2 of pereopod 4 rectolinear and less than half as broad as article 2 on pereopod 5 ..... 3
   Article 2 of pereopod 4 ovatorectangular and about 90 percent as broad as article 2 on pereopod 5..... 4
3. Article 2 of pereopod 4 twice as wide as article 3, palp of maxilla 1 reaching end of outer plate..... ***A. linearis*** K. H. Barnard (1932), South Georgia
   Article 2 of pereopod 3 about 1.3 times as wide as article 3, palp of maxilla 1 shortened to half the length of distance between its base and apex of outer plate. ***A. ingens*** Chevreux (1906), Port Charcot, Antarctica
4. Article 4 of pereopods 4-5 extending as lobe greatly exceeding apex of article 5, article 2 of pereopod 5 ventrally truncate..... ***A. wallaroo,*** new species, Australia
   Article 4 of pereopod 5 with posterior lobe reaching or failing apex of article 5, on pereopod 4 scarcely reaching halfway along article 5, article 2 of pereopod 5 ventrally rounded... ***A. corpulentus*** (Thomson, 1882) (=*abyssorum* Stebbing, 1888) New Zealand

### *Andaniotes wallaroo,* new species

FIGURES 187–188

*?Andaniotes corpulentus.*—Stebbing 1910a:575 [not Thomson].

NOMENCLATURE.—The only Australian specimens of this genus heretofore recorded, from off Wata Mooli in 54-59 fathoms, may belong with this new species, which is clearly distinct from the New Zealand *A. corpulentus.*

DIAGNOSIS (of female).—Head 1.3 times as long as pereonite 2; article 1 of primary flagellum less than half as long as peduncle of antenna 1; mandibles twice as long as broad; palp of maxilla 1 slender, just failing to reach end of outer plate, all spines apical; outer plate of maxilliped reaching about three-fourths along palp article 2, outer plate subcircular, very stout, article 2 of palp nearly 1.5 times as long as article 1, article 3 shorter than 1 and article 4 shorter than 3; coxa 1 with acute apical angle; coxa 4 with ventral margin distinct from posterior margin and extending for at least half of coxal breadth, posterior margin parallel to anterior, then sweeping dorsally to broad lobe followed by shallow sinus; hand of gnathopod 1 about 47 percent as broad as long, bearing large apical spine; weak palm of gnathopod 2 bearing 5 large falcatoserrate spines; article 2 of pereopod 3 linear, of pereopod 4 broadly expanded and ovatorectangular, of pereopod 5 broadly expanded and rectangular, with horizontal distal margin; article 4 of pereopods 3-5 decurrent, with long posterior lobe strongly exceeding apex of article 5 on pereopods 4-5, reaching more than halfway along article 5 of pereopod 3; coalesced urosomites 2-3 with weak dorsal keel anteriorly; outer ramus of uropod 3 uniarticulate.

DESCRIPTION.—Accessory flagellum 2-articulate, article 2 minute, articles 4-5 of peduncle on antenna 2 with lateral setulose ridge; pereopods 1-5 with apical notch on article 6 at base of dactyl and weak distal slit on dactyl; pereopod 2 with bundles of setae on articles 2 and 3 but setae absent on pereopod 1; coxa 4 locked under pellucid anterior lobes of coxa 5; pleonal epimera 2-3 with softly rounded weak posteroventral cusp, epimeron 1 rounded posteroventrally but from lateral body view appearing quadrate.

HOLOTYPE.—NMV, female, 7.3 mm.

TYPE-LOCALITY.—Port Phillip 30, area 58, Queenscliff Point, Lonsdale, 35-40 feet, 2 April 1959.

RELATIONSHIP.—The female of this species differs from the female of *A. corpulentus* (Thomson) (=*A. abyssorum* (Stebbing, 1888), in the shorter article 1 of the primary flagellum on antenna 1, the narrower

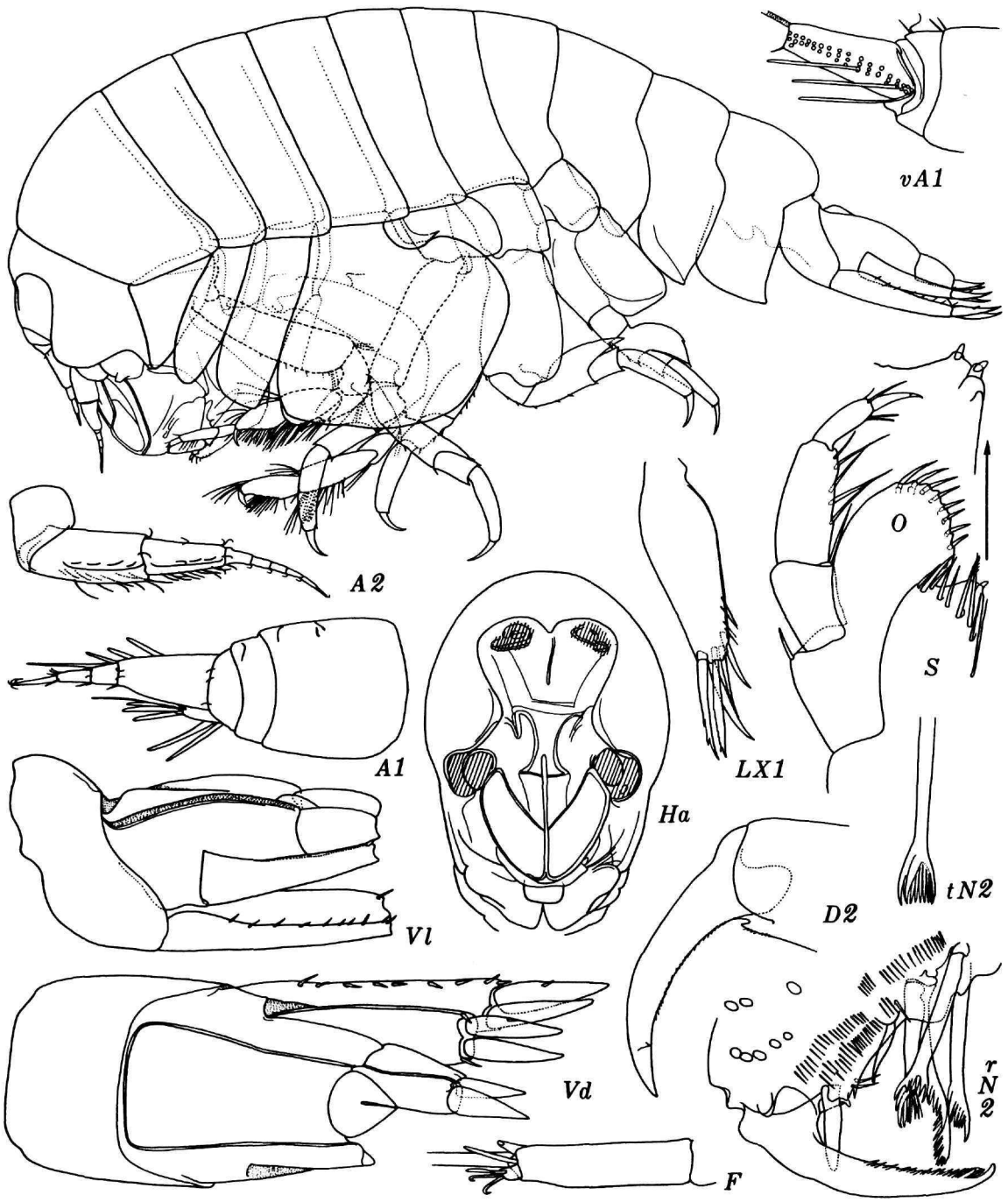


FIGURE 187.—*Andaniotes wallaroo*, new species, holotype, female, 7.3 mm; *c*=female, 6.4 mm; both from Port Phillip 30.

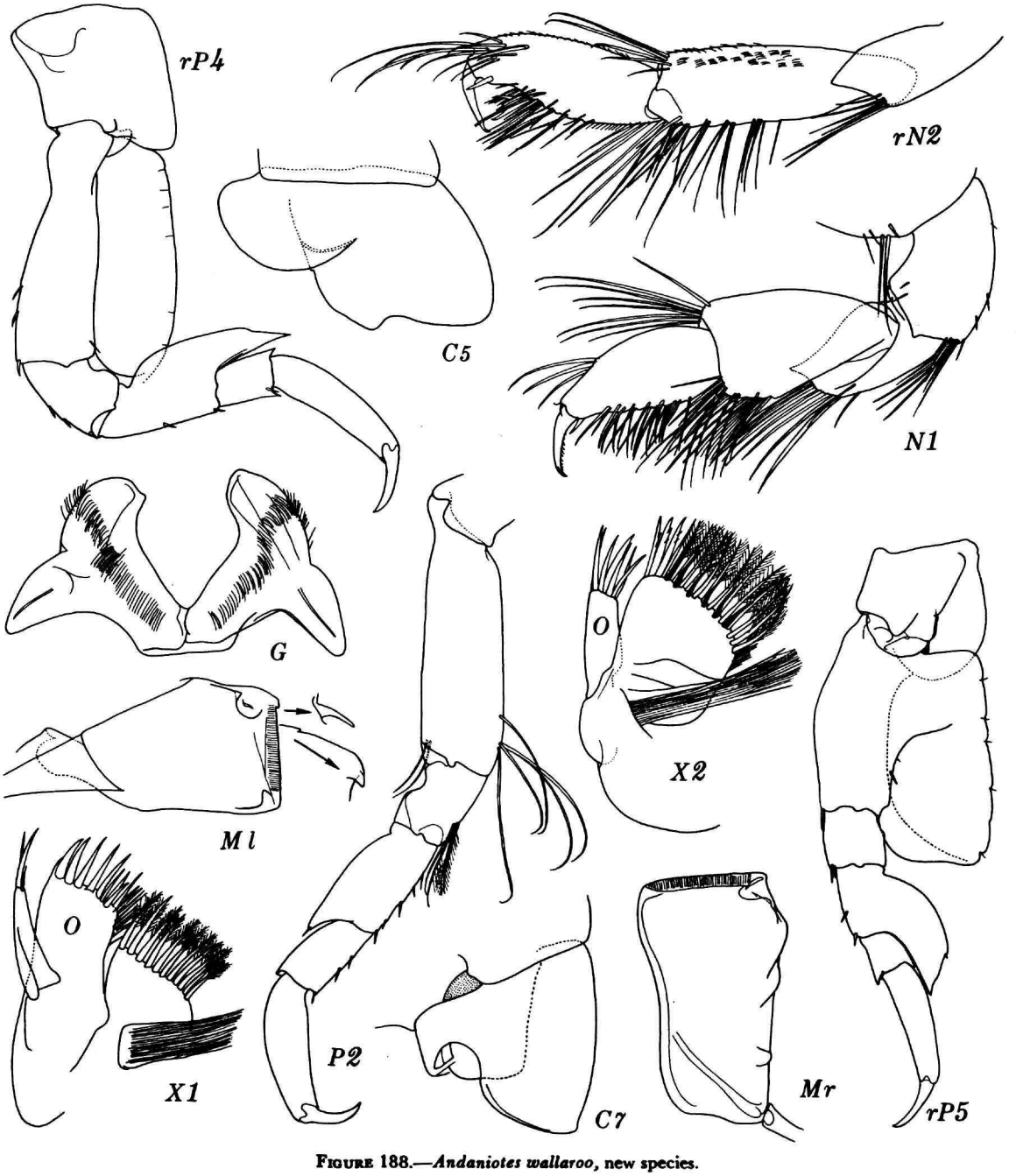


FIGURE 188.—*Andaniotes wallaroo*, new species.

and slightly shorter palp of maxilla 1, the shorter palp and broader outer plate of the maxilliped, the shortened article 1 of the maxillipedal palp, the more strongly distinct ventral and posterior margins of coxa 4, the much longer posterior lobes of article 4 on pereopods 4-5, the ventrally truncate article 2 of pereopod 5, the broader rami of the uropods, and the 1-articulate outer ramus of uropod 3.

The male of *A. corpulentus*, figured by Stebbing (1897), has more distinct ventral and posterior margins of coxa 4 than the female figured by Stebbing (1888), and the male uropod 3 has the rami extremely shortened, the inner more than the outer, and on uropod 1 the inner ramus is relatively much thinner than the thickened outer ramus.

The lobe on article 4 of pereopod 5 is shortened in the male of *A. corpulentus*, and the posterior margin of article 2 on pereopod 4 is weakly excavate.

Males of the Australian new species are not available for comparisons.

MATERIAL.—Four specimens from the type-locality.

DISTRIBUTION.—Port Phillip, Victoria.

## STENOTHOIDAE

### THAUMATELSONINAE

The Thaumatelsonidae were reduced to subfamilial status by J. L. Barnard (in press), who pointed out the inconsistencies in urosomal and telsonic modifications as marks of a family. I retain the subfamily here only as a title to circumscribe a group of stenothoids with an enlarged telson, or a carpochelate gnathopod 2, or a dorsally enlarged pleonite 4, or a small but fleshy telson. Because the genera *Pseudothaumatelson* and *Parathaumatelson* form reasonably perfect intergrades between ordinary stenothoids and *Thaumatelson*, the subfamily should be dismissed entirely. The first two genera have a rudimentarily fleshy telson. *Raumahara* further connects stenothoids with *Prothaumatelson* by maintaining a nearly normal telson but by having developed the carpochelate gnathopod 2. Thamatelsonins, hence, have at least two separate lines of descent, with the parallel evolution of a highly modified telson.

The three thaumatelsonin genera (*Thaumatelson*, *Prothaumatelson*, and *Pseudothaumatelson*) listed by J. L. Barnard (1958) should be expanded to eight genera. *Parathaumatelson* Gurjanova has been revived by Barnard (in press). Four new genera are described below, one based on *Thaumatelson walkeri* Chilton (1912) and the other three on new species from Australia. The following two keys show the relationships of the genera from two points of view, and all of the genera are diagnosed in revision.

### Key to Genera of Thaumatelsoninae

1. **Telson flat, thin; pleonite 4 simple, gnathopod 2 subchelate** ..... **other Stenothoidae**
   **Telson fleshy, slightly thickened, often immensely compressed and elevated, or pleonite 4 with dorsal extension and thickening, or gnathopod 2 carpochelate.**
   **Thaumatelsoninae, Keys A or B**

#### KEY A

1. **Telson small from lateral view, much smaller than lateral surface area of pleonite 4 (or all of urosome)** ..... **2**
   **Telson huge from lateral view, with equal lateral surface area to lateral area of pleonite 4 (and all of urosome)** ..... **4**
2. **Gnathopod 2 chelate, antenna 1 lacking nasiform process, pleonite 4 without dorsal process** ..... ***Raumahara***
   **Gnathopod 2 subchelate, antenna 1 with nasiform process, pleonite 4 with weak-to-strong dorsal process, thickening or posterior extension** ..... **3**
3. **Mandibular palp absent, accessory flagellum absent, gnathopods 1-2 similar to each other in shape and size** ..... ***Parathaumatelson***
   **Mandibular palp 1-articulate, accessory flagellum present (very minute), gnathopods 1-2 highly dissimilar to each other in size and shape** ..... ***Pseudothaumatelson***
4. **Antenna 1 without nasiform process on article 1** ..... **5**
   **Antenna 1 with nasiform process on article 1** ..... **6**

5. Palm of gnathopod 2 subtransverse, mandible with 3-articulate palp, article 2 of antenna 1 with small nasiform process, inner plate of maxilla 2 forming lobe ..... ***Thaumatelson***
   Palm of gnathopod 2 fully oblique, mandible without palp, article 2 of antenna 1 simple, inner plate of maxilla 2 unproduced ..... ***Goratelson***
6. Gnathopod 2 chelate ..... ***Prothaumatelson***
   Gnathopod 2 subchelate ..... 7
7. Palm of gnathopod 2 transverse, mandibular palp 3-articulate, accessory flagellum present, pleonite 3 with dorsal process ..... ***Antatelson***, new genus
   Palm of gnathopod 2 oblique, mandibular palp 1-articulate, accessory flagellum absent, pleonite 3 dorsally tumid but lacking process ..... ***Ausatelson***, new genus

KEY B

1. Gnathopod 2 chelate ..... 2
   Gnathopod 2 subchelate ..... 3
2. Antenna 1 with nasiform process, telson huge ..... ***Prothaumatelson***
   Antenna 1 without nasiform process, telson small ..... ***Raumahara***
3. Antenna 1 without nasiform process ..... Key A, couplet 5
   Antenna 1 with nasiform process on article 1 ..... 4
4. Telson small ..... Key A, couplet 3
   Telson huge ..... Key A, couplet 7

## *Thaumatelson* Walker

*Thaumatelson* Walker, 1906:15; 1907:21.

DIAGNOSIS. — Gnathopods 1-2 subchelate, differing from each other in size and shape, palm of gnathopod 2 nearly transverse, gnathopod 1 with oblique well-defined palm scarcely longer than posterior margin of hand; mandible with 3-articulate palp; palp of maxilla 1 biarticulate; antenna 1 bearing weak nasiform process on article 2 but none on article 1; pereopods 3-5 with rectolinear article 2; pereonite 4 weakly elongate; pleonites 5-6 apparently coalesced basally, telson huge, vertically elevated and laterally compressed, fleshy, lateral surface area subequal to lateral area of pleonite 4; pleonite 4 with weak dorsal tooth overhanging telson, pleonite 3 dorsally normal.

TYPE-SPECIES. — *Thaumatelson herdmani* Walker (1907). Unique.

## *Prothaumatelson* Schellenberg

*Prothaumatelson* Schellenberg, 1931:113.

DIAGNOSIS. — Gnathopod 2 carpochelate; gnathopod 1 with nearly transverse palm slightly shorter than posterior margin of hand; mandible with 1-articulate palp; palp of maxilla 1 biarticulate; antenna 1 bearing strong nasiform process on article 1; pereopods 3-5 with rectolinear article 2; pereonite 4 moderately elongate; pleonites 5-6 possibly coalesced basally, telson huge, vertically elevated and laterally compressed, fleshy, lateral surface area equal to lateral area of pleonite 4, latter apparently without dorsal extension, pleonite 3 dorsally normal.

TYPE-SPECIES. — *Thaumatelson nasutum* Chevreux (1912). Unique.

## *Parathaumatelson* Gurjanova

*Parathaumatelson* Gurjanova, 1938:276.

DIAGNOSIS. — Gnathopods 1-2 subchelate, similar to each other in size and shape, palms oblique but shorter than posterior margins of hands; mandible lacking palp; palp of maxilla 1 biarticulate; antenna 1 bearing strong nasiform process on article 1, pereopods 3-5 with rectolinear article 2; pereonite 4 elongate; pleonites 5-6 coalesced basally, telson small, horozontally arranged, fleshy, much smaller than pleonite 4, latter with dorsal enlargement and weak lobe overhanging telson, pleonite 3 dorsally normal.

TYPE-SPECIES.—*Metopella nasica* Stephensen (1927). Unique.

## *Pseudothaumatelson* Schellenberg

*Pseudothaumatelson* Schellenberg, 1931:110.

DIAGNOSIS — Gnathopods 1-2 subchelate, differing from each other in size and shape, palms of gnathopods oblique, shorter than posterior margins of hands; gnathopod 2 rudimentarily carpochelate; mandible

with 1-articulate palp; palp of maxilla 1 biarticulate; antenna 1 bearing nasiform process on article 1; pereopods 3-5 with rectolinear article 2; pereonite 4 unknown; pleonites 5-6 apparently free; telson medium, horizontally arranged but fleshy, much smaller than pleonite 4, latter with dorsal enlargement and strong lobe overhanging telson, pleonite 3 dorsally with small posterior tooth.

TYPE-SPECIES. — *Pseudothaumatelson patagonicum* Schellenberg (1931).

POSSIBLY INCLUDED. — *Pseudothaumatelson cyproides* Nicholls (1938). The telson of this species is poorly known.

### *Antatelson*, new genus

DIAGNOSIS—Gnathopods 1-2 subchelate, scarcely different from each other in size and shape, palm of gnathopod 2 transverse, palm of gnathopod 1 scarcely oblique and shorter than posterior margin of hand; mandible with 3-articulate palp; palp of maxilla 1 biarticulate; antenna 1 bearing nasiform process on article 1; pereopods 3-5 with rectolinear article 2; pereonite 4 elongate; pleonites 4-6 apparently coalesced; telson huge, vertically elevated and laterally compressed, fleshy, lateral surface area equal to lateral area of urosome; pleonite 3 with erect dorsal process.

TYPE-SPECIES. — *Thaumatelson walkeri* Chilton (1912).

INCLUDED.—*Thaumatelson cultricauda* K. H. Barnard (1932). Many details of this species, such as the mandibular and maxillary palps, are poorly known.

### *Ausatelson*, new genus

DIAGNOSIS.—Gnathopods 1-2 subchelate, gnathopod 2 much larger than gnathopod 1, with enlarged hand bearing oblique palm equal to posterior margin of hand, gnathopod 1 with oblique, ill-defined palm longer than posterior margin of hand; mandible with 1-articulate palp; palp of maxilla 1 biarticulate; antenna 1 bearing nasiform process on article 1; pereopods 3-5 with rectolinear article 2; pereonite 4 highly elongate and tumid; pleonites 5-6 proximally coalesced; telson huge, vertically elevated and laterally compressed, fleshy, lateral surface area subequal to lateral surface area of pleonite 4; pleonite 3 dorsally tumid but lacking process, pleonite 4 weakly extended posterodorsally.

TYPE-SPECIES.—*Ausatelson ule*, new species.

RELATIONSHIP.—In all significant characters but gnathopod 2, this genus has a resemblance to *Prothaumatelson* Schellenberg (1931) (type-species: *Thaumatelson nasutum* Chevreux, 1912), but *Prothaumatelson* has a grossly carpochelate gnathopod 2. *Ausatelson* also resembles *Thaumatelson* except that *Thaumatelson* does not have a nasiform process on antenna 1. *Thaumatelson* does not have a carpochelate gnathopod 2, but the palm is transverse, not oblique as in *Ausatelson*.

*Ausatelson* appears closest to *Antatelson*, new genus, but differs from it in the oblique palm of gnathopod 2, the 1-articulate mandibular palp, and the absence of a dorsal process on pleonite 3.

### *Ausatelson ule*, new species

FIGURES 189–190

DESCRIPTION.—Pereonite 4 greatly elongate and bulging dorsally; pereonite 5 with lateral ridge locking posterodorsal margin of coxa 4; rostrum of medium size; eyes red in formaldehyde, colorless in alcohol; anterolateral corner of head quadrate; article 1 of antenna 1 with large anterodistal process, articles 2-3 subequal to each other in length, accessory flagellum absent; antenna 2 with article 3 curving medially around front of head, article 5 longer than 4; epistome unproduced, upper lip bilobate slightly asymmetrically; mandible bearing 1-articulate palp (both sides) with 2 apical setae, left lacinia mobilis deeply serrate, right smooth and minutely tuberculate; lower lip with 1 cone on each main lobe, mandibular process obsolescent; palp of maxilla 1 biarticulate, outer plate with 6 spines, inner with 1 long seta; maxilla 2 very small, inner lobe very short (Figure 190*X2*); inner plates of maxilliped with 2 spines and with or without 1 long seta, palp article 4 without distinct distal nail but apex extremely sharp; coxa 4 with deep lateral pit, invagination pushing inward toward dorsal margin; pereopod 2 much smaller than pereopod 1; gnathopod 1 with palm very oblique, defined by 2-3 stout spines in tandem, dactyl smooth; palm of gnathopod 2 weakly oblique but well defined by slight hump and 2 spines, palm minutely denticulate, dactyl smooth; article 2 of pereopods 3-5 rectolinear, dactyls of all pereopods with apical hook and comb row of pectinations; pleonal epimera 1-2 with softly quadrate posteroventral corners; pleonite 3 weakly inflated dor-

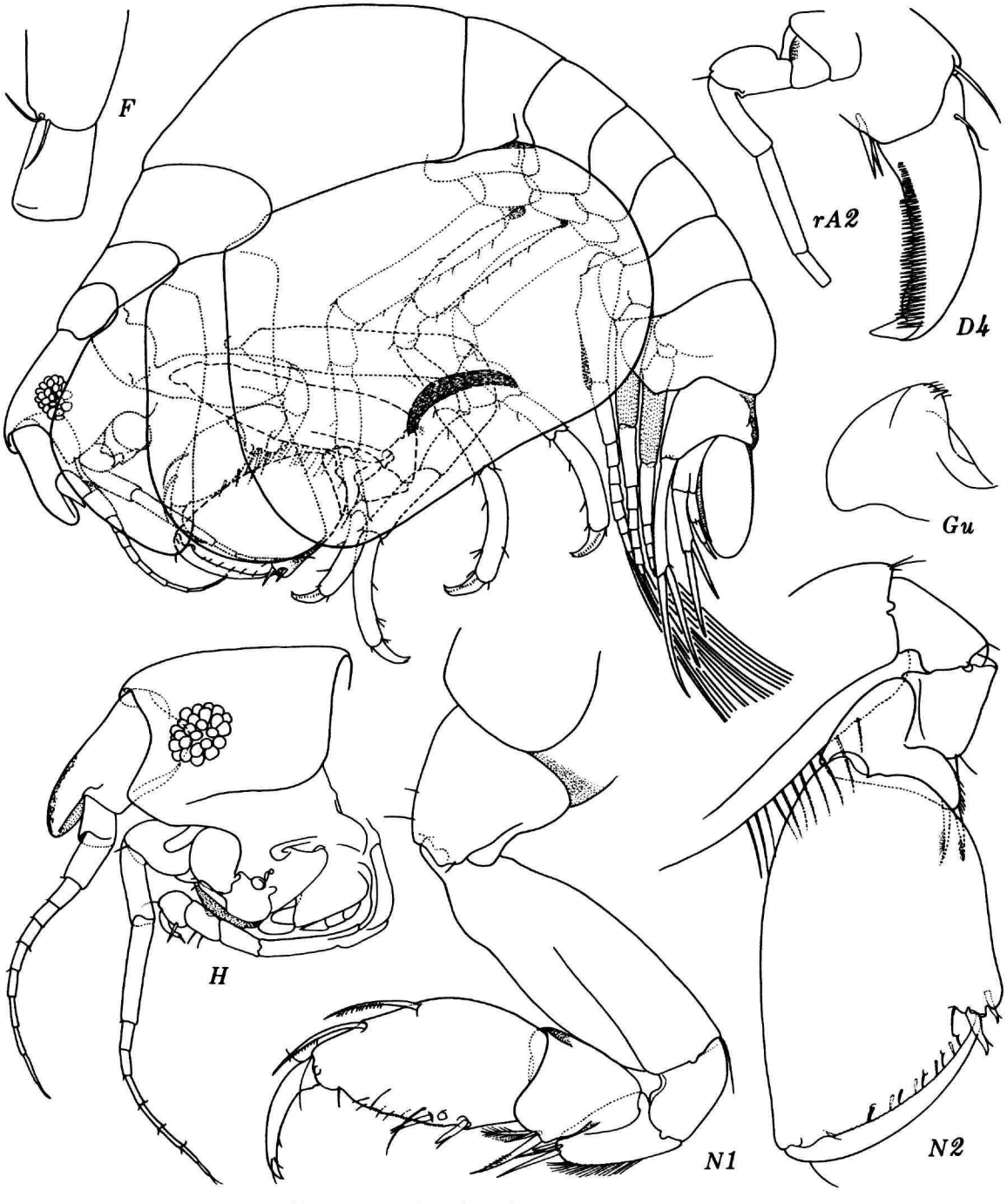


FIGURE 189.—*Ausatelson ule*, new genus, new species.

sally, pleonite 4 with 1 lateral ridge on each side and slight dorsal depression between ridges, pleonites 5 and 6 small and not distinctly separate from each other except distally; telson huge, vertically compressed, lateral surface area subequal to lateral surface area of pleonite 4; uropods 1-3 very slender and elongate, uropod 3 uniramous, ramus biarticulate, article 2 slightly shorter than article 1; body and major coxae covered with small craters and occasional setule, pits and rugosities especially gross on dorsal margins of pleonite 4 and telson.

HOLOTYPE.—WAM, female, 2.2 mm.

TYPE-LOCALITY.—JLB Australia 5, west of Bunker Bay, Cape Naturaliste, Western Australia, intertidal, wash of algae and rocks, 2 September 1968.

RELATIONSHIP.—This species differs from *Pseudothaumatelson cyproides* Nicholls (1938) in the absence of a dorsal process on pleonite 4, the enlarged hand of gnathopod 2, and the larger telson.

MATERIAL.—The holotype; Shepherd 52 (1).

DISTRIBUTION.—Southwestern and South Australia, intertidal.

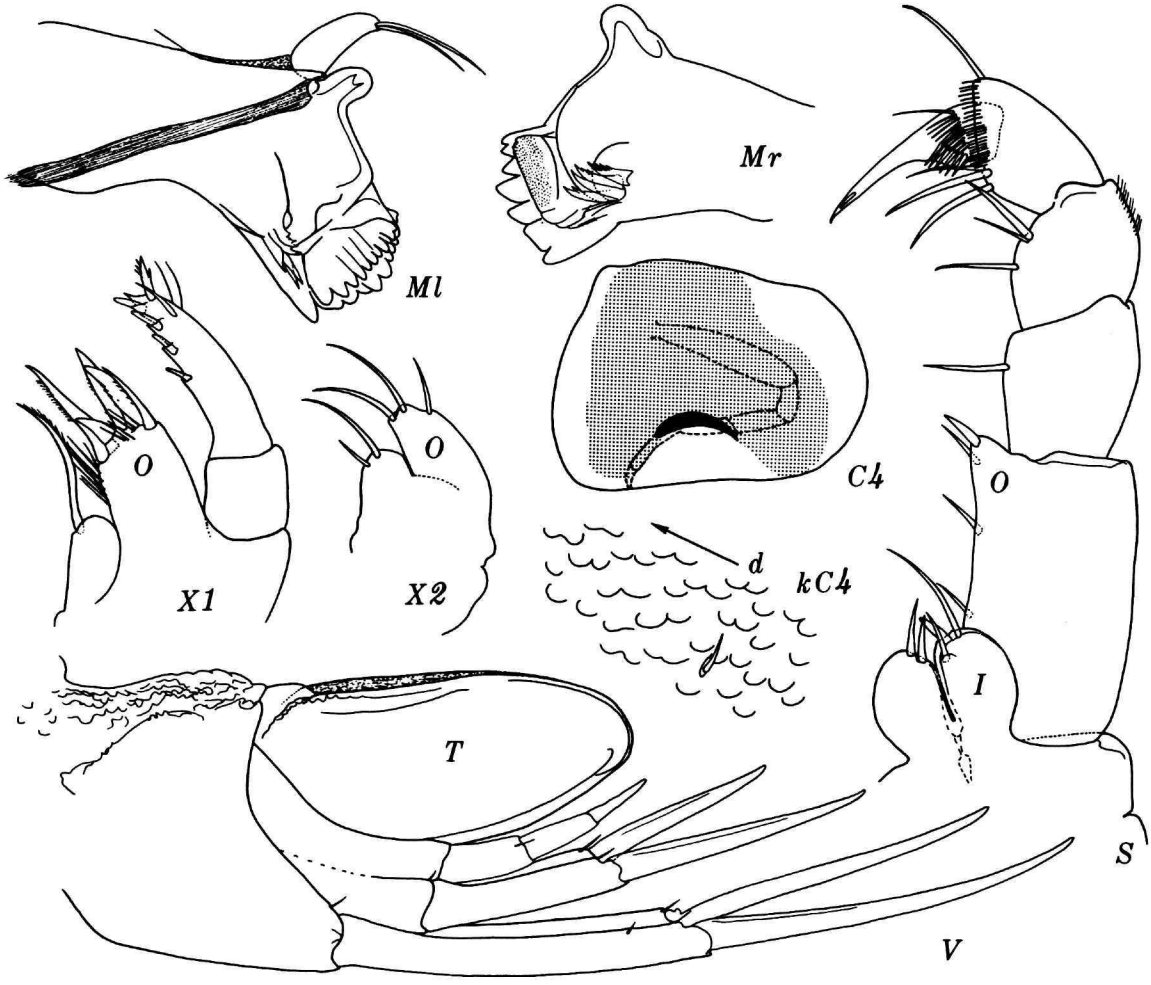


FIGURE 190.—*Ausatelson ule*, new genus, new species, holotype, female, 2.2 mm, JLB Australia 5. (Pereopod 2 removed from body; arrow on *kC4* points dorsally.)

### *Goratelson*, new genus

DIAGNOSIS.—Gnathopods 1-2 subchelate, with fully oblique palms, gnathopod 2 much larger than 1; mandible lacking palp; palp of maxilla 1 biarticulate; antenna 1 lacking nasiform processes; article 2 of pereopods 3-5 rectangular but not linear, pereopods 4-5 with distinct posteroventral lobe on article 2; pereonite 4 not elongate; pleonites 4-6 coalesced, telson huge, very broad and low but with slight increase in elevation, fully covering urosome, but lateral surface aspect with area equivalent to lateral area of urosome; pleonite 3 dorsally tumid but lacking process; inner plate of maxilla 2 unproduced.

TYPE-SPECIES.—*Goratelson warroo*, new species.

RELATIONSHIP.—This thaumatelsonin has little relationship to other thaumatelsonins in the absence of elongation on pereonite 4, the nonlobular inner plate of maxilla 2, and the stout article 2 of pereopods 3-5. The gross telson represents a stage intermediate between that of normal stenothoids and the fully erect telson of the ultimate thaumatelsonin. *Goratelson* demonstrates the lack of phyletic integrity in the thaumatelsonin concept, as, having an extremely thin article 2 on pereopods 3-5, a well-developed inner plate of maxilla 2, and an elongate pereonite 4, it apparently has been derived from an immediate stenothoid ancestor entirely different from that of other thaumatelsonins.

### *Goratelson warroo*, new species

FIGURES 191–192

DESCRIPTION.—Pereonite 4 short; rostrum large; eyes red in formaldehyde, colorless in alcohol; head with distinct, subquadrate lateral lobe; antenna 1 lacking nasiform process, peduncle thin, article 2 shorter than article 3, accessory flagellum vestigial; antenna 2 with article 3 curving weakly around front of head medially, articles 4-5 subequal to each other in length; epistome unproduced, upper lip bilobate; mandible lacking palp, lacinia mobilis on both sides deeply serrate but left side more so than right; lower lip not studied; palp of maxilla 1 biarticulate, outer plate with 6 spines, inner naked; inner plate of maxilla 2 unproduced; inner plates of maxilliped especially small in relation to other thaumatelsonins, bearing 2 long apical sabre-spines each, palp article 4 with weak distal nail; coxa 4 with concave crescentic lower margin rolled inward, no lateral pit, posteroventral corner bearing weak laterocontiguous cusp in adolescents, its supporting lobe more prominent in adults; pereopod 2 not significantly smaller than pereopod 1; gnathopods with palms fully oblique, gnathopod 2 much larger than 1, palm of gnathopod 1 bearing several stout spines and defined by 2 pairs in tandem of apically truncate spines, dactyl reaching between the sets of spines, article 5 with long lobe bearing 1 truncate and 1 sharp spine; gnathopod 2 with setules on palm, bearing lateral submarginal ridge armed with 3 large truncate spines, palm defined by 2 sets of truncate spines, dactyl failing to reach defining spines, but elongate, article 5 with thin naked lobe (laterally), lobe with better medial development and 2 small truncate spines; article 2 of pereopods 3-5 rectangular but stout in relation to other thaumatelsonins, stouter on pereopods 4-5 than on pereopod 3 and posteroventrally lobate, article 5 of all pereopods with active margin densely tuberculate, all dactyls bearing accessory apical tooth and comb row of pectinations; pleonal epimeron 1 broadly rounded and projecting posteriorly, epimera 2-3 deeply sinuous and epimeron 3 with especially attenuate posteroventral corner; pleonite 3 weakly inflated dorsally, all of pleonites 4-6 coalesced but elongate and fully covered by telson; outer rami of uropods 1-2 short, uropod 3 uniramous, ramus biarticulate; telson huge, broad, and low but fleshy and with rudimentary state of dorsal erection, extending posteriorly and camouflaging uropod 3 so as to appear to be overhanging dorsal process, urosome extending and becoming attenuate under telson for attachment of uropod 3; body covered with weakly developed pits, occasional setules and rarely with rugosities, skin sculpture best developed on dorsal part of pleonite 3 and head.

HOLOTYPE.—WAM, female, 2.6 mm.

TYPE-LOCALITY.—JLB Australia 5, west of Bunker Bay, Cape Naturaliste, Western Australia, intertidal, wash of algae and rocks, 2 September 1968.

REMARKS.—In order to demonstrate the integrity of the telson as a complete dorsal shield of the urosome, I pulled it free along its articulation lines in order to compose Figure 191*Vdz*. It is attached only as far as mark 67 along the urosome; when pulled free it reveals a central supporting beam of tissue and 2 parasagittal spaces that appear to be fully open to the urosome. The telson sits on a sclerotic rim of the urosome and overhangs the posterior third, which is

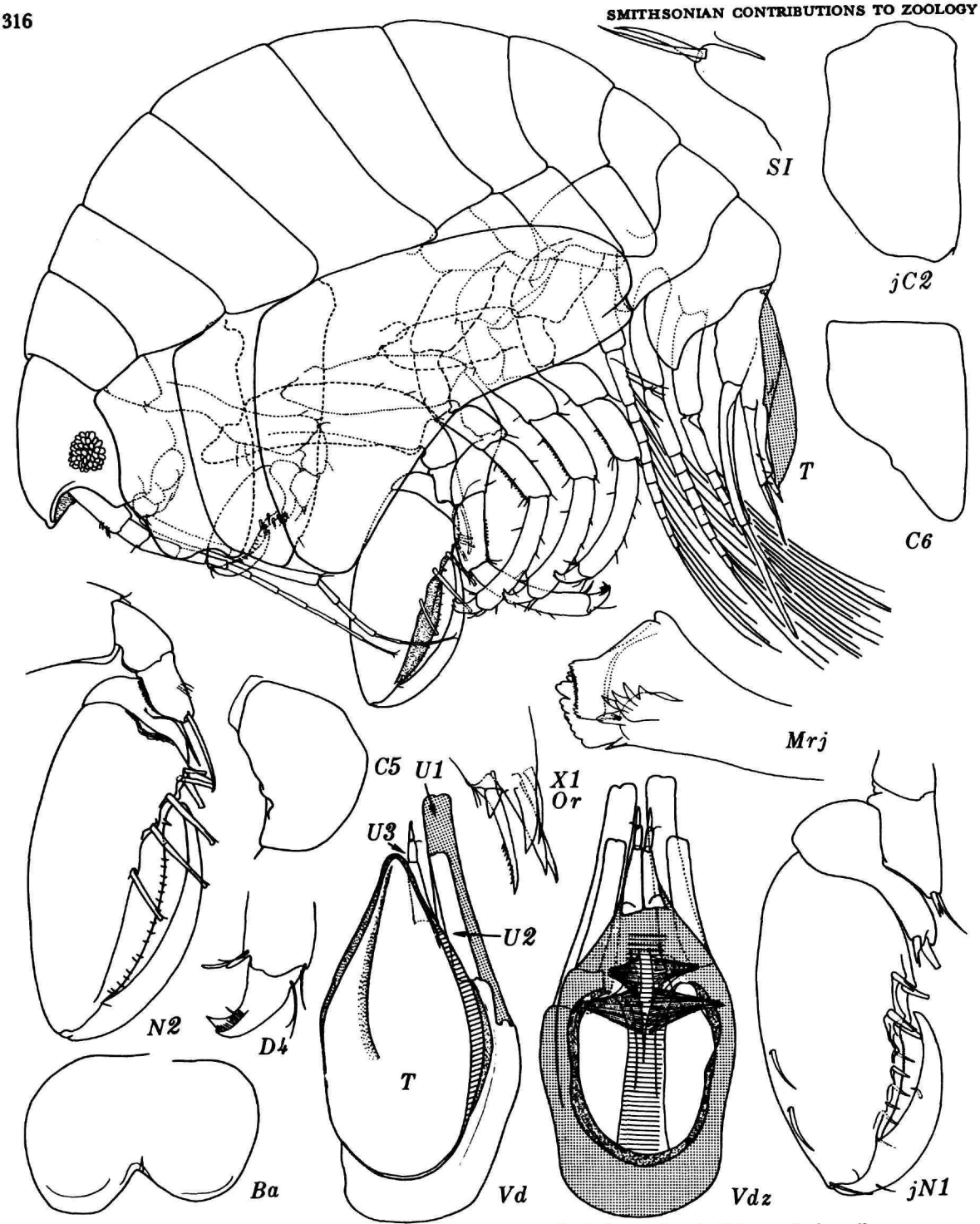


FIGURE 191.—*Goratelson warroo*, new genus, new species, holotype, female, 2.6 mm; *j*=juvenile, 1.5 mm; both from JLB Australia 5. (*Vdz* shows telson removed from central support column, q.v. in text).

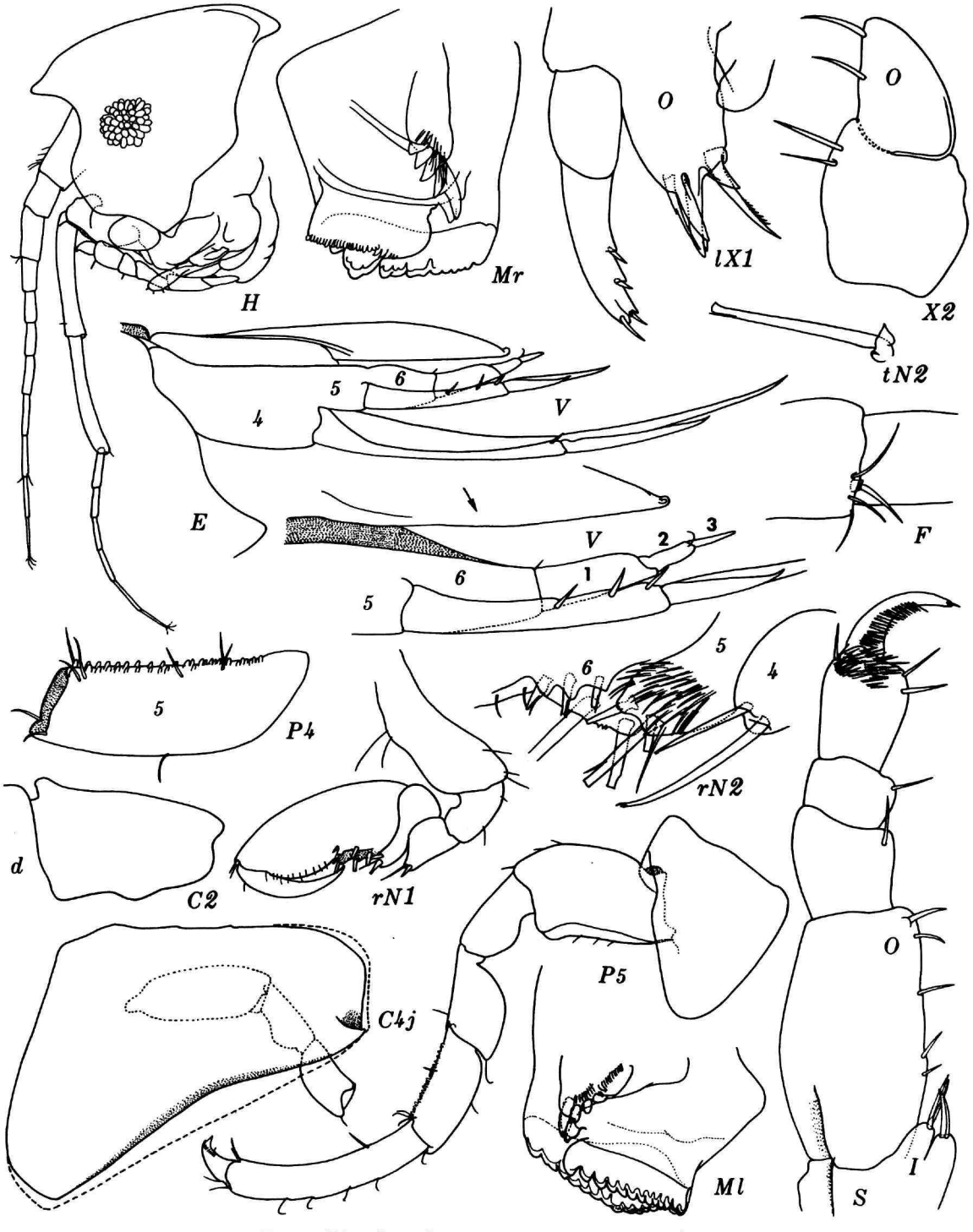


FIGURE 192.—*Goratelson warroo*, new genus, new species.

narrowly attenuate and to which are attached the third uropods so closely as to appear almost coalesced. Muscles of uropods 1-2 that extend to their bases laterally from the medial urosomal beam are also included, but other muscles have been eliminated from the drawing.

ETYMOLOGY.—The aboriginal word "warroo" [boomerang] is used specifically to denote the shape of coxa 4, so unusual in this family, and giving the animal the appearance of a paramphithoid.

MATERIAL.—JLB Australia 5 (15).

DISTRIBUTION.—Southwestern Australia, intertidal.

### *Raumahara*, new genus

DIAGNOSIS.—Gnathopod 2 chelate, gnathopod 1 with subtransverse palm shorter than posterior margin of hand; mandible lacking palp; palp of maxilla 1 biarticulate; antenna 1 lacking nasiform process; pereopods 3-5 with rectolinear article 2; pereonite 4 elongate; pleonites 5-6 free; telson long but flat, scarcely fleshy, lateral area much smaller than lateral area of pleonite 4, latter normal, pleonite 3 normal.

TYPE-SPECIES.—*Raumahara dertoo*, new species.

INCLUDED.—*Prothaumatelson carinatum* Shoemaker (1955); *Raumahara rongo* J. L. Barnard (in press).

### *Raumahara dertoo*, new species

FIGURES 193–194

DIAGNOSIS.—Lateral cephalic lobe weakly mammilliform, midsagittal vertical keel on front of head formed of 2 widely separate humps, lower hump forming epistome; articles 2-3 of antenna 1 equal to each other in length; inner plate of maxilla 1 with 1 long seta; outer plate of maxilla 2 broader apically than inner plate; gnathopod 1 propodochelate, anterior margin of hand bearing only 1 long setal spine; article 6 of gnathopod 2 (excluding chela) about 2.5 times as long as dactyl; coxa 5 with sharp posteroventral corner, coxa 7 with blunt posteroventral corner; both pleonal epimera 2-3 extensively produced posterodistally; pleonite 4 with large dorsal hump vaulting over telson, latter very thick dorsoventrally and bearing only 1 pair of dorsal setules; ramus of uropod 3 with setule.

HOLOTYPE.—WAM, female, 1.55 mm.

TYPE-LOCALITY.—JLB Australia 3, Sugarloaf Rock, Cape Naturaliste, Western Australia, intertidal, wash of common seaweeds, 1 September 1968.

RELATIONSHIP.—The vaulted pleonite 4 and chelate gnathopod 1 are characters of generic value differentiating this species from *R. rongo* J. L. Barnard (in press), but the close resemblance of so many other parts of the two species suggests they have a common affinity.

The body in 2-day formaldehyde is reddish pink and covered with weak pits and setules as in *R. rongo*; the eye is red, fading rapidly in formaldehyde, the ommatidia bearing scattered black granules among them.

The anterior cephalic keel in *R. rongo* has 2 tightly appressed lobes separated by a deep notch; maxilla 1 lacks a seta on the inner plate, the mandibular incisors are more complex than they are in *R. dertoo*, pleonite 4 lacks a hump, the telson is thin and bears many dorsal setules, and the ramus of uropod 3 bears a thick spine. The retention of *R. rongo* in *Raumahara* is provisional and based on the probability that other species will be discovered that will clarify the generic partition of the thaumatelsonin stenothoids.

MATERIAL.—Three specimens from the type-locality.

DISTRIBUTION.—Southwestern Australia, intertidal.

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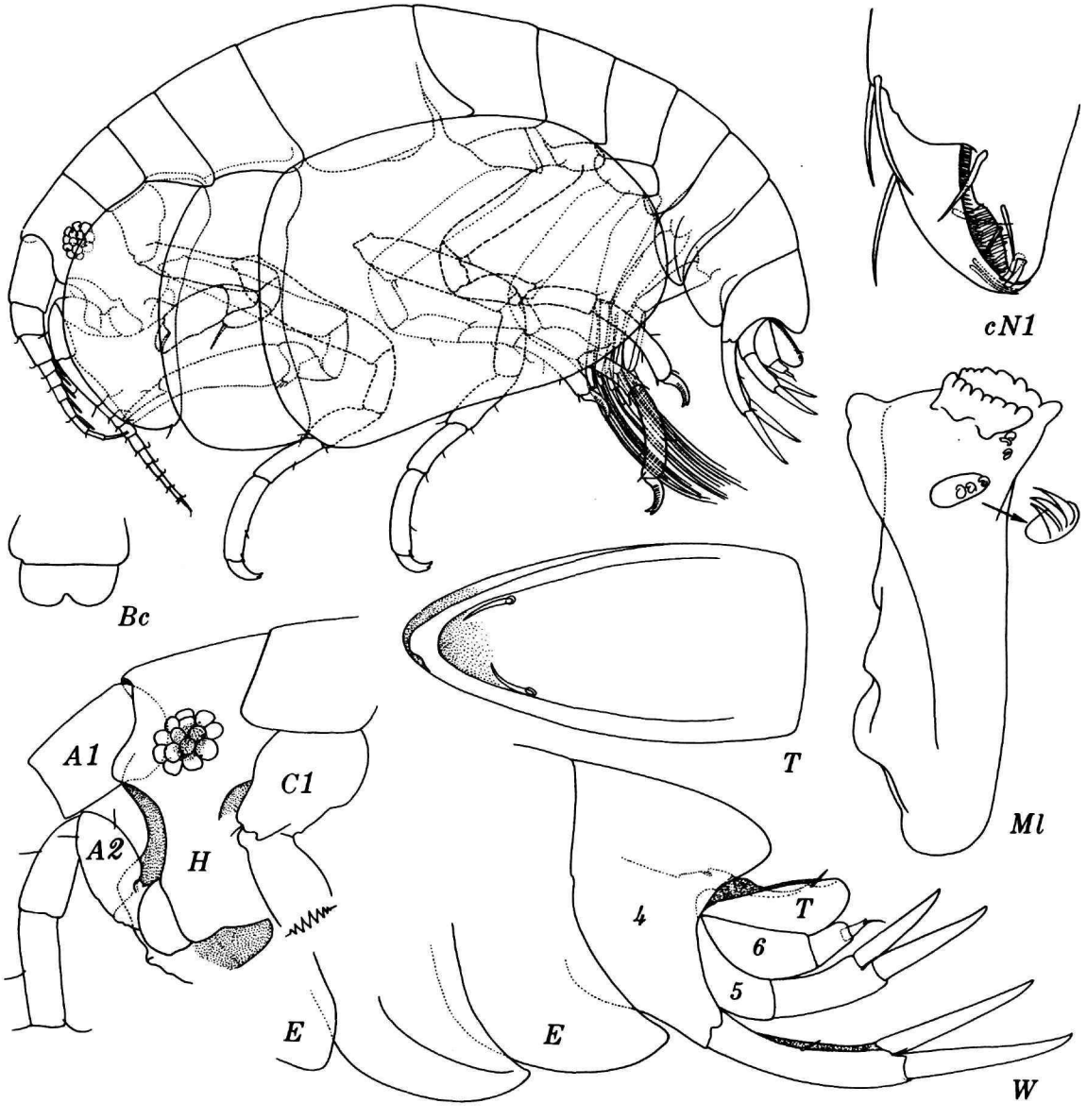


FIGURE 193.—*Raumahara dertoo,* new species, female, 1.50 mm; *c*=female, 1.60 mm; both from JLB Australia 3.

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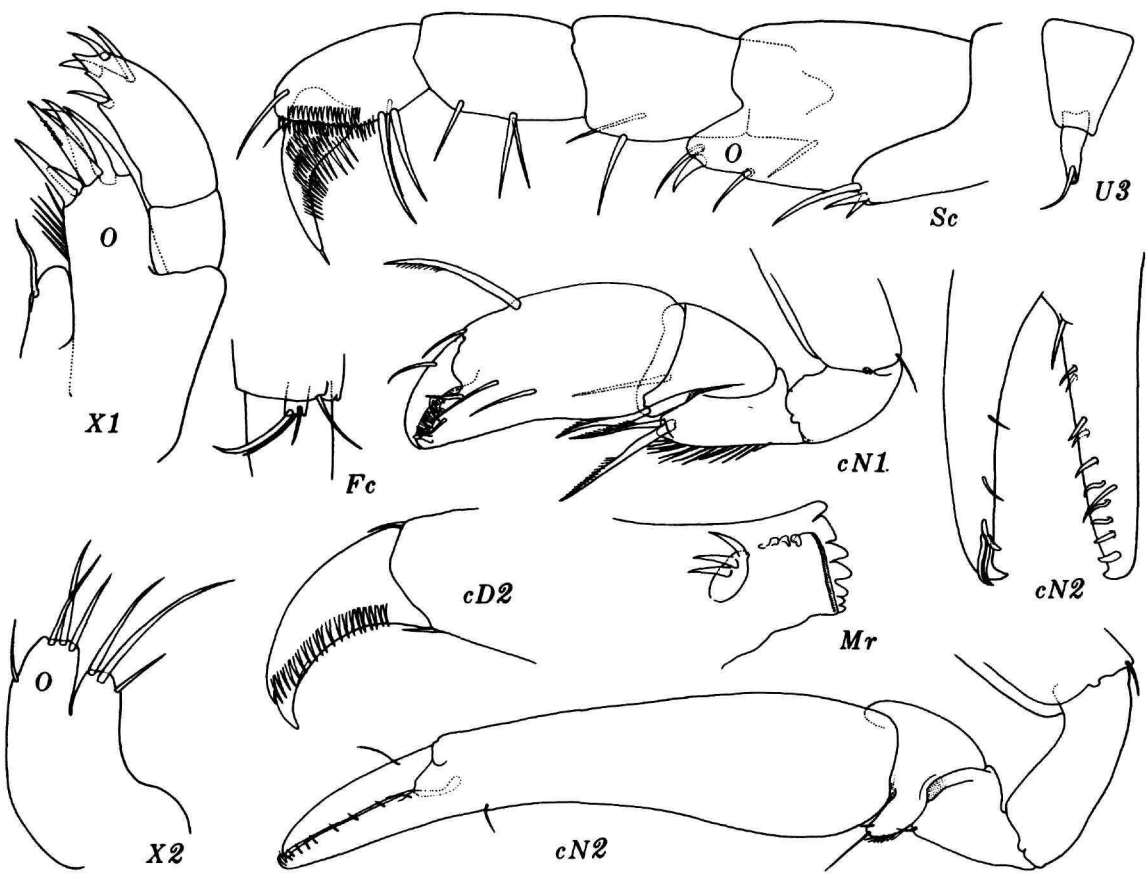


FIGURE 194.—*Raumahara dertoo*, new species.

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# Appendix: Station List

### AM Samples, Sydney, New South Wales

A few samples from the Australian Museum are cited fully in the genera *Paraleucothoe* and *Ceradocus*.

### Drummond Samples, Merimbula, New South Wales

A and B, two similar samples, Merimbula, New South Wales, weedy rock pools covered at high tide, 6 February 1969.

### VicFish Samples, Western Port, Victoria

Collected by a team directed by Dr. Alistair E. Gilmour, Victorian Fisheries Department, Melbourne: over 300 bottom samples from a semi-enclosed bay southeast of Melbourne. For this report, only the family Dexaminidae has been studied in these samples. Data will be reported elsewhere in the literature. Only samples 1-105 are used in this report, which gives the number of specimens and number of samples in which each species is found. Mrs. Margaret Drummond of Victorian Fisheries has processed and sorted the amphipods from the samples into families, genera, and species. Holotypes are deposited in the National Museum of Victoria.

### Port Phillip Samples, Victoria

Collected during a survey sponsored by National Museum of Victoria, John McNally, Director; samples processed and transmitted by Dr. W. D. Williams of Monash University, Victoria. Data to be published elsewhere in the literature. Composed of 90 bottom samples from semi-enclosed bay south of Melbourne. Holotypes are deposited in the above museum.

### Shepherd Samples, South Australia

Collected by Mr. S. A. Shepherd, South Australian Museum, from localities in open sea off South Australia, mainly from Pearson Islands (Investigator Group) and West Island (Encounter Bay). I have assigned these samples arbitrary numbers for sorting efficiency.

Shepherd 1, Pearson Islands, station C, 50 m, in algae, 9 January 1969.

Shepherd 2, Pearson Islands, station G, 8–12 m, in algae, 12 January 1969.

Shepherd 3, Pearson Islands, station A, 20–25 m, horizontal face, 7 January 1969.

Shepherd 4, D-343c, Point Noarlunga, 4 m, in algae, 20 October 1968.

Shepherd 5, Pearson Islands, station E, 70 ft, horizontal face, algae, 10 January 1969.

Shepherd 6, Pearson Islands, station A, 90-100 ft, horizontal face, algae, 7 January 1969.

Shepherd 7, Pearson Islands, station B, 10 m, in *Acrocarpia*, 8 January 1969.

Shepherd 8, Pearson Islands, station C, 50 m, 9 January 1969.

Shepherd 9, Pearson Islands, station B, 15 ft, algae on horizontal face, 8 January 1969.

Shepherd 11, Lady Julia Percy Island, Bass Strait, 13-16 m, near Square Reef in algae, 4 January 1968.

Shepherd 12, Pearson Islands, station G, 22 m, in algae on vertical face, 12 January 1969.

Shepherd 13, Pearson Islands, station B, 40-60 ft, from algae on horizontal face, 8 January 1969.

Shepherd 14, Pearson Islands, station E, 45 ft, from algae, horizontal face, 10 January 1969.

Shepherd 15, Pearson Islands, 8 m, 2/11 $m^2$, horizontal face in algae, January 1969.

Shepherd 16, Pearson Islands, station B, 30 m, in algae, horizontal face, 8 January 1969.

Shepherd 17, Pearson Islands, station F, 200 ft, 11 January 1969.

Shepherd 18, Toad Head, West Island, 4 m, vertical face, algae, 13 October 1968.

Shepherd 22, Pearson Islands, station A, 35 m, in algae, 7 January 1969.

Shepherd 23, Pearson Islands, station E, 30 m, in algae, horizontal rock, 10 January 1969.

Shepherd 24, Pearson Islands, station D, 50 ft, from algae, horizontal face, 9 January 1969.

Shepherd 25, Pearson Islands, station D, 22 m, 3/11 $m^2$, horizontal face, 9 January 1969.

Shepherd 26, Pearson Islands, station D, 85 ft, from algae on horizontal faces, 9 January 1969.

Shepherd 27, Pearson Islands, station D, 50-70 ft, steep slopes, algae, 9 January 1969.
Shepherd 29, D-337, Point Noarlunga, 5 m, reef outside, in algae, 5 September 1968.
Shepherd 30, Pearson Islands, station B, 15-40 ft, algae, 8 January 1969.
Shepherd 31, D-238, Judith Cove, West Island, 0-3 ft, among coralline matting, 5 November 1966.
Shepherd 33, D-258, Lands End, West Island, 55-60 ft, among *Plocamium*, 2 January 1967.
Shepherd 34, D–266, Oedipus Point, West Island, 80-90 ft, among algae, 5 February 1967.
Shepherd 36, D–275, Seal Rock, West Island, 80 ft, among *Rhodophyllis multipartita*, 15 April 1967.
Shepherd 37, D–275, Seal Rock, West Island, 30-35 ft, among algae, 15 April 1967.
Shepherd 39, D–281, Judith Cove, West Island, 0-5 ft, coralline association, May 1967.
Shepherd 40, D–282, Point Gillian, West Island, 0-4 ft, among corallines, *Asparagopsis armata*, and *Halopteris* species, 27 May 1967.
Shepherd 42, D–285, Lands End, West Island, 10-30 ft, 11 June 1967.
Shepherd 46, Judith Cove, West Island, 15 ft [no date].
Shepherd 47, Judith Cove, West Island, 10-12 ft, in coralline association, May 1967.
Shepherd 48, Judith Cove, near Restless Point, West Island, 5 ft, *Ecklonia*, 5 November 1966.
Shepherd 49, Pearson Islands, station A, 20-25 m, in algae, horizontal face, 7 January 1969 [distinct from Shepherd 3].
Shepherd 52, Pearson Islands, station B, 60-80 ft, in algae, 8 January 1969.
Shepherd 54, D–305, Judith Cove, West Island, 2 m, in coralline association [no date].
Shepherd 55, D–267, Judith Cove, Point Gillian, West Island, to 5 ft, mainly corallines [no date].

### Prince Samples, Swan River, Western Australia

Collected by Miss Jane Prince, University of Western Australia.

Swan Basin, 4 March 1969.
Lucky Bay, 4 March 1969.
Middle Swan Bridge, 4 March 1969.

### Slack-Smith Samples, Western Australia

Collected by Mrs. Shirley M. Slack-Smith from Cheyne Beach, east of Albany, and from Cottesloe, near Perth, Western Australia.

Slack-Smith 1, Cheyne Beach, intertidal, on weedy rocks, 4 December 1968.
Slack-Smith 2, Cheyne Beach, intertidal, weedy rocks, 6 December 1968.
Slack-Smith 5, Cottesloe, intertidal, from seaweed clump on outer reef edge, 28 January 1969.

### WAM Samples, Western Australia

Lots from collections of Western Australian Museum, arranged alphabetically by code word, all from Western Australia.

Bunbury, 7 mi SW, 11 fms, FRV *Lancelin*, 13 April 1963.
Cockburn 28, Cockburn Sound, S of Fremantle, Marine Naturalist Club, 31 May 1959.
Cockburn 31, Cockburn Sound, 22 December 1959.
Cockburn 92, 93, Cockburn Sound, Marine Naturalists' Club, 10 October 1958 and 22 December 1959.
Cottesloe, Victoria Street, Cable Station, Collected by W. H. Butler, 16 March 1961.
Cottesloe, determined by C. Chilton, July 1926.
Denmark, west of Albany, Wilason Inlet, 1 mi S, reef, 16 January 1959.
Favourite Islands, Jurien Bay, collected by R. W. George, 16–18 September 1964.
Fremantle, jetty piles, October 1912.
Garden Island, off Fremantle, 2 fms, beam trawl, FRV *Lancelin*, July 1963; on old boom piles, collected by P. B. Lenhard, 14 March 1959; diving on green weeds and gorgonian, southwest end, R. Slack-Smith, 16 December 1964.
Lancelin Island, on deck from craypots and sponges, collected by J. Shea, February 1956.
Naval Base, 2 mi W, in Cockburn Sound, dredged at 10 fms, FRV *Lancelin*, 22 June 1961.
Point Peron, Cockburn Sound, collected by L. Glaubert, October 1929.
Point Peron, reef collecting, collected by R. Kenny, 25 November 1946.
Rottnest Island, off Fremantle, 4 mi E, 18 fms, dredged, FRV *Lancelin* [no date].

### Banner Samples, Australia and Philippine Islands

Collected by Dr. and Mrs. A. H. Banner of the University of Hawaii.

BAU 2, Point Peron, Western Australia, off south side of point, in loose pieces of beach sandstone, 2-4 ft within surf line, December 1968.
BAU 3, islet off Lancelin Township, Western Australia, from dead coral heads 2-8 ft deep, islet almost at surf line 0.25 mi from shore, on outer reef, 14 December 1968.
BAU 27, between Hammond and Waiwea Islands, Torres Straits, from heads of dead coral, depth of reef surface to 10 ft, 10 January 1968.
BPI 26, Philippine Islands, eastern end of Big Santa Cruz Island, from various coral heads, –2 to –15 ft, sandy pocket, 24 March 1968.

## JLB and RLB Australia Samples, Western Australia

Collected by J. L. Barnard and Robert L. Barnard in Western Australia between Perth and Albany.

JLB Australia 1, Mosman Bay, Swan River, 0.3–1.0 m, seaweed, 17 May 1968.

JLB Australia 2, Jervois Bay, Cockburn Sound, S of Fremantle, on groin 1.6 mi SE of Woodman Point, algae on rocks, 1 m, scuba collection by Dr. Barry R. Wilson, 10 June 1968.

JLB Australia 3, Sugarloaf Rock, Cape Naturaliste, intertidal, wash of common seaweeeds, 1 September 1968.

JLB Australia 4, Sugarloaf Rock, Cape Naturaliste, intertidal, wash of algae, mainly green *Caulerpa* species, 1 September 1968.

JLB Australia 5, W of Bunker Bay, Cape Naturaliste, intertidal, wash of algae and rocks, 2 September 1968.

JLB Australia 6, W of Bunker Bay, Cape Naturaliste, intertidal, wash of algae and small sponges, 2 September 1968.

JLB Australia 8, 3 mi NE of Dunsborough, near Cape Naturaliste, wash of sponges and tunicates on pilings of old jetty, 2 September 1968.

JLB Australia 9, Canal Rocks, near Yallingup, S of Cape Naturaliste, wash of beach wrack caught between rocks on sand, 3 September 1968.

JLB Australia 10, Cottesloe Beach, near Perth, intertidal, wash of algae, collected by R. L. Barnard, 7 September 1968.

JLB Australia 11, Middleton Beach, Albany, intertidal, wash of algae and rocks, 30 September 1968.

JLB Australia 12, Middleton Beach, Albany, intertidal, wash of sandy rocks, coralline algae, 30 September 1968.

JLB Australia 13, Middleton Beach, Albany, intertidal, wash of sandy rocks, coralline algae, 30 September 1968.

JLB Australia 14, inside Forsythe Bluff, 12 mi W of Albany, intertidal, wash of dense algae on heavily wave-splashed, smooth rocks, 1 October 1968.

RLB 19, Matilda Bay, Swan River, shallow water, in dead clam, 24 July 1968.

## Antarctica Samples

Collected mainly by Dr. John C. McCain.

Arthur Harbor, AH–3, near old Palmer Station, 64°46′36″S, 64°03′29″W, 85 ft, small bottom grab of 0.10 $m^2$, collected by J. C. McCain and W. E. Stout, 17 January 1969.

Arthur Harbor, AH4–20, same, diving sample, 20 ft, 25 January 1969.

Arthur Harbor, AH4–25, same, diving sample, 25 ft, 25 January 1969.

Arthur Harbor, AH4–30, same, diving sample, 30 ft, 25 January 1969.

Arthur Harbor, AH4–35, same, diving sample, 35 ft, 25 January 1969.

Arthur Harbor, AH5–30, Palmer Station, 64°49′ S, 64°08′W, diving, 30 ft, 25 January 1969.

Hoseason Island, Palmer Peninsula, 50 fms, vessel *Hero*, 30 January 1969.

All of the above samples recorded at Smithsonian Oceanographic Sorting Center under SOSC reference number 465.

Eltanin 436, 63°14′S, 58°45′W, 73 m, 40 ft otter trawl, 8 January 1963.

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