Littoral Gammaridean Amphipoda from the Gulf of California and the Galapagos Islands

J. LAURENS BARNARD

SMITHSONIAN CONTRIBUTIONS TO ZOOLOGY • NUMBER 271

SERIES PUBLICATIONS OF THE SMITHSONIAN INSTITUTION

Emphasis upon publication as a means of "diffusing knowledge" was expressed by the first Secretary of the Smithsonian. In his formal plan for the Institution, Joseph Henry outlined a program that included the following statement: "It is proposed to publish a series of reports, giving an account of the new discoveries in science, and of the changes made from year to year in all branches of knowledge." This theme of basic research has been adhered to through the years by thousands of titles issued in series publications under the Smithsonian imprint, commencing with *Smithsonian Contributions to Knowledge* in 1848 and continuing with the following active series:

Smithsonian Contributions to Anthropology
Smithsonian Contributions to Astrophysics
Smithsonian Contributions to Botany
Smithsonian Contributions to the Earth Sciences
Smithsonian Contributions to the Marine Sciences
Smithsonian Contributions to Paleobiology
Smithsonian Contributions to Zoology
Smithsonian Studies in Air and Space
Smithsonian Studies in History and Technology

In these series, the Institution publishes small papers and full-scale monographs that report the research and collections of its various museums and bureaux or of professional colleagues in the world cf science and scholarship. The publications are distributed by mailing lists to libraries, universities, and similar institutions throughout the world.

Papers or monographs submitted for series publication are received by the Smithsonian Institution Press, subject to its own review for format and style, only through departments of the various Smithsonian museums or bureaux, where the manuscripts are given substantive review. Press requirements for manuscript and art preparation are outlined on the inside back cover.

S. Dillon Ripley
Secretary
Smithsonian Institution

SMITHSONIAN CONTRIBUTIONS TO ZOOLOGY • NUMBER 271

Littoral Gammaridean Amphipoda from the Gulf of California and the Galapagos Islands

J. Laurens Barnard

SMITHSONIAN INSTITUTION PRESS
City of Washington
1979

ABSTRACT

Barnard, J. Laurens. Littoral Gammaridean Amphipoda from the Gulf of California and the Galapagos Islands. *Smithsonian Contributions to Zoology*, number 271, 149 pages, 74 figures, 11 tables, 1979.—Less than 40 percent of the Galapagan littoral Gammaridea are endemic and almost all affinity lies with the eastern Pacific continental fauna. The strictly littoral Gammaridea of the Galapagos Islands and the Gulf of California are impoverished of specific diversity in comparison with the richer shores of California and Australia. Evolutionary events at high level are few in the entire eastern Pacific Ocean. Only one family, Bateidae, is endemic to American waters and the majority of species belong to "invasive" cosmopolitan genera. Newly described genera are *Anchialella, Posophotis, Varohios,* and *Zoedeutopus*, and new species are described in the following genera: *Ampithoe, Anchialella, Dulzura, Elasmopus, Gitanopsis, Heterophlias, Hyale, Lembos, Maera, Microjassa, Najna, Pontogeneia, Posophotis, Varohios, Zoedeutopus.*

OFFICIAL PUBLICATION DATE is handstamped in a limited number of initial copies and is recorded in the Institution's annual report, *Smithsonian Year*. SERIES COVER DESIGN: The coral *Montastrea cavernosa* (Linnaeus).

Library of Congress Cataloging in Publication Data
Barnard, Jerry Laurens, 1928–
Littoral gammaridean Amphipoda from the Gulf of California and the Galapagos Islands.
(Smithsonian contributions to zoology ; no. 271)
Bibliography: p.
Supt. of Docs. no.: SI 1.27:271
1. Amphipoda—California, Gulf of. 2. Amphipoda—Galapagos Islands. 3. Crustacea—California, Gulf of. 4. Crustacea—Galapagos Islands. I. Title. II. Series: Smithsonian Institution. Smithsonian contributions to zoology ; no. 271.
QL1.S54 no. 271 [QL444.M315] 591'.08s [595'.371'091641] 78-606012

Contents

Littoral Gammaridean Amphipoda from the Gulf of California and the Galapagos Islands

J. Laurens Barnard

Introduction

The intertidal faunas of crustaceous Gammaridea in the Gulf of California and the Galapagos Islands share many similar taxa. In neither area is the intertidal zone richly populated with diverse taxa though on occasion high densities of the particular species prevail. This study treats the hitherto poorly known Gammaridea as based on widespread but sparse sampling.

Acknowledgments

I am indebted to Dr. John R. Hendrickson and Dr. Newell Younggren of the University of Arizona for their many kindnesses during my protracted stay in their laboratories. I am grateful for the use of the facilities of the marine station at Puerto Peñasco operated jointly by the University of Sonora and the University of Arizona. The University of Arizona and the Smithsonian Institution provided funds for several field expeditions and Sigma Xi generously contributed to these expenses through a subvention to me and Dr. Richard C. Brusca of the University of Arizona. I am indebted to Dr. Brusca for many aids and fine fellowship during our trips to Mexico. Mr. and Mrs. James Wood and Dr. Hendrickson dived for me with scuba gear at Bahía Kino. Dr. P. E. Pickens of the University of Arizona provided many collections for examination. Many of the drawings were made by Mrs. Wilma A. Findley; she, Carolyn L. Cox, Biruta Akersbergs, Debra Horner and Katherine M. Hepburn inked the plates.

At the Smithsonian Institution I must thank Dr. David L. Pawson, former Chairman of the Department of Invertebrate Zoology, Mrs. Montague Smith, Mr. Roland H. Brown and Mrs. Dessie M. Best for their extensive aid to me in the execution of this project; Dr. I. E. Wallen kindly arranged travel funds for moving my laboratory to Tucson for a period of 4 years.

My collections in Panama in 1955 were greatly assisted by Mr. and Mrs. R. L. Miller, then of Balboa, Canal Zone, now of Sun City, California. The late Dr. E. Yale Dawson gave me many fine materials from El Salvador and the Galapagos Islands. Over 60 colleagues on the 1964 Galapagos International Scientific Expedition under the leadership of Dr. Robert I. Bowman, made possible my 9 week exploration of those islands, among them deserving special mention are Dr. Donald P. Abbott, Dr. J. Wyatt Durham, Dr. Richard N. Mariscal, the late Allyn G. Smith and Dr. Victor A. Zullo, and among them were the previously mentioned Dr. Hendrickson and Dr. Dawson. My thanks go to the Angermeyer family of Academy Bay who safely conducted us by sea through the islands and provided our every need and good fellowship. The Ecuadorian Navy also provided excellent transportation to Tower Island (Genovesa). The Charles

J. Laurens Barnard, Department of Invertebrate Zoology, National Museum of Natural History, Smithsonian Institution, Washington, D. C. 20560.

Darwin Foundation (Contribution 230), University of California, California Academy of Sciences, and the National Science Foundation made this expedition possible with the superb cooperation of the California Maritime Academy.

Mr. and Mrs. R. F. Dwyer of Corona del Mar, California, kindly transported Dr. Brusca and me to several islands in the Gulf of California aboard their research vessel *Sea Quest II*.

Dr. A. A. Myers of University College, Cork, Ireland, kindly offered valuable suggestions on this manuscript. We differ, however, in the interpretation of certain relationships in the new corophiid genera.

Methods

Amphipoda were collected largely in "formalin-wash" samples, for which intertidal flora and substrates are placed in a container of seawater laced with formaldehyde. After death, the organisms are strained from the residue through fine mesh screens, preserved in a 5 percent solution of formaldehyde and seawater, returned to the laboratory, sorted to taxa in clean water and represerved for microscopic study in 70 percent ethanol. Where seaside laboratories were available certain samples were sorted after collection as rapidly as possible to facilitate initial division into taxa by color pattern (J. L. Barnard, 1970).

Aliquots of each sample were analyzed, and the taxa and their individuals identified and counted. The samples were then arranged into 6 groups: (1) Puerto Peñasco, (2) Bahía Kino, (3) Topolobampo, (4) Inner Baja California from La Paz to Bahía Concepcíon, (5) Cabo San Lucas region, and (6) the Galapagos Islands. The average number of specimens per sample in each group was multiplied by 10 to provide whole numbers so as to compose tables showing general rankings of abundance of the species in the several areas.

Counts of juveniles in samples with more than two species of a genus are divided among the species in proportion to the ratio of adults. This is clearly a poor practice as juveniles of different species may be in quite different proportions than their adults, but the identification of juveniles to the species level in such difficult genera as *Amphithoe, Hyale,* and *Photis* could not be accomplished in any event given the poor knowledge about juvenile morphology.

After aliquots had been sorted into taxa the remainder of each sample was examined for any species not found in the aliquot. In most cases these were rare species at the locality and are reported as the final members of the minor species for each sample. In the grouping of samples for the comparative tables many of these species also are appended as minor species; in other cases a minor species in one sample may dominate another sample from the same area and therefore is advanced to a higher rank.

Unnamed species include a variety of taxa too poorly represented in the collections to be described herein and include two new species of *Melita,* new species of *Batea, Leucothoides,* acanthonotozomatid, *Elasmopus, Hyale, Synchelidium* from the Gulf of California, and new species of *Ericthonius, Photis, Lembos, Hyale, Maera, Melita,* liljeborgiid, oedicerotid, from the Galapagos Islands and Cocos Island. The few stenothoids and cyproidein found in the collections are reserved for future studies when a wider variety of tropical material facilitates their identification. Many unanalyzed Galapagan and Panamanian samples remain for subsequent study in Smithsonian collections. Islands in the Galapagos are cited by their familiar names, rather than strictly adhering to the Spanish appellations.

Types are registered either in the National Museum of Natural History, Smithsonian Institution (USNM collection) or in the Allan Hancock Foundation, University of Southern California, Los Angeles (AHF). All remaining material collected and noted in the station data was apportioned among the Smithsonian Institution, the Allan Hancock Foundation, and the University of Arizona. All new names commemorate American Indians except those specified.

Voucher material refers to specimens used, in addition to the holotype, for illustration and verification of the specific identification. These materials are labeled and deposited under the taxonomic name in the collections of the Smithsonian Institution or in the museum from which they were borrowed. Other materials, cited elsewhere, are not necessarily segregated into specific vials, but may be returned, along with their compatriots of other species, into the original sample jars, which are in the museums as unsorted samples and labeled according to collector and locality.

Diagnoses and descriptions are not internally parallel in this study; rather they follow conventions in the literature according to each genus.

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

Figure Abbreviations

Capital letters indicate structures; lower case letters on the left side of capital letters denote specimens cited in the legends and voucher material of the text; lower case letters on the right side of capital letters (or within a drawing, as is often the case with "*e*" and "*s*") indicate characteristics of the structures. Other lower case letters not in the list below are defined in the legends. Where space does not allow a horizontal alinement of the label, the resulting vertical arrangement has the same order of elements top to bottom as found in the horizontal from left to right.

A	antenna
B	prebuccal from lateral
C	head
D	dactyl of pereopod
E	coxa
F	accessory flagellum
G	gnathopod
H	peduncle
I	identified in legend
J	lacinia mobilis
K	spine, seta, or denticle
L	lower lip
M	mandible
N	molar
O	sternum
P	pereopod
Q	cuticle
R	uropod
S	maxilliped
T	telson
U	upper lip
V	palp
W	pleon (pleonites 1–3 bearing epimera; pleonites 4–6, also referred to as urosomites 1–3, comprising urosome; often shown with attached structures: adjoining pereonites, telson, and uropods 1–3)
X	maxilla
Y	pleopod
Z	calceolus
a	outer (ramus or plate)
d	dorsal
e	broken
i	inner (ramus or plate)
l	lateral
m	medial
o	opposite or right
p	apex
s	setae removed
v	ventral

Exploration and Environment

Impetus for this study came from the Symposium on Biogeography in the Gulf of California (Garth and Savage, editors, 1960) and the low degree of knowledge about Amphipoda in the east Pacific Ocean outside of California and to a degree the Oregonian Province. However small in body size, Amphipoda are generally a diverse and, in the aggregate, a conspicuous element of intertidal regions, though they usually are far more dominant on level mud bottoms in relation to other groups of organisms. Prior to 1960 the known Amphipoda of the tropical eastern Pacific Ocean totaled fewer than 35 species and most of these had been described by Shoemaker (1925, 1942) from sublittoral trawls made by the *Albatross* and *Houston* in the Gulf of California. Actually, most of these species were collected in Bahía Magdalena, in Baja California, just outside the Gulf of California. Literature on amphipods in the waters of the Gulf of California and Galapagos Islands was contained in these few papers (Shoemaker, 1925, 1926, 1942, Schellenberg, 1936, J. L. Barnard, 1954b, 1960, 1969a).

Collections of Amphipoda from both areas deposited with the Allan Hancock Foundation, University of Southern California, were examined; these are mainly composed of occasional specimens or lots from scattered dredge hauls; they do not comprise a comprehensive or consistent series of material. The first extensive Galapagan collection was provided by the late Dr. E. Y. Dawson, who, during his exploration of Galapagan algae in 1962 collected 40 special samples of phycophilic amphipods. I supplemented these with my collections made during the Galapagos International Scientific Expedition of 1964 (Figure 1).

Massive collecting in the Gulf of California (Figure 1) commenced in 1962 (J. L. Barnard, 1969a) when opportunity was afforded through the Beaudette Foundation to make several journeys to Bahía de Los Angeles. More widespread collecting was accomplished between 1970 and 1974 when intensive study of the intertidal was undertaken near the marine laboratory at Puerto Peñasco operated by the University of Arizona and the University of Sonora. This was capped by an expedition to Cabo San Lucas, Bahía Concepcíon, and other places in Baja California.

Several colleagues at the University of Arizona also provided materials they collected during sojourns to the Gulf of California and these are reported upon where they yield new information.

Despite a large amount of field effort, the results of this study barely scratch the surface of ignorance about amphipods in these two regions. The study

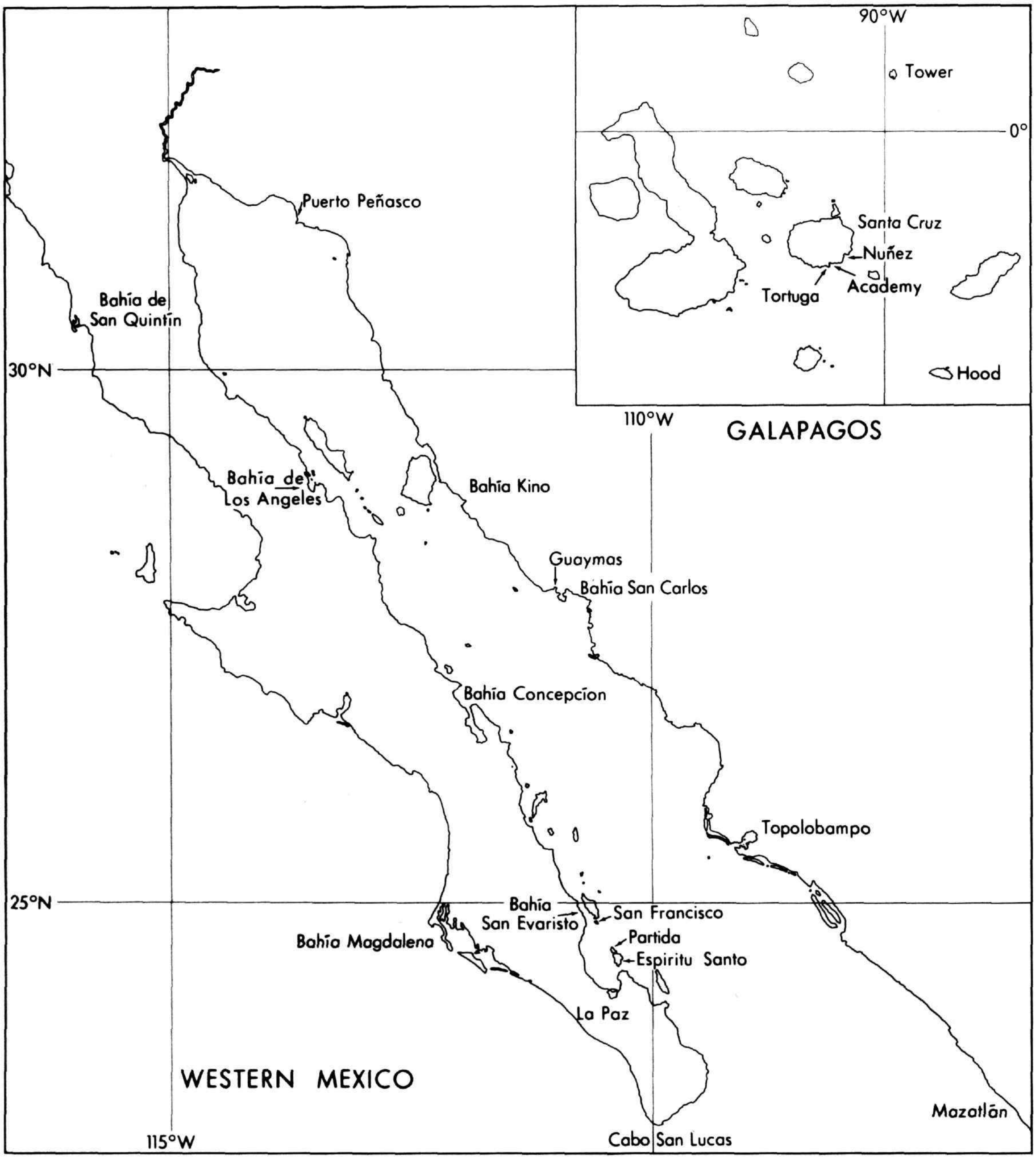

FIGURE 1.—Gulf of California and the Galapagos Islands.

had to be confined to intertidal or very shallow water zones because of the lack of any other collecting means. This biotic zone in both regions is very improverished either of suitable substrates or of amphipod taxa.

The intertidal zone of the Galapagos Islands, in the two places intensively studied, is very barren of the ordinary substrates in which amphipods are usually found in midlatitudes (Hedgpeth, 1969). Apparently most of the intertidal algae are consumed by marine iguanas except in the most fierce of the breaking seas. Multitudes of Sally Lightfoot crabs appear to scrape away most of the microscopic algal mats remaining on the hot barren rocks. Intertidal amplitudes are moderate in any event. E. Y. Dawson braved the treacherous breaking seas in his search for algae and acquired the better set of phytic samples in the Galapagos. My colleagues and I, however, were able to pry apart slabs of intertidal strata to find rich encrustations secreted in crevices out of reach of reptiles and crabs. Two scuba divers were able to acquire sublittoral substrates in quiet waters but for the most part these yielded few small crustaceans.

Tidal amplitudes in the Gulf of California range from low to high. At Puerto Peñasco, the main focus of this study, the amplitude on occasion reaches 5 or more meters, revealing during certain times of the year a wide belt of intertidal flora, which, at other times, is depleted by dieoff. Individuals of Amphipoda here are very numerous but diversity of taxa is low compared to such numbers as are found at Cayucos, California (J. L. Barnard, 1969b:10). Surface sea temperatures commonly range between 10° and 32° C (Brusca, 1974:7) so that amphipods living in such shallow waters all year must have wide thermal tolerance. Others may oscillate from deep to shallow waters to remain in suitable thermal regimes.

Somewhat richer samples were found at Topolobampo, but these came from an area of low tidal amplitude in sublittoral depths constantly underwater. The rocks here were covered with a recently settled spatfall of tunicates.

Samples from Cabo San Lucas, the tip of Baja California exposed to upwelling and open Pacific swells, were not as rich as predicted, but collecting was hampered by precipitous cliffs, sharply sloping reefs, moderately heavy seas, and severe restrictions against trespass.

In the area between La Paz and Concepción our expedition, arriving in November and December, met a heavy dieoff of intertidal algae along a shore of low tidal amplitude. Many of these intertidal samples were destitute of amphipods yet one might predict that amphipods would thrive as scavengers during such dieoffs. The richest locality in that inner apex of Baja California appeared to be Bahía San Evaristo where the intertidal region not only supported a rich flora but a heavy concentration of influent mud among the rocks.

The Fauna of Gammaridea

Tables 1–10

Despite the vagaries confronted in an attempt to compare intertidal localities, a certain resemblance occurs in the fauna of amphipods from place to place; but where differences occur, partial explanation can be suggested.

Intensive sampling during two seasons, October (peak summer) and February (cool winter), in Puerto Peñasco (Table 1) showed relatively similar dominance ranking, *Ericthonius brasiliensis* being an order of magnitude more abundant than the next dominants, *Hyale yaqui, Ampithoe plumulosa, Lembos macromanus,* and *Posophotis seri.* In Table 1 all of the major species except *Zoedeutopus cinaloanus* and the species of *Elasmopus* were well represented in both seasons, *Zoedeutopus* appearing

Table 1.—Rank in abundance of intertidal Gammaridea from Puerto Peñasco, Mexico (based on aliquots from 21 samples, total specimens averaged per sample, multiplied by 10; asterisks denote domicolous species)

**Ericthonius brasiliensis*	1851	**Zoedeutopus cinaloanus*	26
Hyale yaqui	326	*Elasmopus tiburoni*	26
**Ampithoe plumulosa*	235	*Melita sulca*	19
**Lembos macromanus*	81	**Photis elephantis*	16
**Posophotis seri*	76	**Ampithoe pollex*	15
Podocerus fulanus	72	*Heterophlias seclusus*	13
**Gammaropsis tonichi*	39	*Podocerus brasiliensis*	11
Tethygeneia nasa	34	**Photis* sp.	7
Elasmopus rapax	29	*Leucothoe alata*	5

Minor species: *Elasmopus bampo,* **Rudilemboides stenopropodus,* **Corophium baconi, Gitanopsis baciroa, Podocerus brasiliensis,* **Acuminodeutopus periculosus, Elasmopus serricatus, Paraphoxus spinosus, Synchelidium* sp., *Lysianassa dissimilis,* **Lembos tehuecos, Leucothoides pacifica.*

only in the February samples. The minor species fluctuated greatly from season to season. Many of these, except perhaps the domicolous forms, may actually fluctuate hourly as tides change.

The strong dominance of *Ericthonius* in Puerto Peñasco, almost at the head of the Gulf of California, where maximum thermal ranges occur in the gulf, suggests a permanent stressful situation. *Ericthonius brasiliensis* (or a series of close siblings), though widely distributed throughout the world seas, is best known to dominate shallow water habitats in or near harbors where human influences have altered the natural environment. To a slight degree the species may show a pattern of distribution similar to that of the polychaete, *Capitella capitata,* which generally abhors the presence of other organisms and thus signifies by its presence a great tolerance to physical variables but virtually no tolerance to the presence of other Metazoa. Several genera of amphipods, *Corophium, Podocerus,* and *Jassa* also become dominant in weakly polluted or artificial environments.

The dominance of *Ericthonius* over *Hyale* by an order of magnitude in frequency is a precise reversal of the usual situation found in California (J. L. Barnard, 1969b:19), the only other place where intertidal amphipods have been counted and ranked extensively. The dominance of *Hyale* also occurs in the Galapagos Islands but not elsewhere in the Gulf of California samples analyzed herein. Specific samples often have a dominance of *Hyale* but the aggregate from a locality does not. *Hyale* dominated in about a third of the samples from New Zealand intertidal (J. L. Barnard, 1972b:201-204), but only once by an order of magnitude. Because *Hyale* is associated with algae in greatest degree, any sample strictly limited to preferential algae would be dominated by that genus.

At Puerto Peñasco almost half of the top 18 dominant species are domicolous or belong to families in which domicoly is thought to be universal. This includes the premier dominant *Ericthonius.* Domicolous amphipods usually spin a tube or loose nest of weblike material emitted from apical meati on pereopods 1 and 2. The nest is usually attached to a substrate, or inside the hole or tube of another animal, though occasional domicolous amphipods, such as *Cerapus,* may drag the tube about in the fashion of a hermit crab. Inquilinous genera at Peñasco include only *Leucothoe* and *Leucothoides* as far as known. Inquilinous species usually live in close association with sessile invertebrates, often inside sponges or tunicates. The remaining species are loosely classified as nestlers, those simply hiding in anastomoses but often swimming freely from place to place. However, this category is a simplification because such genera as *Podocerus* may be highly sedentary; they are often found crawling slowly about on hydroids in the fashion of caprellids. Species of *Hyale, Elasmopus, Pontogeneia,* and *Melita* are presumed to be errant nestlers, actively moving about amongst the flora and encrustations, but at low tide finding a moist hiding place to withstand desiccation.

Rarely in my studies of intertidal amphipods in California, Hawaii, New Zealand, and Australia have more than one species of *Hyale* been collected in a small sample; but the species of *Elasmopus* appear to occupy small territories and perhaps are separated from each other by much less obvious niche criteria than volume of space. One species in California was found by Barnard (1969b:117) to be associated with sponges in contrast to algae. The seasonal fluctuation of *Elasmopus* at Peñasco suggests that in the intertidal the species might replace each other from sublittoral sources.

As in California, the species of *Ampithoe* and *Photis* are largely composed of juveniles. Adults generally form much less than 5 percent of the total individuals found in a sample, whereas significantly higher percentages of the other species occur in adult morphology adequate for identification. To further complicate the taxonomic procedure, adult males of *Ampithoe* and *Photis* are usually extremely rare; identification of the several species is most easily accomplished by examining males.

The fauna of Peñasco (Table 1) may be compared with the richest locality in California, Cayucos (Table 7). Peñasco has 30 species, Cayucos 52. Ten of the Peñasco species do not occur in California as far as known and more than 20 of the Cayucos species apparently do not occur, at least commonly, in the intertidal of the Gulf of California, though several are known in sublittoral depths. Several species occur at Cayucos that are predominantly tropical and will be expected to occur very abundantly in sublittoral zones of the Gulf of California, for example *Chevalia aviculae.* But such species have not, as yet, been found intertidially in the Gulf of California.

One is therefore left with the impression that the major factors constraining the composition and diversity of the Peñasco fauna are simply the wide ranging sea temperatures, and the aridity and summer heat from the sun impinging on the intertidal zone during low tides. As a result, the dominance of the main nestling genus, *Hyale*, is suppressed slightly, whereas the tube dweller *Ericthonius brasiliensis*, able to retain moisture within its tube during dry periods, and highly tolerant of wide ranging sea temperatures, and released to some extent from pressures of interordinal diversity, comes to prominence in the Peñasco fauna.

The high consistency of occurrence of *Heterophlias seclusus* is also of interest. This armoured, dinosaurian-like amphipod, indeed all members of its family Philantidae, are rarely collected by marine explorers. Species of the family, but not specimens, are numerous in museums. J. L. Barnard (1969b:16) suggested that *Heterophlias* lives mainly in or on sands between rocks in the intertidal, and that the rod-like translucent but red or ochre stained posterior gut contents might be coagulates from a lignin diet during scavenging of dead algal rhizomes or other parts of woody algae.

The isopod-like body shape of *Heterophlias* suggests that it may be a functional replacement in the impoverished intertidal of Puerto Peñasco for some other crustacean group unable to survive the wide yearly extremes of climate.

In any event the taxonomist is likely to see more specimens of this family in one sample from Puerto Peñasco than during a lifetime of other exploration.

The fauna in the five samples from Bahía Kino, 330 km south of Peñasco, though sparse and poorly diverse (perhaps from low sampling density), has a distinctive composition, the only place in this study where *Parhyale* is prominent and where a species of *Elasmopus* is the premier dominant (Table 2).

At Topolobampo, near the mouth of the gulf, three underwater samples also show an occurrence of *Parhyale* and *Elasmopus bampo* and species of *Podocerus*, with *Lembos macromanus* being the premier dominant (Table 3). Owing to the high densities of the tunicate, *Polycheria osborni*, a species usually found buried in colonies of *Amaroucium* sp., was also prominent. The samples at Kino and Topolobampo may actually be typical of sublittoral rocks in the Peñasco region, but that zone has not been investigated.

TABLE 2.—Rank in abundance of intertidal Gammaridea from Bahía Kino, Gulf of California (based on aliquots from 5 samples, total specimens averaged per sample, multiplied by 10; asterisks denote domicolous species)

Elasmopus bampo	752	**Amphithoe pollex*	144
Parhyale penicillata	400	*Elasmopus tiburoni*	140
Hyale yaqui	380	amphilochids	66
Podocerus fulanus	368	*Hyale californica*	38
Tethygeneia nasa	166	**Ampithoe plumulosa*	16
**Ericthonius brasiliensis*	158	*Leucothoe alata*	14

Minor species: **Corophium baconi*, *Lysianassa dissimilis*, **Lembos macromanus*, **Gammaropsis* sp. 2, lysianassid, **Posophotis seri*, *Heterophlias seclusus*.

TABLE 3.—Rank in abundance of subintertidal Gammaridea from Topolobambo, Mexico (based on aliquots from 3 samples, total specimens averaged per sample, multiplied by 10; asterisks denote domicolous species)

**Lembos macromanus*	509	*Tethygeneia nasa*	90
Elasmopus bampo	450	**Corophium baconi*	87
Podocerus fulanus	256	**Ericthonius brasiliensis*	77
Polycheria osborni	243	**Ampelisca lobata*	33
Podocerus brasiliensis	190	*Lysianassa dissimilis*	33
**Microjassa macrocoxa*	176	**Ampithoe plumulosa*	23
Parhyale penicillata	150	*Hyale yaqui*	23
Gitanopsis baciroa	133	**Lembos tehuecos*	20
**Gammaropsis tonichi*	127	*Maera simile*	17

Minor species: stenothoid sp. 1, acanthonotozomatid, *Colomastix* sp., *Leucothoe alata*, stenothoid sp. 2, *Leucothoe spinicarpa*, *Melita sulca*, **Photis* sp., **Ampelisca schellenbergi*.

Of the 16 samples from several localities between La Paz and Bahía Concepción (about 350 km apart) 14 are grouped together in Table 4. Ten of these samples contained fewer than 9 species each, reflecting the November red algal dieoff noticed throughout the region. The dieoff was especially intense at certain subareas of Pichilinque Bay, Isla Espiritu Santo, Isla Partida, and Bahía Concepción. Two of these 10 samples lacked any amphipods and are removed from Table 4.

The eight impoverished samples (subtracting the two without amphipods) were dominated by *Ampithoe plumulosa* (in 7 out of 8 samples), and *Lembos macromanus* (3 out of 8), whereas other species with numerous aggregate specimens never occurred in more than two samples out of eight: *Pontogenia opata*, *Elasmopus rapax*, *E. bampo*, and *Ericthonius brasiliensis*.

TABLE 4.—Rank in abundance of intertidal Gammaridea along Inner Baja California, from La Paz to Bahía Concepción (based on aliquots from 14 samples, parentheses = number of samples in which species is present, total specimens averaged per sample, multiplied by 10; asterisks denote domicolous species)

**Ericthonius brasiliensis* (7)	421	*Lysianassa holmesi* (9)	51
**Zoedeutopus cinaloanus* (5)	248	**Ampithoe* juveniles	50
**Ampithoe plumulosa* (11)	215	*Elasmopus tiburoni* (1)	34
Hyale yaqui (6)	194	*Podocerus fulcanus* (2)	25
**Ampithoe pollex* (6)	172	*Amphilochus picadurus* (4)	24
**Varohios topianus* (5)	169	*Elasmopus* juveniles	22
Elasmopus rapax (4)	159	**Ampithoe ramondi* (1)	21
**Lembos macromanus* (11)	129	*Melita sulca* (6)	19
Elasmopus bampo (2)	123	*Leucothoe alata* (4)	19
Podocerus brasiliensis (1)	97	**Rudilemboides stenopropodus* (1)	15
Pontogeneia opata (3)	59	**Lembos tehuecos* (2)	14
		Batea rectangulata (3)	11
		Paraphoxus spinosus (4)	11

Minor species: *Maera reishi, Lysianassa macromera, Pontogeneia quinsana,* **Microdeutopus schmitti, Batea susurrator,* **Microdeutopus* sp., *Tethygeneia nasa, Podocerus* juveniles, **Acuminodeutopus* sp., *Anamixis linsleyi, Leucothoides pacifica, Podocerus cristatus, Synchelidium* sp., *Leucothoe* juveniles, **Corophium baconi, Pontogeneia* juveniles, *Ceradocus paucidentatus, Heterophlias seclusus, Metaphoxus frequens, Polycheria osborni, Batea transversa, Lysianassa dissimilis, Leucothoe spinicarpa, ?Gitanopsis neapolitanus, Leucothoides ?yarrega.*

The six other samples were collected at enriched areas of Bahía Concepción and Isla Espiritu Santo or at Bahía San Evaristo and Isla San Francisco; they comprise the bulk of species and specimens in Table 4. The maximum number of species in an enriched sample is 20. This aggregation of samples over 350 km of coast approximately matches the diversity found at Cayucos, California (Table 7).

The most abundant species, *Ericthonius brasiliensis,* was found in greatest numbers in only a few samples (predominantly the otherwise impoverished samples). The next dominant *Zoedeutopus cinaloanus* was found in only five samples. However, the more characteristic dominant, *Ampithoe plumulosa* was found consistently abundant or present in 11 of the 14 samples. *Lembos macromanus* was also found in 11 of the samples and would also be considered more characteristic than other species with higher aggregate densities. Five of the enriched samples are aggregated in Table 8 to show the pre-

TABLE 5.—Rank in abundance of intertidal Gammaridea from region of Cabo San Lucas, Mexico (based on aliquots from 10 samples, total specimens averaged per sample, multiplied by 10; asterisks denote domicolous species)

Elasmopus serricatus	278	**Cheiriphotis megacheles*	29
**Ampithoe pollex*	264	*Hyale guasave*	28
Hyale yaqui	240	**Ampithoe plumulosa*	27
Hyale zuaque	179	*Maera chinarra*	19
Elasmopus antennatus	126	*Heterophlias seclusus*	15
Elasmopus tubar	94	*Tethygeneia nasa*	12
Elasmopus juveniles	88	**Varohios topianus*	7
**Photis elephantis*	77	*Hyale* juveniles	4
Elasmopus rapax	75	*Lysianassa macromera*	4

Minor species: **Lembos macromanus, Amphilochus picadurus,* **Ampelisca schellenbergi, Leucothoe alata,* **Rudilemboides stenopropodus.*

dominance of *Varohios topianus* and the sparsity of *Ericthonius brasiliensis.*

The dominance of nestlers in the 10 samples taken from the region of Cabo San Lucas (Table 5) may reflect the exposure to open seas of the Pacific Ocean. Only to a slightly lesser extent is this reflected in the samples from the Galapagos Islands where many species of *Elasmopus* also came to prominence (Table 6). The fauna from 54 samples is presented in Table 6 in comparison with 54 samples from Cayucos, California, presented in Table 7. Although the Galapagan samples represent a much greater diversity to sea exposure, rock angles, depth of crevices explored and thermal regimes from several different islands, fewer species (42) were found than at Cayucos (52). Needless to say the 42 days of arduous Galapagan exploration (travel time subtracted) was much less productive than the three days consumed in the Cayucos survey.

BIOGEOGRAPHY

The Galapagan fauna now comprises 51 species, of which 17 are provisionally endemic (Tables 6, 9). The two anchialine taxa, *Galapsiellus* and *Anchialella,* represent endemic genera probably descended from *Eriopisa* and/or *Paraniphargus.* Neither of the latter genera has yet been found along Galapagan shores but the exploration of those islands has scarcely commenced, even with the present work. Except for the deepwater *Proharpinia tropicana,* with subantarctic affinities, all of the remaining 49 species appear to have affinities with eastern Pacific

TABLE 6.—Rank in abundance of intertidal Gammaridea from the Galapagos Islands (based on aliquots from 54 samples, total specimens averaged per sample, multiplied by 10; asterisks denote domicolous species)

Hyale darwini	1176	*Hyale zuaque*	41
•*Ericthonius brasiliensis*	384	*Elasmopus ocoroni*	37
•*Ampithoe pollex* complex (includes *A. tahue* and *vacoregue*)	234	•*Lembos macromanus*	36
Elasmopus tubar	212	*Amphilochus neapolitanus*	36
Elasmopus mayo	197	•*Photis elephantis*	27
Elasmopus serricatus	130	•*Chevalia aviculae*	16
•*Microjassa chinipa*	93	*Maera chinarra*	16
•*Posophotis seri*	82	*Meximaera diffidentia*	15
Elasmopus zoanthidea	79	*Hyale humboldti*	14
•*Lembos achire*	75	•*Microdeutopus hancocki*	11
•*Ampithoe plumulosa*	63	*Elasmopus ecuadorensis*	7
		•*Ampelisca lobata*	6
		•*Ampithoe guaspare*	5

Minor species: *Maera reishi, Hyale guasave,* •*Varohios topianus, Heterophlias galapagoanus, Gitanopsis baciroa, Leucothoe spinicarpa, Podocerus* spp., •*Corophium baconi, Parhyale hawaiensis, Polycheria osborni, Anamixis linsleyi, Melita* sp., *Elasmopus temori, Colomastix* sp., *Dulzura gal, Leucothoides pottsi.*

Other known species in shallow-water benthos from Galapagos Islands: Barnard (1954): *Ampelisca milleri* Barnard, *Ampelisca pugetica* Stimpson; Barnard (1960): *Paraphoxus calcaratus* (Gurjanova) (46–73 m); *Proharpinia tropicana* Barnard (27–46 m); Barnard (1967b): *Hyachelia tortugae* J. L. Barnard, from turtle mouth; Myers (1968): •*Microdeutopus trichopus* Myers (58–110 m); •*Neomegamphopus roosevelti* Shoemaker; Monod (1970) and Barnard (1977): *Galapsiellus leleuporum* (Monod); this paper: *Anchialella vulcanella.*

TABLE 7.—Amphipoda from a rich intertidal locality, Cayucos, California (based on 53 samples, specimens per 0.1 m^2, recomposed from J. L. Barnard, 1969b; asterisks denote domicolous species)

Hyale frequens	750	•*Ischyrocerus* sp. A	31
•*Aoroides columbiae*	262	•*Cheiriphotis megacheles*	24
•*Photis brevipes*	167	•*Gammaropsis spinosus*	21
•*Photis bifurcata*	136	•*Gammaropsis thompsoni*	17
Calliopiella pratti	130	*Pontogeneia rostrata*	14
•*Microjassa litotes*	96	•*Ericthonius brasiliensis*	13
•*Photis conchicola*	81	*Elasmopus mutatus*	12
Parallorchestes ochotensis	73	•*Ampithoe simulans*	10
Elasmopus antennatus	70	•*Megamphopus effrenus*	9
•*Jassa falcata*	63	•*Chevalia aviculae*	6
Oligochinus lighti	57	•*Ampelisca schellenbergi*	6
•*Ampithoe pollex*	50	*Parapleustes pugettensis*	6
Paraphoxus spinosus	33	amphilochids	5

Minor species: *Maera vigota,* •*Ischyrocerus* sp. B, *Elasmopus holgurus,* •*Ampelisca lobata, Leucothoe alata, Pleustes depressus, Parapleustes nautilus, Atylus levidensus,* •*Photis californica,* •*Ampithoe lacertosa, Podocerus cristatus,* •*Cerapus tubularis,* •*Ericthonius hunteri,* •*Corophium baconi, Leucothoides pacifica, Lysianassa macromera, Maera simile, Fresnillo fimbriatus, Melita sulca, Podocerus brasiliensis, Lysianassa pariter,* •*Ampithoe humeralis,* •*Ampithoe lindbergi, Allorchestes anceps, Pleusirus secorrus, Maera reishi.*

TABLE 8.—Dominant species in 5 enriched samples from Inner Baja California, PAZ 3, 10, 12, 13, 24, with 19 other minor species not cited (based on aliquots, total specimens averaged per sample, multiplied by 10; asterisks denote domicolous species)

•*Varohios topianus*	948	*Lysianassa holmesi*	90
Hyale yaqui	510	*Podocerus fulanus*	78
•*Ampithoe pollex*	444	•*Ampithoe ramondi*	58
•*Ampithoe plumulosa*	344	•*Ericthonius brasiliensis*	54
Podocerus brasiliensis	272	*Leucothoe alata*	46
•*Zoedeutopus cinaloanus*	252	*Lembos tehuecos*	42
•*Lembos macromanus*	112	*Batea rectangulata*	36
Amphilochus picadurus	96		
Elasmopus tiburoni	92		

taxa (or with complexes of taxa known to have representatives) in eastern Pacific waters. Many of the endemic species are scarcely distinct from partners on the continent; and once subspeciation in eastern Pacific Amphipoda has been studied, they may be relegated to infraspecific level. Endemicity is, therefore, not very strong in the Galapagan fauna except in the anchialine element. The Panamic province, sensu stricto, has not been studied for Amphipoda and may contain many of the provisional Galapagan endemic species.

The remaining 29 species found in Galapagos (Table 10) can be divided into those 12 species as yet found elsewhere only in the Panamic and Gulf of California provinces, the 6 species that extend through those provinces as far as the warm-temperate of southern California, and 11 more that are even more widespread, ranging northward into cold American waters. Four of the species, *Parhyale hawaiensis, Colomastix "pusilla", Ericthonius brasiliensis,* and *Chevalia aviculae* are in the category "circumtropical" though intensive study on speciation in such complexes has not been carried out. *Polycheria osborni* and *Podocerus brasiliensis* require better taxonomic investigations also.

TABLE 9.—Geographic affinities of endemic Galapagan Amphipoda (Gammaridea)

Species	Affinity
Anchiallea vulcanella	Indo-Pacific *Eriopisa*
Ampithoe guaspare	Circumtropical *Ampithoe ramondi*
Ampithoe tahue	E. Pacific *A. pollex* complex
Ampithoe vacoregue	E. Pacific *A. pollex* complex
Elasmopus ecuadorensis	Tropical Pacific *E. hawaiensis-antennatus* complex
Dulzura gal	E. Pacific *D. sal*
Elasmopus ocoroni	Californian *E. mutatus*
Elasmopus temori	E. Pacific *Elasmopus rapax* complex
Elasmopus zoanthidea	E. Pacific *Elasmopus rapax* complex
Galapsiellus leleuporum	Indo-Pacifica Eriopisa
Heterophlias galapagoanus	E. Pacific *Heterophlias escabrosa*
Hyale darwini	Pan-Pacific *H. rubra-frequens* complex
Hyale humboldti	Pacific *H. grandicornis* complex, especially Japan
Lembos achire	Gulf of California *L. tehuecos*
Microdeutopus trichopus	Not elucidated
Microjassa chinipa	California *M. claustris*
Proharpinia tropicana	Subantarctic

TABLE 10.—Geographic distribution of non-endemic Galapagan Amphipoda (Gammaridea)

1. Panamic and Gulf of California Provinces	
Elasmopus tubar	*Microdeutopus hancocki*
Elasmopus mayo	*Meximaera diffidentia*
Gitanopsis baciroa	*Neomegamphopus roosevelti*
Hyale guasave	*Parhyale hawaiensis*
Hyale zuaque	*Posophotis seri*
Lembos macromanus	*Varohios topianus*
Maera chinarra	
2. Item 1 plus Southern California	
Anamixis linsleyi	*Maera reishi*
Chevalia aviculae	*Photis elephantis*
Elasmopus serricatus	*Polycheria osborni*
3. Items 1 and 2 plus Extrinsic Areas	
Ampelisca lobata	*Corophium baconi*
Ampelisca milleri	*Ericthonius brasiliensis*
Ampelisca pugetica	*Hyachelia tortugae*
Amphilochus neapolitanus	*Leucothoe spinicarpa*
Ampithoe pollex	*Leucothoides pottsi*
Ampithoe plumulosa	*Paraphoxus calcaratus*
Colomastix sp.	*Podocerus* spp.
4. Unknown Affinity	
Melita sp.	

Recorded species from the Gulf of California and close proximity in depths shallower than 200 meters total 121 (Table 11). The treatment is very uneven because in depths of 1–200 m only the Ampeliscidae and Phoxocephalidae have been studied to any extent. By narrowing the treatment to species collected in the very shallow waters the species are reduced to 86. Some of these have not yet been collected in the gulf but their distribution pattern in other parts of the Pacific suggests they will be found in the gulf. Of these only 40 extend northward to southern California and very few occur north of Point Conception, California.

One may conclude that about half of the Gammaridea so far found in the Gulf of California are species ranging northward to the warm-temperature region of California and which, in many cases, probably occur much to the south of the Gulf in the Panamic province. The other half of the species probably belong with the greater eastern Pacific tropical fauna, which would include the Panamic province and to a more limited extent the Gulf of California.

Isolation from the great pantropical fauna is evident in the cluster of species in *Elasmopus* (though several of those are very close to Hawaiian counterparts) and in the occurrence of endemic taxa (such as *Leucothoides pacifica, Anamixis linsleyi, Parhyale penicillata,* species of *Photis,* and in the endemic genera of Corophiidae, some related to Hawaii, and the endemic Bateidae). The Caribbean fauna is too poorly known to suggest the degree of its influence on the eastern Pacific though J. L. Barnard (1958) has presented a small amount of evidence that Caribbean and western Atlantic warm-temperate faunas have Pacific imports. Exceptionally, brackish water taxa, such as *Grandidierella,* may have had easier ingress to the eastern Pacific from the Caribbean Sea than from Hawaii.

Except in the Corophiidae, containing such endemic genera as *Varohios, Zoedeutopus, Rudilemboides, Acuminodeutopus,* and *Neomegamphopus,* the east tropical Pacific is barren of important taxa denoting evolutionary events at high levels. However, the family Bateidae is endemic to the greater

Table 11.—Gammaridea of the Gulf of California

Species	Reference	Depth in Gulf (m)	Extrinsic distribution and depth (m)
Acuminodeutopus heteruropus	Myers, 1968	unknown	California to Costa Rica, 1–82
	Barnard, 1964a	unknown	
Acuminodeutopus periculosus	here	0–38	
Ampelisca agassizi (= *vera*, = *compressa*)	Barnard, 1969a	15–137	Pan-American, 1–450
Ampelisca brevisimulata	Barnard, 1954a, 1971a	38	Pan-American, 9–456
Ampelisca cristata	Barnard, 1969a, 1971a	15–58	Pan-American, 6–310
Ampelisca cristoides	Barnard, 1954a, 1967a	0–46	Pan-American, 9–73
Ampelisca hancocki	Barnard, 1954a, 1971a	59–110	Oregon to Costa Rica, 9–210
Ampelisca indentata	Barnard, 1954a, 1967a	38	to California, 33–98
Ampelisca lobata	here	0–137	Pan-American, 0–234
Ampelisca mexicana	Barnard, 1969a	25–46	Pan-American, 9–73
Ampelisca milleri	Barnard, 1969a	18–101	California to Ecuador, 0–187
Ampelisca pacifica	Barnard, 1954a, 1966a	unknown	Pan-American, 24–496
Ampelisca pugetica	Barnard, 1954a, 1969a, 1971a	0–119	Washington to Peru, 0–765
Ampelisca romigi	Barnard, 1954a, 1967a	15–128	Pan-American, 3–504
Ampelisca schellenbergi	here	0–128	Pan-American, 0–128
Ampelisca venetiensis	Barnard, 1954a, 1969b	37–274	Pan-American, 0–274
Amphideutopus oculatus	Myers, 1968	0–41	California to Costa Rica, 0–162
	Barnard, 1969a		
Amphilochus ?neapolitanus	here	1	subcosmopolitan, 0–80
Amphilochus picadurus	here	0	to California, 0–41
Ampithoe plumulosa	here	0	Canada to Ecuador, shallow
Ampithoe pollex	here	0	Pan-American, shallow
Ampithoe ramondi	here	0	tropicopolitan, shallow
Ampithoe tea	Barnard, 1969a	0–25	to California, 0–67
Anamixis linsleyi	here	0	to California and Galapagos, 0
Argissa hamatipes	Barnard, 1969a	0	N. Hemisphere, 0–1096
Batea catharinensis	Shoemaker, 1942	18–27	Pan-American, 0–46
Batea rectangulata	here	0–40	
Batea sussurator	here	0–37	
Batea transversa	here	0–37	to California, 0–60
Byblis veleronis	Barnard, 1954a, 1971a	38	to Oregon, 27–422
Carinobatea conductor	Barnard 1969a	0	
Ceradocus paucidentatus	here	0	to Outer Baja California, 0
Cerapus tubularis	Shoemaker, 1942	11–27	questionable
Cheiriphotis megacheles	here	probable	California, Galapagos, and Cocos, 0–16
Chevalia aviculae	here	probable	California and Galapagos, 0–35
Colomastix sp.	here	0	questionable
Corophium baconi	here	0–9	Bering Sea to Peru, 0–55
Corophium uenoi	Barnard, 1969a	0	Japan, California, 0–2
Elasmopus antennatus	here	probable	California to Cabo San Lucas, 0–11 m
Elasmopus bampo	here	0	
Elasmopus mayo	here	0	to Galapagos and Ecuador, 0
Elasmopus ?rapax	here	0	
Elasmopus serricatus	here	0	to California and Ecuador, 0
Elasmopus tiburoni	here	0	
Elasmopus tubar	here	probable	to Galapagos, 0
Ericthonius brasiliensis	here	0–42	cosmopolitan in lower latitudes, 0–171

Table 11.—Continued

Species	Reference	Depth in Gulf (m)	Extrinsic distribution and depth (m)
Gammaropsis spinosus	Barnard, 1969b	probable	California to Bahía Magdalena, 0–27
Gammaropsis thompsoni	Barnard, 1969b	0	to Washington, 0–218
Gammaropsis tonichi	here	0–38	
Garosyrrhoe disjuncta	Barnard, 1969a	0–24	
Gitanopsis baciroa	here	0–1	Galapagos, 0
Gitanopsis pusilloides	Barnard, 1969a	0–9	to California, 0–20
Grandidierella nottoni	Shoemaker, 1935b	probable	only Mazatlán, 0
Heterophlias seclusus escabrosa	here	0	to California, 0–16
Heterophoxus oculatus	Barnard, 1969a	0–46	Washington to Panama, 0–1941
Hippomedon ?propinquus	Barnard, 1969a	15–30	to Subarctic, 0–183
Hyale californica	here	0	to California, 0
Hyale guasave	here	probable	to Galapagos, 0–6
Hyale yaqui	here	0–7	to bays of outer Baja California, 0–7
Hyale zuaque	here	0	to Galapagos and Ecuador, 0
Jassa falcata	Barnard, 1969a, b	7–18	cosmopolitan, 0–18
Lembos macromanus	here	0–9	to California, Hawaii, and Galapagos, 0–9
Lembos tehuecos	here	0–1	
Leucothoe alata	here	0	to California, Galapagos, Japan, 0–24
Leucothoe spinicarpa	here	0–1	cosmopolitan, 0–1505
Leucothoides pacifica	here	0	to California, 0–8
Leucothoides ?yarrega	here	1	Australia, shallow
Liljeborgia marcinabrio	Barnard, 1969a	46	
Listriella melanica	Barnard, 1969a	7–44	to California, 2–97
Lysianassa dissimilis	here	0–1	to California and Galapagos, 0–73
Lysianassa holmesi	here	0	California to Ecuador, 0–183
Lysianassa macromera	here	0	to California, 0
Maera chinarra	here	probable	to Galapagos, 0
Maera reishi	here	0	to California and Galapagos, 0–6
Maera simile	here	1	to Puget Sound, 0–221
Megaluropus falciformis	Barnard, 1969a	2	to California, 2–108
Megaluropus visendus	Barnard, 1969a	2–17	
Melita sulca	here	0–24	to Puget Sound, 0–101
Melita sp. ("*nitida*")	Shoemaker, 1935b	probable	only Mazatlán, 0
			Costa Rica to Ecuador and Cocos
Metaphoxus frequens	here	0	Oregon to Isla Isabel, 0–496
Meximaera diffidentia	here	0–24	to Galapagos, 0–24
Microdeutopus schmitti	here	0–44	California to Costa Rica, 0–221
Microjassa macrocoxa	here	1	to outer Baja California, 0–27
Monoculodes hartmanae	Barnard, 1969a	0–41	to California, 2–146
Neomegamphopus roosevelti	Barnard, 1969a; Myers, 1968	0–24	Pan-American, 0–60, Galapagos
Orchomene magdalenensis	Barnard, 1969a	6–46	to outer Baja California, 0–46
Pachynus barnardi	Barnard, 1969a	30–46	to California, 12–373
Parajassa angularis	Shoemaker, 1942; Barnard, 1969a	18–27	California to Bahía Magdalena, 0–27
Paraphoxus cognatus	Barnard, 1969a	6	to California, 0–325
Paraphoxus epistomus	Barnard, 1969a	9	Pan-American, 0–507
Paraphoxus floridanus	Barnard, 1960	unknown	Pan-American, 4–44
Paraphoxus gemmatus	Barnard, 1969a	2–9	

TABLE 11.—Continued

Species	Reference	Depth in Gulf (m)	Extrinsic distribution and depth (m)
Paraphoxus obtusidens	Barnard, 1960	unknown	Kuriles to Columbia, 0–459
"Paraphoxus" spinosus	here	0–24	to Puget Sound and Atlantic, 0–519
Paraphoxus tridentatus	Barnard, 1969a	19–38	to Washington, 0–89
Parapleustes commensalis	Barnard, 1969a	9	to California, 9
Parhyale fascigera	here	probable	Pan-American tropics, shallow
Parhyale hawaiensis	here	probable	pantropical, shallow
Parhyale penicillata	here	0	
Photis bifurcata	Barnard, 1969a	38–46	to California, 0–93
Photis brevipes	Barnard, 1969a	9–36	to Oregon, 0–266
Photis californica	Barnard, 1969a	34–46	to California, 0–139
Photis elephantis	here	0	to California, Galapagos, 0–6
Photis spinicarpa	Shoemaker, 1942	probable	Bahía Magdalena, 18–27
Platyischnopus metagracilis	Barnard, 1969a	13–46	to outer Baja California, 13–73
Platyischnopus viscana	Barnard, 1969a	0	to California, 0–27
Podocerus spp? (*"brasiliensis"*, and *"cristatus"*)	here	0	California, Mexico, 0–171
Podocerus fulanus	here	0–42	to California bays, 0–42
Polycheria osborni	here	0–1	to California, Galapagos, 0–1
Pontogeneia opata	here	0	to California and Cocos, 0–7
Posophotis seri	here	0	to Panama, Galapagos, 0–6
Rhachotropis luculenta	Barnard, 1969a	38–46	
Rildardanus tros	Barnard, 1969a	9–16	
Rudilemboides stenopropodus	here	0–38	to California, 0–68
Synchelidium rectipalmum	Barnard, 1969a	0–24	Canada to Costa Rica, 0–100+
Tethygeneia nasa	here	0–1	
Tethygeneia quinsana	here	0	to outer Baja California, 0–6
Uristes entalladurus	Barnard, 1969a	38	to California, 2–38
Varohios topianus	here	0	
Westwoodilla cornuta	Barnard, 1969a	19–46	
Zoedeutopus cinaloanus	here	0	

Pan-American region and may be said to be the only event of familial magnitude yet discovered in the evolutionary pattern of eastern Pacific Gammaridea. Once the so-called Pontogeneias, Tethygeneias, and similar taxa are well studied, other endemic genera may be discovered. The Panamic province remains unworked although I have examined more than 100 samples from Pacific Panama and El Salvador and find little of potential importance in the evolutionary picture. For the most part the east tropical Pacific fauna is composed of widespread tropical or warm-temperate genera, many with endemic species and evidence of adaptive radiation (*Elasmopus*), but which one might call "invasive" in the botanical vein. The dominance by *Ericthonius*, a cosmopolitan genus occurring in many localities in the Gulf of California, supports this attribution of the appellation "weedy" to the fauna.

AMPELISCIDAE

Ampelisca lobata Holmes

Ampelisca lobata Holmes, 1908:517.—J. L. Barnard, 1954b: 11–14, pls. 5, 6; 1969a:188.

MATERIAL.—TOP 3; PAZ 24; GAL 108, 113, 119; DAW 15, 16, 23, 32.

DISTRIBUTION.—Gulf of California, 0-137 m; Galapagos Islands, 0-128 m; generally Caribbean Sea and Eastern Pacific Ocean from Puget Sound, Washington, to Ecuador, 0-234 m.

Ampelisca schellenbergi Shoemaker

Ampelisca schellenbergi Shoemaker, 1933a:3-5, fig. 2.—J. L. Barnard, 1954b:14-16, pls. 7, 8; 1969a:188.

MATERIAL.—TOP 2; PAZ 19, 20.

DISTRIBUTION.—Gulf of California, 0-128 m; generally Caribbean Sea, Gulf of Mexico and Eastern Pacific Ocean from Cayucos, California to Peru, 0–128 m, probably rare below 20 m.

AMPHILOCHIDAE

Many of the specimens of this family were lost in transit between Mexico and Washington, D.C.; much of the data were reconstituted by sorting out fresh specimens from new aliquots in the original samples but the following samples could not be reconstituted because all specimens had been sorted out in the original examination and were therefore lost: SCO 1, 18; KNO 1; TOP 1; PAZ 3, 21, 22.

Taxonomy of this family in the eastern Pacific Ocean remains unsatisfactory. Close comparison of specimens with European taxa will be needed to determine if the type-species of *Amphilochus* and *Gitanopsis* are distinct generically from eastern Pacific species. The eastern Pacific taxa bear an accessory flagellum, lack setation on article 3 of the mandibular palp, have more poorly developed mandibular molars (even in *Gitanopsis*), have strong setation on the palps of maxilla 1 and usually bear much better developed gnathopods with distinctive shapes.

Amphilochus ?neapolitanus Della Valle

[?]*Amphilochus neapolitanus* Della Valle, 1893:595 [probably distinct from Pacific material].
Amphilochus neapolitanus.—J. L. Barnard, 1962c:126, fig. 3; 1969b:83. [?Not Della Valle.]

REMARKS.—Eastern Pacific specimens remain to be compared with European types.

MATERIAL.—PAZ ?2; GAL 106, 107, 108, 113, 115, 116, 118, 121; DAW 4, 5, 6, 9, 16, 17, 18, 20, 26, 27, 31, 32, 33, 35, 37, 38; COCOS 3; ECU 2; PAN 14.

DISTRIBUTION.—Possibly pantropical and warm-temperate, 0–80 m; eastern Pacific Ocean specific distribution; Cayucos California south to Ecuador and the Galapagos Islands, in the Gulf of California as yet recorded only from Bahía La Paz, 1 m; generally shallow water.

Amphilochus picadurus J. L. Barnard

Amphilochus picadurus J. L. Barnard, 1962c:126–129, fig. 4; 1969b:82.

REMARKS.—Distinguished from *Gitanopsis baciroa*, new species, to which it bears great similarity except in mandible, by the wavy serrations on the palm of gnathopod 2 as contrasted to the extremely fine comb of *G. baciroa*. The anterolateral spines on the hand of gnathopod 2 in *G. baciroa* are difficult to see except under highest magnification. The eyes of *A. picadurus* in Gulf of California material have distinct cores like those of *G. baciroa*.

MATERIAL.—PAZ 12, 13, 24.

DISTRIBUTON.—Goleta, California, southward into Gulf of California at Bahía San Evaristo and Bahía Concepción, 0–41 m.

Gitanopsis baciroa, new species

FIGURES 2, 3

DIAGNOSIS OF FEMALE.—Pleonites dorsally smooth. Eyes large, formed of dark core surrounded by unpigmented ommatidia (in alcohol). Gnathopod 1 large, similar in structure to gnathopod 2, subchelate, process of article 5 reaching about three-fourths along posterior margin of article 6; gnathopod 2 larger than gnathopod 1, posterodistal end of article 2 with slender seta, article 6 with 2 anterior thin spines laterally, process of article 5 reaching fully along posterior margin of article 6. Telson much shorter than peduncle of uropod 3. Coxa 1 more or less quadrate, coxa 2 rounded ventrally.

MALE.—Body size much smaller than female, ranging between 1.50 and 1.75 mm in length, females of similar size with small eye, males with eye relatively as large as that of ovigerous females longer than 2.50 mm, males with juvenile-like conditions of sparser spination and less expanded hand of gnathopod 2.

ILLUSTRATIONS.—Following mouthparts magnified identically: mandible, lower lip, maxillae 1–2, maxilliped; coxae 3–4 reduced in magnification in comparison with coxae 1–2; pereopod 2 similar to pereopod 1; apices of pereopods 3–5 missing on material; detached telson and uropod 3 magnified to same degree.

HOLOTYPE.—USNM 169028, female "n," 2.77 mm (illus.).

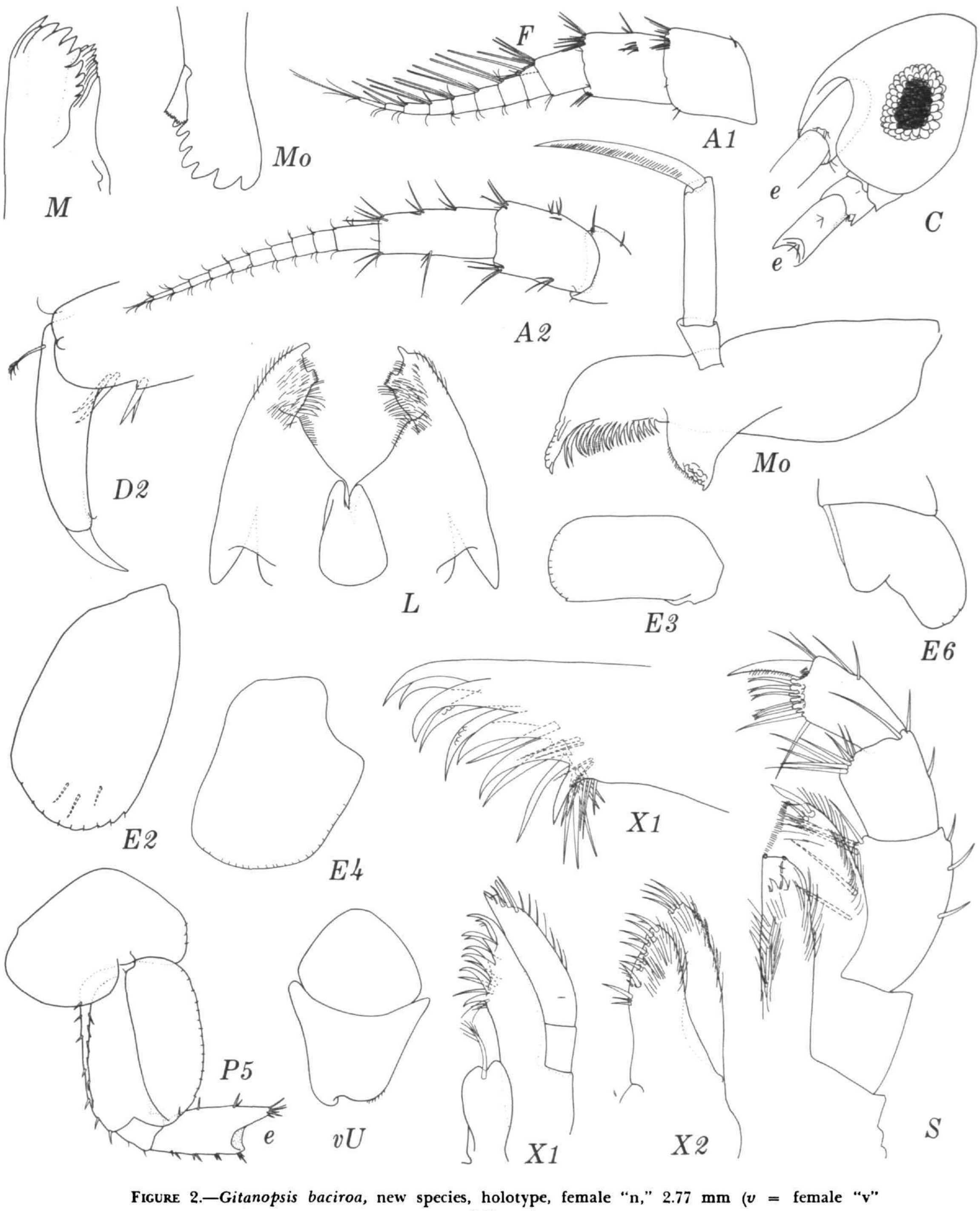

FIGURE 2.—*Gitanopsis baciroa*, new species, holotype, female "n," 2.77 mm (*v* = female "v" 2.89 mm).

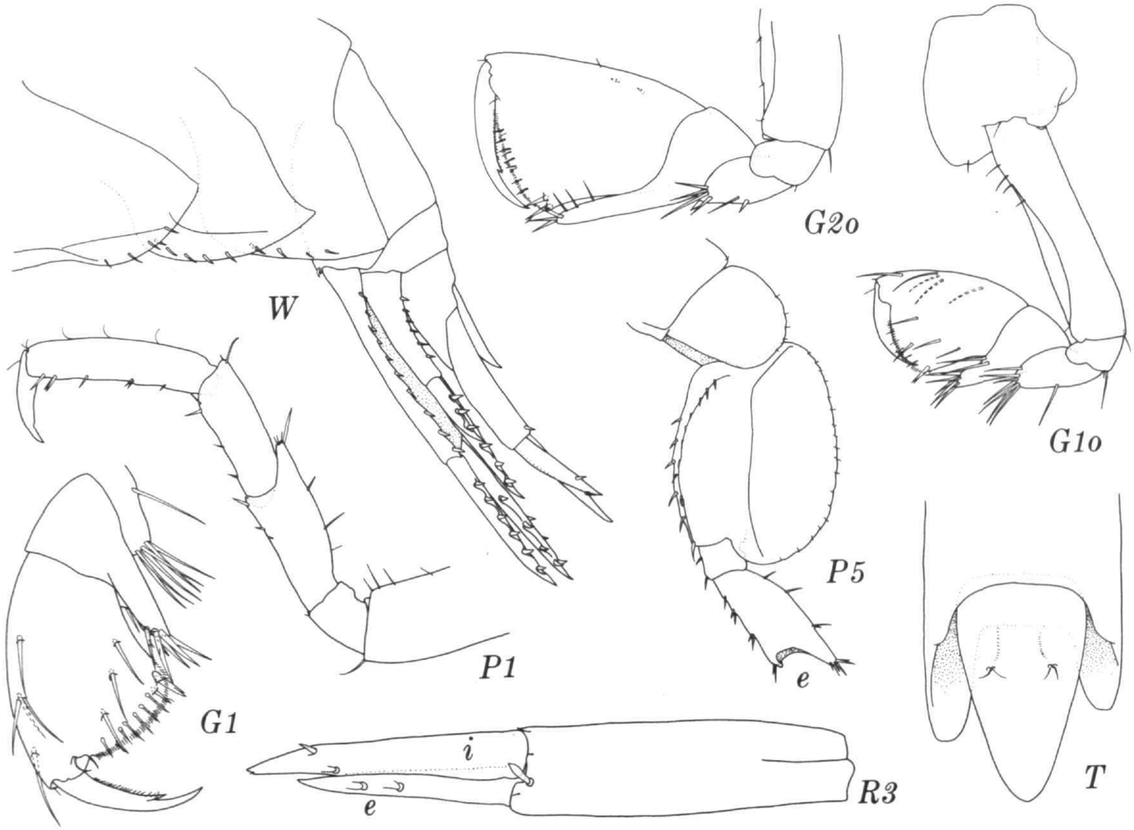

FIGURE 3.—*Gitanopsis baciroa*, new species, holotype, female "n," 2.77 mm.

TYPE-LOCALITY.—DAW 8, Galapagos Islands, Isla Santa Cruz, off Academy Bay on Isla Coamaño, 13 February 1962, wash of *Cystophora* (depth unknown).

VOUCHER MATERIAL.—Type-locality, female "v," 2.89 mm (illus.).

RELATIONSHIP.—This species scarcely differs from *Gitanopsis vilordes* J. L. Barnard (1962c) but consistently bears a thin posterodistal seta on article 2 of gnathopod 2, instead of a stout spine, and has a much different shaped coxa 2, being narrow and apically rounded rather than subquadrate.

MATERIAL.—SCO 19; TOP 3; GAL 116, ?120; DAW 3, 8, 19.

DISTRIBUTION.—Gulf of California at Puerto Peñasco and Topolobampo, 0–1 m; Galapagos Islands, intertidal.

AMPITHOIDAE

Ampithoe guaspare, new species

FIGURE 4 (part)

DIAGNOSIS OF MALE.—Epimera 2–3 flat posteriorly, posteroventral corners rounded-quadrate. Article 5 of gnathopod 1 shorter than article 6, posterior lobe truncate, extended as sharp tooth distally, article 6 subrectangular, palm oblique, poorly developed, defined by strong spine, dactyl overlapping palm. Gnathopod 2 with oblique and weakly excavate palm defined by medium sized subacute projection, anterodistal margin of hand tumid, weakly produced, heavily setose, dactyl slender, fitting palm, article 5 elongate, with moderately developed, broad, blunt posterior lobe, article 2 with large

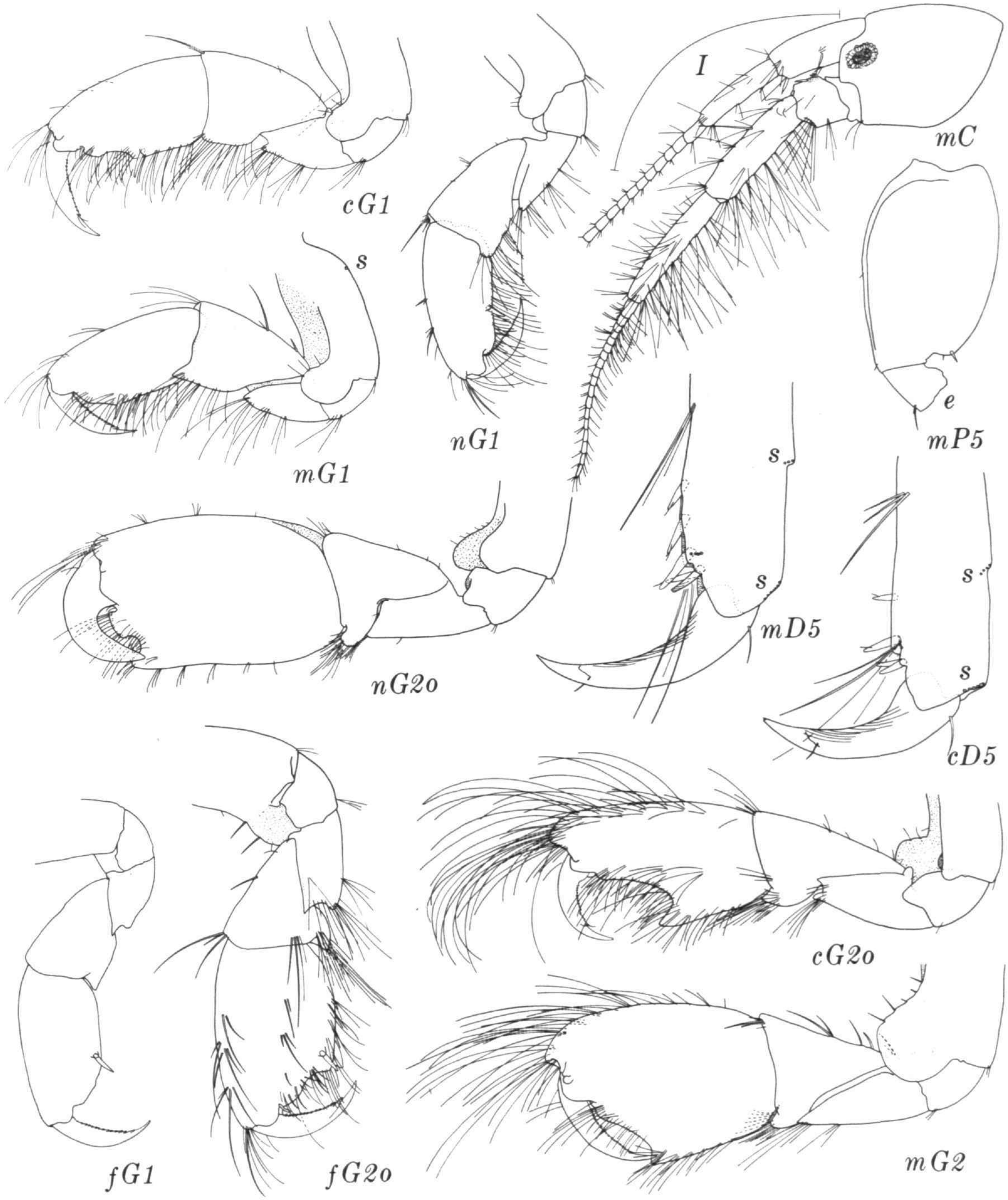

FIGURE 4.—*Ampithoe guaspare,* new species (*m* = holotype, male "m," 6.24 mm; *f* = female "f," 6.32 mm; *I* = remainder of antenna). *Ampithoe ramondi* Audouin (*c* = male "c," 5.23 mm). *Ampithoe plumulosa tepahue,* new subspecies (*n* = holotype male "n" 10.49 mm).

blunt lobe at anterodistal corner laterally. Antenna 1 longer than antenna 2, both pairs slender, peduncle of antenna 1 reaching apex of article 4 on peduncle of antenna 2, antenna 2 moderately setose, flagellum slender, about three-fourths as long as article 4–5 of peduncle together. Lateral apical lobule of lower lip projecting strongly, medial lobule very broad, blunt, scarcely projecting. Coxa 1 produced forward. Peduncular process of uropod 1 absent. Body poorly pigmented, eyes red in alcohol.

FEMALE.—Gnathopod 1 with article 5 shorter than in male and less strongly produced apicoposteriorly; gnathopod 2 small, article 5 shorter than in male, palm oblique, slightly concave.

DESCRIPTION.—Lower lip as shown for *Ampithoe ramondi* by J. L. Barnard (1965a, fig. 15e), pereopods generally similar but articles 2, 6, and 7 of pereopod 7 shown herein; outer ramus of uropod 3 as in figure 16j of Barnard (1965a), but inner ramus with only 3 spines and 6 setae.

HOLOTYPE.—USNM 169014, male "m," 6.24 mm (illus.).

TYPE-LOCALITY.—DAW 27, Galapagos Islands, Isla Santa Cruz, Academy Bay, 16 February 1962, intertidal, rock wash.

VOUCHER MATERIAL.—Type-locality, female "f," 6.32 mm (illus.).

RELATIONSHIP.—This species is very similar to *Ampithoe ramondi* and might appear to be a youthful stage of that species; but in the Galapagos Islands *A. ramondi* is much smaller than this species when the hand of male gnathopod 2 is fully developed with deep incision and blunt tooth. The palm of male *A. guaspare* remains scarcely excavate, the hand is broadened and the anterodistal tumidity remains weaker than in *A. ramondi.*

MATERIAL.—GAL 114, 116; DAW 27, 31, 35, 40.

DISTRIBUTION.—Galapagos Islands, Academy Bay, Isla Santa Cruz, Darwin Bay, Tower Island; intertidal.

Ampithoe plumulosa Shoemaker

Ampithoe plumulosa Shoemaker, 1938:16–19, fig. 1; 1942:39.—J. L. Barnard, 1959:37; 1965b:20, figs. 11, 12; 1969a:190; 1969b:84.

MATERIAL.—SCO 1, 5, 7, 10, 12, 14, 16, 18, 19, 21, 22; KNO 1; TOP 3; PAZ 2, 3, 6, 7, 8, 9, 10, 11, 13, 18, 20, 24, 25; GAL 101, 107, 108, 115, 120; DAW 3, 4, 5, 9, 16, 20, 27, 30, 33, 35, 38, 40; ECU 2, 3; PAN 14.

DISTRIBUTION.—British Columbia to Ecuador, including Gulf of California and Galapagos Islands, intertidal and shallow sublittoral.

Ampithoe plumulosa tepahue, new subspecies

FIGURE 4 (part)

DIAGNOSIS.—Differing from the nominate subspecies in the terminal male by the development of a sinus and square tooth on the palm of gnathopod 2.

DESCRIPTION.—Subterminal males as in typical subspecies.

HOLOTYPE. USNM 169015, male "n," 10.49 mm (illus.).

TYPE-LOCALITY.—DAW 31, Galapagos Islands, Isla Santa Cruz, halfway between Academy Bay and Tortuga Bay, 22 February 1962, 6–9 m, algae-rock wash.

MATERIAL.—DAW 31 (7 specimens).

DISTRIBUTION.—Galapagos Islands: Isla Santa Cruz, 6–9 m.

Ampithoe pollex Kunkel

FIGURE 5 (part)

Ampithoe pollex Kunkel, 1910:92–94, fig. 36.—J. L. Barnard, 1954a:29–31, pls. 27, 28; 1969a:190, fig. 8; 1969b:84.

VOUCHER MATERIAL.—GAL 102, male "k," 3.44 mm (illus.).

RELATIONSHIP.—Galapagan specimens differ from continental specimens in the broader article 2 of pereopods 4–5, which resembles that seen in *Ampithoe tahue.* The rami of uropod 3 are generally smaller as in *A. tahue.* Tracing of the ancestry of *A. tahue* and *A. vacoregue* appears possible through these features, as well as conformity in lower lips and gnathopod 1. *Ampithoe pollex* often occurs in samples with *A. tahue* and *A. vacoregue.* The latter 2 species are known only in the female phase. Until their reproductive biology is studied, they are segregated at specific level rather than being considered phases of *A. pollex.*

The samples in which occur *A. tahue* and *A. vacoregue* also contain occasional juvenile males and very rarely terminal males of *A. pollex*; the

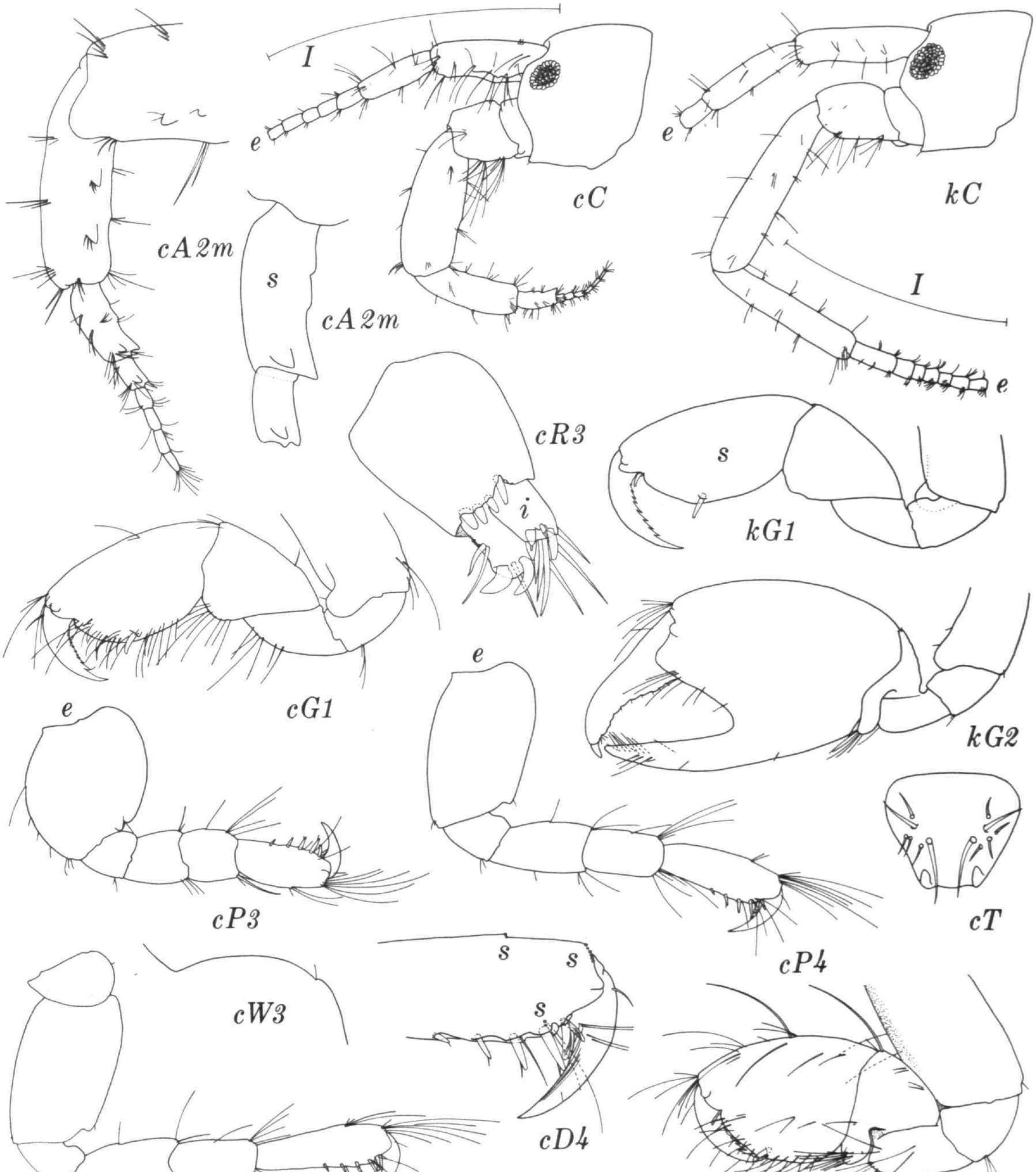

FIGURE 5.—*Ampithoe pollex* Kunkel (*k* = male "k," 3.44 mm). *Ampithoe tahue,* new species (*c* = female "c," 4.01 mm; *I* = remainder of antenna).

juveniles have stout antenna 2 like juvenile females of the other two species, but whether or not these represent males of those species is unknown. The samples have been retained in mixed condition to facilitate future disentanglement of the problem.

MATERIAL.—SCO 1, 12, 13, 14, 19; KNO 2, 3, 5, 6, 10; PAZ 3, 7, 10, 12, 13, 14, 15, 16, 17, 19, 21, 22, 23, 24; GAL 102, 108, 109, 113, 114, 115, 116; DAW 1, 2, 3, 5, 9, 10, 13, 16, 19, 21, 22, 26, 27, 33, 37; BRU 1.

DISTRIBUTION.—Bermuda and eastern Pacific Ocean from Coos Bay, Oregon into the Gulf of California and across to the Galapagos Islands, littoral and shallow sublittoral.

Ampithoe ramondi Audouin

FIGURE 4 (part)

Ampithoe ramondi Audouin, 1826:93.—Shoemaker, 1942:40.—J. L. Barnard, 1955a:28–29; 1965b:25–27, figs. 15, 16; 1969a:190, fig. 7o,p.

VOUCHER MATERIAL.—GAL 105, male "c" 5.23 mm (illus.).

REMARKS.—Males of this species in the Galapagos Islands reach only 5.5 mm in length, about 1 mm shorter than *A. guaspare*, new species, and much smaller than in other parts of its range. The palm of gnathopod 1 is definitely excavate. This may be a distinction marking the specificity of this taxon in the Galapagos Islands.

The inner ramus of uropod 3 has 4 spines and 5 setae apically. The antennae generally resemble those of *A. guaspare* in contrast to specimens illustrated from the Hawaiian Islands by J. L. Barnard (1970; fig. 18a). Article 2 of pereopod 7 has 1 spinule at the posteroventral corner.

MATERIAL.—PAZ 24; GAL 105, 109, 114, 115, 118, ?120; DAW 6, 17, 18, 23, 28, 31, 35.

DISTRIBUTION.—In the Gulf of California only recorded from Bahía de Los Angeles and Bahía Concepción; Galapagos Islands; eastern Pacific northern record at Bahía de San Ramon, Baja California; said to be tropicopolitan; phycophilous, intertidal or shallow sublittoral.

Ampithoe tahue, new species

FIGURE 5 (part)

DIAGNOSIS OF FEMALE—Pleonal epimera 2–3 with small setule notch at posteroventral corner, no lateral ridges. Article 5 of gnathopod 1 shorter than article 6, posterior edge of article 5 with rounded-truncate lobe, palm oblique, gnathopod 2 especially stout, posterior lobe of wrist thin and elongate, hand tumid; article 2 of both gnathopods with anterodistal lobe laterally, not prominent on gnathopod 2. Article 2 of pereopods 1–2 about 2.6–2.8 times as long as broad. Ventral edge of article 1 on antenna 1 not spiniferous; peduncles of antennae 1–2 short, peduncle of antenna 2 stout, article 5 only 0.7 times as long as article 4, medial surfaces of articles 4–5 with weak conical protuberances, 2 or 3 cones on article 4, 2 on article 5, first article of flagellum elongate, with apicomedial cone and apicoposterior tooth, article 2 of flagellum very short but also with cone and tooth, flagellum only 7-articulate and about as long as article 5 of peduncle. Apical lobules of lower lip about equally short, bulbous, appressed. Coxa 1 produced forward. Peduncular process of uropod 1 vestigial. Rami of uropod 3 especially small. Article 2 of pereopods 4 and 5 weakly expanded, with protruding posteroventral corner. Telson ordinary.

MALE.—Unknown.

HOLOTYPE.—USNM 169016, female "c," 4.01 mm (illus.).

TYPE-LOCALITY.—GAL 102, Galapagos Islands, Isla Santa Cruz, Academy Bay, 23 January, 1964, intertidal, from rocks in tidepool.

RELATIONSHIP.—This species is an apparent sibling of *A. pollex* Kunkel. The female is very similar to the female of *A. pollex*, especially in the critical features of lower lip and gnathopods but differs from that species in the shortened antennae, especially antenna 2, which resembles in rudimentary form the very stout antennae of the *A. lindbergi* group. In addition, the medial surfaces of articles 4–5 on the peduncle bear weak cone-teeth and article 1 of the flagellum on antenna 2 is elongate and also bears teeth. Uropod 3 is like that of male *pollex* with shortened rami. Gnathopod 2 is very tumid for a female of the genus.

DAW 27 has most males and females of the *pollex* form with thin bodies, thin antennae, but one stout female of *A. tahue* is present and one large stout male of this species with juvenoid gnathopod 2 like that of *A. pollex* is present. At 4.8 mm this stout male is significantly larger than the normal terminal males (about 3.5 mm) but lacks any of the modifications on the antennae of females of *A. tahue* and *A. vacoregue* except for the stoutness of antenna 2 and the relatively short flagellum. One might suggest that *A. tahue* and *A. vacoregue* are therefore simply aberrant superfemales, though they bear normally setose brood plates and carry eggs.

MATERIAL.—GAL 102, 103; DAW 27, 40.

DISTRIBUTION.—Galapagos Islands, Isla Santa Cruz, Academy Bay, intertidal.

Ampithoe vacoregue, new species

FIGURE 6 (part)

DIAGNOSIS OF FEMALE.—Pleonal epimera 2–3 with weak setule notch at posteroventral corner, no lateral ridges. Article 5 of gnathopod 1 shorter than article 6, posterior edge of article 5 with rounded posterior lobe, palm oblique, gnathopod 2 of female form, article 5 short and lobate, article 2 of both gnathopods with anterodistal lobe laterally. Article 2 of pereopods 1–2 about twice as long as wide. Ventral edges on articles 1–3 of antenna 1 not spiniferous, furnished with elongate setae, especially dense on articles 1–2; antenna 2 much shorter than antenna 1, flagellum of antenna 1 slightly longer than peduncle, flagellum of antenna 2 shorter than article 5 of peduncle, article 4 of peduncle with sharp posterodistal extension medially. Apical lobules of lower lip obsolescent, apices of outer lobes weakly sinuate. Coxa 1 produced forward. Peduncular process of uropod 1 absent; rami of uropod 3 especially small. Article 2 of pereopods 3–5 weakly expanded, with protruding posteroventral corner. Knobs on telson slightly enlarged.

MALE.—Unknown.

HOLOTYPE.—USNM 169017, female "g," 5.65 mm (illus.).

TYPE-LOCALITY.—DAW 31, Galapagos Islands, Isla Santa Cruz, halfway between Academy Bay and Tortuga Bay, 22 February 1962, 6–9 m, algae and rock wash.

RELATIONSHIP.—The only known species in the eastern Pacific to which this taxon, known only for the female, is related, appear to be *A. pollex* and *A. tahue*. The shapes of gnathopod 1 and the lower lip are the clues to this relationship. *Ampithoe vacoregue* appears on first sight to be identifiable with *A. tahue* but differs from *A. tahue* in the duplication on pereopod 3 of the shapes on pereopods 4–5, in the lack of medial cones on antenna 2, the sharpness of the posterodistal and medial extensions on article 4 of the peduncle on antenna 2, the much more setose peduncle of antenna 1 and the more slender gnathopod 2.

MATERIAL.—DAW 31 (4 females only).

DISTRIBUTION.—Galapagos Islands, Isla Santa Cruz, vicinity of Academy Bay, intertidal.

Ampithoe kulafi J. L. Barnard

Pleonexes(?) species.—J. L. Barnard, 1965a:542–543, fig. 34.
Ampithoe kulafi J. L. Barnard, 1970:30.

HOLOTYPE.—USNM 106907, male, 4.0 mm.

TYPE- LOCALITY.—Abbott Station 141-D 3, Ifaluk Island, west reef between Elangalap Islet and north tip of Falarik Islet, 20 October 1953, 1 fathom, wash from algae, lagoonward reef margin.

REMARKS. Heretofore a holotype had not been designated.

ANAMIXIDAE

Anamixis linsleyi J. L. Barnard

Anamixis linsleyi J. L. Barnard, 1955c:28–30, figs. 2a–d, f–m, o–w; 1969b:89.

MATERIAL.—PAZ 3, 12; DAW 31.

DISTRIBUTION.—Gulf of California: Bahía San Evaristo and Isla Espiritu Santo, intertidal; generally, from Carmel, California, to Bahía San Evaristo, Gulf of California and across to the Galapagos Islands, intertidal, probably associated with tunicates and sponges.

BATEIDAE

Batea rectangulata Shoemaker

Batea rectangulata Shoemaker, 1925:31, figs. 7–9; 1926:9–13, figs. 5–7.—J. L. Barnard, 1969a:193.

MATERIAL.—PAZ 10, 12, 13.

DISTRIBUTION.—Gulf of California at Bahía de San Francisquito, at Isla San Francisco, and Bahía San Evaristo, 0–40 m.

Batea susurrator J. L. Barnard

Batea susurrator J. L. Barnard, 1969a:193–195, fig. 10.

MATERIAL.—PAZ 1, 11.

DISTRIBUTION.—Gulf of California; Bahía de Los Angeles, Isla San Francisco, and La Paz, 0–37 m.

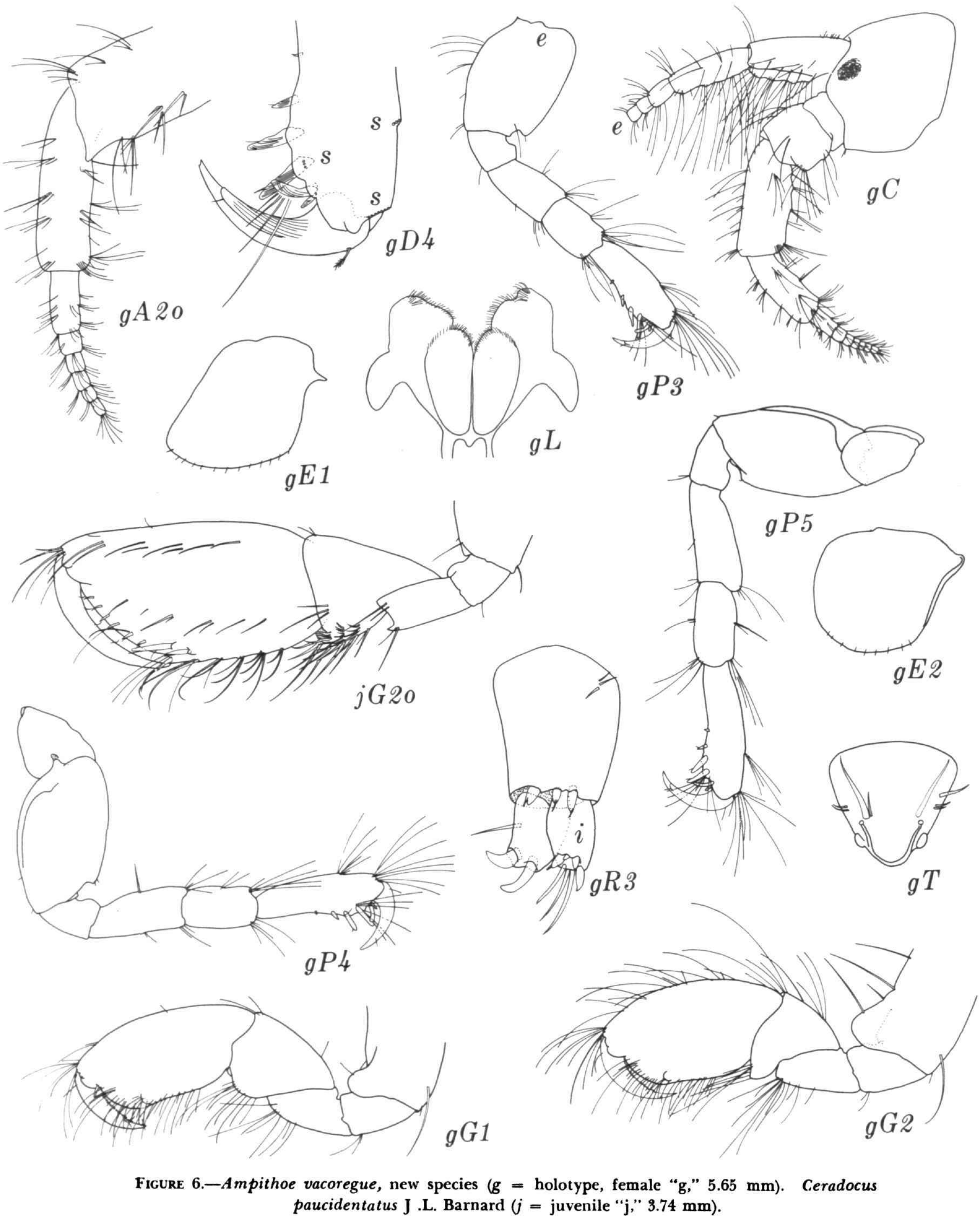

FIGURE 6.—*Ampithoe vacoregue*, new species (*g* = holotype, female "g," 5.65 mm). *Ceradocus paucidentatus* J .L. Barnard (*j* = juvenile "j," 3.74 mm).

Batea transversa Shoemaker

FIGURE 7

Batea transversa Shoemaker, 1926:13–18, figs. 8–11.—Hewatt, 1946:204.—J. L. Barnard, 1962b:80, fig. 6.—Reish and Barnard, 1967:15–16.—J. L. Barnard, 1969b:94–95.
Batea transversa coyoa J. L. Barnard, 1969a:195, fig. 7d,e,f,g.

VOUCHER MATERIAL.—AHF 4818, male "a," 5.7 mm (illus.).

REMARKS.—Intertidal specimens (3–4 mm long) are half to two-thirds the size of sublittoral specimens (5–6 mm) but are sexually mature. They have been identified by the key in J. L. Barnard (1969a) according to coxa 2, pereopod 3, epimeron 3, and the mandibular palp; but the small size of the specimens complicates identification because of the poorly toothed dactyls on gnathopod 2, the poor development and setation of article 2 on pereopods 3–5, and the generally more stout gnathopod 2 than in sublittoral adults.

DESCRIPTION OF FEMALE.—Apart from presence of brood plates no apparent differences from male except that all definitely identified females 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; 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 discussion under "Female," above; dorsal process of pleonite 3 highly variable, not apparently associated with size (above 3.7 mm), varying from high rhombic (Figure 7) to quadrato-rhombic to transverse-rhombic, pleonite 2 often bearing similar but smaller rhombic process or rounded lobe; pereopod 5 occasionally with ex-

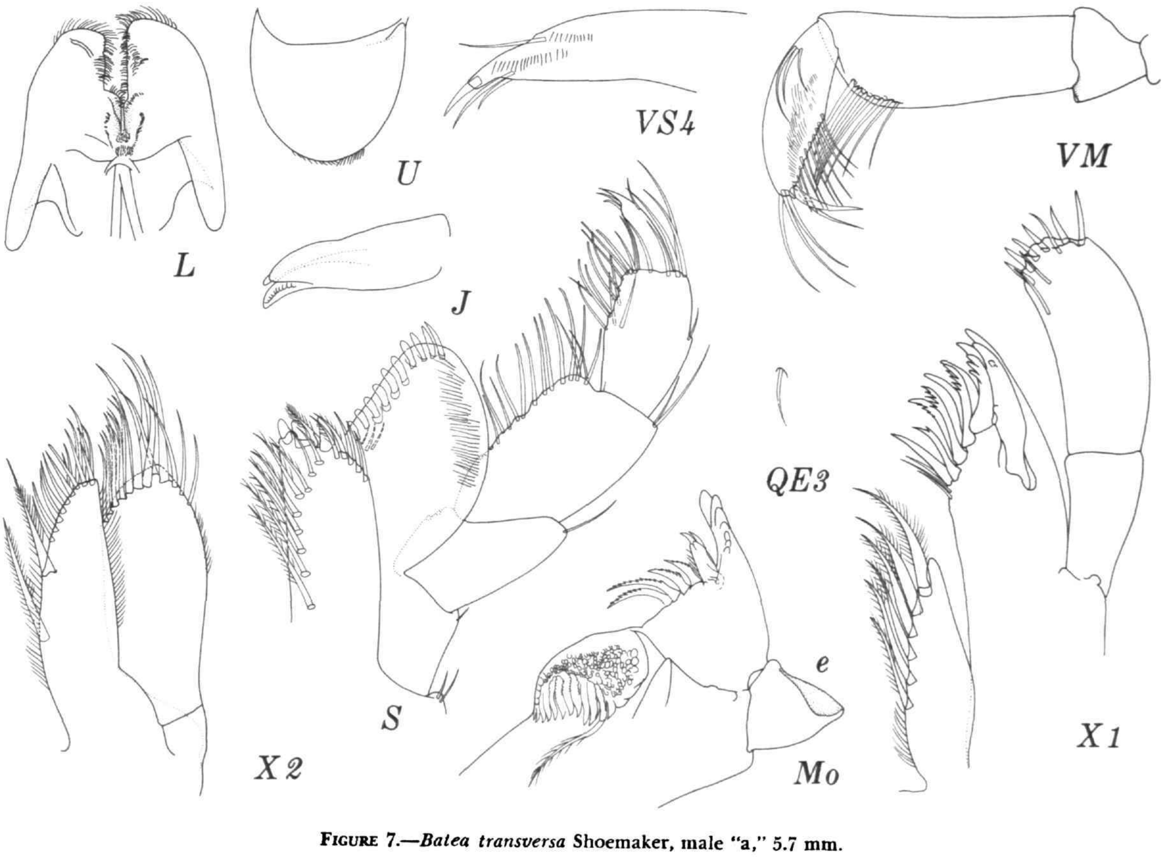

FIGURE 7.—*Batea transversa* Shoemaker, male "a," 5.7 mm.

treme rounded protrusion on article 2 at posterodorsal corner, protrusion weak in most specimens, absent in small specimens and males.

ADDITIONAL RECORD.—Allan Hancock Station 4818, southern California, 34°30′20″N, 120°30′30″W, 19.8 m, 16 January 1957.

MATERIAL.—PAZ 8.

DISTRIBUTION.—California, Morro Bay, Channel Islands (abundant) off southern California, and coastal shelf of southern California (rare) southward to Gulf of California at Isla Partida, 0–60 m, with subspecies *coyoa* at Bahía de Los Angeles, 9–37 m.

COLOMASTIGIDAE

Colomastix species

Colomastix pusilla.—Shoemaker, 1942:12.—J. L. Barnard 1969b:100–101 [not Grube].

REMARKS.—Specialists studying this group have advised me that the so-called "*Colomastix pusilla*" of Hawaii and California may represent a new species. Until their works can be completed, the specimens of this genus in the collections at hand are held for future study.

MATERIAL.—TOP 2, 3; GAL 115.

COROPHIIDAE

Acuminodeutopus periculosus J. L. Barnard

Acuminodeutopus periculosus J. L. Barnard, 1969a:190–192, fig. 9.

MATERIAL.—SCO 13; unidentified specimens of genus from PAZ 8, DAW 31.

DISTRIBUTION.—Gulf of California: Puerto Peñasco and Bahía de Los Angeles, 0–38 m.

Cheiriphotis megacheles (Giles)

FIGURE 34 (part)

Melita megacheles Giles, 1885:70–71, pl. 3.
Cheiriphotis megacheles (Giles).—J. L. Barnard, 1962a:17, fig. 4; 1969b:141–142.

VOUCHER MATERIAL.—DAW 9, male "h," 2.26 mm (illus.).

REMARKS.—This species is presumably tropicopolitan but more investigation is required on the taxonomy of the complex.

VARIATION.—The Galapagos material has the middle tooth on the palm of male gnathopod 2 shifted more proximally than in continental specimens (Figure 34: *hG2*).

MATERIAL.—PAZ 22; GAL 102, 103, 116; DAW 3, 8, 23, 26, 27, 35, 40; COCOS 1, 9.

DISTRIBUTION.—Eastern Pacific Ocean: Cayucos, California southward to Cabo San Lucas but not yet recorded in the Gulf of California; Galapagos Islands; Cocos Island; intertidal to 16 m.

Chevalia aviculae Walker

Chevalia aviculae Walker, 1904:288–290, pl. 7: fig. 50, pl. 8: fig. 50.—J. L. Barnard, 1962a:17–20, fig. 5; 1969b:142.

VARIATION.—The Galapagos specimens are like those of California (J. L. Barnard, 1962a) in contrast to those of Hawaii (J. L. Barnard, 1970) in the shape of article 2 on pereopod 5 and shape of palm on gnathopod 2.

MATERIAL.—DAW 7, 9, 35, 40.

DISTRIBUTION.—Eastern Pacific form, from Cayucos, California southward to shelf off Bahía de San Quintín, outer Baja California, 0–35 m; Galapagos Islands, Isla Santa Cruz, intertidal, but not recorded in the Gulf of California.

Corophium baconi Shoemaker

Corophium baconi Shoemaker, 1934:356–359, fig. 1.—J. L. Barnard, 1969b:101.

MATERIAL.—SCO 14, 16, 19, 21, 22; KNO 1; TOP 2, 3; PAZ 3, 13; DAW 31, 36.

DISTRIBUTION.—Bering Sea to Peru, and into the Gulf of California and across to the Galapagos Islands, 0–55 m.

Ericthonius brasiliensis (Dana)

Pyctilus brasiliensis Dana, 1853–1855:976–977, pl. 67: fig. 5a–h.
Ericthonius brasiliensis (Dana).—J. L. Barnard, 1955a:37–38; 1959:39; 1961:183; 1964a:112; 1964b:219; 1969a:197; 1969b: 102, fig.24f–i.

MATERIAL.—SCO 1, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 21, 22; KNO 1, 10; TOP 2, 3; PAZ 2, 3, 10, 11, 24, 25; GAL 106, 107, 108, 113, 114, 115, 116, 118, 119, 120; DAW 1, 3, 4, 5, 6, 8, 9, 16, 17, 18, 19, 21, 26, 27, 28, 32, 33, 35, 36, 37, 40; COCOS 1, 3; ECU 2; PAN 14.

DISTRIBUTION.—Eastern Pacific Ocean from Puget Sound, Washington, southward to Punta Centinela, Ecuador; into the Gulf of California as far as Puerto Peñasco, 0–42 m; and at the Galapagos Islands and Cocos Island; generally cosmopolitan in tropical and boreal seas, 0–171 m.

Gammaropsis tonichi (J. L. Barnard)

Eurystheus tonichi J. L. Barnard, 1969b:212, fig. 23.

MATERIAL.—SCO 9, ?15, 16, ?18, 19; KNO ?1; TOP 2, 3.

DISTRIBUTION.—Gulf of California, Puerto Peñasco, Bahía de Los Angeles, Bahía Kino, Topolobampo, 0–38 m.

Lembos Bate

Only adult males are identified to species.

The following key contains known species from the eastern Pacific Ocean. A key to Hawaiian species (Barnard, 1971b) may also be used to sort out probable new species that will be encountered in the eastern Pacific Ocean. *Lembos concavus* and *L. audbettius* are treated by J. L. Barnard (1962b).

Key to the Males of the Species of *Lembos* from the Eastern Pacific Ocean

1. Thorax lacking sternal teeth .... *L. concavus*
   Thorax bearing sternal teeth 2
2. Some sternal teeth doubled 3
   Each sternite with only one tooth 4
3. Coxa 1 strongly setose, setae elongate .... *L. tehuecos*, new species
   Coxa 1 poorly setose, setae minute .... *L. achire*, new species
4. Thorax with only 2 sternal teeth, eyes small, anterior margin of article 6 on male gnathopod 1 deeply convex .... *L. macromanus*
   Thorax with 6 sternal teeth, eyes enlarged, anterior margin of article 6 on male gnathopod 1 almost straight .... *L. audbettius*

Lembos macromanus (Shoemaker)

Bemlos macromanus Shoemaker, 1925:36–41, figs. 10–13.
Lembos macromanus.—J. L. Barnard, 1962a:9, fig. 3; 1964a:110; 1969a:192; 1969b:90–91 [?misidentification].

MATERIAL.—SCO 1, 12, 13, 14, 15, 16, 17, 18, 19; KNO 1; TOP 3; PAZ 3, 5, 6, 7, 8, 10, 12, 13, 18, 19, 24; GAL ?116, 117, 120; DAW 3, 4, 16, 32, 36.

DISTRIBUTION.—Gulf of California, 0–9 m; outer Baja California northward definitely to Estero de Punta Banda and provisionally northward to Cayucos, California, 0 m; Galapagos Islands, 0 m; Hawaii, 0 m; depth range, 0–9 m.

Lembos achire, new species

FIGURE 8

DIAGNOSIS OF MALE.—Lateral cephalic lobes strongly extended forward, truncate, anteroventral margin of head excavate, nearly flat-bottomed, then produced to weak, obtuse anteroventral cusp. Eyes subcircular, brownish black cores in alcohol surrounded by 1 or 2 layers of clear ommatidia. Coxa 1 short and broad, rectotrapezoidal, scarcely attenuate and subsharp anteroventral corner; anterior coxae poorly setose, setae sparse and short. Gnathopod 1 of medium to strong enlargement, article 2 of normal stoutness, anterodistal corner with strong, thin, mammilliform lobe, article 4 with distal point not free, article 5 of medium breadth, less than half as long as article 6, latter expanded, bulging anteriorly, with anteromedial setal brush curving freely distad, palm oblique, bearing deep incision separating 2 processes, unarmed defining process of medium length or short and projecting strongly posteriad, dactyl slender and scarcely overlapping palm, dactyl overriding face of hand; article 2 of gnathopod 2 with large anterodistal lobe similar to that of gnathopod 1, article 5 slightly broader and longer than article 6, palm weakly oblique, defined by spine, setation dense on anterior margins of articles 5–6. Thoracic sternites usually with 2 teeth each, one tooth occasionally obsolescent, sternite 5 with 2 tiny nipples, sternite 6 smooth, sternite 1 with 1 thick ventral tooth, teeth not arranged in bifid fashion as in *L. intermedius*, teeth

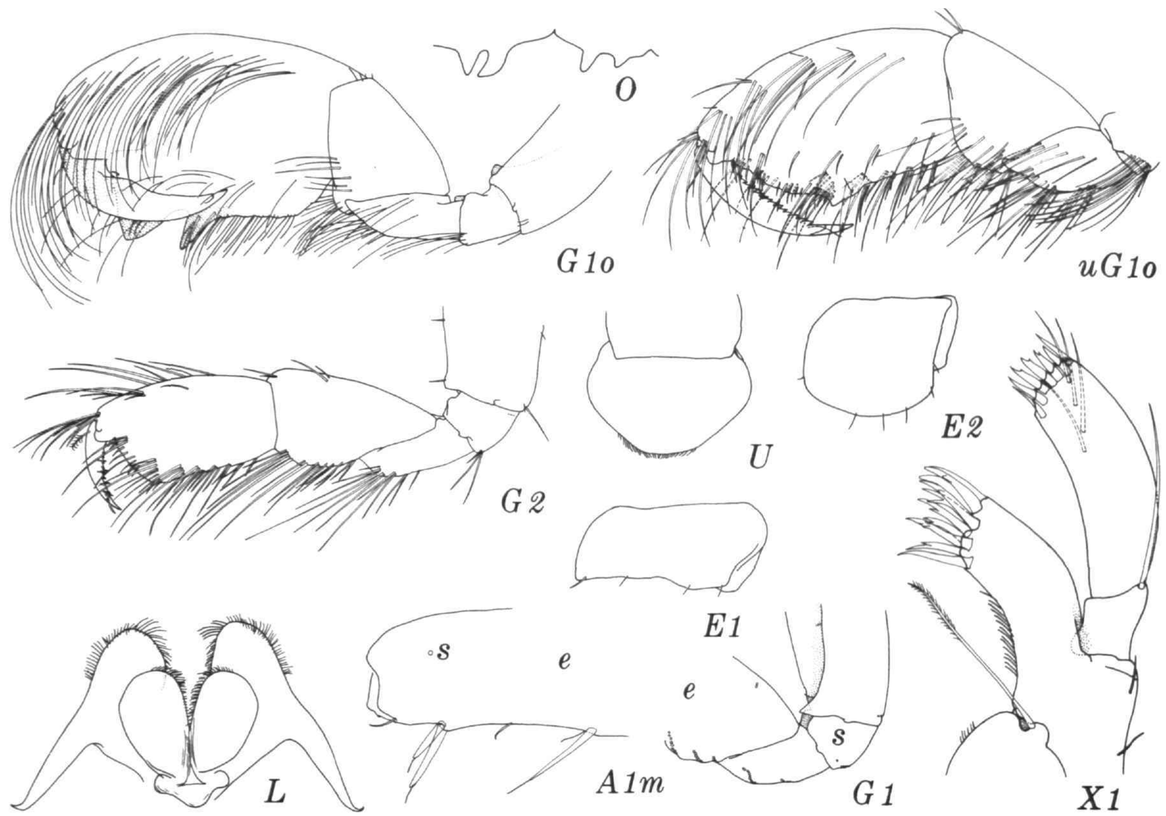

FIGURE 8.—*Lembos achire*, new species, holotype, male "a," 4.1 mm (*u* = female "u," 5.4 mm).

of sternite 3 closely contiguous. Pleonal epimera 1–3 with bulging posterior margins, weak lateral ridges and slight notch and tooth at posteroventral corners, ventral setules present on epimera 2–3. Outer ramus of uropod 3 uniarticulate.

FEMALE.—Coxa 1 longer and slightly less pointed anteroventrally than in male, bearing only short, dispersed setae ventrally; gnathopod 1 of normal kind in *Lembos*, anterodistal corner of article 2 lacking process, palm oblique, defined by 1 spine, terminal females with slightly sinuous palm and weak defining tooth; gnathopod 2 like that of male but lacking protuberance on article 2; epimeron 2 with ventral setae generally shown for *L. tehuecos* but lacking posterior setae, epimera 1 and 3 lacking all but 1 small seta at posteroventral corner.

DESCRIPTION.—Length of antennae unknown, antennae broken distally; epistome rounded anteriorly; article 1 of antenna 1 with 3 or 4 ventral spines as in *L. tehuecos*, rarely apical spine with partner; mouthparts generally as shown by Shoemaker (1925, figs. 10d, 11b–e) for *L. macromanus*, left mandible similar and bearing molarial seta about half as long as right, with large shark-tooth flake, right mandible as shown for *L. tehuecos*, palp as shown by Shoemaker, see Figure 8:*U* and *L* of upper lip and lower lip herein, see Figure 8: *X1* of maxilla 1, similar for *L. tehuecos* and *L. achire*, article 1 of palp with 1 long seta, palp with 4 facial setae; gnathopod 1 of female illustrated, note sinuous palm and weak defining tooth, this condition typical of *L. tehuecos* and *L. achire*, see Figure 9: *nG1o* of female gnathopod 1 in *L. tehuecos* for subterminal condition of female gnathopod 2 in both species; see Figure 8:*G2* of female gnathopod 2 in *L. achire* for condition typical of both *L. tehuecos* and *L. achire;* pereopods 3–5 unknown, missing on all specimens; pigment unknown, specimens long aged in alcohol.

ILLUSTRATION.—Setal densities of gnathopods 1–2 have been reduced in Figures 8 and 9.

HOLOTYPE.—USNM 142294, male "a," 4.1 mm (illus.).

TYPE-LOCALITY.—DAW 27, Galapagos Islands, Isla Santa Cruz, Academy Bay, 16 February 1962, intertidal, rock wash.

VOUCHER MATERIAL.—Type-locality, female "u," 5.4 mm (illus.).

RELATIONSHIP.—This species is almost identical to *L. tehuecos* from Gulf of California and may represent a subspecies of *L. tehuecos,* but this taxonomic refinement is difficult to ascertain because of the close relationship of *L. tehuecos* and *L. intermedius* Schellenberg from Hawaii. Both *L. tehuecos* and *L. achire* differ from *L. intermedius* primarily in the male sternal teeth, which in *L. intermedius* are usually paired and thrust outward on a pedicle, whereas in the other two species the teeth sit directly on the sternites. *Lembos achire* resembles *L. intermedius* in the poorly developed setae of the male coxae and thus lacks the second good character distinguishing *L. intermedius* and *L. tehuecos.* The only other character suggesting that *L. achire* and *L. tehuecos* are distinct species is the odd attachment region of the dactyl on the hand of male gnathopod 1, which is somewhat extended, truncate, and appears to force the dactyl to override the medial face of the hand. All males in the collections are preserved with the dactyl folded in this fashion. The upper lip of *L. achire* is not excavate as it is in *L. tehuecos.* Epimeron 2 of the male lacks a facial seta, but this character is typical only of a few of the oldest males of *L. tehuecos.*

Lembos achire, L. intermedius, and *L. tehuecos* form a triad of species showing strong interrelationships between the Galapagos, Hawaii, and America continents.

MATERIAL.—GAL 105, 107, 109, 113, 114, 116; DAW 1, 5, 9, 13, 19, 23, 26, 27, 31, 35, 36, 40; COCOS 3.

DISTRIBUTION.—Galapagos Islands, 0–6 m; Cocos Island, intertidal.

Lembos tehuecos, new species

FIGURES 9, 10

DIAGNOSIS OF MALE.—Lateral cephalic lobes strongly extended forward, truncate, anteroventral margin of head excavate, nearly flat-bottomed, then produced to weak, obtuse anteroventral cusp. Eyes subcircular, brownish black cores in alcohol surrounded by 1 or 2 layers of clear ommatidia. Coxa 1 short and broad, rectotrapezoidal, with slightly attenuate but rounded anteroventral corner; anterior coxae heavily setose below, setae dense and long and parallel to flat plane of coxa. Gnathopod 1 of medium to strong enlargement, article 2 of normal stoutness, anterodistal corner with strong, thin mammilliform lobe, article 4 with distal point not free, article 5 of medium breadth, less than half as long as article 6, latter expanded, bulging anteriorly, with anteromedial setal brush curving freely distad, palm oblique, bearing deep incision separating 2 processes, unarmed defining process of medium length or short, dactyl slender and scarcely overlapping palm; article 2 of gnathopod 2 with large anterodistal lobe similar to that of gnathopod 1, article 5 slightly broader and longer than article 6, palm weakly oblique, defined by spine, setation dense on anterior margins of articles 5–6. Thoracic sternites 2, 3, 4 usually with 2 teeth each, one tooth often obsolescent or absent, sternite 5 often with 2 tiny teeth (nipples), sternite 6 often smooth, occasionally with rudiments of nipples, sternite 1 with 1 thick ventral tooth, teeth not arranged in bifid fashion as in *L. intermedius.* Pleonal epimera 1–3 with bulging posterior margins, weak lateral ridges and slight notch and tooth at posteroventral corners, ventral setules present on epimera 2–3, epimeron 2 with long subventral seta. Outer ramus of uropod 3 uniarticulate.

FEMALE.—Coxa 1 longer and slightly less pointed anteroventrally than in male, bearing only short, dispersed setae ventrally; gnathopod 1 of normal kind in *Lembos,* anterodistal corner of article 2 lacking process, palm oblique, defined by 1 (aberrantly by 2) spine, terminal females with slightly sinuous palm and weak defining tooth; gnathopod 2 like that of male but lacking protuberance on article 2; epimera heavily setose, especially posterior margins of epimera of 1–2 and ventral margin of epimeron 2.

DESCRIPTION.—Antenna 1 as long as head, pereon and first 2 pleonites together, antenna 2 scarcely shorter than antenna 1; epistome rounded anteriorly; mouthparts generally as shown by Shoemaker (1925, figs. 10d, 11b–e) for *L. macromanus,* left mandible similar and bearing molarial seta

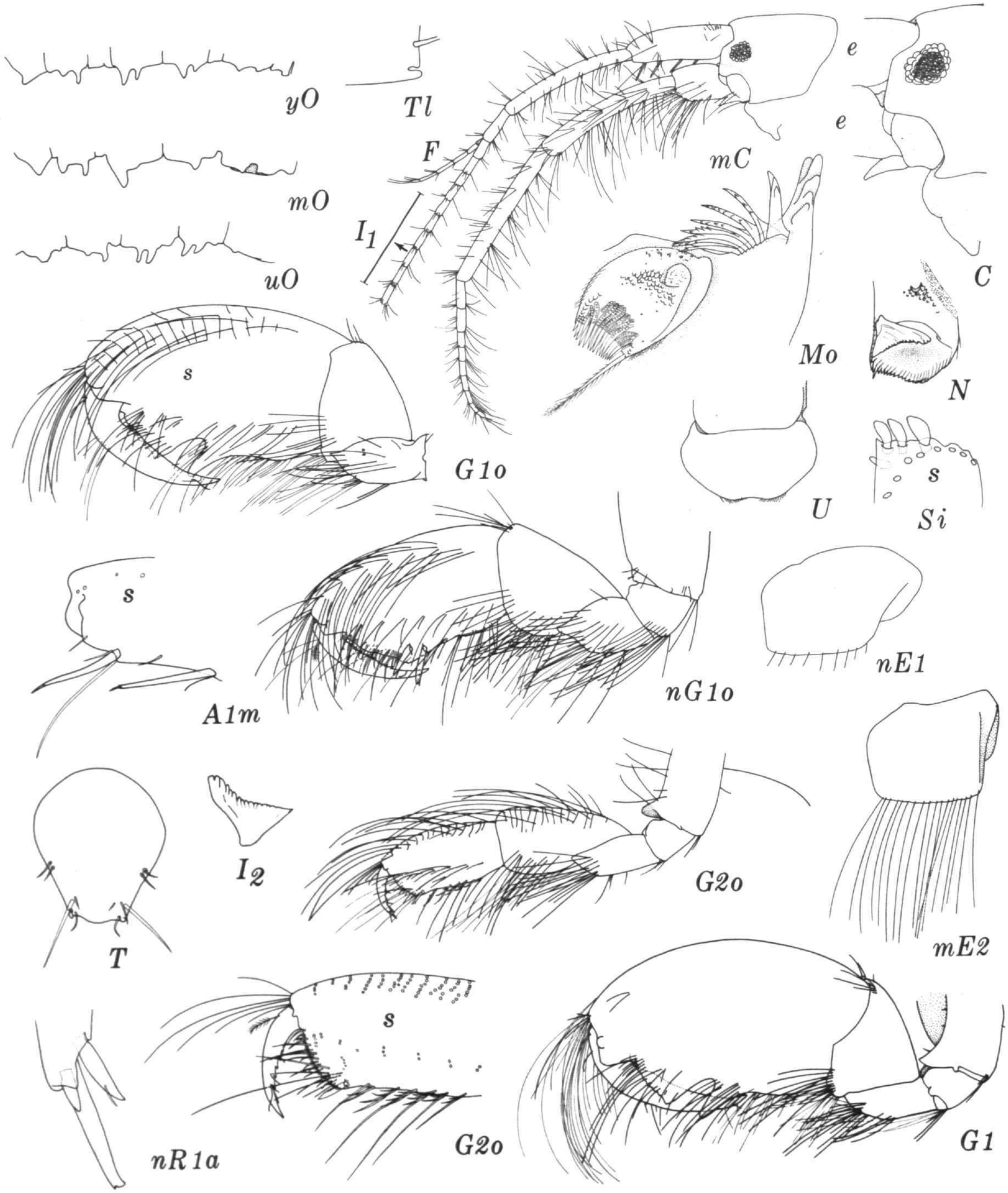

FIGURE 9.—*Lembos tehuecos*, new species, holotype, male "a," 4.4 mm (m = male "m," 3.6 mm; n = female "n," 4.8 mm; u = male "u," 4.4 mm; y = male "y" 4.3 mm; I_1 = remainder of antenna; I_2 = molarial flake).

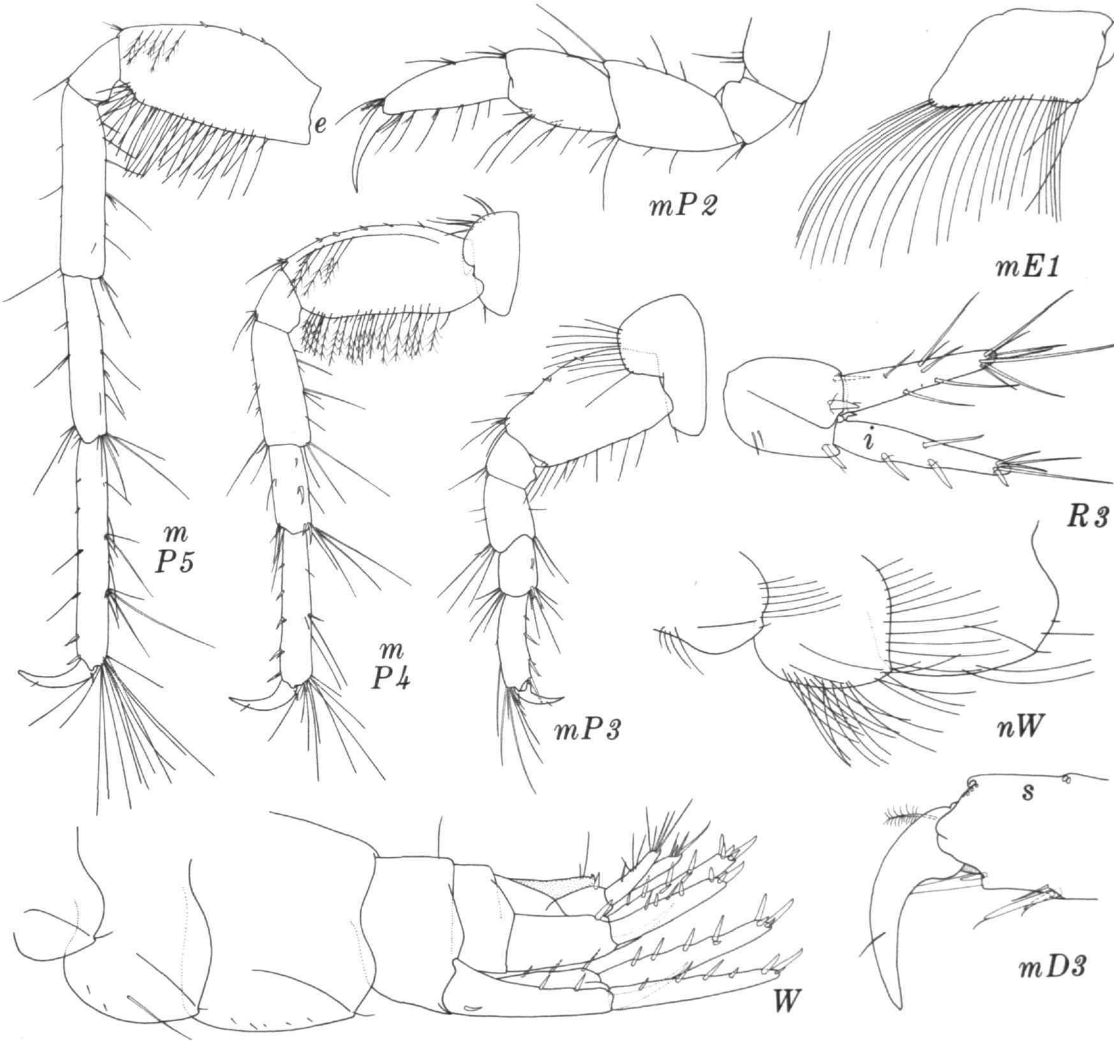

FIGURE 10.—*Lembos tehuecos*, new species, holotype, male "a," 4.4 mm (*m* = male "m," 3.6 mm; *n* = female "n," 4.8 mm).

about half as long as right, with large shark-tooth flake, right mandible figured, palp as shown by Shoemaker, palp of maxilla 1 with 4–6 facial setae, see Figures 9:*U* and *Si* of upper lip and inner plate of maxilliped, see Figures 8:*X1* and *U* of *L. achire* for similar maxilla 1 and lower lip but mandibular lobes uncurled apically; pereopods as illustrated; uropods 1–2 each with long interramal tooth; telson with weak apicolateral slit: female gnathopod 1 terminal condition as for *L. achire* (Figure 8: *uG1o*).

VARIATION.—One terminal male of PAZ 24 with coxa 1 like that of *L. achire*, long setae absent; smaller males in same sample with long setae of coxa 1 moderately well developed.

REMARKS.—In alcohol, on male pigmentary blotches composed of trabeculae covering postero-dorsal part of head, patches on epimera 1–3 and medial to epimera outlining bases of pleopods, vertical bands, 1 each on pereonites 1, 7, pleonites 1, 2; 2 bands on pereonites 4, 5, 6; 1.5 bands on pereonites 2, 3; coxae 2 and 5 clear, other coxae pigmented; occasionally pereonite 5 clear (this formula represents specimens with densest pigmentation, numerous other specimens with less pigmentation); female with 1 anterior and 1.5 posterior bands on pereonite 1 (or no posterior bands), 2 bands on pereonites 2, 3, 4, 6, and 1 band on pereonite 5 (or clear), and on pleonites 1, 2, 3; pereonite 7 clear. Note that *L. macromanus* (Shoemaker) is characterized by pigmentary trabeculae organized into stellate figures, whereas trabeculae of *L. tehuecos* meander.

ILLUSTRATIONS.—Setal densities of gnathopods 1–2 have been reduced in Figure 9.

HOLOTYPE.—USNM 142310, male "a," 4.4 mm (illus.).

TYPE-LOCALITY.—TOP 3, Gulf of California, Topolobampo, 25 November 1971, 1 m, rock wash, with tunicates and sponges.

VOUCHER MATERIAL.—Type-locality, female "n," 4.8 mm (illus); male "m," 3.6 mm (illus); male "u," 4.4 mm (illus.); male "y," 4.3 mm (illus.).

RELATIONSHIP.—This species bears close resemblance to *L. intermedius* Schellenberg from the Hawaiian Islands. This relationship is marked by the doubling of ventral teeth on certain sternites of the male, but in *L. intermedius* the outline forms a single bifid process on the several segments whereas in *L. tehuecos* the teeth are separate basally from each other. The heavy brush of medial setae on male gnathopod 1 is also congruent between the two species; but *L. tehuecos* has a setal brush on male coxa 1, and dense, long setae on coxae 2–4, untrue of *L. intermedius*. The two species show a relationship in the absence of article 2 on the outer ramus of uropod 3, and in the mammilliform lobe on article 2 of the male gnathopods. Perhaps these 2 species should be ranked at subspecific level.

Lembos tehuecos is easily distinguished from *L. macromanus* (Shoemaker), its sympatriot, in the setal brush of male gnathopod 1 and in the diffuse pigment, which in *L. macromanus* forms trabecular stellate figures.

Lembos concavus Stout (J. L. Barnard, 1962a) may form a subspecies of this complex or be an extreme clinal member of the *L. tehuecos* epigenotype, in which case *L. concavus* would have nomenclatural priority. *Lembos concavus,* however, lacks elongate setae on the anterior male coxae and has a very narrow article 6 on male gnathopod 1; sternal teeth on the male are obsolescent.

MATERIAL.—SCO 14; TOP 2, 3; PAZ 13, 24.

DISTRIBUTION.—Gulf of California at Puerto Peñasco, Topolobampo, Bahía Concepción, and Bahía San Evaristo, 0–1 m.

Microdeutopus Costa

Microdeutopus hancocki Myers

Microdeutopus hancocki Myers, 1968:497–501, figs. 1b,c,e–1,k, 6a; 1969:124, figs. 12a, 13a,c, 14d,h,m, 15, 16c,e, 20k, pl. 1a.

MATERIAL.—GAL 108; DAW 32.

DISTRIBUTION.—Galapagos Islands, 0–18 m; generally from Costa Rica to Ecuador, 3–15 m.

Microdeutopus schmitti Shoemaker

Microdeutopus schmitti Shoemaker, 1942:18–21, fig. 6.—J. L. Barnard, 1959:32–33, pl. 9; 1961:180; 1964a:110; 1964b:218; 1966a:17; 1966b:60.—Reish and Barnard, 1967:15.—Myers, 1968:497, fig. 1a,d,j,l; 1969:120–122, figs. 11, 13b,d, 14a–c,f,g,l, 15, 16a,b,d, 20m, pl. 16.—J. L. Barnard, 1969a:192;1969b:91.

MATERIAL.—PAZ 11, ?13.

DISTRIBUTION.—Gulf of California from Isla San Francisco to Bahía de Los Angeles as yet on Baja California side only, 0–44 m; generally from Monterey Bay, California, south to Costa Rica, 0–221 m, rare in depth greater than 65 m.

Photis Krøyer

Photis elephantis J. L. Barnard

Photis elephantis J. L. Barnard, 1962a:39–42, figs. 16, 17; 1969b: 151.

MATERIAL.—SCO ?6, 8, 10, 14, ?15, 18; PAZ 18, 21; GAL ?101, 105, 108; DAW ?5, 16, 31.

DISTRIBUTION.—Gulf of California, Puerto Peñasco, Cabo San Lucas, 0 m; Galapagos Islands, 0–6 m; to Corona del Mar, California; depth range, 0–6 m.

Posophotis, new genus

ETYMOLOGY.—*Posophotis* is from the Greek *posos* (how much) and *photis* (from the classic generic name).

DIAGNOSIS.—Article 3 of antenna 1 as long as article 1; accessory flagellum 2-3 articulate (possibly with tiny additional article). Head deeply recessed for reception of antenna 2. Coxae 1–5 elongate, large, and overlapping. Mandible with 3-articulate palp, article 3 shorter than article 2, clavate, strongly setose. Dactyl of maxilliped short, stubby, multisetose apically. Gnathopod 1 small, weakly subchelate, article 5 about 1.1 times longer than article 6. Gnathopod 2 of both sexes slightly larger than gnathopod 1, wrist of moderate length, broadly but weakly lobate, hand slightly longer than wrist, broad, subchelate, palm oblique, sculptured. Peduncle of uropod 3 elongate, rami styliform, slightly shorter than peduncle, outer ramus 1-articulate, inner ramus as long as outer or occasionally in male shortened, about 60 percent as long as outer ramus. Telson ordinary, with small posterior recessment.

TYPE-SPECIES.—*Posophotis seri*, new species (here designated).

COMPOSITION.—Monotypic; possible member is *Gammaropsis photosimilis* Ruffo, 1969.

RELATIONSHIP.—This genus has the external facies of *Photis* and *Cedrophotis* but differs in the absence of article 2 on the outer ramus of uropod 3, the well-developed accessory flagellum and the stubby dactyl on the maxillipedal palp. This genus would key to the *Gammaropsis* complex (J. L. Barnard, 1973) but differs from all the genera of that complex except *Pseudeurystheus* in the stubby dactyl of the maxillipedal palp and from the vast majority in the *Photis*-like appearance of the coxae. Males of *Pseudeurystheus* have an elongate wrist on gnathopod 2, much longer than the hand, and the coxae are not elongate.

Posophotis seri is diagnosed and described below in expanded form for purposes of comparison to members of the *Gammaropsis* complex and *Photis*.

Posophotis seri, new species

FIGURES 11, 12

DIAGNOSIS.—Accessory flagellum composed of 2–3 long articles possibly tipped by minute fourth. Coxae of elongate form as in *Photis*, coxae 1–2 longer than broad but slightly shorter than coxae 3–5, latter as long as coxa 4, coxae 3–4 of male only expanded in middle; stridulation ridges absent everywhere. Article 5 of gnathopod 1 longer than article 6, palm oblique and weakly excavate, poorly defined but with 2 widely spread defining spines, dactyl overlapping defining spines. Male gnathopod 2 small, article 2 not lobate, article 5 large, weakly lobate, article 6 broad, only 1.4 times as long as article 5, palm oblique, bearing 1 sinus and weak defining tooth, dactyl not reaching apex of palm; female gnathopod 2 with deep palmar excavation guarded by tooth bearing large spine, dactyl overreaching palm. Article 2 of pereopod 3 very broad and grossly lobate posteroventrally, of pereopod 4 narrower and unlobate, of pereopod 5 scarcely expanded and unlobate; article 4 of pereopod 3 expanded and strongly spinose posteriorly, of pereopods 4–5 narrow and poorly spinose; locking spines composed of 1 long and 1 short simple spines; dactyls simple. Epimera 1–3 almost evenly rounded posteriorly, posteroventral corners with weak notch and setule, epimeron 3 with additional setule and notch, these together not contiguous. Peduncle of uropod 1, but not uropod 2, with long interramal tooth, outer rami of both pairs shorter than inner rami, spines not heavily thickened. Peduncle of uropod 3 elongate, rami styliform, rami shorter than peduncle, outer ramus bearing 3 thick marginal spines, apex lacking article 2, bearing 2 spinules, inner ramus of female as long as outer ramus, inner ramus of male about 65 percent as long as outer ramus, with 1 subapical spine in male, 3 marginal spines in female (mixed on opposite margins). Telson trapezoidal, apex broad, with ventroapical protrusion and apicodorsal excavation marked by 2 large dorsal spines, 1 apicolateral setule each side, 2 minute apicolateral knobs each side, with pair of penicillate setules each side in middle.

DESCRIPTION.—Upper lip with ventral notch; incisors of mandibles with 5 teeth, right lacinia mobilis bifid, spine row with 3 spines, molar with large flake and long seta, weakly triturative at cutting edge, left mandible with 4 spines, no flake or seta on molar; lower lip as shown for *Photis reinhardi* by Sars (1895, pl. 202) but mandibular lobes sharper; maxilla 1 as shown by Sars, outer plate with 11 spines but inner plate lacking seta, palp with 5 spines and 4 setae (both sides); maxilla 2 as shown by Sars, inner plate with submarginal oblique setal row medially; maxilliped as shown by Sars except for palp article 4 illustrated herein, inner plate with 3–5 stout apical spines, 1 medial locking spine and about 7 terminal and 5 medial setae, outer plate with about 6 medial and 4 apical spines and setae.

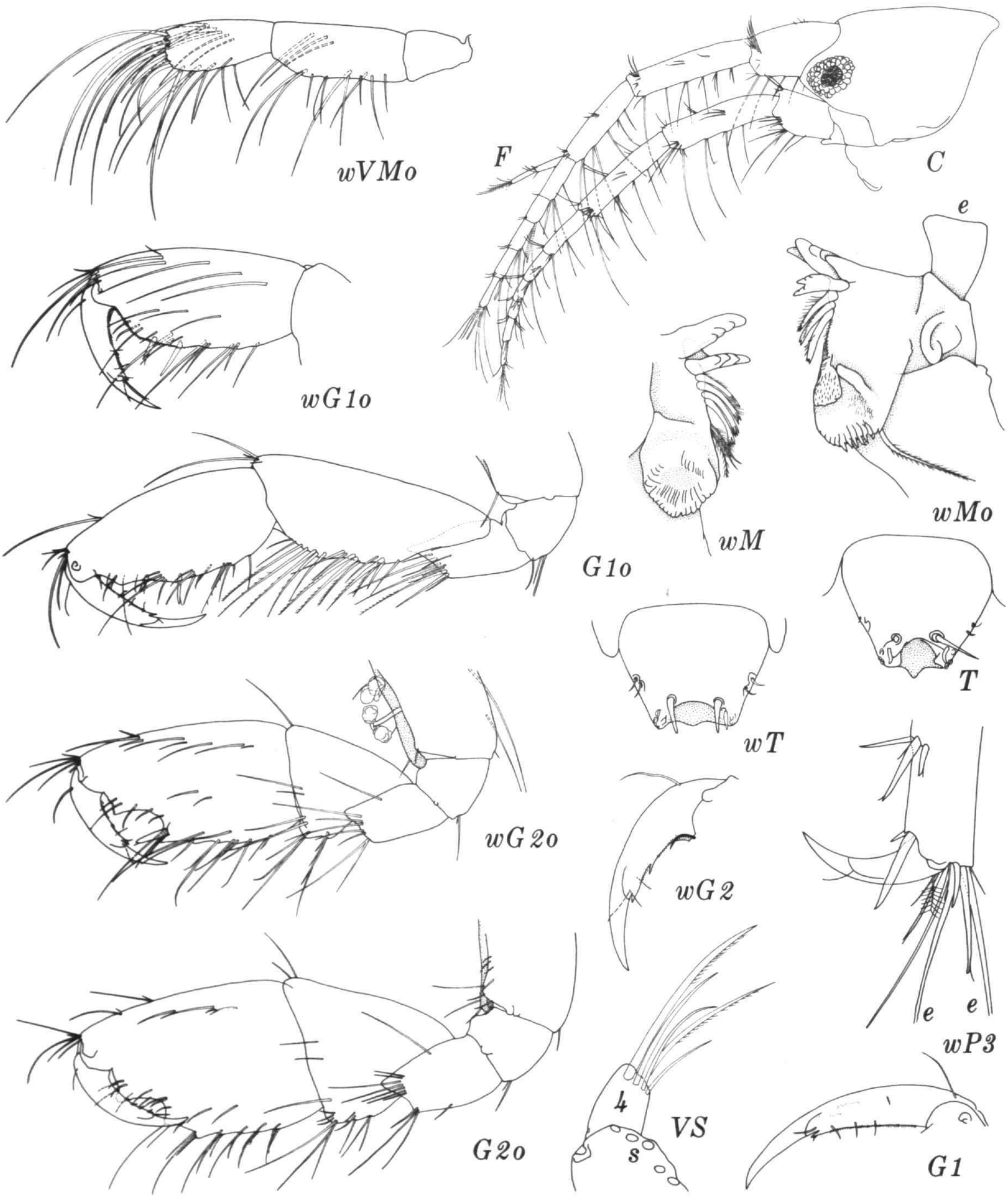

FIGURE 11.—*Posophotis seri*, new species, holotype, male "a," 3.12 mm (*w* = female "w," 2.77 mm).

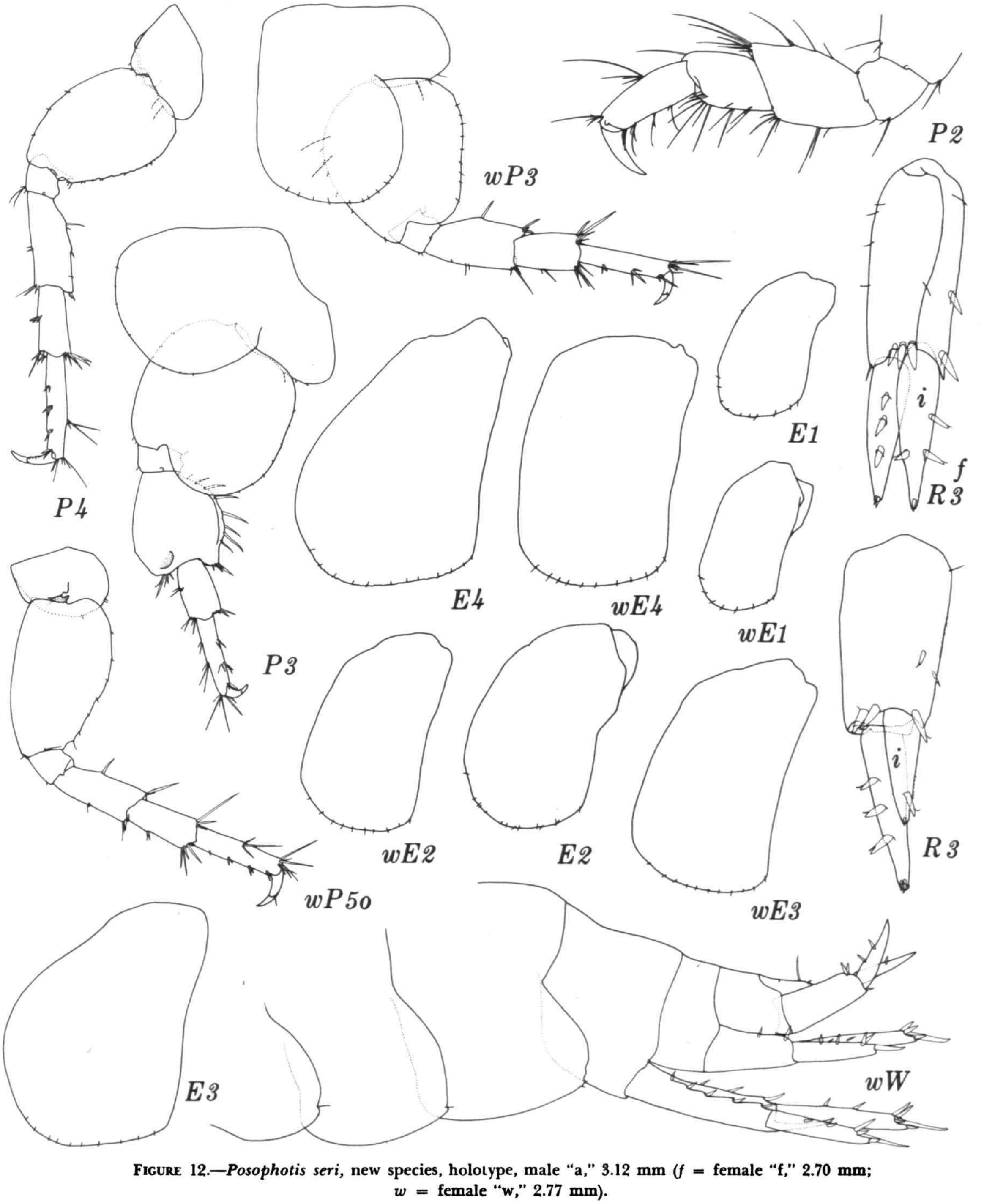

FIGURE 12.—*Posophotis seri*, new species, holotype, male "a," 3.12 mm (*f* = female "f," 2.70 mm; *w* = female "w," 2.77 mm).

VARIATION.—Galapagan males have inner ramus of uropod 3 as long as that of female.

ILLUSTRATIONS.—Gnathopod 1 enlarged greater than gnathopod 2; female pereopod 4 like that shown for male; only terminal male lacking pereopod 5 but presumed to resemble that of female illustrated herein; two main setae of uropod 3 elongate but appearing short and stout in illustration.

HOLOTYPE.—USNM 149507, male "a," 3.12 mm (illus.).

TYPE-LOCALITY.—SCO 10, Gulf of California, Puerto Peñasco, 23 February 1971, intertidal, *Sargassum* sp.

VOUCHER MATERIAL.—Type-locality, female "w," 2.77 mm (illus.): SCO 19, female "f," 2.70 mm (illus.).

MATERIAL.—SCO 1, 10, 18, 19, 21; KNO 1; GAL 101, 105, 106, 107, 118, 120; DAW 1, ?3, 4, 5, 6, 9, 20, 21, 26, 28, 31, 33, 35, 36, 38, 40; PAN 14.

DISTRIBUTION.—Gulf of California at Puerto Peñasco, Bahía Kino, 0 m; Galapagos Islands, 0–6 m; Panama, 0 m.

Rudilemboides J. L. Barnard

Rudilemboides stenopropodus J. L. Barnard

Rudilemboides stenopropodus J. L. Barnard, 1959:31–32, pl. 8; 1961:180; 1964a:110; 1969a:192–193.

MATERIAL.—SCO 18, 19; PAZ 11.

DISTRIBUTION.—Gulf of California at Puerto Peñasco, Bahía de Los Angeles and Isla San Francisco, 0 m; from Point Conception, California, to Bahía de San Quintín, Baja, California, 1–68 m.

Varohios, new genus

DIAGNOSIS.—Antenna 2 inserted deeply below head and behind eye, ocular lobes strongly protuberant; article 3 of antenna 1 longer than article 1, accessory flagellum 2-articulate; antennae 1–2 extending subequally, thin, of medium length. Mandibular palp article 3 tumid, heavily setose. Inner plate of maxilla 1 small, bearing 1 medial seta. Maxillipedal palp article 4 short, stubby, with stout apical spine and several subapical setae. Male gnathopod 1 much larger than gnathopod 2, bearing only 6 articles (either article 5 or article 7 absent or resorbed in adjacent articles), article 6 forming dactyl bearing large inner tooth and closing on long chela of article 5 (forming hand), gnathopod 2 small, moderately setose, article 6 longer than article 5, female gnathopods 1–2 small like male gnathopod 2, subequal in size to each other. Coxae overlapping serially, coxa 1 of male broader than coxa 2, coxa 5 with anterior lobe as long as coxa 4. Rami of uropod 3 extending equally and subequal to peduncle, latter slightly elongate (in familial context), outer ramus with small barrel-shaped article 2.

TYPE-SPECIES.—*Varohios topianus*, new species.

RELATIONSHIP.—This genus keys to *Aloiloi* J. L. Barnard or *Pseudomegamphopus* Myers because of the enlarged male gnathopod 1 but differs so radically from those genera that discussion of similarities is pointless. Like those genera, *Varohios* appears to be another example of axial reversal in gnathopods 1–2, which in a hypothetical ancestor would have had gnathopod 2 enlarged but in evolutionary descent has that gnathopodal form shifted to the position of gnathopod 1. An alternative hypothesis is that the ancestor of *Varohios* bore a male gnathopod 1 which conceivably might have lost an article to assume the form seen in *Varohios*. The best example of this possibility could be visualized in gnathopod 1 of *Neomegamphopus* Shoemaker. That gnathopod bears the normal 7 articles and the 6th bears a large inner hump similar to the hump of article 6 on *Varohios*. In this hypothesis one would presume that article 7, the dactyl, was fused to article 6, the latter now assuming the function of a dactyl and closing on the chela of article 5, found in both *Varohios* and *Neomegamphopus*. I find no line of fusion separating two parts of the new dactyl on *Varohios* except near its base, proximal to the hump; this small segment does not qualify as a remnant of the fully articulate system in *Neogamphopus* since the hump of *Neomegamphopus* lies on article 6, whereas the hump in *Varohios*, by this definition, would lie on article 7. There are no articular remnants visible in the region of articles 3–4 on *Varohios*, where one might expect fusion to be more common than apically. Nevertheless, I find the first hypothesis more attractive, that articles 6–7 of a *Neomegamphopus*-like gnathopod 1 have become fused to assume the condition found in *Varohios*.

In the other proposal, that gnathopod 1 of *Varohios* is a direct result of axial reversal from a *Gam-*

maropsis-Podoceropsis-Megamphopus ancestor, few concrete examples can be found, because no extant species of those 3 genera is known to have lost an article on male gnathopod 1, and only the following species have a chelate gnathopod 2 closely fitting the form seen in *Varohios: Gammaropsis lina* (Kunkel, 1910), *G. semichelatus* (K. H. Barnard, 1957), and *Audulla chelifera* Chevreux (1901, see Sivaprakasam, 1970:564).

In those species, however, the chela is found on article 6, whereas the chela of *Varohios* is found on article 5. In the transformation from one stage to another, one would have to assume loss of article 3 or 4 in *Varohios,* thus increasing the number of steps in evolutionary descent. The most parsimonious system is one involving descent of *Varohios* from a *Neomegamphopus*-like ancestor.

Because female and juvenile gnathopod 1 bears 7 articles it follows that adult males must lose the 7th article during maturation; the material at hand lacks any males in stages showing this supposed transformation.

Varohios topianus, new species

FIGURES 13, 14

DESCRIPTION OF MALE.—Eyes subovate, with black core surrounded by 3 or 4 layers of tiny ommatidia. Upper lip broadly rounded below, prebuccal parts rounded anteriorly, no epistomal spike. Lower lip, maxilla 2 and dactyls of pereopods 1–2 as shown

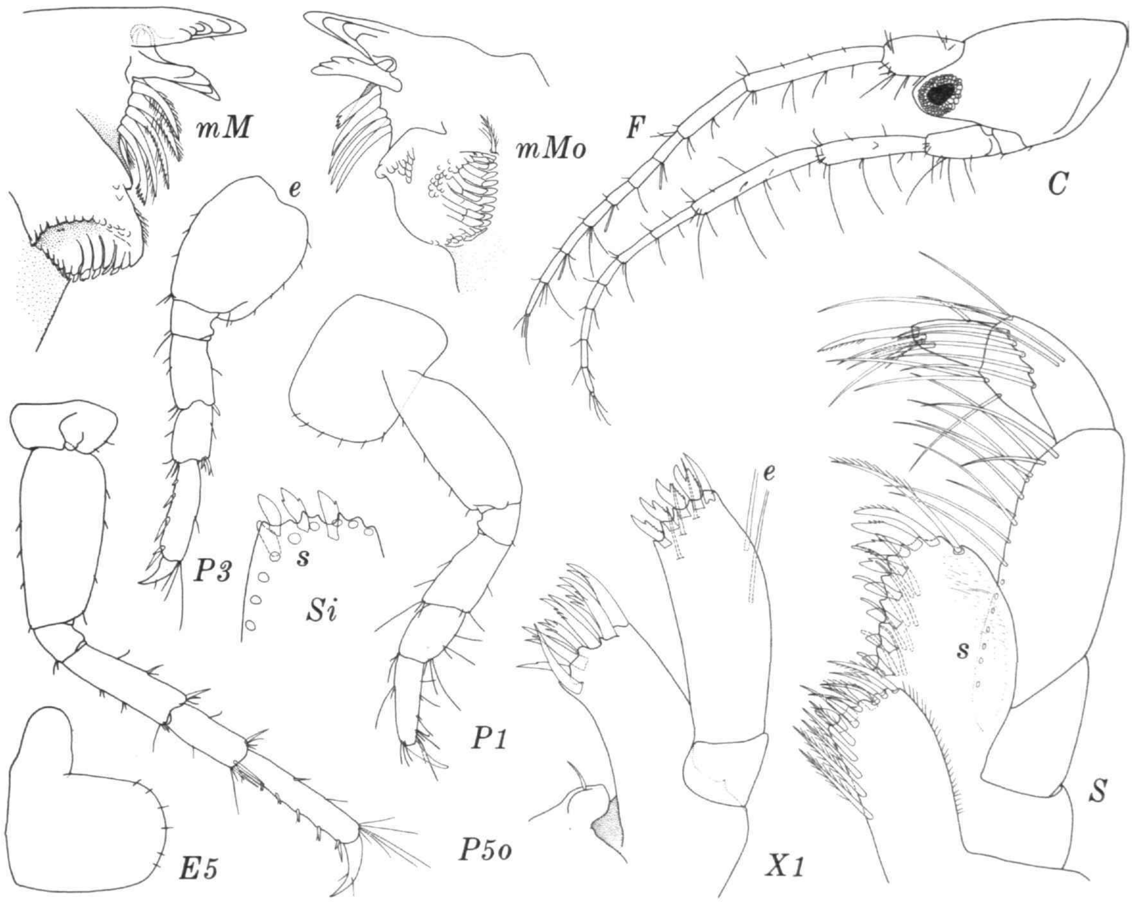

FIGURE 13.—*Varohios topianus*, new species, holotype, male "a," 2.53 mm (*m* = male "m," 2.61 mm).

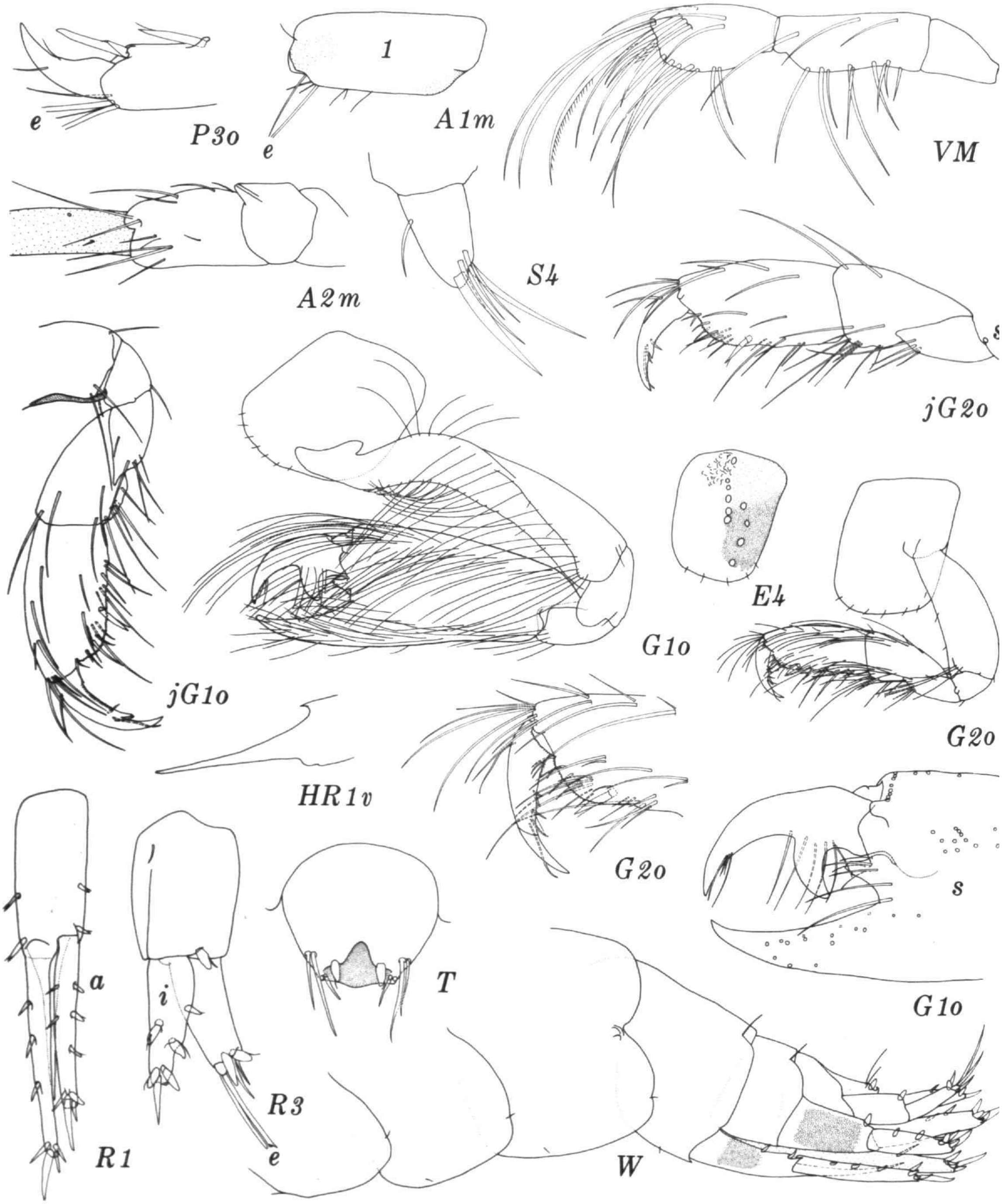

FIGURE 14.—*Varohios topianus*, new species, holotype, male "a," 2.53 mm (*j* = juvenile "j," 1.57 mm).

for *Zoedeutopus cinaloanus;* only right mandibular molar with small plumose seta. Hand (article 5) of gnathopod 1 with secondary palmar tooth inside chela. Uropod 1 with immense interramal tooth, uropod 2 lacking interramal tooth. Pleonites 4–5 each with 1 dorsolateral seta on each side marking dorsal limit of pellucid chitinous sleeve overlapping next posterior segment. Telson with short, deep dorsoposterior excavation guarded by stout spine each side, pair of lateral setae each side, 1 distal setule each side, 1 small boss each side and lateral to setule. Pereonal sternites lacking teeth.

Pigment in alcohol; following parts covered with dark purple brown pigment: pereonites 4–5, posterior half of coxa 4, dorsoposterior parts of head or scattered lightly over entire head; uropods 1–2 bearing peduncular bands of similar pigment, pereonites 5, 7, pleonites 1, 2 each with small dorsal spot, coxa 2 with medium density spot on posteroventral face, coxa 5 with scattered pigment on anteroventral face, pleonites 1–2 with scattered lateral pigment, bases of pleopods behind epimera 1–3 outlined with diffuse purple pigment.

FEMALE (largest, 2.88 mm).—Gnathopod 1 smaller than gnathoped 2, gnathopods as illustrated herein for juvenile. Pigment similar to male but pigment dark on head, pereonites 1–2, coxae 1–2, no pigment on pereonites 4–5 and dorsal spots present only on pereonite 7 and pleonite 1.

HOLOTYPE.—USNM 142349, male "a," 2.53 mm (illus.); pereopod 4 missing both sides.

TYPE-LOCALITY.—PAZ 19, Baja California, 11 km E of Cabo San Lucas, 4 December 1971, intertidal, from small polychaete-like (possibly amphipod tubes of this species).

VOUCHER MATERIAL.—Type-locality, male "m," 2.61 mm (illus.), juvenile "j," 1.57 mm (illus.).

MATERIAL.—PAZ 3, 12, 13, 19; GAL 108; DAW 16.

DISTRIBUTION.—Gulf of California at Bahía San Evaristo, Isla Espiritu Santo and Cabo San Lucas, 0 m; Galapagos Islands, 0 m.

***Zoedeutopus*, new genus**

DIAGNOSIS.—Lateral cephalic lobes strongly produced, antenna 2 deeply inserted along ventral cephalic margin. Mandibular palp articles 2 and 3 subequal in length to each other, article 3 linear, setose apically, article 1 more than half as long as articles 2–3. Mandibular lobes of lower lip subacute. Inner plate of maxilla 1 broadly expanded, apically rounded, bearing 2 facial setae. Gnathopod 1 larger than gnathopod 2 in female, in male enlarged and of *Microdeutopus*-form, carpochelate, article 6 shorter and narrower than article 5, gnathopod 2 in male also enlarged and larger than gnathopod 1, weakly carpochelate, article 6 shorter and narrower than article 5, chelate. Rami of uropod 3 subequally long but inner distinctly shorter than outer, latter with distinct article 2. Telson ordinary.

TYPE-SPECIES.—*Zoedeutopus cinaloanus*, new species.

RELATIONSHIP.—This genus superficially resembles *Microdeutopus* Costa, which has been monographed by Myers (1969). *Zoedeutopus cinaloanus* resembles the *armatus-chelifer* group of that genus in which male gnathopod 2 is enlarged and propodochelate but *Zoedeutopus* differs from *Microdeutopus* generally in the deeply inserted antenna 2, the short, linear article 3 of mandibular palp on which all setae are terminal, in the facial and not apical setae on the inner plate of maxilla 1, and in the presence of a distinct article 2 on the outer ramus of uropod 3. In these respects, especially the head and uropod 3, *Zoedeutopus* appears to belong to the group of genera including *Neomegamphopus* Shoemaker, *Amphideutopus* J. L. Barnard, *Acuminodeutopus* J. L. Barnard, *Konatopus* J. L. Barnard, from the east tropical Pacific and Hawaii, all of which have the *Microdeutopus*-like male gnathopod 1. Those four genera may be divided into two groups based on the flabellate expansion of article 3 on the mandibular palp in *Amphideutopus, Neomegamphopus,* and *Konatopus,* and its simple, linear condition in *Acuminodeutopus* and *Zoedeutopus.* The new genus appears to be the most primitive member of this generic group, because of the simple article 3 of the mandibular palp, moderate insertion of antenna 2 (deep but not as extreme as in the other genera), and the slight shortness of the inner ramus of uropod 3. The facial setae on the inner plate of maxilla 1, however, may be an advancement. *Acuminodeutopus* appears to be the most closely related genus to *Zoedeutopus* but is more specialized by virtue of the strong shortening of the inner ramus on uropod 3 while retaining the small male gnathopod 2 typical of *Microdeutopus.* *Zoedeutopus* is peripheral to the triangle of

Amphideutopus-Neomegamphopus-Konatopus discussed by J. L. Barnard (1970:70), a group characterized by shortening of the *outer* ramus of uropod 3 or the precise equality of both rami, bears the enlarged male gnathopod 2 characteristic of *Amphideutopus* and in *Neomegamphopus* and *Konatopus* has article 4 of the maxillipedal palp reduced in size. In the four genera related to *Zoedeutopus* the setae on the inner plate of maxilla 1 appear to have migrated to the medial margin.

In a phyletic sequence one would place *Zoedeutopus* in the center, with *Acuminodeutopus* forming one line of descent and *Amphideutopus* forming the first member of a second line of descent, followed by *Neomegamphopus*. The Hawaiian *Konatopus* would appear to be descendent from *Neomegamphopus*.

These 5 genera, containing only 8 known species, form a group so far discovered only in East Africa, middle America, and Hawaii. The counterpart and presumedly more primitive ancestors comprise the genera *Microdeutopus* and *Chevreuxius* Bonnier from both tropical and cooler latitudes. A second counterpart, composed of *Grandidierella* Coutière and *Neomicrodeutopus* Schellenberg (=?*Grandidierella*) is found in the tropical eastern hemisphere but appears to be descendent from *Microdeutopus* because of the poorly inserted antenna 2.

Zoedeutopus cinaloanus, new species

FIGURES 15–17

DESCRIPTION.—Antenna 1 about as long as pereonites 1–6 together, antenna 2 about three-fourths as long as antenna 1, article 1 of antenna 1 with 1 midventral spine, 1 apicoventral spine, article 3 approximately half as long as article 1, accessory flagellum 2-articulate, antenna 2 inserted deeply into head because of protrusion of lateral cephalic lobe but insertion reaching only posterior margin of eye and not as deep as in *Amphideutopus-Neomegamphopus*. Upper lip broadly rounded below. Molar of left mandible with seta only half as long as shown for right mandible. Interramal tooth of uropod 1 extending nearly 40 percent along outer ramus, uropod 2 lacking interramal tooth. Male lacking sternal teeth.

REMARKS.—Pigment in alcohol brownish purple on posterior part of head and marked by vacuoles, on pereonite 5 and parts of pereonites 4 and 6, broad stripe on article 2 of pereopod 3, blotch on anterior face of epimeron 1, pigment generally consistent on more than 80 percent of specimens.

ILLUSTRATIONS.—Maxilla 1 enlarged in comparison to maxilla 2.

HOLOTYPE.—USNM 142350, male "a," 2.37 mm (illus.).

TYPE-LOCALITY.—SCO 14, Gulf of California, Puerto Peñasco, 24 February 1971, intertidal, rock wash.

VOUCHER MATERIAL.—Type-locality, female "w," 3.14 mm (illus.); PAZ 12, male "b," 2.70 mm (illus).

MATERIAL.—SCO 1, 12, 14, 17, 18; PAZ 3, 5, 9, 12, 24.

DISTRIBUTION.—Gulf of California, at Puerto Peñasco, Bahía Concepción, Bahía San Evaristo, Isla Partida, and Isla Espiritu Santo, 0 m.

DEXAMINIDAE

Polycheria osborni Calman

Polycheria osborni Calman, 1898:268–269, pl. 32: fig. 2.—Skogsberg and Vansell, 1928:268–282, figs. 1–26.—J. L. Barnard, 1969a:200, fig. 25g; 1969b:103.

Polycheria antarctica.—Alderman, 1936:63.—J. L. Barnard, 1954a:21 [not Stebbing, 1888].

MATERIAL.—PAZ 3; TOP 2, 3; DAW 16.

DISTRIBUTION.—Gulf of California, at Bahía de Los Angeles, Topolobampo, and Isla Espiritu Santo, 0–1 m; Galapagos Islands, 0 m; California, northward to Monterey Bay, intertidal; usually burrowing into tests of *Amaroucium* spp.

EUSIRIDAE

Pontogeneia Boeck

J. L. Barnard (1972a:186) redefined several genera of the Eusiridae and excluded from *Pontogeneia* all but 1 valid species and 2 questionable species. Part of that decision rested on the erroneous basis that the rostrum of the type-species *P. inermis* (Krøyer) was short and blunt, according to figures in Sars (1895, pl. 159c). I have now examined specimens of *P. inermis* and find the rostrum larger than supposed, somewhat smaller but similar to that of several mid-American species which should now be

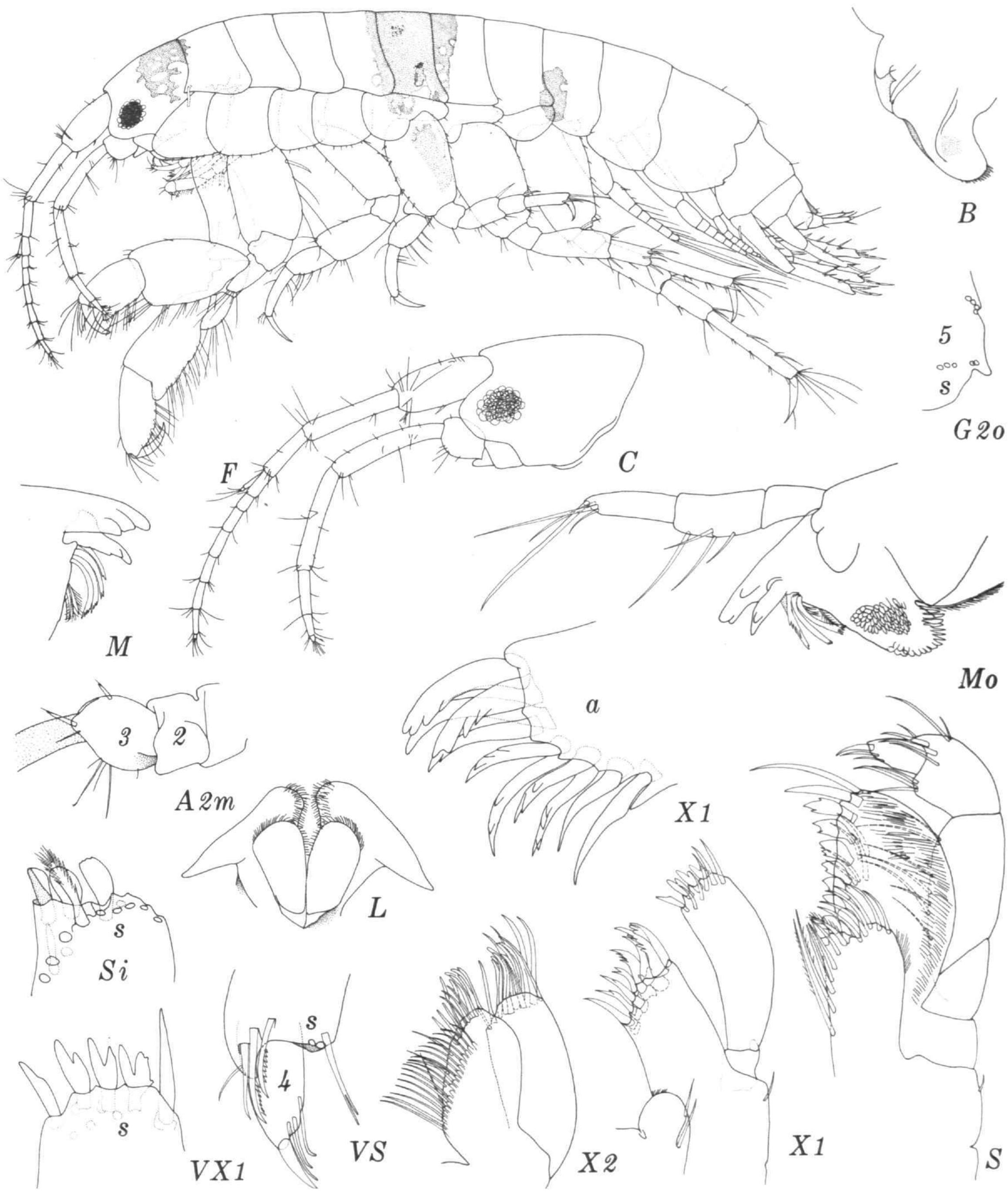

FIGURE 15.—*Zoedeutopus cinaloanus*, new species, holotype, male 'a," 2.37 mm.

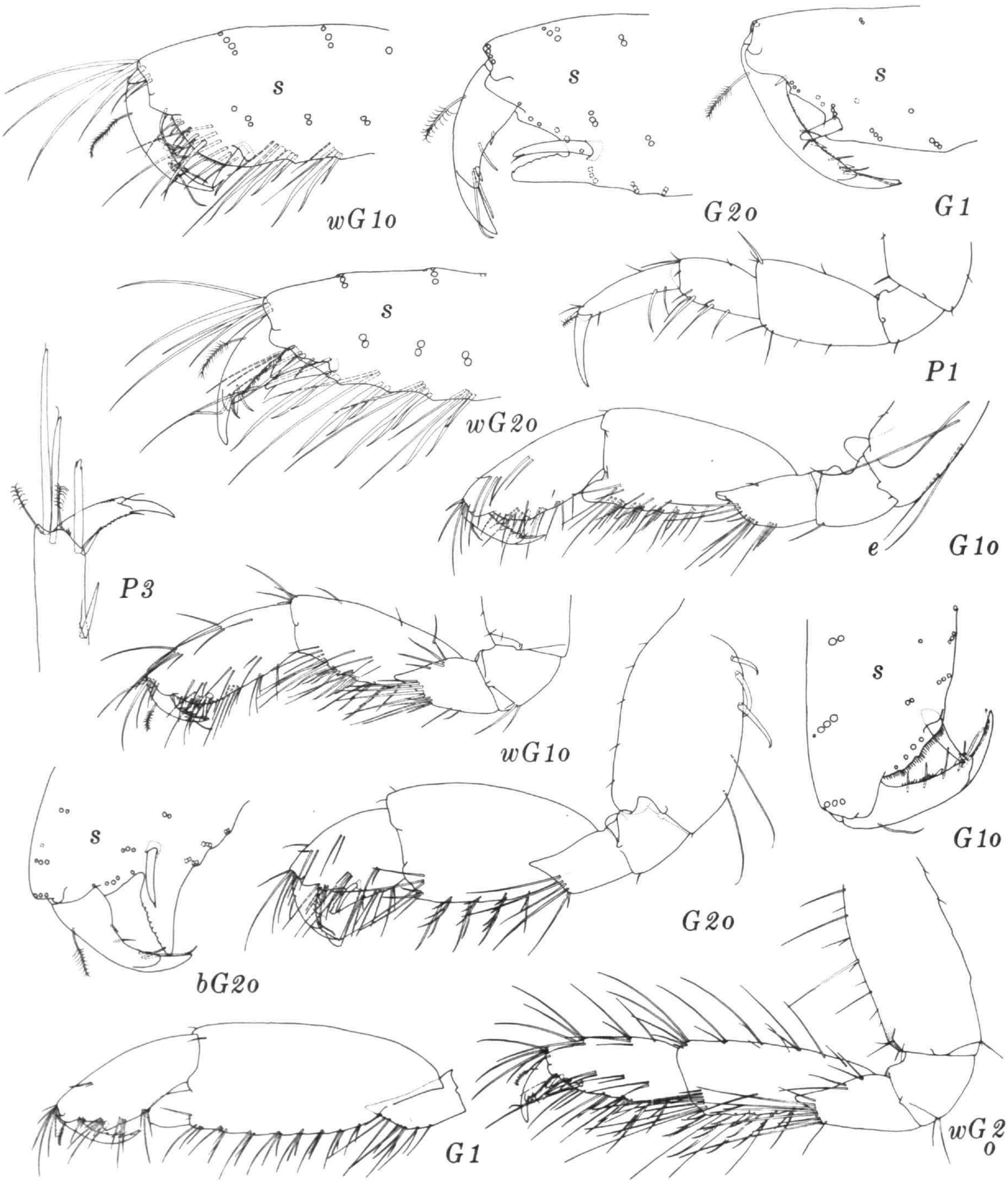

FIGURE 16.—*Zoedeutopus cinaloanus*, new species, holotype, male "a," 2.37 mm (*b* = male "b," 2.70 mm; *w* = female "w." 3.14 mm; note *G1* bottom left with tilted article 6).

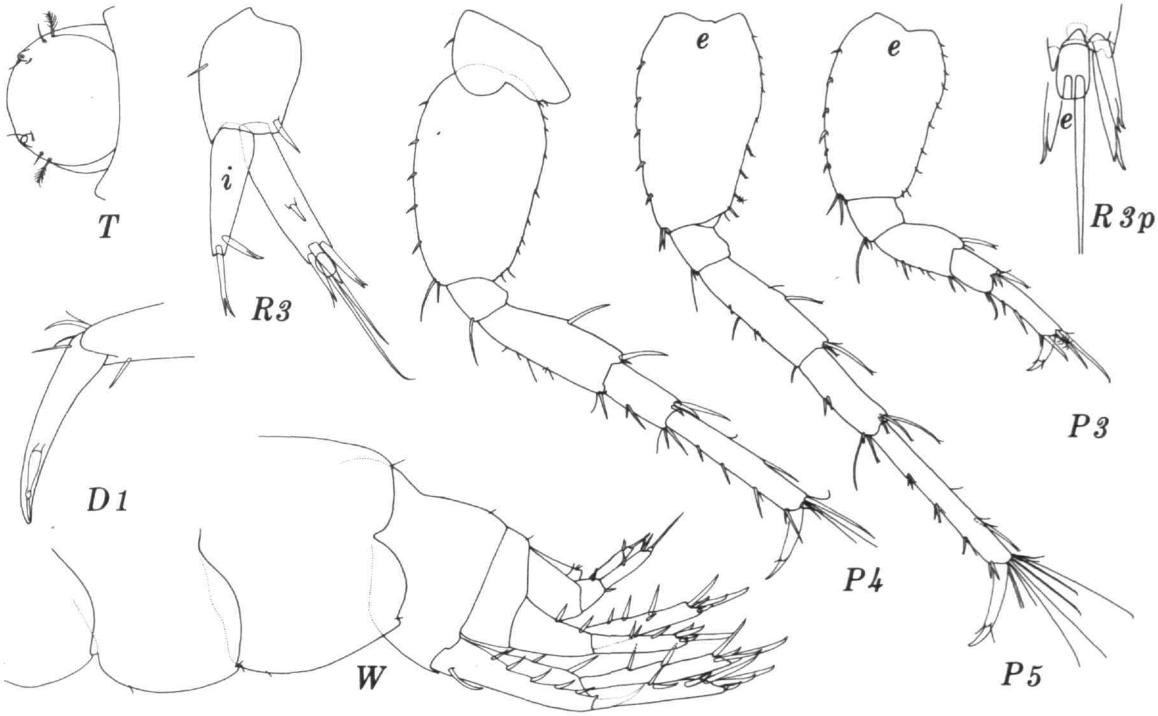

FIGURE 17.—*Zoedeutopus cinaloanus*, new species, holotype, male "a," 2.37 mm.

reinstated in *Pontogeneia* and removed from *Tethygeneia* where they were placed in 1972. Maxilla 2 of *P. inermis* has also been clarified and shown to have 4 enlarged or partially enlarged medial setae similar to the mid-American species with 2 or 3 of these setae. The calceoli of several of those mid-American species have now been studied and are found to be similar to the calceoli of *P. inermis* as shown by Sars (1895); therefore, these species can now be considered to be congeneric. *Pontogeneia inermis* has distinct but vestigial inner lobes on the lower lip, whereas the mid-American species have these lobes so evanescent as to be nearly invisible. I believe that these lobes should be discounted in this case, although this would require revision of the arrangement in Figure 111 of J. L. Barnard (1972a). Needless to say that arrangement is but a strawman ready to be modified as various facts are uncovered to regulate the confusion in the pontogeneiid genera. The correspondence in rostra, accessory flagella (their absence), maxillae 1–2 and calceoli among *P. inermis, P. rostrata, P. intermedia, P. opata, P. quinsana* (calceoli unknown), and *P. bartschi* seems sufficient to group these warm-temperate and cold-temperate species from the northern hemisphere in Pontogeneia and to contrast them with *Tethygeneia* and *Gondogeneia* from the southern hemisphere. *Tethygeneia* includes the northern *P. nasa* J. L. Barnard from the Gulf of California. Aesthetascs of *Pontogeneia longleyi* Shoemaker (1933b) and *P. quinsana* J. L. Barnard (1964a) are unknown. The main distinctions among these genera involve the calceoli of the male antennae. A calceolus of *Pontogeneia* consists of 2 large subequal parts, that of *Gondogeneia* consists of 4 parts arranged linearly and that of *Tethygeneia* consists of 1 main part and a cluster of 3 small basal lobes. Rostra of *Pontogeneia* and *Tethygeneia* are long and thin (except *P. bartschi* with short and thin rostrum), whereas the rostrum of *Gondogeneia* is very short and blunt, the head very massive, and the eyes greatly enlarged. The head of *Pontogeneia quinsana* is somewhat similar to that of *Gondogeneia* and that species cannot be firmly

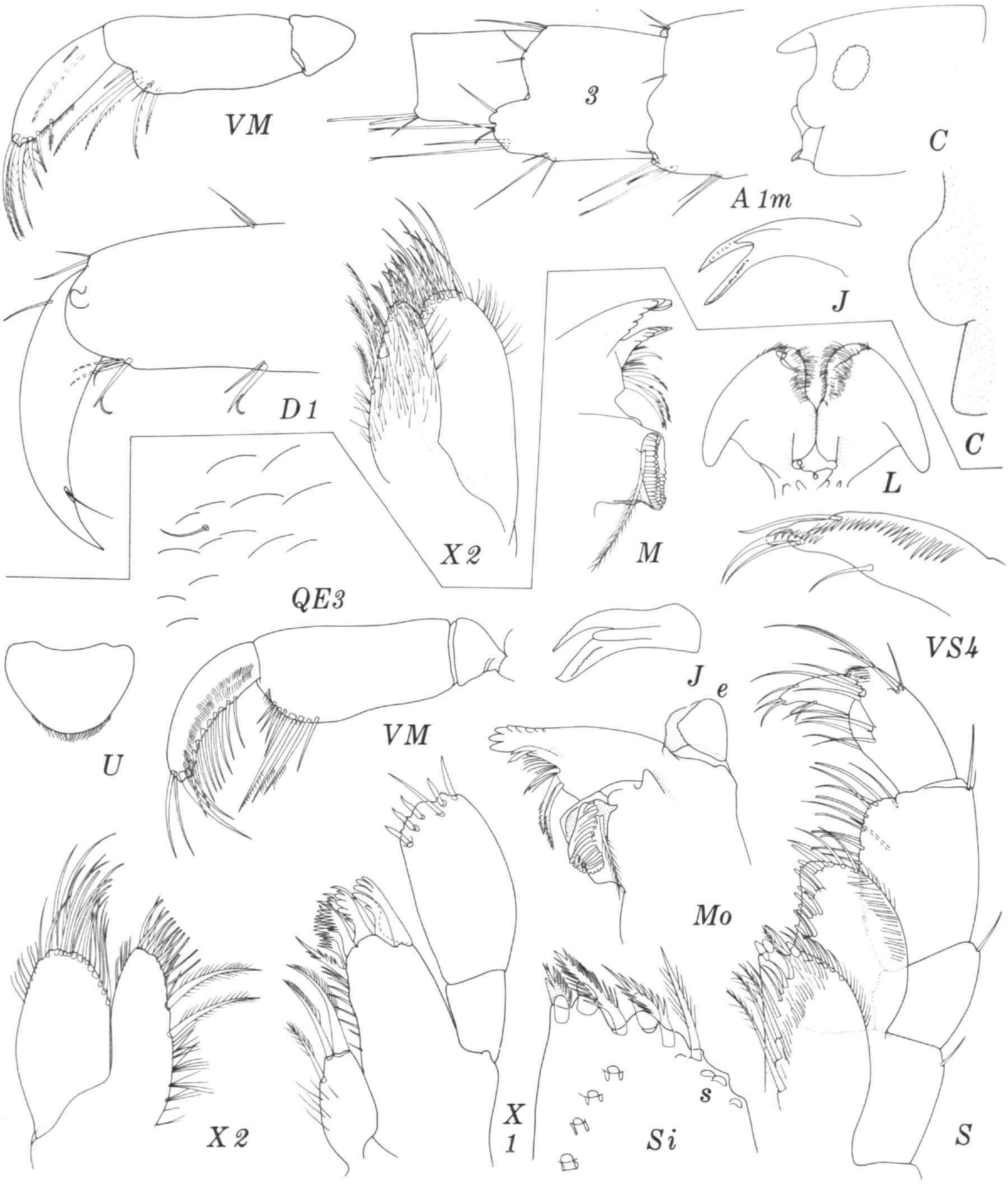

Figure 18.—Above: *Pontogeneia inermis* (Krøyer), male "a," 4.4 mm. Below: *Tethygeneia? quinsana* (J. L. Barnard), new combination, female "a," 3.2 mm.

assigned to *Pontogeneia* because male calceoli have never been observed. Most specimens of *P. quinsana* lose their antennae in preservative; the few males observed with antennal remains have lacked calceoli. Nevertheless, *P. quinsana* is very close to *T. nasa* and must be presumed to be a sibling of that species; *quinsana* is therefore tentatively placed in *Tethygeneia*.

Pontogeneia inermis (Krøyer)

FIGURE 18 (part)

Amphithoe inermis Krøyer, 1838:275–278, pl. 3: fig. 11.
Pontogeneia inermis.—Sars, 1895:451–453, pl. 159.

VOUCHER MATERIAL.—Devon Island, Dundas Harbor, Canada, British Columbia, 23 July 1946, sta. 54, Duvall and Handley, U.S. Fish and Wildlife Service, USNM 174174, young male "a," 4.4 mm (illus.).

REMARKS.—Sars' fine portrayal of this species is supplemented here with drawings of the rostrum, accessory flagellum, setation of maxilla 2, and the locking spines and dactyl of pereopods 1–5.

DISTRIBUTION.—Panboreal.

Pontogeneia intermedia Gurjanova

FIGURES 19–21

Pontogeneia intermedia Gurjanova, 1938:333–335, fig. 41; 1951:722, fig. 502.—J. L. Barnard, 1969b:110, figs. 16, 17.

VOUCHER MATERIAL.—Smith 13 (male "a," 5.8 mm, illus.), 14 (female, 7.12 mm). California, Bodega Bay, intertidal, August 1972, collected by Dr. Ralph I. Smith.

VARIABLES.—The inner plate of maxilla 2 has 3–5 enlarged marginal setae; antenna 1 varies in length, often on the same specimen, from 30 to 40 percent of the body length; the illustrated male has the short form of flagellum on antenna 1 but generally the flagellum is 1.6 times as long as that shown; antenna 2 generally half as long as body; the cuticle is like that of *P. rostrata* (Figure 25: *QW*); the deep spine sheath shown on the dactyl of pereopod 3 is abnormal; all figures are from the male; the female is similar except in the presence of brood plates and absence of penes.

DISTRIBUTION.—Japan Sea; California: Bodega Bay to Corona del Mar.

Pontogeneia opata, new species

FIGURES 22–24

Pontogeneia minuta.—J. L. Barnard, 1959: 23, pl. 3; 1964a:106, fig. 21b,c.—Reish and Barnard, 1967:16–17. [Not Chevreux.]

DIAGNOSIS.—Rostrum large, extending more than halfway along article 1 of antenna 1, broad dorsoventrally, tapering apicad to rounded point. Accessory flagellum absent but article 3 of antenna 1 with large quadrate extension on mediodistal margin; male calceoli bipartite, weakly bell-shaped. Article 3 of mandibular palp about 70 percent length of article 2. Inner lobes of lower lip obsolescent, marked only by weak ridges and swellings. Inner plate of maxilla 1 with 2 terminal and 1 mediοterminal setae; inner plate of maxilla 2 with 2 enlarged medial setae, 1 of these weakly submarginal. Coxae 1–3 each with 1 large posterior spine. Gnathopods small, subequal in size to each other, similar between the sexes, palms oblique, posterior lobe of article 5 on gnathopod 1 short, tapering conically, lobe on gnathopod 2 extended, blunt, turned distad partially, extending about halfway along hand towards palm, occasionally longer. Pereopods elongate, with setae on both margins of article 6, distal pair of locking spines equal or subequal to each other in length, smaller than adjacent spines, smooth, distalmost simple, next proximal with setular trigger, spines weakly curved, dactyl smooth marginally, bearing subapical slit and long, thin setule proximal to slit. Pleonal epimera with moderate posterior bulge sweeping on straight margin to weak posteroventral tooth on epimera 1–2, rounded posteroventral corner on epimeron 1, ventral margins of epimera 1–3 with about 2, 5, and 5 spines in tandem respectively on ventral margins, epimera 1–2 each with lateral ridge. Telson ordinary, apices blunt and naked. Cuticle covered with conspicuous imbedded spicules resembling thin fibrous highly elongate crystals, spicules often nearly straight but especially parabolic on epimera.

DESCRIPTION.—Eyes, when originally preserved, with dark purple core of pigment concealing all but outer row of ommatidia, now pigment strongly bleached (23 years of preservation); dimensions of rostrum variable (J. L. Barnard, 1959, pl. 3); male antenna 2 much longer than antenna 1 and thus longer than female antenna 2 (male antenna 2 of

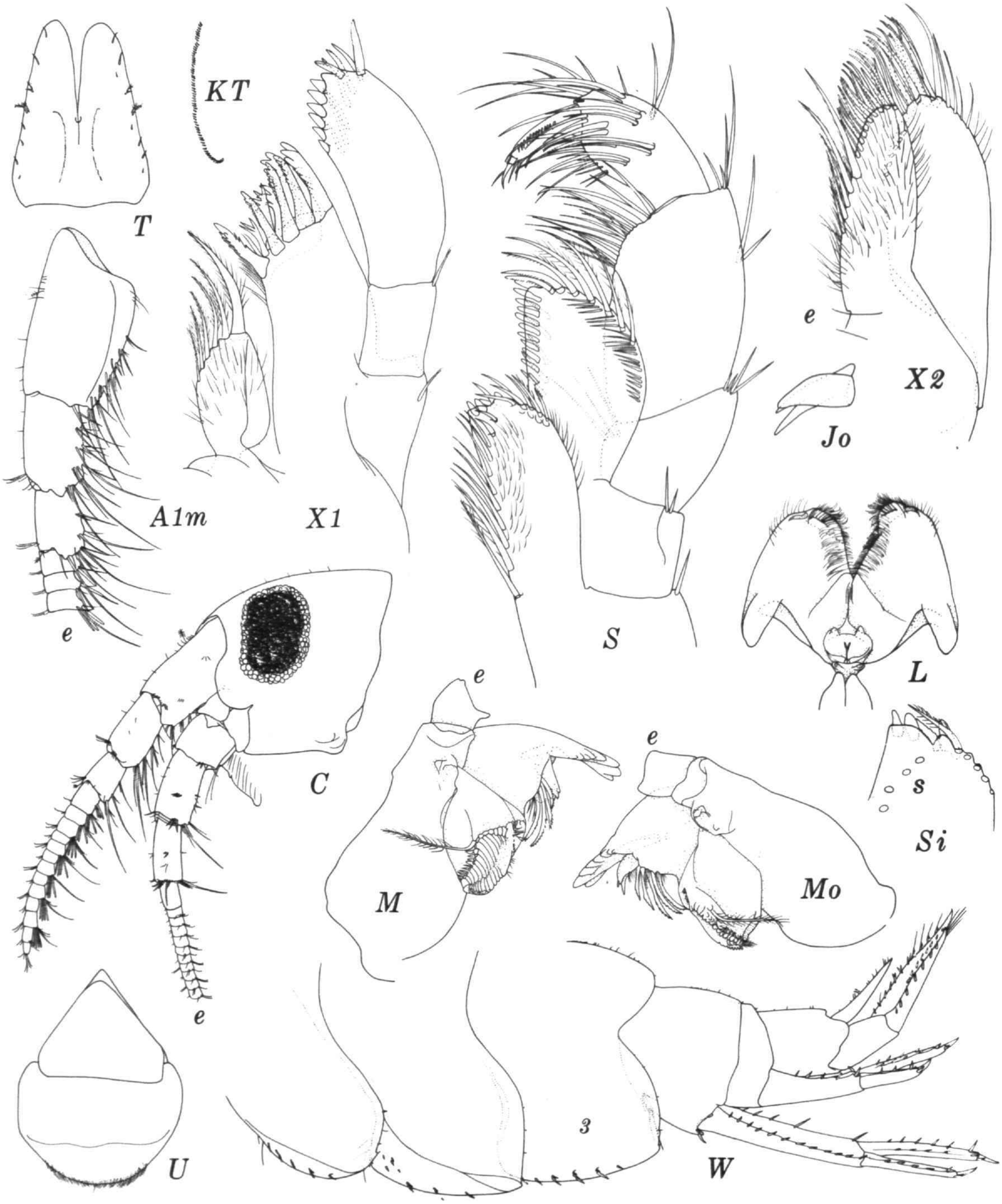

FIGURE 19.—*Pontogeneia intermedia* Gurjanova, male "a," 5.8 mm.

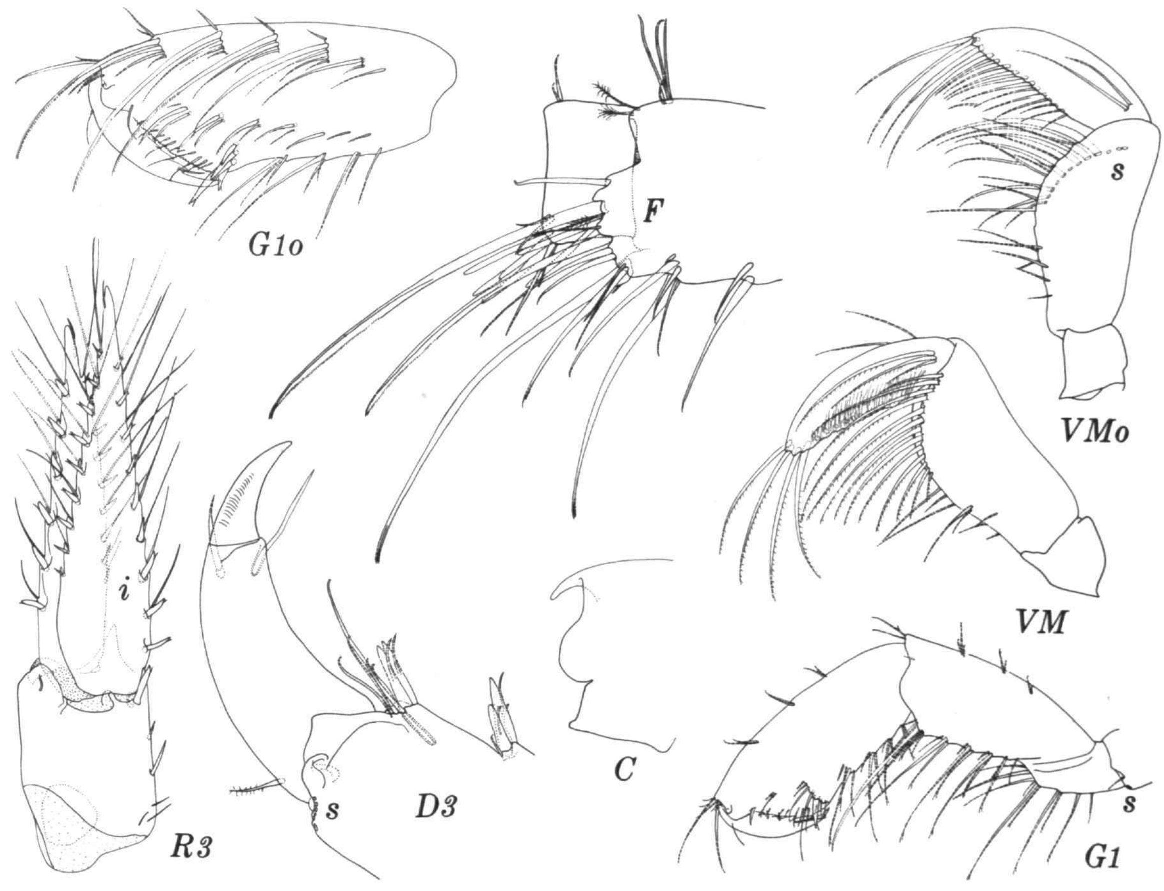

FIGURE 20.—*Pontogeneia intermedia* Gurjanova, male "a," 5.8 mm.

Figure 22: *A2* drawn to same scale as antennae attached to female head, Figure 22: *wC*), articles of flagella of antennae 1–2 on male especially swollen alternately, weakly so on female antenna 1 but not female antenna 2, calceoli of male antenna 1 flagellum also alternating in zigzag pattern of attachment but this pattern weakly developed, calceoli poorly fingerprinted with striae in comparison to calceoli of *P. rostrata;* right lacinia mobilis bifid, with short accessory cusp; male gnathopods slightly larger and better developed than gnathopods of female, posterior margins of hands in female with one group of elongate setae, in male with 2 short spines in tandem; uropod 3 of female as shown for male but lacking elongate setae, bearing only short spines; posteroventral tooth of epimeron 2 occasionally absent; spines of uropods 1–2 reduced in number in young adults, outer ramus of uropod 1 with 0–1 dorsal spines, of uropod 2 with no dorsal spine, inner rami more conservative, generally maintaining normal condition of 2 spines on inner ramus of uropod 1, 1 spine on inner ramus of uropod 2 (hidden in Figure 24: *W*).

VARIATION.—Cocos Island male gnathopods 1–2 with posterior margin of hand scarcely notched and armaments thin as in female.

HOLOTYPE.—AHF 4923, male "a," 4.20 mm (illus.).

TYPE-LOCALITY.—Upper Newport Bay, California, intertidal, 28 June 1949, collected by Dr. John L. Mohr.

VOUCHER MATERIAL.—Type-locality, female "a,"

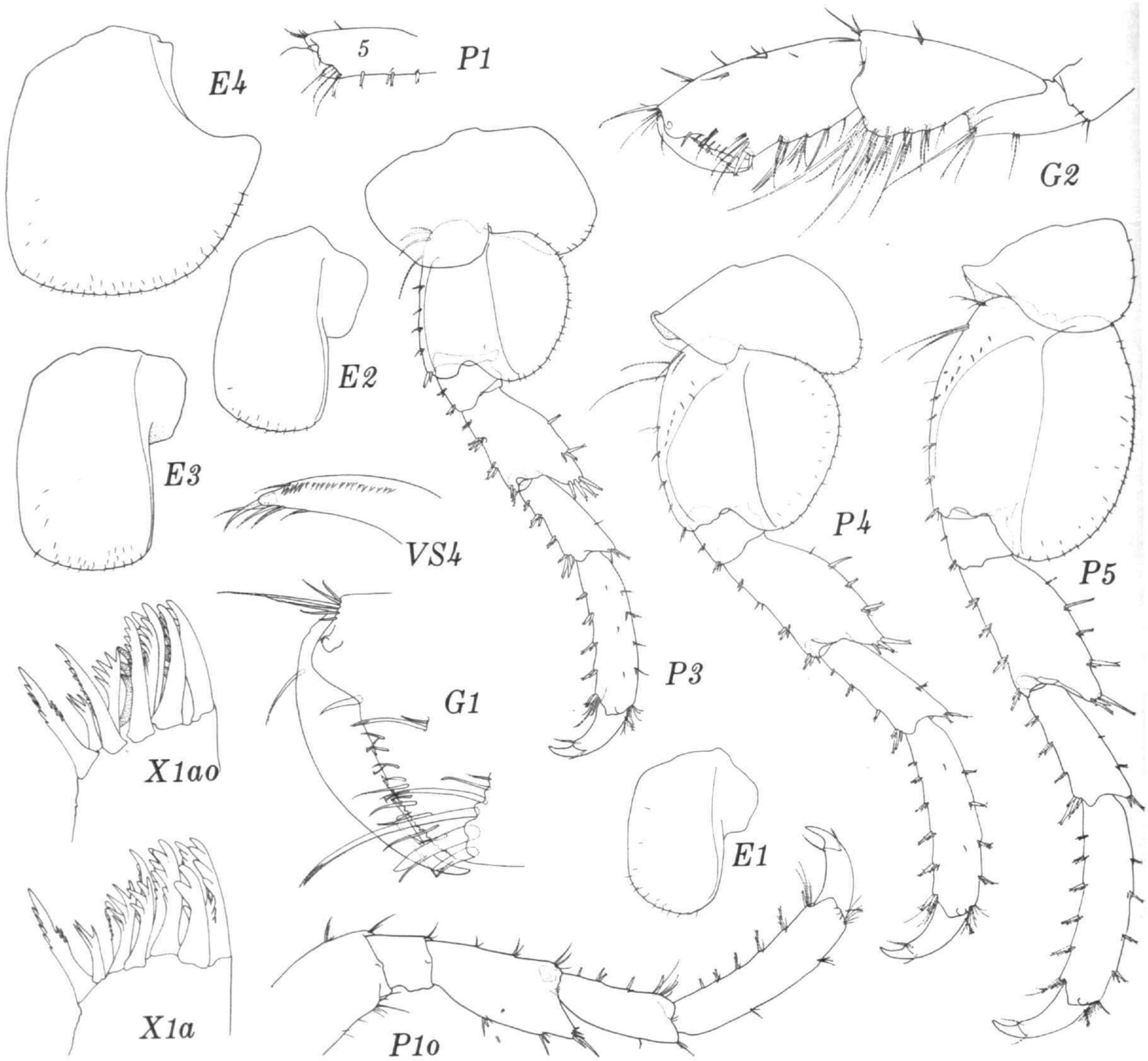

FIGURE 21.—*Pontogeneia intermedia* Gurjanova, male "a," 5.8 mm.

4.4 mm; female "w," 3.5 mm (illus.); female "p," 3.8 mm (illus.); male "k," 4.16 mm.

RELATIONSHIP.—*Pontogeneia opata* may be a sibling of *P. longleyi* Shoemaker (1933b) from the Caribbean Sea, but *P. opata* has a much longer lobe on article 5 of gnathopod 2, spines on coxae 1–3, a slightly longer article 3 of the mandibular palp and does not have the weak dorsal protrusions of pleonites 1–2.

Pontogeneia minuta Chevreux (1908) differs from *P. opata* in the shorter lobe of article 5 on gnathopod 2 and the absence of coxal spines.

MATERIAL.—PAZ 2, 25; COCOS 9.

DISTRIBUTION.—California, in bays such as Morro, Newport, 0 m; Baja California, in Bahía de San Quintín, 7 m; Gulf of California, Pichilinque Bay at Las Paz, Bahía Concepción, 0 m; Cocos Island, 0 m.

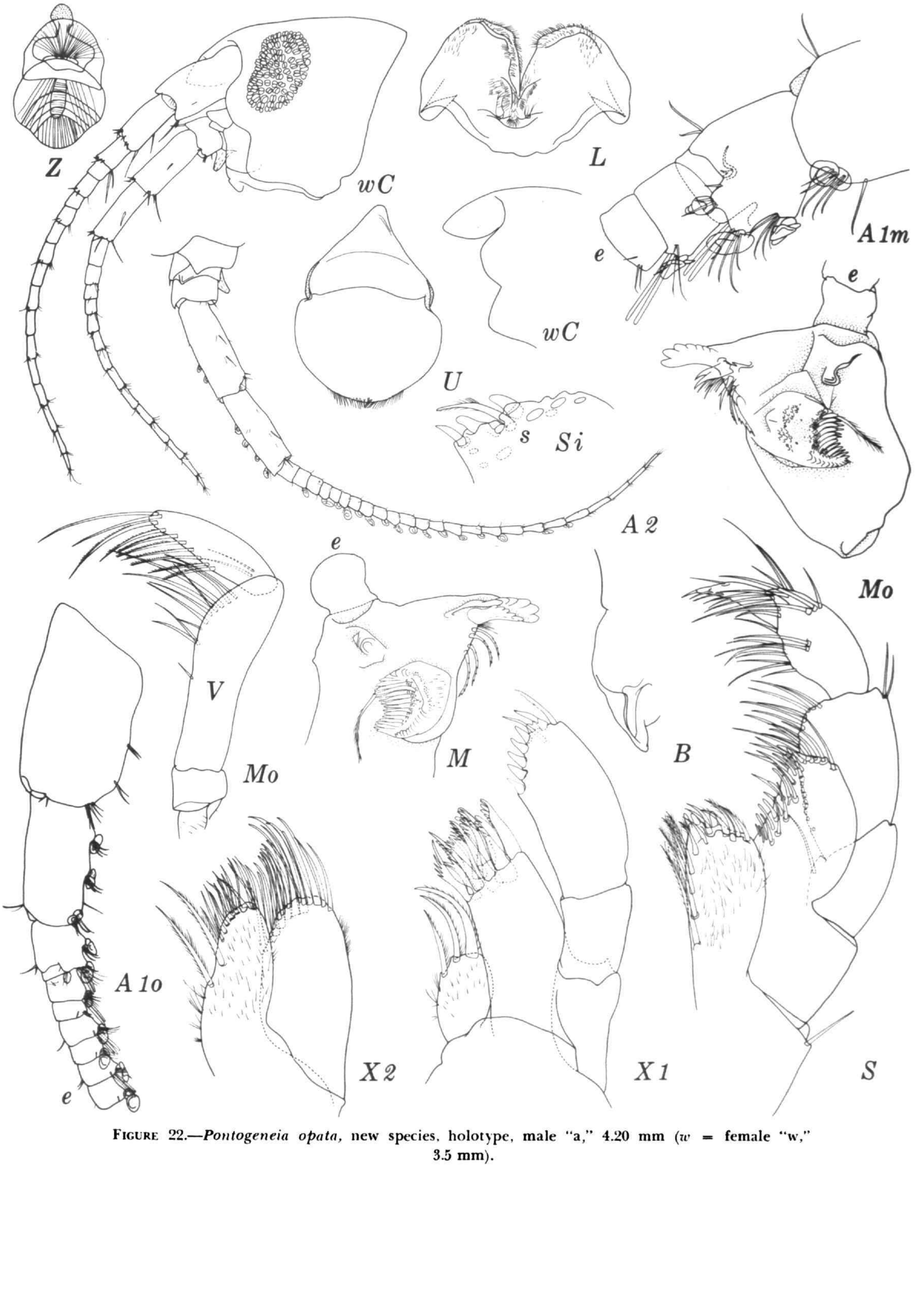

FIGURE 22.—*Pontogeneia opata,* new species, holotype, male "a," 4.20 mm (*w* = female "w," 3.5 mm).

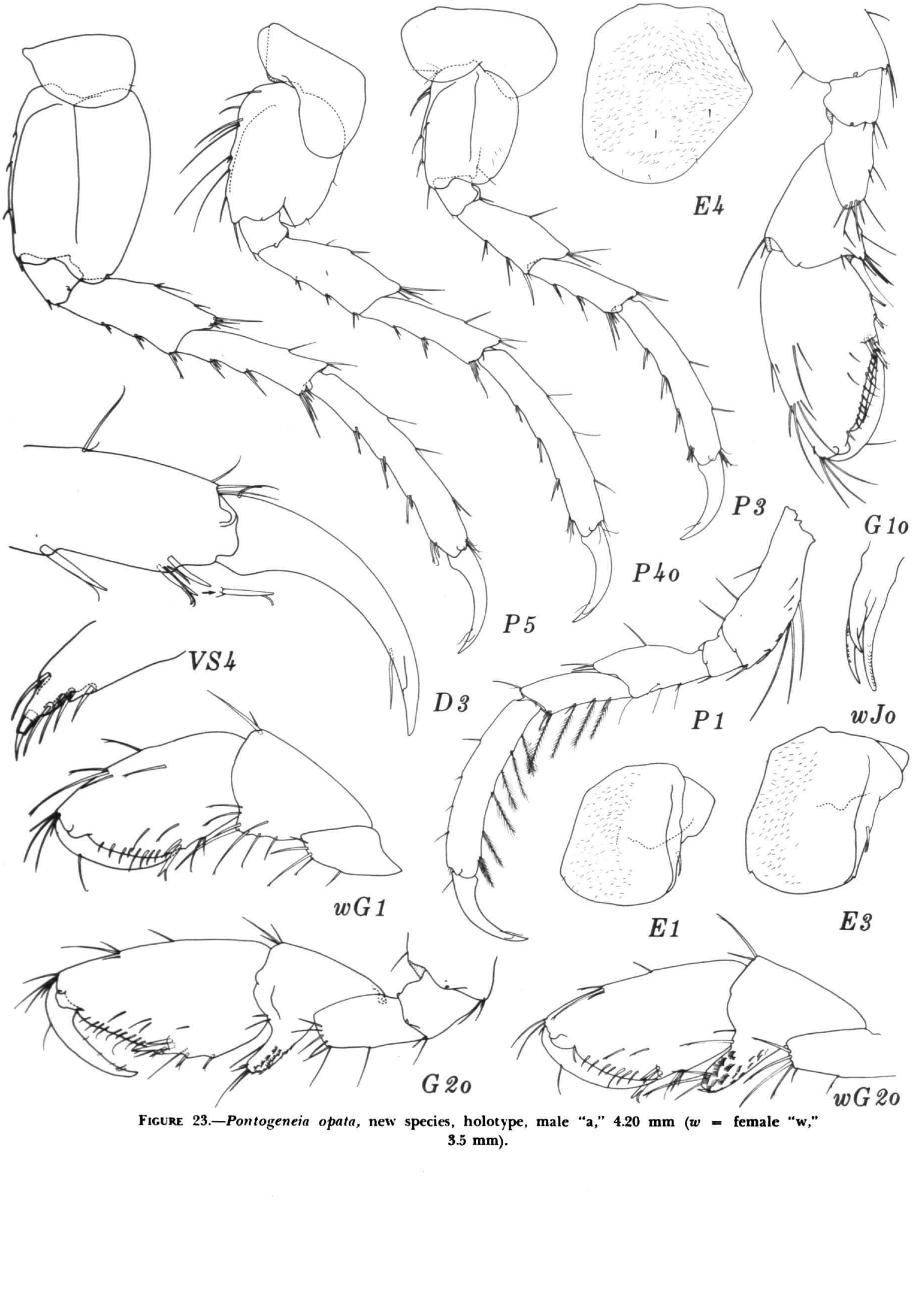

FIGURE 23.—*Pontogeneia opata,* new species, holotype, male "a," 4.20 mm (*w* = female "w," 3.5 mm).

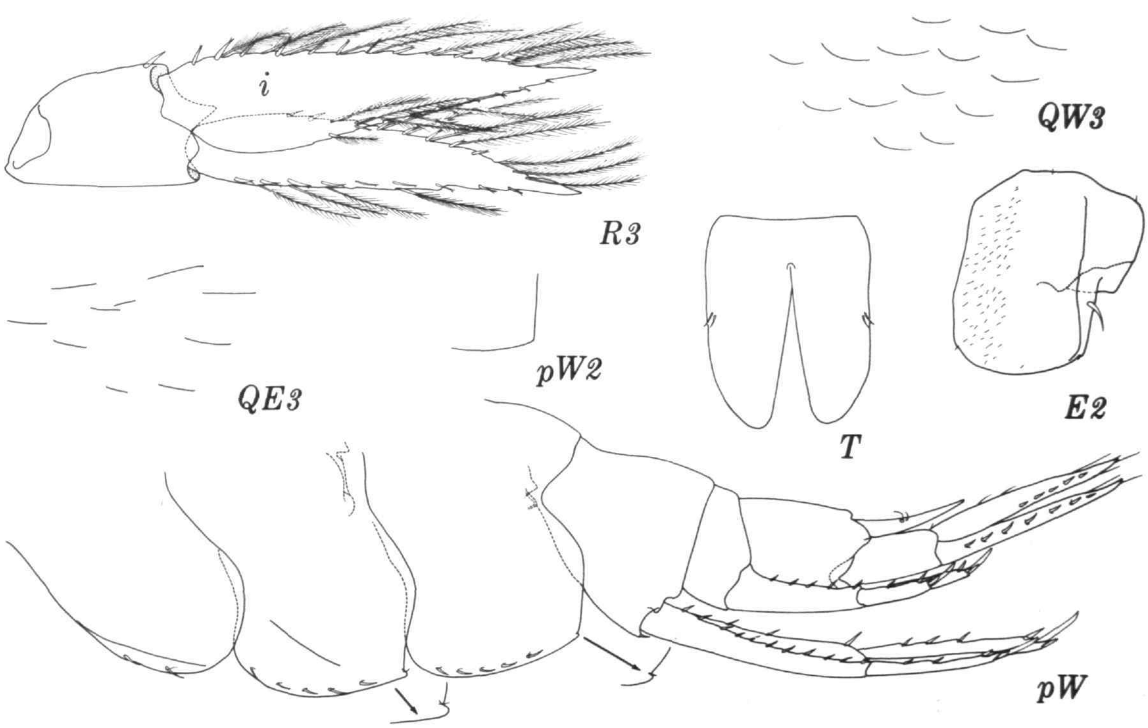

FIGURE 24.—*Pontogeneia opata*, new species, holotype, male "a," 4.20 mm (*p* = female "p," 3.8 mm).

Pontogeneia rostrata Gurjanova

FIGURES 25–27 (part)

Pontogeneia rostrata Gurjanova, 1938:330, 398, fig. 39; 1951:719, fig. 500.—J. L. Barnard, 1962b:81; 1964a:114–116, fig. 20; 1969b:111–114.

VOUCHER MATERIAL.—Smith 16, female "a," 6.2 mm (illus.); male "v," 4.2 mm (illus.); female "w," 4.6 mm.

REMARKS.—Small (4.0 mm) southern specimens from Mexico were previously figured by Barnard (1964a, figure 20); figures of the larger (6.0 mm) specimens from middle California are here presented but no adult male with calceoli has been found; therefore, an old collection of males from southern California has been dissected to obtain a male antenna 1 and enlargements of calceoli. The latter conform in gross generalities to those found on *Pontogeneia bartschi* Shoemaker by J. L. Barnard (1972a:186).

The cuticle bears scattered setules, those on pereonites and pleonites with conspicuous basal bulbs; the epimera bear blunt scales.

Antennae 1–2 project almost equally, antenna 1 slightly the shorter, the antennae about 50–55 percent as long as the body and head together.

MATERIAL.—Smith 16 (8), 17 (9), 18 (15); California, Bodega Bay, intertidal, August 1972, collected by Dr. Ralph I. Smith. Barnard 39–K–1 (male) (see Barnard, 1969b:111).

DISTRIBUTION.—Japan Sea; California from Bodega Bay to Bahía de San Quintín, Mexico, 0–100 m.

Tethygeneia J. L. Barnard

Tethygeneia nasa (J. L. Barnard), new combination

FIGURE 27 (part)

Pontogeneia nasa J. L. Barnard, 1969a:200, figs. 14, 15.

VOUCHER MATERIAL.—SCO 19, male "a," 4.6 mm (illus.); female "w," 4.6 mm (illus.); TOP 1, male "v," 3.7 mm (illus.).

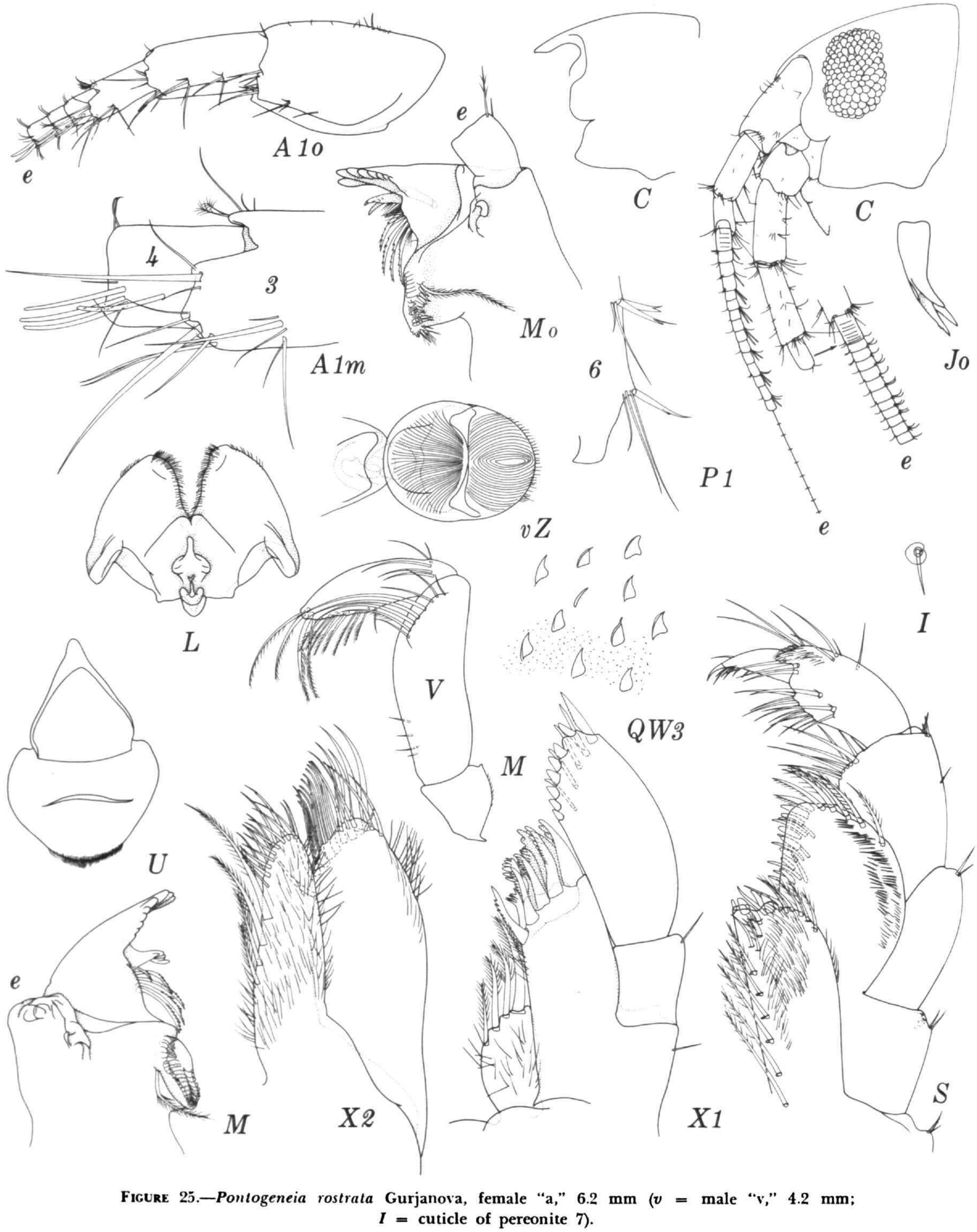

FIGURE 25.—*Pontogeneia rostrata* Gurjanova, female "a," 6.2 mm (*v* = male "v," 4.2 mm; *I* = cuticle of pereonite 7).

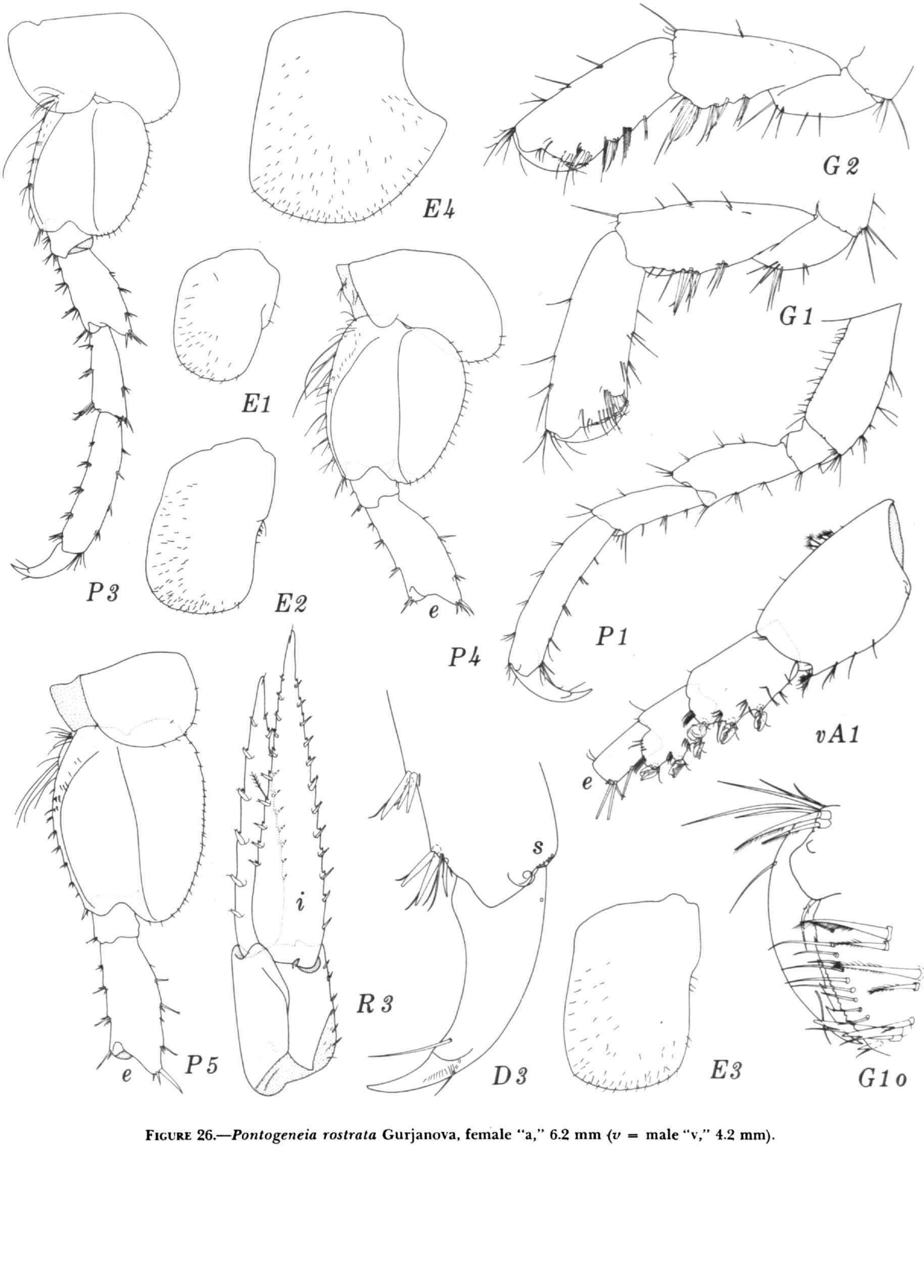

FIGURE 26.—*Pontogeneia rostrata* Gurjanova, female "a," 6.2 mm (*v* = male "v," 4.2 mm).

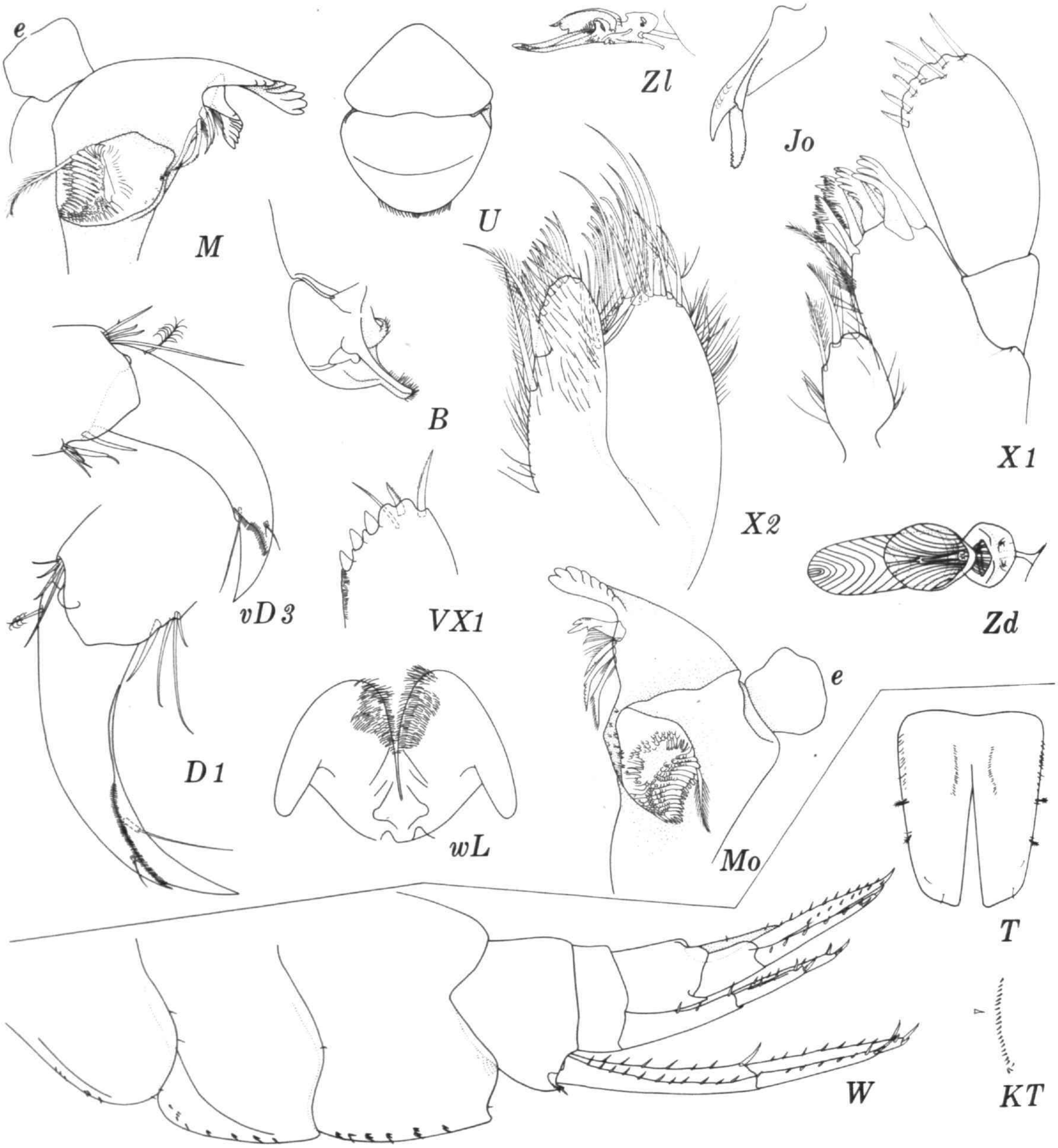

FIGURE 27.—Above: *Tethygeneia nasa* (J. L. Barnard), new combination, male "a," 4.6 mm (*v* = male "v," 3.7 mm; *w* = female "w," 4.6 mm). Below: *Pontogeneia rostrata* Gurjanova, female "a," 6.2 mm.

ILLUSTRATIONS.—The figures provided herein supplement and complete the original description of *P. nasa*. Epimeron 2 bears the ordinary lateral ridge of this genus; the cuticle bears scattered, ordinary long projecting setules, no surficial patterns on cuticle.

MATERIAL.—SCO 1, 7, 12, 14, 15, 18, 19, 22; KNO 1; TOP 1; PAZ 6, 18, 20.

DISTRUBUTION.—Gulf of California, at Puerto Peñasco, Bahía de Los Angeles, Bahía Kino, Topolobampo, Isla Espiritu Santo, and Cabo San Lucas, 0–1 m.

Tethygeneia? quinsana (J. L. Barnard), new combination

FIGURE 18 (part)

Pontogeneia quinsana J. L. Barnard, 1964a:106–108, fig. 19.

VOUCHER MATERIAL.—SQ 53 (Barnard, 1964:57) female "a" 3.2 mm (illus.).

REMARKS.—Specimens from an embayment near La Paz, Baja California, are assigned to this species despite one strong distinction from *T. quinsana* as formerly known only from Bahía San Quintín, hundreds of kilometers north of La Paz. Specimens from La Paz have the telson as deeply cleft as in *T. nasa*. In other respects the La Paz specimens differ from *T. nasa* in the shorter rostrum, poorly protruding anteroventral cephalic corner, broader article 2 of pereopod 5 and straight posterior lobe on article 5 of gnathopod 2, all characters distinguishing *T. quinsana* from *T. nasa*. This second record of *T. quinsana* suggests that the species is a sibling of *T. nasa* confined to embayments whereas *T. nasa* is confined to the open sea.

I believe that the heads in Figure 19j,n in Barnard (1964a) are erroneously attributed to *T. quinsana* and should be deleted hereafter from the visual image of the species. The heads as shown in Figure 19a,b (Barnard, 1964a) are valid.

One specimen of this series from PAZ 3 bears apices on pereopods 1 and 4, confirming that the locking spines and dactyls of these pereopods resemble the same appendages of *T. nasa*.

MATERIAL.—PAZ 3.

DISTRUBUTION.—Gulf of California, Isla Espiritu Santo, 0 m; outer Baja California, Bahía de San Quintín, 0–6 m.

GAMMARIDAE

Anchialella, new genus

TYPE-SPECIES.—*Anchialella vulcanella*, new species.

ETYMOLOGY.—*Anchialella* (Greek), little inhabitant of seaside pool.

DIAGNOSIS.—Coxal gills 2–6, ovate, scarcely pedunculate, not 2-articulate. Sternal gills absent. Only female known, sexual dimorphism unknown, oostegites elongate, evenly slender, with 0–2 apical setae. Body subvermiform. Head unnotched. All coxae very short, of similar length. Uropod 3 greatly exceeding uropod 1, parviramous, outer ramus 1-articulate, peduncle weakly elongate, longer than urosomite 3 but shorter than rami of uropod 1. Telson cleft, lobes triangular, pointed, each bearing apicomedial spine. Female gnathopod 1 of ceradocin form, wrist weakly elongate, palm oblique, articles 4–6 pubescent. Female gnathopod 2 of melitin form, enlarged, palm well defined, oblique, armed with hooked setules, unsculptured, wrist weakly elongate and lobate, posterior margin of hand with hadziid-form, setal groups weakly developed, pubescence absent. Mandibular palp article 3 linear, shorter than article 2, bearing 1 D seta, 2 E setae (Stock, 1974:77). Lower lip with weak inner lobes marked as creases on outer lobes. Inner plate of maxilla 1 with 4 apical setae, of maxilla 2 weakly setose medially, lacking oblique facial row of setae. Outer plate of maxilla 1 with 7 spines. Dactyl of maxillipedal palp with well-developed nail. Pleopods biramous. Urosomites free, only urosomite 2 with dorsolateral spine on each side, no other ornamentation.

RELATIONSHIP.—This genus forms a transitional grade of morphology between *Eriopisa* Stebbing and *Galapsiellus* J. L. Barnard (1976:422). It differs from *Eriopisa* in the absence of article 2 on the outer ramus of uropod 3, in the elongation of the peduncle on uropod 3, in the extremely weakened inner lobes on the lower lip, and in the generally greater reduction in medial setosity on the maxillae.

Galapsiellus is an apomorph bearing severely enfeebled female gnathopod 2 with greatly elongate wrist, an even more elongate peduncle on uropod 3, turgid telsonic lobes, only 6 spines on the outer plate of maxilla 1, the absence of a nail on the dactyl of the maxilliped and uneven spination on the outer plate of the maxilliped.

Anchialella appears to be very close to *Paraniphargus* Tattersall, a genus with 2 freshwater, probably hypogean, species in Java and the Andaman Islands, but the anterior coxae are short as in *Eriopisa,* maxilla 2 retains a few medial setae, the mandibular lobes of the lower lip are not strongly extended, and mandibular palp article 2 retains at least 3 medial setae. *Anchialella,* therefore, cannot be descendent from *Paraniphargus* but instead appears to be an apomorph of *Eriopisa.*

Psammoniphargus Ruffo, a monotypic genus found in hypogean waters of Madagasgar, has no direct relationship to *Anchialella* because of several apomorphic characters, such as weakly fused telesonic lobes, loss of articles on the mandibular palp, medially unsetose maxilla 2, complete loss of inner lobes on lower lip, and smaller female gnathopod 2.

The shape and setation of the mandibular palp are good indications of the relationship of *Anchialella* to *Eriopisa* and not to *Paraniphargus* even though one may hypothesize an evolutionary step from *Paraniphargus* directly to *Anchialella* in other attributes.

Anchialella vulcanella, new species

FIGURES 28, 29 (part)

DESCRIPTION.—As in diagnosis of the genus. See illustrations.

NOTES.—Pereopod 4 slightly smaller than pereopod 3. Telson of holotype aberrant, one side apparently damaged, shortened and missing main spine, only other known specimen, juvenile, 2.10 mm, with somewhat more normal telson, though one side larger than other side. Juvenile with only 1 basofacial spine on uropod 1 at Mark 44.

HOLOTYPE.—USNM 169018, female "u," 4.06 mm (illus.).

TYPE-LOCALITY.—GAL 103, Galapagos Islands, Isla Santa Cruz, Academy Bay, 23 January 1964, intertidal, mangrove tidepool 305 m from sea near lower bodega, anchialine.

VOUCHER MATERIAL.—Type-locality, juvenile "j," 2.10 mm (illus.).

DISTRIBUTION.—Galapagos Islands, Isla Santa Cruz, anchialine.

ETYMOLOGY.—The epithet *vulcanella* is from Latin meaning "fire."

Ceradocus Costa

Ceradocus paucidentatus J. L. Barnard

FIGURE 6 (part)

Ceradocus paucidentatus J. L. Barnard, 1952b:55–58, pls. 11–13.

REMARKS.—This is the second known collection of this elusive species originally described from the region of Punta Eugenia, Baja California.

A figure of the juvenile gnathopod 2 is shown to represent juvenile or female-like conditions. Heretofore only males were known. Epimeron 2 bears 1 spine, epimeron 3 bears 3 ventral spines, in each case the spines being much enlarged in comparison with adult males. Possibly these spines do not increase in size with age, as they are almost as large as those of males near 8 mm in length.

MATERIAL.—PAZ 13, juvenile, 3.74 mm (illus.).

DISTRIBUTION.—Near Punta Eugenia, outer Baja California and Bahía San Evaristo, Gulf of California, intertidal.

Dulzura J. L. Barnard

Dulzura gal, new species

FIGURE 34 (part)

DIAGNOSIS.—Article 2 of pereopods 5–7 with only 1–2 serrations at posteroventral corners. Apicolateral spine on peduncle of uropod 1 extending to Mark 60 of outer ramus. At least 2 spines on each lobe of telson as long as telson.

DESCRIPTION.—Other appendages and mouthparts generally similar to the type-species of the genus, *Dulzura gal* J. L. Barnard (1969b) except peduncle of uropod 1 with 5 small dorsolateral spines, of uropod 2 with 4 dorsolateral spines, apicalmost spine unpaired; urosomite 1 with 1 spine-seta dorsolaterally on each side, urosomite 2 with 1 spine and 1 setule on each side, urosomite 3 with 1 spine on each side at base of telson; rami of uropods 1–2, dorsal spines consist of uropod 1 outer 1, inner 3, uropod 2 outer 3, inner 4; epimeron 1 lacking ventral spines, epimeron 2 with 2 ventral spines, epimeron 3 with 4 ventral spines; mandibular palp article 2 with only 1 apical seta, 1 inner basad setule; palm of gnathopod 1 slightly oblique.

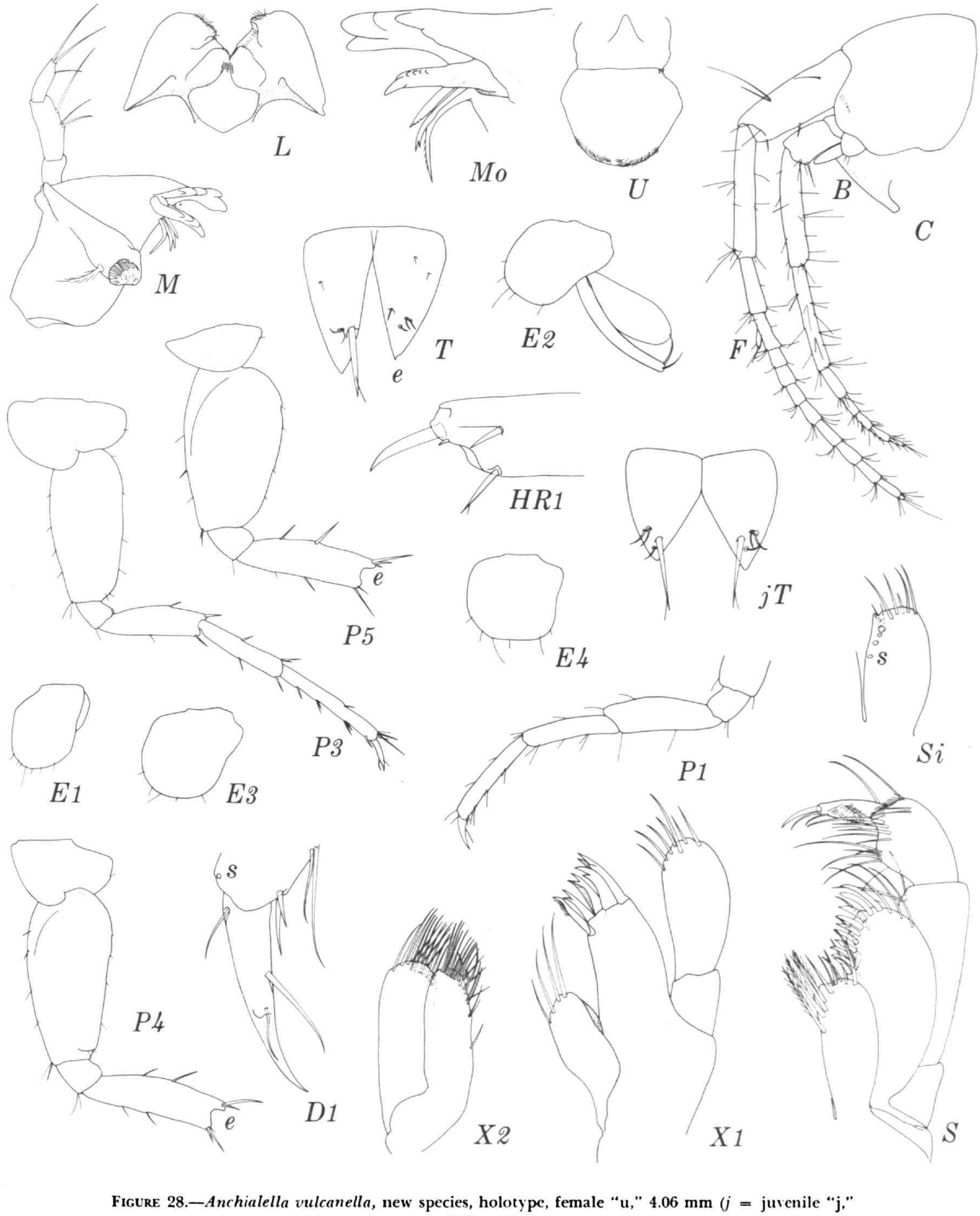

FIGURE 28.—*Anchialella vulcanella,* new species, holotype, female "u," 4.06 mm (*j* = juvenile "j," 2.10 mm).

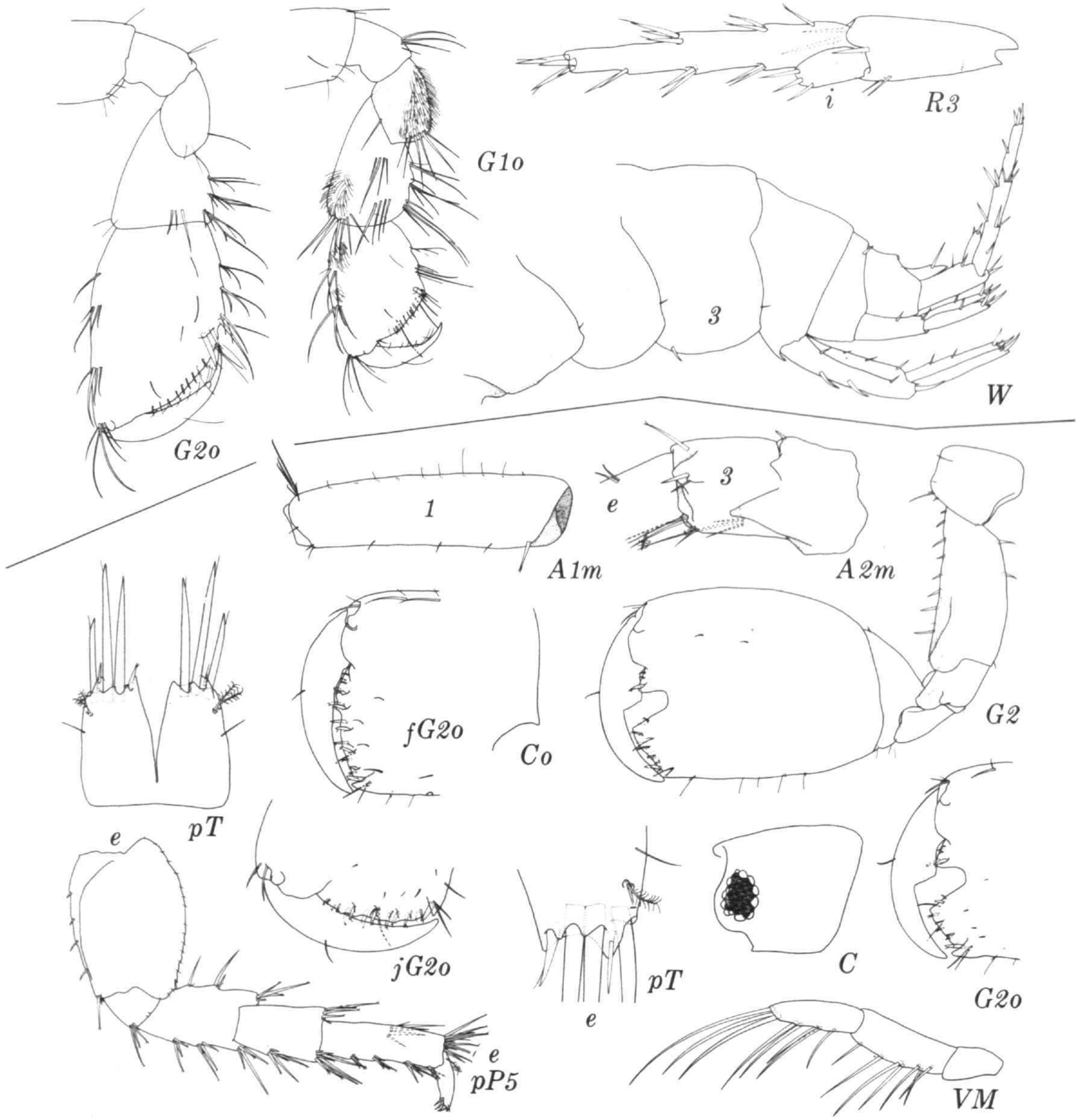

FIGURE 29.—Above: *Anchialella vulcanella*, new species, holotype, female "u," 4.06 mm. Below: *Maera chinarra*, new species, holotype, male "a," 3.7 mm (*f* = female "f," 3.4 mm; *j* = juvenile "j," 2.9 mm; *p* = male "p," 3.6 mm).

HOLOTYPE.—USNM 169019, male "w," 3.00 mm (illus.). Unique.

TYPE-LOCALITY.—GAL 108, Galapagos Islands, Isla Santa Cruz, Academy Bay, 24 January 1964, offshore of lower bodega in shallow water, wash from 3 rocks.

REMARKS.—This species differs from the type-species in the greater length of both the telsonic spines and the main spine of uropod 1 and in the fewer posteroventral serrations on article 2 of pereopods 3–5.

Dulzura gal is so similar to *Dulzura hamakua* (J. L. Barnard, 1970, formerly in *Eriopisa*) that the two species may necessarily be reduced to subspecific level when more can be learned of speciation in the genus. During the interim, the two species can be distinguished by the great length of spines on uropod 1 and the telson of *D. gal.*

MATERIAL.—GAL 108.

DISTRIBUTION.—Galapagos Islands, Isla Santa Cruz, 1 m.

Elasmopus Costa

Several subspecies and phenotypes of *Elasmopus rapax* Costa from California and Mexico have been described by J. L. Barnard (1962b, 1969b). A larger quantity of widely distributed material is now available so that replication of identifications is possible and certain limits to variability can be seen. I conclude that all forms, phenotypes and subspecies defined in the key on pages 118–119 of J. L. Barnard (1969b) should be given full specific names. The so-called formae are now shown to be widely distributed sympatric populations minutely distinct from one another. Characters of recognition are confined mainly to terminal males, though subadult males and females can usually be distinguished from one another by minute characters of epimeron 3 or telson. Juveniles of the several species appear very similar to each other but I have not studied the life history of each species intensively and thus have not discriminated juveniles adequately.

Because of the consistency of certain conservative characters, these species of *Elasmopus* from California and Pacific Mexico appear to have a common ancestry. For the purposes of this discussion the common ancestor is stated to be *E. rapax* Costa, a species widely distributed throughout the world and apparently living also in the California-Mexico area. There is room for doubt, however, in this contention, as the so-called *Elasmopus rapax* of western America can be distinguished minutely from specimens reported in the type-area of Europe in the same way that American species can be distinguished from the local representative known as *E. rapax*. These minute distinctions have generally been ignored throughout the world in the various identifications of *E. rapax*. Such minutiae must now be recognized in light of the adaptive radiation found in eastern Pacific elasmopuses.

My approach is to consider as *E. rapax* those specimens closest to the European type in terms of male gnathopod 2 and to consider this founder taxon as a race of *E. rapax* from which have developed the several descendent species.

These observations confound the taxonomy of this genus throughout the world as it becomes apparent that several identifications in the earlier literature, including papers by me, are erroneous. For example, the species identified as *E. rapax* from Hawaii by J. L. Barnard (1970:131) is probably synonymous with *E. bampo*, new species, from Mexico, so that true *E. rapax* appears not to have been collected as yet in Hawaii, if indeed it exists there at all. If the cluster of species in Mexico is truly a tightly radiated group, in this Hawaiian case, we may be observing one of the descendants of *E. rapax* having already migrated to Hawaii.

One of the descendent species of *E. rapax* in Mexico has gnathopod 2 of the male in form similar to that of *E. pocillimanus* (Bate), another European species identified throughout the Pacific Ocean. This remarkable convergence suggests the probability that the Pacific *E. pocillimanus* may actually be distinguishable from the European *E. pocillimanus* because the Pacific species has highly characteristic locking spines on the pereopods in contrast to the European species. The Mexican species, *E. tiburoni*, appears closer to the European *E. pocillimanus* than does the Hawaiian taxon identified by J. L. Barnard (1970:130) as *E. pocillimanus*. Nevertheless, the Mexican species can be distinguished from European *E. pocillimanus* by other minute characteristics.

The European and eastern Pacific evolutes in *Elasmopus* are probably secondary and are derived from species endemic to the heart of the Indo-Pacific fauna, as yet poorly studied. Virtually nothing is known of variability correlated with biogeographic increments. We therefore have few bases on which to erect a taxonomic hierarchy in this highly diverse genus.

Specific Characters in *Elasmopus*

The main taxonomic characters in *Elasmopus* are confined to a few criteria in contrast to other diverse amphipodan genera, such as *Paradexamine* (J. L. Barnard, 1972a) where virtually every part of the external body structure bears significant taxonomic characters. In *Elasmopus* these are limited primarily to male gnathopod 2, epimeron 3, telson, pereopods, article 3 of the mandibular palp, and the eyes. Few taxonomic characters have been reported on mouthparts other than article 3 of the mandibular palp, or on the coxae, uropods 1–2, gnathopod 1, antennae, and epimera 1–2. Now that most carinate species of *Elasmopus* have been removed to *Mallacoota* J. L. Barnard (1972a:243) the ornaments of the urosome are found in only a few species in the western Pacific Ocean. The antennae differ among species in setosity and lengths of articles or flagella but these tenuosities are poor taxonomic devices. Uropod 3 on occasion has variables of taxonomic use but not as significantly as believed by J. L. Barnard (1969b:118).

Gnathopod 2 of the terminal male is of highest taxonomic value, but this usefulness is obviously confined to a few specimens of any collection. The palm and posterior margin of the hand are generally confluent but often are distinguished from each other by a defining tooth. Near the dactylar hinge most species of *Elasmopus* bear a spinose hump and, slightly proximal to that, a naked tooth. Setae are often sparse and evenly distributed along the palm and posterior margin of the hand. This description fits *E. rapax* of Europe. Other species often differ in one of the following modifications: the loss of spines on the main hump or its total loss, the loss or reduction of the naked tooth or the defining tooth, or the reduction of the defining tooth to a ridge bearing a spine, or the anomalous development of setal patterns, the palm naked and the posterior hand margin heavily setose, or setae developed so densely as to obscure the palm. In several species a fourth palmar tooth forms a companion to the spinose hump, whereas the ordinary tooth proximal to the hump is generally attached more medially than the fourth companion tooth.

The apices of pereopods 1–5 provide identification characteristics among many species, but in the Mexican *rapax* group these apices are similar among the several species and afford no help in identifying juveniles. In the simplest condition the pair of apical locking spines is short, thin, almost straight and poorly striate; in many species one or both of these are enlarged or heavily striate, flabellate or curved, occasionally truncate or claviform. The pereopodal dactyls in the simplest cases have smooth inner margins and a thin or tiny subapical setule. In other species the setule may be grossly enlarged, even spine-like, the inner margin may have minute notches or grossly extended castellations and an internal sclerotic slit is found near the subapical setule. The Mexican *rapax* group has the simplest case of locking spines and dactyl.

The Mexican *rapax* group is characterized by long posterior setae on article 2 of pereopods 3–5 but *E. rapax* from Europe and many other species of *Elasmopus* lack those setae.

Pleonal epimeron 3 varies among the species but often so insignificantly as to defy identification. *Elasmopus rapax* from Europe has a straight posterior margin bearing several small denticles or notches evenly projecting, the dorsal notches often bearing setules. The denticle-notches are highly reduced in the northern European populations of *E. rapax*. Asymmetry occurs in the denticles of many other species of *Elasmopus*, the ventralmost denticle being enlarged as a tooth, the posterior margin becoming bulbous to form a weak S-shaped curve, the denticles dorsal to the main tooth often being lost, or the main tooth often being marked by a small sinuosity just dorsad. Juveniles of the Mexican *E. rapax* group generally have the latter condition. The denticle pattern is generally similar between fully terminal males and females but subadults usually have fewer denticles, smaller denticles, or smooth margins in varying degrees in the several species.

The telson of species in the *E. rapax* group everywhere in the world appears to be characteristic. The apices of each lobe are protuberant and naked but are defined laterally by a subtendant notch or incision, itself defined laterally by a sharp protrusion and largely covered with one or more spines inserted dorsally just proximal to the invagination.

No spines are fully apical nor generally medial. Spine number varies in terminal adults among the species, and spine length may vary between the sexes of a single species; for example, the females of the Mexican *E. rapax* group have highly elongate telsonic spines whereas males have extraordinarily short spines. Other species groups of *Elasmopus* have apically truncate telsonic lobes bearing fully apical spines often extending fully mediad.

Mandibular palp article 3 in *Elasmopus* is falcate and medially pectonosetiferous. The degrees of falcateness and stoutness of the article vary among the species, but this shape is useful to the taxonomist mainly as a clue to differentiating subadults of otherwise similar morphology and then only if the adult palp is grossly distinct. Many species have such similar palps that discriminations are difficult.

Ocular structure has been useful in rectifying identification errors where gross ocular distinctions can be made but these differences are not widespread. For example, J. L. Barnard (1970:115) was able to distinguish *E. calliactis* from other similar species in Hawaii mainly on the presence of red ocular pigment in contrast to black and purple in other species. The so-called *E. pocillimanus* of Hawaii is easily recognized by the slight enlargement but extreme blackness of the eyes. This kind of character loses its usefulness in all but the most freshly preserved of materials because of the slow deterioration of ocular pigment in various preservatives.

A distinction in the length of and degree of spinosity between the rami of uropod 3 has limited usefulness; J. L. Barnard (1969b:118–119) used this group of characters for distinction among several members of eastern Pacific *Elasmopus* and suggested that equality in rami marked the *E. rapax* group, but this is now seen to be fallacious. Females and juveniles of the Mexican *E. rapax* have a shortened inner ramus of uropod 3, but in terminal males and many terminal females this ramus enlarges to match the outer ramus.

Clearly, the genus *Elasmopus* will be a major problem for systematists until a monographer can study a wide diversity of materials and until some understanding of phenotypy can be obtained. My treatment here is far from satisfactory but follows the reasoning that the operable taxonomic units, recognized by their replicability in several samples, should be named as species. Because these units are, as yet, recognizable only in a terminal male stage, the material available is reduced to a small amount of the total specimens in the genus, at least in the *E. rapax* complex which dominates the eastern Pacific Ocean. The literature contains other examples of this complex not yet integrated into the system, such as *Elasmopus pseudaffinis* Schellenberg (J. L. Barnard, 1965a:501), the so-called *E. rapax* of Micronesia (J. L. Barnard, 1965a:503), perhaps *E. hooheno* J. L. Barnard and *E. piikoi* (J. L. Barnard, 1970:121, 127) and others. To make the system somewhat more understandable I have erected new names for various taxa encountered in this study and have raised to specific level other names I had created earlier. Such OTUs as the *Elasmopus rapax* of Bahía de Los Angeles (J. L. Barnard, 1962b: fig. 16 and J. L. Barnard, 1969b:119, key) are left nameless until more replicability can be demonstrated. I cannot find distinctions between the *E. rapax* of J. L. Barnard (1970:131, Hawaii) and the new species, *E. bampo,* created herein from the Gulf of California, except in telsonic spine lengths, which themselves are considered to be variable and were found to be so in the *E. rapax* of Alamitos Bay, California by J. L. Barnard (1962b:94). One might presume that the Alamitos Bay form of *E. bampo,* residing in a bay and probably at the northern margin of the species range, would exhibit abnormalities.

Presumably the typical *E. rapax* Costa is represented in Chevreux and Fage (1925:244) because the type-locality resides in Taranto, Italy, near Mediterranean France. Chevreux and Fage depict the species as lacking long setae on article 2 of pereopods 3–5. The telson has on each lobe only 2 spines strongly constrained to a small lateral notch. Male gnathopod 2 has 3 palmar teeth, the hinge tooth being simple, the middle tooth near but distinctly separate from the hinge tooth, the defining tooth small but distinct, the dactyl reaching beyond the halfway mark between teeth 2 and 3; the palm is poorly setose and the posterior margin of the hand moderately setose. Mandibular palp article 3 is elongate. The rami of male uropod 3 extend equally. Epimeron 3 is multiserrate densely, with a distinct tooth at the posteroventral corner.

Sars (1895, pl. 183) depicts this species from Norway with a much broader spread of and more numerous spines on the telson, especially in the male. Epimeron 3 is poorly serrate. The inner ramus of uropod 3 is slightly shortened. The hinge tooth on the palm of male gnathopod 2 is rounded and not sharp as in the Mediterranean form. These minor character alternatives would appear to be variations normally attributed to phenotypy but in the Pacific Ocean many species are based on this kind of small difference. The problem to be faced is whether or not such variation in the eastern Atlantic is phenotypy within a single species and in the Pacific is a mark of speciation.

Key to the Males of the Species of Eastern Pacific *Elasmopus* and the *E. rapax* Complex of Hawaii

1. Telson with medial part of each lobe protruding, rounded or subtruncate and free of spines, spinose laterally from Mark 63 to Mark 100, rarely from Mark 40 2
   Telson with truncate or slightly concave apices spinose laterally at least from Mark 50 and usually from Mark 25 or Mark 0 9
2. Epimeron 3 lacking tooth at posteroventral corner 3
   Epimeron 3 bearing tooth at posteroventral corner 4
3. Proximal palmar tooth on male gnathopod 2 well developed, palm heavily setose.................... ....***E. ocoroni***, new species
   Proximal palmar tooth on male gnathopod 2 vestigial, palm almost devoid of setae ....***E. mutatus***
4. Male gnathopod 2 palm with only 2 processes, one near dactylar base, one defining palm, hollow formed on medial face of hand ....***E. tiburoni***, new species
   Male gnathopod 2 palm with 3–4 processes, no hollow on medial face of hand 5
5. Male gnathopod 2 palm with 4 distinct processes, epimeron 3 posterodistally serrate, teeth sharp (includes part of *E. rapax* of Alamitos Bay) 6
   Male gnathopod 2 palm with 3 processes (fourth rudimentary), epimeron 3 posterodistally smooth or with minute notches 7
6. One or more telsonic spines half as long as telson (inner ramus of uropod 3 in male shortened) (includes part of *E. rapax* of Alamitos Bay) ....***E. bampo***, new species
   No telsonic spine more than one-fourth as long as telson (inner ramus of uropod 3 in male not shortened) (includes part of *E. rapax* of Alamitos Bay and through *E. rapax* of Hawaii) .... ***E. bampo***, new species
7. Male gnathopod 2 palmar process near dactylar base bifid or trifid (includes *E. rapax* form I of Bahía de Los Angeles, J. L. Barnard, 1969b:119) ....***E. ?rapax*** from eastern Pacific
   Male gnathopod 2 palmar process near dactylar base simple 8
8. Middle palmar tooth on male gnathopod 2 immediately adjacent to hinge process, dactyl of gnathopod 2 strongly shortened, article 2 of pereopod 5 strongly setose ....***E. mayo***, new species
   Middle palmar tooth on male gnathopod 2 slightly removed from hinge process, dactyl of gnathopod 2 scarcely shortened, article 2 of pereopod 5 naked ....typical ***E. rapax*** from Mediterranean
9. Male gnathopod 2 hand with large medial hollow ....***E. tiburoni***, new species
   Male gnathopod 2 hand lacking medial hollow 10
10. Male pereopod 5 article 2 with deep castellations 11
    Male pereopod 5 article 2 with weak serrations 13
11. Male gnathopod 2 article 6 with anterodistal stridulation hump, palm lacking middle tooth, (epimeron 3 with small posteroventral tooth) .... ***E. tubar***, new species
    Male gnathopod 2 article 6 lacking stridulation hump, palm bearing middle tooth (epimeron 3 variable) 12
12. Pleonal epimeron 3 with slightly convex posterior margin, rounded-quadrate at posteroventral corner, sparsely serrate posteriorly; pereopodal dactyls strongly constricted; middle process on palm of male gnathopod 2 short, broad, truncate ....***E. serricatus***, new status
    Pleonal epimeron 3 of the "antennatus" morphology, posterior margin slightly convex, smooth, with medium-sized posteroventral tooth; pereopodal dactyls moderately constricted; middle palmar process on palm of male gnathopod 2 very long and pointed ....***E. rapax*** form II of Bahía de Los Angeles

13. Midpalmar process of male gnathopod 2 absent, defining tooth absent 14
Midpalmar process(es) of male gnathopod 2 present, defining tooth present 15
14. Telson cleft more than halfway, epimeron 3 with posterior margin oblique and bearing distal tooth .... *E. antennatus*
Telson cleft halfway or less, epimeron 3 with vertical posterior margin lacking tooth .... *E. ?ecuadorensis*
15. Eyes red in life, bleaching clear in alcohol in 2–3 weeks .... *E. calliactis*
Eyes with dark pigment not bleaching in alcohol in 2–3 weeks 16
16. Palm of male gnathopod 2 with 2 midprocesses, each conical, plus facial ridge and spine, epimeron 3 with small sharp posteroventral tooth .... *E. temori*, new species
Palm of male gnathopod 2 with 1 midprocess, variable, epimeron 3 variable 17
17. Midprocess of male gnathopod 2 an asymmetrical cone, epimeron 3 with extended and upturned posteroventral corner .... *E. holgurus*
Midprocess of male gnathopod 2 broad, truncate, epimeron 3 with small sharp posteroventral tooth .... *E. zoanthidea*, new species

Elasmopus antennatus (Stout)

Neogammaropsis antennatus Stout, 1913:645–646.
Elasmopus antennatus.—J. L. Barnard, 1962b:88–91, figs. 12, 13; 1964b:222; 1969b:115–117.

MATERIAL.—PAZ 21.

DISTRIBUTION.—California and Baja California from Carmel to Cabo San Lucas, 0–11 m.

Elasmopus bampo, new species

FIGURES 30, 31

Elasmopus rapax of Alamitos Bay.—J. L. Barnard, 1962b, fig. 17; 1969b:119. [In part.]
?*Elasmopus rapax* of Hawaii.—J. L. Barnard, 1970:131–135, figs. 79, 80.

DIAGNOSIS.—Eyes ordinary. Mandibular palp article 3 deeply falcate. Palm of male gnathopod 2 with ordinary spinose hump near dactylar hinge, then supernumerary (4th) sharp enlarged tooth on same plane, naked apically, rounded mediofacial tooth, palm defined by tapering medial tooth, palm and posterior margin of hand evenly and sparsely setose. Article 2 of pereopods 3–5 with long posterior setae in male only; locking spines of pereopods 1–5 ordinary, inner margin of dactyl smooth but with minute shagreen proximally, main subapical setule thick but apically flexible. Epimera 2–3 with long ventral setae, epimera 1–3 with short ventral spines; epimeron 3 with nearly straight posterior margin bearing 5 or more sharp denticles becoming blunter dorsally, each sinus armed with setule except ventralmost, posteroventral tooth not larger than other denticles and its guarding sinus not enlarged greater than other sinuses. Rami of uropod 3 equally long in male, inner ramus shortened in females and juveniles; inner ramus with several stout basomedial spines. Telson with naked protrusive apices placed mediad, laterally defined by sinus and sharp tooth, spines submarginal from sinuosity and forming row of about 3 laterally; some spines very long in female, all spines short in male.

DESCRIPTION.—Female lacking long setae of article 2 on pereopods 3–5, small females and large juveniles lacking serrations of epimeron 3 except for ventralmost sinus and tooth; juvenile males with fourth tooth of palm on gnathopod 2 much smaller than in adults, small juvenile males apparently with gnathopod 2 as in *E. rapax* and therefore indistinguishable from that species.

Following parts as shown for *E. rapax* (Figures 35–37) head, antennae, accessory flagellum, eye, mouthparts (except for parts of mandibles illustrated), pereopods 1–5 (except 1 slightly anomalous pereopod 5 illustrated), dactyls, gnathopod 1 except article 4 as illustrated, urosome, uropods 1–2, female gnathopod 2 except proportions as outlined in figures, female uropod 3, coxae, cuticle, medial view of article 1 on antenna 1 except for several additional ventral setae.

VARIANT.—Subadult males from PAZ 9 with long spines on telson.

HOLOTYPE.—USNM 149390, male "a," 6.88 mm (illus.).

TYPE-LOCALITY.—TOP 3, Topolobampo, Mexico, 25 November 1971, 1.6 km seaward of town, 1 m, rock wash.

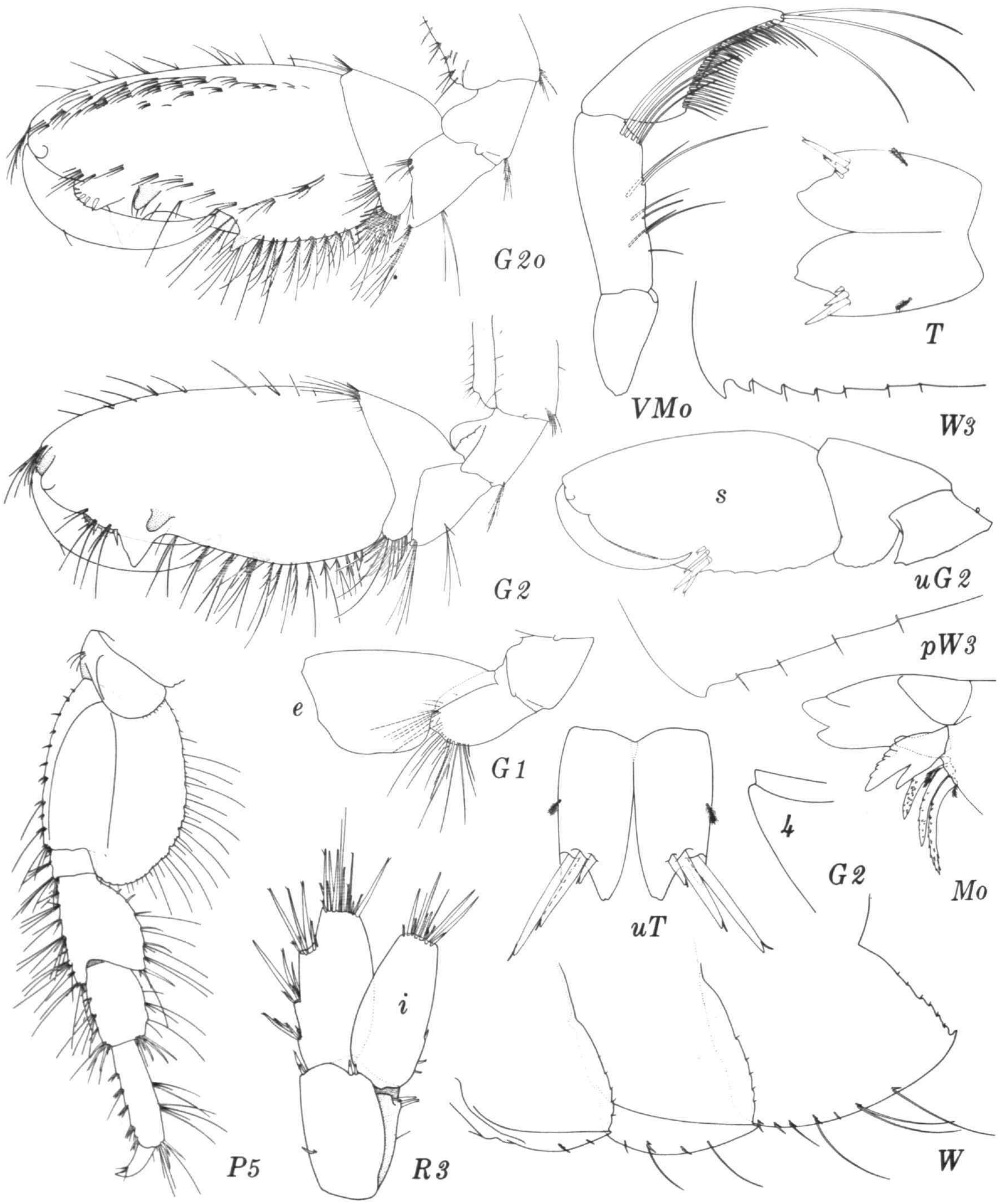

FIGURE 30.—*Elasmopus bampo,* new species, holotype, male "a," 6.88 mm (*p* = male "p," 6.2 mm; *u* = female "u," 6.56 mm).

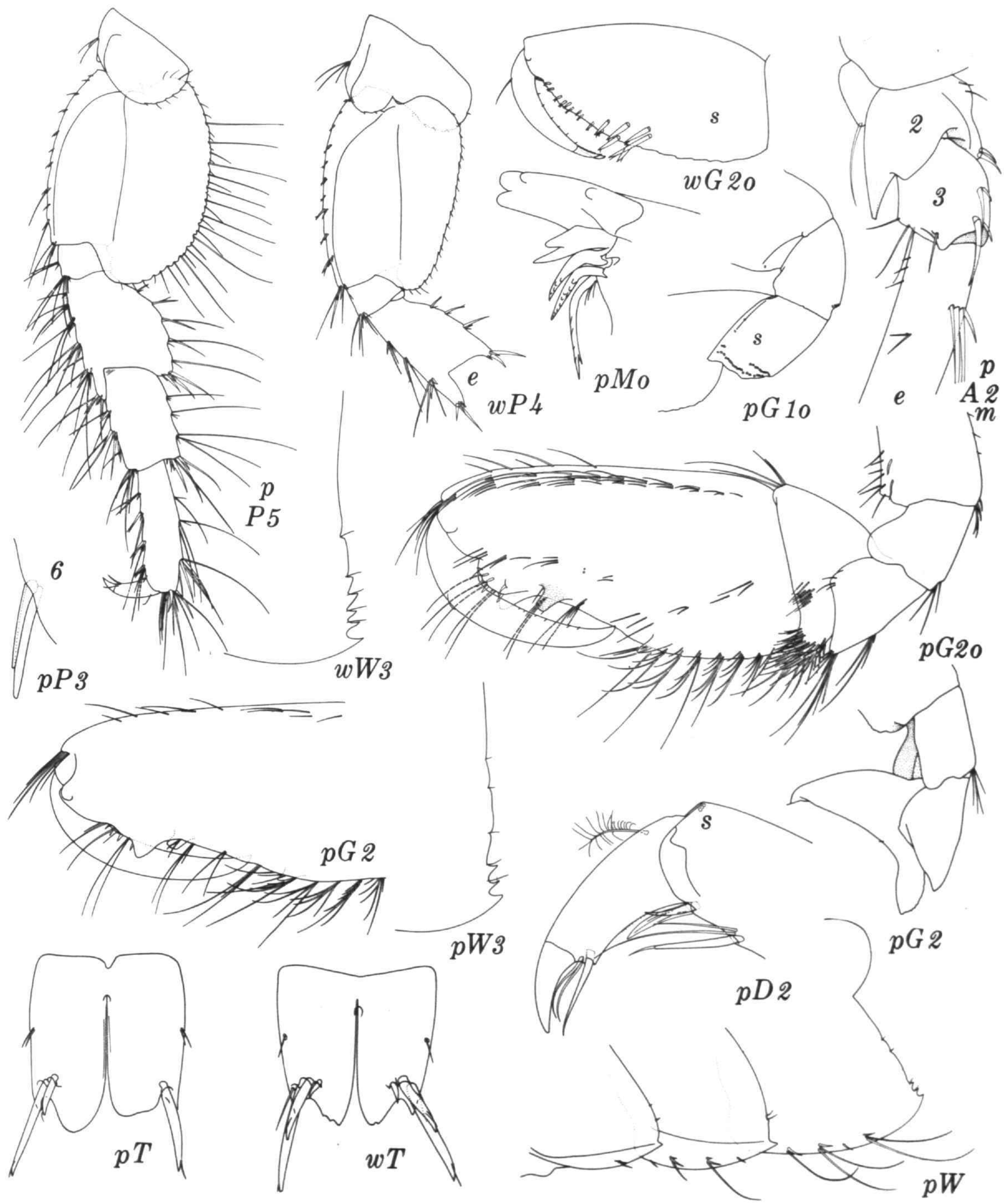

FIGURE 31.—*Elasmopus bampo*, new species, male "p," 6.2 mm (*w* = female "w," 6.3 mm).

VOUCHER MATERIAL.—Type-locality, female "u," 6.56 mm (illus.); PAZ 9, male "p," 6.2 mm (illus.), female "w," 6.3 mm (illus.).

RELATIONSHIP.—This species differs from Mexican *E. rapax* in the presence of a fourth tooth on the hand of male gnathopod 2 and in the even serrations of epimeron 3 in terminal adults.

The *Elasmopus rapax* described from Alamitos Bay, California, by Barnard (1962b:94, 1969b:119) appears to belong with *E. bampo*. However, the telsonic spines of the juveniles are not as long as those of typical *E. bampo* and adults were said to have the spines reduced to the size one sees in the *E. rapax* of Hawaii described by J. L. Barnard (1970:131). One must place the Hawaiian taxon provisionally in *E. bampo* until the nature of telsonic spines can be elucidated; they would form an excellent subspecific or specific distinction between the two widely separated regions were it not for the variability encountered in Alamitos Bay, California.

MATERIAL.—SCO 16; KNO 1; TOP 2, 3; PAZ 5, 9.

DISTRIBUTION.—Gulf of California: Puerto Peñasco, Bahía Kino, Isla Espiritu Santo and Isla Partida, intertidal; California, bay form in Alamitos Bay; ?Hawaii, as a subspecies.

Elasmopus ?ecuadorensis Schellenberg

FIGURES 32, 33 (part)

[?]*Elasmopus ecuadorensis* Schellenberg, 1936:153–154, fig. 1 [see identification below].

IDENTIFICATION.—These are the only specimens found in the Galapagan collections matching Schellenberg's description and illustrations in the condition of epimeron 3, uropod 3, mandibular palp, pereopod 5, accessory flagellum, lateral aspect of gnathopod 2 and generally in the telson. The cleft on the telson in the male is very slightly greater than shown by Schellenberg but approximates that found in the female.

DIAGNOSIS.—Eyes ordinary. Mandibular palp deeply falcate. Palm of male gnathopod 2 with rounded and poorly spinose hump near dactylar hinge, no middle tooth, weak mediofacial ridge on hand near apex of dactyl, medial face with line of dense setal rows axially, palm and posterior margin of hand densely setose throughout. Article 2 of pereopods 3–5 lacking long posterior setae, article 2 of pereopod 5 normally serrate; locking spines of pereopods 3–5 ordinary, thin, straight, weakly striate longitudinally, inner locking spine on pereopods 1–2 also normal, but striate, outer locking spine enlarged, curved, striate, proximal face of dactyl striate or with fine prickles, main subapical setule very thick, short, scarcely flexible apically. Epimera bearing only short ventral spines, epimeron 3 weakly convex to straight posteriorly, sparsely notched, posteroventral corner rounded. Uropod 3 of male with shortened inner ramus bearing 1 medial spine. Telson with truncate apices each armed with 3–4 spines, three spines always elongate, lateral spine most elongate, fourth spine when present medial and very short.

DESCRIPTION.—Generally like *E. antennatus* (Stout) (J. L. Barnard, 1962b) but herein compared to Figures 35–37 of *E. rapax* for expediency. Eyes stained brownish magenta; antennae stout, flagellum of antenna 1 especially stout (abnormally shortened on head view, see Figure 32:*A1m* of normal length), articles 2–3 with ventral setae weakly elongate, accessory flagellum 2-articulate; mandibles like *rapax* except palp like *E. tubar,* article 3 short, very stout, each mandible with 4 rakers, article 2 of palp with inner setal formula of 1–2–1, first seta highly basal; upper lip, lower lip like *E. rapax,* maxilla 1 with thin palp, spines on outer plate with more numerous and longer cusps, outer plate of maxilla 2 thin, dactyl of maxilliped shorter and nail longer than in *rapax*. Gnathopod 1 like *rapax* but article 4 evenly rounded apically (details of hand on Figure 32:*G1o*). Anterior margin of coxa 1 straight, coxa 2 broader, coxa 3 slightly tapering and coxa 4 with posterior excavation shallower and tooth blunter than in *rapax,* long ventral setae of coxae 1–4 in male "a" =5–6–6–6. Pereopods 1–2 slightly stouter than in *rapax,* article 4 with only 2 posterior bundles of setae, 3 anterior sets of spines, article 5 with one set of midanterior setae and one set apically, posterior margin with 5–7 spines, in larger specimens 2 spines paired in basal set, article 6 with only 5 posterior spine positions besides locking set, some middle sets with 2–3 spines (pereopods 3–5, epimera, uropods and telson on Figures 32 and 33). Males with ventral spines on epimeron 3 largely absent in posterior third, in largest male "v" 7.52 mm (not illustrated), epimeron 1 with pair of ventral spines, epimeron 2 with 2–1 (anterior to posterior), epimeron 3 with 1–1–1–1, male "a"

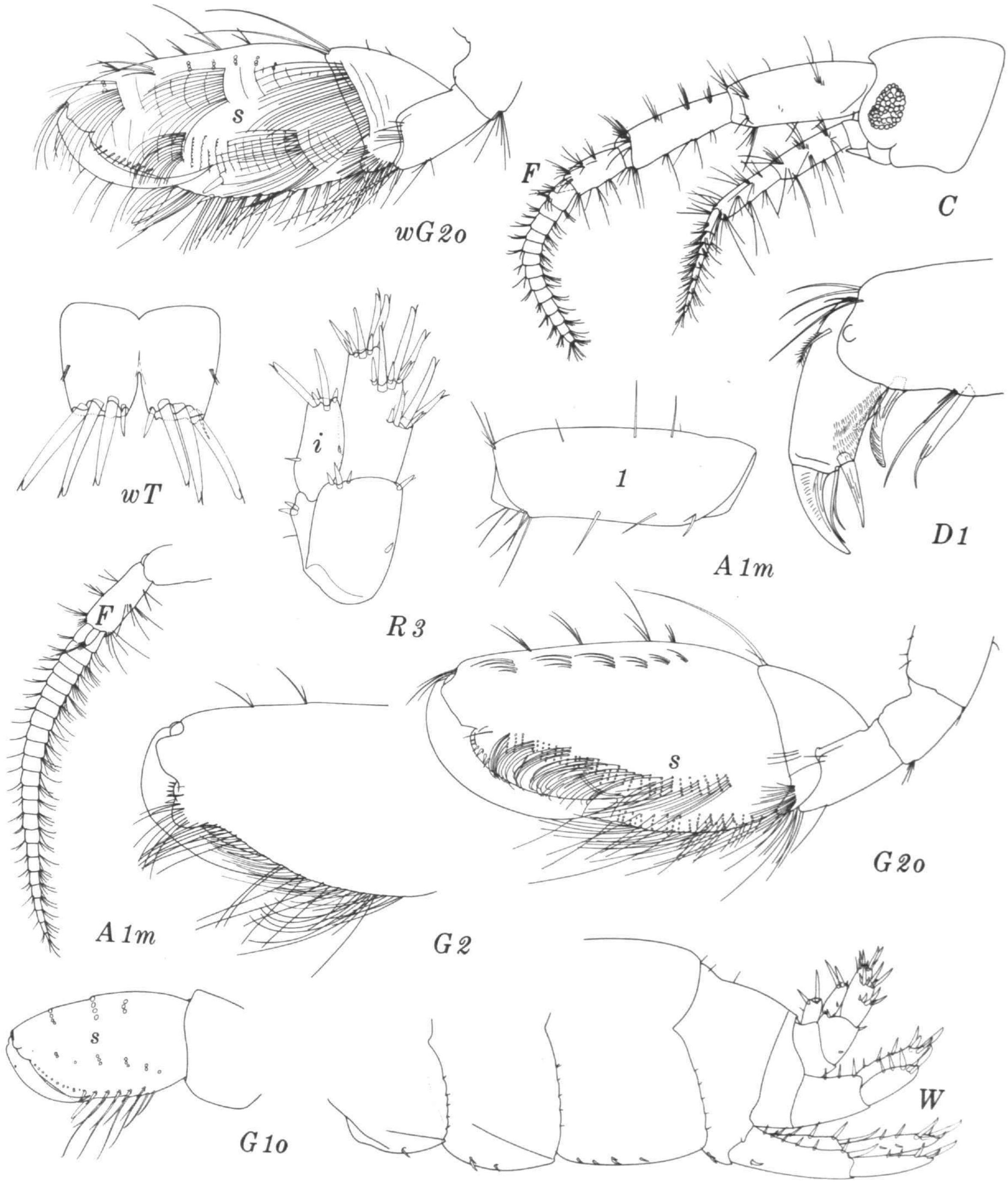

FIGURE 32.—*Elasmopus ?ecuadorensis* Schellenberg, male "a," 6.35 mm (*w* = female "w," 7.29 mm).

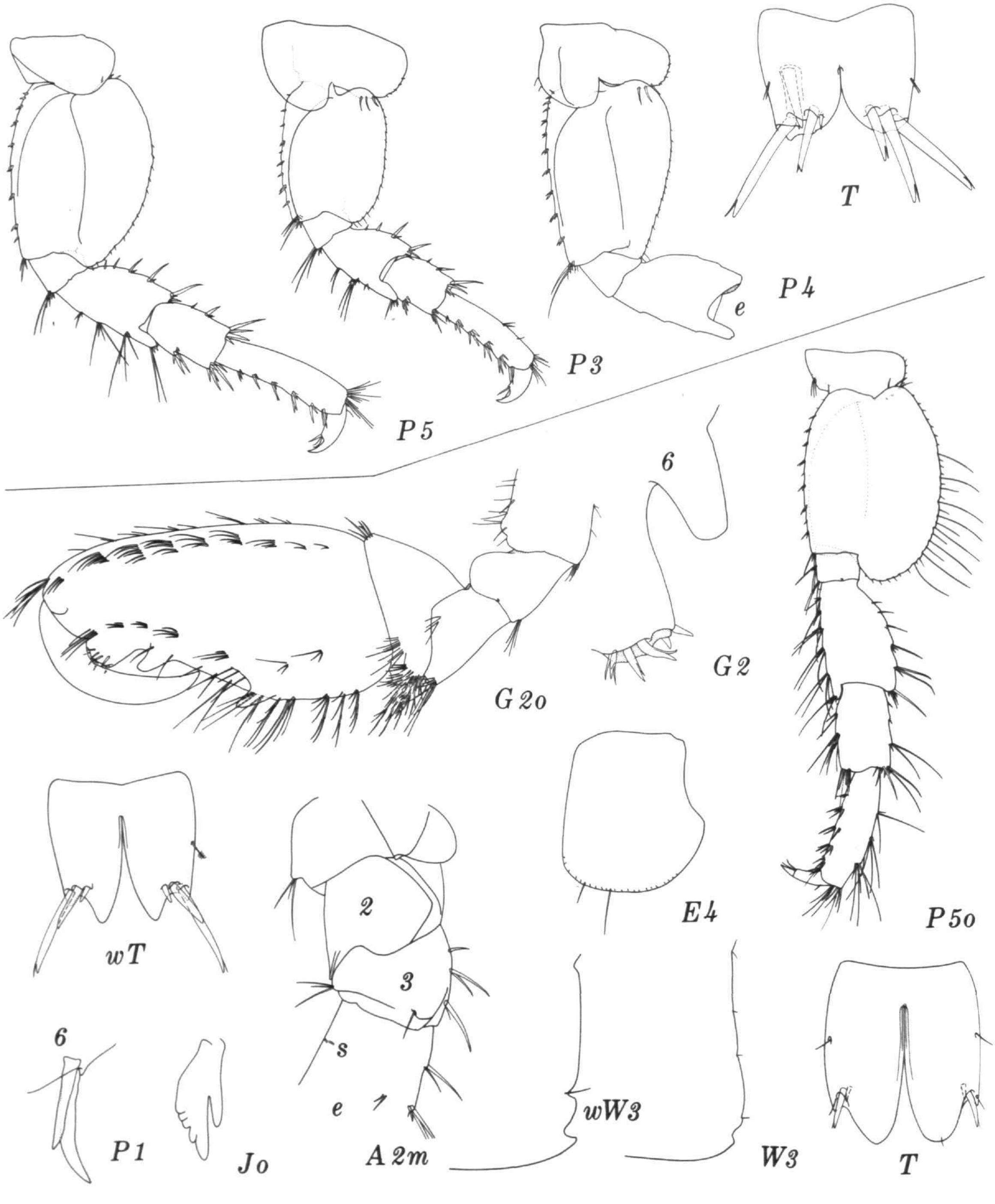

FIGURE 33.—Above: *Elasmopus ?ecuadorensis* Schellenberg, male "a," 6.35 mm. Below: *Elasmopus mayo*, new species, holotype, male "a," 8.72 mm (*w* = female "w," 7.75 mm).

with formulae of 1, 2–1, and 1–1–2–1. Most specimens lacking abnormal gap in peduncular spines of uropod 1 (in contrast to Figure 32:*W*); uropod 3 especially small.

FEMALE.—Like male but gnathopod 2 smaller, medial face of hand immensely setose, bearing mediofacial spine on hand near apex of dactyl; spines on epimeron 3 proceeding fully posteriad, formula for epimera 1–3 of female "w" = 2, 1–2–1 and 1–1–2–2–1–1.

ILLUSTRATIONS.—Flagellum on antenna 1 of male head abnormal, see normal flagellum in Figure 32:*A1m*; telsonic apices of normal adult males and females are like Figure 32:*wT*, but adult males have a slightly deeper cleft; note abnormal spination and apical shapes for male "a" telson (Figure 33: *T*, above).

TYPE-LOCALITY.—Galapagos Islands, Albemarle (Schellenberg, 1936:153).

VOUCHER MATERIAL.—DAW 2, male "a," 6.35 mm (illus.); female "w," 7.29 mm (illus.); male "v," 7.52 mm.

RELATIONSHIP.—This species resembles *E. antennatus* (Stout) but differs in the quadrate epimeron 3 lacking a posteroventral tooth. Schellenberg (1938a: 54) was undoubtedly correct that *E. ecuadorensis hawaiensis* from the Hawaiian Islands (J. L. Barnard, 1970:119) is closely similar to the Galapagan taxon but the redescription of *E. e. ecuadorensis* herein suggests that the differences between the two are sufficient to elevate *E. hawaiensis* to full specific level. *Elasmopus hawaiensis* has a deeper telsonic cleft, fewer apical spines on the telson, more strongly excavate telsonic apices with more protrusive middle limbs. If terminal males were indeed described by J. L. Barnard (1970:119) then *E. hawaiensis* has a much more poorly setose male gnathopod 2 than does *E. ecuadorensis*.

MATERIAL.—DAW 2.

DISTRIBUTION.—Galapagos Islands, intertidal.

Elasmopus hawaiensis Schellenberg, new status

Elasmopus ecuadorensis hawaiensis Schellenberg, 1938a:54–55, fig. 27.—J. L. Barnard, 1970:119–121, fig. 69.

Schellenberg's subspecies is here elevated to full specific status.

Elasmopus mayo, new species

FIGURE 33 (part)

Elasmopus rapax form I of Tiburon Island—J. L. Barnard, 1969b:119 [part].

DIAGNOSIS.—Eyes ordinary. Mandibular palp article 3 deeply falcate and stout as in *E. bampo*. Palm of male gnathopod 2 with ordinary but narrowed spinose hump near dactylar hinge, next tooth naked, subcolumnar, closely proximal to main hump, palm defined by strong conical tooth, palm and posterior margin of hand poorly setose, dactyl reaching only part way along palm. Article 2 of pereopods 3–5 with posterior setae in male only, locking spines of pereopods generally ordinary but largest spine apically curved on pereopods 1–2, inner margin of dactyl smooth, main subapical setule thick but apically flexible. Epimera 1–3 similar to those of *E. rapax* but long setae on epimera 1–2 absent, epimeron 3 with nearly straight posterior margin armed with 1–2 notches bearing setules, posteroventral tooth small in female, nearly obsolescent in male, sinus above tooth naked. Rami of uropod 3 equally long in male, inner ramus with 3 basomedial spines, inner ramus shortened in females. Telson with naked protrusive apices placed mediad, laterally defined by sinus and medium sized tooth, with 1 or 2 spines on each lobe in male (second spine developing for next instar seen on 1 male), female with 3 spines, 1 spine much longer than spines of male.

DESCRIPTION.—Following parts as shown for *E. rapax* (Figures 35–37): head, lateral antenna 1, accessory flagellum (3-articulate), antenna 2, upper lip, right mandible (but lacinia mobilis illustrated), left mandible, lower lip, maxilliped, gnathopod 1, general appearance and spination of pereopods 1–4 (but posterior setae of article 2 on pereopods 3–4 fewer), coxae 1–3, urosome, uropods 1–2 (but spines on peduncle of uropod 2 fewer), uropod 3 of both sexes (but outer ramus with only 2 lateral spine groups and peduncle lacking basolateral spines); female gnathopod 2 (but article 4 with sharp posterodistal point). Following parts as described or in Figure 33: medial aspect of antenna 1 but proximal spine group with only 1 spine; inner plate of maxilla 1 with 2 large and 3 or 4 small setae, palp with 8 spines and 6 or 7 setae; inner plate of maxilla 2 with only 1 medial seta; coxa 4 illustrated; formula of spines on epimera 1–3, front to rear, respectively: 1–2; 1–4–2–3; 1–1–1–2–3–2 (with 1 seta in last 2 positions on epimeron 3); pereopod 5 of male with much narrower article 2 than in *E. rapax* (illustrated), the figure composed on a medial view for articles 1–5 and lateral view for articles 6–7.

HOLOTYPE.—USNM 142469, male "a," 8.72 mm (illus.)

TYPE-LOCALITY.—Bahía San Carlos, Mexico (near Guaymas), 24 January 1971, intertidal, collected by R. C. Brusca.

VOUCHER MATERIAL.—Type-locality, female "w," 7.75 mm (illus.).

RELATIONSHIP.—This species differs from *E. rapax* and *E. bampo* in the presence of only 3 palmar teeth on male gnathopod 2; the fourth tooth as seen in *E. bampo* can be visualized rudimentarily on *E. mayo*. The latter and *E. tiburoni* were mixed together in my key (Barnard, 1969b:119), as "*Elasmopus rapax* form I of Tiburon Island, couplet IC" as I assumed that juveniles of *E. mayo* belonged with what is now named *E. tiburoni*.

MATERIAL.—GAL 102, 107, 108, 109, 113, 114, 115, 116; DAW 1, 3, 19, 23, 27, 31, 32, 33, 35, 40; ECU 2; BRU 1.

DISTRIBUTION.—Gulf of California, Bahía San Carlos; Galapagos Islands; Ecuador; intertidal.

The distribution of this species is peculiar. It has been found abundantly in Galapagan samples but in only one sample from the Gulf of California.

Elasmopus ocoroni, new species

FIGURE 34 (part)

DIAGNOSIS.—Eyes ordinary. Mandibular palp deeply falcate. Palm of male gnathopod 2 with sharp falcate spinose hump near dactylar hinge, palm short, middle tooth stout, blunt, palm defined by broad conical tooth bearing spine, palm and posterior margin of hand strongly setose throughout, setae highly elongate, medial face of hand poorly setose. Article 2 of pereopods 3–5 lacking long posterior setae, article 2 of pereopods 4–5 normally serrate; locking spines of pereopods 3–5 ordinary, thin, straight, weakly striate longitudinally, inner locking spine on pereopods 1–2 enlarged, curved, blade-like, face of dactyls on pereopods 1–2 with faint shagreen, margins unnotched on pereopods 1–5, main subapical setule thick but apically flexible. Epimera bearing only short and thin ventral spines, epimeron 3 weakly convex posteriorly, sparsely notched, postoventral corner rounded-quadrate. Uropod 3 of male with shortened inner ramus bearing 1 medial spine. Telson with apices rounded and protruding medially, each lateral acclivity broad, shallow, bearing 3 spines grading from short to medium from medial to lateral.

DESCRIPTION.—Generally like *E. mutatus* (J. L. Barnard, 1962b:96, fig. 18); eyes slightly enlarged, ommatidia all stained burgundy, no pigment core, antennae very similar, including elongate article 3 of antenna 1, article 2 with 2 pairs of very short ventral setae, article 3 with several pairs of longer setae, accessory flagellum 2-articulate; mouthparts as shown for *E. rapax* (Figure 35) but mandibular palp article 3 slightly less attenuate, mandibular lobes of lower lip blunter, palp of maxilla 1 only as wide as outer plate, latter with medial tooth formula of spines 2–5 = 2, 3 small, 3 large, 2 small; outer plate of maxilla 2 much thinner; nail of maxillipedal dactyl slightly elongate; palm of gnathopod 1 with 3 defining spines, medial comb of article 4 shortened, articular outline distinctive (Figure 34: *aG1o*); coxae 1–4 like those of *E. rapax* but coxa 4 with posteroventral lobe blunter and broader, long setae similar, formula of coxae 1–4 = 10–7–7–9; pereopods 1–2 as in *E. rapax* but spines and setae fewer; pereopods 3–5 as in *E. mutatus* or *E. zoanthidea* (Figure 44); uropod 2 with only 1 subapical dorsal spine on peduncle.

FEMALE.—Unknown; dominant females of sample from type-locality are not of this species but deposited in male collections for future reference.

HOLOTYPE.—USNM 169020, male "a," 5.00 mm (illus.).

TYPE-LOCALITY.—DAW 24, Galapagos Islands, Isla Santa Cruz, Academy Bay, 18 February 1962, intertidal, rock wash in mangrove cove.

VOUCHER MATERIAL.—Six males from type-locality.

RELATIONSHIP.—This species is closely similar to *E. mutatus* from California but differs in male gnathopod 2 having the proximal palmar ridge bearing a spine extended onto the palmar margin and forming a projecting tooth that defines the palm. The palm is also heavily setose in contrast to *E. mutatus*.

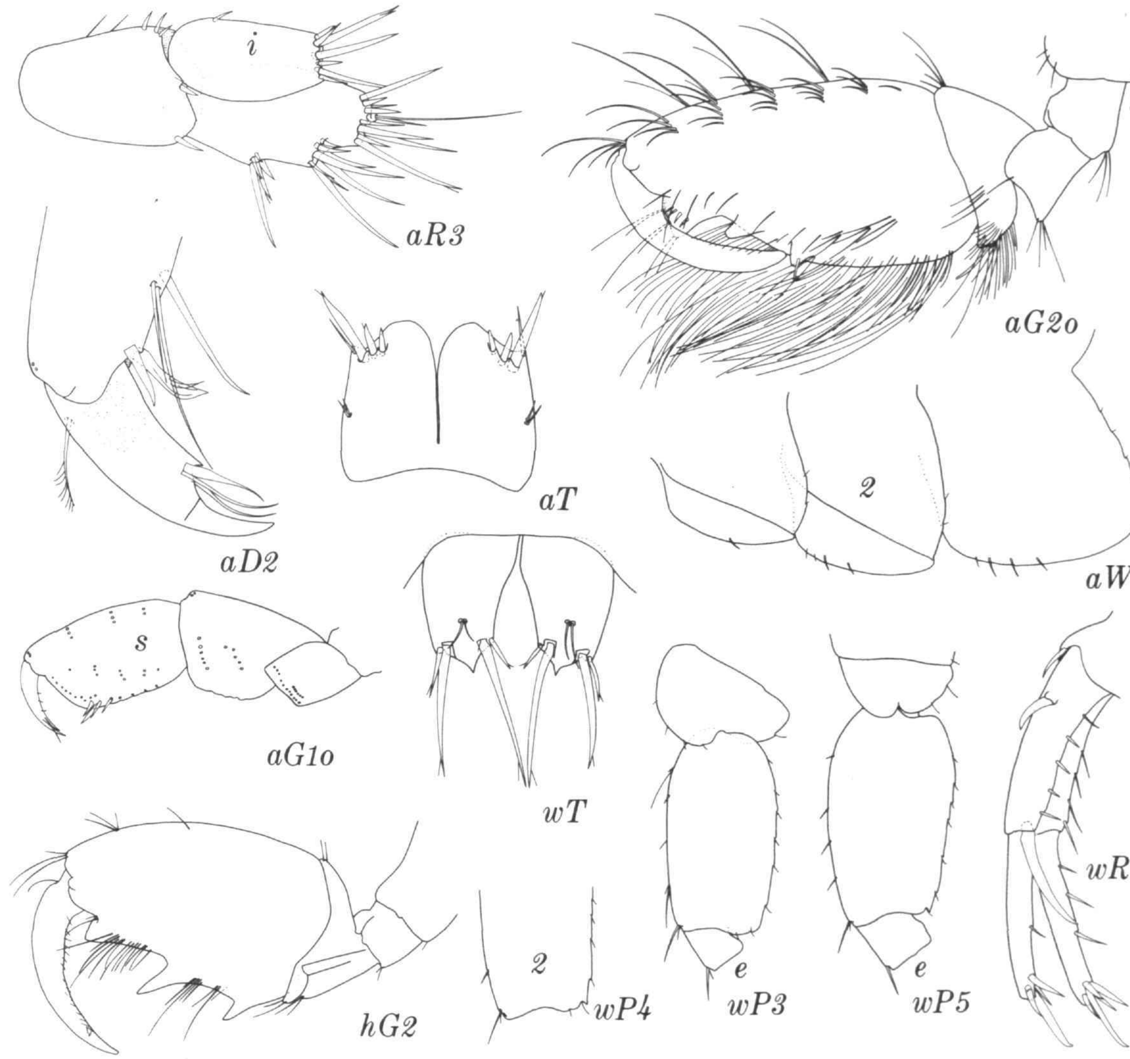

FIGURE 34.—*Elasmopus ocoroni*, new species (*a* = holotype, male "a," 5.00 mm). *Dulzura gal*, new species (*w* = holotype, male "w," 3.00 mm). *Cheiriphotis megacheles* (Giles) (*h* = male "h," 2.26 mm).

MATERIAL.—DAW 24; COCOS 9.

DISTRIBUTION.—Galapagos Islands, Isla Santa Cruz; Cocos Island; intertidal.

Elasmopus ?rapax Costa from Eastern Pacific

FIGURES 35-37

Elasmopus rapax Costa, 1853:175.
Elasmopus rapax form I of Bahía de Los Angeles.—J. L. Barnard, 1962b, fig. 16; 1969b:119.

DIAGNOSIS.—Eyes ordinary. Mandibular palp article 3 deeply falcate. Palm of male gnathopod 2 with ordinary spinose hump near dactylar hinge, then truncate proximal tooth on plane mediad, palm defined by tapering medial tooth, palm and posterior margin of hand evenly and sparsely setose. Article 2 of pereopods 3–5 with long posterior setae in male only; locking spines of pereopods 1–5 ordinary, inner margin of dactyl smooth but with minute proximal shagreen or fuzz, main sub-

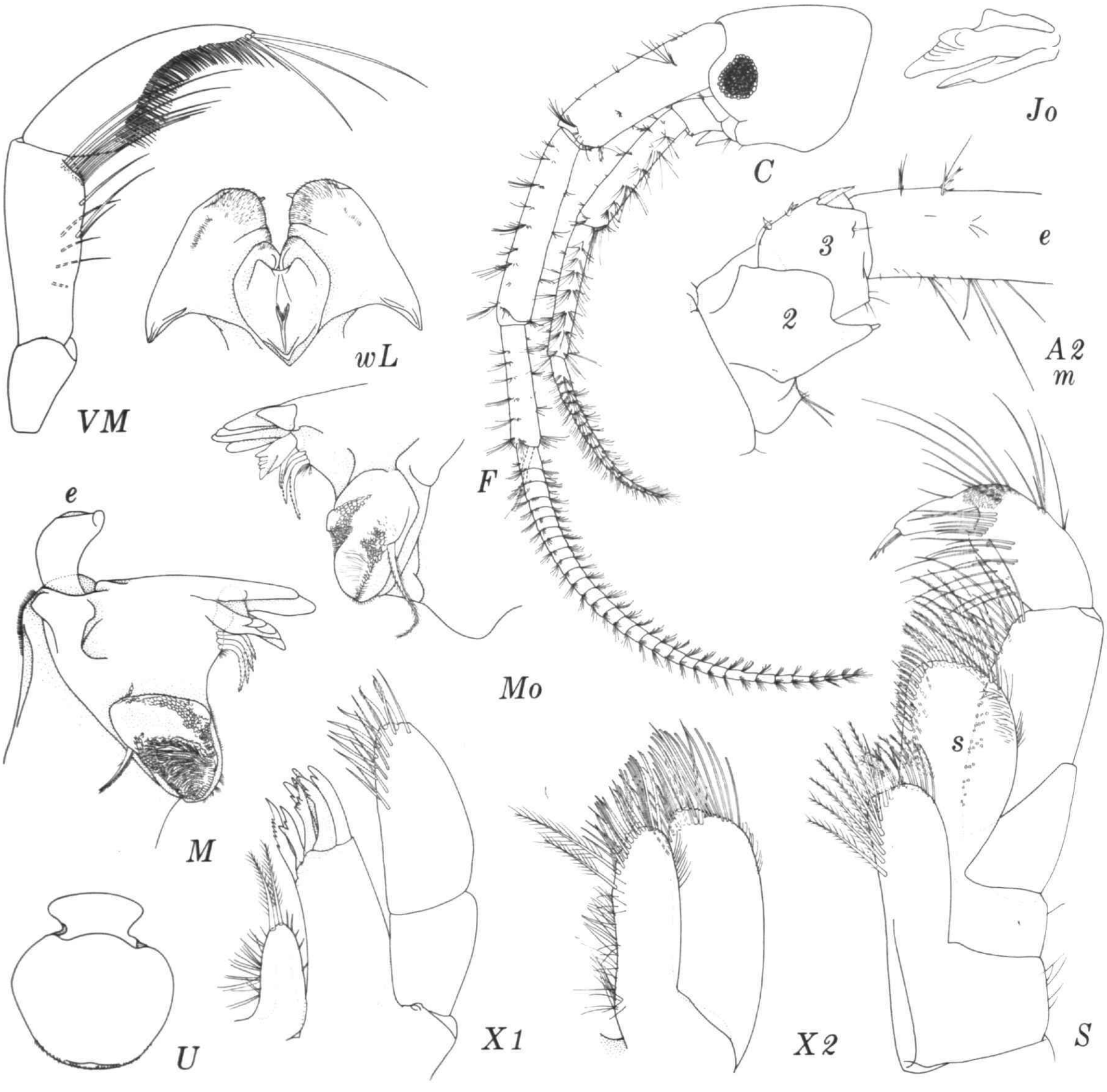

FIGURE 35.—*Elasmopus ?rapax* Costa, male "a," 10.5 mm (*w* = female "w," 7.7 mm).

apical setule thick but apically flexible (with 2 subsidiary setules apparently normal to genus). Epimera 2–3 with long ventral setae, epimera 1–3 with short ventral spines; epimeron 3 with weakly S-shaped posterior margin bearing setular notches, margin flat between notches, final notch lacking setule, guarded by small sharp tooth, then gross invagination defined ultimately by slightly enlarged posteroventral tooth. Rami of uropod 3 equally long in male, inner ramus with several stout basomedial spines, inner ramus of females and juveniles shorter then outer ramus. Telson with naked protrusive apices placed mediad, laterally defined by sinus and sharp tooth, spines submarginal from sinus and forming row of 2–5 laterally, some spines very long in female, all spines very short in male.

NOMENCLATURE.—No synonymy or references are provided as my application of this name to the

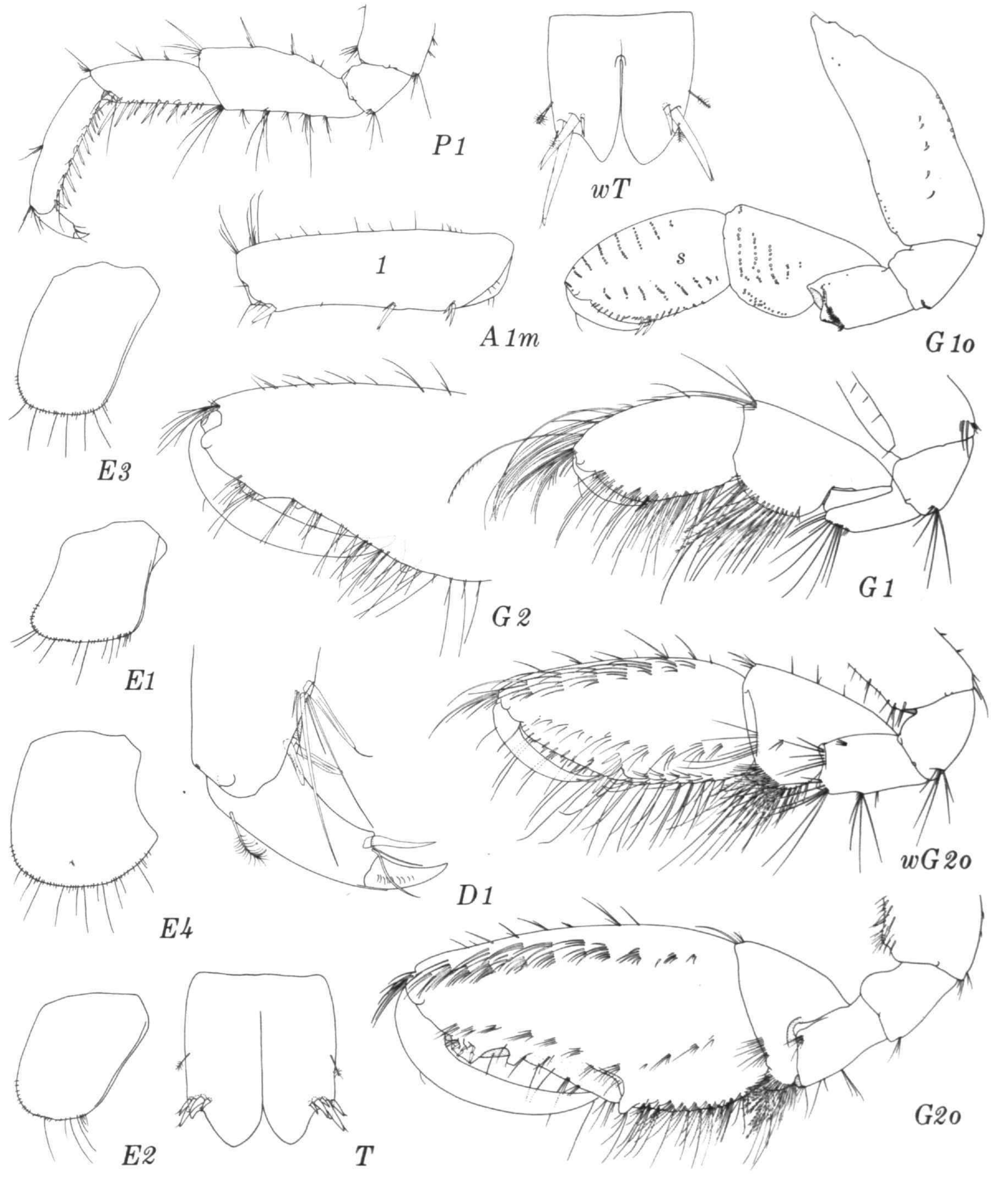

FIGURE 36.—*Elasmopus ?rapax* Costa, male "a," 10.5 mm (*w* = female "w," 7.7 mm).

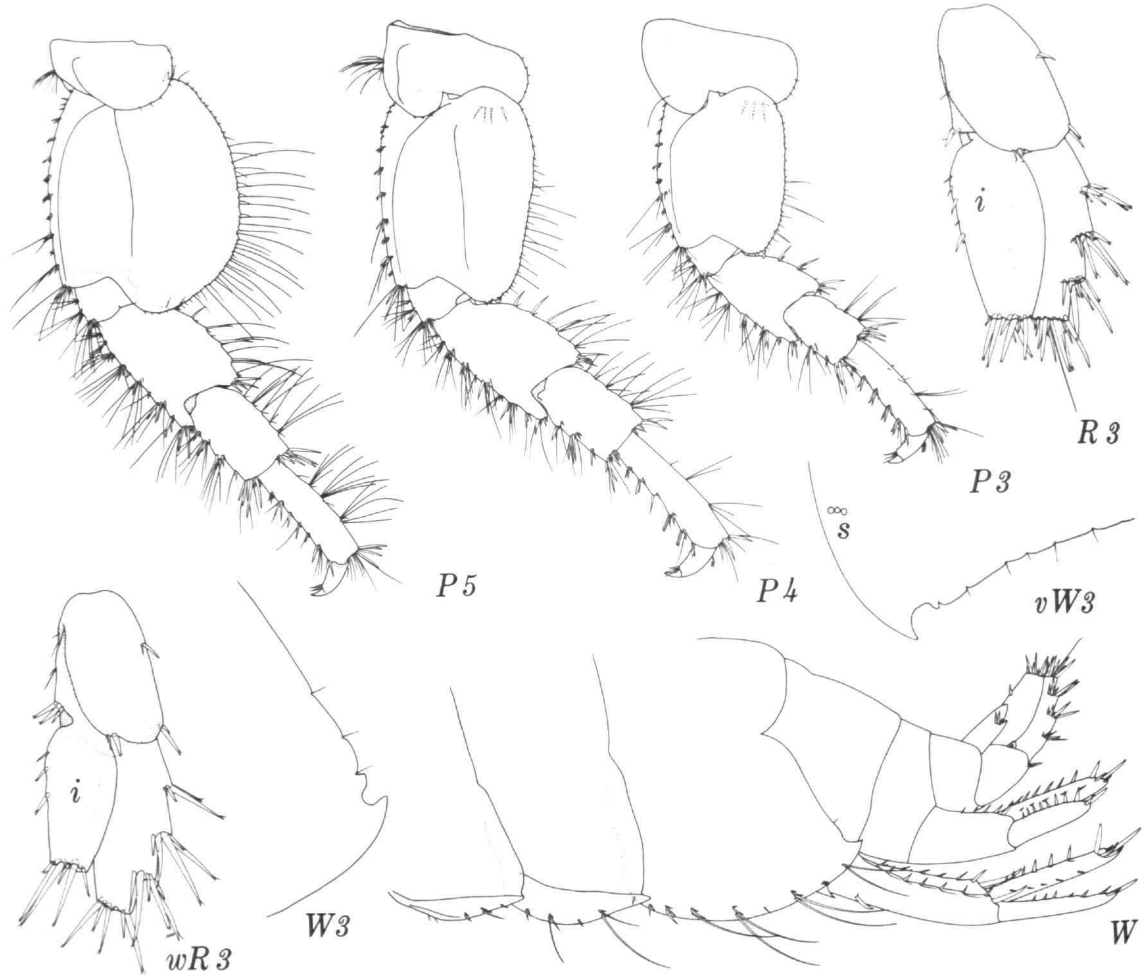

FIGURE 37.—*Elasmopus ?rapax* Costa, male "a," 10.5 mm (*u* = male "u," 6.39 mm; *v* = male "v," 9.7 mm; *w* = female "w," 7.7 mm).

material in question is fraught with doubt that European and eastern Pacific populations of similar morphology are identical. These Mexican specimens are the closest to *E. rapax* of any found in the area and may represent a race of *E. rapax* from which has been derived many of the other local species of *Elasmopus*.

REMARKS.—The Mexican *E. rapax* differs from European *E. rapax* (using Sars, 1895, and Chevreux and Fage, 1925, as models) in the presence of long posterior setae on article 2 of pereopods 3–5 in the male; the female lacks these setae as do males of European *rapax;* in the stoutness of the subapical seta on the dactyls of pereopods 1–5; in the stronger falcation on mandibular palp article 3; in the apical truncation of the naked tooth proximal to the main hump on male gnathopod 2 palm; in the slightly broader inner ramus of uropod 3 bearing distinct spines basomedially (male inner ramus as long as outer, female inner ramus shorter than outer in Mexican *rapax,* rami apparently subequal or equal to each other in European *rapax*); in the full definition of a small posteroventral tooth on epimeron 3 distinct from other serrations; in the presence of only 1 other distinct but small denticle dorsal to the sinuosity defining the main tooth and in the truncation of the other denticles (in European *E. rapax* the epimeron bears several evenly developed serrations and no enlargement of the ultimate corner tooth and no distinct sinuosity); in the greater disparity in size of telsonic spines between males and females (in European *E. rapax* the telsonic spines are subequally long). Note that Norwegian *E. rapax* has 2 or 3 long spines, occasionally the third short, whereas Mediterranean *rapax* has 1 long, 1 short spine only on each lobe of the telson.

The pleonal epimera of Mexican *rapax* have long setae and short spines ventrally whereas Sars' (1895) *rapax* apparently has naked epimera, unknown in the Mediterranean specimens of Chevreux and Fage (1925).

The other species of the Mexican *rapax* group are described herein as if descendent from this species; adjectives describing shapes are simplified so that references to illustrations are often required for precise definition.

VOUCHER MATERIAL.—SCO 18: male "a," 10.5 mm (illus.); female "w," 7.7 mm (illus.); male "v," 9.7 mm (illus.); PAZ 7: male "u," 6.39 mm (illus.).

MATERIAL.—SCO 1, 13, 18, 19; PAZ 6, 7, 11, ?16, 24.

DISTRIBUTION.—Gulf of California at Bahía de Los Angeles, Puerto Peñasco, Bahiá Concepción, Isla Espiritu Santo-Isla Partida, Isla San Francisco; intertidal.

Elasmopus serricatus J. L. Barnard, new status

FIGURES 38, 39

Elasmopus rapax serricatus J. L. Barnard, 1969b:121, fig. 24j–m.

DIAGNOSIS.—Eyes ordinary. Mandibular palp article 3 deeply falcate. Palm of male gnathopod 2 with single falcate hump near dactylar hinge, then blunt middle tooth, palm defined by ridge bearing spine, palm and posterior margin of hand setose throughout. Article 2 of pereopods 3–5 lacking long posterior setae, article 2 of pereopod 5 deeply sericate; locking spines of pereopods ordinary, though enlarged, weakly curved and apically blunt, inner margin of dactyl smooth but with minute shagreen proximally, main subapical setule thick but apically flexible. Epimera bearing only short ventral spines; epimeron 3 weakly convex posteriorly, evenly and sparsely notched, posteroventral corner bearing similar notch and weak tooth. Uropod 3 of male with shortened inner ramus as in females and juveniles, inner ramus with cluster of 2 medial spines. Telson with excavate apices armed with 4 spines, 2 long and 2 short in male, 2–3 long and 2 short in female, latter with spines closer to margin and margin more truncate than in male.

DESCRIPTION.—Following parts as shown for *E. rapax* (Figures 35–37): head (but eye slightly larger), antenna 1 (medial aspects of article 1 on antenna 1 and base of antenna 2 illustrated for minor details); antenna 2 (but setae fewer and stouter), upper lip, right mandible (3 spines), left mandible (4 spines), mandibular palp, lower lip, maxilla 1 (but inner plate on Figure 38: *X1i*) (palp with 9 spines, 5 setae), maxilliped (except for longer apical spine, Figure 38: *VS4*, on palp article 4); gnathopod 1 (except for article 4, Figure 39: *G1*), shape of pereopods 1–2 (but article 6 with sets of 2 spines, Figure 39: *P1*), articles 4–7 of pereoped 3; female uropod 3 like that of male *E. serricatus* but outer ramus with 1 less set of lateral spines, inner ramus with only 1 medial spine instead of 2; accessory flagellum of both sexes 3–4 articulate.

VARIATIONS.—Panama material. Middle tooth on palm of male gnathopod 2 becoming obsolete in adults and in juvenile specimens more proximally located (away from hinge tooth) than in Californian specimens. Galapagan material: medial face of hand on male gnathopod 2 either bearing or lacking the small ridge, when present ridge armed only with a seta.

VOUCHER MATERIAL.—SCO 14: male "d," 7.91 mm (illus.). PAZ 22: male "a," 6.91 mm; male "b," 6.21 mm (illus.); female "k," 5.24 mm (illus.).

REMARKS.—This taxon is elevated to full specific status; it lies outside the *rapax* morph in the shape and spination of the telson and the shortened inner ramus of male uropod 3.

MATERIAL.—SCO 14, 19; PAZ 20, 22; GAL 101, 118, ?120; DAW 3, 4, 6, 8, 10, 17, 21, 26, 27, 28, 31, 37, 38; ECU 3; PAN 14; BRU 1, 2.

DISTRIBUTION.—California, from Carmel to La Jolla; Gulf of California at Puerto Peñasco, Bahía San Carlos, Guaymas, Cabo San Lucas; Galapagos Islands; Ecuador; Panama; intertidal.

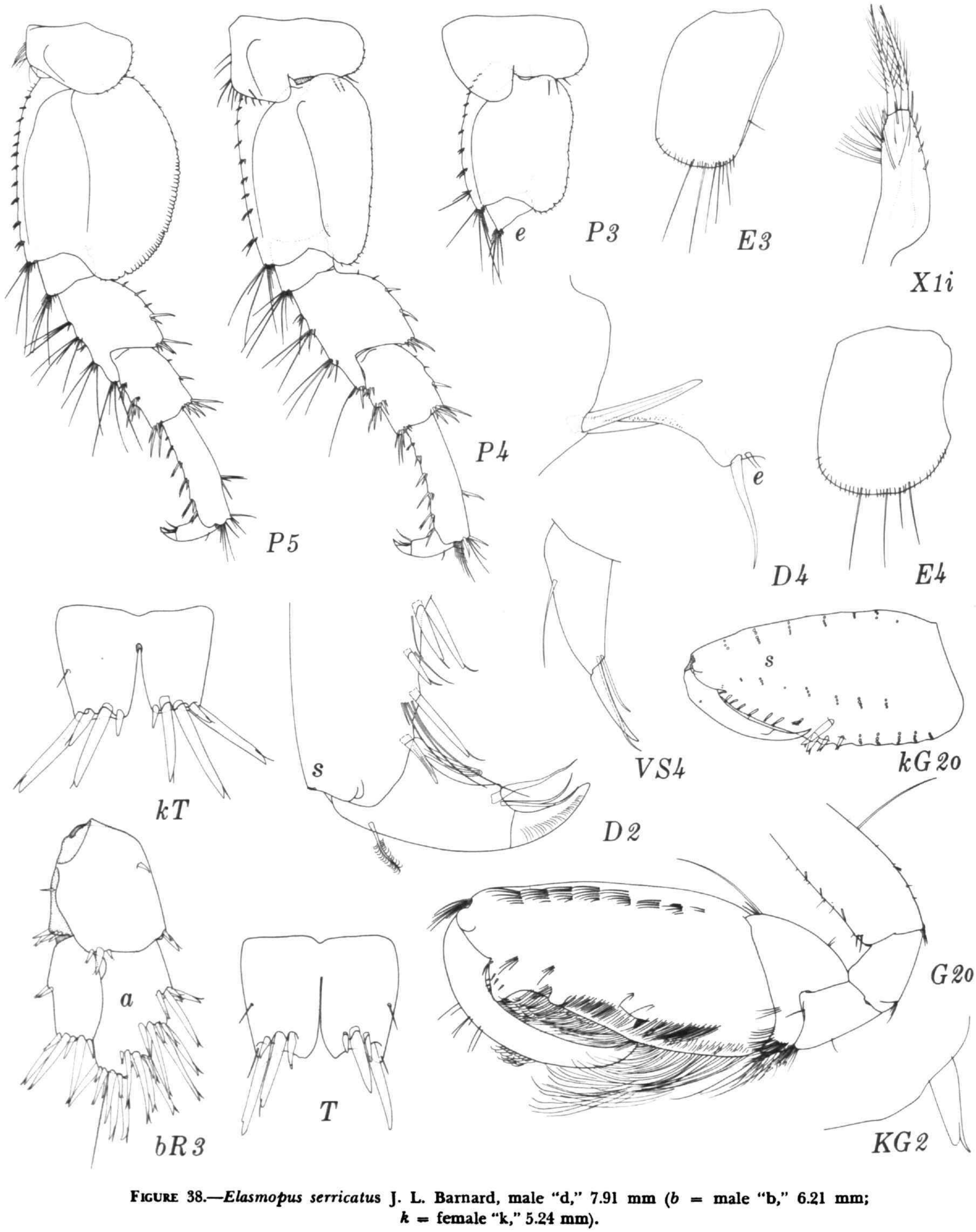

FIGURE 38.—*Elasmopus serricatus* J. L. Barnard, male "d," 7.91 mm (*b* = male "b," 6.21 mm; *k* = female "k," 5.24 mm).

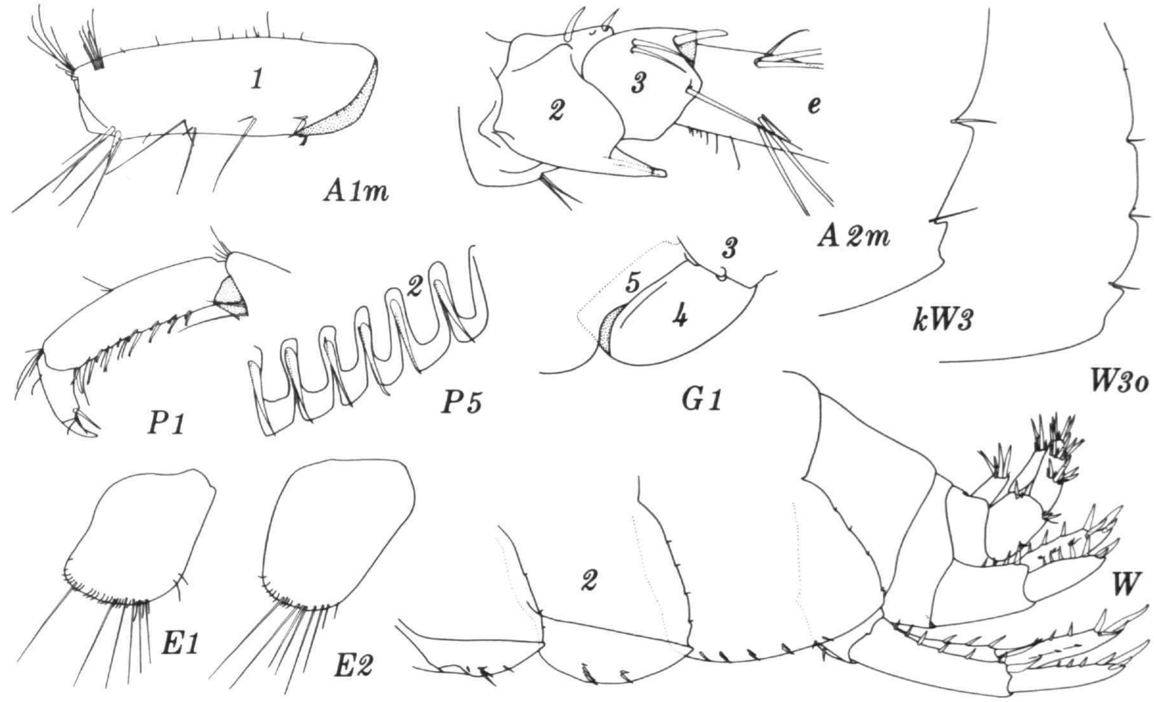

FIGURE 39.—*Elasmopus serricatus* J. L. Barnard, male "d," 7.91 mm (*k* = female "k" 5.24 mm).

Elasmopus temori, new species

FIGURE 40 (part)

DIAGNOSIS.—Eyes ordinary. Mandibular palp deeply falcate. Palm of male gnathopod 2 with small quadrate spinose hump near dactylar hinge, then immediately adjacent short conical tooth, middle of palm with weak, broadly conical hump, palm defined by minute protrusion bearing small spine, medial face with ridge bearing large spine, palm highly elongate, posterior margin of hand scarcely one-third as long as palm, moderately setose, palm almost naked, medial face of hand poorly setose, dactyl elongate and fitting palm. Article 2 of pereopods 3–5 lacking long posterior setae, article 2 of pereopod 5 normally serrate; locking spines of pereopods 3–5 ordinary, straight, one slightly larger than other, smooth, inner locking spine on pereopods 1–2 enlarged, weakly curved, blade-like, inner margin on dactyl of pereopods 1–5 with faintest shagreen marginally, main apical setule thick but apically flexible. Epimera bearing mixtures of short spines and medium setae, epimeron 3 weakly convex posteriorly, sparsely notched, posteroventral corner bearing weak sinus and weak sharp tooth. Rami of male uropod 3 elongate, reaching equally; inner ramus with several sets of medial spines. Telson with narrow, excavate apices armed with 3–4 spines, at least 1 spine highly elongate.

DESCRIPTION OF MALE.—Generally like *E. rapax* but eyes with enlarged ommatidia clear of pigmentary core, article 3 of peduncle on antenna 1 shortened (illustrated), articles 1–3 with ventral setae elongate. Following parts like *E. rapax* (Figures 35–37): upper lip, lower lip, mandibles (except palp, Figure 40: *aM*), maxilla 1 (but with thin inner plate, spine 2 (from medial edge) with 2 medial teeth, spines 3–4 with 3 medial teeth, palp of medium stoutness), plates of maxilla 2 (but thin), dactyl of maxilliped (but of shortened variety with elongate nail as in *E. serricatus*). Coxae 1–4 (but slightly broadened), posteroventral lobe of coxa 4 (but slightly weaker, poorly setose, elongate setae on coxae 1–4 = 3–1–2–1); article 4 of gnathopod 1 (but rounded posterodistally, article 6 slightly more elongate and rectangular, illustrated); pereopods

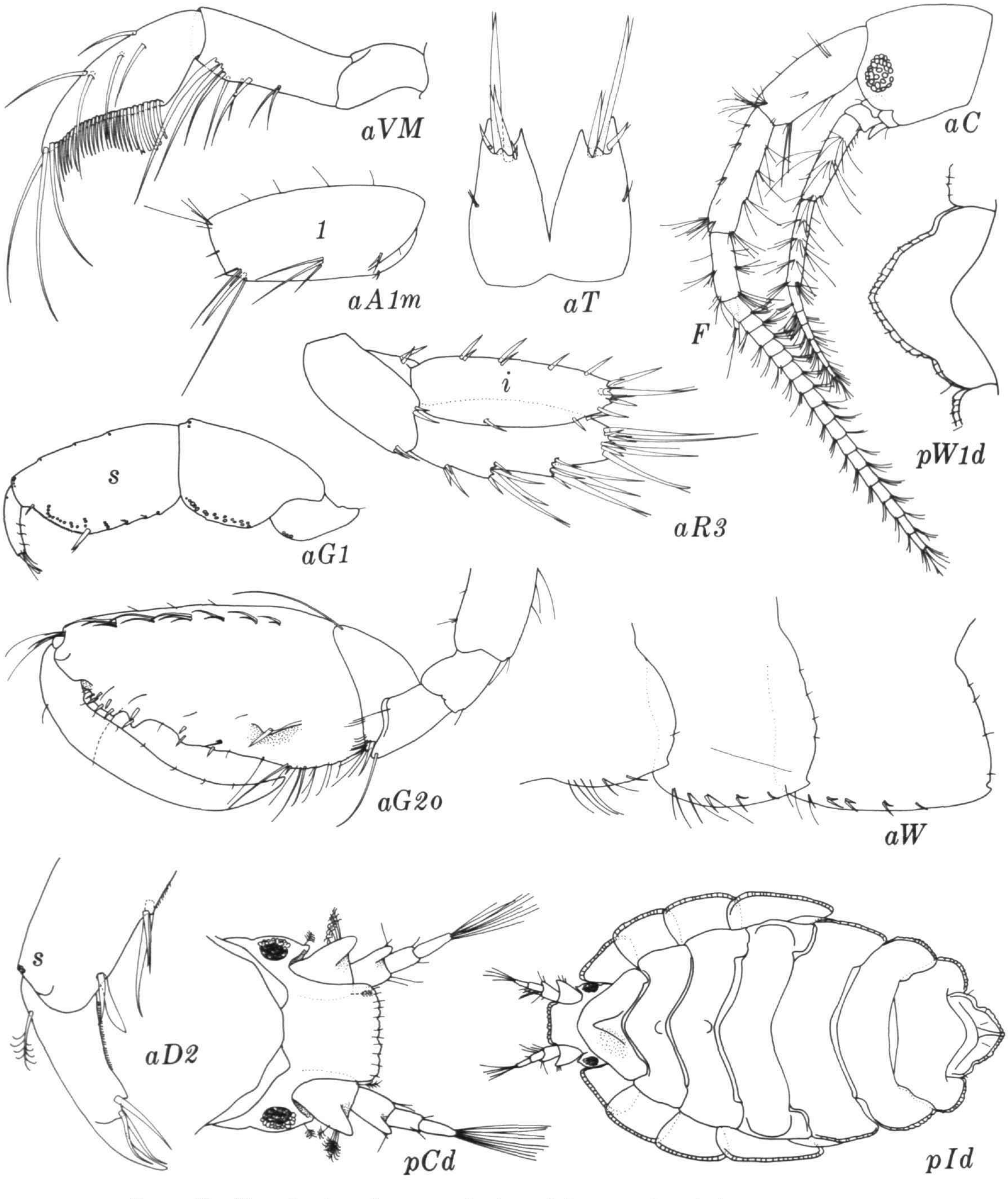

FIGURE 40.—*Elasmopus temori*, new species (*a* = *holotype*, male "a," 4.17 mm). *Heterophlias seclusus escabrosa* J. L. Barnard (p = sex unknown "p," 3.12 mm).

1–2 (poorly setose, article 6 with 4–6 posterior spine positions besides locking spines, all positions with short spine, some with seta or additional spine); pereopods 3–5 (generally as in *E. zoanthidea* but article 2 slightly narrower and article 6 elongate, on pereopod 3 about 0.7 times as long as articles 4–5 combined, on pereopods 4–5 almost 0.8 times). Urosome and uropods 1–2 (but less spinose).

FEMALES.—Females and juveniles associated with unique male apparently of distinct species owing to significant differences in dactyls of pereopods, epimera, uropod 3, and telson; males similar to these not yet discovered; collection in the Smithsonian Division of Crustacea with provisional name of "*E. temori*—associated females" for future reference.

HOLOTYPE.—USNM 169022, male "a," 4.17 mm (illus.). Unique.

TYPE-LOCALITY.—GAL 113, Galapagos Islands, Tower Island (Genovesa), Darwin Bay, 29 January 1964, intertidal, rock wash.

VOUCHER MATERIAL.—The holotype.

RELATIONSHIP.—The unique male of this species may be an aberration of *E. zoanthidea;* it finds its closest relationship to that species in telson, epimera, and article 2 and dactyls of pereopods. It differs in the palmar configuration of gnathopod 2 on which are borne 2 weak middle processes instead of 1 strong process and in the full development of a mediofacial ridge bearing a spine. The main dactylar seta of pereopods 1–5 is enlarged, the medial face of the hand on gnathopod 2 is poorly setose and uropod 3 and the epimera have greater maturity in the sense that the epimera bear setae as well as spines and the inner ramus of uropod 3 is fully elongate. Both right and left gnathopod 2 are similar so that the aberration, if so to be interpreted, is bilateral and not simply confined to 1 appendage.

MATERIAL.—GAL 113.

DISTRIBUTION.—Galapagos Islands, Tower Island, intertidal.

Elasmopus tiburoni, new species

FIGURE 41

Elasmopus rapax form I of Tiburon Island.—J. L. Barnard, 1969b:119 [part].

DIAGNOSIS.—Eyes ordinary. Mandibular palp article 3 deeply falcate. Palm of male gnathopod 2 with ordinary spinose hump near dactylar hinge but hump weak and concealed laterally by flange-like inflation of entire palm, with dactyl overriding face of palm, medial face of palm deeply hollowed as in *E. pocillimanus* (Bate), palm and hollow defined by small tapering medial tooth but third tooth absent, hollow defined anteriorly by sharp setose ridge, palmar margin nearly naked, posterior margin of hand densely setose but setae in rows of short to long. Article 2 of pereopods 3–5 with long posterior setae in male only; locking spines of pereopods 1–5 ordinary, inner margin of dactyl usually smooth but occasionally with 1–2 notches (forming broad castellations) and minute proximal shagreen, main subapical setule thick but apically flexible; articles 4–5 of pereopods 4–5 especially broad in comparison to *E. rapax,* increase in breadth confined primarily to male. Epimera 1–3 with long ventral setae and short spines; epimeron 3 with nearly straight posterior margin armed with notches bearing setules, margins between notches flat except for ultimate posteroventral tooth and one tooth dorsal to it, these teeth small and of subequal size, sinus above ultimate tooth lacking setule. Rami of uropod 3 equally long in male, inner ramus with several stout basomedial spines, inner ramus in females and juveniles shorter than outer ramus. Telson with naked protrusive apices placed mediad, laterally defined by sinus and sharp tooth, spines submarginal from sinus and forming row of 2–4 laterally, but row extending mediad across axis of each lobe, male with 2 short spines, female with 4 long spines on each lobe.

DESCRIPTION.—Following parts not illustrated and as shown for *E. rapax* (Figures 35–37): head, antennae, accessory flagellum, eye (slightly larger than in *E. rapax*), mouthparts, pereopods 1–2, dactyls, urosome, uropods 1–2. Female gnathopod 2, coxae, cuticle, medial view of article 1 on antenna 1; female lacking long setae of article 2 on pereopods 3–5, small females and juveniles lacking serrations of epimeron 3 except for ventralmost sinus and tooth. Juvenile males with gnathopods like juvenile *E. rapax*; female uropod 3 with 3 apicomedial peduncular spines instead of 2 as in Figure 37: *wR3* of *E. rapax.*

HOLOTYPE.—USNM 149405, male "f," 8.76 mm (illus.).

TYPE-LOCALITY.—SCO 12, Puerto Peñasco, Mexico, 23 February 1971, intertidal, wash of *Colpomenia* sp.

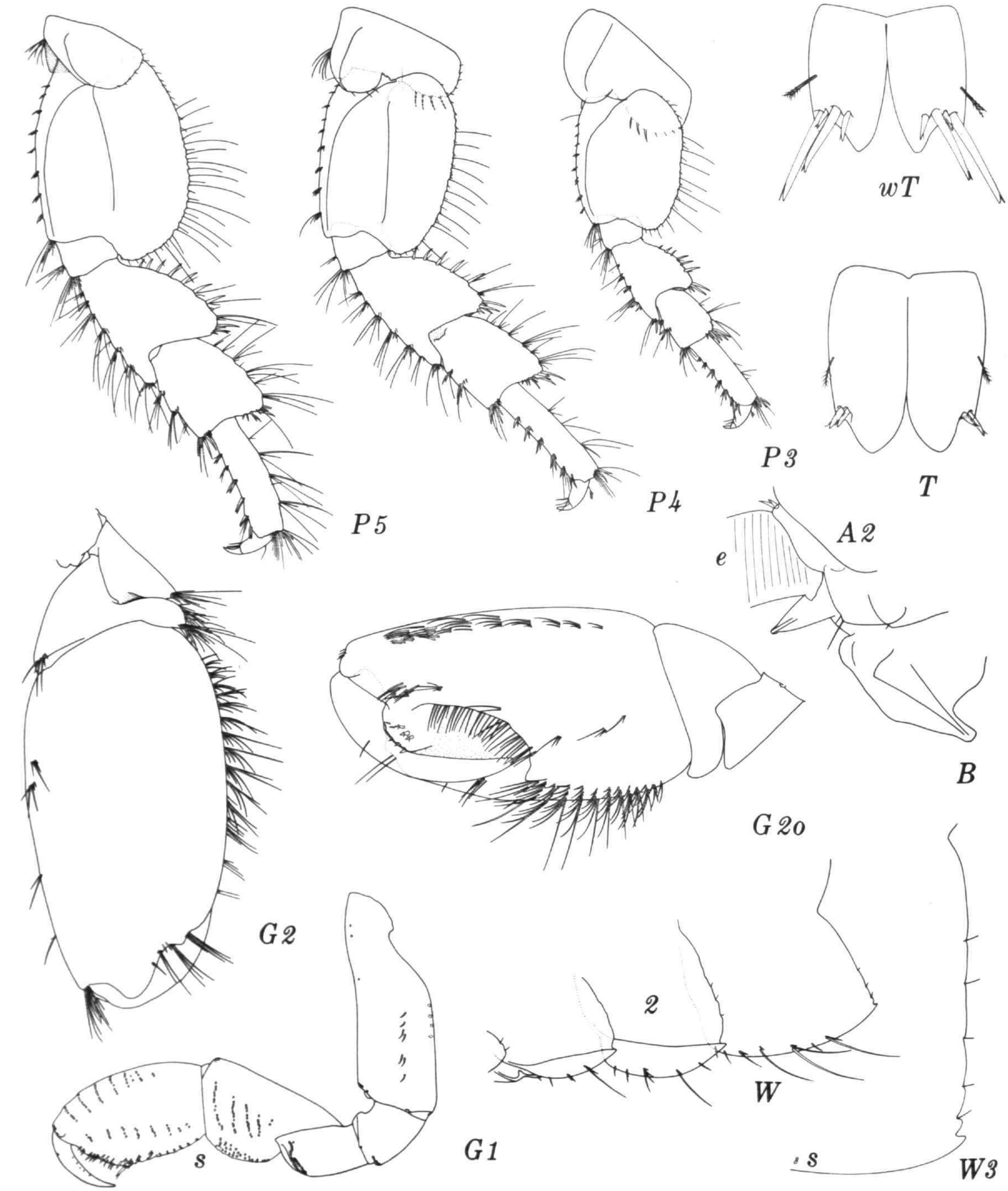

FIGURE 41.—*Elasmopus tiburoni*, new species, holotype, male "f," 8.76 mm (*w* = female "w," 6.58 mm).

VOUCHER MATERIAL.—Type-locality, female "w," 6.58 mm (llus.).

REMARKS.—This species differs from Mexican *E. rapax* in the *pocillimanus*-like gnathopod 2 of the terminal male bearing only 2 palmar teeth and a large hollow, with uneven setal distribution, in the even serrations of epimeron 3, and in the enlarged articles 4–5 of pereopods 4–5, with larger spines in tandem on article 4 of pereopod 3.

MATERIAL.—SCO 12, 14, 19; KNO 3, 6; PAZ 3, 12, 13; BRU 1, 2; SNY 1. Also, AHF *Velero III* 1042 near Isla Tiburon.

DISTRIBUTION.—Gulf of California; Puerto Peñasco, Bahía Kino, Turners Island south of Isla Tiburon, Bahía San Carlos, Guaymas, Bahía San Evaristo, Isla Espiritu Santo; found in shells of hermit crab in SNY 1; intertidal.

Elasmopus tubar, new species

FIGURES 42, 43

DIAGNOSIS.—Eyes ordinary. Mandibular palp article 3 deeply falcate and extraordinarily stout. Palm of male gnathopod 2 with hump near dactylar hinge, hump setose but not spinose, medial face of hand with weak ridge-hump hidden by setae, no defining tooth, palm and posterior margin of hand heavily setose throughout, apex of hand anterodistally bearing stridulation-like ridges or rays. Article 2 of pereopods 3–5 lacking long posterior setae, male pereopod 5 with posteroventral margin of article 2 serricate or castellate; locking spines of pereopods 3–5 ordinary, on pereopods 1–2 composed of one short truncate spine, one long, subtruncate spine, inner margin of dactyl with minute shagreen proximally, main subapical setule thick but apically flexible. Epimera 1–3 bearing short ventral spines only; epimeron 3 with weakly sinuous posterior margin bearing weak acclivities each with setule, posteroventral tooth and sinus very small. Inner ramus of uropod 3 in both sexes shorter than outer ramus, inner ramus with several widely separated medial spines. Telson with narrow, weakly excavate apices bearing 1 long spine and 1 medium spine, or in female with 1 long, 1 medium to long and occasional short third spine.

DESCRIPTION.—Following parts as shown for *E. rapax* (Figures 35–37): head (eyes slightly enlarged), antennae (but much less setose), accessory flagellum (2-articulate), upper lip, lower lip (but mandibular lobes blunter), maxilla 2, maxilliped (but apical spine on palp article 4 slightly longer), urosome, uropods 1–2, pereopod 3 (but spines fewer and long setae of article 2 absent). Pereopods 1–2 like those of *E. serricatus*, bearing extra spine at each posterior position. Outer plate of maxilla 1 with 7 spines (1 hidden in Figure 43: *X1o*), inner plate with 2 long and 2 short setae, palp with 6 spines and 5 setae on both sides; coxae 1–3 like those of *E. rapax* but many fewer long setae (about 3 per coxa), coxa 4 as Figure 43: *E4*; female epimeron 3 like that of male, occasionally posteroventral tooth blunter; gnathopod 1 distinct from adults of other species of *Elasmopus* presented herein, retaining juvenile appearance in adult but heavily setose, slightly less setose in female.

HOLOTYPE.—USNM 142482, male "a," 5.1 mm (illus.).

TYPE-LOCALITY.—PAZ 17, Baja California, 11 km E of Cabo San Lucas, 4 December 1971, intertidal wash of *Padina*.

VOUCHER MATERIAL.—Type-locality, female "w," 4.3 mm (illus.).

RELATIONSHIP.—This species approximates *E. antennatus* (Stout) in male gnathopods 1 and 2, uropod 3, and telson but the main protrusion on the hand of male gnathopod 2 is larger in *E. tubar*, male pereopod 5 bears castellations on article 2, the telson has fewer spines per apex and the spines are much longer than in *E. antennatus*, male gnathopod 2 bears a "stridulating" hump and female gnathopod 2 has a much stouter hand in *E. tubar* than in *E. antennatus*. Perhaps the odd declivity of article 4 on male pereopod 4 is also characteristic (Figure 43: *P4*) but insufficient material is available to confirm this characteristic.

MATERIAL.—PAZ 17, 18; GAL 102, 108, 109, 119, 120; DAW 5, 9, 13, 16, 17, 18, 19, 23, 27, 33, 40.

DISTRIBUTION.—Baja California, Cabo San Lucas; Galapagos Islands; intertidal.

Elasmopus zoanthidea, new species

FIGURE 44

ETYMOLOGY.—The epithet "zoanthidea" is from Greek, *zoön* (animal) and *antheros* (blooming).

DIAGNOSIS.—Eyes ordinary. Mandibular palp deeply falcate. Palm of male gnathopod 2 with

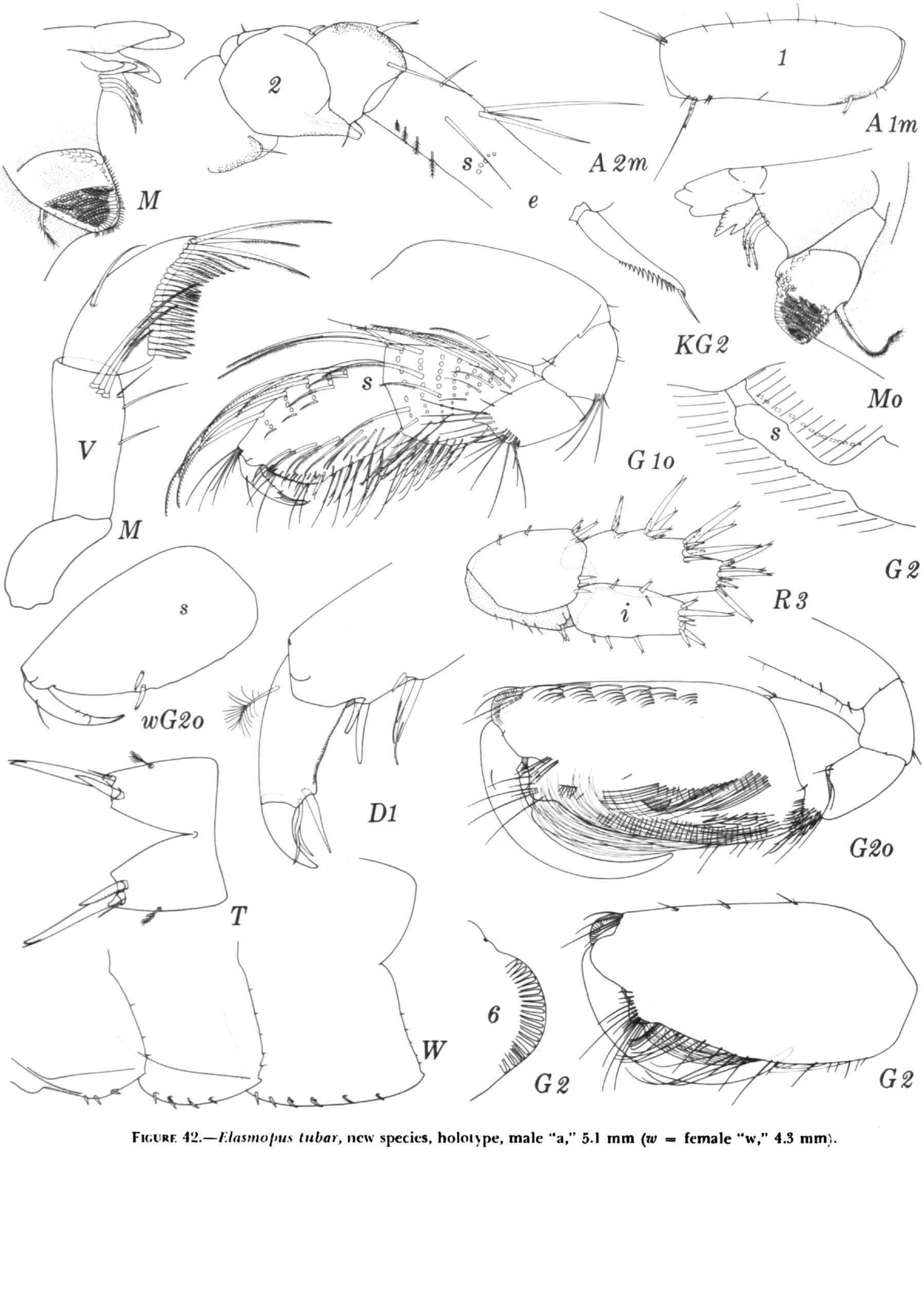

FIGURE 42.—*Elasmopus tubar*, new species, holotype, male "a," 5.1 mm (*w* = female "w," 4.3 mm).

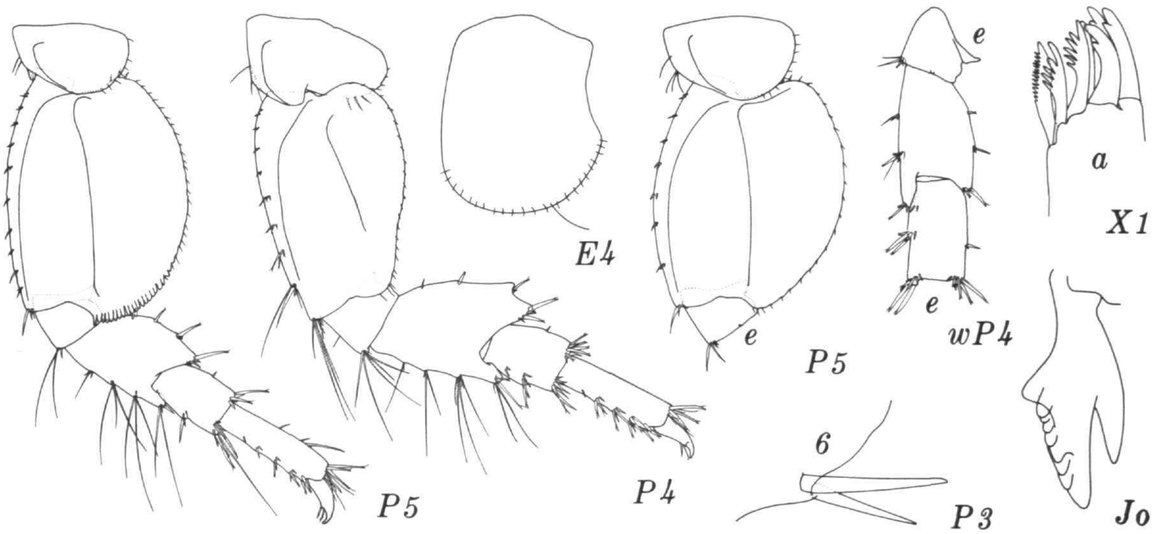

FIGURE 43.—*Elasmopus tubar*, new species, holotype, male "a," 5.1 mm (*w* = female "w," 4.3 mm).

ordinary spinose hump near dactylar hinge but hump weak, then broadly quadrate, weakly bifid or trifid, middle tooth separated from spinose hump by distance equal to width of hump 2, palm defined by obsolescent tooth on margin, palm and posterior margin of hand strongly setose throughout, medial face of hand with numerous bundles of setae in row paralleling palm and posterior margin. Article 2 of pereopods 3–5 lacking long posterior setae, article 2 of pereopods 4–5 normally serrate; locking spines of pereopods 3–5 ordinary, thin, straight, weakly striate longitudinally, inner locking spine on pereopods 1–2 enlarged, curved, blade-like, inner margin of dactyl on pereopods 1–2 with faintest shagreen, on pereopods 3–5 with occasional obsolescent serration, main subapical setule thick but apically flexible. Epimera bearing only short ventral spines, epimeron 3 weakly convex posteriorly, sparsely notched, posteroventral corner bearing weak sinus and weak, sharp tooth. Uropod 3 of male with shortened inner ramus bearing 2 pairs of medial spines. Telson with excavate apices armed with 3 spines, grading from short to greatly elongate from medial to lateral.

DESCRIPTION.—Generally like *E. rapax* (Figures 35–37) as follows: Eyes slightly smaller and with far fewer ommatidia, all stained brownish magenta, antennae 1–2 like *E. rapax* but article 1 of antenna 1 as in Figure 44: *A1m*, articles 2–3 with ventral setae elongate, accessory flagellum 3-articulate; mandibles like *rapax* but left mandible with first raker spine very thick and denticulate; upper lip, and lower lip like *rapax;* maxilla 1 with spines 2, 3, and 6 (from medial) each with 2 elongate and sharp side cusps, palp scarcely broader than outer plate; plates of maxilla 2 thinner than in *E. rapax*; dactyl of maxilliped shortened, main nail elongate, almost as long as dactyl; palm of gnathopod 1 with only 1 defining spine, medial comb of article 4 shortened, elements enlarged, article 5 with or without midanterior pair of setae; shapes of coxae 1–4 like those of *E. rapax* but elongate ventral setae fewer, formula of coxae 1–4 = 5–3–4–1, coxae 2–3 smaller relative to coxae 1 and 4 than in *E. rapax*; pereopods 1–2 generally as in *E. rapax* but spines and setae fewer; pereopods 3–5 and uropod 1 as in Figure 44, uropod 2 as in *E. rapax* but peduncle bearing only 1 dorsolateral spine set apically.

FEMALE.—Unknown.

HOLOTYPE.—USNM 169023, male "a," 4.35 mm (illus.).

TYPE-LOCALITY.—GAL 113, Galapagos Islands, Tower Island (Genovesa), Darwin Bay, 29 January 1964, intertidal, rock wash.

VOUCHER MATERIAL.—Type-locality, male "v," 4.41 mm (illus.) and 4 younger males.

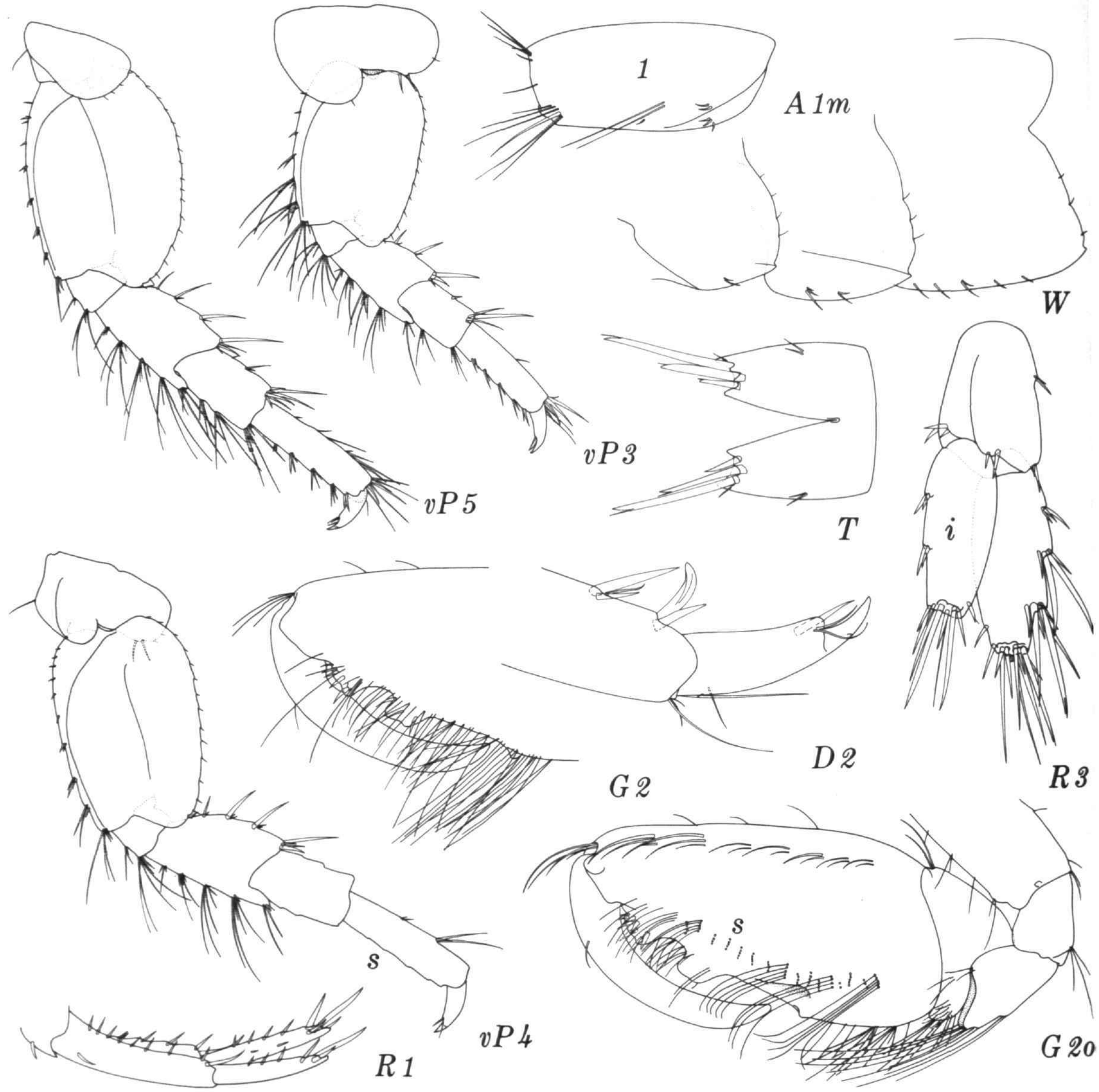

FIGURE 44.—*Elasmopus zoanthidea*, new species, holotype, male "a," 4.35 mm (*v* = male "v," 4.41 mm).

RELATIONSHIP.—This species resembles *E. holgurus* in terms of telson and male gnathopod 2 but differs in the breadth and shape of the middle palmar tooth on male gnathoped 2, in the shallowness of posterior notches on article 2 of pereopod 5, and in the unextended epimeron 3. Other differences in setosity and shape may be a function of the small body size of *E. zoanthidea* and, therefore, juveniles of *E. holgurus* may resemble adults of *E. zoanthidea* in those characteristics.

Elasmopus zoanthidea resembles *E. mayo* and *E. rapax* especially in the palm of male gnathopod 2, but *E. zoanthidea* has many more setae on the medial face of the hand, lacks the protrusive medial limbs on the telsonic apices, and lacks long posterior setae on article 2 of pereopods 3–5.

MATERIAL.—GAL 102, 109, 113, 119; DAW 9, 23.

DISTRIBUTION.—Galapagos Islands, intertidal.

Galapsiellus J. L. Barnard

Galapsiellus leleuporum (Monod)

Paraniphargus leleuporum Monod, 1970:13–25, figs. 6–45.
Galapsiellus lelouparum [sic].—J. L. Barnard, 1976:422–423.

MATERIAL.—GAL 103.

DISTRIBUTION.—Galapagos Islands, Isla Santa Cruz, Academy Bay, anchialine.

Maera Leach

Maera reishi, new species

FIGURES 45–47

Maera inaequipes.—J. L. Barnard, 1959:25–26, pl. 5 [not Costa]; 1969a:205; 1969b:121–122.

ETYMOLOGY.—Dedicated to Dr. Donald James Reish for his numerous contributions to our knowledge of eastern Pacific lagoons and estuaries.

DIAGNOSIS.—Lateral cephalic lobes weakly mammilliform, anteroventral corner of head produced as narrow elongate tooth. Eyes ovate, brownish pink in alcohol. Article 1 of antenna 1 with 2 basoventral spines and 1 apicoventral spine. Article 3 of mandibular palp 1.2 times as long as article 2. Coxa 1 weakly extended forward, coxae 1–4 lacking posteroventral notch. Gnathopod 1 of medium stoutness, article 6 ovatorectangular, palm oblique and convex, equal in length to posterior margin of article 6, defined by spine, article 5 with several medial rows of diverse setal spines, article 4 lacking posterodistal cusp; gnathopod 2 very large, article 2 heavily spinose anteriorly, with medium-sized anterodistal lobe, article 3 with similar lobe, article 4 slightly extended posterodistally, article 5 very short, with long tumid posterior lobe, article 6 very large, subrectangular, slightly expanded distally, palm transverse, defined by large tooth, bearing spine, tooth adjacent to weak sinus, palm with one deep incision in males, occasionally in females, latter usually without main sinus, dactyl fitting palm, bearing inner acclivity near position of sinus, acclivity weak to strong, usually absent in females and juveniles. Article 2 of pereopods 3–5 narrowly ovatorectangular, with slightly extended, angular posterodistal corners, posteroproximal margins rounded; dactyls of pereopods 1–5 with strong distal constriction bearing sharp defining corner and armed with seta, sharp but stunted nail bearing accessory tooth, facial setule, constriction also bearing stout setule appressed to margin of nail, locking spines small, straight or slightly curved. Pleonal epimera 1–3 with slightly convex posterior margins, each with small sharp posteroventral tooth, ventrally spinose; pleonites dorsally smooth. Uropod 3 extending flush with other uropods, rami flat, narrow, apically truncate and spinose, inner extending to Mark 80 along outer, tiny article 2 on outer ramus. Telson deeply but not fully cleft, with strongly fixed medial gape, lobes thin, apically truncate or convex, each lobe with 4 long spines, some longer than telson. Dorsoposterior margin of urosomite 3 rounded.

JUVENILES.—Smallest available, 1.9 mm long; proportions of mandibular palp articles 2–3 similar to adult; inner ramus scarcely exceeding Mark 50 on outer ramus; each lobe of telson with 2 long spines; cephalic tooth small but distinct.

DESCRIPTION.—Upper lip and epistome fused together; outer plate of maxilla 1 with 5 bifid and 4 serrate spines; cuticle smooth extent for occasional bulbar setule and occasional seta on coxae; palmar sinus of gnathopod 2 developing before dactylar acclivity and before article 2 heavily spinose.

VARIATIONS.—At the northern end of its range, in suburban California, specimens of *Maera reishi* reach a length just less than 7 mm whereas their maximum length in more southerly waters of Mexico is less than 5.5 mm. In these large specimens from southern California, the gland cone of antenna 2 extends only two-thirds along article 3 of antenna 2 whereas in southerly specimens the gland cone overreaches the end of article 3. No females with a palmar sinus on gnathopod 2 have been found in the northern end of the range. The dactylar acclivity on gnathopod 2 of many, but not all, males in the north becomes extremely developed as it is in *Maera chinarra*.

HOLOTYPE.—USNM 142568, male "a," 5.3 mm (illus.).

TYPE-LOCALITY.—PAZ 3, Gulf of California, Isla Espiritu Santo, 28 November 1971, 0.3–1.0 m, algae, rock wash.

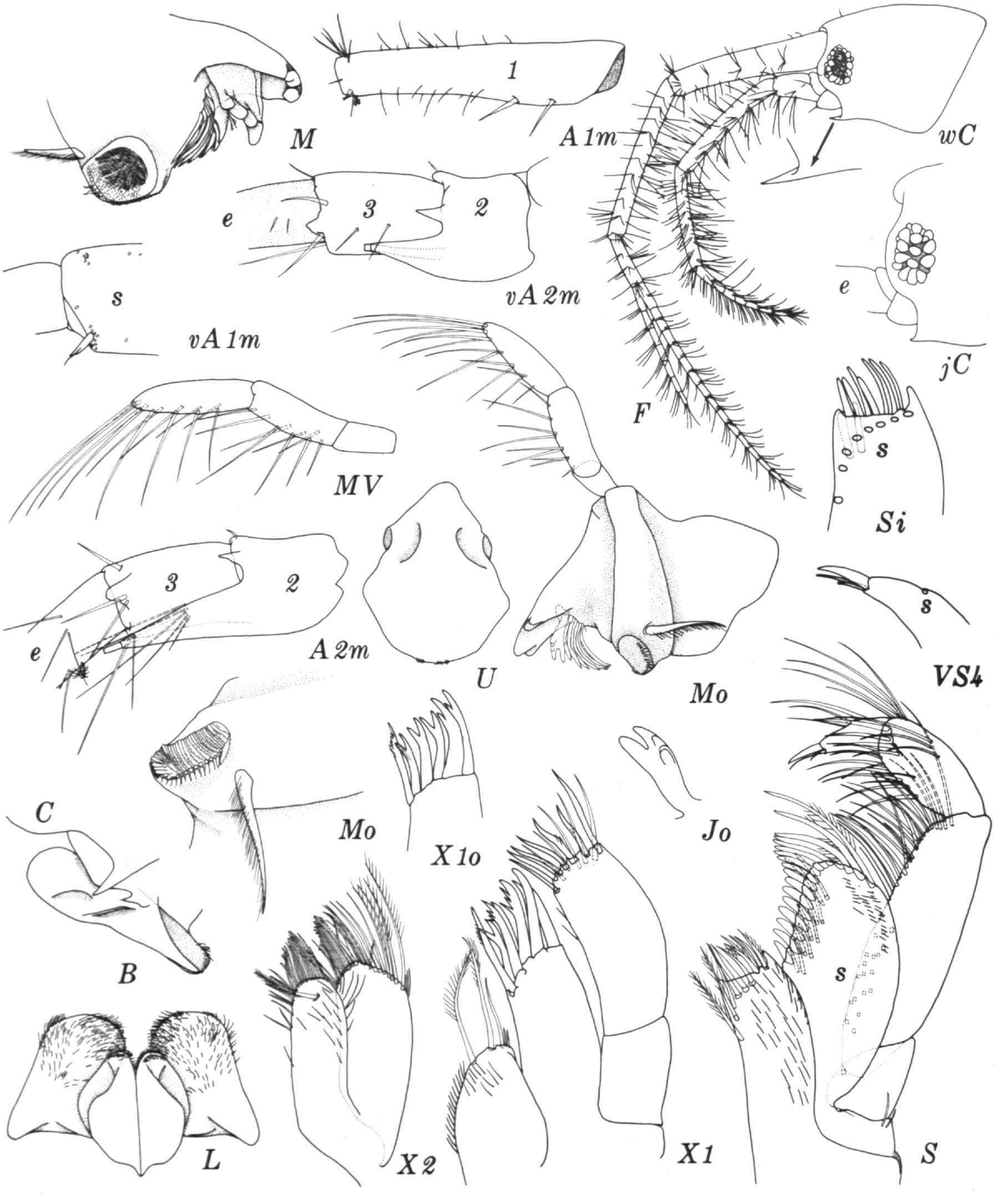

FIGURE 45.—*Maera reishi*, new species, holotype, male "a," 5.3 mm (*j* = juvenile "j," 2.6 mm; *v* = male "v," 6.5 mm; *w* = female "w," 5.4 mm).

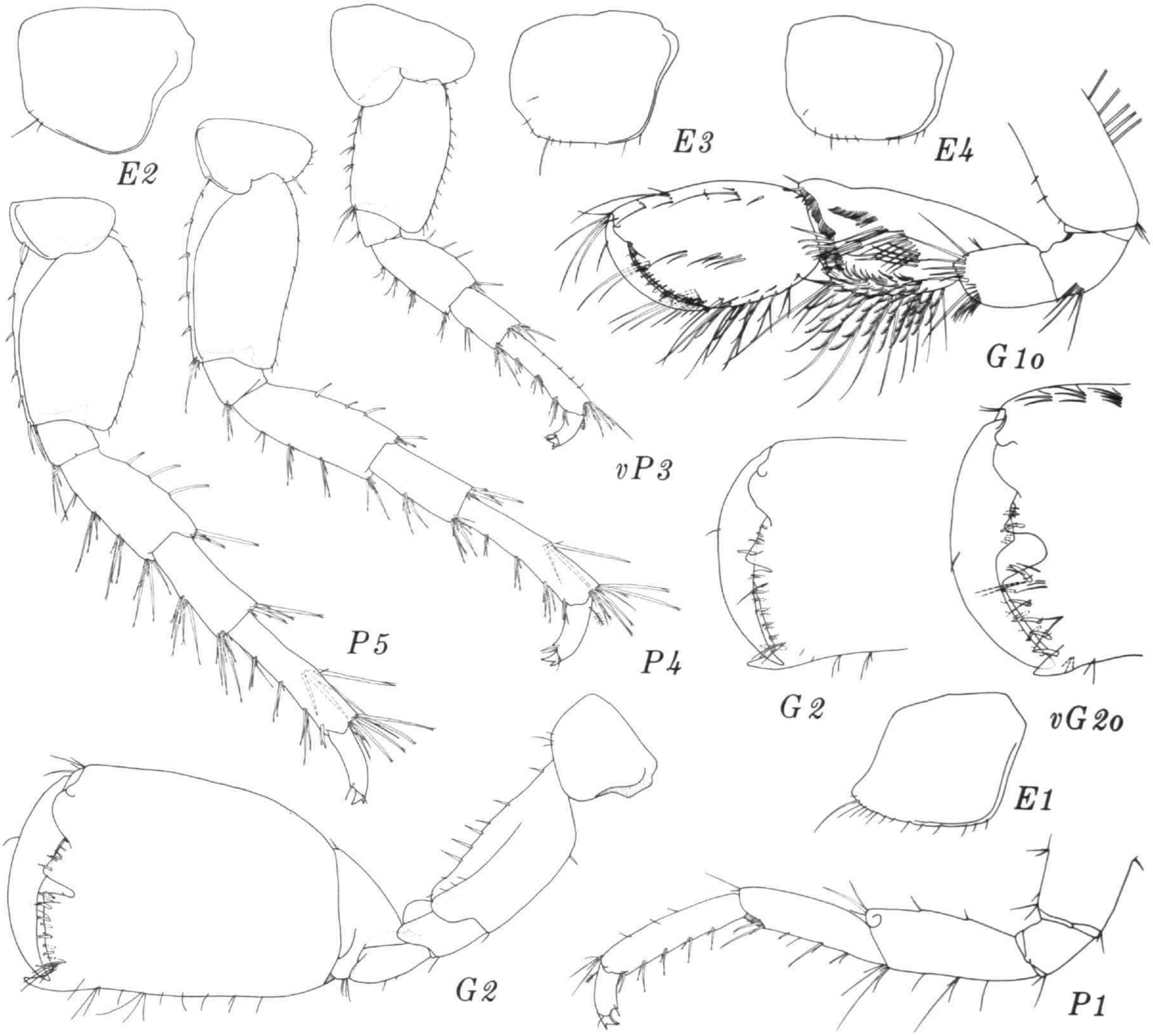

FIGURE 46.—*Maera reishi*, new species, holotype, male "a," 5.3 mm (*v* = male "v," 6.5 mm).

VOUCHER MATERIAL.—Type-locality: female "w," 5.4 mm (illus.); juvenile "j," 2.6 mm (illus.). Corona del Mar, California, 6 February 1951, *Sabellaria* bed, male "v," 6.5 mm (illus.).

RELATIONSHIP.—This species is distantly related to *M. rathbunae* Pearse (1908) from Florida, the latter bearing a distinctly oblique palm on gnathopod 2, equally extending rami of uropod 3 and sharply pointed, poorly spinose telsonic lobes. The identification of *Maera rathbunae* by Kunkel (1910) from Bermuda appears to be a distinct species much more similar to *M. reishi* than is the Floridian *M. rathbunae*. The Bermudan species has truncate telsonic apices with numerous "setae," the inner ramus of uropod 3 is shortened and the palm of gnathopod 2 is transverse as in *M. reishi*. The absence of spines on article 2 of gnathopod 2 and the absence of all but 1 spine on the palm of gnathopod 2 appear to be good characters differentiating the Bermudan species from *M. reishi*. The mandibular palp and the inner plate of maxilla 1 also appear distinctive and there are possible differences in epimera and

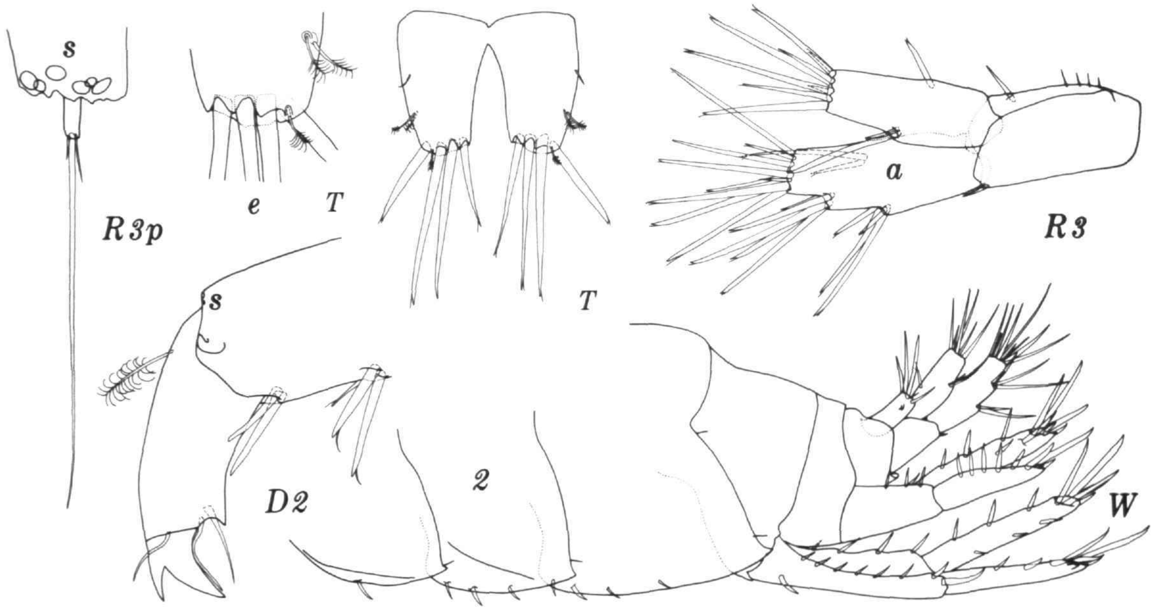

FIGURE 47.—*Maera reishi*, new species, holotype, male "a," 5.3 mm.

second maxillae. I reserve the naming of the Bermudan species to a person with material available who can describe this species minutely and determine whether the "setae" of the telson are thin and flexible or stout and spine-like.

Maera reishi differs from European *M. inaequipes* in the blunt telsonic apices each bearing 4 spines, whereas *M. inaequipes* has bifid apices bearing 2 spines. Actually 1 spine on each lobe in both species emerges from the ventrolateral surface of the lobe. *Maera inaequipes* has a very sharp anteroventral corner on coxa 1, the gnathopodal palm in both sexes slopes obliquely, and article 2 of gnathopod 2 is poorly spinose or free of spines.

Among several species of the central Pacific Ocean (J. L. Barnard, 1970:147–161), *Maera reishi* appears to be closest to *M. pacifica* Schellenberg, from which *M. reishi* differs in the presence of numerous stout spines on article 2 gnathopod 2 in both sexes and in the male in the shallower sinus adjacent to the defining tooth of the palm.

J. L. Barnard (1972b:107) gives a brief synopsis of species in the *M. quadrimana* complex, to which *M. reishi* belongs.

MATERIAL.—PAZ 3; GAL 108; DAW 3, 8, 27, 31.

DISTRIBUTION.—Gulf of California at Isla Espiritu Santo and Bahía de Los Angeles, 0 m; Galapagos Islands, 0–6 m; California north to Cayucos, 0–3 m.

Maera chinarra, new species

FIGURE 29 (part)

DIAGNOSIS.—Lateral cephalic lobes weakly mammilliform, anteroventral corner of head with obsolescent sharp cusp. Eyes ovate, brownish pink in alcohol. Article 1 of antenna 1 with 1 basoventral spine and often *no* thickened apicoventral spine, or small spine occasionally present. Article 3 of mandibular palp shorter than article 2. Coxa 1 weakly extended forward, coxae 1–4 lacking posteroventral notch. Gnathopod 1 of medium stoutness, article 6 ovatorectangular, palm oblique and convex, equal in length to posterior margin of article 6, defined by spine, article 5 with several medial rows of diverse setal spines, article 4 lacking posterodistal cusp; gnathopod 2 very large, article 2 heavily spinose anteriorly, with medium-sized anterodistal lobe, article 3 with similar lobe, article 4 slightly extended posterodistally, article 5 very short, with long tumid posterior lobe, article 6 very large, subrectangular, not expanded distally, palm transverse, defined by medium tooth, bearing spine, tooth adjacent to weak sinus, palm with 1 deep incision in males, smooth in females, dactyl fitting palm, bearing large inner acclivity near position of sinus, acclivity absent in females and juveniles. Article 2 of pereopods 3–4 narrowly ovatorectangular, broader on pereopod 5, wih slightly extended, angular posterodistal corners, posteroproximal margins slightly extended but rounded; dactyls of pereopods 1–5 with strong distal constriction bearing sharp defining corner and armed with seta, sharp but stunted nail bearing accessory tooth, facial setule, constriction also bearing stout setule appressed to margin of nail, locking spines small, straight or slightly curved. Pleonal epimera 1–3 with slightly convex posterior margins, each with small sharp posteroventral tooth, ventrally spinose; pleonites dorsally smooth. Uropod 3 extending flush with other uropods, rami flat, broader than in *M. reishi,* apically truncate and spinose, inner extending to Mark 80 along outer, tiny article 2 on outer ramus. Telson deeply but not fully cleft, with strongly fixed medial gape, lobes thin to medium broad, apically incised but weakly and broadly, each lobe with 3 or 4 spines, some longer than telson. Dorsoposterior margin of urosomite 3 rounded.

Description and Illustrations.—Following parts similar to *M. reishi* (Figures 45–47): lateral views of antennae 1–2; epistome-upper lip; anterior view of latter also; mandibles, except for palp, left molar with 5 sharp projecting spines (2 shown for *reishi,* Figure 45: *M*) lower lip; maxilla 1 (but palpar apex with 6 spines and 4 setae only); maxilla 2 (but medial margin of inner plate with 1 additional seta); maxilliped; coxae 1–4 (but these slightly broader anterior to posterior and coxa 1 with anterior margin slightly less concave); gnathopod 1; pereopods 1–4 (except article 4 of pereopods 3–4 slightly broader); dactyls; locking spines; uropods 1–2; uropod 3 (with slightly broader rami); epimera (but epimeron 3 with only 3 ventral spines); cuticle.

Holotype.—USNM 142556, male "a," 3.7 mm (illus.).

Type-Locality.—PAZ 21, Baja California, 11 km E of Cabo San Lucas, 4 December 1971, intertidal, algal wash.

Voucher Material (all illustrated).—PAZ 22: female "f," 3.4 mm; juvenile "j," 2.9 mm; male "p," 3.6 mm.

Relationship.—This species appears to be a twin of *M. reishi* and differs from the latter mainly in the obsolescent cephalic tooth, the shortened article 3 of the mandibular palp and in the weakly excavate telsonic apices. The greatly thickened acclivity on the dactyl of male gnathopod 2 resembles that found only in the northern specimens of *M. reishi*; where *M. reishi* and *M. chinarra* occur sympatrically only *M. chinarra* bears the extremely thickened acclivity; *M. chinarra* has not been found in southern California coastal shallows where *M. reishi* specimens bear this thickened acclivity. *Maera chinarra* can be considered to be a dwarf sibling of *M. reishi* because specimens of *M. chinarra* appear to reach terminal morphology at body lengths between 3.5 and 4.0 mm, whereas specimens of *M. reishi* reach terminal stages at body lengths in excess of 5.0 mm in warm waters and 5.5 mm in cool waters. My material is insufficient to confirm these approximations.

Maera chinarra differs from the Bermudan species of Kunkel (1910:46) misidentified as *M. rathbunae* in the presence of numerous spines on gnathopod 2, both on the palm and article 2, but apparently has a similar mandibular palp. The excavate telsonic apices of *M. chinarra* are distinctive.

The apicoventral spine on article 1 of antenna 1 appears to be confined to females, whereas that spine in males is a slender seta.

Galapagan specimens correspond in almost all attributes to specimens from Mexico but the gland cone extends two-thirds along article 3 of antenna 2. Because this character is variable in *M. reishi* its significance subspecifically is discounted at present in Galapagan specimens of *M. chinarra.*

The value of 2 characters used to distinguish continental *Maera chinarra* from *M. reishi* is reduced in Galapagan specimens of *M. chinarra.* The mandibular palp of a specimen from GAL 114 has article 3 over 90 percent as long as article 2. In another specimen, a male from GAL 113, antenna 1 has the thickened and enlarged apical spine on article 1. Both of these specimens otherwise have the typical head, telson and uropod 3 of *M. chinarra.*

Material.—PAZ 14, 17, 18, 21, 22; GAL 113, 114, 116, 118, 120; DAW 1, 6, 7, 8, 9, 17, 18, 19, 26, 27, 35, 40; COCOS 1, 3.

Distribution.—Baja California, Cabo San Lucas, 0 m; Galapagos Islands, 0 m; Cocos Island, 0 m.

Maera simile Stout

Maera simile Stout, 1913:644–645.—Shoemaker, 1942:12.—Hewatt, 1946:199.—J. L. Barnard, 1959:24–25; 1961:179; 1964b:222; 1966a:19; 1966b:62; 1969b:122–123.
Maera inaequipes.—J. L. Barnard, 1954a:16–18, pls. 16, 17 [not Costa].

MATERIAL.—TOP 3.

DISTRIBUTION.—Gulf of California, Topolobampo, 1 m; generally from Puget Sound, Washington to Bahía Magdalena, 0–221 m (depths greater than 50 m usually in submarine canyons).

Melita Leach

Melita sulca (Stout)

Caliniphargus sulcus Stout, 1913:641–642.
Melita palmata.—Shoemaker, 1941b:187.—Hewatt, 1946:199 [not Montagu].
Melita sulca.—J. L. Barnard, 1969a:209; 1969b:126–130, figs. 22, 23.

MATERIAL.—SCO 1, 5, 7, 8, 14; TOP 3; PAZ 1, 2, 7, 10, 24, 25.

DISTRIBUTION.—Gulf of California, at Puerto Peñasco, Bahía de Los Angeles, Topolobampo, Bahía Concepción, Isla San Francisco, Isla Espiritu Santo and La Paz, 0–24 m; generally Puget Sound, Washington, to Isla Cedros, Baja California, 0–101 m.

Meximaera J. L. Barnard

Meximaera diffidentia J. L. Barnard

FIGURES 48, 49

Meximaera diffidentia J. L. Barnard, 1969a:209–210, figs. 21, 22.

VOUCHER MATERIAL.—GAL 111, male "a," 4.46 mm (illus.), male "b," 4.37 mm, female "c," 4.40 mm, female "f," 4.88 mm (illus.).

REMARKS.—The Galapagan specimens differ from those described from the Gulf of California in the equally projecting apical cusps on each lobe of the telson. At present, this seems inadequate for subspecific distinction.

Each mandibular molar bears a long pluseta; the inner plate of maxilla 1 bears 2 long apical, 1 long apicolateral and none or 1 short apical seta. In Figures 48 and 49 gnathopod 1 is magnified 5 percent more than gnathopod 2.

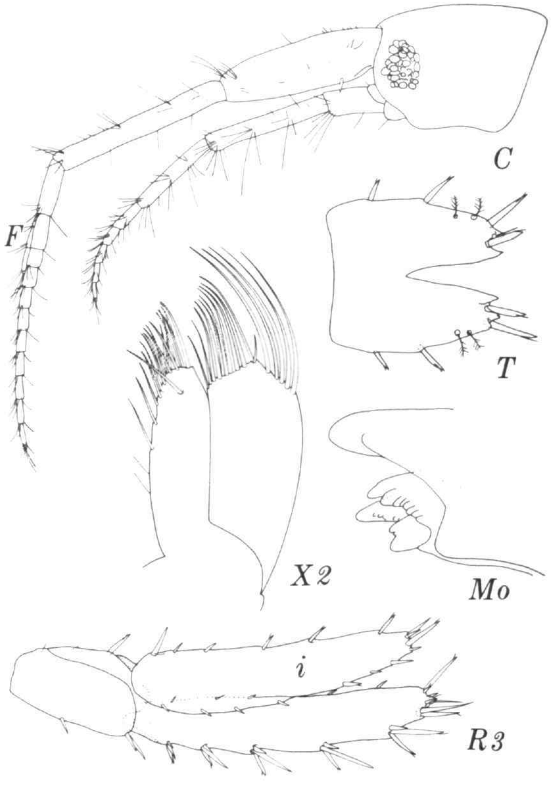

FIGURE 48.—*Meximaera diffidentia* J. L. Barnard, male "a," 4.46 mm.

The female was unknown heretofore. Females in the Galapagos Islands resemble the males in all characters, including size of gnathopods, except that the medial face on the hand of gnathopod 2 has several doublets of spines (Figure 49: *fG2O*).

The validity of *Meximaera* and its possible senior synonym *Linguimaera* Pirlot, remain in question. This hinges on rediscovery of the so-called type-species of *Linguimaera* and a global evaluation of the taxonomic importance of cephalic slits, presence or absence of article 2 on the outer ramus of uropod 3, the loss of prehensility on gnathopods and probably on many other characters (J. L. Barnard, 1972a:224).

MATERIAL.—GAL 108, 110, 111.

DISTRIBUTION.—Gulf of California, Bahía de Los Angeles, 0–24 m; Galapagos Islands, 0 m.

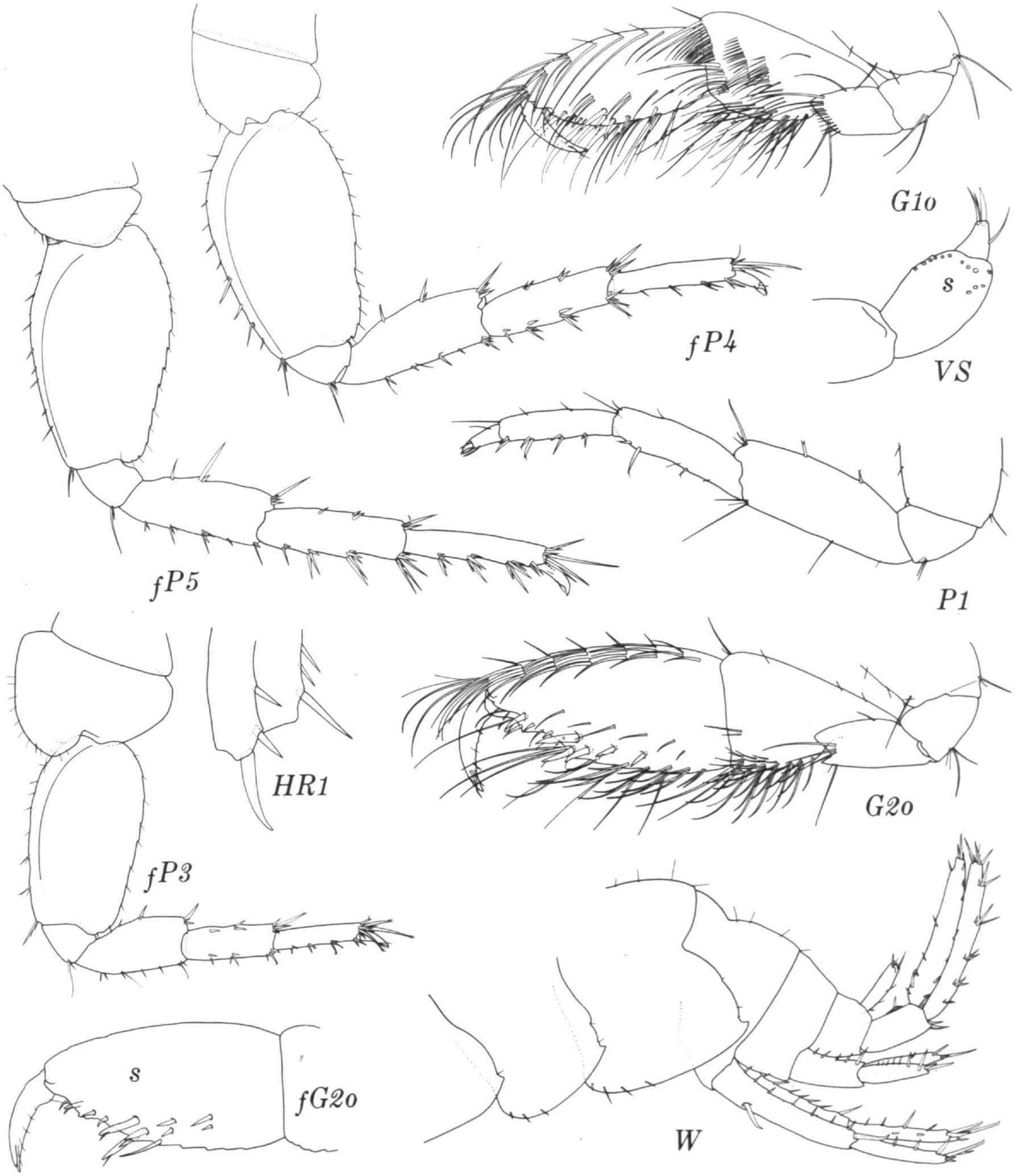

FIGURE 49.—*Meximaera diffidentia* J. L. Barnard, male "a," 4.46 mm (*f* = female "f," 4.88 mm).

HYALIDAE

Allorchestes Dana

Allorchestes Dana, 1849:136; 1852:205.—Stebbing, 1905:581.—J. L. Barnard, 1974:41.
Aspidophoreia Haswell, 1880:101.

DIAGNOSIS.—Talitroidean and hyalid with palp of maxilla 1 vestigial. Article 4 of maxillipedal palp unguiform. Gnathopods of both sexes subchelate, male gnathopod 2 larger than 1, female gnathopod 2 generally similar to female gnathopod 1. Uropod 3 with 1 ramus, apical armament weak (setae always present, spines rare or absent). Telson broad, rectangular, partially cleft but lobes not divergent.

TYPE-SPECIES.—*A. compressa* Dana (1852).

REMARKS.—J. L. Barnard (1974) has revised this genus to exclude many species now transferred to *Hyale;* those species have a long palp on maxilla 1, no apical setae on uropod 3, just spines and triangular telsonic lobes, the telson fully or deeply cleft. The presence or absence of a lobe on article 5 of male gnathopod 2 is discounted as a generic character; all known species of *Allorchestes* have this lobe, most species of *Hyale* lack this lobe. This reorganization restricts *Allorchestes* to species in cool waters, 3 in the North Pacific Ocean and 2 in the South Pacific Ocean. The genus, therefore, has biboreal discontiguity.

Taxonomic characters are focused on male gnathopod 1. A key to species is provided by J. L. Barnard (1974:42).

Allorchestes compressa Dana from Australia appears to have the least specialized male gnathopod 1, the hand being rectangular or bearing a slight posterior bulge near the palm, the dactyl fitting the palm or just failing this on the bulged form. The inner palmar spines are of medium to small size, are situated near the palmar margin and in adults number 3–4, often up to 7.

Allorchestes novizealandiae Dana from New Zealand has a highly specialized male gnathopod 1, the palm bearing a strong axial protrusion against which the dactyl closes but overlaps. The freely projecting part of the dactyl is about one-third of the length of the dactyl. Four palmar spines form a semicircular row partially divorced from the palmar margin.

All species of northern *Allorchestes* appear to be united by the reduction in number and enlargement of palmar spines on male gnathopod 1. In *Allorchestes angusta* only 2 inflexible spines remain on the inner face of the hand, 1 near the defining corner of the palm, another strongly submarginal and near the middle of the palm. The dactyl is strongly shortened and apically bifid.

Allorchestes carinata Iwasa has an ordinary rectangular hand with the dactyl fully fitting the palm. Two enlarged spines occur on the medial palmar face, 1 near the defining angle, the other submarginal from the middle of the palm. Both spines are much smaller than in *A. angusta.*

The third species of *Allorchestes* in the North Pacific resembles *A. novizealandiae* in the protrusive chela on the palm of gnathopod 1 and in the dactyl strongly overlapping the palm, but in *A. bellabella* the dactyl is tumid whereas in *A. novizealandiae* it is slender. In terminal males only 1 enlarged spine occurs on the medial palmar face but juvenile males have 2 of these spines.

Subsidiary taxonomic characters necessary to support the thesis that species of *Allorchestes* are definable by characters of male gnathopod 1 are difficult to find. The identification problem is especially tedious in females and juveniles. Because the life histories of the several species have not been studied in detail, owing to an absence of materials of juveniles, the few minor subsidiary distinctions among species cannot be confirmed as invariable. *Allorchestes carinata* and *A. bellabella* have posterior body carinations, presumably absent in juveniles. Spines on articles 4–5 of pereopods 3–5 are very stout and blunt in *A. carinata* and *A. bellabella* but not in other species. *Allorchestes bellabella* has straighter posterior margins on epimera than do the other species from the North Pacific. *Allorchestes carinata* never develops more than one spine each on the inner rami of uropods 1–2 but this character is scarcely needed for identification in terminal adults since carinations are so obvious. The presence or absence of a stout spine mixed among the apical setae of uropod 3 is of little value because apparently it is a phenotypic variable in *A. angusta.* The adult shape of male gnathopod 2 varies from species to species but has no value in identifying juveniles because the latter have a female-like gnathopod. Differences in female gnathopod 2 remain to be confirmed; these differences are mainly of proportion and setosity and probably vary phenotypically and with instar.

Allorchestes angusta Dana

FIGURES 50–52 (part)

Allorchestes angustus Dana, 1856:177.—J. L. Barnard, 1952a: 20–23, pl. 5: figs. 2–6; 1959:28.—Nagata, 1965:308.—Reish and Barnard, 1967:17.—J. L. Barnard, 1974:42.
Allorchestes malleolus Stebbing, 1899:409–410, pl. 33A.—Iwasa, 1939:285–288, figs. 20–22, pl. 20.—Bulycheva, 1957: 115–118, fig. 43.—Tzvetkova, 1967:183–184.
Allorchestes oculatus Stout, 1913:651.
Allorchestes vladimiri Derzhavin, 1937:95–96, pl. 5: fig. 2.—Gurjanova, 1951:822, fig. 575.
Not *Allorchestes angustus*.—J. L. Barnard, 1954a:21–23, pl. 21 [=*A. bellabella*].

DIAGNOSIS.—Mature male gnathopod 1 with hammer-shaped hand protruding at palmar corner, dactyl much shorter than palm, weakly striate, not heavily swollen, with bifid apical nail (or nail actually with outer accessory tooth), medial face of hand with submarginal falcate spine divorced from palmar corner, second spine simple, blunt, elongate, highly submarginal, set inward from middle of palm and usually pointing anteriorly. Posteroventral protrusions of epimera 2–3 of medium extent. Body not dorsally carinate. Cuticle with ordinary bulbar setules, no plaques. Spines of pereopods 3–5 sharp, elongate.

DESCRIPTION.—See Figures 50–52 for generalities. Right lacinia mobilis with 1–3 subbasal teeth (one tooth shown in Figure 50: *Jo*). Hand of female gnathopod 1 especially elongate and slightly curved. Cuticle between bulbar setules smooth. Largest specimen at hand, male, 9.3 mm, Yakutat Bay.

VARIABLES.—Apex of ramus on uropod 3 with 2–4 apical setules and occasionally with short stout spine, this character variable, apparently not correlated with adult body size nor geography (occurring both in Japan and California); castellations on dactyls of pereopods increasingly numerous with enlargement of body; simple spine of male gnathopod 1 hand especially elongate in large bodied adults from high latitudes.

IDENTIFICATION.—Stebbing's original material of *Allorchestes malleolus* from the Universitets Zoologiske Museum, Copenhagen, has been examined in order to clarify his illustration of male gnathopod 1. That appendage fits the configuration of *A. angusta* from the eastern Pacific and his various Japanese specimens exhibit similar variations found in eastern Pacific specimens; no subspecific distinctions have been found between the specimens from the eastern and western Pacific, nor in specimens from high latitudes, so that *A. malleolus* and *A. vladimiri* must fall to *A. angusta*. Stebbing's erroneous view of male gnathopod 1 must be attributed to a poor discernment of the dactylar apex which fits the falcate palmar spine so closely that they often appear as a unit.

LECTOTYPE.—*Allorchestes malleolus* Stebbing, male, 8.3 mm, here selected. Deposited in Universitetets Zoologiske Museum, Copenhagen.

TYPE-LOCALITY.—34°14′N, 129°34′E, Korlo-sho, *Andréa*, 1869 [Tsushima, Japan].

VOUCHER MATERIAL.—Newport Bay, California, male "a," 6.9 mm (illus.), female "n," 6.3 mm (illus.), female "w," 6.3 mm; Laguna Beach, California, male "m," 7.8 mm (illus.); Yakutat Bay, Alaska, male "u," 9.3 mm; Port Alice, British Columbia, male "y," 8.5 mm.

REMARKS.—Females and juveniles of this species are probably difficult to distinguish from subadult specimens of *A. carinata* but the problem does not arise in materials at hand because of a sparsity of samples and lack of juveniles in samples from the known sympatric areas of the two species in high latitudes.

A weak cline in adult body size apparently is correlated with latitude or temperature or with degree of enclosure of environment within lagoons or bays, the species reaching sexual maturity at small body sizes in southern warm latitudes or within enclosed bays. In southern California sexual maturity appears to occur at a body length of about 4.0–4.5 mm, whereas in colder latitudes sexual maturity may be reached at a body length of 6.0–7.0 mm (observations minimal). Little if any modification of spine shape occurs in cold water specimens so that the specimens of *A. carinata* at hand can be readily distinguished from *A. angusta* by their heavily blunted pereopodal spines.

MATERIAL.—Stebbing's original material of *A. malleolus*, Universitetets Zoologiske Museum, Copenhagen: Japansker Hav., 9/3 1872, H. Koch (3); Wladiwostock?, 9/3 1872, H. Koch (6); 31°40′N, 125°50′E, Tong-hai, F. Tang, *Andréa* 1869 (70); *Andréa* 1869 (10); 34°14′N, 129°34′E, Korlo-sho, F. Tang [Tsushima, Japan]; 34°40′N, 129°50′E, Japan, 50′, *Andréa* 1869 (18); 37°0′N, 131°20′E, *Andréa* 1869 (1); Smithsonian collections, full data cataloged in museum: California: Laguna Beach, Newport Bay, Pt. Fermin, Portuguese Bend, Venice,

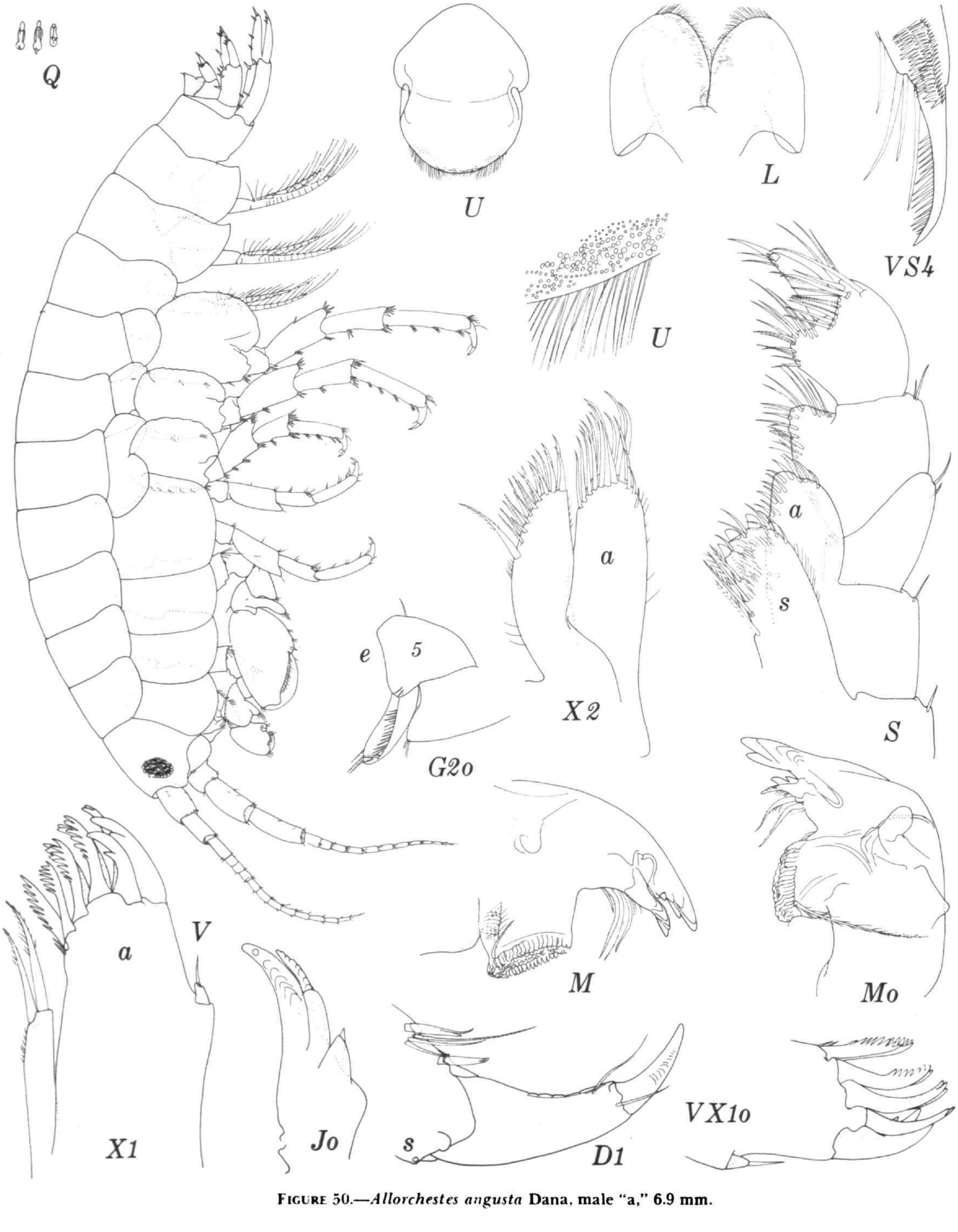

FIGURE 50.—*Allorchestes angusta* Dana, male "a," 6.9 mm.

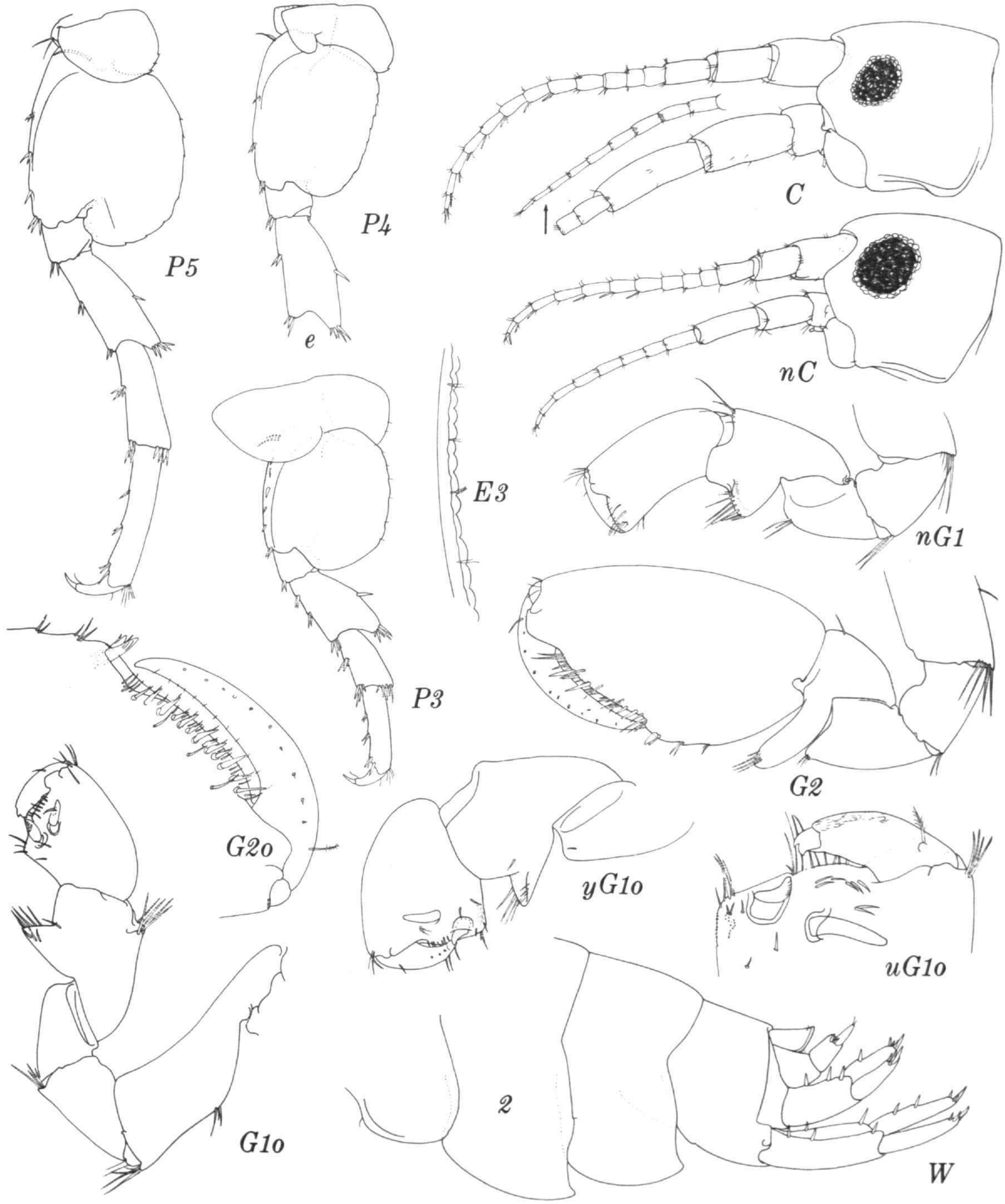

FIGURE 51.—*Allorchestes angusta* Dana, male "a," 6.9 mm (*n* = female "n," 6.3 mm; *u* = male "u," 9.3 mm; *y* = male "y," 8.5 mm).

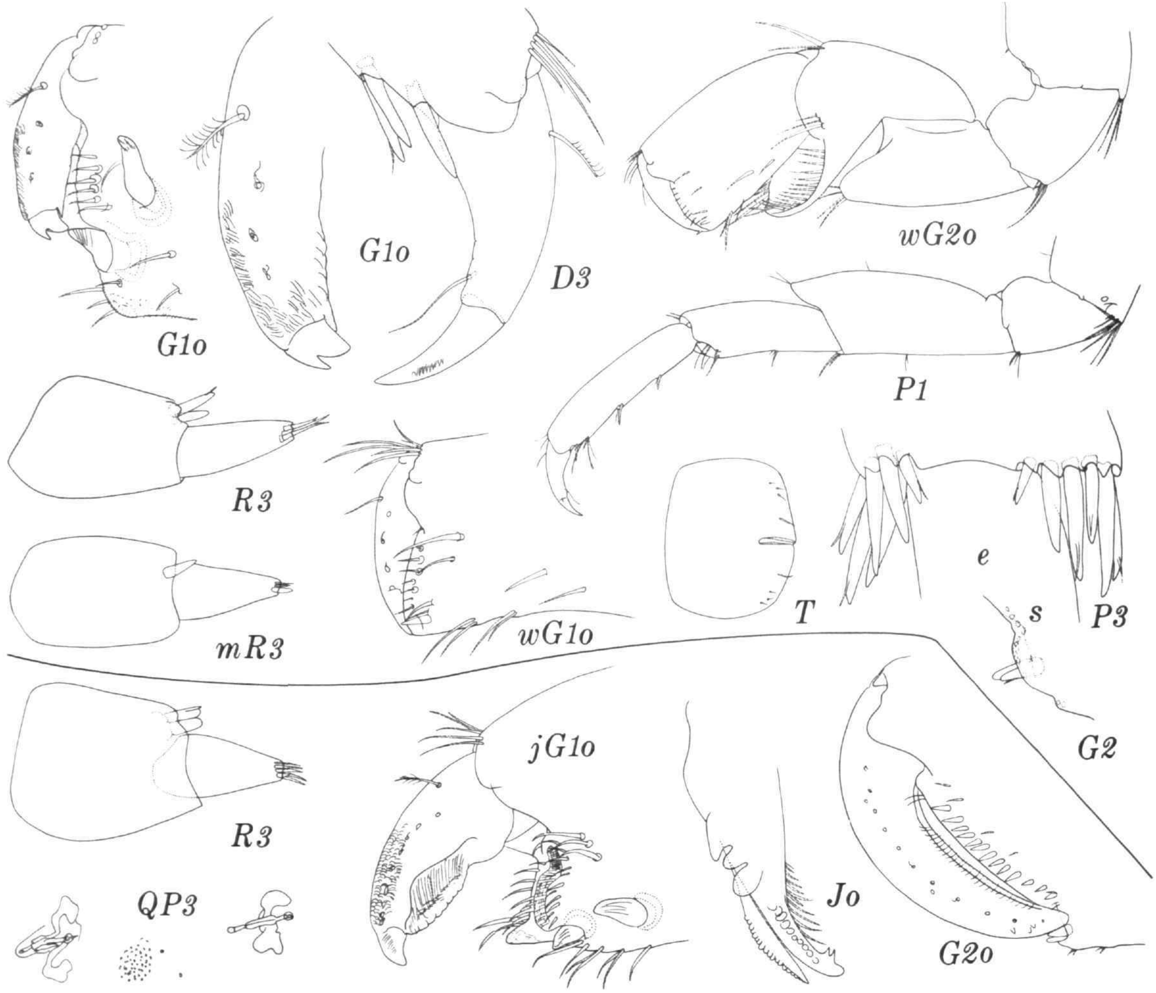

FIGURE 52.—Above: *Allorchestes angusta* Dana, male "a," 6.9 mm (*m* = male "m," 7.8 mm; *w* = female "w," 6.3 mm). Below: *Allorchestes bellabella* J. L. Barnard, holotype, male "a," 12.4 mm (*j* = juvenile, male "j," 8.5 mm).

Morro Bay, Hazard Canyon, Monterey Bay, Berkeley Beach, Pt. Richmond, Oakland Estuary, Alameda, Bodega Bay; Washington: Meadow Point at Seattle, Golden Gardens at Seattle, San Juan Island; Canada: Port Alice, Vancouver Island; Alaska: Saginaw Bay, Yakutat Bay; Ostrov Mednyy, 13 June 1906 [Medne Island, Commander Islands].

DISTRIBUTION.—Japan, about 31°N, northward through Kuriles, apparently across Aleutian chain to Alaska, southward to California, about 32°N, generally intertidal, phycophilous, rarely subtidal.

Allorchestes bellabella J. L. Barnard

FIGURES 52 (part), 53

Allorchestes bellabella J. L. Barnard, 1974:43.
Allorchestes angustus.—J. L. Barnard, 1954a:21–23, pl. 21 [not Dana].

DIAGNOSIS.—Mature male gnathopod 1 with weakly hammer-shaped hand bearing long tooth projecting distally from palmar corner, dactyl overlapping palm, moderately to heavily striate, strongly swollen, with simple, short apical nail, medial

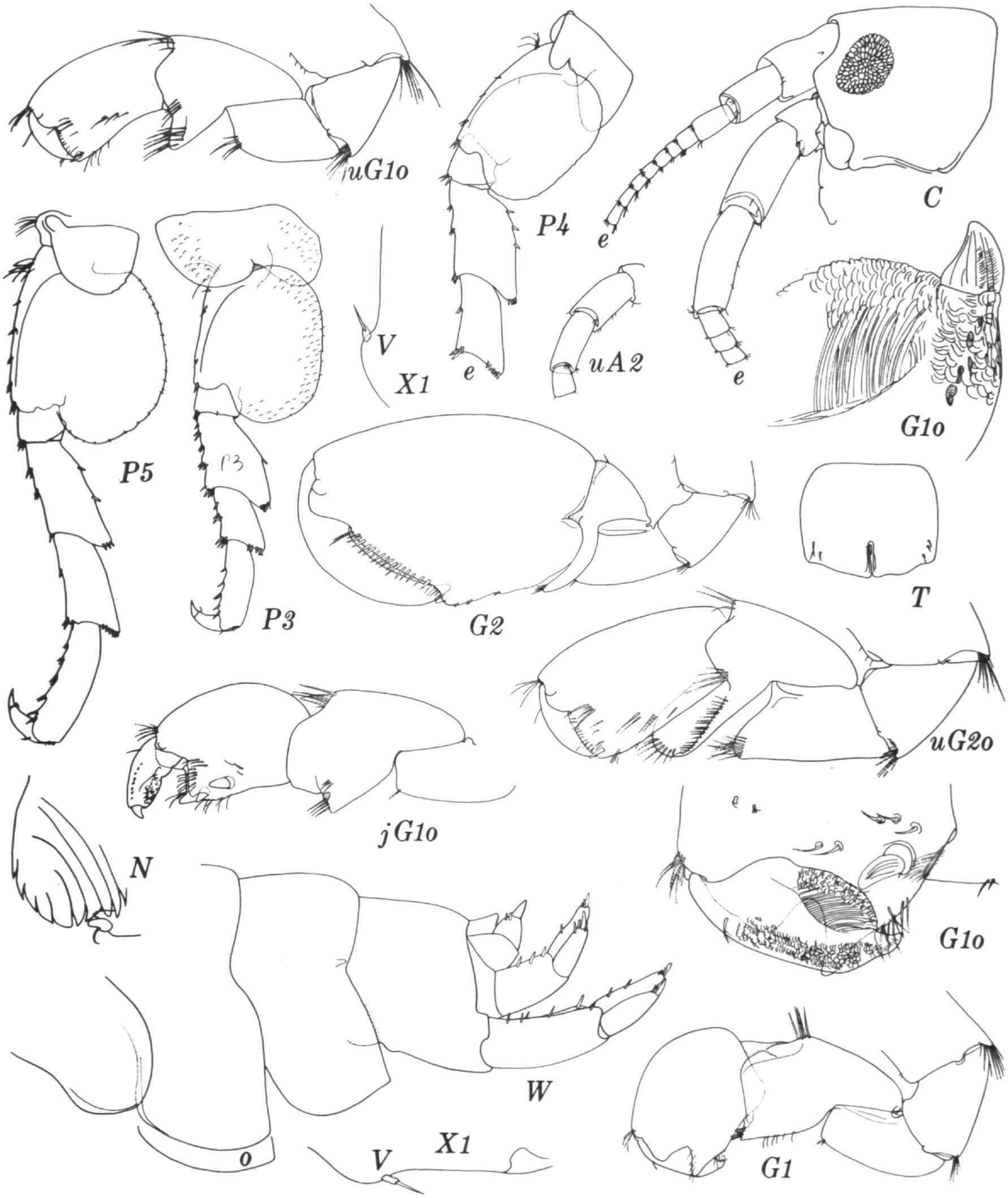

FIGURE 53.—*Allorchestes bellabella* J. L. Barnard, holotype, male "a," 12.4 mm (*j* = juvenile "j," 8.5 mm; *u* = female "u," 12.6 mm).

face of hand with 1–2 medium to large spines, terminal male with 1 large spine located posteriorly but highly proximal to protrusion, second spine of juvenile male apparently lost in adult, spines simple (weakly striate); posteroventral protrusions of epimera weak to obsolete. Body dorsally with weak posterior crest. Cuticle with complex alae surrounding bulbar setules, chitinous surface granular. Spines of pereopods 3–5 blunt, short.

DESCRIPTION.—See Figures 52 and 53 for generalities. Following parts generally like those of *A. angusta* (Figures 50–52): upper lip, lower lip, maxilliped, coxae; following parts like *A. angusta* with modifications noted: setae of inner plate on maxilla 1 very tumid and palp thin (see Figure 53: *VX1*, drawn to same scale as in *A. angusta,* Figure 50: *X1*); outer plate of maxilla 2 with additional 2 medial setae, thus setae extending farther proximally; mandibles, but right lacinia mobilis with 3 fully developed subbasal teeth (also in largest specimens of *A. angusta*), main seta on molar vestigial in male, fully developed on female (possibly male aberrant); following parts similar to those of *A. carinata* (Figure 54): pereopods 1–2 and their dactyls, inner setule of latter small as in *A. carinata,* 6 sets of sharp spines on article 6, including locking spines; stoutness of pereopods 3–5 similar to *A. carinata;* raker edges of basal gnathopodal articles present as in *A. carinata;* female gnathopodal dactyls with striae weaker than in *A. carinata.*

The distinctive pattern of cuticular pit-slits is drawn fully on pereopod 3; female head and antenna 1 like male but antenna 2 (Figure 53: *uA2*) shorter and thinner than in male; cuticle with alate slit-pits especially prominent on article 2 of pereopods 3–5, and the coxae, sparse elsewhere, granules or punctations very fine, occasional slightly enlarged prickle spine emerging between alae.

HOLOTYPE.—USNM 140995, male "a," 12.4 mm (illus.).

TYPE-LOCALITY.—Kyska Harbor, Alaska, beach, W. H. Dall (presumably from sponge in 1873).

VOUCHER MATERIAL.—Type-locality, juvenile male "j," 8.5 mm (illus.). Bering Island, Alaska, female "u," 12.6 mm (illus.).

MATERIAL.—Smithsonian collections, full data cataloged in museum: Bering Island, 4 collections by L. Stejneger, 29–30 December 1882 (22) (one collection from crop of *Simorhynchus pusillus,* which is old name of *Aethia pusilla* (Pallas), Least Auklet); Izemleck Bay, Unimak Island, Alaska, from duck stomach, 29 June 1925 (3); Kyska Harbor, Alaska, beach, W. H. Dall (7).

DISTRIBUTION.—Bering Island, Alaska, to Cape Arago, Oregon, intertidal and neritic ("planktonic").

Allorchestes carinata Iwasa, new status

FIGURE 54

Allorchestes malleolus carinatus Iwasa, 1939:288–289, figs. 23, 24, pl. 21.—Bulycheva, 1957:118–120, fig. 44.

DIAGNOSIS.—Mature male gnathopod 1 with ordinary or weakly hammer-shaped hand scarcely protruding at palmar corner, dactyl fitting palm, weakly striate, not heavily swollen, with simple apical nail, medial face of hand with 2 medium to small spines resembling each other, 1 spine near palmar corner, other spine situated submarginally from middle of palm and pointing distalwards, neither spine elongate. Posteroventral protrusions of epimera 2–3 of medium extent. Body dorsally carinate posteriorly. Cuticle with abnormal immersed setules bearing small plaque apically, chitinous surface granular. Spines of pereopods 3–5 blunt, short.

DESCRIPTION.—See Figure 54 for generalities; following parts not illustrated and like those shown for *A. angusta* (Figures 50–52): head, antennae 1–2, upper lip, generalities of mandibles, lower lip, maxillae 1–2, maxilliped, coxae and their marginal setules, epimera 2–3; following parts similar to *A. angusta* with stated exceptions: pereopods 1–2 with spines relatively smaller in relation to thick and inflated articles, dactyl with numerous castelloserrations (15 or more), marginal dactylar seta relatively shortened; article 2 of pereopod 3 similar but articles 4–6 stouter, article 2 of pereopods 4–5 slightly broadened but posterior notch-setae more numerous; flagellar articles of antenna 1 slightly more tumid; epimeron 1 lacking posteroventral setule; inner ramus of uropod 1 with only 1 spine, peduncle with 3 proximal spines, 3 peduncular spines of uropod 2 evenly separated from each other; female antennae 1–2 similar to those of male, thus stouter than in *A. angusta;* dactyls of female gnathopods 1–2 with fine striae unlike *A. angusta;* lacinia mobilis with 2 large and rudimentary third subbasal teeth.

REMARKS.—The sudden transformation of male gnathopod 1 from the juvenile condition similar to

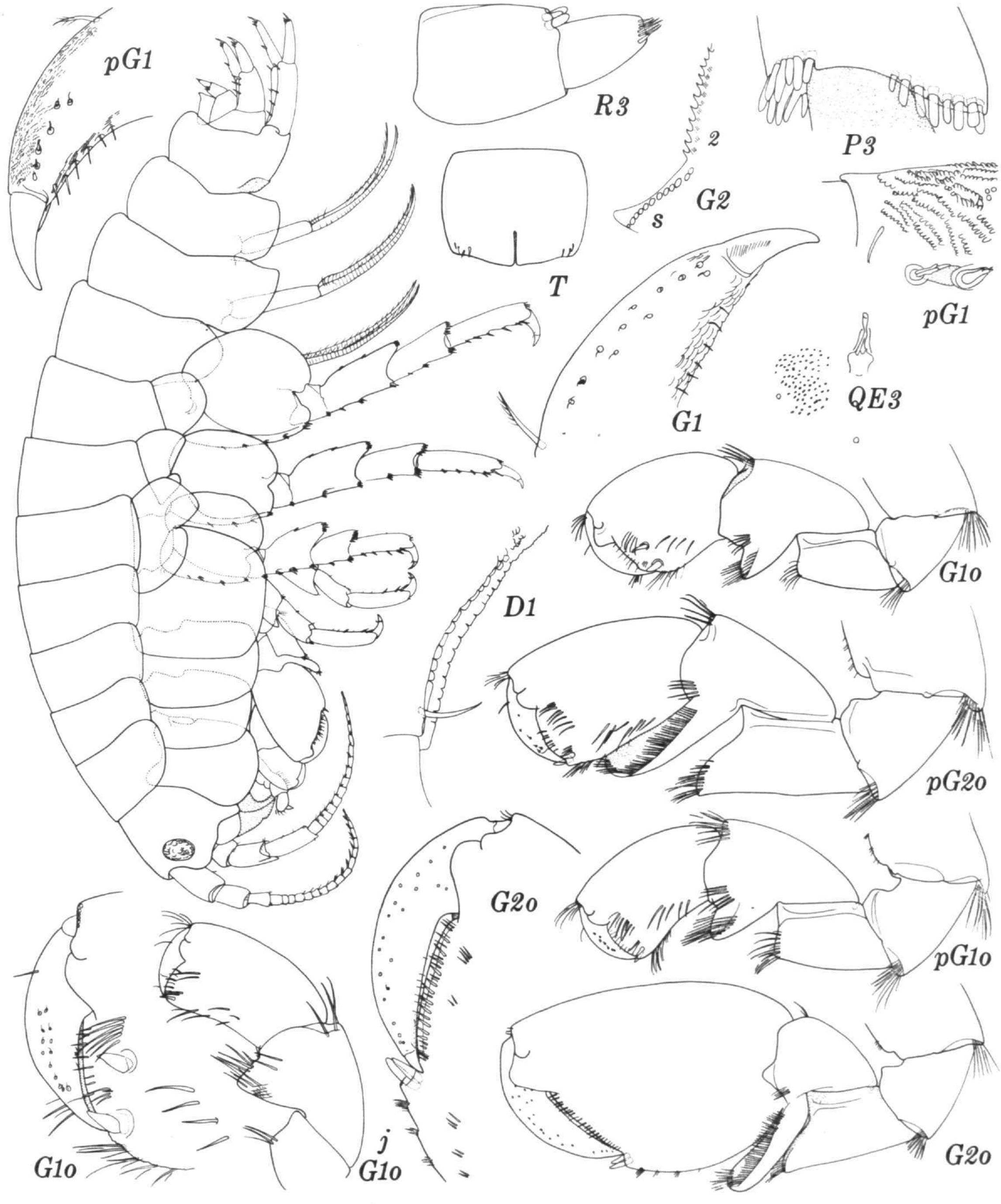

FIGURE 54.—*Allorchestes carinata* Iwasa, male "a," 15.9 mm (*j* = juvenile "j," 6.3 mm; p = female "p," 15.6 mm).

that of the female to the male condition is demonstrated in 1 male specimen at hand preserved just before ecdysis. The next instar is seen within the old cast, the first gnathopod bearing 1 large new spine replacing the 2 spines at the palmar angle and a new large spine appearing on the medial subpalmar face; male gnathopod 2 is well developed at this stage of transformation. The late C. R. Shoemaker noted these 2 stages of male gnathopod 1 as forms when he identified the material at hand.

The smallest juvenile at hand is 6.3 mm long (from St. Paul Island) and, like adults, has evidence of a dorsal crest, stout gnathopod 1, and blunt pereopodal spines.

VOUCHER MATERIAL (all illustrated).—St. Paul Island, Alaska, male "a," 15.9 mm; juvenile "j," 6.3 mm; female "p," 15.6 mm

MATERIAL.—Universitetets Zoologiske Museum, Copenhagen: Melne Bay, Simushir Island, Kuril Islands, 23 June 1906, Steamer "Albatross" (1); Smithsonian collection: St. Paul Island, Alaska, C. H. Townsend (50); Bering Island, L. Stejneger (3).

DISTRIBUTION.—Kurile Islands and Bering Sea, presumably intertidal or very shallow water.

Hyale Rathke

This genus and *Elasmopus* in the Gammaridae contain the most numerous individuals of intertidal amphipods in the Californian-Mexican-Galapagan area. *Ericthonius* (Corophiidae) is dominant also in Mexico and the Galapagos Islands. The main taxonomic problem in this genus in the eastern Pacific region has been Barnard's (1962c, 1969b) attempts to find the affinities of *H. frequens*. He relegated the species either to *H. nigra* or to *H. rubra*, but Barnard (1974:66–67) redescribed those 2 species from Australia thereby demonstrating that *H. frequens* is a valid species. *Hyale rubra* indeed occurs in the eastern Pacific Ocean from Peru southward to Chile and westward to the Juan Fernandez Islands. The morph is slightly distinct from the Australian morph and may eventually deserve a subspecific name. The *Hyale rubra* found by Barnard (1969b: 138) from Isla Cedros is a distinctive species found also in the Galapagos Islands, herein described as *H. darwini*. Another new species, *H. yaqui* has very close affinities with *H. nigra* from Australia.

The *Hyale grandicornis* complex is reviewed again and the decision made to segregate all Pacific taxa at specific level. This requires elevating *H. californica* J. L. Barnard (1969b:133) and *H. rupicola* (see J. L. Barnard, 1974:54) and requires the segregation of Iwasa's (1939:276) identification of *H. novaezealandiae* to the status of *Hyale* sp. (p. 115).

Key to the Males of the Species of *Hyale* from Mexico, California, and the Galapagos Islands

1. Uropod 1 with apicolateral peduncular spine on uropod 1 enlarged 2
   Uropod 1 with apicolateral peduncular spine on uropod 1 not enlarged 9
2. Article 6 of gnathopod 1 with posterior setae widely spread 3
   Article 6 of gnathopod 1 with posterior setae confined narrowly 7
3. Dactyl of maxillipeds with long setae 4
   Dactyl of maxillipeds with short setae 6
4. Wrist of gnathopod 1 with midanterior spine .... ***H. canalina*, new species**
   Wrist of gnathopod 1 lacking midanterior spine 5
5. Male gnathopod 2 with small hump on palm near hinge of dactyl, male gnathopod 1 with posterior setae on article 6 divided into groups .... ***H. darwini*, new species**
   Male gnathopod 2 with smooth palm, male gnathopod 1 with posterior setae on article 6 continuously and evenly set (eastern Pacific) .... ***H. rubra***
6. Outer ramus of uropod 1 with dorsal spines, pereopods with 2 locking spines in tandem .... ***H. yaqui*, new species**
   Outer ramus of uropod 1 dorsally naked, pereopods with only 1 locking spine surrounded by setae (Galapagan) .... ***H. zuaque*, new species**
7. Coxae 2–4 with sharply extended posterior acclivity, outer ramus of uropod 1 dorsally naked (Mexican) .... ***H. zuaque*, new species**
   Coxae 2–4 with blunt, unextended posterior acclivity, outer ramus of uropod 1 with dorsal spines 8

8. Locking spine of pereopods 3–5 very small but other anterior spines of article 6 enlarged, male gnathopod 1 palm with large medial spine, palm of male gnathopod 2 fully occupying posterior margin of article 6 and densely setose .... ***H. guasave,*** new species
Locking spine of pereopods very small, other anterior spines of article 6 also small, male gnathopod 1 palm lacking large medial spine, palm of male gnathopod 2 distinct from posterior margin of article 6, spiny but not densely setose .... ***H. frequens***
9. Main inner dactylar setule on pereopods 1–5 very thin 10
Main inner dactylar setule on pereopods 1–5 very thick, often striate 11
10. Posterior acclivity on coxa 1 situated in middle, large, male antenna 2 article 5 lacking marginal posterior setae .... ***H. anceps***
Posterior acclivity on coxa 1 situated dorsally, small, male antenna 2 article 5 bearing marginal posterior setae. .... ***H. plumulosa***
11. Hand of male gnathopod 2 not tapering distally, cuticle smooth ....***H. californica,*** new status
Hand of male gnathopod 2 strongly tapering distally, cuticle bearing weak polygons .... ***H. humboldti,*** new species

Hyale darwini, new species

FIGURE 55

ETYMOLOGY.—Named for Charles Darwin.

DESCRIPTION OF MALE.—Anterior margin of lateral cephalic lobe slightly oblique, weakly concave. Eyes of medium size, mostly formed of dark core surrounded by 1–2 layers of clear ommatidia (in alcohol). Antenna 2 about as long as head and pereon together, peduncle slender, almost fully naked, flagellum slightly less than 4 times as long as peduncle, almost fully naked; antenna 1 about 45 percent as long as antenna 2, reaching less than 20 percent along length of flagellum of antenna 2, aesthetascs 1–2 per article of flagellum. Upper lip evenly rounded below, setules long. Mandibular incisors toothed, right lacinia mobilis evenly bifid and with accessory side tooth, spine row with 1 large, 1 small spine, molar moderately triturative, right and left molars with long plumose seta, left mandible with 3 spines in spine row. Maxilla 1 as figured, outer plate with 8 spines, inner plate softly acclivitous, 2 terminal setae short. Each terminal segment of maxilliped with 1 or more lateral spines (setae), article 3 of palp simple, apical spine of article 4 articulate, short, with 1 accessory setule and numerous elongate terminal setae and shorter proximal setae on inner margin. Posterior acclivities of coxae 1–3 obsolescent and soft, 2 medial setae on coxa 1 (lower part of plate), dorsoposterior excavation of coxa 4 not bisinuate or scarcely so. Article 2 of gnathopod 1 with 3 posterior spinules, of gnathopod 2 with 4 spinules, article 2 of gnathopod 1 broadly lobate and protuberant distolaterally, article 4 with soft posterodistal protrusion, article 5 with 2 anterodistal spines, posterior lobe of article 5 large and broadly rounded, scarcely scalloped and strongly spinose (setose), article 6 softly subrectangular but weakly tapering distally, posterior margin with 5 setae in disjunct sets of 3, 1, 1, occupying 30 percent of marginal length, palm short, rounded and weakly oblique, defined by 1 large medial and 1 small lateral spine, dactyl overlapping defining spines, dactyl with medium development of minute ridges; article 2 of gnathopod 2 grossly lobate and weakly spinulose anteriorly, article 3 with nasiform lobe, article 4 protrusively rounded apically, article 5 fully cryptic, hand of ordinary hyalid proportions, with 3 anteroproximal spines on margin, palm oblique, slightly longer than posterior margin of hand, latter with 1 acclivity bearing 2 short setae, palm defined by weak hump and pocket for apex of dactyl but enlarged spine absent, palm lined with small stout spines, bearing weak quadrate protrusion near base of dactyl, latter fitting palm, with weak hump near inner base. Pereopods ordinary, like those of *H. yaqui*, pair of locking spines not larger than other marginal spines on article 6, distalmost locking spine slightly shorter than proximalmost, distalmost scarcely striate, slightly bent, several setae between locking spines, dactyls minutely striate, inner margins smooth, main inner seta very small, thin and highly terminad. Uropod 1 with enlarged apicolateral spine, apicomedial spine not

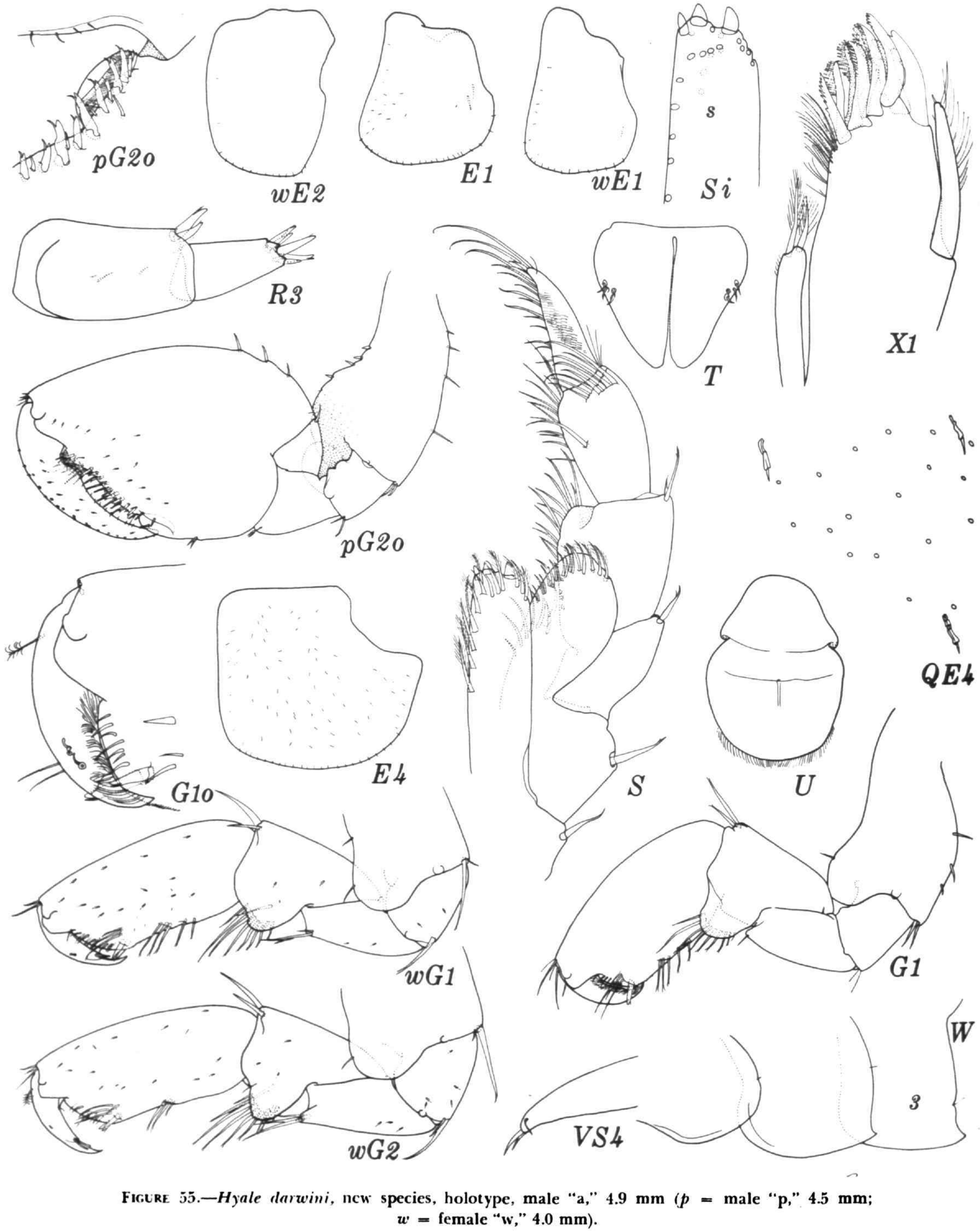

FIGURE 55.—*Hyale darwini*, new species, holotype, male "a," 4.9 mm (*p* = male "p," 4.5 mm; *w* = female "w," 4.0 mm).

enlarged, peduncles and rami of uropods 1–2 ordinarily spinose; uropod 3 ordinary but peduncle slightly elongate, ramus short, peduncle with 2 apicodorsal spines, ramus with about 5 apical spines, none disjunct from others. Telson split nearly to base, lobes otherwise ordinary. Epimeron 1 ordinary, epimeron 2 with anterofacial ridge, medium posteroventral sharp tooth, epimeron 3 with tooth similar to but slightly stouter than that of epimeron 2. Cuticle with ordinary bulbar setules and surficial matrix of widely scattered punctations.

FEMALE.—Body about three-fourths length of male, antenna 2 reaching only three-fourths as far as in male, peduncle even thinner than in male; coxae 1–2 narrower relative to coxa 4 than in male; article 2 of gnathopod 1 lacking posterior spines, of gnathopod 2 with only 1 setule, dactyl with only a few long ridges, hand narrower and more elongate than in male, scarcely tapering distally, posterior margin with setae similar to those of male, article 4 with long setae on strong apical protrusion; gnathopod 2 like gnathopod 1 but slightly stouter, posterior setae on article 6 composed only of group of 3.

ILLUSTRATIONS. Following parts similar to those shown for *H. yaqui* (Figures 57–59): head, lateral views of antennae, epistome from lateral view, mandibles (but molarial seta present on both sides and elongate), lower lip, maxilla 2, coxae 2, 3, pereopods 1–5 (but article 4 of pereopods 3–5 slightly stouter), dactyls and locking spines, urosome, uropods 1, 2.

HOLOTYPE.—USNM 142488, male "a," 4.9 mm (illus.).

TYPE-LOCALITY.—GAL 118, Galapagos Islands, Isla Santa Cruz, Academy Bay, 4 February 1964, intertidal, wash of alga.

VOUCHER MATERIAL.—Type-locality, male "p," 4.5 mm (illus.); female "w," 4.0 mm (illus.).

RELATIONSHIP.—This species belongs with the group composed of *H. rubra* (Thomson), *H. frequens* (Stout), and *H. yaqui*, new species. It differs from Australian *H. rubra* in the short nail on palp article 4 of the maxilliped, in the discontiguous setal groups on the posterior margin of article 6 on male gnathopod 1, and in the quadrate protrusion on the palm of male gnathopod 2.

Hyale darwini differs from *H. frequens* and *H. yaqui* in the elongate apical setae of palp article 4 on the maxilliped, from *H. frequens* in the wider spread of posterior setae on article 6 of male gnathopod 1 and from *H. yaqui* in the narrower spread, fewer setae and clear grouping of the posterior setae on article 6 of male gnathopod 1. Coxa 4 of *H. darwini* is especially broad and posteriorly extended in comparison to *H. frequens* and *H. yaqui*. The deep telsonic cleft of *H. darwini* contrasts to the shorter cleft of *H. yaqui*, and the longer palm of *H. darwini* contrasts to the short palm of gnathopod 2 in male *H. frequens*.

MATERIAL.—GAL 101, 108, 113, 114, 115, 116, 118, 119, 120; DAW 1, 3, 4, 5, 6, 7, 8, 9, 12, 13, 16, 17, 18, 19, 20, 21, 22, 23, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 40; PAN 14.

DISTRIBUTION.—Galapagos Islands, 0–6 m; Pacific Panama, wharf.

Hyale rubra (Thomson)

FIGURE 56 (part)

Nicea rubra Thomson, 1879:236, pl. 10B: fig. 3.
Hyale rubra.—Stebbing, 1906:572.—Hurley, 1957:918–913, figs. 30–50.—J. L. Barnard, 1974:67–72, figs. 43–45.
?*Hyale schmidti*.—Iwasa, 1939:278–280, fig. 17, pl. 17.
Hyale species [cf. *rubra*].—J. L. Barnard, 1970:268–271, fig. 178.
Not *Hyale rubra rubra*.—J. L. Barnard, 1969b:138, fig. 24a–e [= *H. canalina*, new species].
Not *Hyale rubra frequens*.—J. L. Barnard, 1969b:139–141 [= *H. frequens*].

VOUCHER MATERIAL.—Antofogasta Bay, Chile, male "h," 6.72 mm (illus.).

REMARKS.—Specimens from Chile, Peru, and the Juan Fernandez Islands identified by C. R. Shoemaker have been compared minutely with J. L. Barnard (1974:67), a depiction of *H. rubra* from its type area, Australia. These specimens compare favorably with Australian specimens except that the first proximal spine on the spinose margin of article 6 on pereopods 1–5 is larger than the distalmost tandem-pair of locking spines and the posterior row of setae on article 6 of male gnathopod 1 flows evenly from proximal to distal end, with a slight apical increase in the length of the setae. In Australian *H. rubra*, the proximal spines on the spinose margin of article 6 on pereopods 1–5 are not enlarged and in terminal males the distalmost few setae on article 6 of male gnathopod 1 are shorter than the other setae. Reexamination of Australian *H. rubra* reveals that young males develop 1 or more distal setae near the defining spine fully dis-

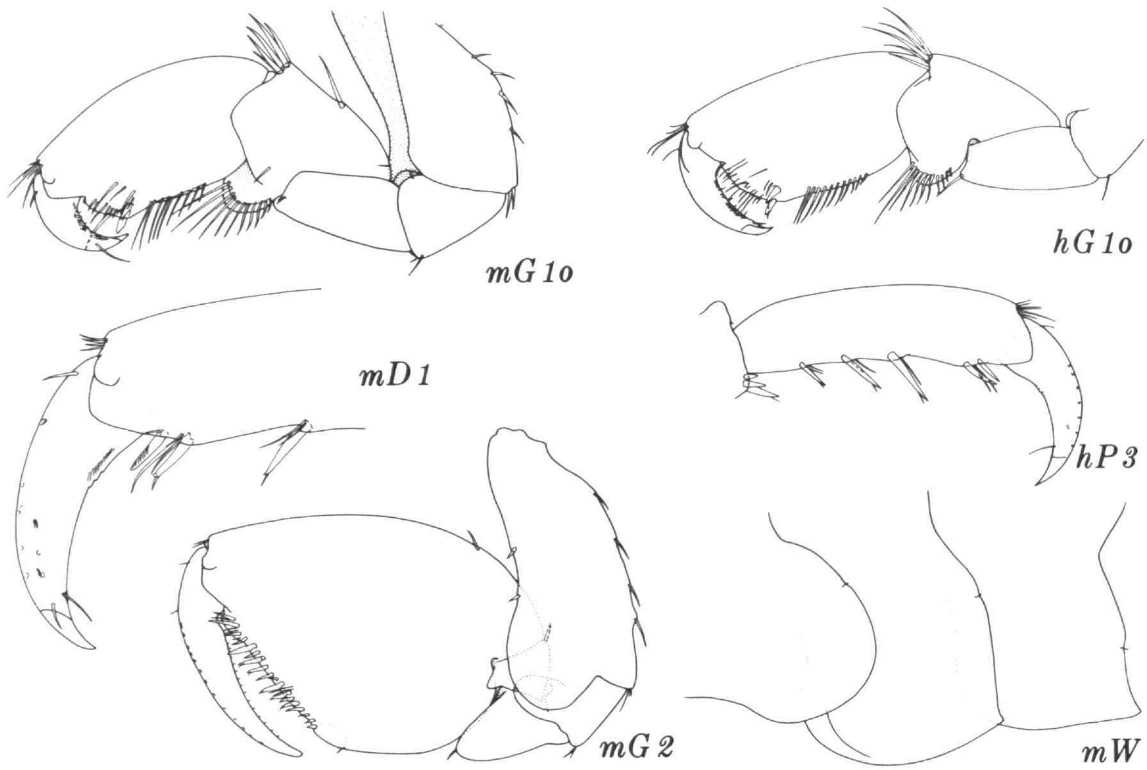

FIGURE 56.—*Hyale rubra* (Thomson) (*h* = male "h," 6.72 mm). *Hyale canalina*, new species (*m* = holotype, male "m," 6.33 mm).

junct from the posterior row and that as growth proceeds these setae increase in number and eventually become contiguous with the main row.

These minute differences may have future value in splitting the *rubra* complex into subspecies. The main purpose of this analysis is to demonstrate that *H. frequens* (Stout) and *H. darwini* are distinct from *H. rubra*. The former species has short setae on the maxillipedal dactyl and the latter species has a hump on the palm of male gnathopod 2.

MATERIAL.—Juan Fernandez Islands, coll. W. L. Schmitt, samples 34, 38, 59, 8–22 December 1926, intertidal, one of these samples labeled "from tufts of seaweed in *Plagusia* collected on weed covered rocks along shore" (250+); Chile, Chanarel, 16 November 1926, W. L. Schmitt (2); Chile, Antofogasta Bay, 15 November 1926, W. L. Schmitt (male "h" 6.72 mm, Figure 56) (30+); Peru, Independencia Bay, *Velero* 380–35, 14 January 1935, shore east side of bay, W. L. Schmitt (20+). All material identified by Shoemaker.

DISTRIBUTION.—Species complex: Australia, Japan, Hawaii, Juan Fernandez Islands, Peru, Chile.

Hyale canalina, new species

FIGURE 56 (part)

Hyale rubra rubra.—J. L. Barnard; 1969b:138 [not Thomson].

DESCRIPTION OF MALE.—Anterior margin of lateral cephalic lobe slightly oblique, weakly concave. Eyes of medium size, completely and darkly pigmented. Antenna 2 slightly longer than head and pereon together, peduncle slender, almost fully naked, flagellum about 4 times as long as peduncle, almost fully naked; antenna 1 about 45 percent as long as antenna 2, reaching less than 20 percent along length of flagellum of antenna 2, aesthetascs 1–2 per article of flagellum. Upper lip evenly rounded below, setules long. Mandibular incisors toothed, right lacinia mobilis evenly bifid and with accessory side tooth, spine row with 1 large, 1 small spine, molar moderately triturative, right and left molars with long plumose seta, left mandible with 3 spines in spine row. Maxilla 1 as in Figure 55 of *Hyale darwini*, new species, setae on inner plate slightly more elongate. Maxilliped as in Figure 55 of *H. darwini* but article 3 of palp lacking medioproximal seta on face, apical spine of article 4 on palp articulate, short, with 1 accessory seta and numerous elongate apical setae and shorter setae proximally on inner margin. Posterior acclivities of coxae 1–3 obsolescent and soft, 2 medial setae on coxa 1 (lower posterior part of plate), dorsoposterior excavation of coxa 4 weakly bisinuate. Article 2 of gnathopod 1 with 3–4 posterior spinules, of gnathopod 2 with 4 spinules, article 2 of gnathopod 1 broadly lobate and protuberant distolaterally, article 4 with soft posterodistal protrusion, article 5 with 5 apicodorsal spines and 1 midanterior spine, posterior lobe of article 5 large and broadly rounded, scarcely scalloped and strongly spinose, article 6 softly subrectangular but weakly tapering distally, posterior margin with 9 setae in contiguous sets of 3–1–2–3 or 4–3–2 (proximal to distal), occupying 35+ percent of marginal length, palm short, rounded and oblique, defined by 1 small medium and 1 larger lateral spine, dactyl overlapping defining spines, dactyl with medium development of minute ridges; article 2 of gnathopod 2 grossly lobate and weakly spinulose anteroventrally, article 3 with nasiform lobe, article 4 protrusively rounded apically, article 5 fully cryptic but with sharp posterior protrusion, hand stout, with 1–2 anteroproximal spines on margin, palm oblique, slightly longer than posterior margin of hand, latter with 1 setule, palm defined by weak hump and pocket for apex of dactyl but enlarged spines absent, palm lined with small stout spines, bearing weak quadrate protrusion near base of dactyl, latter fitting palm, with weak hump near inner base. Pereopods ordinary, like those of *Hyale yaqui*, pair of locking spines not larger than other marginal spines on article 6, locking spines of identical size, both weakly striate, unbent, several setae between locking spines, dactyls minutely striate, inner margins with few very weak castellations proximally, stronger on pereopods 1–2, main inner seta very small, thin and highly terminad. Uropod 1 with enlarged apicolateral spine on peduncle, apicomedial spine not enlarged, peduncles and rami of uropods 1–2 ordinarily spinose; uropod 3 ordinary but peduncle slightly elongate, ramus short, peduncle with 2 apicodorsal spines, ramus with 5 apical spines, not disjunct from others. Telson split nearly to base, lobes otherwise ordinary. Epimeron 1 ordinary, epimeron 2 with anterofacial ridge, weakly protuberant posteroventrally, epimeron 3 with similar protuberance but slightly sharper than that of epimeron 2. Cuticle with ordinary bulbar setules and surficial matrix of widely scattered punctations.

FEMALE.—Unknown.

HOLOTYPE.—AHF 5928, male "m," 6.33 mm (illus.).

TYPE-LOCALITY.—J. L. Barnard, Sta. 36, Isla Cedros, Baja California, 3.2 km SE of north point, 21 March 1959, in intertidal wash of *Phyllospadix* sp.

VOUCHER MATERIAL.—AHF *Velero III* 1370–41, Santa Catalina Island, 3 males.

RELATIONSHIP.—This species may prove to be a subspecies of *Hyale darwini*, or, that species, this species and *H. rubra* may form an eastern Pacific Rassenkreis. The three species are minimally distinct in the sparse material in hand from essentially 3 areas, Peru and Juan Fernandez (*rubra*), the Galapagos Islands (*darwini*), and Cedros-Catalina (*canalina*), the offshore islands of the Californias.

Hyale canalina forms an intergrade between *H. rubra* and *H. darwini*. *Hyale canalina* bears 1 or 2 spines on the anteroproximal margin of the hand on male gnathopod 2, whereas *H. rubra* lacks these spines and *H. darwini* bears 3. *Hyale canalina* bears about 9 posterior setae on the hand of male gnathopod 1 very slightly divided into groups of 1–4 whereas these setae are unifromly set in *H. rubra* and divided into fully disjunct groups in *H. darwini*. *Hyale canalina* differs from either *H. rubra* or *H. darwini* in the presence of a midanterior spine on the wrist of gnathopod 1.

MATERIAL.—See holotype and voucher material (4 specimens).

DISTRIBUTION.—Santa Catalina Island and Isla Cedros, intertidal.

Hyale yaqui, new species

FIGURES 57–59 (part)

Hyale nigra, bay form.—J. L. Barnard, 1964a:109, fig. 21A [not Haswell, nor other references to *H. nigra* by J. L. Barnard].
Hyale rubra frequens.—J. L. Barnard, 1969a:212 [not Stout, nor other references to *H. rubra* or *H. frequens* by J. L. Barnard].

IDENTIFICATION.—Material noted in synonymy from Bahía de Los Angeles, Bahía de San Quintín, and Estero de Punta Banda is referred to this species.

DESCRIPTION OF MALE.—Anterior margin of lateral cephalic lobe slightly oblique, weakly concave. Eyes of medium size, mostly formed of deep purple to black core surrounded by 2 layers of clear ommatidia (in alcohol). Antenna 2 about as long as head and pereon together, peduncle slender, almost fully naked, flagellum slightly less than 4 times as long as peduncle, almost fully naked; antenna 1 scarcely more than half as long as antenna 2, reaching scarcely 30 percent along length of flagellum on antenna 2, aesthetascs about 2 per article on flagellum. Upper lip evenly rounded below, setules short. Mandibular incisors toothed, right lacinia mobilis evenly bifid and with accessory side tooth, spine row with 1 large, 1 small spine, molar moderately triturative, right molar with short plumose seta; left mandible with 3 spines in spine row, long molarial seta. Maxillae as illustrated, outer plate of maxilla 1 with 9 spines (some hidden in figures), inner plate of maxilla 2 with 1 enlarged inner seta. Each terminal segment of maxilliped with 1 or more lateral spines, article 3 of palp simple, apical spine of article 4 articulate, short, with 1 accessory apical spine and several inner marginal spine-setae and 1 outer seta. Posterior acclivities of coxae 1–3 obsolescent and soft, setae on inner faces vestigial, dorsoposterior excavation of coxa 4 scarcely bisinuate. Article 2 of gnathopod 1 with 5 posterior spinules, of gnathopod 2 with 6 or 7 small spines, article 2 of gnathopod 1 broadly lobate distolaterally, article 4 with soft posterodistal protrusion, article 5 with several anterodistal spines on protrusion set back from sleeve holding article 6, posterior lobe of article 5 large and broadly rounded, weakly scalloped and strongly spinose, article 6 softly subrectangular but weakly tapering distally, posterior margin with long row of setae occupying nearly 40 percent of marginal length, palm short, rounded and weakly oblique, defined by 1 large lateral and 1 small medial spine, dactyl fitting palm but slightly overlapping defining spines, dactyl with medium development of minute ridges; article 2 of gnathopod 2 grossly lobate and weakly spinulose anteriorly, article 3 with nasiform lobe, article 4 protrusively rounded apically, article 5 with weak but cryptic lobe on medial surface, hand of ordinary hyalid proportions, with 1 anteroproximal spine on margin, palm oblique, slightly longer than posterior margin of hand, latter almost naked, palm defined by weak hump, spine and pocket for apex of dactyl, palm lined with small stout spines, bearing weak quadrate protrusion near base of dactyl, latter fitting palm, scarcely humped near inner base. Pereopods ordinary (Figure 58) pair of locking spines not larger than other marginal spines on article 6, distalmost locking spine slightly shorter than proximalmost, distalmost weakly striate spirally, slightly bent, several setae between locking spines, dactyls minutely striate, with obsolescent inner notches, main inner seta very small, thin and highly terminad. Uropod 1 with enlarged apicolateral spine, apicomedial spine not enlarged, peduncles and rami of uropods 1–2 ordinarily spinose; uropod 3 ordinary but peduncle slightly elongate, ramus short, peduncle with 2 or 3 apicodorsal spines, ramus with about 6 apical spines, none disjunct from others. Telson split only about two-thirds towards base, lobes otherwise ordinary. Epimeron 1 ordinary, epimeron 2 with anterofacial ridge, medium posteroventral sharp tooth, epimeron 3 with tooth similar to that of epimeron 2. Cuticle with split pits especially well developed on coxae and article 2 of pereopods 3–5, pits with setule and shaped like sagittal views of medusae with tiny inserted setules on surface between pits, epimera rarely with pits but mainly with tiny inserted setules, occasional pit on body segments dorsally and appearing as craters from oblique views.

FEMALE.—Body about two-thirds length of male (4.2 against 6.2 mm maximum sizes in material available), antenna 2 reaching only two-thirds as far as in male, peduncle even thinner than in male; coxae 1–2 narrower relative to coxa 4 than in male; article 2 of gnathopod 1 lacking posterior spines, of gnathopod 2 with only 1 setule, dactyl with only a few long ridges, hand narrower and more elongate than in male and not tapering apically, posterior

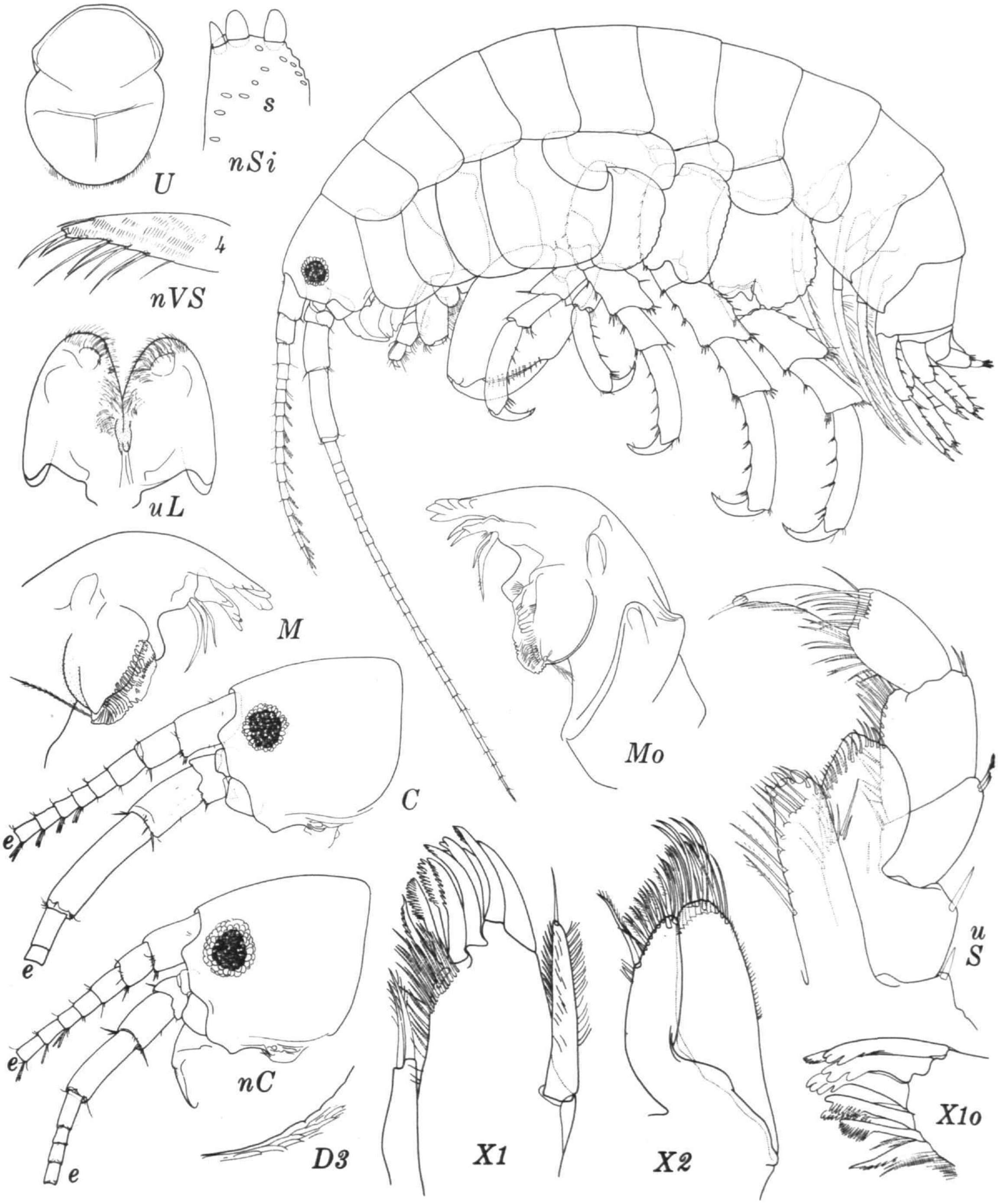

FIGURE 57.—*Hyale yaqui*, new species, male holotype "a," 6.2 mm (*n* = female "n," 4.2 mm; *u* = male "u," 4.2 mm).

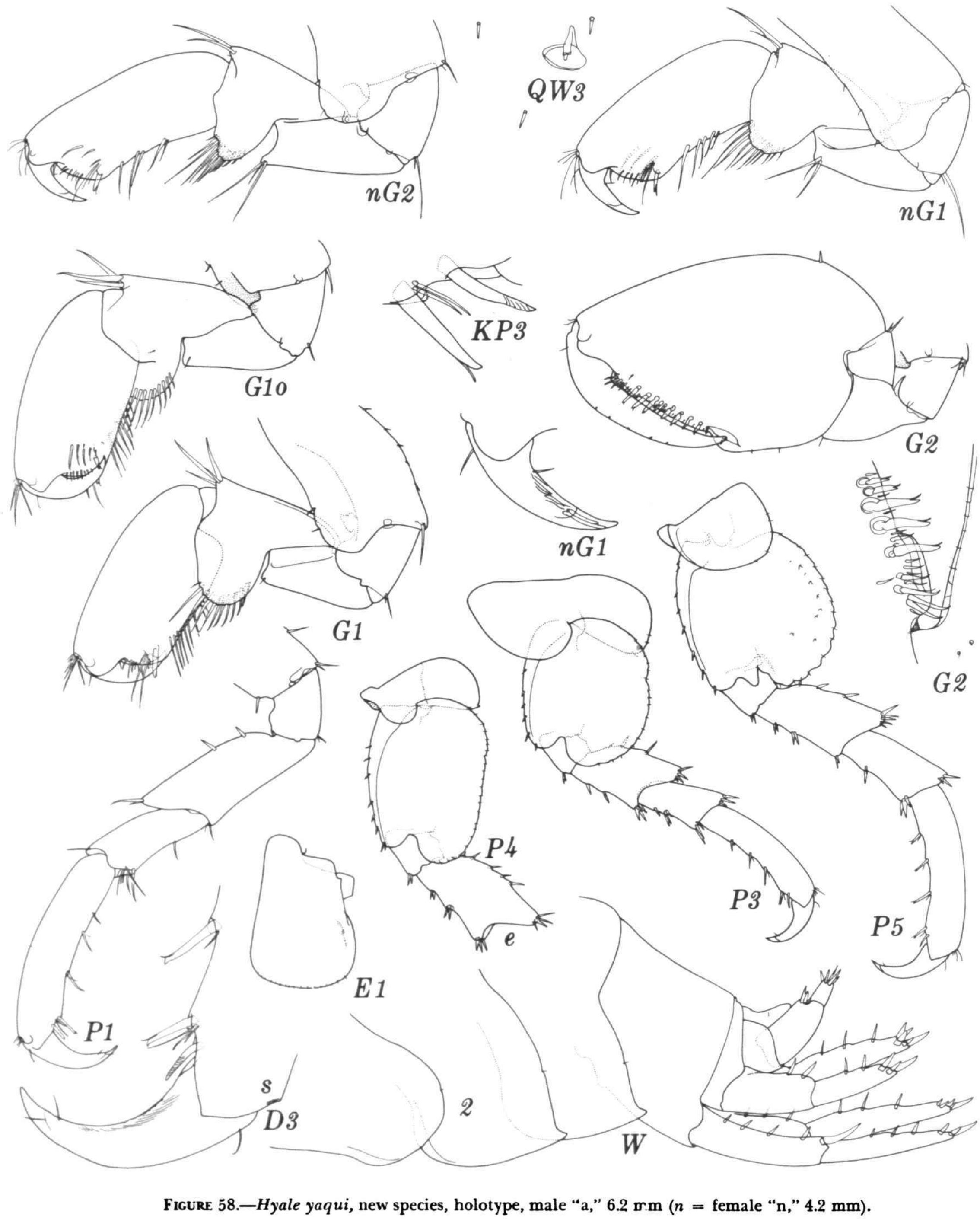

FIGURE 58.—*Hyale yaqui*, new species, holotype, male "a," 6.2 mm (*n* = female "n," 4.2 mm).

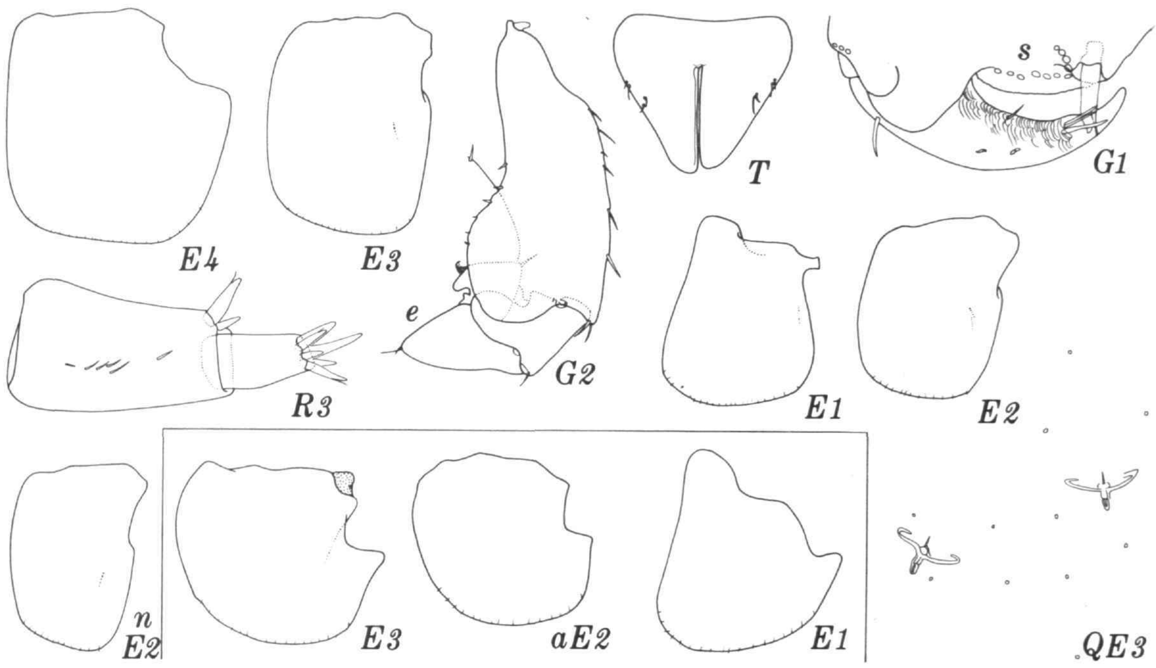

FIGURE 59.—*Hyale yaqui*, new species, holotype, male "a," 6.2 mm (*n* = female "n," 4.2 mm). Below: *Hyale zuaque*, new species, holotype, male "b," 5.3 mm (*a* = female "a," 4.46 mm).

margin with setae divided into 3 groups of 1–2 each, sleeve of article 5 poorly developed, article 4 with long setae on apical protrusion; gnathopod 2 like gnathopod 1 but slightly larger, posterior setae on article 6 (hand) more closely contiguous but groups discernible.

REMARKS.—Specimens from KNO 1, Bahía Kino, have the spines on the palm of male gnathopod 2 much longer than in the typical series and the locking spines on pereopods 1–2 have a stronger corkscrew pattern, but those on pereopods 3–5 are like the typical series.

HOLOTYPE.—USNM 149451, male "a," 6.2 mm (illus.).

TYPE-LOCALITY.—SCO 10, Gulf of California, Puerto Peñasco, 23 February 1971, intertidal, wash of *Sargassum* sp.

VOUCHER MATERIAL.—Type-locality, female "n," 4.2 mm (illus.); male "u," 4.2 mm (illus.).

RELATIONSHIP.—This species differs from its nearby allopatriot and probable sibling, *Hyale frequens* (Stout), in the wider setal distribution on the posterior margin of article 6 on gnathopod 1, on which *H. frequens* has several setae tightly compacted and occupying far less of the posterior margin; the division of these setae into groups on female gnathopod 1 is another distinction because males and females of *H. frequens* are alike in their compact setal bundle. The protrusion on the palm of male gnathopod 2, though weak, is better defined in *H. yaqui* than it is in *H. frequens*.

Hyale yaqui has article 5 of antenna 2 on the male relatively longer and article 4 relatively shorter than in *H. frequens*. Pereopodal spines are generally sharper in *H. yaqui*, the palmar protrusion on gnathopod 2 is weakly larger and female gnathopod 2 has 3 sets of posterior setae on article 6 in contrast to 2 sets in *H. frequens*.

Hyale nigra (Haswell) from Australia is another sibling of this species group and differs from *H. yaqui* in the simplicity and straightness of the distalmost locking spine on pereopods 1–5 and in the smaller tooth on epimeron 2.

MATERIAL.—SCO 1, 5, 7, 8, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 21, 22; KNO 1, 2; TOP 3; PAZ 2, 3, 10, 12, 13, 16, 17, 18, 20, 24; BRU 1, 2.

DISTRIBUTION.—Gulf of California: Puerto Peñasco, Bahía de Los Angeles, Bahía Kino, Bahía San Carlos, Guaymas, Topolobampo, Bahía Concepción, Bahía San Evaristo, Isla San Francisco, Isla Espiritu Santo, La Paz, and Cabo San Lucas, intertidal to 7 m; outer Baja California, Bahía de San Quintín, and Estero de Punta Banda, intertidal.

Hyale zuaque, new species

FIGURES 59 (part), 60, 61

DESCRIPTION OF MALE.—Anterior margin of lateral cephalic lobe vertical. Eyes of medium size, dark core surrounded by 1–2 layers of clear ommatidia (in alcohol). Antenna 2 about as long as head and half of pereon together, peduncle of medium stoutness, articles 4–5 with medioposterior setal brushes, flagellum about twice as long as peduncle, proximal articles with medial setal brushes; antenna 1 about two-thirds as long as antenna 2, aesthetascs about 2 per article on flagellum. Upper lip evenly rounded below, setules short. Mandibular incisors toothed, right lacinia mobilis evenly bifid and with blunt accessory tooth, spine row with 4–5 spines, molar moderately triturative, with long plumose seta (broken off on left illustration and usually broken on left side). Maxilla 1 as in Figure 60:*mX1*, outer plate with 9 spines, inner plate of maxilla 2 with 1 enlarged inner seta (like Figure 57:*X2* of *H. yaqui* but outer plate slightly narrower). Each terminal segment of maxilliped with 1 lateral spine, article 3 of palp simple, apical spine of article 4 articulate, short, with numerous inner marginal spine-setae, inner plate with only 1 medial seta and various setules. Posterior acclivities of coxae 1–3 strong, blunt, margin below posterior acclivity of coxa 4 sinuous, dorsoposterior excavation not bisinuate. Article 2 of gnathopod 1 with 2 posterior spines, of gnathopod 2 with 3 spines, article 2 of gnathopod 1 thick but not lobate distolaterally, article 4 with subsharp posterodistal protrusion, article 5 with 1 anterior spine on distal hump, posterior lobe ordinary, article 6 softly subrectangular, posterior margin with short row of setae occupying about 30 percent of marginal length, palm oblique, defined by 2 medium spines (lateral and medial), dactyl scarcely overlapping palm, with medium development of minute ridges; article 2 of gnathopod 2 grossly lobate and naked, article 3 with weakly nasiform lobe, article 4 protrusively rounded apically, article 5 with weak naked lateral lobe and subcryptic setose medial lobe, hand of ordinary hyalid proportions, anteriorly naked, palm oblique, much shorter than posterior margin of hand, latter almost naked, palm defined by weak hump, 2 spines and small pocket for apex of dactyl, palm lined with cycles of long and short spines, bearing extremely weak protrusion near dactylar hinge (visible only medially), dactyl fitting palm, not humped. Pereopods ordinary (Figure 61) bearing only one striate locking spine, this spine clavate and truncate on pereopods 1–2, sharp on pereopods 3–5, smaller than other spines on pereopods 3–5 but unknown on pereopods 1–2 as latter without inflexible spines on article 6, only flexible setae, dactyls minutely striate, with weak inner castellations, main inner seta long and of medium thickness. Uropod 1 with enlarged apicolateral spine, apicomedial spine not enlarged, outer rami of uropods 1–2 lacking dorsal spines; uropod 3 ordinary, peduncle with 3 apicodorsal spines, apex of ramus with about 6 spines, none disjunct from others. Telson split fully to base, lobes triangular, lateral margins weakly concave, apices thus subsharply extended. Epimeron 1 ordinary, epimeron 2 with subvertical anterofacial ridge, broad and blunt posteroventral protrusion and broad strongly extended anteroventral lobe, epimeron 3 with weakly convex posterior margin, medium and blunt posteroventral tooth. Urosome exceptionally tall and short relative to ordinary species of *Hyale*. Cuticle with ordinary bulbar setules and occasional minute punctation.

FEMALE.—Antenna 2 shorter and much thinner than in male; setal brushes weaker; coxa 2 relatively narrower than coxa 2 of male; gnathopod 1 like that of male, dactylar ridges weak, gnathopod 2 similar to gnathopod 1 but article 2 with gross distolateral lobe, article 5 with posterior lobe narrower than on gnathopod 1.

ILLUSTRATIONS.—Female antenna 2 (Figure 60: *hA2*) drawn in same proportions as view of male antenna 2 (Figure 60:*C*) attached to head; telson of specimen "r" flattened, of holotype male unflattened.

HOLOTYPE.—USNM 142511, male "b," 5.3 mm (illus.).

TYPE-LOCALITY.—PAZ-22, Baja California, 11 km E of Cabo San Lucas, 4 December 1971, intertidal, algal wash.

VOUCHER MATERIAL.—Type-locality, female "h," 4.45 mm (illus.); male "m," 5.26 mm (illus.).

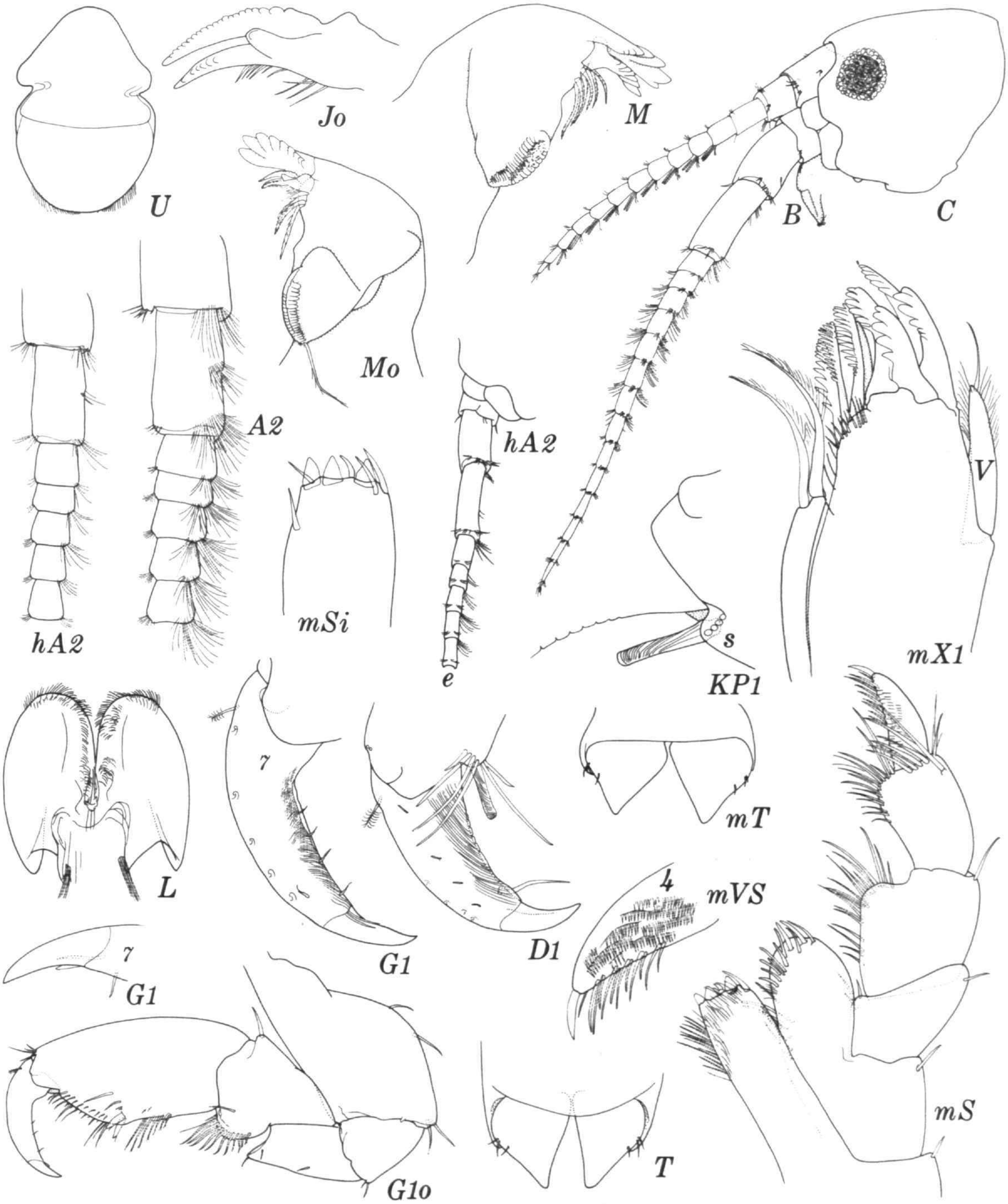

FIGURE 60.—*Hyale zuaque*, new species, holotype, male "b," 5.3 mm (*h* = female "h," 4.46 mm; *m* = male "m," 5.26 mm).

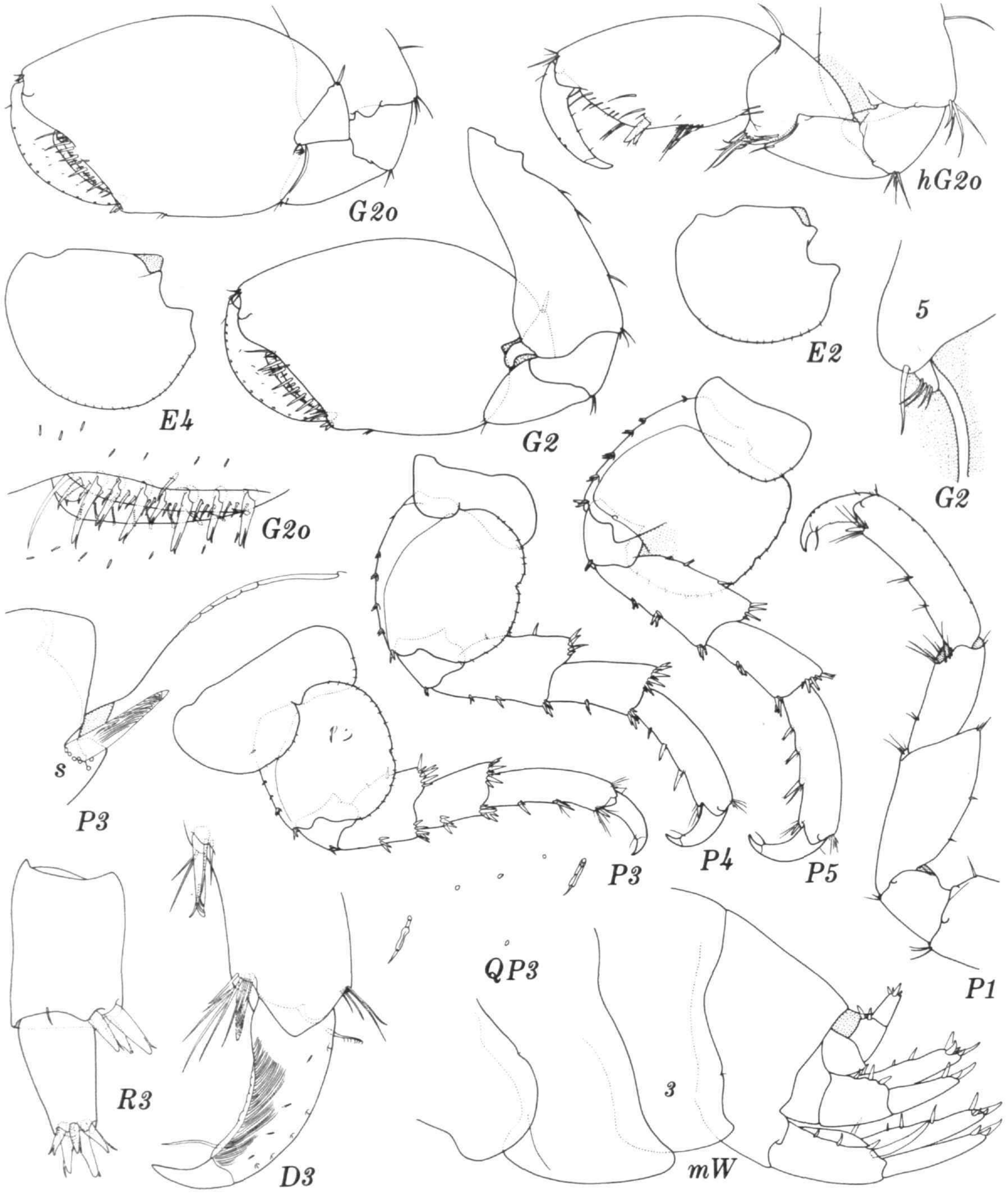

Figure 61.—*Hyale zuaque,* new species, holotype, male "b," 5.3 mm (*h* = female "h," 4.46 mm; *m* = male "m," 5.26 mm).

RELATIONSHIP.—This species differs from *Hyale plumulosa* Stimpson in the lateral position of the enlarged spine on the peduncle of uropod 1 and the absence of dense setular fringe in the male on article 5 of the peduncle of antenna 2.

Hyale iole J. L. Barnard (1970:260) from the Hawaiian Islands bears superficial resemblance to *H. zuaque* because of setose antenna 2 and presence of only 1 locking spine on the pereopods. *Hyale iole* has the main enlarged spine of uropod 1 on the mediodistal side, the main dactylar seta of the pereopods is thick, and the lobes of the telson are subquadrate.

Hyale ayeli J. L. Barnard (1970:254) is also in this species complex but the locking spine of pereopods 1–2 is not apically truncate and the palm of male gnathopod 2 has a conspicuous hump; the absence of spines on the outer rami of uropods 1–2 and the enlargement of the distolateral spine on the peduncle of uropod 1 suggest that *H. ayeli* and *H. zuaque* are a sibling pair of species.

A few terminal males from the Galapagos have the setae on the posterior margin of article 6 on gnathopod 1 as widely spread as in *H. yaqui,* but medium-sized males have the normal spread of setae seen in Mexican specimens.

MATERIAL.—PAZ 14, 15, 21, 22; DAW 2, 10; ECU 3; BRU 2.

DISTRIBUTION.—Gulf of California: Guaymas; Cabo San Lucas; Galapagos Islands; Ecuador; intertidal.

Hyale guasave, new species

FIGURES 62, 63

DESCRIPTON OF MALE.—Anterior margin of lateral cephalic lobe truncate, vertical. Eyes of medium to large size, formed of dark core surrounded by 2 layers of clear ommatidia (in alcohol). Antenna 2 scarcely as long as pereon alone, peduncle slender, almost fully naked, flagellum less than 3 times as long as peduncle, with tufts of very short setae on each article; antenna 1 about two-thirds as long as antenna 2, reaching halfway along flagellum of antenna 2, aesthetascs 1–2 per article on flagellum. Upper lip evenly rounded below but unusually narrow for genus, setules long. Mandibular incisors toothed, right lacinia mobilis evenly bifid and with accessory side tooth, spine row with 1 large, 1 small spine, molar triturative, with long plumose seta; left mandible with 3 spines in spine row, no molarial seta (unless rudimentary) (mandibles like those of *H. yaqui* as in Figure 57 with exceptions noted). Following parts like Figures 57–59 for *H. yaqui:* lower lip, maxilla 2; maxilla 1 like *H. yaqui* but spines of outer plate more densely toothed (Figure 62:*X1*) and palp with 2–5 small tubular truncate setules (?spouts) proximal to main terminal spine. Maxilliped like *H. yaqui* but article 3 of palp broader (Figure 62:VS), and main spines on inner plate pointed (Figure 62:*Si*). Posterior acclivities of coxae 1–3 strongly quadrate, only coxa 1 with 2 spines on inner face, dorsoposterior excavation of coxa 4 strongly bisinuate. Article 2 of gnathopod 1 with 3 midposterior spines (2 sets), of gnathopod 2 with 3 spines in 2 sets and 1 seta, article 2 of gnathopol 1 broadly lobate distolaterally, article 4 with sharp posterodistal protrusion, article 5 ordinary, article 6 enlarged, broadened, with hump defining expanded palm, hump bearing stridulation ridges, posterior margin of article 6 with 2 weakly separated groups of several setae occupying about 25 percent of margin length, dactyl failing to fit palm, middle of palm with 1 enlarged submarginal spine, defining hump with second enlarged spine, dactyl with weakly defined inner ridges; article 2 of gnathopod 2 broadly lobate and bearing marginal spinules, article 3 with nasiform lobe, article 4 protrusively rounded apically, article 5 cryptic, hand elongate, palm and posterior margin of hand confluent and setose throughout, medial margin with several rows of shorter setae, no spines or spinules, dactyl nearly as long as palm and fitting into pocket of hand near proximal end of palm, latter weakly undulating but lacking defined protrusions. Pereopods ordinary (Figure 62), distalmost locking spine small, next proximal spine large and of size similar to other marginal spines of article 6, spines all deeply striate in corkscrew fashion, numerous setae between locking spines but setae otherwise absent on article 6, dactyl minutely striate, inner margins smooth, main inner seta very small, thin. Uropod 1 with enlarged apicolateral spine, apicomedial spine not enlarged, peduncles and rami of uropods 1–2 ordinarily spinose; uropod 3 ordinary but ramus elongate, about three-fourths as long as peduncle, bearing about 6 apical spines, none disjunct from others. Telson split nearly to base. Epimeron 1 ordinary, epimeron 2 with antero-

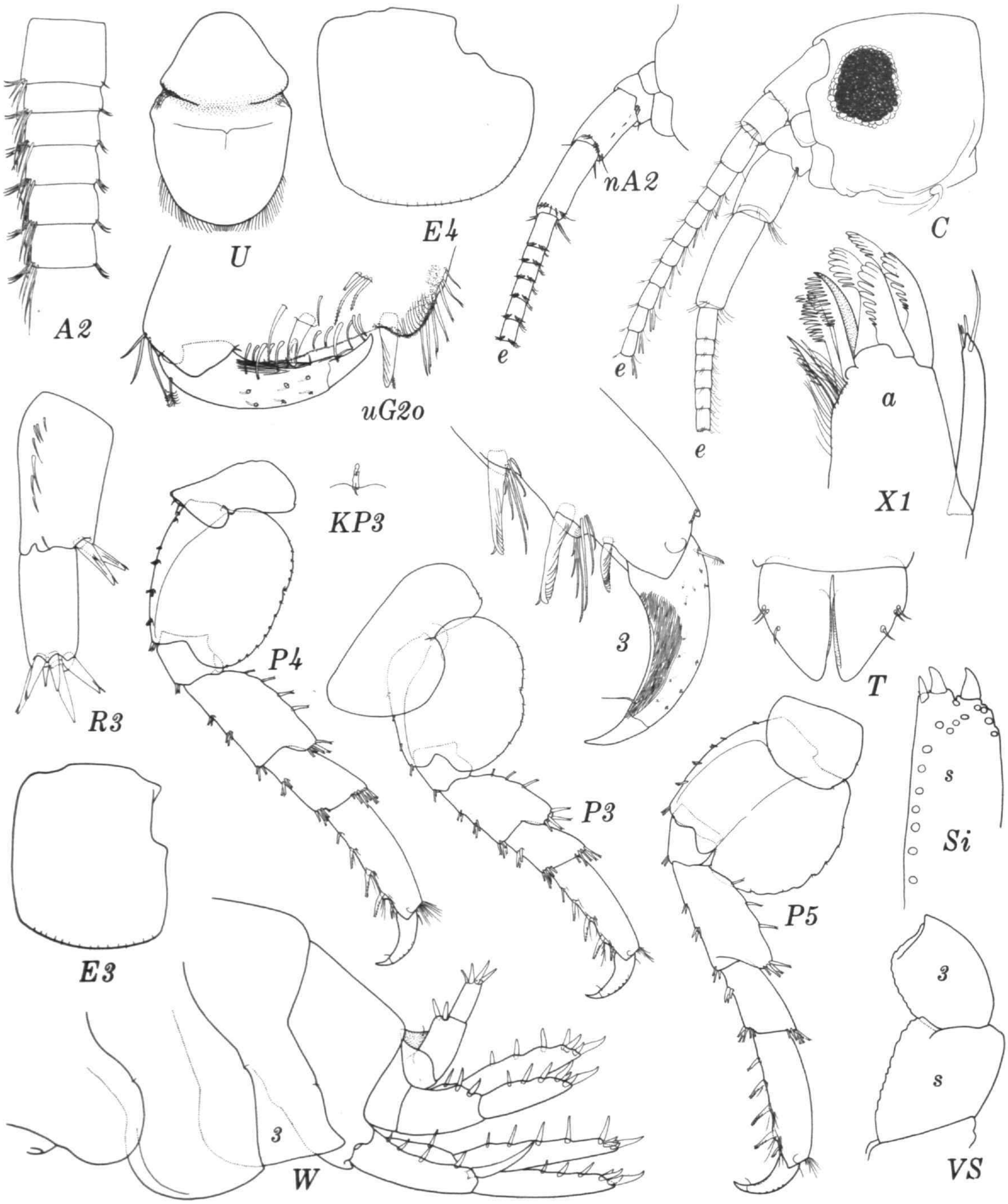

FIGURE 62.—*Hyale guasave*, new species, holotype, male "a," 4.8 mm (*n* = female "n," 4.0 mm; *u* = male "u," 4.7 mm).

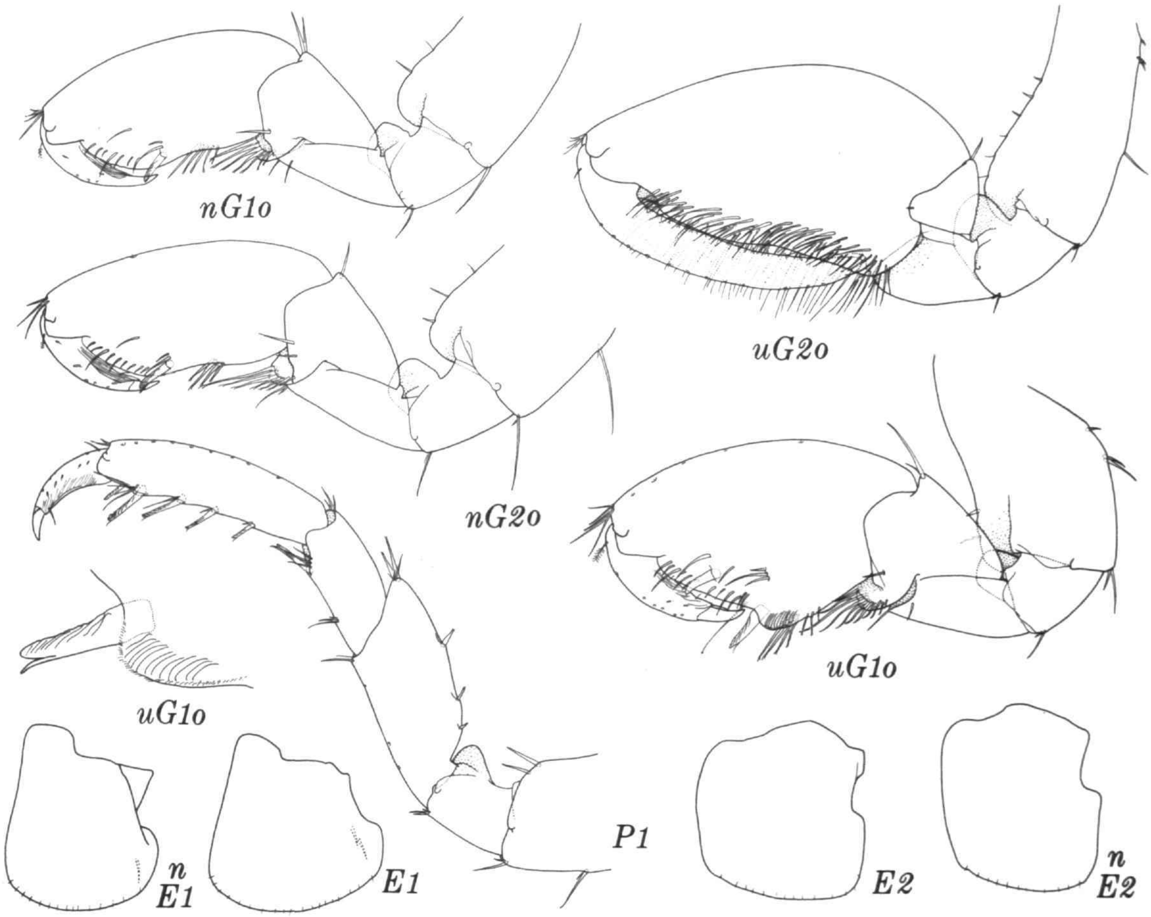

FIGURE 63.—*Hyale guasave*, new species, holotype, male "a," 4.8 mm (*n* = female "n," 4.0 mm; *u* = male "u," 4.7 mm).

facial ridge tightly submarginal towards anterior edge, posteroventral tooth obsolescent, epimeron 3 with medium sized posteroventral tooth. Cuticle with very weak slit-pits, each bearing setule.

FEMALE.—Body about four-fifths as long as male, antenna 2 scarcely shorter than in male, peduncle thinner than in male; coxae 1–2 narrower relative to coxae 4 than in male; article 2 of gnathopods 1–2 lacking posterior spines of male, gnathopods of ordinary female dimensions, posterior margins of hands on gnathopods with group of 4 or 5 setae, no enlarged midpalmar spine, palm defined by large spine, no hump, dactyl fitting palm, weakly striate.

ILLUSTRATION.—Female antenna 2 magnified to similar dimension as antenna 2 of male shown on head (Figure 62).

HOLOTYPE.—USNM 142502, male "a," 4.8 mm (illus.).

TYPE-LOCALITY.—PAZ 22, Baja California, 11 km E of Cabo San Lucas, 4 December 1971, intertidal, algal wash.

VOUCHER MATERIAL.—Type-locality, female "n," 4.0 mm (illus.); male "u," 4.7 mm (illus.).

RELATIONSHIP.—This species belongs with a group formed of *H. macrodactyla* Stebbing, *H. chevreuxi* K. H. Barnard, and *H. honoluluensis* Schellenberg; these species are distributed in the tropical Indo-Pacific region. *Hyale guasave* appears to be closest to *H. chevreuxi* because of the distinct hump defining the palm of male gnathopod 1, a characteristic poorly developed on the other 2 species. *Hyale guasave* apparently differs from all other species in the group in the presence of an enlarged midpalmar spine on male gnathopod 1, similar to that seen in species of *Allorchestes* and *Parhyale*. This eastern Pacific species is, therefore, more distinctive than are *H. chevreuxi* and *H. honoluluensis* between themselves, and indeed those may be synonymous and actually be based on clines within characters. *Hyale chevreuxi*, type area in the Seychelles, has a strong hump defining the palm of gnathopod 1, whereas *H. honoluluensis*, type area in Hawaii, has that hump reduced in prominence; the two species are found sympatrically in Micronesia. *Hyale macrodactyla* is found in the Caribbean Sea but appears less similar to nearby *H. guasave* than does *H. chevreuxi*, and *H. macrodactyla* lacks the palmar hump of male gnathopod 1 and has a midhump on the palm of male gnathopod 2 and apparently has but a single row of setae on the palm of male gnathopod 2.

MATERIAL.—PAZ 22; DAW ?10, ?17, 31.

DISTRIBUTION.—Baja California: Cabo San Lucas intertidal; Galapagos Islands, 0–6 m.

Hyale frequens (Stout)

Allorchestes frequens Stout, 1913:650–651.
Hyale frequens.—Shoemaker, 1941b:187; 1942:17.—Hewatt, 1946:199.—J. L. Barnard, 1952a:23; 1954a:23.
Hyale nigra.—J. L. Barnard, 1962c:153–156, figs. 19, 20 [not Haswell].
Hyale rubra frequens.—J. L. Barnard, 1969b:139–141 [not Thomson].
Not *Hyale nigra*, bay form.—J. L. Barnard, 1964a:109, fig. 21A [not Haswell].
Not *Hyale rubra frequens*.—J. L. Barnard, 1969a:212 [not Stout].

RELATIONSHIP.—This species is neither identical with, nor a subspecies of *Hyale rubra* (Thomson) and *H. nigra* (Haswell). J. L. Barnard (1974:67) has reexamined those species from Australia and found them to be distinct from each other.

DISTRIBUTION.—*Hyale frequens* has not been found in the collections of the present study and may have its southern limit somewhere on the outer coast of Baja California.

The rejected references in the synonymy are referred to *Hyale yaqui*, new species.

Hyale anceps (J. L. Barnard)

Allorchestes anceps J. L. Barnard, 1969b:130–133, figs. 25, 26.
Hyale anceps.—J. L. Barnard, 1974:42.

DISTRIBUTION.—California: Carmel to Cayucos, intertidal.

Hyale plumulosa (Stimpson)

Allorchestes plumulosus Stimpson, 1857:79.
Hyale plumulosus.—Thorsteinson, 1941:55–56, pl. 1: figs. 10–15.
Hyale plumulosa.—J. L. Barnard, 1969b:138.—Bousfield, 1973: 155–156, pl. 44.2.

DISTRIBUTION.—Western Atlantic, Maine to North Carolina; Eastern Pacific, southern Alaska to southern California.

The *Hyale grandicornis* Complex

The *grandicornis* group of *Hyale* comprises species with an immense inner setule or seta on the dactyl of pereopods 1–5 close to the middle of the margin. The eyes are very large, dark, and oblatovate. Uropod 1 has the apicolateral spine on the peduncle either small or medium sized and the apicomedial spine also middle sized, in neither case is the spine enlarged. This eliminates *H. longicornis* (Haswell) from the discussion.

This discussion concerns only those species of the group in the Pacific Ocean, those having been described from Chile, New Zealand (2 species), Japan, Hawaii, California, and, now, the Galapagos Islands. The taxa are to be rectified herein nomenclaturally so that each is established at full specific level. This would appear to be the best way to treat these taxa until much more extensive exploration and study of morphs can be undertaken to determine whether certain clusters are better reduced to a subspecific level.

The first species described, *Hyale grandicornis* (Krøyer, 1845) from Chile, was redescribed by Stephensen (1949:33). It and *Hyale thomsoni* Hurley (formerly known as *Hyale grandicornis* forma *thomsoni* Hurley, 1957, here elevated to specific level) from New Zealand differ from other Pacific species in the presence of "fur" on pereopod 4, in the absence of a disjunct subapical spine on the ramus of uropod 3, and in the reduction or absence of the dorsal spination on the outer rami of uropods 1–2. *Hyale grandicornis* also has a sharply posteroventral lobe on pereopod 5 but this is unknown in *H. thomsoni*.

All other Pacific species lack "fur" on pereopod 4, have a rounded lobe on article 2 of pereopod 5, bear 2 or more dorsal spines on the outer rami of uropods 1–2 and have at least 1 disjunct proximal spine on the ramus of uropod 3.

The following species appear to form a group characterized by normal spacing of dorsolateral spines on the peduncle of uropod 1: *Hyale novaezealandiae* (Thomson, 1879, redescribed by Hurley, 1957, but formerly known as *Hyale grandicornis* forma *novaezealandiae*) from New Zealand, and *Hyale bishopae* J. L. Barnard, 1955a (formerly known as *H. grandicornis bishopae* in J. L. Barnard, 1970) from Hawaii. These two species are very difficult to separate but apparently differ in the castellations on the pereopodal dactyls and the presence of a supernumerary facial spine on the ramus of uropod 3 in *H. novaezealandiae*. *Hyale rupicola* (Haswell) (J. L. Barnard, 1974:54) is also indistinguishable from *H. novaezealandiae* as reflected in the following key.

The final group is characterized by the extreme discontiguity of dorsolateral spine 2 from spine 1 (apicalmost) on the peduncle of uropod 1: *Hyale californica* J. L. Barnard, 1969b (formerly known as *H. grandicornis californica*) from California, *Hyale* species (formerly identified as *H. novaezealandiae* by Iwasa, 1939) from Japan, and *Hyale humboldti*, new species, from the Galapagos Islands. These species differ among themselves in castellations on dactyls of pereopods and a supernumerary facial spine on the ramus of uropod 3 as shown in the key to follow.

The 7 species form a Rassenkreis divisible into 3 parts, between Chile and New Zealand, between New Zealand and Hawaii, and among Japan, California, and the Galapagos Islands. Study of collections from intermediate localities is now required to demonstrate the validity of these species.

Key to the Males of the Species in the *Hyale grandicornis* Complex from the Pacific Ocean

1. All spines on ramus of uropod 3 terminal 2
   At least 1 spine on ramus of uropod 3 set subterminally and disjunctly from other spines 4
2. Outer rami of uropods 1–2 with 0 or 1 spine, articles 2 and 4 of pereopod 4 with posterior "fur" 3
   Outer rami of uropods 1–2 with 2+ spines, pereopod 4 lacking "fur" ....***H. crassicornis***
3. Uropods 1–2 lacking dorsal spines on outer rami ....***H. grandicornis***
   Uropods 1–2 bearing dorsal spine on outer rami ....***H. thomsoni***
4. Gap between distalmost lateral spine on peduncle of uropod 1 and next proximal spine about 1.6 times distance between spines 2 and 3 5
   Gap between distalmost lateral spine on peduncle of uropod 1 and next proximal spine about 2.3 times or greater distance between spines 2 and 3 6
5. Dactyls of pereopods 1–5 with minute castellations or pectinations ....***H. rupicola*** and ***H. novaezealandiae***
   Dactyls of pereopods 1–5 lacking pectinations ....***H. bishopae***
6. Dactyls of pereopods 1–5 castellate, hand of male gnathopod 2 strongly tapering distally 7
   Dactyls of pereopods 1–5 not castellate, hand of male gnathopod 2 not tapering distally ....***H. californica***, new status
7. Uropod 3 with supernumerary inner, midlevel facial spine on ramus ....***H. humboldti***, new species
   Uropod 3 lacking supernumerary inner facial spine besides ordinary subdistal spine ....***H. species***

Hyale species

Hyale novaezealandiae.—Iwasa, 1939:276–278, fig. 16, pl. 16 [not Thomson].

This speciman is not *H. novaezealandiae* and according to notes of the late C. R. Shoemaker (USNM files) is probably *Hyale pugettensis* (Dana), which is probably synonymous with *Allorchestes japonica* Stimpson. This taxon is included in the key to the species of the *Hyale grandicornis* complex as *Hyale* species.

Hyale californica J. L. Barnard, new status

Hyale grandicornis californica J. L. Barnard, 1969b:133–138, figs. 27, 28.

DESCRIPTION OF MALE.—Anterior margin of lateral cephalic lobe truncate vertically. Eyes very large, ommatidia all darkly pigmented. Antenna 2 only as long as first 4 pereonites together, peduncle of medium stoutness, minimally setose, flagellum about 1.35 times as long as peduncle, with tufts of very short setae on each article; antenna 1 about 0.83 times as long as antenna 2, reaching about one-fourth along flagellum of antenna 2, aesthetascs about 2 per article on flagellum. Upper lip evenly rounded below, broad, setules long. Mandibular incisors toothed, right lacinia mobilis evenly bifid and with accessory side tooth, spine row with 2 spines and 1 setal plume, these plumes filamentous, molar triturative, with long plumose seta, left mandible with 4 raker spines and plume, seta on molar present. Lower lip and maxilla 1 like *H. yaqui* but mandibular lobes of lower lip broader, shape of maxilla 2 as in *H. humboldti,* spines on outer plate of maxilla 1 more densely toothed as in *H. guasave,* palp apparently with 1 vestigial spout. Maxilliped as in *H. humboldti,* palp especially stout. Posterior acclivities of coxae 1–4 strongly extended and pointed, no coxa with mediofacial spines. Article 2 of gnathopod 1 with 1 midposterior spine, of gnathopod 2 with 2 spines, article 2 of gnathopod 1 trapezoidal, not apically lobate, article 4 with protrusion, article 5 ordinary, article 6 scarcely broadened, palm defined only by pair of spines, no hump, posterior margin of article 6 with 1 group of setae occupying only 20 percent of marginal length, dactyl fitting palm, palm ordinarily setose, dactyl with small erect inner setules; article 2 of gnathopod 2 scarcely lobate, article 3 with medium anterior lobe, article 4 pointed apically, article 5 cryptic, hand stout, not tapering apically (in comparison to *H. humboldti*), palm elongate, defined by 2 spines, armed with rows of short spines and setae, convex posterior margin of article 6 with bundle of setules, dactyl fitting palm, apex inserting into pocket near defining spines, inner margin of dactyl with erect setules. Pereopods 1–2 illustrated in J. L. Barnard (1969b, fig. 27), distalmost locking spine small, unridged, straight, next proximal spine short and immersed by setae, dactyl curved, with giant inner setule, margin proximal to setule castellate, face striate distally; pereopods 3–5 with distal locking spine larger than on pereopods 1–2, larger than next proximal spine, itself weakly enlarged, proportions figured in J. L. Barnard (1969b, fig. 27), article 6 naked posteriorly. Uropod 1 with small apicolateral spine on peduncle, next proximal spine separated by especially long gap from apicalmost, apicomedial spine of medium size, peduncles and rami of uropods 1–2 otherwise normally but sparsely spinose; ramus of uropod 3 slightly shorter than peduncle, bearing 3 apical spines and spinules, 1 subapical spine. Telson almost split to base, apices rounded. Epimeron 1 ordinary, epimeron 2 lacking facial ridge, with medium posteroventral tooth, epimeron 3 with small to medium sized tooth. Cuticle with short bulbar setules, no polygons (in contrast to *H. humboldti*).

HOLOTYPE AND TYPE-LOCALITY.—See Barnard, 1969b:136.

REMARKS.—This subspecies is elevated to full specific status owing to the reevaluation of the *H. grandicornis* complex as discussed above. The description is based on reobservation of characters from original materials of this species deposited in the Smithsonian Institution.

The presence of this species in a sample from Bahía Kino is exceptional. Barnard (1969b:138) believed the species to be of cold-water provenance and to be declining in density with southward progression through California.

MATERIAL.—KNO 3.

DISTRIBUTION.—California: Carmel to La Jolla, intertidal; Gulf of California, Bahía Kino, intertidal.

Hyale humboldti, new species

FIGURE 64

ETYMOLOGY.—Named for Alexander von Humboldt.

DESCRIPTION OF MALE.—Anterior margin of lateral cephalic lobe truncate vertically. Eyes very large, ommatidia all darkly pigmented. Antenna 2 only as long as first 4 pereonites together, peduncle of medium stoutness, minimally setose, flagellum about 1.5 times as long as peduncle, with tufts of very short setae on each article; antenna 1 about three-fourths as long as antenna 2, reaching about one-third along flagellum of antenna 2, aesthetascs

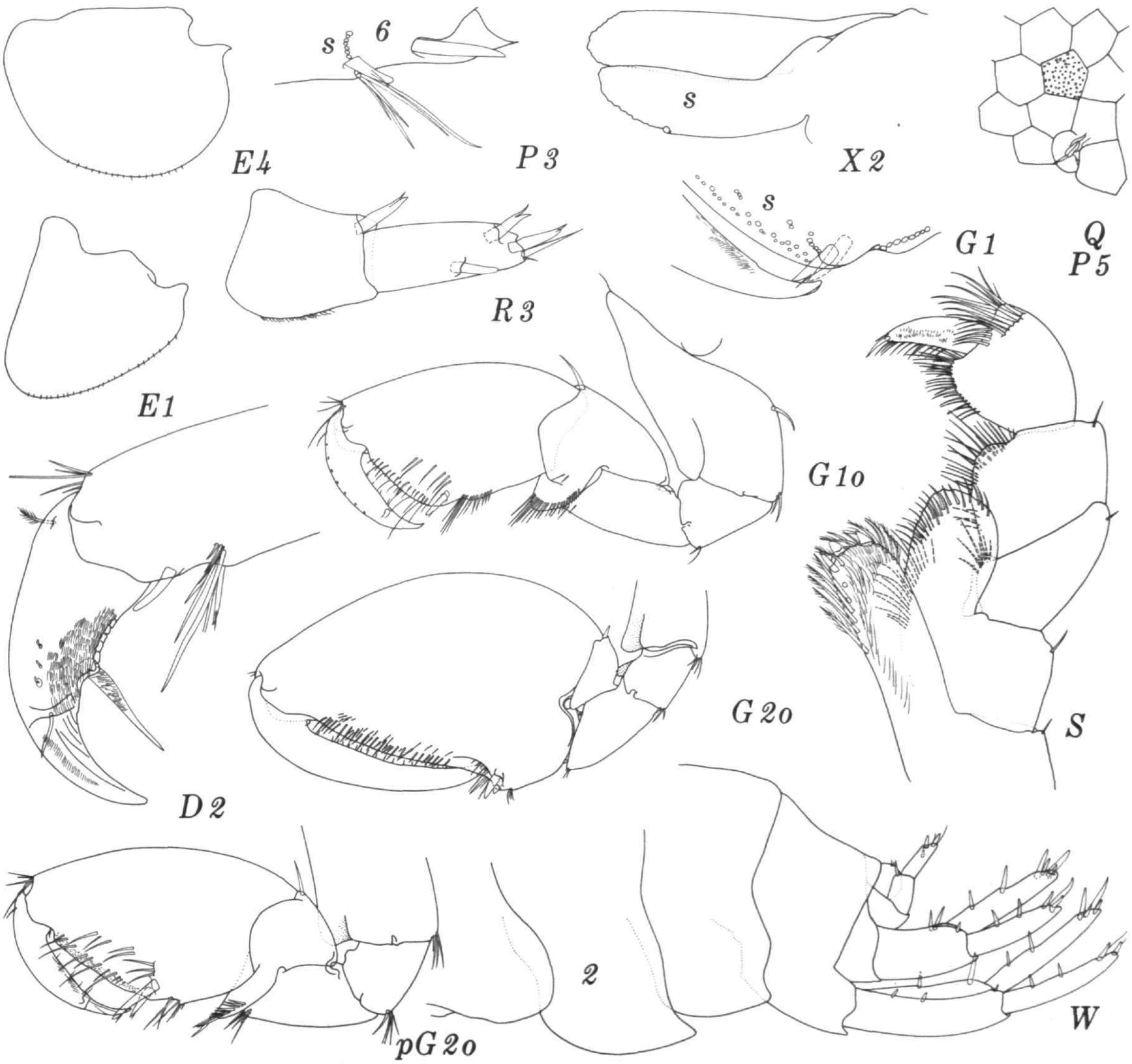

FIGURE 64.—*Hyale humboldti*, new species, holotype, male "a," 9.75 mm (*p* = female "p," 7.61 mm).

about 2 per article on flagellum. Upper lip evenly rounded below, broad, setules long. Mandibular incisors toothed, right lacinia mobilis evenly bifid and with accessory side tooth, spine row with 3 spines and 1 setal plume, these plumes thick and leaf-like, molar triturative, with long plumose seta, left mandible with 4 raker spines and leaf-plume, seta on molar absent. Lower lip, maxilla 1, and maxilla 2 like *H. yaqui* (Figure 57) but shape of maxilla 2 as in Figure 64:*X2*, spines on outer plate of maxilla 1 more densely toothed as in *H. guasave* (Figure 62:*X1*), palp apparently with 1 vestigial spout. Maxilliped illustrated, palp especially stout. Posterior acclivities of coxae 1–4 strongly extended and pointed, no coxa with mediofacial spines. Article 2 of gnathopod 1 with 1 midposterior spine, of gnathopod 2 with 3 spines, article 2 of gnathopod 1 trapezoidal, not apically lobate, article 4 with protrusion, article 5 ordinary, article 6 slightly broadened, palm defined only by pair of spines, no hump, posterior margin of article 6 with 1 group of setae occupying almost 30 percent of marginal length, dactyl fitting palm, palm ordinarily setose, dactyl with small erect inner setules; article 2 of gnathopod 2 with small anterodistal mammilliform lobe, article 3 with nasiform lobe laterally, article 4 pointed apically, article 5 cryptic, hand elongate, pyriform, sharply tapering, palm elongate, defined by 2 spines, armed with rows of short setae, weakly sinuous posterior margin of article 6 with bundle of setules, dactyl fitting palm, apex inserting into pocket near defining spines, inner margin of dactyl with erect setules. Pereopods 1–2 similar in proportions to those of *H. zuaque*, distalmost locking spine small, scarcely ridged longitudinally, weakly curved, next proximal spine thin and immersed by setae, dactyl strongly curved, with giant inner setule, margin proximal to setule castellate, face striate; pereopods 3–5 with first spine proximal to locking spine slightly larger than on pereopods 1–2, stouter, proportions of articles on pereopods 3–5 generally as in *H. zuaque* but articles 4–6 thinner, article 6 naked posteriorly (opposite to point of dactyl). Uropod 1 with very small apicolateral spine on peduncle, next proximal spine separated by especially long gap from apicalmost, apicomedial spine of medium size, peduncles and rami of uropods 1–2 otherwise normally but sparsely spinose; ramus of uropod 3 longer than peduncle, bearing 2 apical spines, 1 subapical spine and 1 subfacial spine near middle of ramus. Telson split to base, apices rounded; epimeron 1 ordinary, epimeron 2 lacking facial ridge, with strong posteroventral tooth, epimeron 3 with medium sized tooth. Cuticle with weak polygons filled with tiny villi, occasional polygon with disrupted margins, surface naked, bearing short bulbar setule.

FEMALE.—Slightly smaller than male, antennae slightly shorter, eyes fully enlarged, article 2 of gnathopods 1–2 with posterior spines; gnathopod 1 overall like that of male but slightly smaller relative to anterior coxae, palmar defining spines larger than in male; gnathopod 2 forming enlarged version of gnathopod 1, stouter, posterior setae on article 6 narrowly confined.

ILLUSTRATION.—Cuticle of Figure 64: *QP5* with small villi shown only in 1 polygon.

HOLOTYPE.—USNM 169026, male "a," 9.75 mm (illus.).

TYPE-LOCALITY.—DAW 10, Galapagos Islands, Hood Island, 3 February 1962, intertidal, wash of algal turf.

VOUCHER MATERIAL.—Type-locality, male "b," 7.68 mm; female "p," 7.61 mm (illus.).

RELATIONSHIP.—This species and the specimens from Japan identified as *H. novaezealandiae* (Thomson) by Iwasa (1939:276), now named *Hyale* species, are extremely similar but the Japanese species has more apical spinules on uropod 3, the medial spine is more disjunct from the apical spines and the subfacial spine appears to be absent. Otherwise the 2 species share the unusual gap between the lateral spines on the peduncle of uropod 1 and the castellate dactyls of the pereopods not reported in combination for any other species of the *Hyale grandicornis* group except *H. humboldti*. Article 4 of pereopods 3–5 is stouter in the Japanese species than in the Galapagan.

Hyale humboldti differs from *H. californica* J. L. Barnard, 1969b (as *H. grandicornis californica*) in the tapering hand on male gnathopod 2.

This species appears to have little affinity with *H. grandicornis*, the basic species of the group from Chile, in that uropod 3 bears not only the subdistal spine on the ramus but an additional facial spine, and in the spinal disjunction of uropod 1, the absence of "fur" on pereopod 4 and the well spinose outer rami of uropods 1–2. The closeness of relationship is to the Japanese species followed by the Californian species.

MATERIAL.—GAL 113, 120; DAW 2, 5, 10.

DISTRIBUTION.—Galapagos Islands, Tower Island, Isla Santa Cruz, Hood Island, intertidal.

Najna Derzhavin

Najna kitamati, new species

Najna ?consiliorum.—J. L. Barnard, 1962c:157–160, figs. 21, 22 [not Derzhavin].

DIAGNOSIS.—*Najna* with molar composed of 1 or 2 long, wire-like spines. Dactyl of palp on maxilliped only 0.12 times as long as article 3. Article 4 of pereopods 1–5 about half as long as wide. Posteroventral corner of epimeron 3 rounded. Ramus of uropod 3 less than 0.15 as long as peduncle.

HOLOTYPE.—AHF 5745, male, 8.0 mm.

TYPE-LOCALITY.—AHF *Velero IV* station 4822, southern California, 34°21′15″ N, 120°14′45″ W, 17 January 1957, 16.5 m bottom depth.

REMARKS.—This species is now seen to be clearly distinct from *Najna consiliorum* Derzhavin on the points in the diagnosis.

DISTRIBUTION.—California, 1–17 m.

Parallorchestes Shoemaker and *Parhyale* Stebbing

Parhyale Stebbing, 1897:27.
Parallorchestes Shoemaker, 1941a:183.

REMARKS.—I do not intend to synonymize *Parallorchestes* with *Parhyale* but to discuss them together. Gurjanova (1951:813) and Bulycheva (1957:78) believed that *Parallorchestes* is a synonym of *Parhyale*. *Parallorchestes* formerly contained 2 species, the type-species, *P. ochotensis* (Brandt), and *P. zibellina* (Derzhavin), the latter having been originally described in *Parhyale*. Because the palp of maxilla 1 is unknown, *P. zibellina* cannot be confirmed as a member of *Parallorchestes* and in some of its appearance better fits *Parhyale*.

The type-species of *Parallorchestes, P. ochotensis,* differs from *Parhyale* only in the biarticulation of the palp on maxilla 1 and in the unprotruding posterior acclivities on coxae 1–3, the comparison to be made especially on coxa 3 because coxae 1–2 are variable in *Parhyale*. Formerly, the 2 genera also differed in the presence (*Parallorchestes*) or absence of a posterior lobe on article 5 of male gnathopod 2 fully separating articles 4 and 6; however, Krapp-Schickel (1974:326) has placed *Hyale plumicornis* (Heller) in *Parhyale* and that species also bears the parallorchestian lobe. J. L. Barnard (1974:42) has dismissed that kind of character differentiation as having no generic value in two allied genera, *Hyale* and *Allorchestes*.

Parallorchestes should be maintained as long as possible to distinguish the primitive mark of a 2-articulate palp on maxilla 1. Because of the extreme basal position of the articulation one might suspect it to be a secondary development from a uniarticulate condition but until that avenue can be explored the retention of *Parallorchestes* is desirable. Both *Parhyale* and *Parallorchestes* retain an inner ramus on uropod 3, another mark of primitiveness in the Hyalidae. One might therefore suggest a scheme of evolutionary flow in this family from *Parallorchestes* to *Parhyale,* then to *Hyale,* and later to *Allorchestes. Hyale* and *Allorchestes* lack the inner ramus of uropod 3 and *Allorchestes* has a vestigial palp on maxilla 1 and what appears to be a secondarily developed telson with mostly amalgamated lobes. The geographic sequence would proceed from cold temperate of North Pacific (*Parallorchestes*) to tropical and Mediterranean (*Parhyale*) to tropical and warm-temperate *Hyale* and back to biboreal (*Allorchestes*), suggesting a more logical sequence than if *Allorchestes* proceeded outward from *Parallorchestes* in a line of development separate from *Parhyale* and *Hyale*. If the biarticulate maxillary palp of *Parallorchestes* is found to be a secondary development, then a more logical geographic procession from *Parhyale* to *Hyale, Parhyale* to *Parallorchestes,* and *Hyale* to *Allorchestes* would ensue.

Apparently several of the species in *Parhyale* in the warm-temperate fringe of the tropics show the progressive loss of the inner ramus of uropod 3. This is especially well seen in the 3 species Krapp-Schickel (1974:326–327) has discovered recently in the Mediterranean Sea. This condition would appear to occur also in 1 or more species from southern Japan.

There remain some considerable problems regarding speciation to be studied in both *Parhyale* and *Parallorchestes*. Herein, *Parhyale fascigera penicillata* is raised to full specific status, because its distribution is intercalated within or closely adjacent to the distributions of *P. fascigera* and *P. hawaiensis* and it probably, therefore, does not exist as an allopatric subspecies.

Shoemaker (1956) studied *P. hawaiensis* and *P. fascigera* intensively and concluded that *P. hawaiensis* occurred both in the Atlantic and Pacific oceans and that *P. inyacka* from South Africa was a junior synonym of *P. hawaiensis*. J. L. Barnard (1977:298) points out that Atlantic and Pacific specimens of *P. hawaiensis* have minor differences in coxa 1 and that the name "*P. inyacka*" may have to be restored to the Atlantic population to signify at the least a degree of subspeciation. However, *P. inyacka* from South Africa has not been compared minutely to Atlantic tropical *P. hawaiensis* (unless Shoemaker did this without referring to such action in print) and might be distinctive.

Now that *Parhyale* has been found, by the actions of Krapp-Schickel and the following dissection of the literature, to contain a wide array of species one must examine various collections from tropical waters with extreme care to be certain that more species are not contained within the *P. hawaiensis* and *P. fascigera* complex.

A key to the species of both genera combined together is presented below. The following possible taxa have been omitted: *Parhyale inyacka* (K. H. Barnard), *Parhyale* sp. of Sivaprakasam (see p. 126) and the *Parhyale inyacka* of Ledoyer, 1972, (see synonymy of *P. hawaiensis*, p. 122). The identification of *Allorchestes plumicornis* (Heller) by Chilton (1912:515) from St. Vincent Island in the Caribbean Sea is removed to unknown status. It is an apparent *Hyale* or *Parhyale* with tufted antennae.

Key to the Species of *Parhyale* and *Parallorchestes*

1. Outer ramus of uropod 3 with 1 or more spines located on dorsal margin disjunctly from apical spines 2
   All spines on outer ramus of uropod 3 apical and contiguous 5
2. Palp of maxilla 1 biarticulate, antenna 2 not exceeding antenna 1. .... ***Parallorchestes ochotensis****
   Palp of maxilla 1 uniarticulate, antenna 2 strongly exceeding antenna 1 3
3. Peduncle and flagellum of antenna 2 with numerous short tufts of marginal setae .... ***Parhyale plumicornis***
   Peduncle and flagellum of antenna 2 sparsely setose 4
4. Hand of male gnathopod 2 pyriform, posterior margin much shorter than palm .... ***Parhyale? zibellina***
   Hand of male gnathopod 2 subrectangular, posterior margin as long as palm .... ***Parhyale? iwasai***
5. Article 6 of pereopod 5 with posterier spines .... ***Parhyale hawaiensis***
   Article 6 of pereopod 5 naked posteriorly 6
6. Outer ramus of uropod 1 naked dorsally 7
   Outer ramus of uropod 1 spinose dorsally 9
7. All rami of uropods 1-2 naked dorsally, inner ramus of uropod 3 fused to peduncle .... ***Parhyale eburnea***
   Some rami of uropods 1–2 spinose dorsally, inner ramus of uropod 3 fully articulate 8
8. Male antenna 2 with dense elongate setal brushes on peduncular articles 4–5, male gnathopod 1 with sharp taper near defining corner of palm .... ***Parhyale penicillata***, new status
   Male antenna 2 lacking setal brushes, male gnathopod 1 with scarcely any or no taper near defining corner of palm .... ***Parhyale fascigera***
9. Article 2 of pereopod 5 with broadly rounded posteroventral lobe .... ***Parhyale aquilina***
   Article 2 of pereopod 5 with narrowly conical posteroventral lobe 10
10. Peduncle of uropod 1 with large apicolateral spike, palm and posterior margin of hand on male gnathopod 2 confluent, palm with long setae, peduncle of antenna 1 with long midventral setae on articles 1–3 .... ***?Parhyale* sp. of Bulycheva**
    Peduncle of uropod 1 with medium apicolateral spine, palm and posterior margin of hand on male gnathopod 2 distinct, palm with short spines, peduncle of male antenna 1 lacking long ventral setae .... ***Parallorchestes ochotensis***

* ***P. ochotensis*** **also keyed to couplet 10.**

Parallorchestes ochotensis (Brandt)

Allorchestes ochotensis Brandt, 1851:143–144, pl. 6: fig. 27.—Holmes, 1904:233–234, fig. 118.

Allorchestes Ochotensis.—Bate, 1862:36, pl. 1a: fig. 4.

Hyale ochotensis.—Stebbing, 1906:561–562.

Parhyale ochotensis.—Uschakov, 1948:182.—Gurjanova, 1951: 814–815, fig. 568.—Bulycheva, 1957:82–83, fig. 28.

Parhyale kurilensis Iwasa, 1934:1–7, fig. 1, pls. 1–2; 1939:284–285.

Parallorchestes ochotensis.—Shoemaker, 1941a:184–185.—J. L. Barnard, 1952a:23–24, pl. 5: fig. 1; 1954a:24; 1962c:160, fig. 23; 1964a:118; 1969b:141.

DIAGNOSIS.—One or more spines on outer ramus of uroped 3 located disjunctly from apex on dorsal margin (or occasionally those extra spines absent), inner ramus small and fully articulate. Palp of maxilla 1 biarticulate, basal article very short. Hand of male gnathopod 1 not expanded, thin and rectangular, bearing 2 spines side by side at defining corner, palm setose; palm and posterior margin of hand on male gnathopod 2 distinct, posterior margin much longer than palm, palm lined with thin short to medium spines. Article 2 of pereopod 5 with narrow, conical posteroventral lobe. Peduncle of uropod 1 with enlarged apicolateral spine, outer ramus with 3 or more dorsal spines. Peduncle of antennae 1–2 poorly setose. Coxa 3 with weak unprotuberant posterior acclivity. Epimera 2–3 moderately and sharply protuberant posteroventrally, or epimeron 3 poorly produced.

VARIABLES.—Pleonites 1–4 carinate dorsally, or weakly so, or nearly uncarinate. Occasional adults from Bering Sea part of west Alaska (Smithsonian collections) lacking supernumerary spines on uropod 3; southern "race" based on material from California (J. L. Barnard, 1962c:160), with posteroventral corner of epimeron 3 much sharper and more extended than in Alaskan specimens.

RELATIONSHIP.—This species differs from *P. zibellina* Derzhavin in the thin, rectangular, and elongate hand of male gnathopod 2.

DISTRIBUTION.—Japan Sea, Okhotsk Sea, Bering Sea, eastern Pacific south to Bahía de San Quintín, Baja California.

Parhyale plumicornis (Heller)

Nicea plumicornis Heller, 1867:5–6, pl. 1: figs. 8, 9.

Allorchestes plumicornis.—Stebbing, 1899:412–413, pl. 33c; 1906:583–584.—Walker, 1901:299, pl. 27: figs. 20, 21.—Chevreux, 1911:241–242, pl. 17: figs. 1–3.—Chevreux and Fage, 1925:291–292, fig. 302.—Ruffo, 1936:30–31; 1941:119.—Soika, 1949:196.

Parhyale plumicornis.—Krapp-Schickel, 1974:326, pls. 3, 4.

Not *Allorchestes plumicornis*.—Iwasa, 1939:289–292, figs. 25, 26, pl. 22.—Nagata, 1965:308 [? = *Hyale penicillata* (Stimpson)].—?Stephensen, 1944:71–72, fig. 25.

Not *Allorchestes ptilocerus* Derzhavin, 1937:96–97, 111, pl. 6: fig. 1.—Gurjanova, 1951:823–824, fig. 576 [probably allied to *Hyale plumulosa* Stimpson].

DIAGNOSIS.—One or more spines on outer ramus of uropod 3 shifted disjunctly from apex onto dorsal margin, inner ramus strong but fused to peduncle. Palp of maxilla 1 uniarticulate. Hand of male gnathopod 1 unexpanded, rectangular, bearing 2 spines in tandem at defining corner of palm, none facial, palm setose; palm and posterior margin of male gnathopod 2 of approximately equal length, distinct, palm lined with short spines. Article 2 of pereopod 5 with broad, rounded but shallow posteroventral lobe. Peduncle of uropod 1 with large apicolateral spine, outer ramus with 2 dorsal spines. Peduncle of antenna 1 poorly setose ventrally; articles 4–5 of peduncle on antenna 2 and proximal articles of flagellum with dense tufts of short setae; coxa 3 with protruding, subsharp posterior tooth. Epimera 1–3 weakly protuberant posteroventrally, strongest on epimeron 2.

DISTRIBUTION.—Mediterranean Sea.

Parhyale? zibellina Derzhavin

Parhyale zibellina Derzhavin, 1937:92–93, 109–110, pl. 4: fig. 1.—Gurjanova, 1951:815–816, fig. 569.—?Tzvetkova, 1967:182–183.

Not *Parhyale zibellina*.—Bulycheva, 1957:78–82, fig. 27 [see *Parhyale* sp.].

DIAGNOSIS.—One or more spines on outer ramus of uropod 3 shifted disjunctly from apex onto dorsal margin, inner ramus apparently strong and articulate. Palp of maxilla 1 unknown. Hand of male gnathopod 1 unexpanded, rectangular, palm apparently with 1 small defining spine, no facial spines, palm setose; palm and posterior margin of hand on male gnathopod 2 distinct, posterior margin significantly shorter than palm, palm lined with thin spines. Article 2 of pereopod 5 with shallow but broadly rounded posteroventral lobe. Peduncle of uropod 1 apparently lacking apicolateral spike, apical spine apparently not enlarged, outer rami of uropods 1–2 apparently with dorsal spines (highly unclear). Peduncle of antenna 1 poorly setose ventrally. Antenna 2 poorly setose. Coxa 3 probably with protruding subsharp posterior tooth (if similar to coxa 2). Epimera 1–3 sharply protruding posteroventrally, epimeron 2 strongest.

DISTRIBUTION.—Japan Sea, 0–5 m.

Parhyale? iwasai Shoemaker

Hyale gracilis Iwasa, 1939:282–284, fig. 19, pl. 19 [homonym, not Bate].

Parhyale iwasai Shoemaker, 1956:356 [new name].

Hyale iwasa [sic] Bulycheva, 1957:107–109, fig. 39 [new name].

DIAGNOSIS.—One or more spines on outer ramus of uropod 3 shifted disjunctly onto dorsal margin, inner ramus unknown. Palp of maxilla 1 uniarticulate but constricted in middle. Hand of male gnathopod 1 unexpanded, thin, rectangular, apparently bearing only 1 or 2 weakly enlarged spines side by side at defining corner of palm, palm weakly setose, setae elongate; palm and posterior margin of hand on male gnathopod 2 of approximately equal length, distinct, palm sparsely lined with spines. Article 2 of pereopod 5 with broad, rounded posteroventral lobe. Peduncle of uropod 1 with ordinary apicolateral spine, outer rami of uropods 1–2 with 2 and 1 dorsal spines, respectively. Peduncle of antennae 1–2 poorly setose. Coxa 3 apparently with protuberant subsharp posterior tooth. Epimera 2–3 with weak and sharp posteroventral tooth. Article 6 of pereopod 5 with posterior spines.

RELATIONSHIP.—Shoemaker (1956:356) thought this species to be close to *P. hawaiensis*. At present it cannot be made a synonym of *P. hawaiensis*, because of the thin and normally armed hand of male gnathopod 1 and the disjunct dorsal spine on the outer ramus of uropod 3. The inner ramus of uropod 3 remains to be discovered. The posterior spines on article 6 of pereopod 5 are known only for *P. iwasai* and *P. hawaiensis*.

DISTRIBUTION.—Taiwan and southern Japan.

Parhyale hawaiensis (Dana)

Allorchestes hawaiensis Dana, 1853–1855:900, pl. 61: figs. 5a–h.
Allorchestes Hawaiensis.—Bate, 1862:47–48, pl. 8: fig. 1.
Hyale brevipes Chevreux, 1901:400–402, figs. 15–18.—Walker, 1909:337.—Chilton, 1921a:545–548, fig. 9; ?1921b:118, figs. 2, 2a; 1925:536.—Schellenberg, 1928:658–659.—K. H. Barnard, 1935:292–294, fig. 10.
Hyale nilssoni.—Walker, 1905:925, fig. 140.1 [not Rathke].
Hyale hawaiensis.—Stebbing, 1906:573.—Schellenberg, 1938a: 66–67, fig. 34.—Ruffo, 1950:57–60.—Bulycheva, 1957:109–110, fig. 40.—Nayar, 1959:30–31, pl. 10: figs. 10–24.
Hyale prevostii.—Kunkel, 1910:66–69, fig. 25 [not Milne Edwards].—Shoemaker, 1920:378.
Hyale pontica.—Kunkel, 1910:69–72, fig. 26 [not Rathke].
Hyale trifoliadens Kunkel, 1910:72–74, fig. 27.
Hyale inyacka.—Chevreux, 1926:370–372, fig. 17.—?Stephensen, 1927:590; 1933:441–446, figs. 3, 4.—Bulycheva, 1957:88–90, fig. 29 [not K. H. Barnard].
Parhyale fasciger.—Fage and Monod, 1936:105–108, figs. 3–7a [not Stebbing].
Hyaloides dartevillei Schellenberg, 1939:126–128, figs. 6–10.
Parhyale inyacka.—Stephensen, 1947:6–7.—J. L. Barnard, 1955a:23, fig. 12.—Mateus and Mateus, 1966:185.—?Sivaprakasam, 1970:562–564, fig. 6.—?Ledoyer, 1972:275, pl. 80 [not K. H. Barnard].
Parhyale hawaiensis.—Shoemaker, 1956:351–356, figs. 3, 4.—Ruffo, 1959:17–18.—J. L. Barnard, 1965a:521–523, fig. 24.—Nayar, 1967:156–157.—Ruffo, 1969:38.—Sivaprakasam, 1970: 560–562, fig. 5.—Bousfield, 1971:266–267.—J. L. Barnard, 1971b:131.—Vader, 1972:15.—Wilkens and Parzefall, 1974: 430.—J. L. Barnard, 1977:295–298.
?*Hyale stolzmanni* Wrzesniowski, 1879:201.

DIAGNOSIS.—All spines on outer ramus of uropod 3 apical and contiguous, inner ramus fully articulate. Palp of maxilla 1 uniarticulate. Hand of male gnathopod 1 weakly expanded, bearing slightly enlarged spine at defining corner and 1 slightly enlarged spine on inner face along posterior margin of hand, palm setose; palm and posterior margin of hand on male gnathopod 2 of approximately equal length, distinct, palm densely lined with medium spines. Article 2 of pereopod 5 with broad, rounded posteroventral lobe. Peduncle of uropod 1 with enlarged apicolateral spine, outer rami of uropods 1–2 with 2 and 1 dorsal spines, respectively. Peduncle of antennae 1–2 poorly setose. Coxa 3 with weakly protuberant subsharp posterior tooth. Epimera 2–3 almost perfectly quadrate, scarcely but very minutely protuberant posteroventrally. Article 6 of pereopod 5 with posterior spines.

REMARKS.—See "Remarks" under *P. inyacka*. The synonymy and references for both species are provisional.

Specimens reported by J. L. Barnard (1955a:23) from Hawaii have been reexamined and found to have sparse ordinary bulbar setules on the cuticle lacking plaques. See *P. penicillata* and *P. fascigera* for notes about this condition.

MATERIAL.—DAW 15.

DISTRIBUTION.—Apparently pantropical in shallow water, but not yet collected inside Gulf of California.

Parhyale eburnea Krapp-Schickel

Parhyale eburnea Krapp-Schickel, 1974:327–328, pls. 8–11.

DIAGNOSIS.—All spines on outer ramus of uropod 3 apical and contiguous, inner ramus small and fused to peduncle. Palp of maxilla 1 uniarticulate but weakly constricted in middle. Hand of male gnathopod 1 weakly expanded, bearing enlarged spine at defining corner and enlarged facial spine in middle, palm weakly setose; palm and posterior margin of hand on male gnathopod 2 of approximately equal length, distinct, palm lined with elongate spines. Article 2 of pereopod 5 with broad, rounded but shallow posteroventral lobe. Peduncle of uropod 1 with tiny apicolateral spine, outer ramus naked dorsally (all rami of uropods 1–2 naked dorsally). Peduncle of antenna 1 poorly setose ventrally; antenna 2 poorly setose. Coxa 3 with protruding and subsharp posterior tooth. Epimera 1–3 rounded or unprotuberant posteroventrally.

DISTRIBUTION.—Italy, Sirolo (Ancona).

Parhyale penicillata Shoemaker, new status

FIGURES 65–67

Parhyale fascigera penicillata Shoemaker, 1956:350–351, fig. 2g–i.

DIAGNOSIS.—All spines on outer ramus of uropod 3 apical and contiguous, though several spines somewhat facial and subterminal, inner ramus fully articulate. Palp of maxilla 1 uniarticulate. Hand of male gnathopod 1 expanded, bearing 2 enlarged spines in tandem at defining corner, palm weakly setose; palm and posterior margin of hand on male gnathopod 2 of approximate equal length, distinct, palm lined with short spines. Article 2 of pereopod 5 with broad, rounded posteroventral lobe. Peduncle of uropod 1 with enlarged apicolateral spine, outer ramus of both uropods 1–2 naked dorsally. Peduncle of antenna 1 poorly setose ventrally; articles 4–5 of peduncle on antenna 2 with dense but short tufts of ventral setae. Coxa 3 with protruding subsharp posterior lobe. Epimera 2–3 protruding weakly posteroventrally, epimeron 3 strongest.

DESCRIPTION.—Male gnathopod 2 hand with up to 9 setae in posterior acclivity; locking spines on pereopods 3–5 accompanied by up to 4 setae in large adults but setae absent elsewhere, occasionally pereopod 5 with 3 locking spines and 3 setae; gnathopods 1–2 each with 3 recurved posterior spines on article 2; female coxae 2–4 narrower anteroposteriorly than in male and posterior cusps slightly sharper on coxae 2–3, cuticle with scattered alate slit-pits each with a setule, surrounded by simple setules (seen as holes on Figure 66:*QE5*) and very finely punctate or frosted matrix on cuticular surface, on dorsum of pleonites slit-pits with slightly elevated rims; epimera with frosted surface but bearing only simple bulbar setules (Shoemaker found no setules on *P. fascigera*).

VOUCHER MATERIAL.—KNO 6: male "a," 7.8 mm (illus.); female "n," 6.1 mm (illus.).

REMARKS.—Shoemaker distinguished *P.f. penicillata* also on the fact that most populations of circumtropical *P.f. fascigera* have 1 of the enlarged spines on male gnathopod 1 moved anteriorly towards the middle of the palm but *P.f. penicillata* differs little from specimens in the Virgin Islands figured by Shoemaker in which that spine is scarcely removed from the palmar defining corner.

Specimens from TOP–1 have the cuticular alae poorly developed or absent and the posteroventral tooth on epimeron 3 is poorly developed, almost rounded.

This species differs from *P. fascigera,* to which it formerly was assigned as a subspecies, in the characters of couplet 8 in the key to the species of *Parhyale* and *Parallorchestes* (p. 120).

MATERIAL.—KNO 6; TOP 1.

DISTRIBUTION.—Gulf of California: Bahía Kino, Topolobampo, La Paz, 0 m.

Parhyale fascigera Stebbing

Parhyale fasciger Stebbing, 1897:26–28, pl. 6.—?Schellenberg, 1925:162; ?1938b:215; ?1939:128.

Parhyale fascigera.—Stebbing, 1906:556.—Shoemaker, 1935a: 244; 1956:346–350, figs. 1, 2a–f.

Hyale brevipes.—Shoemaker, 1933a:18, figs. 10, 11 [not Chevreux].

Hyale hawaiensis.—Shoemaker, 1942:18 [not Dana].

DIAGNOSIS.—All spines on outer ramus of uropod 3 apical and contiguous (fide Shoemaker, 1956, but Stebbing, 1897, weakly disagreeing), inner ramus fully articulate. Palp of maxilla 1 uniarticulate but weakly constricted in middle. Hand of male gnathopod 1 expanded, bearing large spine in middle of palm or divorced from defining corner plus enlarged facial spine, palm setose; palm and posterior margin of hand on male gnathopod 2 of approximately equal length, distinct, palm densely lined with medium spines. Article 2 of pereopod 5 with broad, shallow, rounded posteroventral lobe. Peduncle of uropod 1 with enlarged apicolateral spine, outer rami of uropods 1–2 lacking dorsal spines. Peduncle of antennae 1–2 poorly setose. Coxa 3 with protuberant subsharp posterior tooth. Epimera 2–3 very weakly and subsharply protuberant posteroventrally.

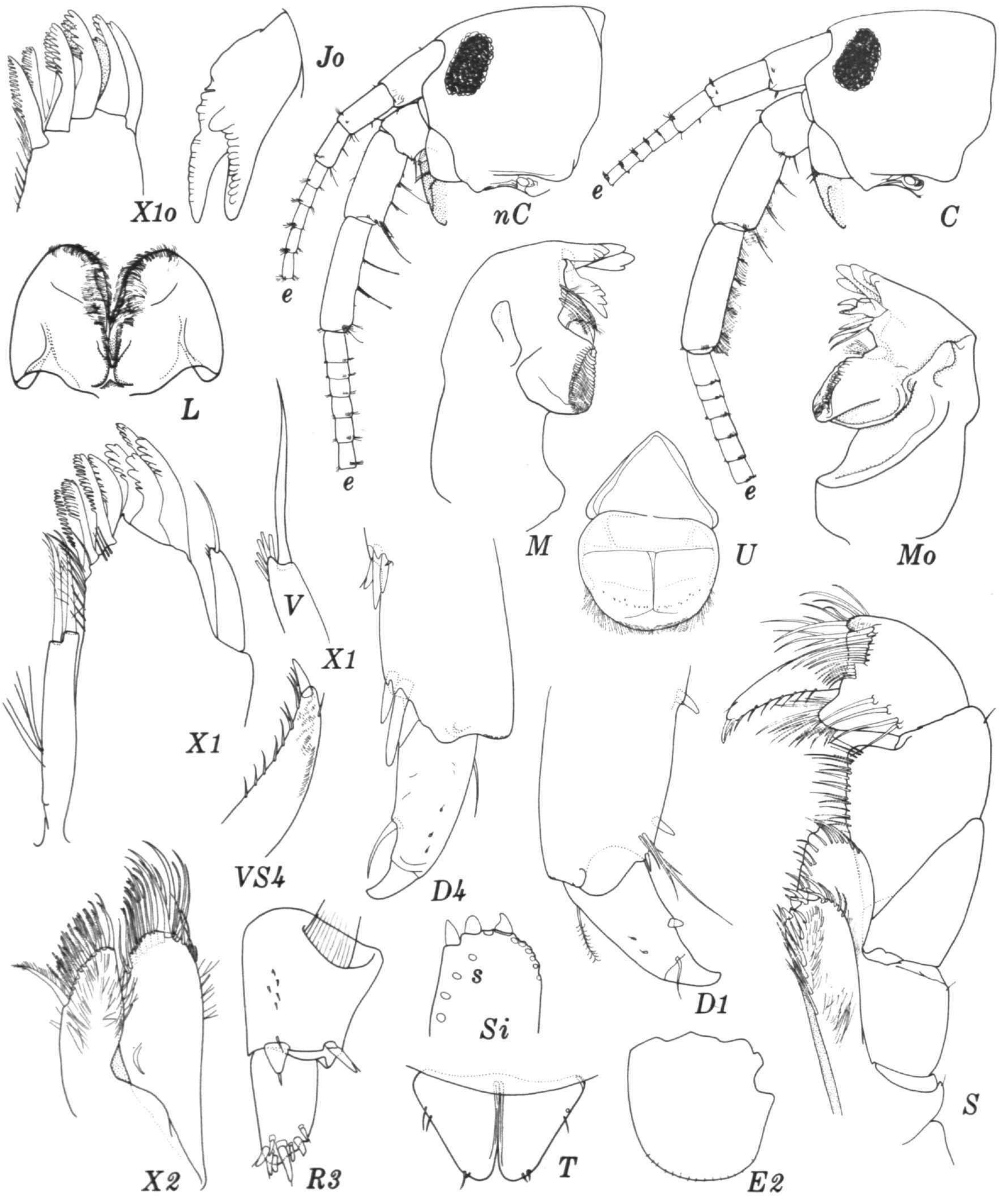

FIGURE 65.—*Parhyale penicillata* Shoemaker, new status, male "a," 7.8 mm (*n* = female "n," 6.1 mm).

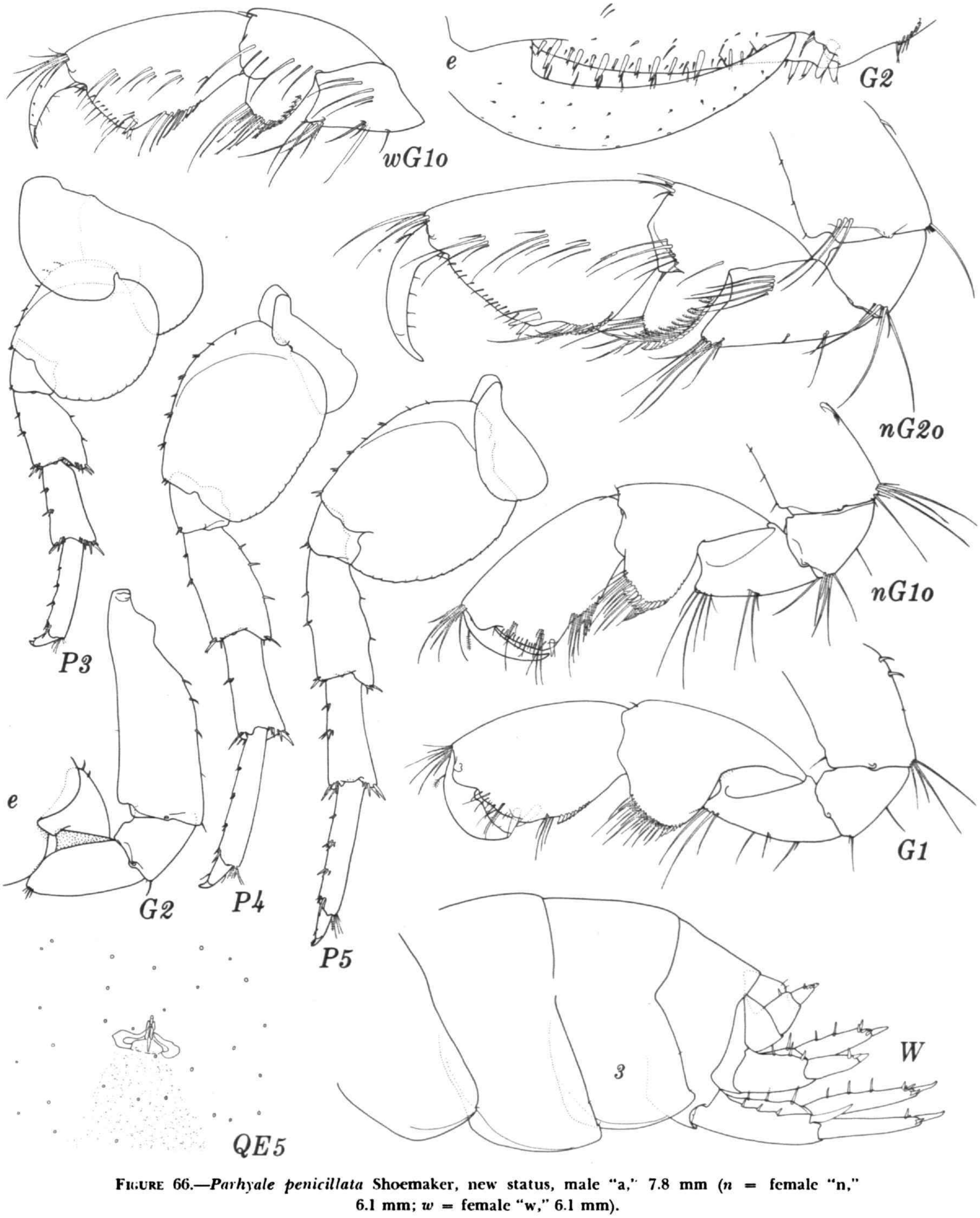

FIGURE 66.—*Parhyale penicillata* Shoemaker, new status, male "a," 7.8 mm (*n* = female "n," 6.1 mm; *w* = female "w," 6.1 mm).

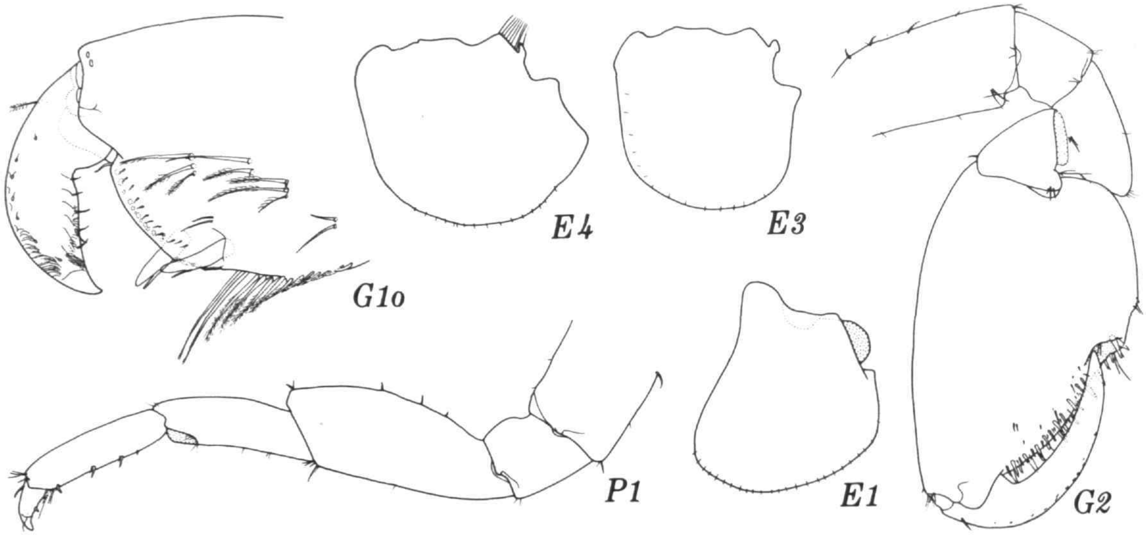

FIGURE 67.—*Parhyale penicillata* Shoemaker, new status, male "a," 7.8 mm.

REMARKS.—Specimens from USNM 120194, Dominica, British West Indies, Soufriére, lower beach in algae on rocks, 5 December 1966, coll. G. S. Schultz and E. L. Bousfield, have been examined and found to have sparse and ordinary bulbar setules on the cuticle lacking plaques. See *P. penicillata* (p. 123) for importance of this observation.

DISTRIBUTION (based only on specimens identified by Shoemaker, 1956).—Atlantic; Florida, Gulf of Mexico, Caribbean Sea; Pacific: west Mexico to Peru and the Juan Fernandez Islands and the Galapagos Islands; not yet collected inside Gulf of California.

Parhyale aquilina (Costa)

Amphithoe aquilina Costa, 1853:174; 1857:202–203, pl. 2: fig. 7.
Nicea fasciculata Heller, 1867:6–7, pl. 1: figs. 10, 11.
Nicea nudicornis Heller, 1867:8–9, pl. 1: figs. 16–19.
Nicea rudis Heller, 1867:12, pl. 1: fig. 33.
Allorchestes aquilina.—Walker, 1901:299, pl. 27: fig. 19.
Hyale aquilina.—Stebbing, 1906:565.
Allorchestes aquilinus.—Chevreux, 1911:240–241, pl. 16: figs. 20–25.—Chevreux and Fage, 1925:289–291, figs. 300, 301.—Chevreux, 1926:372; 1935:123.—Ruffo, 1941:119; 1947:126.—Legrand, 1951:376.
Parhyale aquilina.—Krapp-Schickel, 1974:326–327, 329, 334, pls. 5–7.

DIAGNOSIS.—All spines on outer ramus of uropod 3 apical and contiguous, inner ramus vestigial, fully fused to peduncle. Palp of maxilla 1 uniarticulate but constricted in middle. Hand of male gnathopod 1 expanded, bearing 2 enlarged spines in tandem near defining corner, none facial, palm setose; palm and posterior margin of hand on male approximately equal in length, distinct, palm lined with short stout spines. Article 2 of pereopod 5 with broad rounded posteroventral lobe. Peduncle of uropod 1 lacking spike, bearing medium apicolateral spine, outer ramus with 1 dorsal spine. Peduncle of antenna 1 poorly setose ventrally; antenna 2 poorly setose. Coxa 3 with unprotruding posterior acclivity. Epimera 2–3 only weakly protuberant posteroventrally, epimeron 2 strongest.

DISTRIBUTION.—Mediterranean Sea and Canary Islands.

Parhyale species

Parhyale hawaiensis.—Sivaprakasam, 1970:560–562, fig. 5 [not Dana].

REMARKS.—The shape of gnathopods 1–2 and the presence of setules (possibly green algal tufts) on the telson suggest that this may be a species distinct from *P. hawaiensis*. The possible presence of posterior spines on article 6 of pereopod 5 and the precise spine distribution on the hand of gnathopod 1 must be determined.

DISTRIBUTION.—East coast of India.

Parhyale species of Bulycheva

Parhyale zibellina.—Bulycheva, 1957:78–82, fig. 27 [not Derzhavin, 1937].

DIAGNOSIS.—All spines on outer ramus of uropod 3 apical and contiguous, inner ramus fully articulate. Palp of maxilla 1 uniarticulate. Hand of male gnathopod 1 expanded, bearing 2 enlarged spines at defining corner of palm, none facial, palm setose; palm and posterior margin of hand on male gnathopod 2 confluent, palm long, posterior margin short, palm lined with elongate thin setae. Article 2 of pereopod 5 with narrow, subsharp posteroventral lobe. Peduncle of uropod 1 with large apicodistal spike, outer ramus with more than 2 dorsal spines besides apical spines. Peduncle of antenna 1 with long ventral setae in midmargins of articles 1–3, antenna 2 poorly setose. Coxa 3 with weak, unprotuberant posterior acclivity. Epimeron 3 with small but sharp posteroventral tooth (other epimera unknown).

DISTRIBUTION.—Precisely constrained distribution unknown owing to probable confusion with *Parhyale zibellina;* Bulycheva mentions Japan Sea, Okhotsk Sea, and Bering Sea.

Parhyale inyacka (K. H. Barnard)

Hyale inyacka K. H. Barnard, 1916:233–234, pl. 28: fig. 4.
Parhyale inyacka.—K. H. Barnard, 1940:472–473.—Griffiths, 1973:229–300.

REMARKS.—Actual specimens from South Africa have never been described in detail necessary to identify them with Stephensen's (1933, figs. 3, 4) and Shoemaker's (1956, figs. 3, 4) illustrations of Atlantic *P. hawaiensis,* although Shoemaker considered the 2 species identical. J. L. Barnard (1977: 298) points out a difference in the posterior acclivity of coxa 1 between Atlantic and Pacific specimens of *P. hawaiensis* and suggests the possibility that *P. inyacka* might be a name available for recognizing the Atlantic populations as distinctive subspecies or species. However, it is also possible that South African *P. inyacka* is itself distinctive from the tropical Atlantic form.

ISCHYROCERIDAE

Microjassa chinipa, new species

FIGURES 68, 69

DIAGNOSIS.—Rostrum and lateral cephalic lobe projecting equally, lateral lobe subfalciform and subacute. Eyes large. Mouthparts similar to those of *Parajassa angularis* Shoemaker (1942) except for expanded mandibular palp article 3. Inner plate of maxilla 1 well developed as in *P. angularis.* Maxillipedal palp article 4 short as in *P. angularis* and armed medially with 4 or 5 setae. Coxa 1 in male about 50 percent as long as coxa 2, in female about 75 percent; coxae 3–4 flat to excavate ventrally in both sexes, very broad; coxa 5 in male about as long as coxa 4 but shorter in female, posterior lobe falcate, coxae 6–7 shorter than posterior lobe of coxa 5. Gnathopod 1 small and similar in both sexes, article 5 less than 60 percent as long as article 6, latter moderately expanded, palm slightly exceeding length of posterior margin, defined by 3 spines, gnathopod 2 of female similar to gnathopod 1 but article 5 shorter; gnathopod 2 of male with elongate and enlarged article 6, palm and posterior margin confluent, armed distally with 2 weak humps, proximally with strong, slightly reverted blunt process at joint with article 5, palm sparsely setose, dactyl almost as long as palm, inner margin evenly arcuate, article 5 very small, posterior lobe narrow, short. Article 2 of pereopod 3 sexually dimorphic, with posteroventral lobe in male, absent in female, article 2 of pereopods 4–5 also lobed, narrow on pereopod 4, broad on pereopod 5, but in male somewhat narrower than in female. Pleonal epimera almost straight, posteriorly notched. Outer rami of uropods 1–2 shorter than inner, peduncle of uropod 1 with sharp interramal tooth; uropod 3 elongate, rami about 25 percent as long as peduncle, outer ramus bearing 3 or 4 distolateral cusps, apical cusp not an immersed or articulate spine, margin proximal to cusps minutely scaly, inner ramus simple, straight, bearing 1 basally immersed articulate spinule, lateral margin minutely scaly. Telson short, subtriangular, apically blunt, armed with 2 dorsal spines and several marginal setules.

HOLOTYPE.—USNM 168025, male "q," 2.58 mm (illus.).

TYPE-LOCALITY.—DAW 26, Galapagos Islands,

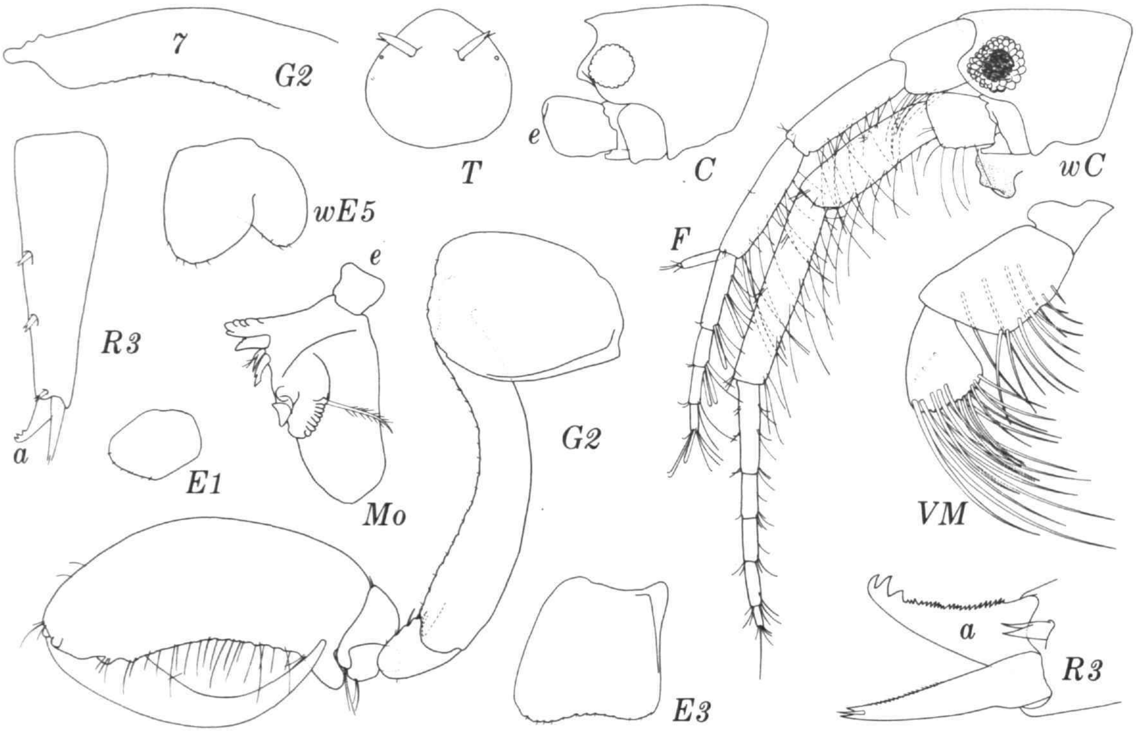

FIGURE 68.—*Microjassa chinipa*, new species, holotype, male "q," 2.58 mm (*w* = female "w," 2.11 mm).

Isla Santa Cruz, Academy Bay, 1962 (date otherwise unknown), intertidal, rock wash.

VOUCHER MATERIAL.—Type-locality, female "w," 2.11 mm (illus.), DAW 40, female "x," 2.08 mm (illus.).

RELATIONSHIP.—This species is very close to *M. claustris* J. L. Barnard, 1969b, from California, and may be the fully developed stage of that species which might, itself, represent the retarded northernmost fringe of the species. Both males and females of *M. chinipa* have broadened coxae 3–4 which are flat or excavate ventrally, whereas *M. claustris* has much narrower coxae with convex ventral margins. Even young males and females of *M. chinipa* have these typical coxae so that the somewhat youthful-appearing *M. claustris* differs in that character. The posterior lobe of coxa 5 is sharper and more elongate in *M. chinipa* than in *M. claustris*. Male gnathopod 2 of *M. chinipa* passes through the stages shown for *M. claustris*.

MATERIAL.—GAL 114, 115, 116, 119, 120; DAW 1, 3, 4, 9, 13, 15, 16, 19, 20, 23, 26, 27, 31, 33, 35, 37, 40; PAN 14.

DISTRIBUTION.—Galapagos Islands, 0–6 m; Pacific Panama, 0 m.

Microjassa macrocoxa Shoemaker

Microjassa macrocoxa Shoemaker, 1942:44–47, figs. 16, 17.—J. L. Barnard, 1964a:111, fig. 21D.

MATERIAL.—TOP 3 (15).

DISTRIBUTION.—Gulf of California, Topolobambo, 1 m; outer Baja California, Bahía Magdalena to Bahía de San Quintín, 0–27 m.

LEUCOTHOIDAE

Leucothoe alata J. L. Barnard

Leucothoe alata J. L. Barnard, 1959:19–20, pl. 1; 1962c:132, figs. 7D,E,F; 1964b:227; 1966a:22; 1969a:214; 1969b:164.—Nagata, 1965b:158–159, figs. 9, 10.

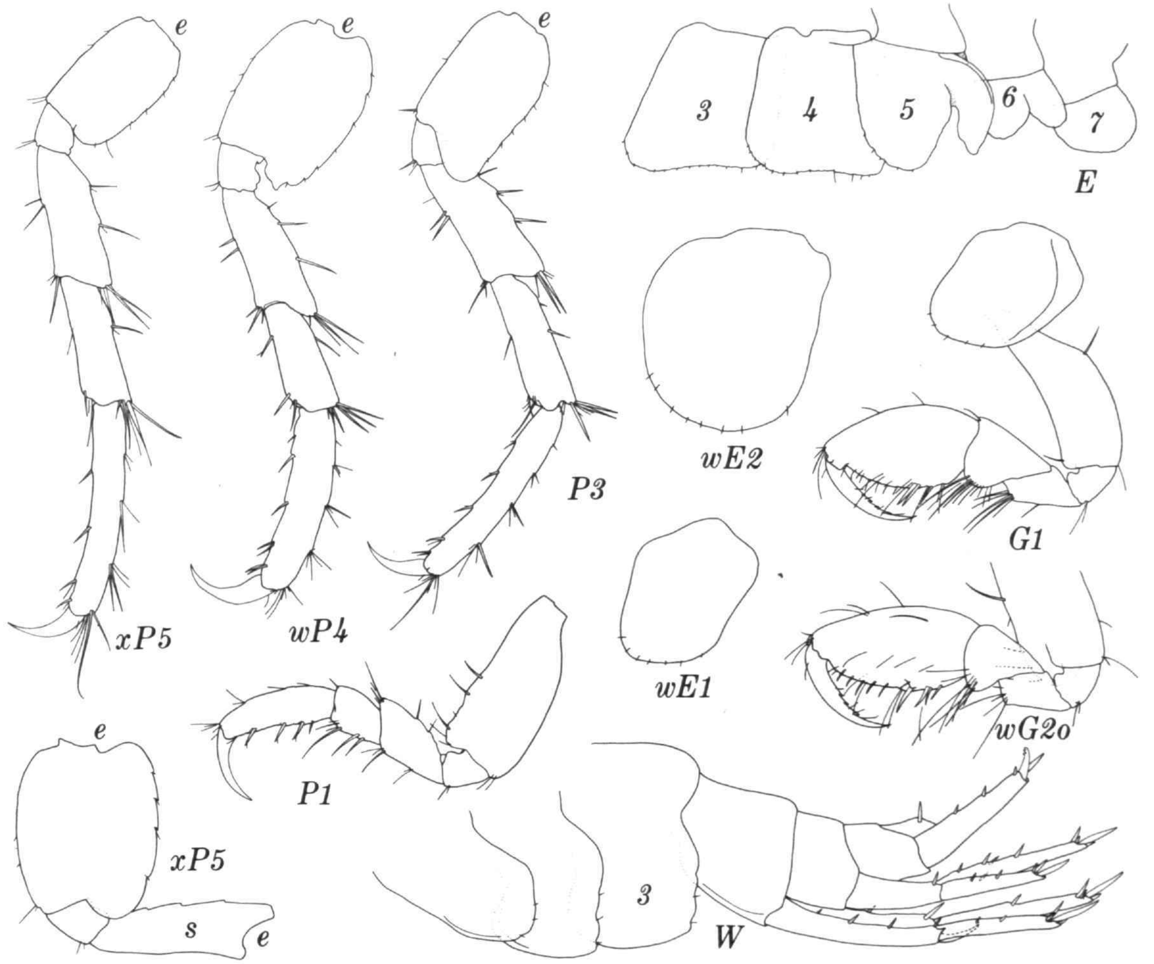

FIGURE 69.—*Microjassa chinipa*, new species, holotype, male "q," 2.58 mm (*w* = female "w," 2.11 mm; *x* = female "x," 2.08 mm).

MATERIAL.—SCO 1, 8, 14, 15, 16, 18; KNO 1; TOP 3; PAZ 15, 24; GAL 108, 114, 115, 118; DAW 3, 8, 17, 27, 28, 31, 36; BRU 1, 2. Presumed to be associated with sponges and tunicates.

DISTRIBUTION.—Gulf of California, Galapagos Islands, outer Baja California and California northward to Monterey Bay, 0–24 m; Japan, 2–4 m.

Leucothoe spinicarpa (Abildgaard)

Gammarus spinicarpus Abildgaard, 1789:66–67, pl. 119: figs. 1–4.

Leucothoe spinicarpa (Abildgaard).—Sars, 1895:283, pls. 100, 101: fig. 1.—Stebbing, 1906:165–166.—J. L. Barnard, 1954a:6; 1962c:132, fig. 7A,B,C; 1964b:227; 1966a:22.

REMARKS.—Another cosmopolitan species requiring closer study; referred to scores of times in the literature, references above limited to early definitive studies and those of eastern Pacific Ocean. Associated with tunicates and sponges.

MATERIAL.—TOP 3; PAZ 24; DAW 31.

DISTRIBUTION.—Cosmopolitan, 0–1505 m; found here in the Gulf of California at Topolobampo and Bahía Concepción, 0–1 m, and in Galapagos Islands, 6 m. Apparently not as tolerant of intertidal conditions as *L. alata*; also not recorded yet from intertidal of California, though abundant in very shallow sublittoral depths.

Leucothoides pacifica J. L. Barnard

Leucothoides pacifica J. L. Barnard, 1955c:26–28, figs. 1, 2e,h,n; 1959:21; 1964a:114; 1969b:165, fig. 24n–r.

MATERIAL.—SCO 14; PAZ 12. Probably associated with tunicates and sponges.

DISTRIBUTION.—Gulf of California: Puerto Peñasco and Bahía San Evaristo, 0 m; California from Carmel to Newport Bay, 0–8 m.

Leucothoides pottsi Shoemaker

Leucothoides pottsi Shoemaker, 1933b [only the holotype, not the description and figures].—J. L. Barnard, 1974:103.

REMARKS.—The single specimen fits the diagnosis of Barnard (1974:103) and differs from *L. yarrega* in the presence of serrations on apposing margins of articles 5–6 on gnathopod 1 and uneven distribution of spines on article 6 of pereopods 1–2.

MATERIAL.—DAW 31.

DISTRIBUTION.—Galapagos Islands, 6–9 m; Caribbean Sea, occurrence in Mediterranean Sea and India doubtful.

Leucothoides ?yarrega J. L. Barnard

[?]*Leucothoides yarrega* J. L. Barnard, 1974:103–104, figs. 62: f, 62: f_1, 63 f.

MATERIAL.—PAZ 3; DAW 31.

REMARKS.—Despite the nearness of Baja California to the Caribbean Sea, the material at hand differs from Caribbean species of the genus and resembles the Australian species very closely. The absence of serrations on the apposing margins of articles 5 and 6 of gnathopod 1 is a crucial feature in this resemblance. Coxa 1 of the material at hand is identical to that of *L. yarrega,* the head is even more broadly rounded than in *L. yarrega* but article 2 of pereopod 5 is slightly less beveled than that of *L. yarrega.* Gnathopod 2 is of the purely tropical form in contrast to gnathopod 2 of *L. pacifica,* the subtropical species.

MATERIAL.—PAZ 3.

DISTRIBUTION.—Gulf of California, Isla Espiritu Santo, 1 m; Australia.

LYSIANASSIDAE

Lysianassa dissimilis (Stout)

Nannonyx dissimilis Stout, 1913:638–639.
Aruga dissimilis.—Shoemaker, 1942:7.—J. L. Barnard, 1955b: 100–103, pl. 29g,i; 1946b:230.
Lysianopsis? dissimilis.—Hurley, 1963:76–77, fig. 21d.
Lysianassa dissimilis.—J. L. Barnard, 1969a:218; 1969b:186–187, fig. 47a–f.

MATERIAL.—SCO 14, 16; KNO 1; TOP 3; PAZ 24; GAL 115.

DISTRIBUTION.—Gulf of California, at Puerto Peñasco, Bahía Kino, Bahía de Los Angeles, Topololambo, Bahía Concepción, 0–1 m; Galapagos Islands, 0–18 m; generally from Tomales Bay, California to Isla Isabel, Mexico, 0–73 m.

Lysianassa holmesi (J. L. Barnard)

Aruga holmesi J. L. Barnard, 1955b:100, pls. 27, 28; 1959:18; 1964a:79.
Lysianopsis(?) holmesi.—Hurley, 1963:74–75, fig. 21b.
Lysianassa holmesi.—J. L. Barnard, 1966a:25; 1966b:69.

MATERIAL.—PAZ 1, 3, 6, 7, 8, 9, 12, 13.

DISTRIBUTION.—Gulf of California at La Paz, Isla Espiritu Santo, Isla Partida and Bahía San Evaristo, 0 m; generally Monterey Bay, California to Ecuador, 0–183 m.

Lysianassa macromera (Shoemaker)

Aruga macromerus Shoemaker, 1916:157–158.
Lysianopsis(?) macromerus.—Hurley, 1963:77.
Lysianassa macromerus.—J. L. Barnard, 1969a:218; 1969b:187–189, figs. 48, 49.

MATERIAL.—PAZ 10, 12, 20.

DISTRIBUTION.—Gulf of California at Cabo San Lucas, Bahía San Evaristo, Isla San Francisco, Bahía de Los Angeles, 0 m; California, from Cayucos to La Jolla, 0 m.

PHLIANTIDAE

Heterophlias seclusus escabrosa J. L. Barnard

FIGURE 40 (part)

Heterophlias seclusus escabrosa J. L. Barnard, 1962b:79–80, fig. 5; 1969a:219; 1969b:195–196.

VOUCHER MATERIAL.—SCO 7, sex unknown "p," 3.12 m (illus).

REMARKS.—Three figures of this subspecies from California and Mexico are given for comparison to the new species from the Galapagos Islands.

Epimeron 3 is like that shown for *H. galapagoanus*; Shoemaker's (1933b, fig. 4c) view of this epimeron for the typical subspecies from the Caribbean Sea is distinctive. The pereopodal dactyls and locking spines of *H. s. escabrosa* also fit those of *H. galapagoanus* (Figures 71, 72). The telson of *H. s. escabrosa* is slightly elliptical side to side.

Juveniles from Puerto Peñasco have elongate processes on antenna 1 and the long inner ramus on uropod 2 typical of *H. s. escabrosa,* but adults have a short inner ramus on uropod 2 typical of the Caribbean stem subspecies, *H. s. seclusus.*

MATERIAL.—SCO 1, 7, 8, 12, 14, 18, 19; KNO 1; PAZ 13, 18, 22.

DISTRIBUTION.—California from Cayucos to La Jolla, 0–16 m; Gulf of California, Puerto Peñasco, Bahía de Los Angeles, Bahía Kino, Bahía San Evaristo and Cabo San Lucas, intertidal.

Heterophlias galapagoanus, new species

FIGURES 70–72

DIAGNOSIS.—Rostrum 1.1 times as long as broad, half as broad as head; dorsal outline of pleonite 1 broadly deltoid, posterolateral margins nearly straight; medial protrusions on peduncles of pleopods reaching approximately to vertical tangents from medial edges of inner rami.

DESCRIPTION.—Right mandible with tiny tripartite comb proximal to lacina mobilis, this comb presumably remnant of spine row, left mandible with conical projection bearing tiny denticles, perhaps combination of lacinia mobilis and comb row; maxilla 1 with 5 spines on outer plate; cuticle minutely punctate, bearing stout setules and various-sized tubes opening externally, remaining parts as illustrated.

Lateral view with coxae depressed and flattened unnaturally, coxae normally splayed; lower lip shown as outer view in situ; detached pereopods 3–5 reduced in size in comparison to pereopods 1–2 and gnathopods 1–2; lateral view of epimera and urosome of specimen "b" joined by view of epimeron 1 from specimen "a" in magnification similar to relative body sizes.

HOLOTYPE.—USNM 142293, sex unknown "a," 2.28 mm (illus.).

TYPE-LOCALITY.—DAW 31, Galapagos Islands, Isla Santa Cruz, halfway between Tortuga Bay and Academy Bay, 22 February 1962, 6–9 m, algal rock wash.

VOUCHER MATERIAL.—Type-locality, sex? "y," 2.12 mm (illus.); sex? "c," 1.28 mm (illus.).

REMARKS.—Lengths of these specimens are taken from the anterior edge of the rostrum to the posterior edge of pleonite 1 from dorsal view. Sex of the specimens is unknown and presumably they are juveniles as no brood plates nor penial protrusions are present.

RELATIONSHIP: The diagnosis distinguishes this species from the only other species of the genus and its holotype. In *H. seclusus* Shoemaker (1933b) pleonite 1 is weakly trifoliate, the rostrum is broader and shorter and the medial protrusions on the pleopodal peduncles are much longer than in *H. galapagoanus.* The one tiny juvenile, 1.28 mm, of *H. galapagoanus* at hand is very similar to *H. seclusus* in the characters mentioned and is, therefore, unidentifiable. Presumably hatched juveniles resemble the parent species *H. seclusus* but the rostrum, pleonite 1, and the pleopods transform during maturation. The Pacific subspecies, *H. s. escabrosa,* resembles the typical subspecies from the Caribbean Sea in the characters being discussed but differs from the typical subspecies in stronger protrusions on antenna 1 and in the longer inner ramus of uropod 2. These characters on *H. galapagoanus* resemble the situation in the Pacific subspecies of *H. seclusus.*

Pariphinotus Kunkel (1910) is presumably a senior synonym of *Heterophlias* Shoemaker (1933b), but Kunkel reported the mandibular molar as absent; until this character is confirmed the two genera should be held separate. The type-species, *P. tuckeri* Kunkel, from Bermuda, is highly similar to *H. seclusus* in the strong protrusion on the pleopodal peduncles, but the head resembles that of *H. galapagoanus;* Kunkel (1910) did not describe pleonite 1.

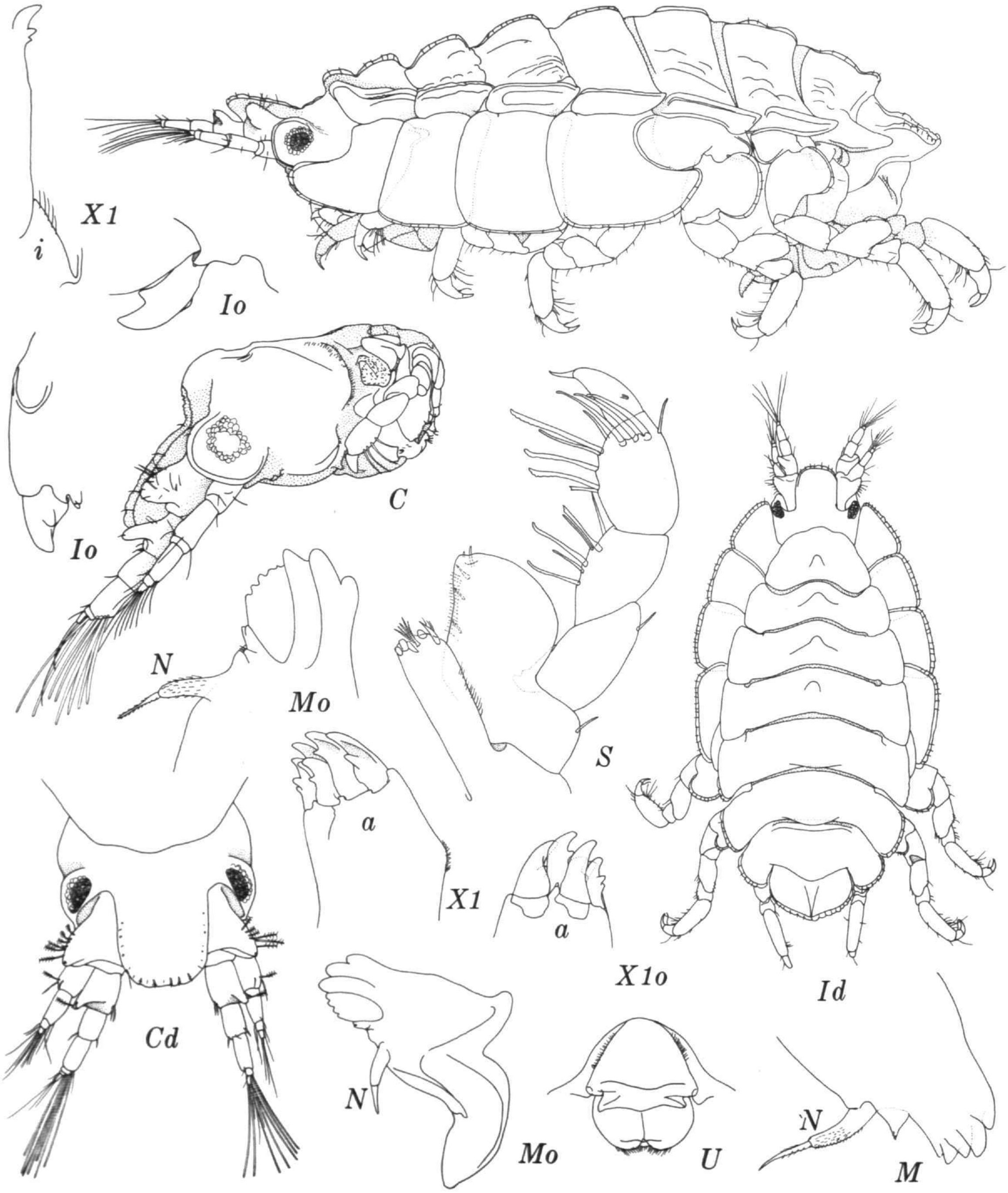

FIGURE 70.—*Heterophlias galapagoanus*, new species, holotype, sex unknown "a," 2.28 mm (*Io* = opposite sides of apical nipple on maxilla 1; *Id* = dorsal view of complete specimen).

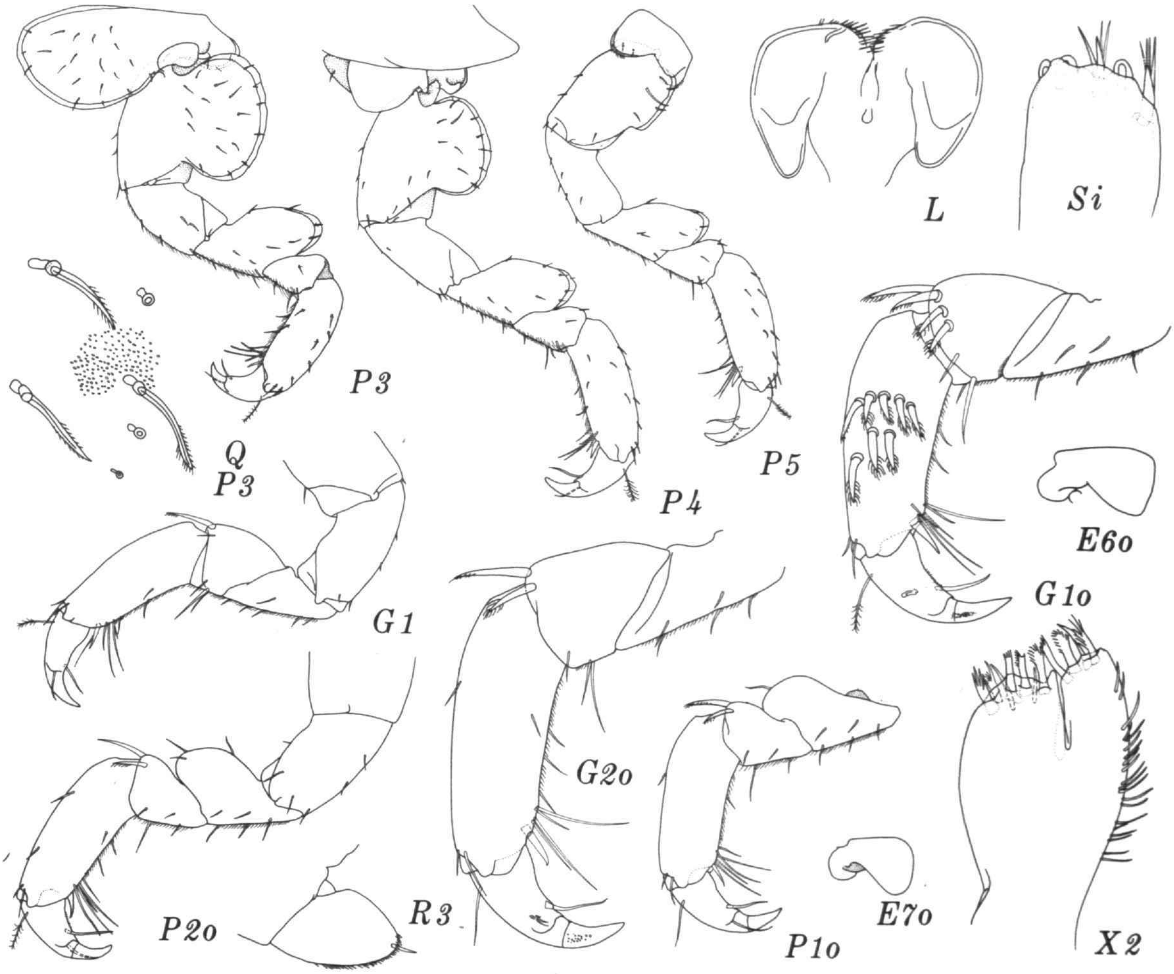

FIGURE 71.—*Heterophlias galapagoanus*, new species, holotype, sex unknown "a," 2.82 mm.

MATERIAL.—GAL 106; DAW 17, 31.

DISTRIBUTION.—Galapagos Islands, Isla Santa Cruz, intertidal.

PHOXOCEPHALIDAE

Metaphoxus frequens J. L. Barnard

Metaphoxus frequens J. L. Barnard, 1960:304–306, pls. 51, 52; 1964b:242; 1966a:28; 1966b:88; 1969b:196; 1971a:68.

MATERIAL.—PAZ 3.

DISTRIBUTION.—Gulf of California at Isla Espiritu Santo, 0 m; generally Oregon to Isla Isabel, Mexico, 0–458 m, rarely intertidal.

"Paraphoxus" spinosus Holmes

Paraphoxus spinosus Holmes, 1905:477–478, unnumbered fig.—Kunkel, 1918:76–78, fig. 13.—Shoemaker, 1925:26–27.—J. L. Barnard, 1959:18; 1960:243–249, pls. 29–31; 1961:178; 1964a:105; 1966b:89; 1969a:224; 1969b:197–198.—Reish and Barnard, 1967:18.—Bousfield, 1973:12, pl. 34.1.

REMARKS.—All members of so-called *"Paraphoxus"* in America will be assigned to other genera; see also Barnard and Drummond (1976).

MATERIAL.—SCO 1, 17; PAZ 3, 5, 11.

DISTRIBUTION.—Gulf of California, widely distributed, 0–24 m; ranging northward to Puget Sound, Washington, 0–73 m; western Atlantic Ocean.

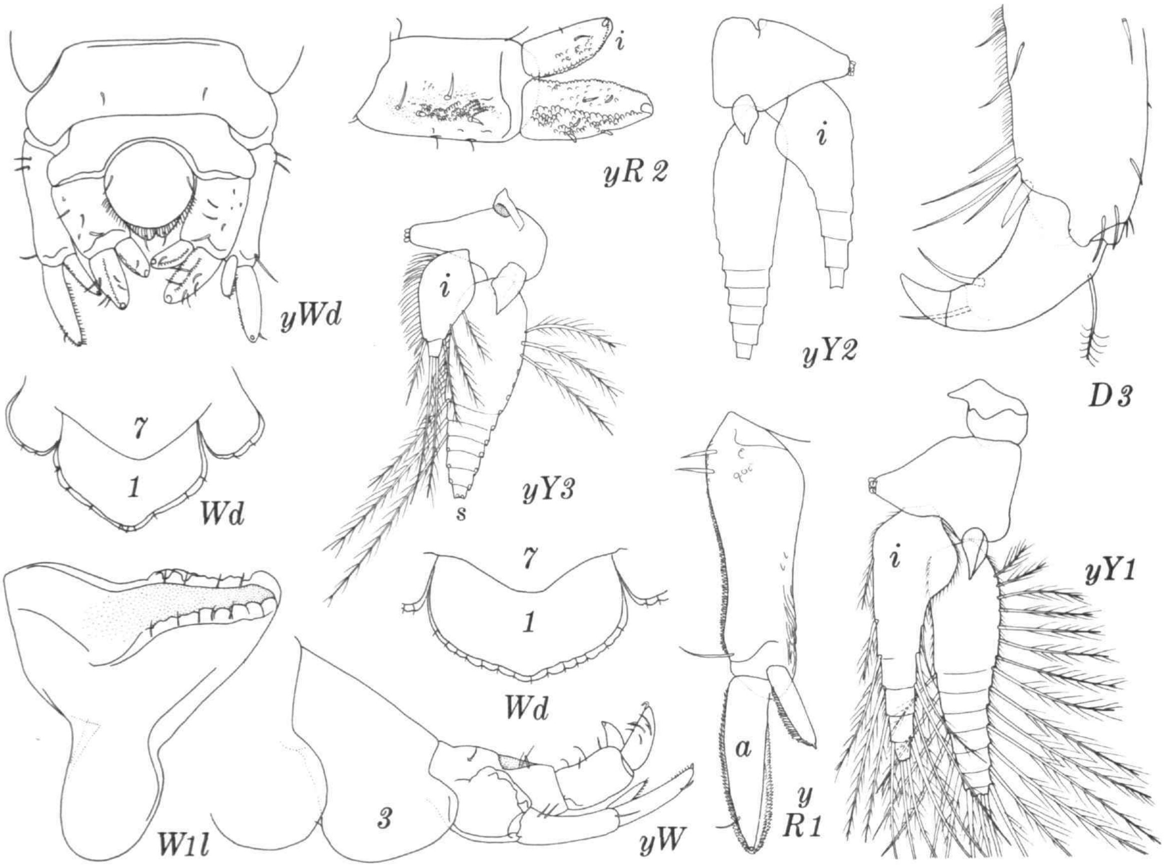

FIGURE 72.—*Heterophlias galapagoanus*, new species, holotype, sex unknown "a," 2.28 mm (*c* = sex unknown "c," 1.28 mm, *y* = sex unknown "y," 2.12 mm).

PODOCERIDAE

Podocerus fulanus J. L. Barnard

FIGURES 73, 74

Podocerus sp.—J. L. Barnard, 1959:40, pl. 14.
Podocerus fulanus J. L. Barnard, 1962a:69; 1969b:224.

VOUCHER MATERIAL (all illustrated).—SCO 1: male "p," 4.2 mm; male "g," 4.0 mm; male "h," 3.4 mm; male "m," 3.6 mm. SCO 10: male "a," 5.4 mm; male "x," 5.3 mm; female "w," 5.1 mm.

REMARKS.—The size and shape of posterodorsal segmental teeth vary widely among specimens of a single collection; females have low, evenly developed teeth, whereas males vary from low and evenly developed teeth to strongly projecting teeth. Certain males have the tooth of pereonite 7 largest, others have the teeth of pereonite 7 and pleonite 1 equally dominant.

The eye forms a bulge on the side of the head in many specimens but in others, and especially in the largest adults, the eye forms no distinct bulge.

The ordinary specimen, 3–4 mm long, has 2 telsonic spines, but a few specimens larger than 4.0 mm have 4 spines. The 5 mm holotype male from Newport Bay has 5 spines.

This species is widely distributed in the opensea of Mexico but in southern California at the periphery of its northern limits the species occurs only in warm, ponded embayments.

Weak lateral cusps occur on 1 or more pereonites 6–7 and pleonites 1–2 especially on males with largest teeth; giant specimens, near 5 mm in length, have a cusp on pereonite 7 just above coxa 7.

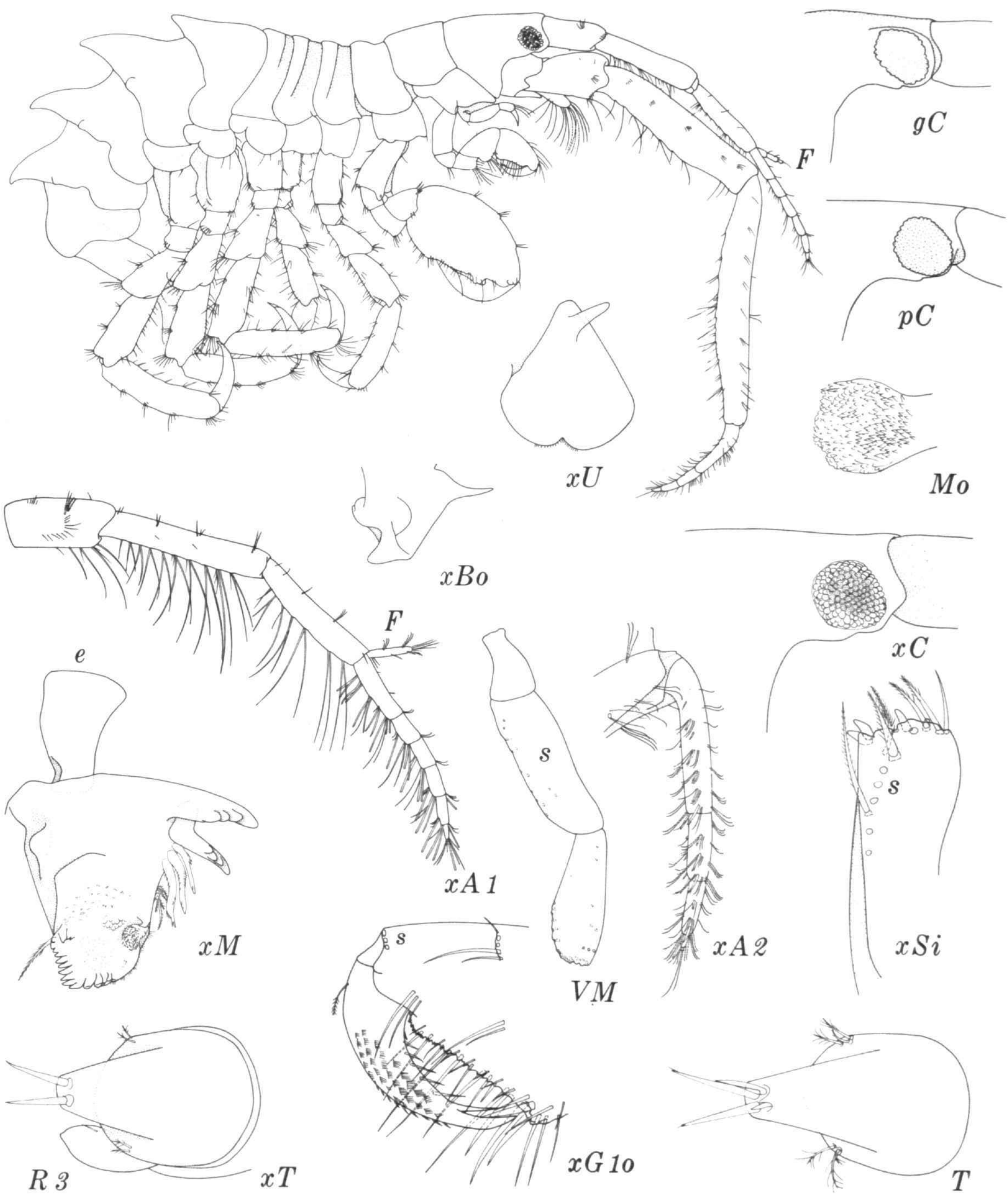

FIGURE 73.—*Podocerus fulanus* J. L. Barnard, male "a," 5.4 mm (*g* = male "g," 4.0 mm; *p* = male "p," 4.2 mm; *x* = male "x," 5.3 mm).

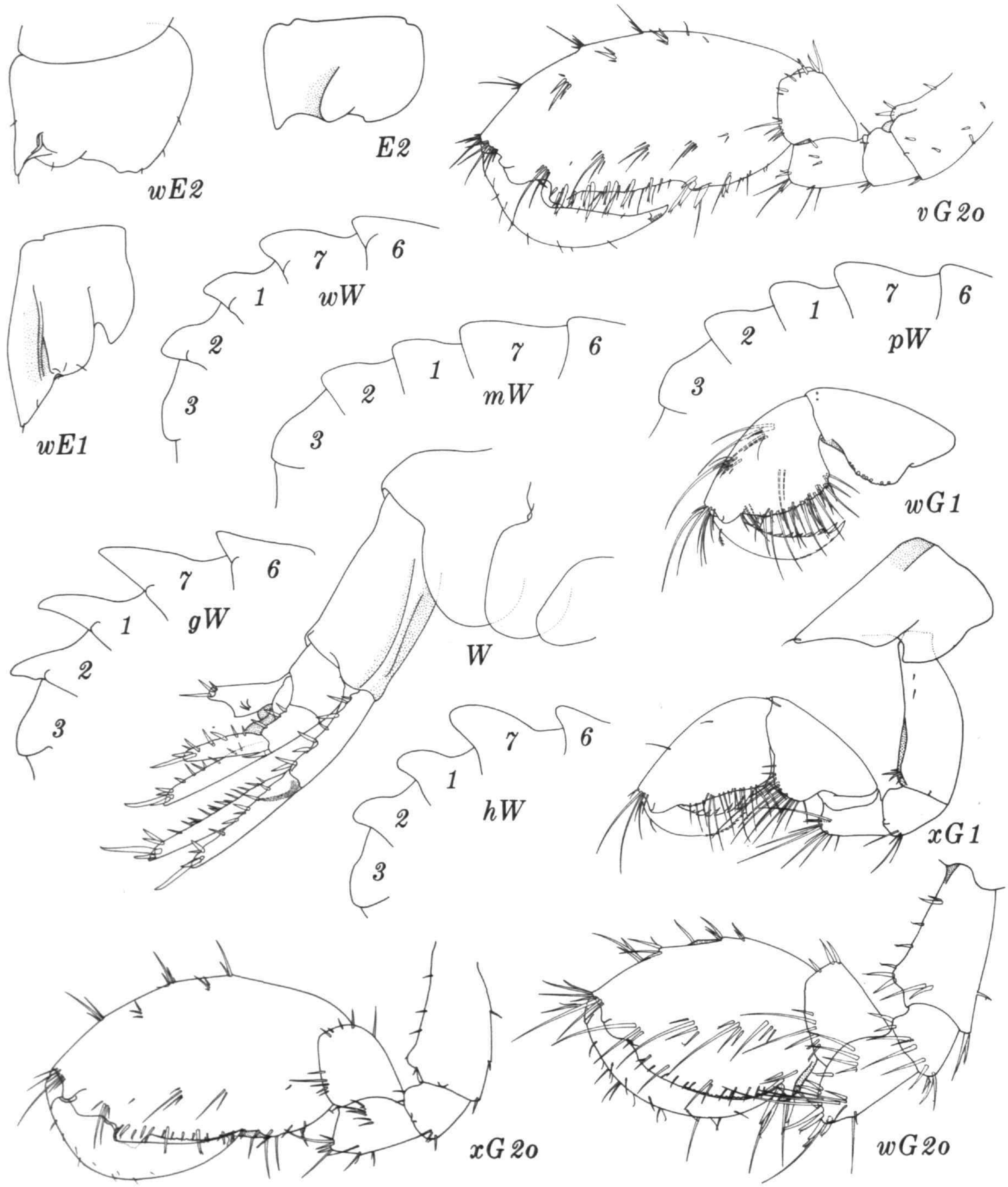

FIGURE 74.—*Podocerus fulanus* J. L. Barnard, male "a," 5.4 mm (*g* = male "g," 4.0 mm; *h* = male "h," 3.4 mm; *m* = male "m," 3.6 mm; *p* = male "p," 4.2 mm; *w* = female "w," 5.1 mm; *x* = male "x," 5.3 mm).

MATERIAL.—SCO 1, 10, 14, 15, 18, 21; KNO 1; TOP 3; PAZ 3, 13.

DISTRIBUTION.—Gulf of California at Puerto Peñasco, Bahía de Los Angeles, Bahía Kino, Topolobampo, Bahía San Evaristo and Isla Espiritu Santo, 0–42 m; California, Newport Bay, 0–2 m.

Podocerus spp.

Podocerus brasiliensis.—J. L. Barnard, 1962a:67.
P. cristatus.—J. L. Barnard, 1962a:67.

REMARKS.—The true *P. brasiliensis* from Brazil and true *P. cristatus* from Australia have not been clarified recently, although they have been identified from widely spread localities throughout the world. Until they have been analyzed satisfactorily there is little purpose in continuing to identify these species from places outside their type-areas. The material at hand will require clarification. A variety of cuspidation patterns occurs on male gnathopod 2, mixing both *brasiliensis* and *cristatus* forms and gradations between. All but a few specimens bear the *brasiliensis* body form.

MATERIAL.—The *brasiliensis* form: SCO 14 (3), SCO 15 (3), SCO 18 (3); TOP 2 (2), TOP 3 (16); PAZ 24 (26); GAL 120 (2); DAW 19 (1); *cristatus* form: SCO 18 (1), PAZ 12 (1).

Appendix

Station Data

SCO, KNO, TOP, PAZ, BRU, and SNY samples collected by J. L. Barnard and associates from the Gulf of California at Puerto Peñasco, Bahía Kino, Topolobampo, and region of La Paz on Baja California.

SCO 1, Puerto Peñasco, 17 October 1970, intertidal, general algal wash, 12 rocks, 2 liters algae.

SCO 2, Puerto Peñasco, 18 October 1970, intertidal, thin layer of turf algae on platform. No amphipods.

SCO 3, Puerto Peñasco, 18 October 1970, intertidal, one rock on moist substrate (shell sand) in platform zone. No amphipods.

SCO 4, Puerto Peñasco, 18 October 1970, intertidal, 0.02 m^2 of sandy algal turf. No amphipods, tanaids only.

SCO 5, Puerto Peñasco, 18 October 1970, intertidal, 1 piece of algae.

SCO 6, Puerto Peñasco, 18 October 1970, intertidal, shale rock 51 × 33 cm, 0.02 m^2 of lower surface covered with sponges and *Amaroucium*.

SCO 7, Puerto Peñasco, 18 October 1970, intertidal, 0.02 m^2 of brown alga in wet pool.

SCO 8, Puerto Peñasco, 18 October 1970, intertidal, 0.02 m^2 of sandy *Padina* in wet pool.

SCO 9, Puerto Peñasco, 14 November 1970, 29–38 m, shrimp trawl, coll. J. R. Hendrickson and Fidel Mendoza Lopez on trawler, squid embryos.

SCO 10, Puerto Peñasco, 23 February 1971, intertidal, *Sargassum* sp. (thin form), 0.5 liter.

SCO 11, Puerto Peñasco, 23 February 1971, intertidal, one red alga, cf. *Gigartina johnstonii*, hanging on rock.

SCO 12, Puerto Peñasco, 23 February 1971, intertidal, wash cf. *Colpomenia* sp.

SCO 13, Puerto Peñasco, 23 February 1971, intertidal, 0.005 m^2 of zoantharians.

SCO 14, Puerto Peñasco, 24 February 1971, intertidal, rocks at low water, washed.

SCO 15, Puerto Peñasco, 24 February 1971, intertidal, sponge, cf. *Leucetta losangelensis*.

SCO 16, Puerto Peñasco, 24 February 1971, intertidal, bryozoan turf and sponges on underhang.

SCO 17, Puerto Peñasco, 24 February 1971, intertidal, 0.02 m^2 sandy algal turf free of *Colpomenia* near lowest tide level.

SCO 18, Puerto Peñasco, 24 February 1971, intertidal mix of *Padina* and brown *Ulva* on cataract and sandy broken rock.

SCO 19, Puerto Peñasco, 25 February 1971, intertidal, general wash of *Padina* sp. plus *Sargassum canouii* (recent winter bloom).

SCO 20, Puerto Peñasco, 25 February 1971, intertidal, 0.02 m^2 algal turf, same place as SCO–2, tanaids only.

SCO 21, Puerto Peñasco, 25 February 1971, intertidal, sprigs of *Sargassum johnstonii* (about 1 year old), with conspicuously attached sandy agglutinations.

SCO 22, Puerto Peñasco, 25 February 1971, intertidal, sprigs of *Sargassum canouii* (new bloom), sandy agglutinations present only on axils.

KNO 1, Bahía Kino, 31 October 1970, 0–2 m, mass wash, brown algae, corallines, sponge, *Amaroucium*, gorgonians, scuba diving, coll. J. R. Hendrickson, J. Wood, F. Wood.

KNO 2, Bahía Kino, 1 November 1970, intertidal, 0.02 m^2 small brown algae, barnacles on platform 0.67 m above water. (Alga turns green in formaldehyde.)

KNO 3, Bahía Kino, 1 November 1970, intertidal, 0.02 m^2 *Enteromorpha* on crustose nobs 0.67 m above low water.

KNO 5, Bahía Kino, 1 November 1970, intertidal, 0.02 m^2 *Ulva* tufts on knobbly surface.

KNO 6, Bahía Kino, 1 November 1970, intertidal, rock wash at splash zone, rocks bare above, with holothurians and tube worms underneath.

KNO 7, Bahía Kino, 1 November 1970, intertidal, algae in hermit crab zone, 2 specimens of *Elasmopus* sp., 3 specimens of *Hyale* sp.

KNO 8, Bahía Kino, 1 November 1970, intertidal, brine pool at upper level, 1 amphipod, 5 worms, vinegaroons, flying insects.

KNO 9, Bahía Kino, 1 November 1970, intertidal, combined scrapings of *Ulva* and *Enteromorpha* on knobbly surface, coll. J. R. Hendrickson. No amphipods.

KNO 10, Bahía Kino, 1 November 1970, intertidal, general gravel wash including clumps of *Enteromorpha*, coll. J. R. Hendrickson.

TOP 1, Topolobampo, 25 November 1971, 1.6 km seaward of town, upper intertidal, shale and flint rocks washed.

TOP 2, Topolobampo, 25 November 1971, 1.6 km seaward of town, 1 m, tunicates and sponges on rocks.

TOP 3, Topolobampo, 25 November 1971, 1.6 km seaward of town, 1 m, tunicates and sponges on rocks, whole rocks washed.

PAZ 1, Bahía Pichilinque, La Paz, 27 November 1971, intertidal, masses of dead red algae adjacent to mangrove swamp. Mostly nebalians and snails.

PAZ 2, Bahía Pichilinque, La Paz, 27 November 1971, intertidal, open pebble reef, 0.5 liter red algae washed.

PAZ 3, Isla Espiritu Santo, Bahía San Gabriel, 28 November 1971, 0.3–1.0 m, rocks covered with finely anastomosed brownish red alga in band of phyciferous rocks 3–7 m wide.

PAZ 4, Isla Espiritu Santo, Bahía San Gabriel, 28 November 1971, old oyster ponds packed with *Caulerpa sertularioides*, wash. No amphipods.

PAZ 5, Isla Espiritu Santo, Bahía Ballenas, 28 November 1971, 1 m, wash of 6 rocks covered with *Caulerpa sertularioides*.

PAZ 6, Isla Espiritu Santo, Isla Partida rift, 29 November 1971, intertidal, wash of 4 rocks covered with *Caulerpa sertularioides* and brownish red alga.

PAZ 7, Isla Espiritu Santo, Isla Partida rift, 29 November 1971, intertidal, wash of 30 pebbles and substrate on shingle beach.

PAZ 8, Isla Partida, Bahía Cardonale, 29 November 1971, intertidal, old oyster weirs on N side, wash of brownish red algae on sand bottom.

PAZ 9, Isla Partida, Bahía Cardonale, 29 November 1971, intertidal wash of old coral rubble cobbles covered with *Caulerpa sertularioides*.

PAZ 10, Isla San Francisco, east bay, 30 November 1971, wash of intertidal cobbles covered with green felt turf.

PAZ 11, Isla San Francisco, east bay, 30 November 1971, 2 m, wash of 4 liters of *Caulerpa sertularioides* on sand bottom.

PAZ 12, Bahía San Evaristo, 1 December 1971, intertidal, SE point, wash of 4 large muddy rocks covered with short brownish felt turf and green patches of algal scum.

PAZ 13, Bahía San Evaristo, 1 December 1971, intertidal, NE point, wash of nonmuddy rocks covered with short tufted brownish red algae.

PAZ 14, 11 km E of Cabo San Lucas at Bajo Colorado Hotel, 4 December 1971, intertidal, 200 cc closepacked green alga.

PAZ 15, 11 km E of Cabo San Lucas at Bajo Colorado Hotel, 4 December 1971, intertidal, 200 cc of *Codium*.

PAZ 16, 11 km E of Cabo San Lucas at Bajo Colorado Hotel, 4 December 1971, intertidal, 200 cc wiry brown alga.

PAZ 17, 11 km E of Cabo San Lucas at Bajo Colorado Hotel, 4 December 1971, intertidal, 200 cc of small *Padina*.

PAZ 18, 11 km E of Cabo San Lucas at Bajo Colorado Hotel, 4 December 1971, intertidal, wash of 1 liter golden *Pelvetiopsis*(?) with golden shrimp.

PAZ 19, 11 km E of Cabo San Lucas at Bajo Colorado Hotel, 4 December 1971, intertidal, 200 cc of small polychaete tubes in sand at low water.

PAZ 20, 11 km E of Cabo San Lucas at Bajo Colorado Hotel, 4 December 1971, intertidal, 1 liter "pinetree" red alga.

PAZ 21, 11 km E of Cabo San Lucas at Bajo Colorado Hotel, 4 December 1971, intertidal, 1 liter heavy green subcalcareous algae.

PAZ 22, 11 km E of Cabo San Lucas at Bajo Colorado Hotel, 4 December 1971, intertidal, 1 liter curl-stripe golden bronze alga in tidepool of barnacle zone.

PAZ 23, 11 km E of Cabo San Lucas at Bajo Colorado Hotel, 4 December 1971, intertidal, 300 cc green scum algae at high tide level, probably *Enteromorpha* and *Ulva*.

PAZ 24, Bahía Concepción, 24 km on east side from entrance, 6 December 1971, 1 m, wash of 6 rocks covered with short cropped brownish red alga in zone 2 m wide.

PAZ 25, Bahía Concepción, 16 km on east side from entrance, 6 December 1971, 1 m, wash of almost dead *?Pelvetiopsis* on rocks.

PAZ 26, Bahía Concepción, 16 km on east side from entrance, 6 December 1971, beach wrack of *?Pelvetiopsis*, wash of 3 liters. No amphipods.

BRU 1: Bahía San Carlos, 24 January 1971, rocky intertidal, collected by Dr. R. C. Brusca.

BRU 2: Guaymas, 25 January 1971, rocky intertidal, collected by Dr. R. C. Brusca.

SNY 1: Puerto Peñasco, 27 January 1975, in hermit crab shells, collected by Elaine Snyder.

GAL, ECU(ador), COCOS, and PAN, samples collected by J. L. Barnard and associates from the Galapagos Islands, Ecuador, and Cocos Island, especially Isla Santa Cruz and Tower Island (Isla Genovesa); note that 36 samples (GAL 122–157) from Isla San Salvador, Isla Baltra, and northern Isla Santa Cruz were not analyzed.

GAL 101, Isla Santa Cruz, Academy Bay, 23 January 1964, area east of lower bodega (warehouse), alga *Cystophyllum?*, 4 liters washed, strongly wave-dashed, strained through 32 Tyler mesh, 15:06 hours, 0.0 tide.

GAL 102, same data as GAL 101, 20 rocks in tidepool washed, 30° C water temperature in tidepool partially sea-connected.

GAL 103, same data as GAL 101, mangrove tidepool 305 m from sea near lower bodega, *Hyale*, and palaeomonid shrimps, tidepool fluctuates with tide but not sea-connected at surface.

GAL 105, same data as GAL 101, wash of 25 *Eucidaris* collected subtidally by Durham and Abbott, many amphipods on spines.

GAL 106, Isla Santa Cruz, 24 January 1964, Academy Bay, offshore of lower bodega in skiff, underwater rocks, 0.3–1.0 m deep, inside reef, wash of 8 liters of *Padina* in plankton net for tanaids; sort in 120 mesh screen.

GAL 107, same as 106 but screen sort of 32 mesh of remainder of sample.

GAL 108, same as 106, wash of 3 underwater rocks covered with short tufted brownish algae, some sponge, numerous gastropods, hermits.

GAL 109, Isla Santa Cruz, Academy Bay, 25 January 1964, offshore of lower bodega in skiff, underwater rocks, 1.0–1.3 m, 32 mesh screen.

GAL 110, same as GAL 109, dredge, sorted in 32 mesh, coral and shell sand, a few cumaceans.

GAL 111, same as GAL 109, coral sand bottom dredged, 32 mesh, ghost shrimps and enteropneust bottom.

GAL 112, Tower Island (Genovesa), Darwin Bay, 29 January 1964, intertidal, scrapings of zoanthids, 5 juvenile amphipods.

GAL 113, same as GAL 112, wash of about 30 small rocks and fragments of large slabs of intertidal lava overturned by crowbar.

GAL 114, same as GAL 112, rock 46 × 20 × 30 cm covered with 3–5 cm of red algal tufts, rock from lateral channel on side of sandbed in quiet water 1 meter deep.

GAL 115, same as GAL 112, wash of *Pocillopora-Porites* heads recovered by divers.

GAL 116, Tower Island, Darwin Bay, 30 January 1964, intertidal, wash of 5 rocks and 5 pieces coral head on outer coast.

GAL 117, same as GAL 116, half liter of algae from trapped pool hole behind volcanic dike connected to sea by tunnels.

GAL 118, Isla Santa Cruz, Academy Bay, 4 February 1964, intertidal adjacent to Nelson cottage, wash of ?*Cystophyllum*.

GAL 119, same as GAL 118, 3 small rocks in 0.3 m water depth.

GAL 120, same as GAL 118, 1 liter of red algae in about 0.66 m

GAL 121, Isla Santa Cruz, Academy Bay, 5 February 1964, southwest end, in Braza type lagoon, wash of one liter of *Caulerpa*, Tyler 32 mesh.

ECU 2, 3, Ecuador, Punta Centinela, 5 March 1964, N of Libertad, half low tide on sandstone reef point, unscreened samples of miscellaneous algae.

COCOS 1, Cocos Island, Chatham Bay, 8 March 1964, wash of *Pocillopora* coral and attached algae, 1 m.

COCOS 2, same as COCOS 1, but dried moss above high tide on cliff. No amphipods.

COCOS 3, same as COCOS 1, wash of rocks covered with tubes and sand, mud, and encrusted coral heads. Largely shrimp recovered.

COCOS 9, same as COCOS 1, 5 March 1964, wash of intertidal rocks with minute turf and tiny sponges.

PAN 14, Panama, Pacific side of Canal Zone, Diablo Swimming Club, 17 April 1955, wharf, wash of sponges and fouling matter from inner brackish tub.

DAW samples collected by the late Dr. E. Yale Dawson from the Galapagos Islands

DAW 1, Isla Santa Cruz, Academy Bay, 20 February 1962, wash of *Caulerpa* sp.

DAW 2, Isla Espagnola (Hood Island), 3 February 1962, algal turf wash in extreme surf.

DAW 3, Isla Santa Cruz, Academy Bay, 17 February 1962, near town landing, wash of intertidal rocks with thin turf cover of articulated corallines (*Jenia amphiroa*).

DAW 4, Isla Santa Cruz, Academy Bay, 16 February 1962, intertidal, *Hypnea* wash, 2 sets.

DAW 5, Isla Santa Cruz, 11 February 1962, intertidal wash of *Padina durvilliae*.

DAW 6, Isla Santa Cruz, Punta Nuñez, 21 February 1962, intertidal, wash of *Cystophora galapagaea*.

DAW 7, same as DAW 6, wash of *Ochtodes crockeri*.

DAW 8, Isla Santa Cruz, off Academy Bay, Isla Coamaño (Jensen Island), 13 February 1962, wash of *Cystophora*.

DAW 9, same as DAW 4, intertidal rock wash.

DAW 10, same as DAW 2, second sample.

DAW 11, Isla Santa Cruz, Academy Bay, filter tide pool back of beach next to *Distichlis* grass, blue green algal wash. No amphipods.

DAW 12, same as DAW 1, wash of *Gigartina*.

DAW 13, same as DAW 1, wash of rocks, *Ulva* and *Ectocarpus*.

DAW 14, Isla Santa Cruz, no date, wash of *Cystophora*. No amphipods.

DAW 15, same as DAW 5, wash of *Cladophoropsis* from under mangroves.

DAW 16, Isla Santa Cruz, Bahía Tortuga, 9 March 1962, algal wash from warm quiet lagoon.

DAW 17, same as DAW 8, wash of *Sargassum* and *Spathoglossum*.

DAW 18, same as DAW 8, intertidal, wash of *Plocamium*.

DAW 19, same as DAW 3, wash of small coral head.

DAW 20, same as DAW 1, wash of *Ochtodes*.

DAW 21, same as DAW 5, wash of *Ulva*.

DAW 22, same as DAW 4, wash of *Centroceras* turf.

DAW 23, same as DAW 4, wash of *Ectocarpus* on upper rocks.

DAW 24, Isla Santa Cruz, Academy Bay, 18 February 1962, wash of rocks covered with *Ulva*, in mangrove cover, intertidal.

DAW 25, same as DAW 8, wash of *Cladophoropsis* in mangrove ground cover; 1 juvenile of *Hyale* sp.

DAW 26, same as DAW 14, wash of intertidal rocks covered with short "*Ulva*."

DAW 27, same as DAW 4, rock wash in upper intertidal.

DAW 28, same as DAW 5, wash of *Blossevillea galapagensis*.

DAW 29, same as DAW 6, wash of *Glossophora Knuthii*.

DAW 30, same as DAW 1, wash of *Laurencia Hancockii*.

DAW 31, Isla Santa Cruz, halfway between Tortuga Bay and Academy Bay, 22 February 1962, 6–9 m, wash of algae and rocks.

DAW 32, same as DAW 7, wash of *Caulerpa racemosa*.

DAW 33, same as DAW 5, wash of *Laurencia* sp. turf.

DAW 34, same as DAW 1, wash of *Galexora*.

DAW 35, same as DAW 1, wash of coral head.

DAW 36, Isla Santa Cruz, bay southwest of Academy Bay, 22 February 1962, 6 m, wash of *Padina*.

DAW 37, same as DAW 3, wash of *Hypnea*.

DAW 38, same as DAW 1, wash of *Glossophora*.

DAW 39, same as DAW 24, wash of *Bostrychia*, beach hoppers only.

DAW 40, same as DAW 4, intertidal rock wash.

Literature Cited

Abildgaard, P. C.

1789. *Zoologia Danica seu animalium Daniae et Norvegiae rariorum ac minus notorum descriptiones et historia.* Volume 3, 120 pages, 71 plates. Havniae: N. Mölleri et Filii.

Alderman, A. L.

1936. Some New or Little Known Amphipods of California. *University of California Publications in Zoology,* 41:53–74, 51 figures.

Audouin, V.

1826. Explication sommaire des planches de Crustacés de l'Egypte et de la Syrie, publiées par Jules-César Savigny, membre de l'Institut; offrant un exposé des caractères naturels des genres, avec la distinction des species. *Description de l'Égypte, histoire naturelle,* 1:77–98.

Barnard, J. L.

1952a. Some Amphipoda from Central California. *Wasmann Journal of Biology,* 10:9–36, 9 plates.

1952b. A New Amphipod of the Genus *Ceradocus* (*Denticeradocus*) from Lower California. *Bulletin of the Southern California Academy of Science,* 51: 55–59, plates 11–13.

1954a. Marine Amphipoda of Oregon. *Oregon State Monographs Studies in Zoology,* 8: 103 pages, 33 plates, 1 figure.

1954b. Amphipods of the Family Ampeliscidae Collected in the Eastern Pacific Ocean by the *Velero III* and *Velero IV. Allan Hancock Pacific Expeditions,* 18: 137 pages, 38 plates.

1955a. Gammaridean Amphipoda (Crustacea) in the Collections of Bishop Museum. *Bernice P. Bishop Museum Bulletin,* 215: 46 pages, 20 figures.

1955b. Notes on the Amphipod Genus *Aruga* with the Description of a New Species. *Bulletin of the Southern California Academy of Science,* 54:97–103, plates 27–29.

1955c. Two New Spongicolous Amphipods (Crustacea) from California. *Pacific Science.* 9:26–30, 2 figures.

1958. Revisionary Notes on the Phoxocephalidae (Amphipoda), with a Key to the Genera. *Pacific Science,* 12:146–151.

1959. Estuarine Amphipoda. *In* J. L. Barnard and D. J. Reish, Ecology of Amphipoda and Polychaeta of Newport Bay, California. *Allan Hancock Foundation Publications Occasional Paper,* 21:13–69, 14 plates.

1960. The Amphipod Family Phoxocephalidae in the Eastern Pacific Ocean, with Analyses of Other Species and Notes for a Revision of the Family. *Allan Hancock Pacific Expeditions,* 18:175–368, 75 plates.

1961. Relationship of Californian Amphipod Faunas in Newport Bay and in the Open Sea. *Pacific Naturalist,* 2:166–186, 2 figures.

1962a. Benthic Marine Amphipoda of Southern California: Families Aoridae, Photidae, Ischyroceridae, Corophiidae, Podoceridae. *Pacific Naturalist,* 3:1–72, 32 figures.

1962b. Benthic Marine Amphipoda of Southern California: Families Tironidae to Gammaridae. *Pacific Naturalist,* 3:73–115, 23 figures.

1962c. Benthic Marine Amphipoda of Southern California: Families Amphilochidae, Leucothoidae, Stenothoidae, Argissidae, Hyalidae. *Pacific Naturalist,* 3:116–163, 23 figures.

1964a. Marine Amphipoda of Bahía de San Quintín, Baja California. *Pacific Naturalist,* 4:55–139, 21 figures.

1964b. Los anfipodos bentonicos marinos de la costa occidental de Baja California. *Revue de la Sociedad Mexicana de Historia Natural,* 24:205–274, 11 figures.

1965a. Marine Amphipoda of Atolls in Micronesia. *Proceeaings of the United States National Museum,* 117 (3516): 459–552, 35 figures.

1965b. Marine Amphipoda of the Family Ampithoidae from Southern California. *Proceedings of the United States National Museum,* 118 (3522): 46 pages, 28 figures.

1966a. Benthic Amphipoda of Monterey Bay, California. *Proceedings of the United States National Museum,* 119 (3541): 41 pages, 7 figures.

1966b. Submarine Canyons of Southern California, Part V, Systematics: Amphipoda. *Allan Hancock Pacific Expeditions,* 27 (5): 166 pages, 46 figures.

1967a. Bathyal and Abyssal Gammaridean Amphipoda of Cedros Trench, Baja California. *United States National Museum Bulletin,* 260: 205 pages, 92 figures.

1967b. A New Genus of Galapagan Amphipod Inhabiting the Buccal Cavity of the Sea-Turtle, *Chelonia mydas. Proceedings of the Symposium on Crustacea Held at Ernakulum from January 12 to 15, 1965,* 1:119–125, 4 figures.

1969a. A Biological Survey of Bahía de Los Angeles, Gulf of California, Mexico, IV: Benthic Amphipoda (Crustacea). *Transactions of the San Diego Society for Natural History,* 15:175–228, 30 figures.

1969b. Gammaridean Amphipoda of the Rocky Intertidal of California: Monterey Bay to La Jolla. *United States National Museum Bulletin,* 258: 230 pages, 65 figures.

1970. Sublittoral Gammaridea (Amphipoda) of the Hawaiian Islands. *Smithsonian Contributions to Zoology,* 34: 286 pages, 180 figures.

1971a. Gammaridean Amphipoda from a Deep-Sea Transect off Oregon. *Smithsonian Contributions to Zoology*, 61: 86 pages, 48 figures.
1971b. Keys to the Hawaiian Marine Gammaridea, 0–30 meters. *Smithsonian Contributions to Zoology*, 58: 135 pages, 68 figures.
1972a. Gammaridean Amphipoda of Australia, Part I. *Smithsonian Contributions to Zoology*, 103: 333 pages, 194 figures.
1972b. The Marine Fauna of New Zealand: Algae-Living Littoral Gammaridea (Crustacea Amphipoda). *New Zealand Oceanographic Institute Memoir*, 62:7–216, 109 figures.
1973. Revision of Corophiidae and Related Families (Amphipoda). *Smithsonian Contributions to Zoology*, 151: 27 pages.
1974. Gammaridean Amphipoda of Australia, Part II. *Smithsonian Contributions to Zoology*, 139: 148 pages, 83 figures.
1976. Affinities of *Paraniphargus lelouparum* Monod, a Blind Anchialine Amphipod (Crustacea) from the Galapagos Islands. *Proceedings of the Biological Society of Washington*, 89:421–432.
1977. The Cavernicolus Fauna of Hawaiian Lava Tubes, 9: Amphipoda (Crustacea) from Brackish Lava Ponds. *Pacific Insects*, 17:267–299, figures 1–16.

Barnard, J. L., and M. M. Drummond
1976. Clarification of Five Genera of Phoxocephalidae (Marine Amphipoda). *Proceedings of the Biological Society of Washington*, 88:515–548, 4 figures.

Barnard, K. H.
1916. Contributions to the Crustacean Fauna of South Africa, 5.—The Amphipoda. *Annals of the South African Museum*, 15:105–302, plates 26–28.
1935. Report on Some Amphipoda, Isopoda, and Tanaidacea in the Collections of the Indian Museum. *Records of the Indian Museum*, 37:279–319, 21 figures.
1940. Contributions to the Crustacean Fauna of South Africa, XII: Further Additions to the Tanaidacea, Isopoda, and Amphipoda, Together with Keys for the Identification of Hitherto Recorded Marine and Fresh-Water Species. *Annals of the South African Museum*, 32:381–543, 35 figures.
1957. Additions to the Fauna-List of South African Crustacea. *Annals and Magazine of Natural History*, series 12, 10:1–12, 8 figures.

Bate, C. Spence
1862. *Catalogue of the Specimens of Amphipodous Crustacea in the Collection of the British Museum*. iv and + 399 pages, plates 1, 1a, 2–58. London.

Bousfield, E. L.
1971. Amphipoda of the Bismarck Archipelago and Adjacent Indo-Pacific Islands (Crustacea). *Steenstrupia*, 1:255–293, 20 figures.
1973. *Shallow-Water Gammaridean Amphipoda of New England*. Ithaca: Cornell University Press.

Brandt, F.
1851. Krebse. *Dr. A. Th. v. Middendorff's Reise in den äussersten Norden und Osten Sibiriens*, series 2, Zoologie, 1:77–148, plates 5,6.

Brusca, R. C.
1974. *A Handbook to the Common Intertidal Invertebrates of the Gulf of California*. Tucson: University of Arizona Press.

Bulycheva, A. I.
1957. Morskie Bloxi Morej SSSR i Sopredel'nyx vod (Amphipoda-Talitroidea). *Opredeliteli po Faune SSSR, Akademija Nauk SSSR*, 65: 185 pages, 66 figures. [In Russian].

Calman, W. T.
1898. On a Collection of Crustacea from Puget Sound. *Annals of the New York Academy of Science*, 11:259–292, plates 31–34.

Chevreux, E.
1901. Crustacés Amphipodes: Mission scientifique de M. Ch. Alluaud aux Iles Séchelles (Mars, Avril, Mai, 1892). *Memories de la Société Zoologique de France*, 14:388–438, 65 figures.
1908. Diagnoses d'amphipodes nouveaux provenant des campagnes de la *Princesse-Alice* dans l'Atlantique nord. *Bulletin de l'Institut Océanographique de Monaco*, 122: 8 pages, 4 figures.
1911. Campagnes de la Melita: Les Amphipodes d'Algerie et de Tunisie. *Memories de la Société Zoologique de France*, 23:145–285, plates 6–20.
1926. Amphipodes I.—Gammariens (*Suite*): Voyage de la goélette *Melita* aux Canaries et au Sénégal 1889–1890. *Bulletin de la Société Zoologique de France*, 50:365–398, figures 13–35.
1935. Amphipodes provenant des campagnes du Prince Albert Ier, de Monaco. *Résultats des Campagnes Scientifiques . . . par le Prince Albert Ier de Monaco*, 90: 214 pages, 16 plates.

Chevreux, E., and L. Fage
1925. Amphipodes. *Faune de France*, 9: 488 pages, 438 figures.

Chilton, C.
1912. The Amphipoda of the Scottish National Antarctic Expedition. *Transactions of the Royal Society of Edinburgh*, 48:455–520, 2 plates.
1921a. Fauna of the Chilka Lake: Amphipoda. *Memoirs of the Indian Museum*, 5:521–558, 12 figures.
1921b. Two Examples of Abnormal Antennae in the Crustacea Amphipoda. *Annals and Magazine of the Natural History*, series 9, 8:116–118, 2 figures.
1925. Zoological Results of a Tour in the Far East: The Amphipoda of Tale Sap. *Memoirs of the Asiatic Society of Bengal*, 6:531–539, 3 figures.

Costa, A.
1853. Relazione sulla memoria del dottor Achille Costa, di ricerche su' crostacei anfipodi del regno di Napoli. *Rendiconto della Società Reale Borbonica, Accademia delle Scienze*, 1853:166–178.
1857. Ricerche sui crostacei anfipodi del regno di Napoli. *Memorie della Reale Accademia de Scienze di Napoli*, 1:165–235, 4 plates [two separates seen, one with color-tinted plates].

Dana, J. D.
1849. Synopsis of the Genera of Gammaracea. *American Journal of the Science and Arts*, series 2, 8: 135–140.
1852. Conspectus Crustaceorum quae in Orbis Terrarum Circumnavigatione, Carlos Wilkes e Classe Republicae Faederatae Duce, Lexit et Descripsit Jacobus D. Dana, Pars III: Amphipoda, No. I. *Proceedings of the American Academy of Arts and Sciences*, 2:201–220.
1853–1855. Crustacea, Part II. *United States Exploring Expedition*, 13:689–1618, atlas of 96 plates.
1856. Catalogue and Descriptions of Crustacea Collected in California by Dr. John Le Conte. *Proceedings of the Philadelphia Academy of Natural Science*, 7:175–177.

Della Valle, A.
1893. Gammarini del Golfo di Napoli. *Fauna und Flora des Golfes von Neapel und der Angrenzenden Meeres-Abschnitte Monographie*, 20: xi + 948 pages, atlas of 61 plates.

Derzhavin, A. N.
1937. Talitridae of the Soviet Coast of the Japan Sea. *Issledovanija Morej SSSR*, 23:87–112, 6 plates. [In Russian with English summary.]

Fage, L., and T. Monod
1936. La faune marine de Jameo de Agua Lac souterrain de l'Ile de Lanzarote (Canaries). *Archives de Zoologie Experimentale et Génerale* (Paris), 78:97–113, 9 figures.

Garth, John S., and Jay M. Savage
1960. Symposium: The Biogeography of Baja California and Adjacent Seas. *Systematic Zoology*, volume 9.

Giles, G. M.
1885. Natural History Notes from H.M.'s Indian Marine Survey Steamer 'Investigator,' Commander Alfred Carpenter, R.N., Commanding, No. 2: Description of a New Species of the Amphipod Genus *Melita* from the Bay of Bengal. *Journal of the Asiatic Society of Bengal*, 54:69-71, plate 3.

Griffiths, C. L.
1973. The Amphipoda of Southern Africa, Part I: The Gammaridea and Caprellidea of Southern Mocambique. *Annals of the South African Museum*, 60:265–306, figures 4–11.

Gurjanova, E. F.
1938. Amphipoda, Gammaroidea [sic] of Siaukhu Bay and Sudzukhe Bay (Japan Sea). *Reports of the Japan Sea Hydrobiological Expedition of the Zoological Institute of the Academy of Sciences, USSR in 1934*, 1:241–404, 50 figures. [In Russian with English title and summary.]
1951. Bokoplavy Morej SSSR i Sopredel'nykh Vod (Amphipoda-Gammaridea). *Opredeliteli po Faune SSSR, Akademiia a Nauk SSSR*, 41: 1029 pages, 705 figures. [In Russian.]

Haswell, W. A.
1880. On Some New Amphipods from Australia and Tasmania. *Proceedings of the Linnean Society of New South Wales*, 5:97–105, plates 5–7.

Hedgepeth, J. W.
1969. An Intertidal Reconnaissance of Rocky Shores of the Galapagos. *Wasmann Journal of Biology*, 27: 1–24, 4 figures.

Heller, C.
1867. Beiträge zur Näheren Kenntniss der Amphipoden des Adriatischen Meeres. *Denkschriften der Kaiserlichen Akademie der Wissenschaften, Mathematisch-Naturwissenschaftlichen Classe, Wien*, 26(2): 62 pages, 4 plates.

Hewatt, W. G.
1946. Marine Ecological Studies on Santa Cruz Island, California. *Ecological Monographs*, 16:185–210, 2 figures.

Holmes, S. J.
1904. Amphipod Crustaceans of the Expedition. *Harriman Alaska Expedition*, pages 233–246, figures 118–128.
1905. The Amphipoda of Southern New England. *United States Bureau of Fisheries Bulletin*, 24:459–529, many unnumbered figures, 13 plates.
1908. The Amphipoda Collected by the U. S. Bureau of Fisheries Steamer, "Albatross," off the West Coast of North America, in 1903 and 1904, with Descriptions of a New Family and Several New Genera and Species. *Proceedings of the United States National Museum*, 35(1654):489–543, 46 figures.

Hurley, D. E.
1957. Studies on the New Zealand Amphipodan Fauna, No. 14: The Genera *Hyale* and *Allorchestes* (Family Talitridae). *Transactions of the Royal Society of New Zealand*, 84:903–933, 9 figures (with subfigures).
1963. Amphipoda of the Family Lysianassidae from the West Coast of North and Central America. *Allan Hancock Foundation Publications Occasional Paper*, 25: 165 pages, 49 figures.

Iwasa, M.
1934. A New Amphipod (*Parhyale kurilensis*, n. sp.) from Urup. *Journal of the Faculty of Sciences, Hokkaido Imperial University*, series 6 (Zoology), 3(1): 7 pages, 2 plates, 1 text figure.
1939. Japanese Talitridae. *Journal of the Faculty of Science, Hokkaido Imperial University*, series 6 (Zoology), 6:255–296, 27 figures, 22 plates.

Krapp-Schickel, G.
1974. Camill Hellers Sammlung Adriatischer Amphipoden—1866 und heute. *Annalen der Naturhistorisches Museum, Wien*, 78:319–379, 28 plates.

Krøyer, H.
1838. Grönlands Amfipoder Beskrevne of Henrik Kröyer. *Det Konigelige Danske Videnskabernes Selskabs Naturvidenskabelige og Mathematiske Afhandlingar*, 7:229–326, plates 1–4.
1845. Karcinologiske Bidrag. *Naturhistorisk Tidsskrift*, NR, 1:283–345, 403, 453–638, plates 1–3, 6, 7.

Kunkel, B. W.
1910. The Amphipoda of Bermuda. *Transactions of the*

Connecticut Academy of Arts and Science, 16:1–116, 43 figures.
1918. The Arthrostraca of Connecticut. *Connecticut Geological and Natural History Survey Bulletin*, 26 (1:*Amphipoda*): 15–181, 55 figures.

Ledoyer, M.
1972. Amphipodes Gammariens . . . (Madagascar). *Tethys Supplement*, 3:165–285, 2 figures, 80 plates.

Legrand, H. C.
1951. Contribution a la fauna des amphipodes de Banyuls observations sur la ponte en hiver. *Vie et Milieu*, 2:371–380.

Mateus, A., and E. Mateus
1966. Amphipodes Littoraux de Principe et de São Tomé. *Annales de l'Institut Océanographique* (Paris), 44:173–198, 13 figures.

Monod, Th.
1970. V, Sur quelques crustacés Malacostracés des Îles Galapagos . . . *Mission zoologique Belge îles Galapagos et en Ecuador (N. et J. Leleup, 1964–1965)*, 2:11–53, 104 figures.

Myers, A. A.
1968. Some Aoridae (Amphipoda: Gammaridea) Collected by the Hancock Expeditions to the Eastern Pacific, 1931–1941. *Pacific Science*, 22:497–506, 6 figures.
1969. A Revision of the Amphipod Genus *Microdeutopus* Costa (Gammaridea: Aoridae). *Bulletin of the British Museum (Natural History), Zoology*, 17:93–148, 22 figures, 1 plate.

Nagata, K.
1965a. Studies on Marine Gammaridean Amphipoda of the Seto Inland Sea, III. *Publications of the Seto Marine Biological Laboratory*, 13:291–326, figures 27–44.
1965b. Studies on Marine Gammaridean Amphipoda of the Seto Island Sea, I. *Publications of the Seto Marine Biological Laboratory*, 13:131–170, figures 1–15.

Nayar, K. N.
1959. The Amphipoda of the Madras Coast. *Bulletin of the Madras Government Museum*, new series (Natural History Section), 6(3): 59 pages, 16 plates.
1967. On the Gammaridean Amphipoda of the Gulf of Mannar with Special Reference to Those of the Pearl and Chank Beds. *Proceedings of the Symposium on Crustacea Held at Ernakulam from January 12 to 15, 1965*, 1:133–168, 17 figures.

Pearse, A. S.
1908. Descriptions of Four New Species of Amphipodous Crustacea from the Gulf of Mexico. *Proceedings of the United States National Museum*, 34(1594): 27–32, 4 figures.

Reish, D. J., and J. L. Barnard
1967. The Benthic Polychaeta and Amphipoda of Morro Bay, California. *Proceedings of the United States National Museum*, 120(3565): 26 pages, 1 figure.

Ruffo, S.
1936. Studi sui crostacei anfipodi, I: Contributo alla conoscenza anfipodi dell'Adriatico. *Bolletino dell' Istituto di Entomologia della R. Università di Bologna*, 9:23–32, 1 figure.
1941. Studi sui crostacei anfipodi, X: Contributo alla conoscenza degli Anfipodi Marini Italiani. *Bolletino dell'Istituto di Entomologia della R. Universita di Bologna*, 11:112–126.
1947. Studi sui crostacei anfipodi, XIV: Su alcune specie di anfipodi dell'Atlantico Orientale (Isole Azorre, Canarie, del Capoverde, Annobon, Guinea Portoghese, Africa Australe). *Memorie del Museo Civico di Storia Naturale di Verona*, 1:113–130, 5 figures.
1950. Studi sui crostacei anfipodi, XXII: Anfipodi del Venezuela Raccolti dal Dott. G. Marcuzzi. *Memorie del Museo Civico di Storia Naturale di Verona*, 2:49–65, 5 figures.
1959. Contributions to the Knowledge of the Red Sea, No. 13. *Sea Fisheries Research Station, Haifa, Bulletin*, 20:1–36, 6 figures.
1969. Studi sui crostacei anfipodi, LXVII: Terzo contributo alla conoscenza degli anfipodi del Mar Rosso. *Memorie del Museo Civico di Storia Naturale di Verona*, 17:1–77, figures 1–24.

Sars, G. O.
1895. Amphipoda. *An Account of the Crustacea of Norway with Short Descriptions and Figures of All the Species*. Volume 1, viii + 71 pages, 240 plates, 8 supplementary plates.

Schellenberg, A.
1925. Crustacea VIII: Amphipoda. *In* J. W. Michaelsen, *Beiträge zur Kenntnis der Meeresfauna Westafrikas*, 3:111–204, 27 figures.
1928. Report on the Amphipoda. *In* Zoological Research of the Cambridge Expedition to the Suez Canal, 1924. *Transactions of the Zoological Society of London*, 22:633–692, figures 198–209.
1936. Zwei Neue Amphipoden des Stillen Ozeans und Zwei Berichtigungen. *Zoologischer Anzeiger*, 116:153–156, 1 figure.
1938a. Litorale Amphipoden des tropischen Pazifiks. *Kungliga Svenska Vetenskapsakademiens Handlingar*, series 3, 16(6): 105 pages, 48 figures.
1938b. Brasilianische Amphipoden, mit Biologischen Bemerkungen. *Zoologische Jahrbücher, Systematik*, 71:203–218, 5 figures.
1939. Amphipoden des Kongo-Mundungsgebietes. *Revue de Zoologie et de Botanique Africaines*, 32:122–138, 29 figures.

Shoemaker, C. R.
1916. Descriptions of Three New Species of Amphipods from Southern California. *Proceedings of the Biological Society of Washington*, 29:157–160.
1920. Amphipods Collected by the American Museum Congo Expedition 1909–1915. *Bulletin of the American Museum of Natural History*, 43:371–378, 6 figures.
1925. The Amphipoda Collected by the United States Fisheries Steamer "Albatross" in 1911, Chiefly in the Gulf of California. *Bulletin of the American Museum of Natural History*, 52:21–61, 26 figures.

1926. Amphipods of the Family Bateidae in the Collection of the United States National Museum. *Proceedings of the United States National Museum*, 68(2626):1–26, 16 figures.

1933a. Amphipoda from Florida and the West Indies. *American Museum Novitates*, 598: 24 pages, 13 figures.

1933b. Two New Genera and Six New Species of Amphipoda from Tortugas. *Papers of the Tortugas Laboratory of the Carnegie Institute of Washington*, 28:245–256, 8 figures.

1934. Two New Species of *Corophium* from the West Coast of America. *Journal of the Washington Academy of Sciences*, 24:356–360, 2 figures.

1935a. The Amphipods of Porto Rico and the Virgin Islands. *Scientific Survey of the Porto Rico and the Virgin Islands, New York Academy of Sciences*, 15:229–253, 5 figures.

1935b. A New Species of Amphipod of the Genus *Grandidierella* and a New Record for *Melita nitida* from Sinaloa, Mexico. *Journal of the Washington Academy of Sciences*, 25:65–71, 2 figures.

1938. Three New Species of the Amphipod Genus *Ampithoe* from the West Coast of America. *Journal of the Washington Academy of Sciences*, 28:15–25, 4 figures.

1941a. A New Genus and a New Species of Amphipoda from the Pacific Coast of North America. *Proceedings of the Biological Society of Washington*, 54:183–186.

1941b. On the Names of Certain California Amphipods. *Proceedings of the Biological Society of Washington*, 54:187–188.

1942. Amphipod Crustaceans Collected on the Presidential Cruise of 1938. *Smithsonian Miscellaneous Collections*, 101 (11): 52 pages, 17 figures.

1956. Observations on the Amphipod Genus *Parhyale*. *Proceedings of the United States National Museum*, 106(3372):345–358, 4 figures.

Sivaprakasam, T. E.

1970. Amphipoda from the East Coast of India, 2: Gammaridea and Caprellidea. *Journal of the Bombay Natural History Society*, 66:560–576, figures 5–12.

Skogsberg, T., and G. H. Vansell

1928. Structure and Behavior of the Amphipod, *Polycheria osborni*. *Proceedings of the California Academy of Sciences*, series 4, 17:267–295, 26 figures.

Soika, A. G.

1949. Gli anfipodi gammarini della Laguna di Venezia. *Archivio di Oceanografia e Limnologia*, 6:165–212, 7 figures.

Stebbing, T. R. R.

1897. Amphipoda from the Copenhagen Museum and Other Sources. *Transactions of the Linnean Society of London*, series 2 (Zoology), 7:25–45, plates 6–14.

1899. Amphipoda from the Copenhagen Museum and Other Sources, II. *Transactions of the Linnean Society of London*, series 2 (Zoology), 7:395–432, plates 30–35.

1906. Amphipoda, I: Gammaridea. *Das Tierreich*, 21: 806 pages, 127 figures.

Stephensen, K.

1927. Crustacea, III: *Amphipoda*. *Faune Colonies Francaises, Contribution a l'Etude de la Faune du Cameroun par Th. Monod*, 1:589–591.

1933. Amphipoda from the Marine Salines of Bonaire and Curacao. *Zoologische Jahrbücher, Systematik*, 64:437–446, 4 figures.

1944. Some Japanese Amphipods. *Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening, København*, 108:25–88, 33 figures.

1947. Amphipods from Curacao, Bonaire, Aruba and Margarita. *Studies Fauna Curacao, Aruba, Bonaire . . . Venezuelan Islands*, 3(11): 20 pages, 3 figures.

1949. The Amphipoda of Tristan da Cunha. *Results of the Norwegian Scientific Expedition to Tristan da Cunha 1937–1938*, 19: 61 pages, 23 figures.

Stimpson, W.

1857. On the Crustacea and Echinodermata of the Pacific Shores of North America. *Boston Journal of Natural History*, 6:444–532, plates 18–23.

Stout, V. R.

1913. Studies in Laguna Amphipoda. *Zoologische Jahrbücher, Systematik*, 34:633–659, 3 figures.

Thompson, G. M.

1879. New Zealand *Crustacea*, with Descriptions of New Species. *Transactions and Proceedings of the New Zealand Institute*, 11:230–248, plate 10.

Thorsteinson, E. D.

1941. New or Noteworthy Amphipods from the North Pacific Coast. *University of Washington Publications in Oceanography*, 4:50–96, 8 plates.

Tzvetkova, N. L.

1967. K Faune Ekologii Bokoplavov (Amphipoda, Gammaridea) Zaliva Poc'et (Japonskoe More). *Akademija Nauk SSSR, Zoologischeskii Institut, Issledovanija Fauny Morei*, 5:160–195, 7 figures.

Uschakov, P. B.

1948. Fauna Bespozovonochyx Amurskogo Limana i Sosednix Opresnennyx Ychastkov Sakhalinskogo Zaliva. *Notebooks of the Academician Sergei Alekseyich Zernov (Hydrobiologist)*, pages 175–191, 2 figures.

Vader, W.

1972. Associations Between Amphipods and Molluscs: A Review of Published Records. *Sarsia*, 48:13–18.

Walker, A. O.

1901. Contributions to the Malcostracan Fauna of the Mediterranean. *Journal of the Linnean Society of London: Zoology*, 28:290–307, plate 27.

1904. Report on the Amphipoda Collected by Professor Herdman, at Ceylon, in 1902. *Report to the Government of Ceylon on the Pearl Oyster Fisheries of the Gulf of Manaar, Supplementary Report*, 17:229–300, 8 plates.

1905. Marine Crustaceans, 16: Amphipoda. *Fauna and Geography of the Maldive and Laccadive Archipelagoes*, 2:923–932, figures 140–142, plate 88.

1909. Amphipoda Gammaridea from the Indian Ocean, British East Africa, and the Red Sea. *Transactions of the Linnean Society of London,* series 2 (Zoology), 12:323–344, plates 42, 43.

Wilkens, H., and J. Parzefall

1974. Die Oekologie der Jameos del Agua (Lanzarote): Zur Entwicklung Limnischer Hoehlentiere aus Marinen Vorfahren. *Annales de Spéléologie,* 29:419–434, 5 figures.

Wrzesniowski, A.

1879. Vorlaufige Mittheilungen über einige Amphipoden. *Zoologischer Anzeiger,* 2:199–202.

Index

(Page numbers of principal accounts in italics)

REQUIREMENTS FOR SMITHSONIAN SERIES PUBLICATION

Manuscripts intended for series publication receive substantive review within their originating Smithsonian museums or offices and are submitted to the Smithsonian Institution Press with approval of the appropriate museum authority on Form SI–36. Requests for special treatment—use of color, foldouts, casebound covers, etc.—require, on the same form, the added approval of designated committees or museum directors.

Review of manuscripts and art by the Press for requirements of series format and style, completeness and clarity of copy, and arrangement of all material, as outlined below, will govern, within the judgment of the Press, acceptance or rejection of the manuscripts and art.

Copy must be typewritten, double-spaced, on one side of standard white bond paper, with 1¼" margins, submitted as ribbon copy (not carbon or xerox), in loose sheets (not stapled or bound), and accompanied by original art. Minimum acceptable length is 30 pages.

Front matter (preceding the text) should include: **title page** with only title and author and no other information, **abstract page** with author/title/series/etc., following the established format, **table of contents** with indents reflecting the heads and structure of the paper.

First page of text should carry the title and author at the top of the page and an unnumbered footnote at the bottom consisting of author's name and professional mailing address.

Center heads of whatever level should be typed with initial caps of major words, with extra space above and below the head, but with no other preparation (such as all caps or underline). Run-in paragraph heads should use period/dashes or colons as necessary.

Tabulations within text (lists of data, often in parallel columns) can be typed on the text page where they occur, but they should not contain rules or formal, numbered table heads.

Formal tables (numbered, with table heads, boxheads, stubs, rules) should be submitted as camera copy, but the author must contact the series section of the Press for editorial attention and preparation assistance before final typing of this matter.

Taxonomic keys in natural history papers should use the alined-couplet form in the zoology and paleobiology series and the multi-level indent form in the botany series. If cross-referencing is required between key and text, do not include page references within the key, but number the keyed-out taxa with their corresponding heads in the text.

Synonymy in the zoology and paleobiology series must use the short form (taxon, author, year:page), with a full reference at the end of the paper under "Literature Cited." For the botany series, the long form (taxon, author, abbreviated journal or book title, volume, page, year, with no reference in the "Literature Cited") is optional.

Footnotes, when few in number, whether annotative or bibliographic, should be typed at the bottom of the text page on which the reference occurs. Extensive notes must appear at the end of the text in a notes section. If bibliographic footnotes are required, use the short form (author/brief title/page) with the full reference in the bibliography.

Text-reference system (author/year/page within the text, with the full reference in a "Literature Cited" at the end of the text) must be used in place of bibliographic footnotes in all scientific series and is strongly recommended in the history and technology series: "(Jones, 1910:122)" or ". . . Jones (1910:122)."

Bibliography, depending upon use, is termed "References," "Selected References," or "Literature Cited." Spell out book, journal, and article titles, using initial caps in all major words. For capitalization of titles in foreign languages, follow the national practice of each language. Underline (for italics) book and journal titles. Use the colon-parentheses system for volume/number/page citations: "10(2):5–9." For alinement and arrangement of elements, follow the format of the series for which the manuscript is intended.

Legends for illustrations must not be attached to the art nor included within the text but must be submitted at the end of the manuscript—with as many legends typed, double-spaced, to a page as convenient.

Illustrations must not be included within the manuscript but must be submitted separately as original art (not copies). All illustrations (photographs, line drawings, maps, etc.) can be intermixed throughout the printed text. They should be termed **Figures** and should be numbered consecutively. If several "figures" are treated as components of a single larger figure, they should be designated by lowercase italic letters (underlined in copy) on the illustration, in the legend, and in text references: "Figure 9b." If illustrations are intended to be printed separately on coated stock following the text, they should be termed **Plates** and any components should be lettered as in figures: "Plate 9b." Keys to any symbols within an illustration should appear on the art and not in the legend.

A few points of style: (1) Do not use periods after such abbreviations as "mm, ft, yds, USNM, NNE, AM, BC." (2) Use hyphens in spelled-out fractions: "two-thirds." (3) Spell out numbers "one" through "nine" in expository text, but use numerals in all other cases if possible. (4) Use the metric system of measurement, where possible, instead of the English system. (5) Use the decimal system, where possible, in place of fractions. (6) Use day/month/year sequence for dates: "9 April 1976." (7) For months in tabular listings or data sections, use three-letter abbreviations with no periods: "Jan, Mar, Jun," etc.

Arrange and paginate sequentially EVERY sheet of manuscript—including ALL front matter and ALL legends, etc., at the back of the text—in the following order: (1) title page, (2) abstract, (3) table of contents, (4) foreword and/or preface, (5) text, (6) appendixes, (7) notes, (8) glossary, (9) bibliography, (10) index, (11) legends.