J. LAURENS BARNARD

Sublittoral Gammaridea (Amphipoda) of the Hawaiian Islands

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ABSTRACT

Barnard, J. Laurens. Sublittoral Gammaridea (Amphipoda) of the Hawaiian Islands. *Smithsonian Contributions to Zoology,* 34:1–286, 1970.—Gammaridean Amphipoda from depths of 0–30 m on hard bottoms are increased from about 40 to about 120 species, including 59 new species and 9 new genera and subgenera. About half of the species is endemic. Nearly 70 percent of the faunule has come from archipelagoes to the southwest of Hawaii, but only 15 percent of the faunule is of tropicopolitan character. About 20 percent of the fauna has affinities with cool waters of the North Pacific. This is the first significant record of cool-water species of any marine group in Hawaii. Most of these species have a tubicolous ecology, suggesting that nestlers are less successful in completing the long journey from the cool waters of northern continents. All but three species with cool-water affinities have diverged specifically from their mainland ancestors and at least two require erection of new genera to describe their divergence. Other endemic genera of Hawaii have low affinities with tropical Pacific faunas and have affinities with places like Antarctica, the Caribbean Sea, and warm-temperate Australia. The tropical component of Hawaiian Gammaridea is not impoverished by a priori standards of diversity. Few elements expected to occur in Hawaii are missing. No evidence of interisland adaptive radiation has been observed, but several pairs and triads of species with sibling affinities are described as a result of successive waves of immigration of parent species. Since no cool-water stepping stones occur between Hawaii and cool mainland shores of the North Pacific, the divergent cool-water species of Hawaii probably reflect morphological changes occurring after one increment of isolation. Some of these fairly radical changes such as loss of palp articles, coalescence of urosomites, and possibly axial reversal of dominance in gnathopods are seen to be of lower conservative value than heretofore accorded. This upsets classifications in Atylidae, Dexaminidae, Aoridae, and Isaeidae to a significant degree.

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Introduction

Gammaridean Amphipoda of the Hawaiian chain were last reviewed by J. L. Barnard (1955a), but that report was based largely on a few intertidal and shallow sublittoral collections accumulated over the years in the Bernice P. Bishop Museum. The true sublittoral faunule had never been collected adequately and a somewhat impoverished fauna was presumed to be present. Through an exchange agreement between the Bishop Museum and the Smithsonian Institution, the writer was fortunate to spend 9 months of 1967 in the Hawaiian chain in order to explore this sublittoral fauna and refine the earlier taxonomy of the intertidal species.

This report treats primarily sublittoral collections, but new species, important new records, and various taxonomic problems involving intertidal amphipods are included. The littoral-sublittoral fauna is now increased from about 40 to about 120 species. Nine new genera and 59 new species are described. Several diverse genera have been studied as thoroughly as necessary to identify their individuals in most of their instars (*Elasmopus, Colomastix, Gammaropsis, Leucothoe, Lembos, Ampithoe, Gitanopsis, Photis, Podocerus*), but other genera remain to be so treated (*Hyale, Maera, Stenothoe, Cymadusa*).

This paper will be supplemented by the publication (Barnard, in press) of an illustrated key to the Hawaiian shallow-water Gammaridea; keys and special discussions on identification from that paper are therefore not included herein.

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Purpose and Scope of the Study

The effects of insular isolation on terrestrial faunas and floras and to a degree in marine biotas are well known in the Hawaiian Islands. The study at hand was not formulated to replicate or reinforce any conclusions in that area of knowledge, for the taxonomy of Indo-Pacific Amphipoda is too rudimentary for any such treatment. This study was motivated simply by the need to establish the faunistic composition of Amphipoda in tropical biotic provinces.

Only one active taxonomic program on Gammaridea is being carried out anywhere in the world tropics (Pillai and Nayar in India) and to my knowledge, except for that contemporary program, there has never been a longtime resident gammaridean specialist in the tropics. James Dwight Dana, aboard the Wilkes U.S. Exploring Expedition, came closest to this categorization nearly 130 years ago.

Previous studies in the Indo-Pacific tropics have been summarized briefly by J. L. Barnard (1965a)[1] in a study of collections from atolls in Micronesia. The tabulation of the Micronesian fauna is no more complete than was the compilation made by J. L. Barnard (1955a) for the Hawaiian Islands. To illustrate the paucity of knowledge on amphipods in the tropics, one must state that the shores and shelves of Oahu now represent the second most intensively studied tropical area (after the Madras and Ceylon coasts) in the Indian and Pacific Oceans. The number of very rare species for which only a few individuals are at hand[2] suggests that further exploratory effort would continue to reveal additional Hawaiian species but probably

[1] To that compilation should be added *Ampithoe alluaudi* Chevreux and *Pleonexes* species (now named *Ampithoe kulafi*, new species), omitted by error.

[2] Appendix 2.

with diminishing returns. The present fund of knowledge on Oahu corresponds to that of many nontropical continental shores and shelves of comparable size. This sampling of Oahu, though representing only a few square miles, presumably is a fair example of the large islands of the chain. One should expect little interisland speciation in a marine group of this kind but naturally some of the other islands may have certain species not recorded from Oahu. This circumstance is known to occur rarely in fishes and mollusks.

The exploratory effort on Oahu seems to be comparable to that effort of J. L. Barnard (1950–67)[3] in the warm-temperate of California, taking a midpoint at Corona del Mar, California, from shore to 70 meters and 50 miles in either direction. It appears to be comparable to exploration carried out in parts of the Mediterranean (to 1925), New England (to 1918), cold-temperate Norway (to 1895), Point Barrow, Alaska (to 1955), South Africa (to 1925), and New Zealand but is undoubtedly exceeded by our knowledge of the current Norwegian cold-temperate fauna, that of cold-temperate British Isles, subarctic western Russia to north Norway and the cold-temperate to subarctic northern Japan Sea to Bering Sea, including the arctic embayment of the Sea of Okhotsk, tropical west Africa, and various antarctic and subantarctic regions. These are only subjective evaluations of the efforts made in exploration of various provinces. They are necessary if we are to make any conclusions about the composition and diversity of Hawaiian Amphipoda, by balancing initial but intensive exploratory efforts against one another on the probability that a major share of the common species has been collected.

Methods

Samples of littoral and sublittoral flora, rocks, and coral heads were obtained either by wading in intertidal zones or by utilizing rock dredges aboard vessels. A few samples were obtained with the help of scuba divers. Substrates were washed in large buckets of seawater poisoned with small amounts of formaldehyde to kill the amphipods. Residues settling to the bottom of the bucket were screened through a Tyler screen of 100 mesh per inch and preserved in a seawater solution of 5 percent formaldehyde. Amphipods were removed from the samples within 2 days of the collecting period and color notes were made, the amphipods being sorted into species and then subdivided according to color phenotypes. This process readily assisted in the detection of several species that might have been overlooked but several species had as many as 4 significant color variants. Rapid sorting of the samples was possible by attention to color patterns in this artificial medium. Color in formaldehyde remained fairly stable for periods of 7 to 30 days after death. Notes on identification methods utilizing color will be presented elsewhere (Barnard, in press).

After gross sorting the specimens were represerved in 70 percent alcohol to await morphological study.

Samples of gross dimensions were made so as to collect large quantities of amphipods (see station list in Appendix 2). Generally an hour was spent collecting the materials for each sample in the field and the number of specimens of amphipods usually exceeded 10,000 per sample. Aliquots of 500 to 1,000 specimens were taken from each sample and counted by species (Appendix 2) and each sample then searched for individuals of rare species. The counts given in Appendix 2 represent the numerical proportions of each species encountered in the aliquot, the numbers occasionally having been reduced to low common denominators. Those species having only one individual in a sample represent taxa not found in the aliquot but found elsewhere in the sample. Besides aliquots many other specimens of rare species were removed from the samples for taxonomic analysis and curatorial preservation in the collections of the Bishop Musuem and the Smithsonian Institution.

Marine Biogeography of the Hawaiian Islands

A conspicuous part of the gammaridean Amphipoda differ so strikingly in their geographic affinities from other marine groups of Hawaii that a brief discussion of those groups is warranted so as to document this contrast clearly. A significant percentage (20) of Hawaiian Gammaridea appear to have direct affinities with warm and cold-temperate waters of adjacent continents and especially to warm-temperate California. Few other marine groups have any affinities with America.

Ekman (1953) summarizes the Hawaiian situation compactly. He notes in Vaughan's work on scleractinian corals their strong relationship to the western Indo-Pacific and the scarcity of endemic genera; but several reef-building families are missing from Hawaii.

More than a third of the warmwater echinoderm

[3] Supplementing and reviewing many earlier works.

species are endemic, but less than ten percent of the genera are endemic and the others are Indo-Malayan.

None of the 70 species of warmwater starfishes lives in America but a few echinoids and ophiuroids do live there.

The fish fauna has smaller percentages of endemic taxa than the invertebrates mentioned, but the west Pacific character of the fauna is even more pronounced in fishes than in the invertebrates.

Edmondson (1940) points out the following generalities about the marine invertebrate biogeography of Hawaii in greater detail than Ekman: (1) corals have their affinities with the Indo-Pacific region but are attenuated by the absence of various families and the absence of all but a few species of the characteristic genus *Acropora* except in the leeward part of the chain; Vaughan finds little relationship of corals to American waters; (2) Hawaiian echinoderms have their affinities with the Indo-Pacific, have a strong Japanese element, but a very small group is believed to have reached Hawaii from tropical America; (3) gastropods also have notable affinities with Japanese faunas though the bulk is purely Indo-Pacific; gastropods have stronger connections to tropical America than do pelecypods, most of which are endemic to Hawaii even though they have Indo-Pacific affinities; (4) many of the common Hawaiian macrocrustaceans have pan-Indo-Pacific or Japanese distributions and there is a strong influence of Polynesian Crustacea on the shores of tropical America but little evidence of migration between America and Hawaii is seen (by Rathbun).

Though students of stony corals (Scleractinia) found little relationship between the faunas of the American tropical Pacific and Hawaii, the most recent study by Squires (1959) shows that 11 of 22 species of eastern Pacific reef corals also occur in the Indo-Pacific, and 8 of 27 coral species in the Gulf of California occur in Hawaii. Ahermatypic corals of the eastern Pacific, however, have a very low specific relationship to the Indo-Pacific, for only 6 of 55 species occur to the west. A total of 18 percent of all American Pacific tropical species also occurs in the Indo-Pacific (13 out of 74 species). The generic relationships are strong with the Indo-Pacific and weak with the Caribbean.

De Laubenfels (1957) notes that a weak affinity with America is the only conspicuous relationship yet to be seen or understood in Hawaiian Porifera, but studies in that group from the Central Pacific were cut short by Dr. de Laubenfels' untimely death.

According to Knox (1958) about 43 percent of the Hawaiian shallow-water polychaetes are endemic to the islands and the relationships of the others are with Japan and Indo-Malaya rather than with the tropical Pacific. Knox treated only a portion of the fauna and since that time Hartman (1966) has reviewed the fauna. She reports 168 species of polychaetes occurring in depths of 0–200 m, of which 42 percent are endemic, 31 percent cosmopolitan or subcosmopolitan in the tropics, 13 percent of Pacific distribution and 14 percent of Indo-Pacific distribution. Connections with warm-temperate North America appear non-existent.

Hawaiian Bryozoa are comprised of 46 genera and 80 species of which only 10 species and no genera are endemic (Okada and Mawatari, 1958). Many Japanese and Californian species occur in the fauna, as yet poorly explored. Continental provinces have many times more species but are more thoroughly explored (Malay province with 637 and California-Peru with 520 species).

Kohn (1959) notes that no species of eastern Pacific *Conus* occur in Hawaii.

About 50 percent of the 400–500 species of inshore Hawaiian fish are endemic but only two endemic genera are known (Gosline, 1958). The fauna is a balanced one and not impoverished. Apparently, no specific connection occurs between Hawaii and the warm-temperate of North America (Gosline and Brock, 1960).

Endemic Gammaridea of the Tropics

Myers (1940) wrote that Hawaiian fish distributions support the thesis of Austin Clark on echinoderms, that the Atlantic Ocean is an inland sea biologically, meaning that the tropical Atlantic Ocean may be defined biogeographically by the lack of certain Indo-Pacific groups and not by the positive occurrence of unique groups. Myers and Clark are of course discussing taxa at the family level. In contrast, the endemic families of Gammaridea are so poorly represented in the tropics that a comparable analysis to that made for fishes and echinoderms has to be concerned with genera. Table 1 has been prepared as a list of facts about the Gammaridea, of which there are more than 500 known tropical species, or about 20 percent of the world total. More than 150 genera, slightly more than 25 percent

TABLE 1.—*Resume of tropical Gammaridea. Includes all Hawaiian species and those from South China Sea (Imbach, in press)*

	Genera		*Species*
Total taxa in world tropics	160		589
Pantropical endemic genera with their species	18	with	57
Pantropical, but genera not endemic, most species topically endemic	55		362
Indo-Pacific endemic genera with their species	32	with	36
Indo-Pacific nonendemic genera, but not occurring in Atlantic, with their species	24	with	51
West Atlantic endemic genera with their species	[a] 5	with	5
West Atlantic nonendemic genera, but not occurring in Indo-Pacific or east Atlantic, with their species	5	with	13
East Atlantic endemic genera, with their species	[b] 2	with	2
East Atlantic nonendemic genera, but not occurring in Indo-Pacific or west Atlantic, with their species [c]	24	with	32
Total taxa east Atlantic	72		185
West Atlantic	40		70
All Atlantic	91		238
Indo-Pacific	126		382
Total Indo-Pacific genera not occurring in Atlantic	56		
Total Atlantic genera not occurring in Indo-Pacific	36		
Total tropical endemic genera, world	55		
Total species in these endemic tropical genera			77

[a] Plus *Batea* and *Carinobatea* occurring in east Pacific.
[b] Plus *Cerapopsis* occurring in Mediterranean.
[c] Mostly from North Atlantic WT–CT.

of the known world genera, occur in the tropics. Very few pantropical endemic genera occur, for most of the pantropical genera have also spread into high latitudes or have entered the tropics from other seas. Only 32 endemic Indo-Pacific genera are known and most of these are monotypic. This approximates the number of endemic abyssal genera and demonstrates how weak Gammaridea appear to be in the tropics. This weakness may be a function of eurythermy and highly successful dispersal methods so that gammaridean genera, once differentiated, tend to radiate out of the tropics. But it also points to the fact that the Gammaridea may be less adapted to tropical climes than to cooler waters. This is especially marked by the large number of tropical west African genera that are simply imports from north Atlantic warm and cold-temperate waters and by the large number of imports to Hawaii from American cold waters. The tropics of west Africa is, of course, a narrower band of environment than an eastern continental shore and may have considerable upwelling like that occurring along western America. And Hawaiian thermal regimes are not purely tropical. West tropical Africa seems to have been adequately studied in relation to the Indo-Pacific tropics, for it has over 70 genera already reported, while nearly 130 occur in the Indo-Pacific. The entire tropical Atlantic has over 90 genera but the western Atlantic is very poorly known. The situation in Gammaridea parallels that in fishes mentioned by Myers; the tropical Atlantic can be described in terms of what it lacks of Indo-Pacific genera, while a strong secondary factor is the high fraction of genera immigrated from cooler seas to replace missing Indo-Pacific taxa. Many of these west African genera are represented by one or a few species of genera otherwise centered in higher latitudes.

The Indo-Pacific also has similar cool-water imports but a significant proportion of their records comes from the days of amphipod taxonomy when species superficially familiar to a European taxonomist were firmly identified with the European members. In my opinion, these identifications remain to be confirmed.

Composition and General Relationships of the Gammaridean Fauna

Even a rudimentary knowledge of the world of Gammaridea and especially their tropical taxa made it possible to predict with fair success the kinds of tropical amphipods that might occur in Hawaii (Table 2),[4] but the overall prediction contained two gross errors that are of interest to biogeographers. In the first place,

[4] Appendix 1 cites taxa not expected in Hawaii.

TABLE 2.—*Groups, or genera and species expected to occur in Hawaiian Islands based on past exploration (3), number and kinds of species in other parts of Indo-Pacific tropics (1), their known ranges (2), kinds of species with known affinity for islands or known affinity for tropical shores (4), known affinity for adjacent warm-temperate environments (7), or nearest insular or continental group (8), expected as ectoparasites (5), or imported by humans (6)*

Numbers in parentheses are codes for column 4. Codes 1 and 2 are amplified in columns 1 and 2. Column 3 provides quick reference to genera known to occur in Hawaii prior to 1967. Note that most would have been predicted to occur according to reasons in column 4. The partial success in predicting additional genera and species demonstrates the low occurrence of generic endemicity and the very low occurrence of sweepstakes dispersal in this marine group. But the occurrence of occasional affinities to North American warm-temperate regions upset the success of the prediction. See Tables 3 and 4. Family names listed are exclusive of genera in those families also expected. The cosmopolitan index ranges from A–G as based on 7 arbitrary geographic areas quoted in Barnard (1965a, table 1), from the Red Sea to Hawaii. The higher the letter (G is highest), the broader is the Indo-Pacific distribution. In column 5 the species expected to occur in Hawaii are in addition to any already known there. If the predicted number is lower than the actual number known to occur then the category is more diverse than predicted. The initials "NM" indicate very strong cases for predicting the number of species stated. Note that many were overfulfilled.

Genus or *group*	(1) Number of species in Indo-Pacific tropics (prior to 1967)	(2) Cosmopolitan index	(3) Species known in Hawaii (prior to 1967)	Why expected in Hawaii, by code numbers 1, 2, 3, 4, 5, 6, 7, 8	Species expected to occur in Hawaii	Total species now known in Hawaii
Acanthonotozomatidae	3	F	0	2	1	0
Ampelisca	13	F	1	1, 2	3	1
Amphilochinae, additional	0	F	0	—	—	5
Amphilochus	3	F	1	2	1	?1
Ampithoe	4	G	2	2	2	7
Anamixidae	3	D	0	8	1	1
Aorid-photid, additional	3	C	0	4	1	4
Byblis	6	E	0	1, 2	1	0
Calliopiid-eusirid, additional	3	D	0	7	1	0
Ceradocus	2	F	1	7	1	1
Cerapus	1	C	0	4, 8	1	0
Cheiriphotis	2	C	0	4, 7, 8	1	0
Chelura	1	D	1	4, 6	1	1
Chevalia	1	C	0	4, 7	1	1
Colomastix	2	G	1	2, 4, 7	1	4
Corophiidae, additional	1	A	0	—	0	0
Corophium	5	G	1	1, 2, 6	2	3
Cymadusa	4	G	3	1, 2	1NM	3
Cyproideinae	2	F	0	2, 8	1	·1
Dexaminidae	11	F	0	1, 2	2	1
Elasmopus	21	G	4	1, 2	4NM	10
Ericthonius	3	G	1	2, 6	1	1
Eriopisa-Eriopisella-etc.	3	E	0	2, 4, 7	1	4
Eusiroides	3	E	1	2, 4	1NM	1
Gammaropsis	8	F	0	1, 2	2	7
Hyale	10	G	4	1, 2	4NM	8
dunella-Listriella	2	D	0	4, 7	1	0

TABLE 2.—Continued

Genus or *group*	(1) Number of species in Indo-Pacific tropics (prior to 1967)	(2) Cosmopolitan index	(3) Species known in Hawaii (prior to 1967)	Why expected in Hawaii, by code numbers 1, 2, 3, 4, 5, 6, 7, 8	Species expected to occur in Hawaii	Total species now known in Hawaii
Isaea	0	—	0	5	1	0
Jassa [1]	1	D	0	6, 7	1	1
Lembos	12	G	2	1, 2	2	8
Lembopsis [2]	1	A	0	4, 8	1	0
Leucothoe	8	F	0	1, 2	1	3
Leucothoides	1	E	0	2, 8	1	1
Liljeborgia	3	D	0	8	1	2
Lysianassidae	16	F	0	1, 2	3	1
Maera	15	G	3	1, 2	3	7
Mandibulophoxus	1	A	0	4, 7	1	0
Megaluropus	1	C	0	7	1	0
Megamphopus-Podoceropsis	1	A	0	8	1	0
Melita	3	G	1	2	1NM	2
Paragrubia	1	E	1	2, 8	1NM	1
Paraphoxus	3	D	1	4, 7	2	1
Parelasmopus	3	F	0	2, 4, 7	1	0
Parhyale	1	G	1	2, 4	1NM	1
Parhyalella	2	E	1	4	1NM	1
Photis	9	G	1	1, 2	2NM	3
Platyischnopus	1	A	0	4	1	0
Podocerus	9	G	1	1, 2	2	3
Podoceridae, additional	2	D	0	4	1	1
Pontogeneia	1	A	1	—	0	1
Stenothoe	4	G	2	2, 6	2NM	4
Synopia	3	F	0	2, 4	1	0
Tiron	1	A	0	4, 8	1	0
Xenocheira	2	C	0	8	1	0

[1] Not *J. falcata* (Montagu), the species expected.

[2] As represented by *L. tridens* (Schellenberg) formerly in genus *Microdeutopus*.

Unexpected Genera and Their Total Species

New genera are marked with asterisks.

*Aloiloi** (1), *Atylus* (1), *Biancolina* (1), *Ischyrocerus* (3), *Kanaloa** (1), *Nuuanu** (1), *Ochlesis* (1), *Palinnotus* (1), *Parajassa* (1), *Parapleustes* (2), *Seba* (1), *Ventojassa** (1).

Genera Substituted for Familial Expectations

Amphilochidae: *Amphilochus* (3), *Gitana* (1). Aoridae: *Aoroides* (2), *Konatopus** (1), *Neomicrodeutopus* (1). Cyproideinae: *Mokuoloe** (1). Dexaminidae: *Wailele** (1). Lysianassidae: *Lysianassa* (1). Podoceridae: *Laetmatophilus* (1).

the estimates were based only on tropical components since no significant occurrence of cold-water imports was expected; in the second place, the maximal estimates based on tropical imports were expected to pinpoint, by negative occurrences, not only an impoverishment of species in common genera but the complete absence of significant familial or generic groups. The fulfillment and overfulfillment of these estimates demonstrate the presence of a rich, balanced fauna of tropical amphipods. The few missing elements appear insignificant in the final analysis and some have probably been replaced by unpredicted taxa. Several of the tropical genera are surprisingly more diverse than expected (Table 2). Appended to the tropical

TABLE 3.—*Hawaiian marine aquatic Gammaridea and their relationships, by distribution and morphological affinities*

Name of species	*Ecology*	*Endemic*	*Geographic affinity if appropriate*		*Depth Distribution in Hawaii* (m)
			Place:	*Species:*	
**Aloiloi nenue*	D	+	WT-CT?		4
Ampelisca schellenbergi	D		Hawaii to Caribbean		94–229
(*Amphilochus marionis*)			Unidentifiable; from Schellenberg, 1938		2
**Amphilochus kailua*	IN	+	WT-California	*G. vilordes*	0–5
**Amphilochus likelike*	IN	+	WT-California	*G. vilordes*	30
**Amphilochus menehune*	IN	+	WT-California	*G. vilordes*	5–30
**Ampithoe akuolaka*	D	+	North America WT	*A. pollex, A. simulans*	0
**Ampithoe kaneohe*	D	+	Micronesia	*A. kulafia*	0–4
Ampithoe orientalis	D		Philippines		0
**Ampithoe poipu*	D	+	Micronesia	*A. kulafia, A. kaneohe*	0
Ampithoe ramondi	D		Circumtropical		0
**Ampithoe waialua*	D	+	Gulf of California		0–30
**Ampithoe* species	D	+	WT-CT		0
**Anamixis stebbingi*	I		Ceylon		0–30
**Aoroides ?columbiae*	D		Oregonian		0–30
**Aoroides nahili*	D	+	Oregonian	*A. columbiae*	0
**Atylus nani*	N	+	Japan	*A. japonicus*	0
**Biancolina mauihina*	L	+	Australia or Mediterranean		0
Ceradocus hawaiensis	N	+	WT Mexico	*C. paucidentatus*	0–30
Chelura insulae	L		Circumtropical; wood borer		0
**Chevalia aviculae*	D		Circumtropical		0–30
**Colomastix kapiolani*	I	+	Antiboreal	*C. fissilingua* *C. subcastellata*	30
**Colomastix lunalilo*	I	+	Australia WT	*C. brazieri*	5
Colomastix pusilla	I		Circumtropical (?)		0
**Colomastix* species	I	+	Unknown		30
Corophium acherusicum	D		Cosmopolitan, possibly introduced		0
**Corophium ?baconi*	D		East Pacific, Alaska-Peru		2
**Corophium insidiosum*	D		Cosmopolitan, possibly introduced		0
Cymadusa filosa	D		Circumtropical		0–5
Cymadusa hawaiensis	D	+	Unknown		0
Cymadusa oceanica	D	+	Unknown		0
Elasmopus calliactis	N	+	Micronesia	*E. pseudaffinis*	0–40
**Elasmopus diplonyx*	N		Micronesia, southern Polynesia		33
Elasmopus e. hawaiensis	N	+	Galapagos	*E. e. ecuadorensis*	0
**Elasmopus hooheno*	N	+	Southern Polynesia	Presumptive	0
**Elasmopus molokai*	N	+	Southern Polynesia	*E. minimus*	0–30
Elasmopus pectenicrus	N		Circumtropical		0
**Elasmopus piikoi*	N	+	Possibly southern Polynesia		0–18
Elasmopus pocillimanus	N		Circumtropical-WT		0–30
Elasmopus rapax	N		Circumtropical-WT		0
Elasmopus spinidactylus	N		Indo-Pacific		0
Ericthonius brasiliensis	D		Cosmopolitan WT-CT		0–30
**Eriopisa hamakua*	N	+	Unknown		4
**Eriopisa laakona*	N	+	Unknown		0–4
**Eriopisella s. upolu*	N	+	Seychelles	*E. s. seychellensis*	3–30
Eusiroides diplonyx	N		Indo-Pacific		0–30

See footnote at end of table.

TABLE 3.—*Hawaiian marine aquatic Gammaridea and their relationships, by distribution and morphological affinities*—Continued

Name of species	*Ecology*	*Endemic*	*Geographic affinity if appropriate*		*Depth Distribution in Hawaii* (m)
			Place:	*Species:*	
**Gammaropsis afra*	D		Indo-Pacific		30–33
**Gammaropsis alamoana*	D	+	Oregonian-Californian	*G. thompsoni*	0–30
**Gammaropsis atlantica*	D		Indo-Pacific		2–30
**Gammaropsis haleiwa*	D	+	Unknown		2
**Gammaropsis kaumaka*	D	+	Unknown		0
**Gammaropsis pali*	D	+	Probably WT-CT		0–2
**Gammaropsis pokipoki*	D	+	Probably Indo-Pacific		2–30
**Gitana liliuokalaniae*	IN	+	CT	*Gitanopsis arctica*	4
**Gitanopsis pele*	IN	+	Caribbean	*G. tortugae*	2
Hyale affinis	N		SouthernPolynesia-Micronesia		0
Hyale ayeli	N	+	WT Southern Hemisphere, possibly Japan also	*H. media*	0
Hyale g. bishopae	N	+	Japan	*H. g. grandicornis*	0
Hyale honoluluensis	N		Micronesia; possibly race of	*H. chevreuxi*	0
**Hyale iole*	N	+	Possibly CT-WT	*?H. plumulosus*	0
**Hyale laie*	N	+	Japan	"*H. dollfusi*" of Iwasa	0
**Hyale* (*Lelehua*) *waimea*	N	+	?Tethyan	*H. carinata*	0
**Hyale* species (cf. *rubra*)	N	+	Unknown, possibly race of	*H. rubra*	0
**Ischyrocerus kapu*	D	+	CT		2–30
**Ischyrocerus oahu*	D	+	CT	*I. anguipes*	0–2
**Ischyrocerus* species C	D	+	Unknown, probably CT		30
**Jassa lilipuna*	D	+	CT		0
**Kanaloa manoa*	N	+	Antiboreal		2–30
**Konatopus paao*	D	+	California-Mexico WT		0–30
**Laetmatophilus hala*	?IN	+	Australia WT	*L. hystrix*	18–30
Lembos ?aequimanus	D		Southern Polynesia		0
Lembos intermedius	D	+	Unknown		0–4
**Lembos kamanu*	D	+	Unknown		0
**Lembos leapakahi*	D	+	Micronesia-West Africa	*L.* species *L. francanni*	0–30
**Lembos macromanus*	D		Indo-East Pacific		2–30
**Lembos pualani*	D	+	California	*L. concavus*	0–4
**Lembos waipio*	D	+	Micronesian race apparent		0–30
**Lembos* species	D	+	Unknown		0
**Liljeborgia heeia*	N	+	Micronesia-Southern Polynesia	*L. proxima*	2–30
**Liljeborgia laniloa*	N	+	Micronesia-Southern Polynesia	*L. proxima*	0
**Leucothoe hyhelia*	I		Micronesia		0–33
**Leucothoe lihue*	I	+	California-WT	*L. alata*	33
**Leucothoe tridens*	I		Micronesia		2–30
**?Leucothoides pottsi*	I		Micronesia to Caribbean		0–30
**Lysianassa ewa*	N	+	Indonesia; Caribbean	*L. cubensis* *L. heterodonta*	0–18
Maera insignis	N		Indo-Pacific		0–30
**Maera kaiulani*	N	+	Micronesia-Southern Polynesia	*M. pacifica*	4
Maera pacifica	N		Micronesia-Southern Polynesia		0–30
Maera quadrimana	N		Tropical Pacific		0–30
**Maera serrata*	N		Southern Polynesia-Micronesia		0–4
**Maera* species A (cf. *hamigera*)	N		Indo-Pacific	*M. hamigera*	30
**Maera* species B	N	+	Indo-Pacific	*M. othonides*	0
Melita appendiculata	N		Circumtropical-WT		0–30

See footnote at end of table.

TABLE 3.—*Hawaiian marine aquatic Gammaridea and their relationships, by distribution and morphological affinities*—Continued

Name of species	*Ecology*	*Endemic*	*Geographic affinity if appropriate*		*Depth Distribution in Hawaii (m)*
			Place:	*Species:*	
**Melita pahuwai*	N	+	Ceylon	*M. zeylanica*	0
**Mokuoloe ninole*	?IN	+	Unknown, possibly Caribbean		30
**Neomicrodeutopus* (?) *makena*	D	+	Boreal?		0
**Nuuanu amikai*	N	+	Unknown		18
**Ochlesis allii*	I	+	Possibly Indonesian species		0
**Palinnotus alaniphlias*	L	+	Australoafrican WT		0
**Paradexamine* (*Wailele*) *maunaloa*	I	+	Unknown		0
Paragrubia vorax	D		Indo-Pacific		0–30
**Parajassa angularis*	D		California-Mexico WT		4–30
Paraphoxus centralis		+	Unknown		?
**Parapleustes d. makiki*	N	+	Japan (Sea of)	*P. d. derzhavini*	3–4
**Parapleutes* (?) *honomu*	N	+	Boreal		33
Parhyale hawaiensis	N		Circumtropical		0
Parhyalella pietschmanni	N	+	Bermuda, Caribbean	*P. batesoni, P. whelpleyi*	0
**Photis aina*	D	+	Australia WT	*P. dolichommata*	2–30
Photis hawaiensis	D	+	Ceylon	"*P. longimanus*" of Walker	0
**Photis kapapa*	D	+	Celebes	*Photis* species of Pirlot	2–30
Podocerus brasiliensis	IN		Circumtropical		0–5
**Podocerus hanapepe*	IN	+	Australia WT	*P. inconspicuus*	0
**Podocerus t. lawai*	IN	+	Micronesia	*P. t. talegus*	0–30
Pontogeneia pacifica	N	+	Caribbean	*P. longleyi*	0
**Seba ekepuu*	I	+	New Zealand	*S. typica*	0
Stenothoe gallensis	IN		Circumtropical		0
**Stenothoe haleloke*	IN	+	CT North Atlantic	*S. monoculoides*	0
Stenothoe ?valida	IN		Cosmopolitan		33
**Stenothoe* species A	IN	+	Unknown		18
**Stenothoe* species B	IN	+	Unknown		2
**Ventojassa ventosa*	D		California-WT		4–33

[1] Asterisks indicate first records for Hawaii. WT=warm-temperate; CT=cold-temperate. Ecological symbols: D=domicolous I=inquilinous; IN=inquilinous nestler; L=lignivorous; N=nestler.

fauna is a diversity increment of more than 70 percent, an element composed mainly of cool-water species from American and Japanese waters. Few of these could have been brought to Hawaii by human means.

These conditions indicate that the main Indo-Pacific amphipod fauna probably will be found to be far more diverse than indicated by previous studies and that my estimates of Hawaiian impoverishment, based on the literature, have been too low. Probably it will be shown that: (1) the tropical component of Hawaii is indeed impoverished by a revised standard and open niches may have been partially filled with cool-water imports; (2) numerous kinds of fully tropical amphipods, though dispersed into the vicinity of the Hawaiian Islands, fail to become established because of marginal thermal conditions and the absence of suitable physical and biotic substrates (e.g., acroporan corals); (3) cool-water organisms also dispersed into the vicinity of Hawaii have been able to survive in the marginal thermal conditions because fully tropical amphipods have not occupied certain favorable niches.

The Hawaiian shallow-water fauna has the normal appearance of the tropics in the presence of numerous species of *Hyale, Elasmopus, Gammaropsis, Cymadusa, Lembos,* and *Maera,* but these widely dispersed genera are not always strong indicators of tropical conditions

for many extend abundantly through warm-temperate regions and become reduced markedly in diversity only within cold-temperate waters. There is a possibility that *Hyale* will be shown to be impoverished in Hawaii when the continental Indo-Pacific fauna is better known, but for the present the other genera mentioned above are far more diverse in Hawaii than expected and more diverse than in any other restricted locality so far studied in the Indo-Pacific.

Various other tropical indicators occur in Hawaii either as members of tropical genera or as specifically tropical species, but a large share of these also extends far into warm-temperate regions (Table 4).

About half of the Hawaiian Gammaridea is endemic, as far as known, to the Hawaiian chain (Table 4), but our knowledge of many taxa to the west and south is poor and some Hawaiian species will undoubtedly be found there. The species of *Amphilochus* and *Gitanopsis*, for instance, are presumably associated with scleractinians and this relationship has been previously

TABLE 4.—*Distribution of Hawaiian Gammaridea by groups of geographic affinity, commencing with widespread species and terminating with endemic species having highly topical (sic!) affinities*

Nonendemic Species

A. Imported by humans (see also asterisks below as possible candidates).
Corophium acherusicum, C. baconi, C. insidiosum.

B. Circumtropical and circum-warm-temperate.
Ampithoe ramondi, Chevalia aviculae, Colomastix pusilla, Elasmopus pocillimanus, E. rapax, Ericthonius brasiliensis, Melita appendiculata, Podocerus brasiliensis*, Stenothoe gallensis*, S. valida*.*

C. Circumtropical only.
Chelura insulae, Cymadusa filosa, Elasmopus pectenicrus, Parhyale hawaiensis.*

D. Indo-Pacific.
Anamixis stebbingi, Elasmopus spinidactylus, Eusiroides diplonyx, Gammaropsis afra, G. atlantica, Hyale honoluluensis, H. ayeli, Maera insignis, Paragrubia vorax.

E. Western tropical Pacific.
Ampithoe orientalis, Lembos macromanus (and east Pacific).

F. Micronesia-Polynesia.
Elasmopus diplonyx, Lembos aequimanus, Leucothoe hyhelia, L. tridens, Hyale affinis, Maera pacifica, M. quadrimana, M. serrata.

G. Caribbean Sea and tropical America.
Ampelisca schellenbergi, Leucothoides pottsi (also Micronesia).

H. Cool waters of North America and Asia.
Aoroides columbiae, Parajassa angularis, Ventojassa ventosa.

Endemic Species with Affinities Classified

I. Indo-Pacific.
Cymadusa hawaiensis, C. oceanica, Elasmopus calliactis, Erisopisella sechellensis upolu, Gammaropsis pokipoki, Lysianassa ewa, Maera species A, *Maera* species B, *Melita pahuwai, Paradexamine (Wailele) maunaloa, Photis aina, P. hawaiensis, P. kapapa.*

J. Western tropical Pacific.
Ochlesis alii.

K. Warm-temperate of Australia.
Biancolina mauihina, Colomastix lunalilo, Laetmatophilus hala, Palinnotus alaniphlias, Podocerus hanapepe, Seba ekepuu.

L. Antiboreal-Antarctica.
Colomastix kapiolani, Kanaloa manoa.

M. Caribbean Sea and tropical America.
Elasmopus ecuadorensis hawaiensis, Gitanopsis pele, Mokuoloe ninole, Parhyalella pietschmanni.

N. Micronesia-Polynesia.
Ampithoe kaneohe, A. poipu, Elasmopus hooheno, E. molokai, E. piikoi, Hyale laie, Lembos intermedius, L. leapakahi, L. waipio, Liljeborgia heeia, L. laniloa, Maera kaiulani, Podocerus talegus lawai.

O. Cool waters of North America and Asia ("J"=Asian species).
Aloiloi nenue, Amphilochus kailua, A. likelike, A. menehune, Ampithoe akuolaka, Ampithoe waialua, Aoroides nahili, Atylus nani (J), *Ceradocus hawaiensis, Gammaropsis alamoana, G. pali* (?J), *Gitana liliuokalaniae, Hyale g. bishopae, H. iole, H. laie* (J), *Hyale* species (J), *Ischyrocerus kapu, I. oahu, I.* species C, *Jassa liliputa, Konatopus paao, Lembos pualani, Leucothoe lihue, Neomicrodeutopus makena, Parapleustes derzhavini makiki* (J), *P. honomu, Pontogeneia pacifica, Stenothoe haleloke.*

P. Unknown affinities.
Colomastix species, *Eriopisa hamakua, E. laakona, Gammaropsis haleiwa, G. kaumaka, Hyale (Lelehua) waimea, Lembos* species, *Nuuanu amikai, Paraphoxus centralis, Stenothoe* species A, *Stenothoe* species B.

unknown and unstudied in the tropics. The small-bodied taxa have apparently been ignored or overlooked previously.

The other half of Hawaiian Gammaridea has broader distributions and one-seventh of the total Gammaridea is circumtropical. A few species are distributed between the central Pacific and the Caribbean Sea but most of the remainder occur either throughout the Indo-Pacific or as far west as Micronesia.

Cognates of endemic species are dominated by those with affinities to American shores, as the remaining half of the endemic species has cognates divided among the Caribbean Sea, warm-temperate Australia, the central Pacific, the Indo-Pacific, and antiboreal regions. This presumably indicates the higher frequency of long-term interruption to continuous gene flow between Hawaii and America than between Hawaii and places to the west and south. The migratory direction of all taxa between America and Hawaii cannot be elucidated. Several of the species of *Amphilochus* and *Gitanopsis* may have moved from west to east because more species of the genera occur in Hawaii than in America and because their scleractinian hosts are a stronger dominant of Hawaiian waters than of American waters. American pocilloporans also came from the west but whether Hawaii formed their stepping stone is debatable. In contrast, the amphipods *Parajassa, Ventojassa,* and other ischyrocerids may have come to Hawaii from America or Asia because the family Ischyroceridae is more typical of cool-water continents than it is of purely tropical zones.

Species of Amphipoda coming to Hawaii from the west must maintain more frequent genetic contact than those from America as there is a smaller proportion of Hawaiian species with immediate [5] southwestern affinities in relation to the total affinity structure of the Hawaiian fauna than with American affinities. Thus, 30 percent of the Hawaiian fauna is of cool-water affinity and nearly 90 percent of those species is endemic, whereas only half of the remaining 70 percent of the Hawaiian fauna with tropical affinities is composed of endemic species.

Taxa not expected to occur in the Hawaiian Islands are heavily oriented to cool waters (Table 2, terminus), primarily in warm-temperate regimes. Only *Ochlesis,* of 12 unpredicted genera, was previously known in tropical waters. Few of the remaining genera are expected to be found as common members of the ultra-tropical regime. A list of nine genera that are substitutes for predicted families is also given in Table 2, and only one of these is of widespread tropical occurrence, whereas most of the others occur primarily in nontropical waters.

The Pantropical and Indo-Pacific Element

Before the present study was commenced, the Indo-Pacific tropics had 297 species of gammarideans, 11 of them endemic to Hawaii (J. L. Barnard, 1965a, Table I and see footnote herein, p. 1). About 40 of those species are widespread through four or more of the seven regions that the Indo-Pacific was divided into by Barnard. The sum of 40 species has been amplified by recent knowledge extending ranges of a few species into the eastern Pacific. Slightly more than half of those species (22) has been collected in Hawaii but several of the remainder can possibly be dismissed as "problem" records. For example, *Leucothoe furina* and *L. spinicarpa,* as representative of widespread species, may be the result of taxonomic errors and *Elasmopus spinimanus* may be the catchall for various misidentifications. Two species of *Synopia* have not been looked for in Hawaii, and various others like *Cyproidea ornata* are difficult to find in cursory surveys. The list of missing members of the 40 is narrowed to the following significant species, that, were they in Hawaii, should have been collected in the surveys so far completed: *Ceradocus "rubromaculatus,"* [6] *Cerapus tubularis, Cheiriphotis megacheles, Jassa falcata, Maera inaequipes, Lembos podoceroides,* and *Parelasmopus suluensis.* The latter two species are confined to the Indo-Pacific region and their absence in Hawaii might indicate Hawaii's isolation or weakly tropical thermal regime but the absence of the other four may indicate primarily isolation as they also occur in the eastern Pacific Ocean. How they may have bypassed Hawaii is of considerable interest. Other widespread species like *Leucothoella bannwarthi, Dexaminoides orientalis,* and *Iphimedia discreta* have been sought in Hawaii but the first two may occur on ascidians and may not have been able to reach Hawaii without a simultaneous journey of their hosts.

Significantly, only two species of Indo-Pacific tropical *Ceradocus* occur, the widespread *C. "rubromacu-*

[5] Referring to northeastern Micronesia and the nearest parts of Polynesia to Hawaii.

[6] Tropical records of this warm-temperate Australian species may be of erroneous identification.

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latus" everywhere but Hawaii, and the endemic *C. hawaiensis*. Though *Cheiriphotis megacheles* occurs from the Indian Ocean eastward to the warm-temperate of California and lives sympatrically in Mexico with *Ventojassa ventosa* and *Parajassa angularis*, the missing *Cheiriphotis* in Hawaii may be the result of the presence of only two niches available for this morphotype; *Cheiriphotis* strongly resembles the other two genera in physical appearance.

The presumed absence of *Cerapus tubularis* reflects the possibility that an organism obligatorily living in a portable cone made of sand grains has not been able to make the long journey to Hawaii whereas organisms with fixed soft tubes would not easily fall off of flotsam. But *C. tubularis* has made the journey from Asia and Europe to N. America or vice versa.

The absence of *Jassa falcata* and *Maera i. inaequipes* may reinforce the heretofore weak supposition that they have been distributed in subcosmopolitan degree by ships rather than by natural means and that, by chance alone, the ships coming to Hawaii have succeeded in bringing *Corophium acherusicum, C. insidiosum*, perhaps *Elasmopus rapax, Stenothoe valida, S. gallensis*, and *Podocerus brasiliensis* but have failed to bring the other 2 species.

The vacuum formed by the absence of an expected acanthonotozomatid is filled by an ochlesid, representing a monotypic family presumed to have evolved from acanthonotozomatid ancestors.

Members of the Calliopiidae such as *Atylopsis* and *Apherusa* have been found in tropical and warm-temperate zones but none has been found in Hawaii.

Tropical genera like *Idunella, Byblis, Tiron*, and *Isaea*, missing so far in Hawaii, occur on sedimentary bottoms or on fishes and have not been pursued.

One might presume that among the list of 297 Indo-Pacific tropical species occurs a significant number that, as explorations continue, will be found to be more widespread than is now known. If not found in Hawaii, these widespread species, when added to the present list, will impart a stronger measure of isolation, and perhaps impoverishment, to the Hawaiian analysis than now shown.

The Pacific Tropical Element

Though Hawaii has many of the pantropical and widely dispersed Indo-Pacific elements in its fauna, they, like the restricted fauna of the central and western Pacific Ocean, have their migratory pathways to Hawaii through the tropical islands nearest Hawaii. The nearest archipelagos are the Line Islands to the south, the Phoenix and Gilbert Islands to the southwest, and the Marshall Islands to the west-southwest. Johnston Island may serve as a stepping stone for southern Polynesian and Micronesian species dispersing to Hawaii. That small atoll "717" miles from Honolulu may be a stepping stone for fishes (Gosline, 1955). Whereas 14 fishes of southern origin have reached Johnston but have not passed on to Hawaii, 16 fishes otherwise endemic to Hawaii have also reached Johnston. Gosline concludes that Johnston is an outlier of the Hawaiian Archipelago rather than a peripheral component of the central Pacific faunal area. The two groups of fishes are notably subequal in number (16 and 14) and this might indicate that Johnston formed a perfect stepping stone except for the probability that the pressure of migration toward Johnston from the west and south must be higher than that from Hawaii. In view of the impressive list of fishes occurring in both places (86) that migratory pressure is obviously of sufficient magnitude to extend well beyond Johnston toward Hawaii from Polynesia. One must presume that most of these fishes are of central Pacific rather than Hawaiian origin. How many of those necessarily using Johnston as a stepping stone is unknown. One has to balance the small target size of Johnston and the large target size of the remoter Hawaiian chain against the probability that once a fish is entrained within a migratory journey it has a greater chance of hitting a large target than a small, despite the moderately greater distance of the larger target.

Phycophilous Gammaridea probably do not migrate as active nekters, although the instigation of an accidental journey may come when a species has fully saturated its habitat and high numbers of individuals in a deme are carried away in flotsam by storms. I judge that few Amphipoda have necessarily required Johnston Island as a way-station for consolidation of their populations before the extended journey to Hawaii has been undertaken. But Gosline's (1955) analysis does offer evidence to refute the target theory in the sense that only a tiny fraction of fish taxa shared between the Line Islands and the Hawaiian chain does not also occur in Johnston Island. This may support the stepping stone theory unless one can demonstrate that Johnston has all of those common fishes because of extremely high dispersion pressure from the direction of the Line Islands or because many of the species have reached Johnston in remigrations from Hawaii.

Approximately 80 percent of the Hawaiian Amphipoda have passed through the nearest tropical islands, and we should expect that the strongest direct affinities of Hawaiian Amphipoda are therefore with those southwestern archipelagos, but the picture is not simple. About 75 percent of the tropical Hawaiian species that obviously had to reach Hawaii from the west or south are composed of species not strictly central Pacific in distribution. They are species of circumtropical character, or those of broad Indo-Pacific affinities. The nearby Micronesian and Polynesian archipelagos seem to have contributed only about 25 percent of the Hawaiian tropical component from their endemic members. This calculation suggests an obvious biogeographic fact that widespread marine species are hindered in their distribution by few barriers within their thermal regimes. But it also equates the proportions of imports from Micronesia-Polynesia with those from North America. Though Polynesia forms the bridge for the dispersal of cosmopolitan species, it has not provided a major share of Hawaiian species from its own pool of endemics. Micronesia may actually have a low proportion of endemics as the archipelagos are not significantly isolated from the Indo-Pacific. Lesser Polynesia is therefore not comparable to the warm-temperate of North America because the species of the latter region are essentially all classed as endemic, not distributed anywhere in the tropics, whereas the fauna of Micronesia-Polynesia is composed mostly of species distributed elsewhere in the tropics. The question is at best academic but one that could be misinterpreted by overestimating the importance of the American contribution to Hawaii in comparing its 20 percent of the input with the 20 percent input from Micronesia-Polynesia. The significance of the American input is that whereas the Micronesian-Polynesian element is presumably broadly preadapted to existence in Hawaii, the cool-water American element is not. The contrast is not completely extreme, however, for Hawaii is not metatropical and many Polynesian elements presumably would not survive on its shores. The real Micronesian-Polynesian element must include all of its nonendemic components. In balancing the mechanisms one must consider the species of the pantropical element in a different light from others. Most of them would have reached and have become established in Hawaii under most circumstances; they occur *in* and therefore originated *from* Micronesia-Polynesia. The cool-water American element may have reached the importance of the endemic Micronesia-Polynesia element because that tropical element is low in diversity, whereas the American element is extremely high in diversity.

Two conspicuous elements of the Polynesian-Micronesian fauna do not appear to have reached Hawaii. *Xenocheira,* with two species in Australia, Indonesia, and Polynesia, and the very abundant Micronesian *Lembopsis tridens* (Schellenberg) (formerly placed in the genus *Microdeutopus*) have not been found in Hawaii.

The Cool-Water Northern Element

Establishment of Hawaiian species in archipelagos to the south and west of Hawaii may be difficult to detect in various marine groups unless one can recognize them through generic analysis and values of probability, because Hawaii apparently is a destination and not a stepping stone for species coming from cool-water America. In another vein Hawaii may be far less significant as a stepping stone from west to east than the Marquesas Islands. No Hawaiian group other than Amphipoda, as yet studied, seems to have any significant affinities with the Americas except perhaps in the direction from west to east (corals). Approximately 25 species of Hawaiian Amphipoda have clear affinities with North America and if cognates of those species occur to the west and south of Hawaii in such places as the Line Islands or the Marshall Islands, one must presume very strongly that Hawaii served as the stepping stone and the evolutionary ground for those taxa. But there is little doubt that any of the cool-water Hawaiian imports will be found in those other places, even as far as Johnston Island. The fishes of Hawaii, as an example of most of the known marine groups, have no affinities with North America; they are of Indo-Pacific tropical origin and in possibly passing to and from Hawaii have left little direct evidence of their migratory directions. One may thus suggest that Hawaii is almost completely positive as an area of biological demand and almost completely negative as an area of biological supply as far as Amphipoda are concerned.

The discovery of a significant fauna of cool-water American origin in Hawaii adds another facet to the calculations heretofore described in attempting to predict the faunal structure of Hawaiian Amphipoda. The previous discussion on the tropical Hawaiian component has already demonstrated that no significantly

diverse tropical group of amphipods has failed to reach Hawaii, although the Lysianassidae are short of species in comparison to the coasts of India. We must consider which of those elements in the rich American faunule has succeeded in becoming established and which has not, so as to suggest, perhaps, fruitful lines of ecologic inquiry. Amphipoda of epifaunal habitat have to be separated from the North American faunal pool because the Hawaiian mud-bottom fauna is not being considered (Table 6).

Again, as in previous conclusions, this discussion is under the influence of various exploratory deficiencies. The score of Hawaiian species with American affinities has been detected primarily under an aegis of a literature that includes only warm-temperate and cold-temperate America. Tropical America is virtually unknown. Additional Hawaiian species may have tropical American affinities and, indeed, several of the American warm-temperate species may extend into American tropical waters. Many of these extended species, if occurring, may not be dismissed as semiubiquitous species if they are found to occur in the tropics only in habitats influenced by cool-water upwelling. Under that circumstance, they would still qualify as cool-water species.

Almost all of the Hawaiian imports from America have an ecological relationship to marine plants but only three of them might be considered as simple nestlers (*Atylus nani, Ceradocus hawaiensis,* and *Pontogeneia pacifica*). At least a half dozen of the species are probably semi-inquilines, being associated with small sessile invertebrates that may be attached to algae or masses of dead material (*Amphilochus, Gitanopsis, Gitana,* and *Leucothoe*). The remainder are tubicolous amphipods, building soft tubes attached mainly to algae or marine grasses or occasionally hard substrates.

In the Californian epifaunal Amphipoda there are 40 species of nestlers, 10 species of inquilines, and 45 species of tubicolous habit (Table 5). The proportion of Hawaiian nestlers (about 20 percent of the total Hawaiian species with American affinities) seems fairly low in relation to the pool of continental nestlers. The high proportion of Hawaiian species of tubicolous habit (nearly 60 percent of the Hawaiian-American imports) and inquilinous relationship (20 percent) suggest that these kinds of taxa with obligatory, or semiobligatory, fixed positions are more successful in completing long and difficult journeys than are nestling amphipods. The latter may have a higher tendency to swim away from an object entrained in a journey than are amphipods with a microhoming instinct oriented to a tube, burrow, or host. The nestler would thus be lost during the journey more frequently as it would evacuate its vehicle, food, and place of rest. As the migratory vehicle passed through different hydrographic environments, the reaction of the nestler may be to swim actively so as to escape unfavorable conditions, whereas the domicolous animal may cling even tighter to its home. If the unfavorable conditions are transitory or not ultimately fatal, the domicolous animal might survive the full journey more frequently than the nestler.

A strong exception to this possibility may occur in the discovery of dense populations of the nestler *Hyale* species accompanying masses of *Sargassum* as flotsam far from shore (J. L. Barnard 1961), but the theory is not an all or none situation, and *Hyale* is not an average nestler in the sense of its enormously dense populations on that substrate. Such flotsam may also not have passed through unfavorable hydrographic conditions.

Two of the three Hawaiian nestlers of American affinity would have been of improbable prediction as one should expect the candidates from the American pool to be composed of very abundant genera in warm-temperate regions, but *Atylus,* especially, and *Pontogeneia* are rare in the Californian warm-temperate. They are primarily centered in cold-temperate waters. The species group from which the Hawaiian *Atylus* may have come is not found farther south than middle California. The one Hawaiian species of *Ceradocus* also has affinities with the southern (Mexican) species of *Ceradocus.* The genus is not abundant in Pacific warm-temperate America.

The puzzle of *Amphilochus, Gitanopsis, Konatopus,* and various ischyrocerids is discussed elsewhere.

Of the remaining species, the two members of *Aoroides,* the two of *Gammaropsis,* the one *Stenothoe,* one *Leucothoe,* and one *Ampithoe* would have been included in a prediction as they belong to genera with high population numbers on continental shores nearest Hawaii. But the occurrence of even one species of *Aoroides* might not have been predicted because of low generic diversity. The new species from Hawaii represents only the third Pacific member of the genus.

Continental Amphipoda that have not arrived in Hawaii or, by the terms of the present exploration, would not seem to be significantly abundant in Hawaii are noted in Table 6. There is a surprising conformity in the total number of epifaunal species in the Cali-

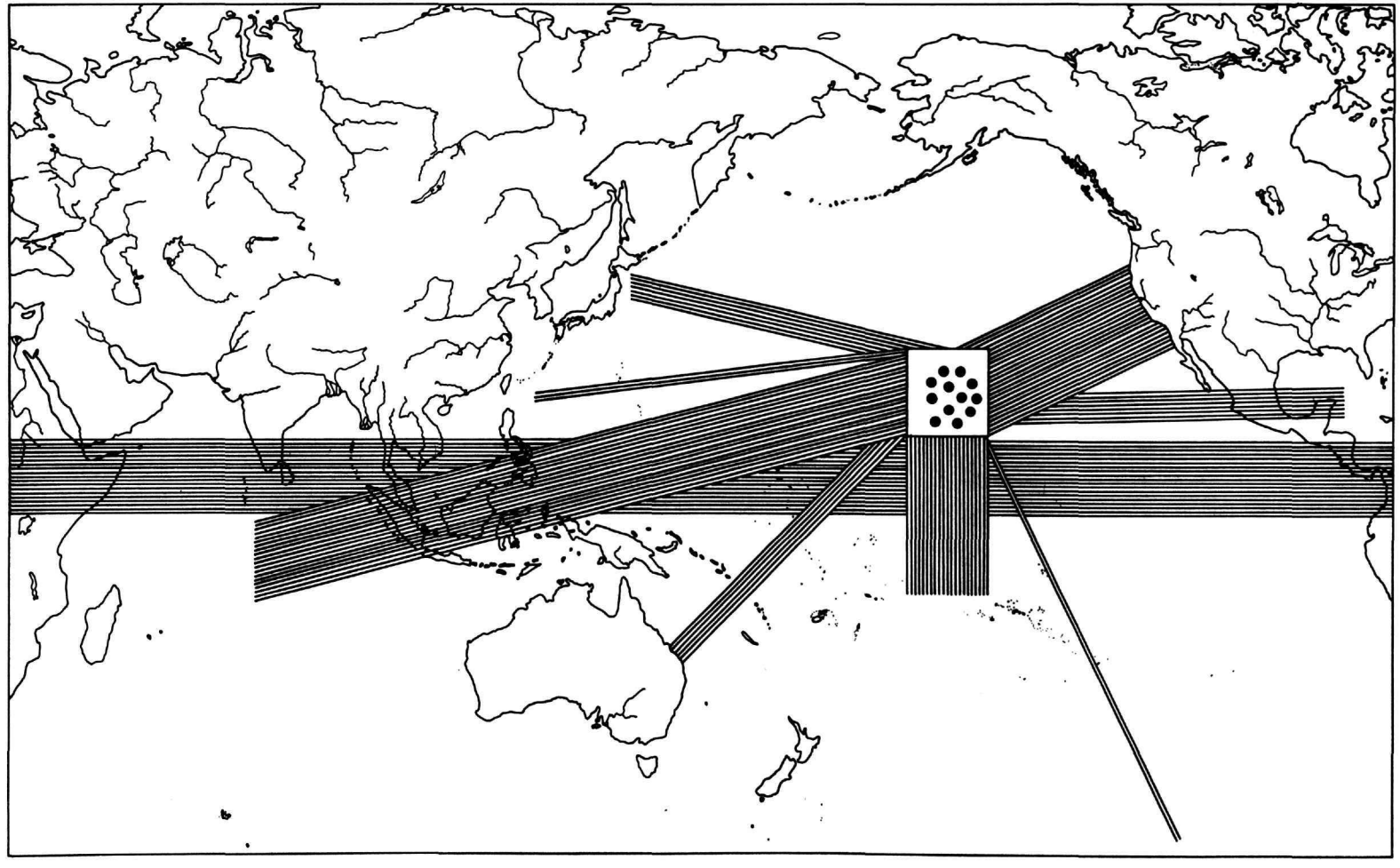

FIGURE 1.—Lines of affinity for 120 species of Hawaiian Gammaridea. Circumferential lines represent circumtropical species and dots within box enclosing Hawaiian Islands represent species with obscure affinities.

fornian warm-temperate (109) and Hawaiian (116) regions, with a fair balance in the familial and generic representation. Hawaii has only four fewer genera than does the Californian warm-temperate. There is scarcely any morphotype or niche represented in the Californian pool that is not already represented in Hawaii either through warm-temperate imports or in the tropical component.

The Southwestern Warm-Temperate Element

There can be no species in Hawaii that also occurs both in the warm-temperate Australian region and in the tropics that would not be classed as a widespread tropical-warm temperate species. No species has been identified as discontinuously distributed between the two extremes, but several endemic Hawaiian species such as *Biancolina mauihina, Colomastix lunalilo, Laetmatophilus hala, Palinnotus alaniphlias, Seba ekepuu,* and *Podocerus hanapepe* have their closest affinities with the antiwarm-temperate region. If one added these species to those widespread tropical-warm-temperate species also occurring in the Australian area, one might strike a remarkable affinity between the two areas. But several of these endemic Hawaiian species may be figmentarily related to the Australian regime as they belong to groups not yet studied in the tropics or subtropics of either the eastern Pacific Ocean or the Indo-Pacific. It may be happenstance that they are known in Australia, possibly as southward extensions from tropical centers of gravity, and not yet found in the main Indo-Pacific. They must be reserved for future consideration.

The Tropical American and Caribbean Element

Only six Hawaiian species of Ampipoda are considered presently to have affinities with tropical America. One of these species, the endemic *Gitanopsis pele,* is a very conspicuous cognate of the Caribbean *G. tortugae* and because the Pacific side of tropical America is virtually unexplored for amphipods we might presume that the more direct relationship is with a taxon in the east tropical Pacific that is either *G. tortugae* itself or another cognate. That a direct pathway between tropical America and Hawaii is possible for amphipods is shown in the occurrence of the Caribbean-E. Pacific *Ampelisca schellenbergi* in Hawaii. There is no morphological distinction among various populations of this species, and it does not qualify as a taxon that could be transported artificially.

Leucothoides ?pottsi represents the next best case of a direct connection between tropical America and the central Pacific Ocean, but there is a modicum of doubt as to whether Pacific and Caribbean populations represent the same species. Like its familial relatives it may be carried from place to place by transport of its possible host, a tunicate (or ?sponge), on ships, but in Hawaii, Micronesia, and the Caribbean Sea it is found in the open sea and only its congener *L. pacifica* has been found in unpolluted Californian harbors.

Elasmopus e. hawaiensis is a subspecies of the Galapagan *E. ecuadorensis,* but I have a few observations that suggest this epigenotype is widely scattered throughout the Pacific Ocean.

The other two species are of very dubious relationships to Caribbean taxa, but some of the cryptic species in Table 4, like *Hyale waimea,* may eventually be added to the list of Hawaiian amphipods with tropical American affinities.

Introduced, Minor, and Cryptic Elements

More than 20 species of Hawaiian Gammaridea do not fit into classifications mentioned in previous pages (various parts of Table 4). Undoubtedly, many mistakes have been made in establishing the affinities of the species heretofore mentioned, but I estimate that, as various species are shifted in classification, the end result, numerically, will be very similar to that now propounded. Ten species of unknown affinity appear to be composed of taxa of the same geographic diversity as computed elsewhere in this paper. For example, one of the species of *Eriopisa* may come from cool water and the other from the tropics, and while the stenothoids are from cool water, the *Paraphoxus* may come from tropical America.

The so-called introduced species are very difficult to evaluate. Doty (1961) has discovered an alga, *Acanthophora* species, probably introduced by shipping and already dispersed from its probable port of entry, Pearl Harbor, to the islands of Kauai and Lanai. Doty also gives references to earlier remarks on other marine organisms known to be introduced and established in Hawaii by shipping and to species known to be introduced but not established.

Numerous amphipods could qualify as candidates for introduction by means of shipping, as many of them form tubes easily attached to hard surfaces, and

many others could nestle among projections or within cavities of thick fouling masses. Some of the tubicolous imports have probably arrived in Hawaii on logs floating naturally from North America as well as logs towed slowly by boats. But little is known about the ability of amphipods to remain with ships moving at speeds creating great water turbulence. I have recovered specimens of *Corophium acherusicum* from fouling matter on the side of the R/V *Velero IV* after it had steamed at a speed of 9.5 knots for several days.

The Amphipoda immediately qualifying as those subject to artificial importation occur commonly in harbors throughout the world or are various congeners of those harbor taxa. Members of *Corophium, Ericthonius, Podocerus, Jassa,* and *Stenothoe* are the strongest candidates (Table 4, various parts). There is little doubt that *Corophium acherusicum* and *C. insidiosum* have been artificially imported to Hawaii as they maintain fairly strong harbor restriction, but the presence of *C. baconi* (if indeed it is correctly identified) may be a natural import on logs. The highly atypical sexual morphology of *C. baconi* in Hilo Harbor suggests that the population may represent a very narrow segment of the total genosome (the "founder effect"). On American shores, *C. baconi* is a sparse inhabitant of harbors for it apparently cannot tolerate the same degree of pollution as its congeners, but it also is more frequent in the open sea than the other species of *Corophium.*

Ericthonius brasiliensis and *Podocerus "brasiliensis"* [7] are strong fouling organisms in harbors, but the former is also extremely abundant in many open-sea localities. One may thus debate its mode of dispersal with equal conviction on either extreme. Both species have, so far, been found in Hawaii mostly in artificial situations such as harbors or on suspended floats and boards.

Stenothoe gallensis is a common tropical fouler and *S. valida* is a common subtropical fouler, but neither builds tubes as do the other species mentioned above. They are commonly associated with masses of hydroids. I am unsatisfied with my taxonomic appraisal of these species in Hawaii, but if they are found to be highly variable species with conspicuous shifts in morphology from one region to another, then I may have identified them correctly. So-called *S. valida* has been found in Hawaii only in association with the black-coral *Antipathes irregularis* off the east coast of Oahu in 33 m of water depth. Under normal circumstances that unusual habitat would suggest a misidentification of *S. valida,* for the species normally inhabits harbors. The associates of *Antipathes* should presumably have been sorted out as highly characteristic species long ago, but the Oahuan population of *Antipathes* is composed of colonies moved by biologists to that locale from other parts of Hawaii. One might thus expect that a eurytopic harbor fouling organism could find an open niche in such an artificial situation. But *S. valida* has not as yet been collected in Hawaiian harbors.

Species of *Elasmopus* may also be carried by shipping even though they do not make tubes on hard substrates. *Elasmopus rapax* is a common inhabitant of unpolluted harbors, and it does show a strong orientation to hard, floating substrates. I have collected it in Newport Harbor, California, as one of the first settlers on bare, anchored, floating wooden blocks. Specimens were collected occasionally even on blocks without other macroscopic foulers; perhaps they graze on microscopic fouling organisms. The Hawaiian population of *E. rapax* may be confined entirely to Pearl Harbor; I found it nowhere in the open sea in my 1967 explorations; my 1955a identification of it in Honolulu Aquarium was erroneous, and I have not been able to locate materials of it identified by me in the open sea in my report of 1955. I probably confused it with one of the other nine species now shown to be present on Hawaiian shores. Thus, *E. rapax* is undoubtedly a strong candidate for reconsideration as an import by artificial means.

The final case to be considered is that of *Tropichelura insulae,* the wood-grazer. This "wood-borer" is circumtropical in distribution and probably, like the well-known *Chelura terebrans* of cool waters, simply enlarges the tunnels of its obligatory associates, *Limnoria* species, by grazing. The question as to whether this species has been distributed around the world by modern shipping is entirely open to question. *Chelura terebrans* is also almost completely circumboreal, but the Japanese species, *Nippochelura brevicauda,* has a highly restricted distribution.

Dispersal by Rafting

Amphipoda reproduce without larval stages. Their dispersal might therefore seem to be impaired and one might expect an extraordinary degree of endemicity and impoverishment of Amphipoda in highly isolated places. On the contrary, we have adequate samples

[7] Possibly misidentified in various harbors.

of their distribution patterns and a sketchy knowledge of their shallow-water dispersal so as to suggest that even the isolated Hawaiian chain, though it might be impoverished, could have a very low endemicity of species and virtually no endemic genera. If Amphipoda reach the Hawaiian Islands at all, we might expect a recurrence of the same founders, and gene flow might be relatively continuous. As a broad generality that thesis is found to be false, though being a complex of ideas, part of the statement remains true. A duplicate recruitment of the same founders that produce cognate species appears to have some basis (see following chapter), but that mechanism requires long periods of interrupted gene flow. Isolation but not impoverishment are apparent in the Hawaiian fauna. Dispersal frequency of amphipods into the region has been high but often interrupted so as to play a role in the development of many endemic species and several novel morphotypes necessarily described in generic terms.

Rafting by means of detached marine plants, debris, and logs is the assumed primary dispersal mechanism of shallow water tropical Amphipoda. Islands within a few hundred kilometers of continents (Azores, Canaries) have few endemic species reported in their shallow waters, thus suggesting that they have been populated continuously by rafted organisms. Even the Galapagos Islands appear to demonstrate this situation by incongruous fashion (report in preparation by J. L. Barnard). For example, those equatorial islands 600 km west of Ecuador have a primarily tropical fauna of Brachyura (reproduction mainly by larvae), whereas their amphipods have a strong warm-temperate affinity (see Garth (1946) for brachyuran summary). Importation of tropical crab larvae must come during the favorable but infrequent El Niño years when warm currents reach the Galapagos from the Bay of Panama. A few crabs have arrived via the relatively constant and swift Humboldt-Peruvian current system and fewer still have come from the north and west through the meandering complex of the California current that becomes mixed with the most anti-Galapagan tropical counter-current.

Since amphipods do not disperse by larval means and presumably are carried over long distances by rafting of adults, it appears incongruous that so many warm-temperate amphipods occur in the Galapagos Islands, whereas many species from nearby Panama have not arrived there. Because few warm-temperate crabs occur in the Galapagos, one might suggest that differences in crab and amphipod reproduction play a role in faunal incongruities. Because the majority of crabs has arrived in the Galapagos as short-lived larvae, they have to come from shores nearly adjacent to the Galapagos during El Niño years. Currents during those years must also bring amphipods aboard flotsam, but the infrequency of storms in the Panamic doldrums may constrict the quantity of rafted material available, whereas storms in warm-temperate latitudes may cast much larger quantities of shallow-water debris into flotation. Although the journeys of rafts from higher latitudes may be extremely tortuous and indeed appear almost impossible from sketchy charts of currents now known, these journeys must be of higher significance to the Galapagan amphipod fauna than journeys during years of El Niño. The implication is also made that the amphipods reproduce during their journeys. But one should not dismiss the indications that the Galapagos have several characteristics of warm-temperate environments and thus are favorably situated for successful immigration of various warm-temperate taxa.

Waters of the Galapagos are only sufficiently tropical to support some impoverished patches of hermatypic corals on particular islands and *Sargassum,* a good tropical indicator in the eastern Pacific Ocean, does occur in isolated patches and might flourish more were it not for the intensive browsing of marine iguanas. Whereas many of the tropical crabs that have arrived from the continent may have been able to survive despite thermal minima below tropical limits (20°C), one may speculate whether a stronger immigration of subtropical or warm-temperate crabs might not alter that balance if it were possible for more of those species to reach the islands. If the thesis about El Niño currents and lack of storms in the Gulf of Panama were incorrect then perhaps those tropical amphipods arriving in the Galapagos have failed in many cases to meet the competition from warm-temperate amphipods arriving earlier or later.

Crabs of continental west America, except in areas of the Las Perlas Islands and near Punta Malo on the northwest Panamic shore, must be primarily eurytopic organisms able to withstand highly turbid conditions of the Central American inshore waters. Those turbid conditions seem to work against the algal flora and thus reduce the supply of materials for rafting tropical amphipods. Unless continental runoff decreases dur-

ing El Niño years, large rafts of terrestrial debris brought into the sea by rivers may become infested with amphipods once the rafts reach salt water.

Despite these numerous suppositions, the fact remains that many Galapagan amphipods are very closely related, if not identical, to species occurring in the warm-temperate zone of the Californias and there must be, or have been in fairly recent times, a ready pathway for their transmissal. The area of upwelling near Punta Malo possibly reflects a Panamanian warm-temperate outpost that supports northern amphipods. It is only academic to question the particular route of migration by calling attention to the complete absence of knowledge about antiwarm-temperate amphipods of the Peruvian-Chilean shores. If the supposed Californian-Galapagan cognates arrived from Chilean shores via the Humboldt current then that warm-temperate fauna must have Californian species established within it. Such knowledge would be strong support of a drifting hypothesis with a major connection in the upwelling area of Panama or in the Galapagos themselves.

Whereas a journey by currents from warm-temperate North America to the Galapagos is tenuous and difficult by appreciation of present-day current charts, a journey from warm-temperate North America to the Hawaiian Islands appears as a direct and almost continuous possibility. Waters entrained from the California current could pass through the Hawaiian chain as northern outliers of the North Equatorial Current. That this direction of surface sea flow dominating the oceanographic picture has had so little influence on the Hawaiian chain except in the amphipodan fauna is difficult to explain in gross terms. Most Hawaiian marine organisms have affinities with the main Indo-Pacific or with Polynesia [8] and Micronesia, but dominant surface currents coming to Hawaii from those directions do not exist although the North Pacific Current could bring immigrants over a long northern route from the China Sea region. The major share of the marine Hawaiian fauna must be a product of survival of immigrants coming from the southwest or west during occasional reverses in the gross current system, or by minor and subsurface currents as yet undiscovered. The weakly tropical Hawaiian thermal regime thus favors those occasional immigrants traveling within warm tropical waters rather than the potential warm-temperate immigrants aimed at Hawaii via the California-North Equatorial Current system. Those taxa originating in warm-temperate North American waters and directed toward Hawaii must encounter primarily lethal conditions as the cool waters become warm; few survive the journey and fewer survive the Hawaiian environment. But the Hawaiian amphipods do reflect in a small way the influence on Hawaii by the west and southward flowing waters from western North America.

[8] Term excludes Hawaii and New Zealand.

The Sweepstakes Phenomenon

The theory of sweepstakes dispersal implies that the biota of an isolated place is a result of the vagaries of transporting mechanisms and the timing of events. On isolated islands this applies most harshly to those terrestrial regimes having contraction of niches and habitat space, but the biota established on islands is also controlled through biotopical preadaptations. Mere examination of a checklist of species from a biota cannot support a statement about the absolute failure of dispersal mechanisms to import various taxa into an extrinsic locality. The paucity of acroporan corals in the Hawaiian Archipelago suggests an unfavorable biotope and not necessarily the failure of the transporting mechanism. The failure may occur in the timing or extent of the scleractinian dispersal in the sense that by chance alone the pocilloporans reached the islands first and the normal dominating mechanisms of an initial immigrant prevent a foothold of later immigrants. But there is also the strong possibility that if the vagaries of sweepstakes dispersal had brought acroporans first, their dominating mechanisms would have failed to prevent establishment of pocilloporans because acroporans are outside of their optimal environment in Hawaii. Sweepstakes dispersal is furthermore a tenuous term disguising various absurdities. It has to be applied only to those species with any chance of reaching the locality under question. Its topical applicability is as variable as the number of places under question. In effect it is best applied to groups of species with generally equivalent preadaptation to the environment under question but with a relatively low, albeit positive chance of reaching that environment. Many of the major incongruities of terrestrial faunistics and floristics on islands seem to have been the result of highly improbable migrations. The dominant avian faunas of the Hawaiian Islands and the Galapagos Islands thus represent immigrations of high improbability as to length of journey, pre-

dictable direction, and frequency of occurrence. These improbabilities may, however, be amplified by our ignorance of the frequency of events, the lack of ecological preadaptations in various other candidates that might have populated those archipelagos, and the extent to which founder species prevent subsequent establishment of competitive taxa.

An evaluation of absurdities suggests the need to restrict the broadest implications of sweepstakes dispersal to a pool of species with definite chances of reaching a locality under question, no matter how slim. Certainly some very large African land mammals could be eliminated from a pool of potential natural immigrants to Hawaii, but a broad spectrum of groups not so obviously unqualified for the journey makes the concept almost incomprehensible. The shore fishes of America probably also should be included in the list of unqualified candidates. Despite their obvious dispersal mechanisms, the single journey to Hawaii has not occurred or the preadaptation to survival in Hawaii does not exist in American shore fishes.

TABLE 5.—*Mega-niche classification of Hawaiian and Californian epifaunal amphipods, noting strongest affinities of Hawaiian species in domicolous taxa*

Classification	*Hawaiian*	*Californian* [1]	*Hawaiian Species with Californian Affinities*
Nestling	43	40	5
Domicolous	43	45	16
Inquilinous	12	10	1
Inquilinous nestlers	15	11	5
Lignivorous	2	2	0
Others	4	0	0

[1] Californian data mostly from J. L. Barnard (1969a).

Amphipods represent a case toward the opposite extreme to fishes, in that many of their species have a distinctly positive chance of reaching the Hawaiian Islands from long distances and from localities outside the local thermal regime. To what extent the vagaries of transportation have affected the composition of Hawaiian immigrants from America cannot be estimated simply by examining the pool of American and Hawaiian species. The general absence of information on the competitive positions of American species against Micronesian species is just one of many defects in a possible analysis. There is a strong indication that nestling species are not as well adapted to making the journey across a thermal boundary as are tubicolous species, and this might account for the disproportionate number of American tubicolous species occurring in the Hawaiian fauna. That nestling species also encounter difficulties in completing the journey to isolated places within their normal thermal regime is also apparent in the following analysis of some statistics that are admittedly inadequate. The epifaunas of the Indo-Pacific have a higher number of nestling (115) than tubicolous (71) species, whereas Hawaii has the numbers in approximately a 1 to 1 ratio. This suggests a possibility that numerous nestling niches remain open or do not exist in Hawaii, whereas those tubicolous niches that remained open because of failures of importation from the southwest direction have been filled with immigrants from America. It is possible, therefore, that vagarious transporting mechanisms operating over a relatively short period of time have failed to supply Hawaii with a full complement of nestling amphipods from a thermally similar area, but have supplemented the deficiency of tubicolous immigrants from that same direction with members from the American pool. The deficiency of nestlers in Hawaii is marked most conspicuously by the presence of only one lysianassid in comparison to the normal complement of five or six species in localities of India. The contradiction that Hawaii has a greater diversity of nestlers in its common genera than do other Indo-Pacific localities may be explained momentarily by the differing taxonomic emphasis that has occurred in tropical studies.

If American nestling amphipods have failed to reach Hawaii, there remains a strange coincidence that warm-temperate America has a pool of nestlers with similar generic and familial composition to that of Hawaii (Table 6). The only conspicuous warm-temperate group not represented either by a congener or a confamilial substitute is the family Bateidae. One could partially reverse the previous supposition so as to suggest that a full measure of nestling amphipods immigrated to Hawaii from the southwest, whereas a deficiency of tubicolous imports was complemented by immigrants from America. American tubicolous imports therefore succeeded in open niches, whereas American nestlers, if imported in equal frequency as tubicolous species, were unable to compete with normally occurring tropical nestlers.

TABLE 6.—*Pool of Californian warm-temperate epifaunal amphipods*

Family	*Epifaunal amphipods*	
	Californian warm-temperate	*Hawaiian*
	Genus	*Genus*
Acanthonotozomatidae	*Panoploea* (1)	See Ochlesidae
Ampeliscidae	*Ampelisca* (2)	*Ampelisca* (1)
Amphilochidae	*Amphilochus* (2)	(*Amphilochus* 4)
	Gitana (1)	*Gitana* (1)
	Gitanopsis (2)	*Gitanopsis* (1)
	None	*Mokuoloe* (1)
Ampithoidae	*Ampithoe* (7)	*Ampithoe* (7)
	Cymadusa (1)	*Cymadusa* (3)
	None	*Paragrubia* (1)
Anamixidae	*Anamixis* (1)	*Anamixis* (1)
Aoridae	*Acuminodeutopus* (1)	None
	Amphideutopus (1)	*Aloiloi* (1)
	Aoroides (1)	*Aoroides* (2)
	Lembos (3)	*Lembos* (8)
	Microdeutopus (1)	*Neomicrodeutopus* (1)
	Neomegamphopus (1)	*Konatopus* (1)
	Rudilemboides (1)	None
Atylidae	*Atylus* (1)	*Atylus* (1)
Bateidae	*Batea* (2)	None
Colomastigidae	*Colomastix* (1)	*Colomastix* (4)
Corophiidae	*Cerapus* (1)	None
	Corophium (4)	*Corophium* (3)
	Ericthonius (1)	*Ericthonius* (1)
Dexaminidae	*Polycheria* (1)	*Paradexamine* (1)
Eophliantidae	*Lignophliantis* (1)	*Biancolina* (1)
Eusiridae	*Eusiroides* (1)	*Eusiroides* (1)
	Pontogeneia (3)	*Pontogeneia* (1)
Gammaridae	*Ceradocus* (2)	*Ceradocus* (1)
	Elasmopus (5)	*Elasmopus* (10)
	None	*Eriopisa* (2)
	Eriopisella (1)	*Eriopisella* (1)
	Maera (4)	*Maera* (7)
	Megaluropus (2)	None
	Melita (3)	*Melita* (2)
	Metaceradocus (1)	None
	None	*Nuuanu* (1)
Hyalellidae	None	*Parhyalella* (1)
Hyalidae	*Allorchestes* (2)	None
	Hyale (3)	*Hyale* (8)
	Parallorchestes (1)	None
	Parhyale (1)	*Parhyale* (1)
Isaeidae (Photidae)	*Cheiriphotis* (1)	None
	Chevalia (1)	*Chevalia* (1)
	Gammaropsis (2)	*Gammaropsis* (7)
	Megamphopus (2) [a]	None
	Photis (5)	*Photis* (3)
Ischyroceridae	*Ischyrocerus* (3)	*Ischyrocerus* (3)
	Jassa (2)	*Jassa* (1)
	Microjassa (1)	None
	Parajassa (1)	*Parajassa* (1)
	Ventojassa (1)	*Ventojassa* (1)

TABLE 6.—*Pool of Californian warm-temperate epifaunal amphipods*—Continued

Family	*Epifaunal amphipods*	
	Californian warm-temperate	*Hawaiian*
	Genus	*Genus*
Leucothoidae	*Leucothoe* (2)	*Leucothoe* (3)
	Leucothoides (1)	*Leucothoides* (1)
Liljeborgiidae	*Liljeborgia* (2)	*Liljeborgia* (2)
Lysianassidae	*Ensayara* (1)	None
	Lysianassa (3)	*Lysianassa* (1)
Ochlesidae	See Acanthonotozomatidae	*Ochlesis* (1)
Oedicerotidae	None	*Kanaloa* (1)
Phliantidae	*Heterophlias* (1)	*Palinnotus* (1)
Pleustidae	*Parapleustes* (2)	*Parapleustes* (2)
Podoceridae	None	*Laetmatophilus* (1)
	Podocerus (2)	*Podocerus* (3)
Sebidae	None	*Seba* (1)
Stenothoidae	*Parametopella* (1)	None
	Stenothoe (2)	*Stenothoe* (5)
	Stenothoides (1)	None

Note.—Generic relationships to Hawaii are noted by dotted lines and direct affinities by dashes. Number of species in parentheses. Californian data mostly from J. L. Barnard (1969a).

[a] Morphologically similar to *Gammaropsis* and possibly not distinct generically.

The affinities of Hawaiian Amphipoda demonstrate a strong preadaptation of Amphipoda from similar thermal regimes to migrate long distances. The problem of sweepstakes dispersal is not so much as to identify missing phyletic units or species (see "Pantropical and Indo-Pacific Elements") but to study the niches and transportational ecology of amphipods so as to determine the biological stresses influencing the present composition of the Hawaiian fauna.

Lack of Adaptive Radiation in Hawaiian Amphipoda

Approximately 20 genera of Hawaiian Amphipoda are represented by two or more species, but there is little evidence of local adaptive radiation in these various species flocks. This situation is a strong contrast to the terrestrial Hawaiian biota in which numerous cases of adapative radiation occur among honey creepers, snails, and fruit flies. Most of the present study of amphipods has occurred on only one of the Hawaiian Islands, but this does not seriously weaken the conclusion that little adaptive radiation occurs in the Amphipoda. The conclusion is supported by results in other marine groups.

Evolution of endemic Hawaiian Amphipoda has undoubtedly occurred, but the lists of affinities in Table 3 demonstrate that cognates of the several species in each genus are located in extrinsic regions. Those few cases of strong interrelationships between a pair or a triad of Hawaiian endemic species can usually be explained by assuming the successive immigration of a parent species.

Discussions of adaptive radiation in marine Gammaridea have not yet entered the literature, but a few potential examples may be cited in the flock of genera and species of haustoriids in the northwest Atlantic, the genus *Harpinia* in the northeast Atlantic, a section of the genus *Ampelisca* in southeast Asia, and especially the flocks of closely related species of *Anonyx, Hippomedon,* and *Orchomene* in the Okhotsk Sea and the genus *Parawaldeckia* in New Zealand. Each of these sympatric flocks must signal the former occurrence of barriers that isolated various populations from one another. Subsequently, the barriers must have retracted and those various isolates again became sympatric. Visualization of the mechanics of this process in marine organisms remains highly rudimentary.

The Hawaiian fauna of Amphipoda is still relatively youthful, but nearly half of the species is now divergent,

morphologically, from their presumed ancestors in Micronesia-Polynesia and adjacent continents. No endemic genus with more than one species occurs in Hawaii, but several multispecific genera have pairs of species in Hawaii with close interrelationships. These pairs can be identified with an extrinsic cognate, but that fact does not necessarily obviate the possibility that one member of the Hawaiian pair did not evolve from its sympatriot. The conclusion that these Hawaiian pairs are the result of successive immigrations of a single parent species and do not represent topical radiation is supported by our knowledge of the high success of amphipods in completing journeys from unexpected sources. If they can both come long distances as well as overcome thermal barriers, then there might occur successive waves of a species from a nearby area of thermal characteristics similar to those of Hawaiian waters.

Among the following multispecific Hawaiian genera there is little question that their various species have diverse affinities (Table 3): *Colomastix, Corophium, Eriopisa, Ischyrocerus-Jassa, Leucothoe, Melita, Photis,* and *Podocerus*. Some of the species of *Corophium* have probably been brought into the islands by ships, but the various species of *Ischyrocerus* and *Jassa* are sufficiently divergent from each other as to suggest the development of incipient subgenera.

Pairs of Hawaiian species among genera with cold-water affinities occur in *Amphilochus, Aoroides, Parapleustes,* and possibly *Gammaropsis, Lembos,* and *Stenothoe*. Heretofore *Aoroides* has been composed of only two continental species, one in America and one in northern Asia. Hawaii has two species—one is possibly synonymous with the American species. and the other is apparently a Hawaiian evolute. Both species are perhaps endemic to Hawaii, but the wide American distribution of *A. columbiae* plus the tubicolous adaptations of the genus suggest a succession of dispersals to Hawaii of the American species rather than a Hawaiian radiation of the genus. If the two Hawaiian members of *Parapleustes* evolved from a single boreal immigrant, there is little morphological evidence to suggest that course. One of the species is an incipient genus in its loss of a part of the maxillipedal palp, and its true affinities are obscured by the change because of the vagaries of classification within the complex of boreal pleustid genera. Three species of *Amphilochus* form a tetrad with an American species. They would probably represent the best potential case of Hawaiian adaptive radiation were it not for inadequate studies of the genus in America elsewhere than the Californias. They may be figmentary siblings in Hawaii because we have yet not found their cognates in America. But the other side of the question can be supported through the ecological evidence that Hawaii is better supplied with their scleractinian hosts than is America.

The pertinent affinities of several members of *Gammaropsis, Lembos,* and *Stenothoe* are very sketchy; this ignorance may conceal the presence of three more pairs of Hawaiian siblings with cool-water affinities.

Most of the remaining Hawaiian multispecific genera have their strongest affinities with tropical regions. They are *Ampithoe* with (5) species, *Cymadusa* (3), *Elasmopus* (9), the complex of *Eriopisa-Eriopsiella-Nuuanu* (4), *Gammaropsis* (7), *Hyale* (8), *Lembos* (8), *Liljeborgia* (2), *Maera* (7), and *Photis* (3).

Ampithoe kaneohe and *A. poipu* form a pair of Hawaiian species with their closest affinities to each other despite the presence of certain morphological characters in one species that heretofore had generic value. *Ampithoe poipu* is assignable to the genus *Pleonexes,* but that genus simply categorizes a grade of evolution. There is little evidence that the Micronesian allopatriot was a precursor to either of the Hawaiian species.

Hawaii is the center of a complex of species represented by the tropicopolitan *A. ramondi,* the Californian *A. simulans,* the Pan-American *A. pollex,* and the Hawaiian *A. akuolaka* and *A. waialua.* A sixth member from the Gulf of California is also apparent in other material. Hawaiian *Ampithoe waialua* has especially close affinities with tropicopolitan *A. ramondi* and may be the result of Hawaiian evolution of an early wave of members of *A. ramondi* before the latter became well established by frequent immigration. Hawaiian *A. akuolaka* may have affinities with *A. simulans* and *A. pollex* that are stronger than its affinities with *A. ramondi,* but all of these species form a complex that requires detailed study. All of them could have been products of former isolation in populations of *A. ramondi.*

Cymadusa has ten species in the world fauna, three of which occur in Hawaii. One of its members, *C. filosa,* is tropicopolitan, like *Ampithoe ramondi.* Owing to the variability of *C. filosa* in its scattered populations, plus the weak divergence of the other nine species, the question arises as to whether the other species

were the products of former isolation of *C. filosa* in places like Hawaii, California or the Gulf of California, the Gulf of Mexico (or farther north), Bermuda, Brazil, South Africa, and Micronesia-Polynesia. If so, *C. filosa* has since become sympatric with most of its congeners. Again, the Hawaiian pair of endemic *Cymadusa* is in the midst of a genus with a tropicopolitan member that could have arrived in Hawaii in successive waves and finally, without diverging, itself become established through frequent immigration. Both *Ampithoe ramondi* and *Cymadusa filosa* have been collected on flotsam far at sea and thus are known to be viable migrants.

Two or more combinations of pairs of endemic *Elasmopus* occur in Hawaii. The clearest case is that pair of *E. piikoi* and *E. molokai,* the latter possibly either synonymous with or forming a cognate pair with Polynesian *E. minimus.* Hawaiian *Elasmopus hooheno* may be added to the pair to form a triad; in all but one character there appears to be morphological convergence between *E. hooheno* and *E. piikoi,* but that character, a spine on pereopods 1–2, may have special significance that will denote a different affinity of *E. hooheno* when the taxonomy of the genus has been properly evaluated. Meanwhile, *E. hooheno* also forms a weak pair with *E. ecuadorensis hawaiensis,* but the latter species (sensu lato) has its strongest affinities with tropicopolitan *E. pectenicrus.* Indeed there is some merit in suggesting that an early wave of *E. pectenicrus* became isolated for a long period of time in an archipelago like Hawaii or the Galapagos and later became codistributed between the two archipelagos. But the stem of *E. ecuadorensis* may have an even broader distribution as I have examined a population resembling *E. ecuadorensis* in flotsam collected by the R/V *Galathea.* The strongest case of possible Hawaiian radiation in *Elasmopus* remains the pair of species *E. molokai-E. piikoi* but again a definite extrinsic geminate is known.

Gammaropsis pokipoki, an endemic Hawaiian species, may form another evolute of an early wave of a tropicopolitan species, *G. afra* (or *G. atlantica*). Two other Hawaiian species of the genus, *G. haleiwa* and *G. kaumaka,* may prove to be members of a system of this sort when their adult morphology has been clarified.

The eight or more species of *Hyale* in Hawaii have mostly diverse affinities. An interrelated pair of species occurs in *H. affinis-H. honoluluensis* but they are also distributed outside of Hawaii. *Hyale ayeli* and *H. g. bishopae* represent Hawaiian endemic species probably derived from widespread parent populations, but the parent species have not immigrated frequently enough to Hawaii either to form a continuous genetic connection with extrinsic regions or to have formed more than one descendent genotype. Both of the parent epigenotypes are confined to nontropical waters.

The situation in *Lembos* is obscured by taxonomic ignorance, but again a potentially widespread *L. macromanus* may have established a pair of descendents in Hawaii; repeated immigration is attested to by the presence of American-Oriental *L. macromanus* in Hawaii.

Both species of Hawaiian *Liljeborgia* are closely related to each other and form a triad with Polynesian *L. proxima.*

Only one pair of related species occurs in Hawaiian *Maera.* A very strong relationship, perhaps the strongest example yet known in Hawaii, occurs between *M. pacifica* and *M. kaiulani. Maera pacifica* occurs both in Polynesia and in Hawaii, whereas *M. kaiulani* is presumably endemic to Hawaii.

Relationships among Hawaiian members of *Stenothoe* are clouded by weak taxonomy; until adults of two species are obtained and the life history of two others worked out, there will only remain a potential case of a pair or triads of species for inclusion in this discussion. That *Stenothoe* is dominantly a cool-water genus does amplify this possibility of a single immigrant having completed the long journey from America (or cool-water Asia) and radiating solely within the Hawaiian Islands.

The numerous cited examples of strong relationships between various Hawaiian species and widespread tropical species that also occur in Hawaii suggest that the Hawaiian endemic evolved from the cosmopolitan member at a time in the history of the archipelago when the environment differed from that of present-day conditions. This may have occurred in the early history of the archipelago when a single small western [9] island or bank had been developed and may have been concomitant with small differences in ocean current systems. A species like *Cymadusa filosa,* possibly in continuous migration aboard flotsam, may have arrived as a small population in a very constricted early

[9] The islands of Hawaii have developed sequentially from west to east and the old western islands have now been eroded to subaqueous level.

Hawaiian environment and have undergone fairly rapid selection to form a species like *C. oceanica*. As more space and niches became available through formation of additional islands, a second wave may have been established that diverged into *C. hawaiensis*. Finally, as the Hawaiian Archipelago assumed its present dimensions or if an increased frequency of immigration occurred in relationship to favorable changes in current patterns, the parent species *C. filosa* may have become established a third time but retained frequent genetic exchange with its extrinsic populations or underwent little morphological change because its optimal niche, in terms of space or food source, had finally appeared in an evolving archipelago.

Results of the One-Step, Long-Distance Isolation of Cool-Water Immigrants to Hawaii

The classic pattern of terrestrial evolution in Hawaii contains the element of saltatory (or incremental) isolation, from which extremely divergent suprageneric taxa evolve fairly rapidly by a series of steps from one isolated biotope to the next, through island hopping, valley hopping, and by other small-scale increments. The genotypical end products of this incremental isolation often are so divergent as to defy any tracing of the steps (Zimmerman, 1948). The primordial end of the process is the recognition of the first step in the isolation of populations; perhaps a few examples occur in Hawaiian amphipods.

Unlike members of the recent terrestrial fauna and flora of the main high islands of the Hawaiian chain, no amphipod of direct cool-water affinity (origin) would have arrived in the Hawaiian chain by incremental isolation, for not since the origin of the chain have there been any intermediate land masses or islands along the cool-water pathway from America or Asia. Zimmerman presumes that part of the terrestrial Hawaiian fauna passed along the now environmentally extinct western islands and diverged with each step. With minor exceptions, this could not have happened in the cool-water amphipod fauna so that many of those species now in Hawaii that have diverged have undergone only one increment in isolation. Some of those species may have, of course, passed to and fro from Hawaii to cold-water continents several times, but this occurrence is entirely hypothetical and supported only vaguely by the triangular occurrence of *Amphideutopus - Konatopus - Neomegampropus* and possibly by Japanese *Atylus:* Hawaiian *Kamehatylus:* American *Atylus*. The hypothesis cannot be entirely dismissed without damaging the concept that certain gammarideans are highly preadapted to making long oceanic journeys; if they could reach Hawaii, perhaps in other times when currents were suitable they would arrive again on the continents after a period of isolation and natural selection in Hawaii. If so, there may be continental evidence of this interchange, but detailed studies have not yet been made on the problem.

A more logical supposition is that a successful reverse journey would be more difficult than the initial trip from cool continent to island, for the amphipod that has undergone genetic change in an island would seem less likely to be a successful reimmigrant to a continent where specific diversity is high and where few niches might be open to an organism that has changed only slightly from its continental ancestors. On the other hand, the establishment on islands should be easier, as niches may be open even though there are fewer in existence. Evidence that journeys to and from the continent to Hawaii have rarely occurred is found in the low incidence of species flocks in amphipods of cool-water affinity. One would expect to see many groups of closely related species that have diverged by a few morphological changes, but the cool-water Hawaiian amphipods are primarily of the one species per genus category, thus indicating a single period of importation for that species, or else the occurrence of only one available broad-scale niche for each morphotype. Three exceptions to this situation seem to occur: (1) in the *Amphilochus* complex, with three closely related species; (2) in the ischyrocerid complex with possibly three related species; and (3) the pair of *Aoroides*. The ischyrocerids, by taxonomic concepts developed from continental studies, would fall into three different genera, but as will be seen from following paragraphs, the changes that have occurred in other taxa suggest that one incremental isolation occasionally results in fairly radical morphological changes. These changes, of course, are only radical in terms of gammaridean morphometrics. We lack any rudiment of understanding of events in gammaridean genetics or whether gammaridean taxonomists oversplit the morphotypes.

The impact on the rich North American fauna by Hawaiian amphipods of these few species is almost nil. Probably, the warm-temperate isolation that has occurred in the northern Gulf of California is of greater importance to the development of endemic species in

the Pacific North American warm-temperate region than any developments in Hawaii, and even there in the Gulf the total impact in a one-step isolation probably is very low (J. L. Barnard, 1969b).

The importance of these divergent Hawaiian cool-water imports is thus not as evidence of a major staging ground for evolution but simply an opportunity to observe changes that have occurred after one increment of isolation. Most of those changes are of no greater degree than seen between sibling sympatriots but, in a few cases, the changes assume the degree of generic differences heretofore considered highly qualitative.

One cannot estimate the morphological changes that may have occurred in these species after the initial impact of isolation on a small population, for there may have been progressive changes associated with genetic drift, mutative accidents, or selective factors associated with slow changes in environment after immigration.

The most striking case of radical change occurs in *Atylus* (*Kamehatylus*) *nani*. By narrow definition, this species, with affinities either to a Japanese or to an American cool-water species of *Atylus*, has changed its familial membership from the Atylidae to the Dexaminidae. Such a change might be dismissed as evidence that the two familial concepts are worthless, but the Gammaridea have several families and genera characterized by a loss of parts. For instance, *Beaudettia palmeri* from Micronesia (J. L. Barnard, 1965a) and a new species of *Maera* like *M. subcarinata* from Australia (in preparation) have strongly reduced or missing mandibular palps, yet they have very close affinities to other living species. The viability of these losses is a function of natural selection and may be conserved more readily in highly isolated environments where competition from immediate phyletic relatives is reduced or absent. The Australian *Maera*, however, is sympatric and cohabitational with its sibling partner.

The simple act of synonymizing two families that have been considered distinct for so long, on the basis of one exception, is poor practice if one considers more than the morphology of the groups. G. O. Sars (1895) may have been prescient in considering the two families as one (they were distinguished in 1906 by Stebbing). The Hawaiian case suggests indeed that the one family came from the other, perhaps by repeated isolation of various atylids that commenced their dexaminid status by loss of a palp. The Dexaminidae are multigeneric, whereas the Atylidae are now monogeneric (recently they were digeneric). The small morphological distance between the only genus of Atylidae and the many genera of the Dexaminidae is not necessarily matched by a functional similarity, for many dexaminids are believed to be associated in various degrees of inquilinous obligation with ascidians, whereas atylids and a few dexaminids are algal nestlers. There is no evidence that *Atylus nani* of Hawaii has become ascidiophilous. Thus, it may be the founder of an entirely new phyletic line and that potential is reinforced by one additional morphological change, the incremental coalescence of urosomite 1 with 2. In dexaminids and atylids only urosomites 2 and 3 are coalesced but *A. nani* has increased that consolidation by one segment. It therefore approximates the conditions found in the Prophliantidae, a family with one species in Polynesia and one in Australia.[10]

Another radical change that has occurred in a cool-water Hawaiian immigrant is the loss of maxillipedal palp article 4 in *Parapleustes*(?) *honomu*. Morphology of maxillipedal palps is often highly stable in various families of Amphipoda and the only morphological variation of generic value in Pleustidae has been the presence or absence of a protrusion on article 3 of the maxillipedal palp. The unique loss of article 4 in *P.*(?) *honomu* obscures its generic relationships because the point of attachment of article 4 has heretofore marked the presence or absence of the process on article 3. *Parapleustes*(?) *honomu* is thus an incipient genus by morphological standards.

Ischyrocerus(?) *kapu* represents a third case of radical change in morphology in a cool-water immi-

[10] Since this study was completed in 1967 I have had the opportunity to study many species of Dexaminidae, Atylidae, Prophliantidae, and Lepechinellidae in Australia and New Zealand. These include two species of *Atylus*, seven species of *Paradexamine*, three species of *Guernea*, six species of *Lepechinella*, one species of *Prophlias*, and specimens in USNM of *Guernea* (=*Prinassus*) *nordenskioldi* (Hansen) and *Dexamonica reduncans* J. L. Barnard. The latter two species have been found to be congeneric, requiring revival of *Prinassus* Hansen as senior synonym of *Dexamonica* J. L. Barnard, *Prinassus* then being attached to *Guernea* Chevreux as a subgenus. The families Dexaminidae, Atylidae, Anatylidae, Prophliantidae, and Lepechinellidae have been found to be synonymous and divisible into only two subfamilies, Dexamininae and Prophliantinae; the latter subfamily contains *Prophlias* Nicholls, *Haustoriopsis* Schellenberg, and *Guernea* Chevreux (*Prinassus* Hansen = *Dexamonica* J. L. Barnard); the remaining genera are assigned to Dexamininae (paper in preparation).

grant to Hawaii. Article 4 of male gnathopod 2 bears a large spike that by analogy seems to replicate the commonly occurring palmar tooth on article 6. This unique occurrence in the diverse family Ischyroceridae also marks the development of an incipient genus.

The case of *Neomicrodeutopus(?) makena* is clouded by the absence of certain information about the genus in African waters, but there is a strong possibility that the Hawaiian species has its closest relationship directly with boreal members of *Microdeutopus* and not through the genus *Neomicrodeutopus*. If so, the Hawaiian species is marked by the loss of an inner ramus on uropod 3 that may have been a direct coincidence with its importation to Hawaii. There is no evidence of incremental relationship to *Acuminodeutopus* on continental America. The latter genus has the inner ramus of uropod 3 present but partially reduced in size.

A less easily documented case of radical change occurs in the endemic Hawaiian genus, *Aloiloi*. This situation has consequences on familial classification in the Aoridae and Isaeidae (=Photidae). From time to time doubts have been expressed as to the phyletic validity of the two families and *Aloiloi* further destroys the concept of the Aoridae except as a taxonomic category of convenience in identification. Isaeidae have gnathopod 2 normally larger than gnathopod 1, whereas Aoridae have the dominance reversed, with secondary sexual modifications also removed to gnathopod 1 in favor of gnathopod 2. But the Aoridae no longer appear to have been funneled through a single line of descent from the Isaeidae, and *Aloiloi* appears to form the strongest example yet known. The closest affinities of *Aloiloi* seem to lie with the isaeid genus *Gammaropsis* rather than with any other known genus of Aoridae. Aorids probably consist of various kinds of isaeids in which a radical reorganization of axial dominance in gnathopods has occurred. In *Aloiloi* this may have occurred within the confines of a single step of isolation.

Another aorid, the Hawaiian endemic *Konatopus*, stands morphologically between two continental American genera, *Amphideutopus* and *Neomegamphopus*. The character of *Konatopus* minimizes the strong differences between the two continental genera and may represent one of two alternatives: (1) the convergence of either continental genus toward the other by the immigration and further evolution of one or the other in Hawaii; (2) the concept that Hawaii forms the evolutionary apex of a triangle; that one of the continental genera diverged in Hawaii, then returned to the continent, and evolved into the second continental genus.

The pair of Hawaiian species of *Aoroides* represents the only case known so far of a presumed double wave of immigration of a single cool-water species to Hawaii. Only two species of the genus have heretofore been known to occur in the northern hemisphere, one in Pacific America and the other in northern Asia. The American *Aoroides columbiae* presumably underwent two waves of immigration to Hawaii to result in one species that is very distinct qualitatively although the differences are small and in a second species that, if not identical to the mainland population, may be found to represent a neotenic dwarf.

The remaining cases of cool-water importation of amphipods to Hawaii represent what might be called normal speciation. For example, *Gammaropsis alamoana* is simply an incremental cognate of American *G. thompsoni* without any radical morphological changes.

If any cases of radical morphological change occur in endemic Hawaiian amphipods with tropical or antiboreal affinities, they are presently obscure. They would occur in the endemic Hawaiian genera, *Mokuoloe, Kanaloa,* and *Nuuanu*. The first genus has obscure affinities, but its generic characters are simply predictable recombinations of characters known for other members of Cyproideinae. *Kanaloa* has affinities with antiboreal genera and though very distinct is not unusual in the presently known framework. *Nuuanu* is apparently a member of the *Eriopisa-Eriopisella* complex that probably includes many species living in interstitial niches. Its deep body and head and deep pereopodal serrations are unusual, but it belongs with an ecological group of organisms yet poorly studied, and it may not prove to be as unusual as it now appears.

Enrichment of Diversity in Gammaridean Genera

The diversity of the Hawaiian genera *Elasmopus, Gammaropsis, Hyale, Lembos,* and *Maera* exceeds that found heretofore in any other tropical locality. Hawaii may represent a fairly unique situation in which niches have been compressed by the establishment of so many exotic species from so many directions. For example, this may be reflected in the impoverished numbers of individuals of *Hyale* in the *Sargassum* zone despite

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the occurrence of a high diversity of species in the region. The unusual latitudinal and thermal position of a group of highly isolated islands like Hawaii may contribute to the possibility of enrichment in taxal diversity, but this circumstance could only occur in a group of organisms like Amphipoda with extraordinarily successful means of dispersal. The possibility that various species of diverse genera have their immediate origins from highly distinct regions suggests the possibility that those allopatric species had already undergone slight shifts in their niches or habitats and thus on their meeting in Hawaii they were already preadapted to occupying very narrow niches. More and more species of certain genera with high dispersive means were thus able to become assorted without an extinctive degree of competition. Because one may presume that isolated and environmentally impoverished Hawaii has fewer niches than a continent in a similar thermal regime, one must look to factors other than compression of niches for an explanation of a high diversity of a genus in Hawaii by continental standards. The total number of epifaunal species is comparable between the warm-temperate of California and Hawaii but one may presume that the Hawaiian fauna, with fewer genera, has several taxa in other genera that serve as ecological substitutes for those missing genera.

But if the Hawaiian fauna is relatively young (assumed average age of 3 million years), one might presume that we are witnessing a late stage of faunal evolution that includes several species in each diverse genus now on the verge of extinction as niche adjustments become perfected by the various immigrants. For instance, the marginally tropical thermal regime of Hawaii may also be able to support an abnormally high number of species in certain genera because the sympatric taxa have different seasons of maximal competitive activity that reflect the slight thermal differences of the warm-temperate and metatropical seas from which they came. Hawaiian thermal extremes may interfere with optimal year round activity of the several species but are of insufficient degree to cause extinction. These species thus occupy, by definition, different niches, but given the same time they have had on continents, some of these species now surviving in Hawaii because of thermal niche separation, may become extinct if their ecological analogues undergo drifting genetic changes that shift their thermal optima to the existing Hawaiian condition. One may imagine a large number of other components of the niche that may also be involved in the selective adjustments of Hawaiian immigrants. These thoughts are antithetical to the concept that species may become more numerous with increasing age of an ecosystem.

The Hawaiian Islands should form an ideal environment for the study of interactions between amphipodan species imported from warm-temperate and metatropical regions, but one must hope that great care is taken not to release such imports into Hawaiian waters before extensive studies have been made on those species already present.

Summary and Conclusions

1. The Hawaiian Gammaridea now comprise 120 species in 52 genera, of which 59 species and 9 genera are newly described and 21 other species are reported for the first time from Hawaii.
2. Nearly 70 percent of the fauna has obviously come to the islands through archipelagoes to the southwest, but only 15 percent of the fauna is of tropicopolitan character. About half of the Hawaiian Gammaridea comprises endemic species. Small percentages (2–6) of the fauna have affinities with Antarctica, the Caribbean Sea, and Australian warm-temperate regions, but a significant percentage (20) of the fauna has affinities with cool waters of North America.
3. Amphipods of cool-water affinity in Hawaii are primarily tubicolous species; nestling taxa apparently are infrequently successful in completing the long journey or surviving once in Hawaii. Three of the cool-water imports have not diverged from their continental populations, but the remainder have; at least two of those species have diverged sufficiently to be assigned to distinct genera and probably several others will eventually be assigned to unique genera.
4. Endemic Hawaiian species of Indo-Pacific affinity include one unique genus, whereas the other discrete Hawaiian genera have apparently come from Antarctica or the Caribbean region or have unknown affinities.
5. The tropical component of the Hawaiian fauna is diverse and not impoverished by *a priori* standards, but those standards may have to be revised in view of the unexpected Hawaiian diversity and the poorly explored tropical regions. Added to the diverse tropical component is the cool-water component. Nearly all of the expected tropical fam-

ilies and genera occur in Hawaii, and some are more diverse than in any other tropical locality so far studied.

6. Micronesia and Polynesia have contributed to Hawaiian amphipods about equally with cool-water North America, but only about half of those central Pacific imports to Hawaii have diverged. The pool of amphipods endemic to the central Pacific is far less than the cool-water pool, and members of the former pool would already be preadapted to Hawaiian thermal regimes in contrast to members of the cool-water pool. As small units, various archipelagoes in the central Pacific should have low endemicity owing to their close connection toward the Indo-Pacific to the west. But their topical influence on Hawaii is great because they form the pathway for immigration of the majority of tropical Hawaiian species having broad Indo-Pacific affinity. Thus, half of the Hawaiian endemic species has come from the Polynesian direction. This degree of endemicity should be sufficient to demonstrate the high degree of isolation of the Hawaiian Archipelago, but the additional isolates from other regions reinforce that knowledge considerably.
7. The low incidence of sympatric polytypy in Hawaiian amphipodan genera and the absence of any multispecificity of endemic Hawaiian genera suggest the near lack of adaptive radiation having occurred within the Hawaiian chain. Several pairs of species with close sympatric relationships can be explained alternatively as the consequence of successive immigrations of the same ancestral species; most of these cases have also resulted in the establishment of one of the members of each pair in nondivergent condition.
8. The absence of any steppingstones between Hawaii and cool waters of the northern warm-temperate regions suggests that Hawaiian species with warm-temperate affinities probably represent good examples of changes that can occur within one increment of isolation. Most of the speciation that has occurred in these warm-temperate imports is of ordinary magnitude but a few species have undergone radical morphological changes within this framework. There is little likelihood that these radical changes occurred stepwise by repeated to and fro migration of populations. Though each case represents only one or two changes and each change may be under the control of simple genetic events, the results seem radical because they concern morphological characters normally considered to be conservative and therefore of familial importance. The suggestion is made that these changes and many others may actually be highly replicative genetic occurrences but that the morphological and functional consequences to the organism result in selective lethality except in very special or youthful environments such as that of Hawaii. There is nothing novel in that idea except in pinpointing the particular characters in Amphipoda that have been held as conservative for many decades. If events like the loss of a mandibular palp, the loss of an article on a maxillipedal palp, the coalescence of two urosomal segments, the development of a special gnathopodal tooth on an abnormally proximal article, and the reversal in dominance of gnathopodal pairs could occur within the framework of a single increment of isolation, then one might prudently reexamine the affinities of various families such as Prophliatidae, Kuriidae, Calliopiidae, Ochlesidae, and Cressidae and reexamine generic goodness in varius inquilinous families such as Stenothoidae and Stegocephalidae now based on palpar metamery. To consider *Aloiloi,* a perfectly good aorid genus under present taxonomic practice, to have arisen from a species of *Gammaropsis* (Isaeidae) that may still be extant, is to remove a mystique of antiquity in our viewpoint that all gammaridean genera are old, solidly fixed, and conservatively developed by eras of slow genetic change and selection.

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Systematical Procedure

A diversity of descriptive methods is used that varies with the state of knowledge in various taxa. Some species require descriptions in view of their uncertain taxonomic positions whereas, at the other extreme, a short diagnosis suffices for species in well-known genera or families. Long diagnoses often characterize species in genera of extreme diversity, and a few taxa have long diagnoses or descriptions because of the richness or variability in morphological detail. Many words are eliminated by consultation of the figures.

Except in obvious cases, the Hawaiian names proposed here for amphipods stand as nouns in apposition to their generic appellations. They are primarily chosen for euphonious reasons from place names scattered throughout the islands or from the names of important personages or deities in Hawaiian history. Some generic names are also proposed in this way but others are formed of contractions containing only partially Hawaiian roots. It is senseless to invent reasons for choosing these names so they are not considered further.

Family AMPHILOCHIDAE

Subfamily AMPHILOCHINAE

Amphilochus Bate

The Hawaiian members of this genus have better developed molars on the mandible than attributed heretofore to Atlantic and west American species. For that reason they approach the genus *Gitanopsis* and remarks on their affinities to members of that genus are included with each of the species.

Amphilochus kailua, new species

FIGURES 2, 3

DIAGNOSIS.—Body without dorsal cusps; lateral cephalic lobe rounded or slightly truncate; eye very large, clear in alcohol; antennae extending equally (including distal setae); gnathopods large, slender lobe of article 5 on gnathopod 1 guarding article 6 and extending almost to palm, on gnathopod 2 extending fully to palm; anterodistal corners of sixth articles on gnathopods softly rounded, dactyls with medial inner tooth but no pectinations or scales; gnathopods of the enlarged kind, but gnathopod 2 larger than 1, hands longer than wide, palms scarcely oblique but convex; coxa 1 elongate, anteroventrally extended as short coniform process; mandibular molar narrow and weakly triturative; distomedial margin of outer plates on maxillipeds not excavate, with 6–7 slender, widely spaced setae; palp article 1 of maxilliped with winglike medial extension; all pereopods with about four sets of spines on "active" margins, distal locking set (and occasionally other sets) paired and closely placed to next proximal set, dactyls with short distal nail and prominent mammilliform bulb proximal to nail; pleonal epimera 1–3 each with sinuous posterior margins and very weak posteroventral tooth or protrusion; telson of medium length, shorter than peduncle of uropod 3, apically rounded but coniform.

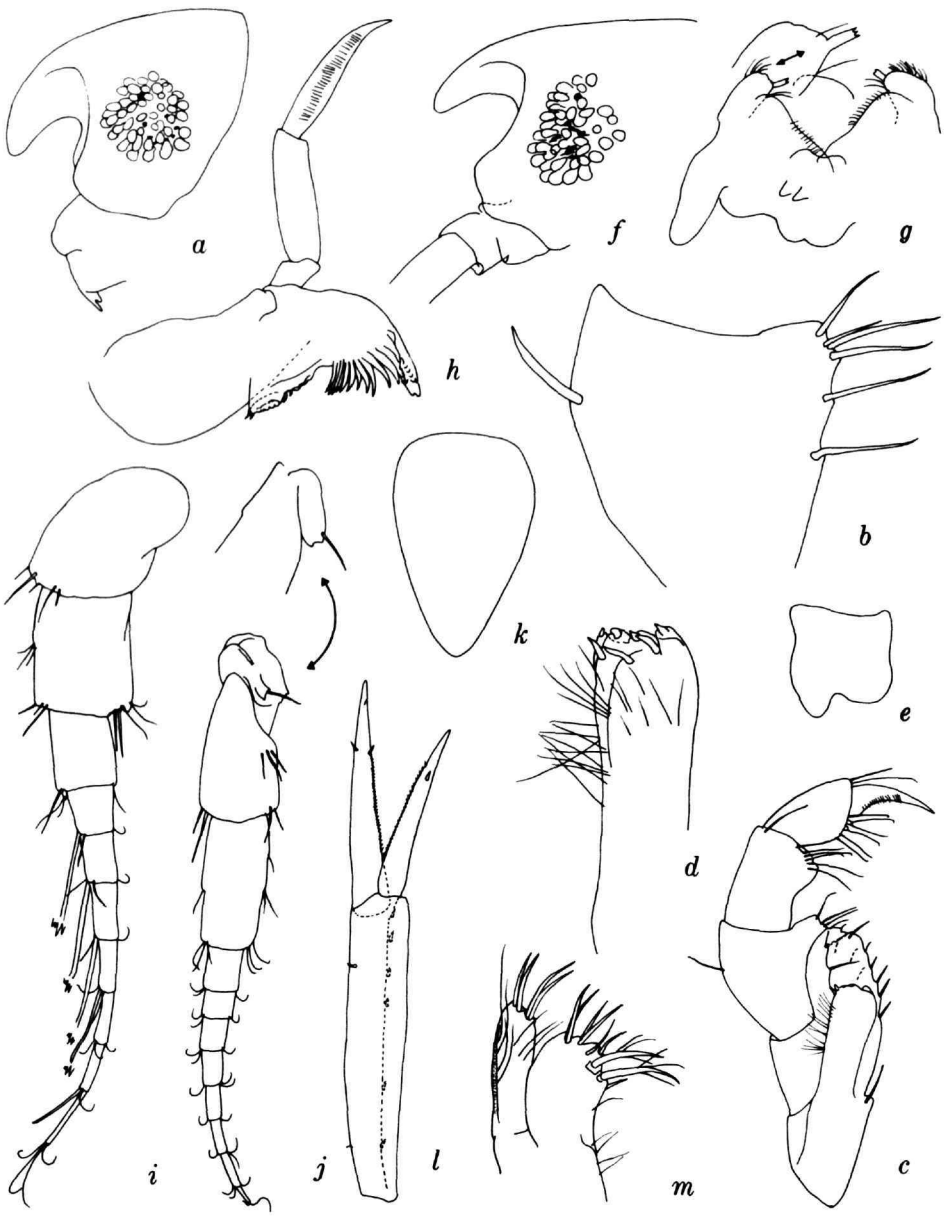

FIGURE 2.—*Amphilochus kailua*, new species, ?female, 1.3 mm, Waikiki, *Sargassum: a*, head; *b*, palp article 1 of maxilliped; *c*, maxilliped; *d*, inner plate of maxilliped; *e*, upper lip. Holotype, ovigerous female, 1.7 mm: *f*, head; *g*, lower lip; *h*, mandible; *i*, *j*, antennae 1, 2; *k*, telson; *l*, uropod 3; *m*, maxilla 2.

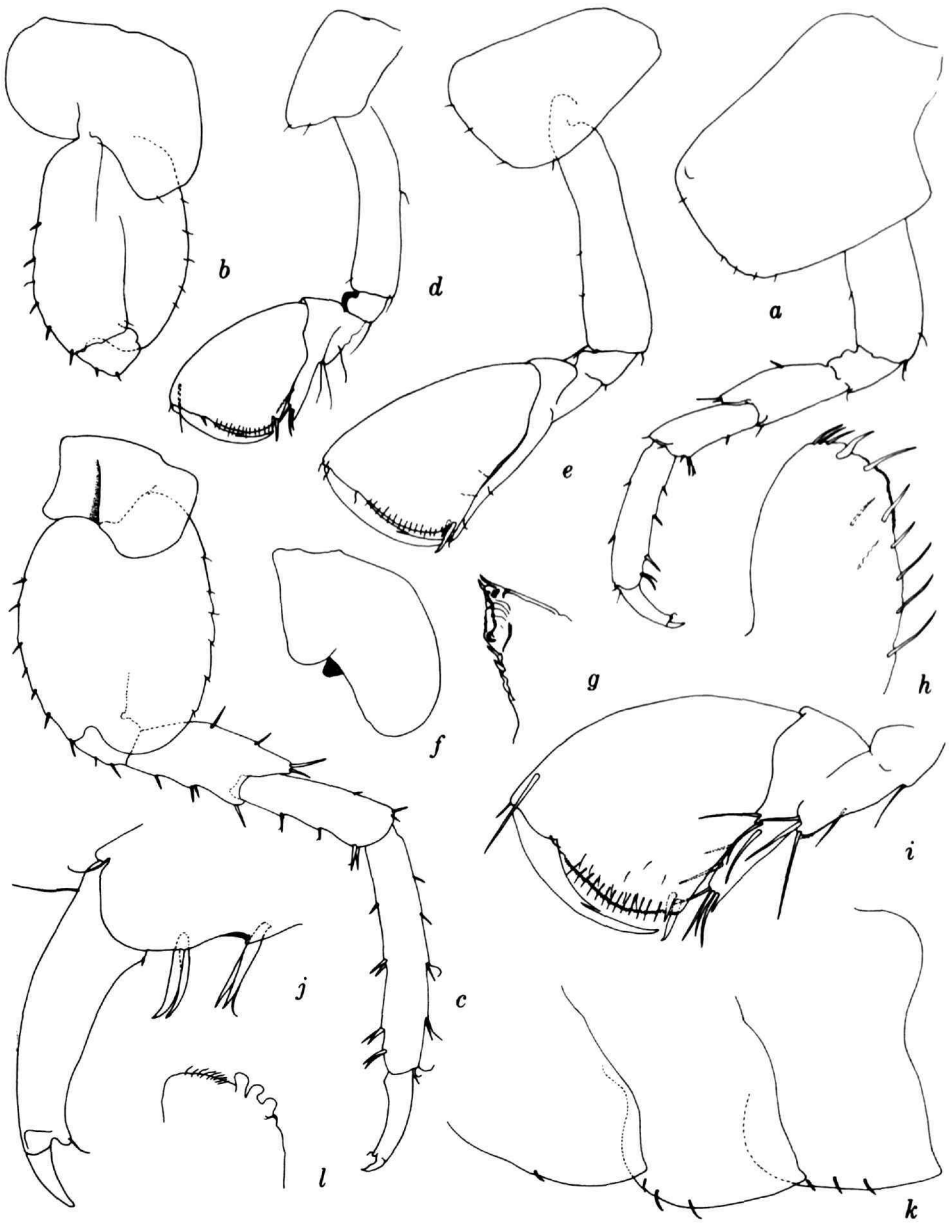

FIGURE 3.—*Amphilochus kailua*, new species, holotype, ovigerous female, 1.7 mm, Waikiki, *Sargassum*: *a*, *b*, *c*, pereopods 2, 3, 5; *d*, *e*, gnathopods 1, 2; *f*, coxa 6; *g*, mandibular molar; *h*, outer plate of maxilliped; *i*, gnathopod 1, enlarged; *j*, dactyl of pereopod 2; *k*, pleonal epimera 1–3, left to right. ?Female, 1.3 mm: *l*, apex of palp article 3 of maxilliped.

HOLOTYPE.—Bishop Museum collections, catalog number 7248, ovigerous female, 1.7 mm.

TYPE-LOCALITY.—Off Waikiki Marine Laboratory, from *Sargassum* in shallow water, 11 March 1964 (3 specimens).

MATERIAL.—Type-locality, also from the alga *Padina* (1). JLB Hawaii 2 (2). Fee 1 (38).

RELATIONSHIP.—The mammilliform process of the pereopodal dactyls is unique to this species. In other characters it comes closest to *Gitanopsis vilordes* J. L. Barnard (1962c) from California, but differs from that species in the rounded and not sharp corner on the anterodistal end of article 6 on gnathopod 1.

Amphilochus kailua resembles *G. pusilla* K. H. Barnard (1916), but *G. pusilla* has a tooth on the dactyls of only pereopods 1–2.

The mammilliform process on the dactyls of the pereopods distinguishes this species from its close relative *Amphilochus neapolitanus* Della Valle (J. L. Barnard, 1962c).

DISTRIBUTION.—Hawaiian Islands.

Amphilochus likelike, new species

FIGURE 4

DIAGNOSIS.—Body without dorsal cusps; lateral cephalic lobe rounded; eye very large, ommatidia of circumference large, those in core much smaller than in other Hawaiian species and more numerous; antenna 1 almost as long as antenna 2 (including distal aesthetascs); stout lobe of article 5 on gnathopod 1 extending about halfway along article 6 and slender lobe on gnathopod 2 extending fully along article 6; anterodistal corner of article 6 on gnathopod 2 softly rounded, article 4 of gnathopod 2 with no stout posterior spines, dactyls of gnathopods not pectinate besides major tooth, each article 2 of gnathopods 1–2 with stout posterodistal spine; coxa 1 short, softly quadrate, bearing 2 weak distal serrations, coxae 2–3 with slight distal serrations; mandibular molar of medium size, conical and weakly triturative; outer plate of maxilliped distomedially excavate, weakly and scarcely pectinate, distolateral end with large sabre-shaped spine; dactyls of pereopods 1–5 simple; pleonal epimeron 1 with slight posteroventral tooth, epimeron 2 with slightly extended and sharp corner, epimeron 3 with rounded quadrate corner; telson exceeding 50 percent length of peduncle of uropod 3, apically rounded but coniform.

Urosome like *Gitanopsis pele*, new species, but inner ramus of uropod 2 reaching three-fourths distance between distal ends of peduncle of uropods 1 and 3.

COLOR IN 2-DAY FORMALDEHYDE.—Body albinid but eye red; eye in alcohol clear with slight rust stain in central core.

HOLOTYPE.—Bishop Museum collections, catalog number 7249, female, 1.6 mm.

TYPE-LOCALITY.—JLB Hawaii 6, off Barbers Point, Oahu, 30 m, coralline footballs, 29 January, 1967.

MATERIAL.—JLB Hawaii 5 (2), 6 (5), 11 (4).

RELATIONSHIP.—Resembles *Amphilochus kailua*, new species, most of any Hawaiian species because the gnathopodal dactyls lack supernumerary pectinations but differs from that species in the simple dactyls of pereopods 1–5. The individuals of *A. likelike* so far collected, though adult, are smaller than 1.7 mm and the undeveloped outer plate of the maxilliped may be a reflection of this small size.

Amphilochus likelike is like G. *vilordes* in many respects, as is *A. menehune*, new species, but *A. likelike* has the stout spine on article 2 of gnathopods 1–2 which *A. menehune* does not have and which *G. vilordes* has only on gnathopod 2; *A. likelike* differs from *G. vilordes* in the shorter article 5 lobe on gnathopod 1 and the more conical mandibular molar. *Amphilochus menehune* differs from *A. likelike* in the presence of stout spine(s) on the posterior margin of article 4 on gnathopod 2.

Among Hawaiian species of the genus, the fine pectinations on the gnathopodal palms are especially small in *A. likelike*.

The absence of spines on article 4 of gnathopod 2 distinguishes this species from its close relative, *Amphilochus neapolitanus* Della Valle (J. L. Barnard, 1962c).

The name is pronounced in English transliteration: leek-ee-leek-ee.

DISTRIBUTION.—Hawaiian Islands.

Amphilochus menehune, new species

FIGURES 5, 6

DIAGNOSIS.—Body without dorsal cusps; lateral cephalic lobe rounded; eye very large, varying from clear in formaldehyde and alcohol to a clear ring of ommatidia surrounding a slightly pigmented core to eyes with fully black pigmented core; antenna 1 scarcely extending to end of peduncle of antenna 2;

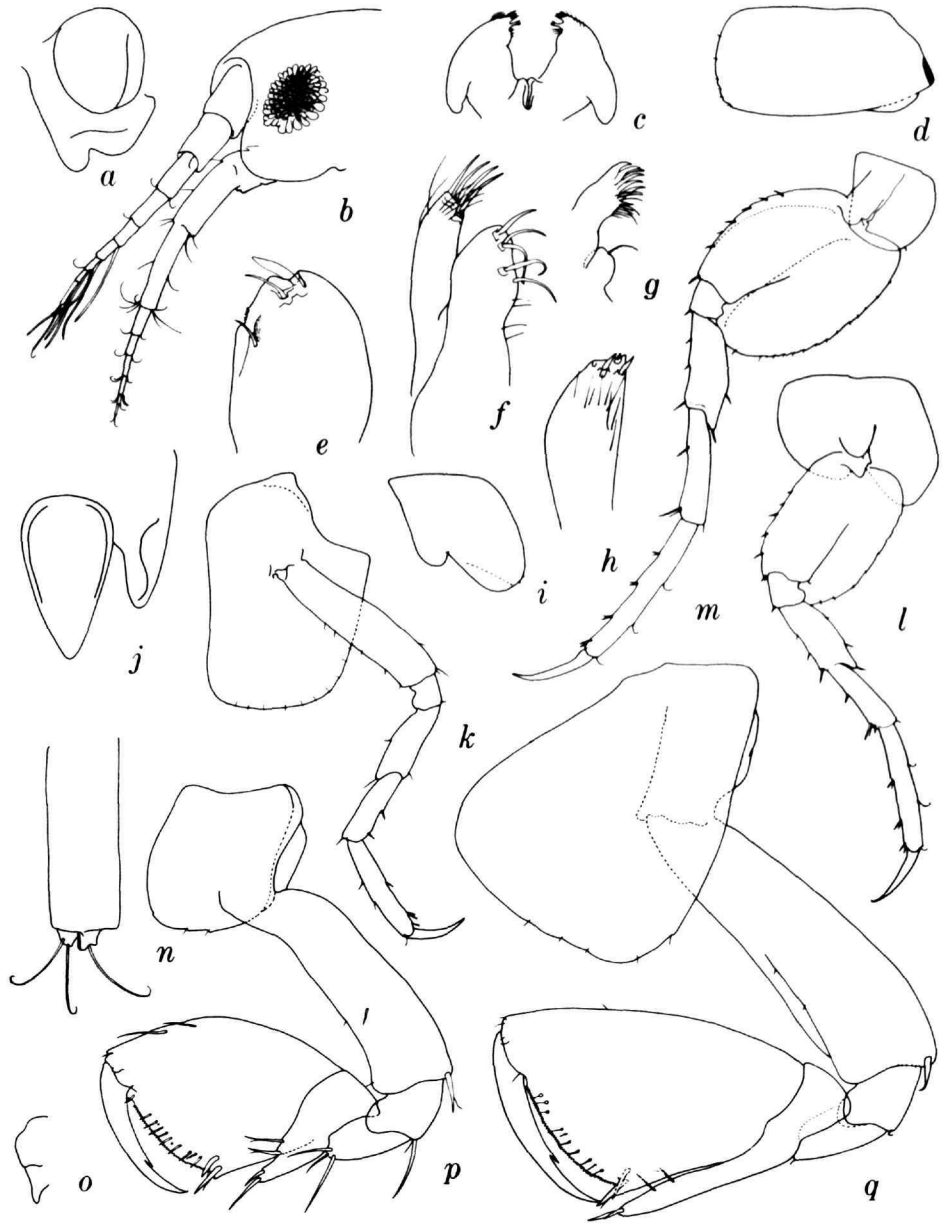

FIGURE 4.—*Amphilochus likelike*, new species, holotype, female, 1.6 mm, JLB Hawaii 6: *a*, upper lip; *b*, head; *c*, lower lip; *d*, coxa 3; *e*, outer plate of maxilliped; *f*, maxilla 2; *g*, maxilla 1, minus palp; *h*, inner plate of maxilliped; *i*, coxa 6; *j*, telson and lateral wing of pleonite 6; *k*, *l*, *m*, pereopods 2, 3, 5; *n*, accessory flagellum on article 3 of antenna 1; *o*, epistome and upper lip; *p*, *q*, gnathopods 1, 2.

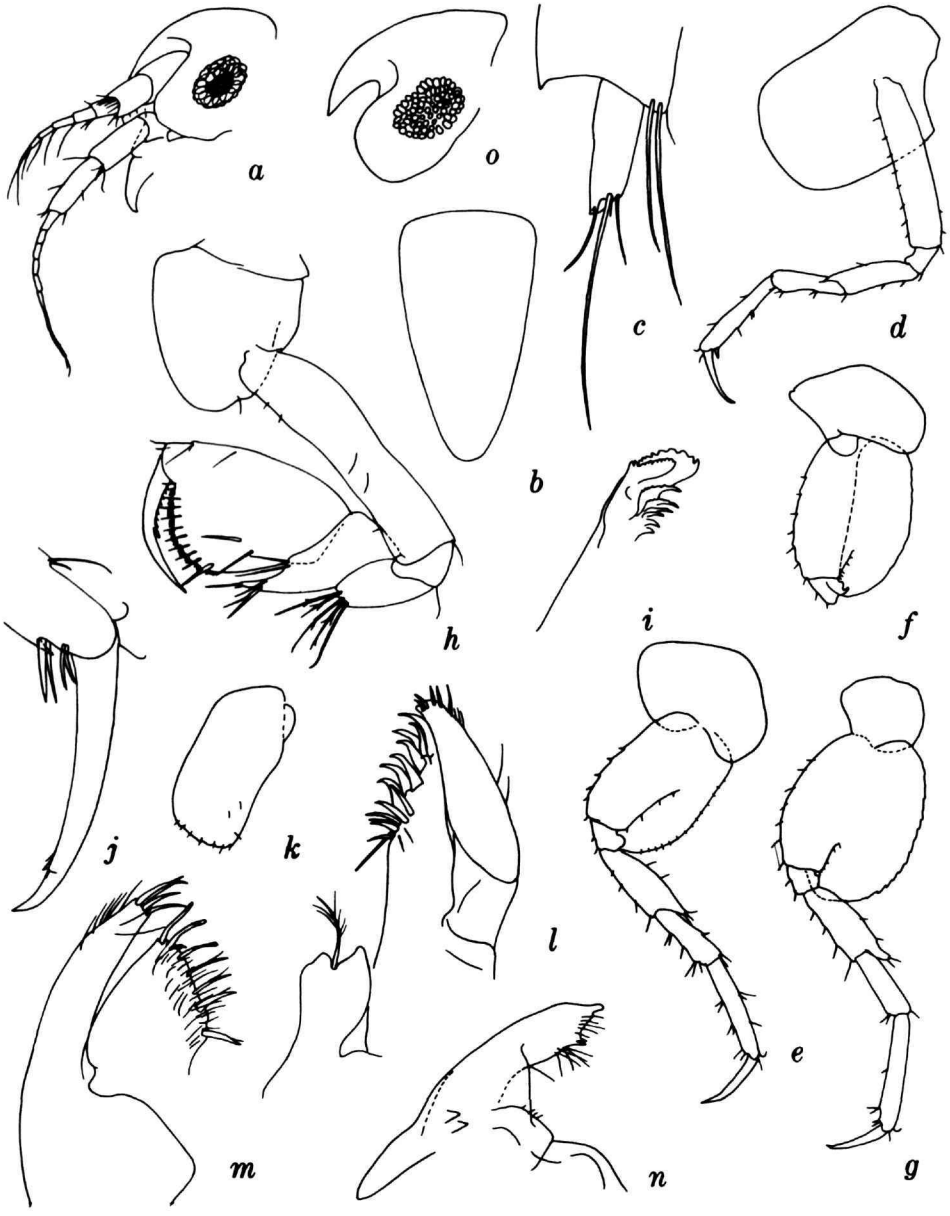

FIGURE 5.—*Amphilochus menehune*, new species, holotype, female, 1.8 mm, JLB Hawaii 5: *a*, head; *b*, telson; *c*, accessory flagellum; *d*, *e*, *f*, *g*, pereopods 2, 3, 4, 5; *h*, gnathopod 1; *i*, mandible; *j*, dactyl of pereopod 4; *k*, coxa 3; *l*, *m*, maxillae 1, 2; *n*, half of lower lip. Female, 1.9 mm, JLB Hawaii 6; *o*, head.

FIGURE 6.—*Amphilochus menehune,* new species, holotype, female, 1.8 mm, JLB Hawaii 5: *a,* head; *b,* upper lip; *c,* maxilliped; *d,* accessory flagellum (arrow); *e,* mandible; *f, g,* gnathopod 2; *h,* gnathopod 1; *i,* pleonal epimera 1–3, left to right. Female, 1.9 mm, JLB Hawaii 6; *j,* gnathopod 2.

stout lobe of article 5 on gnathopod 1 extending about halfway along article 6 and slender lobe on gnathopod 2 extending about 90 percent along article 6, anterodistal corner of article 6 on gnathopod 2 sharply extended, article 4 of gnathopod 2 with 1–3 very stout ventral spines; dactyls of gnathopods pectinate or bearing scales on proximal inner edges; coxa 1 short, almost hemispherical, bearing 1 distal notch, coxae 2–3 with medium-sized distal serrations; mandibular molar weakly triturative, subconical and of medium size; outer plate of maxilliped distomedially excavate and pectinate, distolateral end with large spine; dactyls of pereopods 1–5 simple or with very faint distal nail marked by 1–2 weak scales; pleonal epimeron 1 with slight posteroventral tooth, epimeron 2 with slightly extended corner and 3 with rounded-quadrate corner; telson about 40 percent as long as peduncle of uropod 3, apically rounded but coniform.

Urosome like that of *Gitanopsis pele,* new species, but inner ramus of uropod 2 reaching only to a point halfway between the ends of peduncles of uropods 1 and 3.

COLOR IN 2-DAY FORMALDEHYDE.—Widely variable from completely albinid having black ocular core to medium brown body with brown eye turning clear in alcohol. Forms with medium brown body have the pigment on posterior half of head, pereonites 1–6, coxae 1–6, articles 2–5 of gnathopod 1, all of gnathopod 2 and pereopod 3; these individuals turn rusty pink in alcohol; in formaldehyde also are individuals already turned rusty pink; a fourth form has extremely rare and widely scattered chromatophores over the thorax and abdomen and occasional weak blotches of brown or pink in various places.

HOLOTYPE.—Bishop Museum collections, catalog number 7250, female, 1.8 mm.

TYPE-LOCALITY.—JLB Hawaii 5, off Ewa Beach, Oahu, 30 m, *Pocillopora,* 29 January 1967.

MATERIAL.—JLB Hawaii 2 (3), 3 (2), 5 (8), 6 (8) (3 color phenotypes), 8 (2), 10 (3), 13 (7), 14 (13), 15 (1). Devaney 1 (1).

RELATIONSHIP.—This species resembles the Californian *Gitanopsis vilordes* J. L. Barnard (1962c), but the mandibular molar of *A. menehune* is more conical, article 6 of gnathopod 2 lacks midanterior spines, article 4 of gnathopod 2 has 1–3 posterior spines, article 2 of gnathopod 2 has a posterodistal seta and not a spine, coxa 1 is less quadrate in shape, the lateral cephalic lobe is more rounded, and article 6 of gnathopod 1 smaller relative to article 5, with its posterior lobe stouter and shorter, than in *G. vilordes.*

The short coxa 1 and strong molarial rugosites of *A. menehune* distinguish it from its close relative, *A. picadurus* J. L. Barnard (1962c).

DISTRIBUTION.—Hawaiian Islands.

Gitana liliuokalaniae, new species

FIGURES 7, 8

DIAGNOSIS.—Rostrum large, lateral cephalic lobe weak, rounded, eye large, red in 2-day formaldehyde, clear peripherally with dim orange core in alcohol; flagellum of antenna 1 with numeous long aesthetascs (antenna 2 broken, upper lip unknown); palp article 2 of mandible stout, incisor normal; palp of maxilla 1 apparently 1-articulate; outer plate of maxilliped densely serrate distomedially, not excavate, distolateral margin with long seta, palp article 1 longest but not twice as long as article 2, articles 1 and 2 slightly produced distomedially, dactyl as long as article 3 and bearing 1 apical setule; gnathopods 1–2 very weak, slender, similar to each other, simple article 5 produced in posterodistal lobe strongly on gnathopod 2, lobe overriding article 6, lobe weaker on gnathopod 1, article 5 scarcely longer than article 6, anterior margin of article 6 distally constricted, dactyl pointing distad; coxa 1 broadly rounded below, coxa 2 narrowing evenly from anterior margin only, with 1–2 small posteroventral teeth or one tooth substituted by distomedial notch (right and left sides differ); pleonal epimera 1–3 increasingly sharply quadrate posteroventrally; uropods 1 and 3 extending equally, inner ramus of uropod 2 reaching end of peduncle of uropod 3; telson half as long as peduncle of uropod 3.

HOLOTYPE.—Bishop Museum collections, catalog number 7247, ?male, 1.2 mm. Unique.

TYPE-LOCALITY.—JLB Hawaii 13, Kaneohe Bay, Oahu, 3–4 m, small corals, fleshy algae, corallines, 8 April 1967.

RELATIONSHIP.—Only 4 other species of this genus are known, 3 from the cold-temperate North Atlantic and one from warm-temperate California. *Gitana liliuokalaniae* resembles *G. calitemplado* J. L. Barnard (1962c) from California least of any and has characters of the other three mixed together. The extraordinarily weak article 6 of the gnathopods resembles that of *G. rostrata* Boeck (Sars, 1895, pl. 79, fig. 1) but the presence of a weak lobe on article 5 of gnathopod

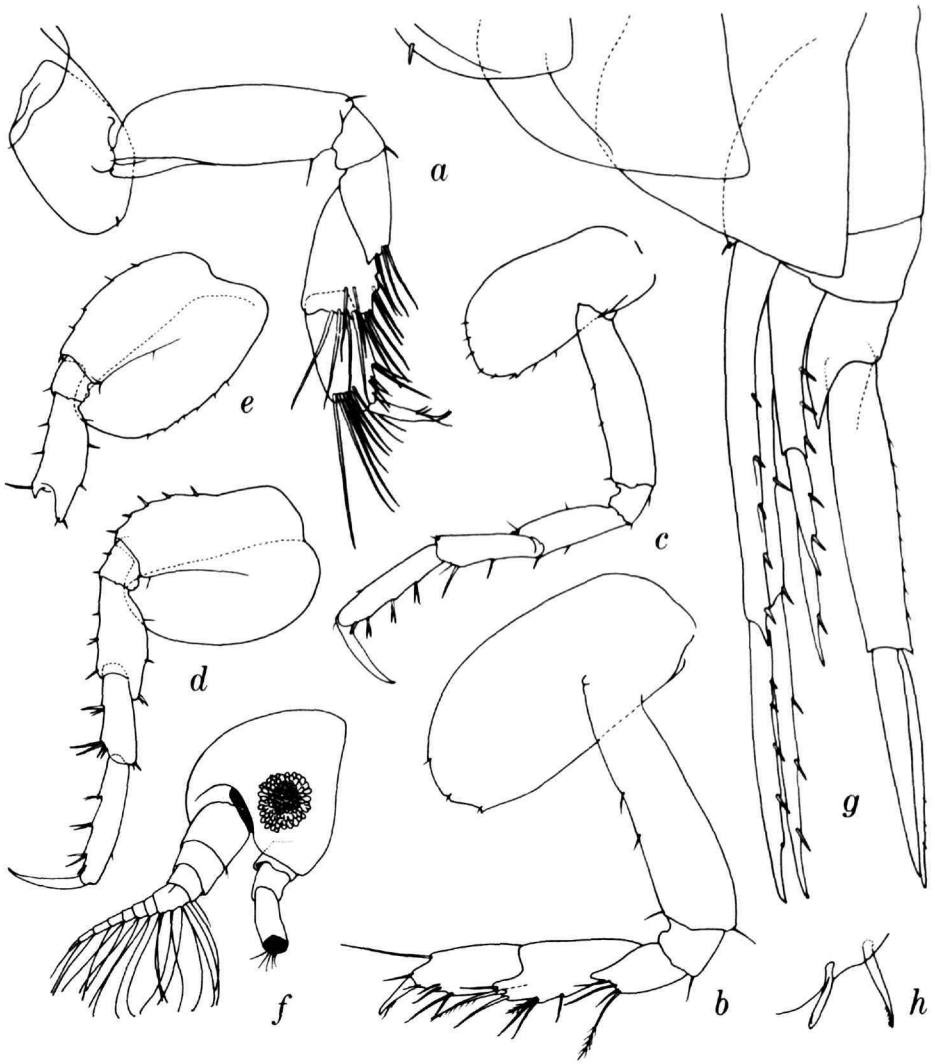

FIGURE 7.—*Gitana liliuokalaniae*, new species, holotype, male, 1.2 mm, JLB Hawaii 13: *a*, *b*, medial gnathopods 1, 2; *c*, *d*, *e*, pereopods 1, 4, 5, medial; *f*, head; *g*, pleon; *h*, spines of article 6 on pereopod 1.

2 is more reminiscent of *G. abyssicola* Sars (1895, pl. 78, fig. 2) or *G. sarsi* Boeck (Sars, 1895, pl. 78, fig. 1). *Gitana liliuokalaniae* also resembles *Gitanopsis arctica* Sars (1895, pl. 77, fig. 2) in maxillipeds and mandibular palp more than it does its congeners. In fact, *G. artica* is intermediate between *Gitana* and *Gitanopsis* in that it has the 2-articulate first maxillary palp of *Gitanopsis* but the weak gnathopods of *Gitana*. *Gitana liliuokalaniae* differs from all cold-temperate species of *Gitana* in the short telson.

Affinities with *Gitanogeiton sarsi* Stebbing (1910) from warm-temperate Australia (Manning River area) are strong in *Gitana liliuokalaniae*, and the Hawaiian species almost forms a good link between *Gitana* and *Gitanogeiton*. The latter monotypic genus differs from *Gitana* in several fairly weak characters: the slightly excavate outer plate of the maxillipeds, the slightly elongate palp article 1 of the maxilliped, and the broadened incisor of the mandibles. Gnathopods of *Gitanogeiton* resemble those of *Gitanopsis*

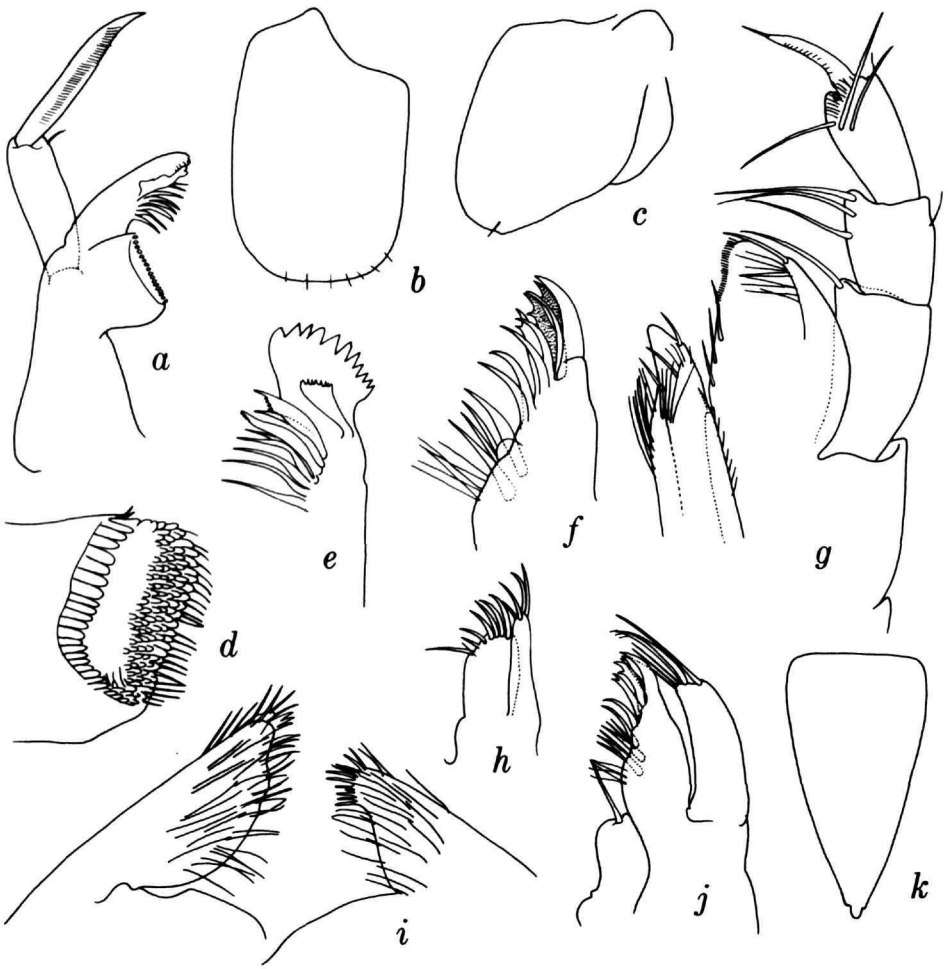

FIGURE 8.—*Gitana liliuokalaniae,* new species, holotype, male, 1.2 mm, JLB Hawaii 13: *a,* mandible; *b, c,* coxae 4, 1; *d,* right mandibular molar; *e,* right mandibular incisor and spines; *f,* outer plate of maxilla 1; *g,* maxilliped; *h,* maxilla 2; *i,* apex of lower lip; *j,* maxilla 1; *k,* telson.

arctica in that gnathopod 2 has a strong palm and gnathopod 1 a weak palm, and each article 5 has a strong posteroventral lobe, stronger than that of *G. liliuokalaniae*. The latter has the strong palp article 2 of the mandible seen in *Gitanogeiton,* but the molar in *G. liliuokalaniae* is stronger, the incisor weaker, the palp of the maxilliped is relatively longer and stouter. Unfortunately, the upper lip of *G. liliuokalaniae* was lost during dissection and cannot be compared with the unusually deeply incised lip of *Gitanogeiton. Gitana liliuokalaniae* seems to have its presently known strongest affinites with *Gitanopsis arctica,* a species that, because of its gnathopods, may rightly belong with *Gitana* rather than with *Gitanopsis* despite the occurrence of a 2-articulate palp on maxilla 1.

Gitanopsis simplex Schellenberg (1926), from Antarctica, resembles the Hawaiian species in gnathopods, but the palm of gnathopod 2 in *G. simplex* is distinct and article 6 is longer than article 5. The telson of *G. simplex* is longer than it is in *G. liliuokalaniae,* and apparently the peduncle of antenna 1 in the first species is much longer than it is in the second species.

DISTRIBUTION.—Hawaiian Islands.

Gitanopsis pele, new species

FIGURE 9

DIAGNOSIS.—Body without dorsal cusps; lateral cephalic lobe broadly rounded; eye large, with core of black pigment in alcohol; antennae extending subequally; gnathopods small but palms strong and nearly transverse, stout lobe of article 5 on gnathopod 1 extending about halfway along article 6 and about 75–85 percent on gnathopod 2, sixth articles weakly expanded distally and much longer than broad, about half as broad as their coxae, dactyls proximally pectinate on inner edges; coxa 1 distally tapering and subconical, posteroventral corner serrate, coxa 2 with 1 small posteroventral notch; mandibular molar large, cushion-shaped, strongly triturative; outer plate of maxilliped with mediodistal margin slightly excavate and pectinate (as in *Gitanogeiton* and *Gitanopsis tortugae*); dactyls of pereopods 1–5 simple; pleonal epimera 1–2 each with small posteroventral tooth, epimeron 3 rounded-quadrate posteroventrally; telson of medium length, about 60 percent as long as peduncle of uropod 3, apically rounded but coniform.

HOLOTYPE.—Bishop Museum collections, catalog number 7251, ovigerous female, 2.7 mm.

TYPE-LOCALITY.—JLB Hawaii 10, Kaneohe Bay, Oahu, 2 m, *Pocillopora*, 23 February 1967.

MATERIAL.—JLB Hawaii 10 (50).

RELATIONSHIP.—This species resembles the Caribbean *G. tortugae* Shoemaker (1933a, p. 248, fig. 2). Maxilla 1 and the accessory flagellum of the 2 species are similar among numerous other characters of even greater importance. *Gitanopsis pele* differs from *G. tortugae* primarily in two minor characters: (1) the serrations of coxae 1–2 and (2) the large eyes.

Gitanopsis pusilla K. H. Barnard (1916) from South Africa and *G. vilordes* J. L. Barnard (1962c) from California differ from *G. pele* and *G. tortugae* in their large gnathopods with article 6 wider than their coxae and strongly expanded distally. *Gitanopsis pusilloides* Shoemaker (1942) from Pacific Mexico has very short processes on article 5 of the gnathopods and more strongly transverse palms than do *G. pele* and *G. tortugae*.

DISTRIBUTION.—Hawaiian Islands.

Subfamily CYPROIDEINAE

Mokuoloe, new genus

DIAGNOSIS.—Rostrum short; flagella of first and second antennae 4 and 2-articulate respectively, bearing long aesthetascs; epistome nearly flat anteriorly; upper lip evenly incised; mandible with triturative molar and normal 3-articulate palp; lower lip angularly excavate medially; palp of maxilla 1 uniarticulate, bearing large strap-shaped terminal setae, outer plate with 7 spines, inner plate short and truncate; maxilla 2 with apically truncate lobes; outer plate of maxilliped large and exceeding end of palp article 2, palp article 3 apicomedially produced as thumb, dactyl stout and closing on thumb; coxa 2 larger than coxa 1; gnathopods 1–2 of medium stoutness, subchelate, dactyl of gnathopod 1 strongly overlapping palm, of gnathopod 2 fitting palm, article 5 of gnathopod 1 lobe obsolete, of gnathopod 2 lobe extending more than halfway along article 6, palms of gnathopods deeply and sharply serrate; pereopods 3–4 with slender article 2, pereopod 5 with expanded article 2; uropod 1 longest, uropods 2–3 extending successively less, outer ramus of uropod 3 shorter than inner ramus; telson extending almost to apex of uropod 3, boat-shaped, triangular, entire, with lateral keel; pleonite 4 long, weakly keeled bilaterally on dorsal surface, pleonite 5 covered by junction of 4 and 6, 6 with weak lateral keel on each side and not vaulting over telson.

TYPE-SPECIES.—*Mokuoloe ninole*, new species.

RELATIONSHIP.—*Peltocoxa* Catta (Chevreux and Fage, 1925) and *Hoplopheonoides* Shoemaker (1956) from Florida are the cyproidins seemingly closest to this genus—not various Australian and New Zealand genera, but even relationships with those two Atlantic genera are weak.

Peltocoxa Catta has a long maxillipedal palp, slender inner plate of maxilla 1, strong mandibular lobes on the lower lip, narrow lobes on maxilla 2, no strap-shaped setae, a dorsoventrally thickened telson, inflated article 2 of pereopod 4, small gnathopods, gnathopod 2 with transverse palm and gnathopod 1 with oblique palm confluent with the posterior margin of article 6 and bearing only articulate spines.

Hoplopheonoides has small gnathopods with rectangular sixth articles and transverse palms, an enormous urosomite 1 with dorsal keel, no mandibular palp, long maxillipedal palp, and numerous other differences.

Mokuoloe ninole, new species

FIGURES 10, 11

DIAGNOSIS.—With the characters of the genus.

COLOR IN 2-DAY FORMALDEHYDE.—Eyes red, becoming clear in alcohol.

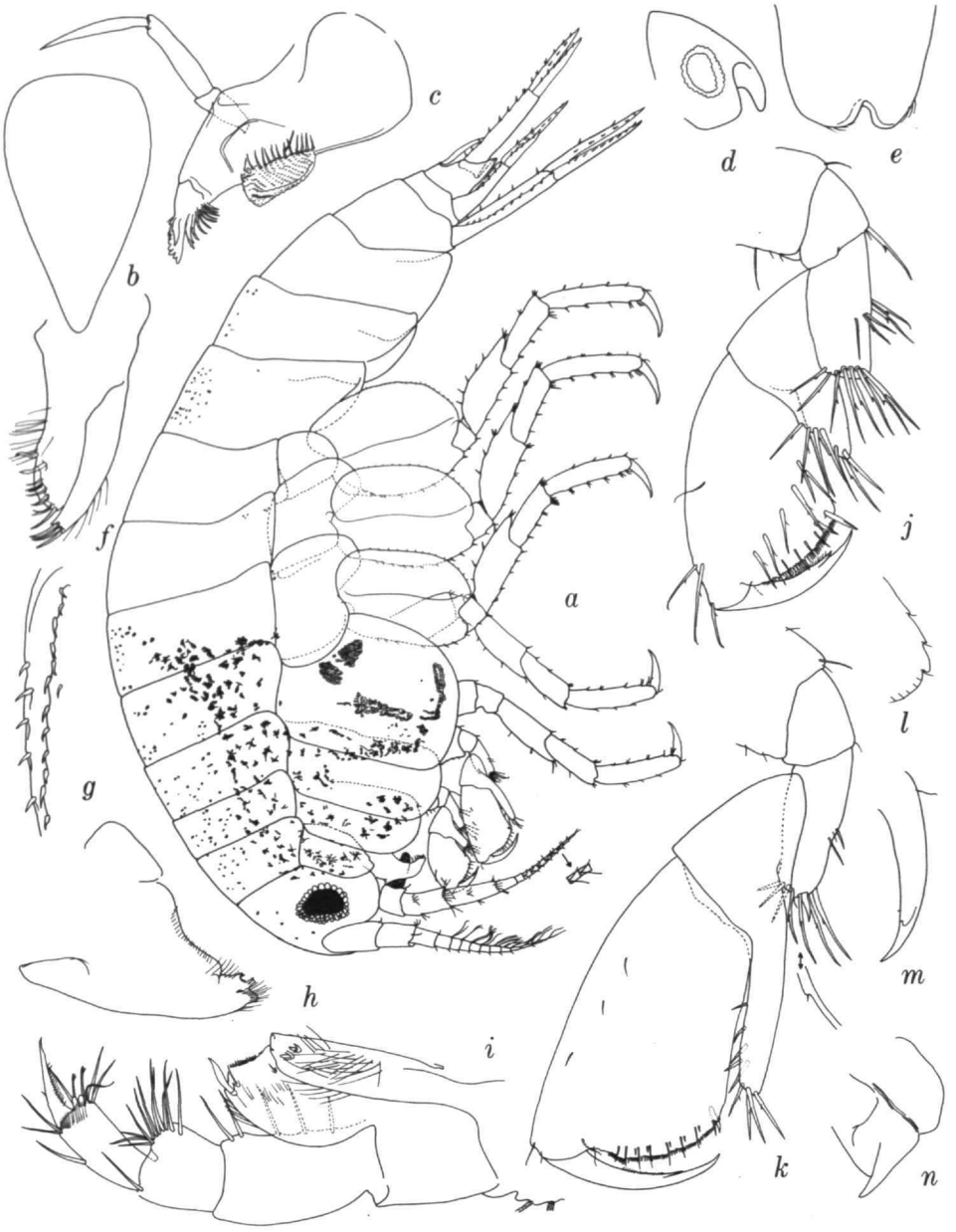

FIGURE 9.—*Gitanopsis pele*, new species, holotype, ovigerous female, 2.7 mm, JLB Hawaii 10: *a*, lateral view of body; *b*, telson; *c*, mandible; *d*, head; *e*, upper lip; *f*, maxilla 2; *g*, spiny ridge on article 2 of pereopods 3–5; *h*, half of lower lip; *i*, maxilliped; *j*, *k*, gnathopods 1, 2; *l*, part of coxa 1; *m*, dactyl of pereopod 3; *n*, epistome and upper lip, right side.

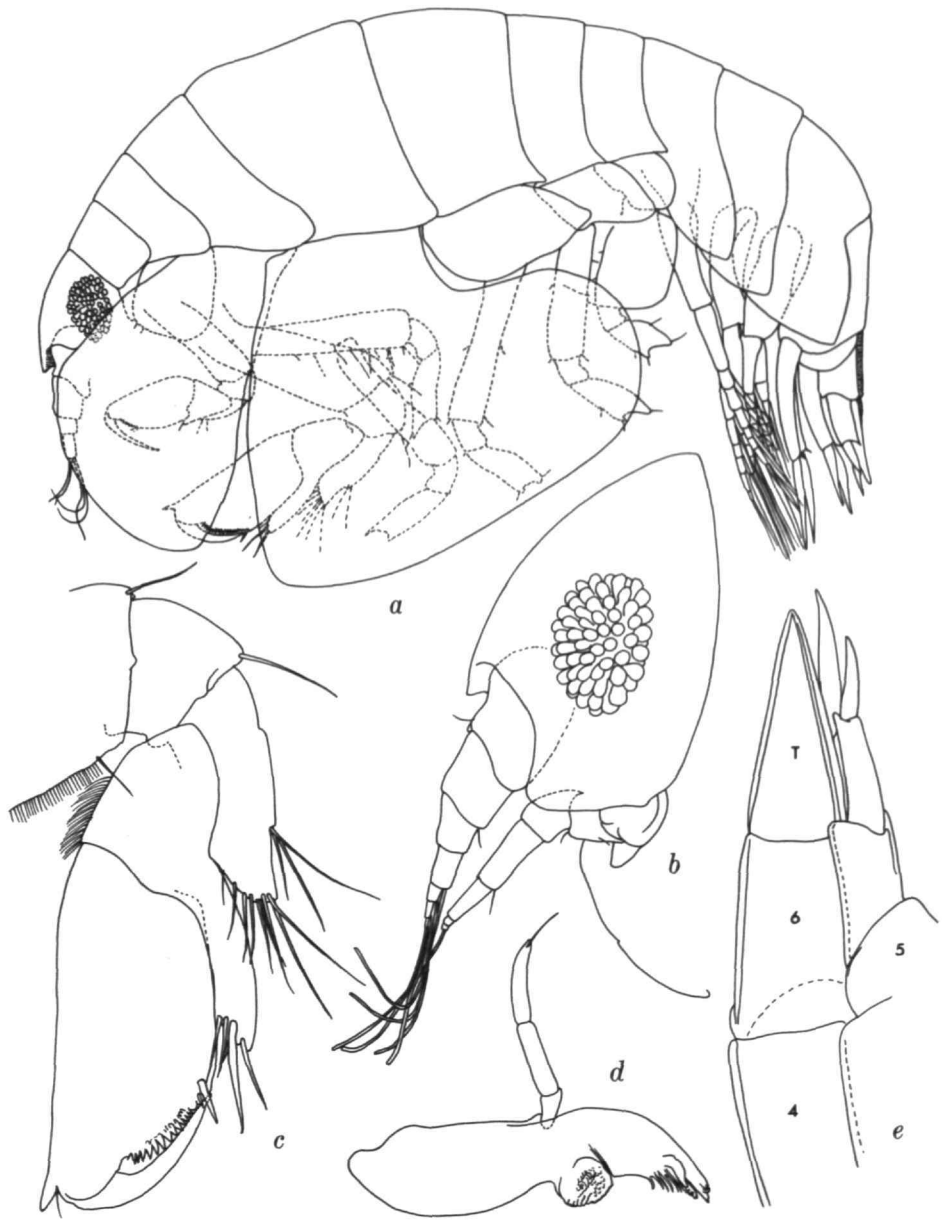

FIGURE 10.—*Mokuoloe ninole*, new genus, new species, holotype, male, 1.5 mm, JLB Hawaii 6: *a*, body; *b*, head; *c*, lateral gnathopod 2; *d*, mandible; *e*, urosomites "4", 5, "6" and telson ("T").

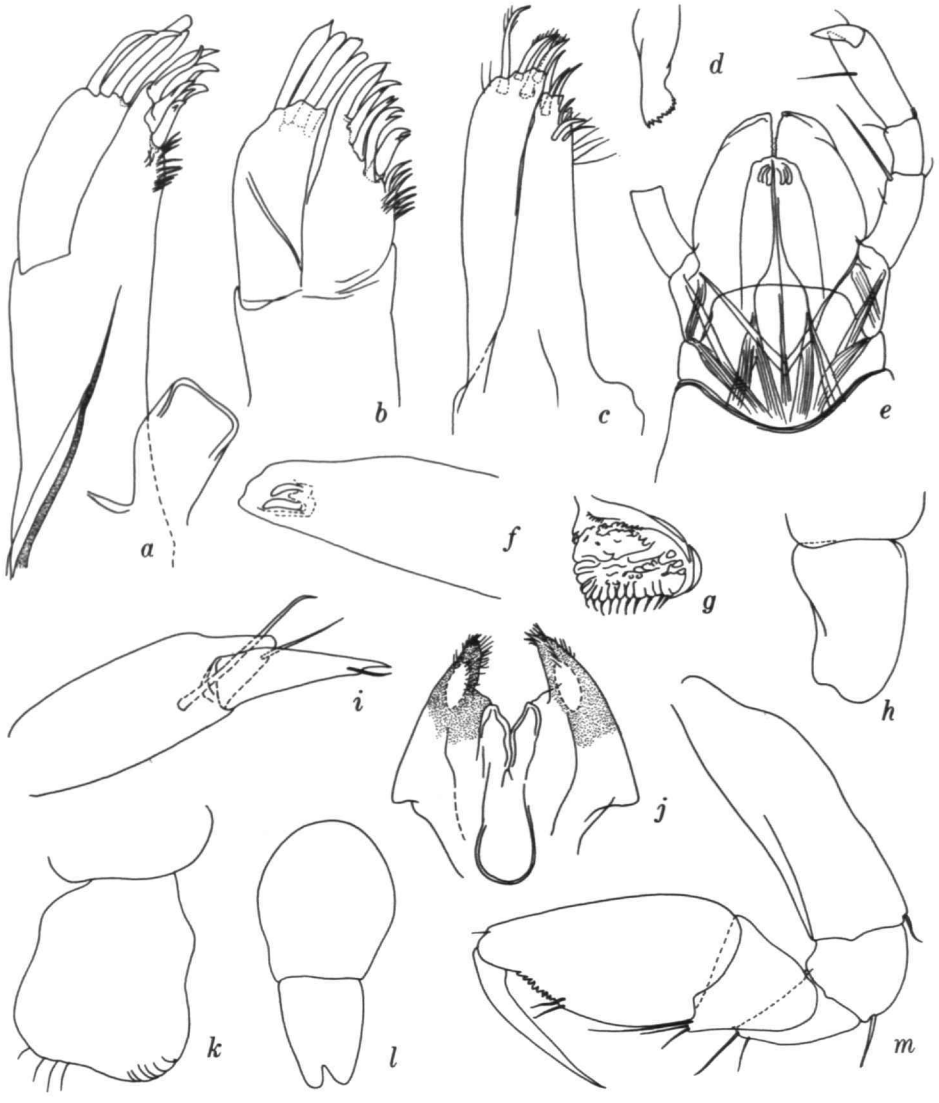

FIGURE 11.—*Mokuoloe ninole,* new genus, new species, holotype, male, 1.5 mm, JLB Hawaii 6: *a,* maxilla 1; *b,* maxilla 1 flattened; *c,* maxilla 2; *d,* right mandibular incisor; *e,* maxilliped; *f,* inner plate of maxilliped; *g,* mandibular molar; *h,* left coxa 1; *i,* maxillipedal palp articles 3–4; *j,* lower lip; *k,* left coxa 2; *l,* upper lip; *m,* lateral gnathopod 1.

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HOLOTYPE.—Bishop Museum collections, catalog number 7252, ?male, 1.5 mm. Unique.

TYPE-LOCALITY.—JLB Hawaii 6, off Barbers Point, Oahu, 30 m, coralline footballs, 29 January 1967.

DISTRIBUTION.—Hawaiian Islands.

Family AMPITHOIDAE

Ampithoe akuolaka, new species

FIGURES 12, 13

DIAGNOSIS OF MALE.—All pleonal epimera with lateral ridges, rounded posteroventrally, but with small obtuse notch bearing setule; articles 5 and 6 equal to each other in length, article 5 with truncate posterior margin and triangular posterodistal extension slightly overlapping article 6, article 2 with large distolateral lobe, article 6 narrowly rectangular and slightly tapering, palm very short and obsolescent, posterior margin of article 6 with defining spine, dactyl strongly overlapping palm; gnathopod 2 of medium size, article 2 with large anterodistal lobe, article 4 weakly coniform distally, article 5 short, with narrow bifid, setose posterior lobe, hand longer than broad, deeply bifid on palm, heavily setose, dactyl strongly overlapping large tooth of palm; article 2 of pereopods 1–2 more than twice as long as broad; pereopods 3–5 with simple sixth articles bearing distal pair of small straight locking spines, one smaller and more erect than other, largest very long on pereopod 3, dactyl simple; article 2 of pereopod 3 very broad and lacking spines or notches, article 2 of pereopods 4–5 with 2 or 3 stout posterodistal spines; antenna 1 about as long as head and pereonites 1–6 together, antenna 2 short, peduncular articles short and of medium thickness, entire antenna about as long as head and pereonites 1–4 together, flagellum slender, almost as long as articles 4–5 together; apical lobules of lower lip very short and tumid, lateral longer than medial; coxa 1 produced forward; peduncular processes between rami of uropods 1–2 absent, peduncles of uropods 1–3 with lateral setae, arranged in axial row on uropod 1, in one bundle on uropods 2–3; eyes pale purple in alcohol.

FEMALE.—Gnathopod 1 lacking posterodistal triangular extension on article 5; gnathopod 2 small, article 5 elongate and bearing medium-sized triangular lobe, palm of narrow article 6 very oblique, slightly S-shaped, defined by large spine, dactyl fitting palm.

JUVENILE (smallest available, 3.6 mm).—Similar to female and bearing peduncular setae on uropods 1–3, notches and lateral ridges on pleonal epimera.

HOLOTYPE.—Bishop Museum collections, catalog number 7253, male, 5.6 mm.

TYPE-LOCALITY.—JLB Hawaii 17, Kawela Bay, Oahu, intertidal, *Sargassum*, other algae, rocks, corals, 24 May 1967.

MATERIAL.—JLB Hawaii 17 (2), 18 (2).

RELATIONSHIP.—The lower lip of this species resembles that of *A. pollex* Kunkel (W Atlantic, NE Pacific) and gnathopod 2 of the male resembles the juvenile male of *A. pollex*. *Ampithoe akuolaka* appears to differ from the Pacific population of *A. pollex* (J. L. Barnard, 1965b), in the shorter medial lobules on the lower lip, the broader article 2 of pereopod 3, the presence of stout spines on article 2 of pereopods 4–5, the stronger palm of gnathopod 1, and the posterodistal triangular extension on article 5 of male gnathopod 1.

The latter characteristic suggests a relationship of *A. akuolaka* to *A. ramondi* Audouin, but the apical hooks on the outer ramus of uropod 3 of that species are highly reverted, no stout spines occur on the posterior margins of article 2 on pereopods 4–5, gnathopod 2 of the male apparently does not go through the *akuolaka* stage, the lateral apical lobules of the lower lip are thinner, and the female hand of gnathopod 2 is stouter. The hand of young male gnathopod 2 is like that of Oregonian *A. simulans* Alderman (1936) (J. L. Barnard, 1965b) and so are pleonal epimera 1–3 highly similar, but male gnathopod 1 article 5 of *A. simulans* is not produced posterodistally, the lateral apical lobule of the lower lip is thin, pereopods 4–5 lack the posterior spines on article 2, and the dactyl of male gnathopod 2 does not strongly overlap the palmar tooth. Possibly the specimens represented in J. L. Barnard (1965b, fig. 18) are a fourth sibling species in the complex of *A. pollex-simulans-akuolaka*.

DISTRIBUTION.—Hawaiian Islands.

Ampithoe kaneohe, new species

FIGURES 14, 15, 16, 24*l*

DIAGNOSIS OF MALE.—All pleonal epimera posteroventrally rounded; article 6 of gnathopod 1 longer than article 5, posterior margin of article 5 moderately broad but with weak, broadly coniform lobe, article 6 ovato-rectangular, of medium stoutness, palm very oblique and defined by stout spine; gnathopod 2 with

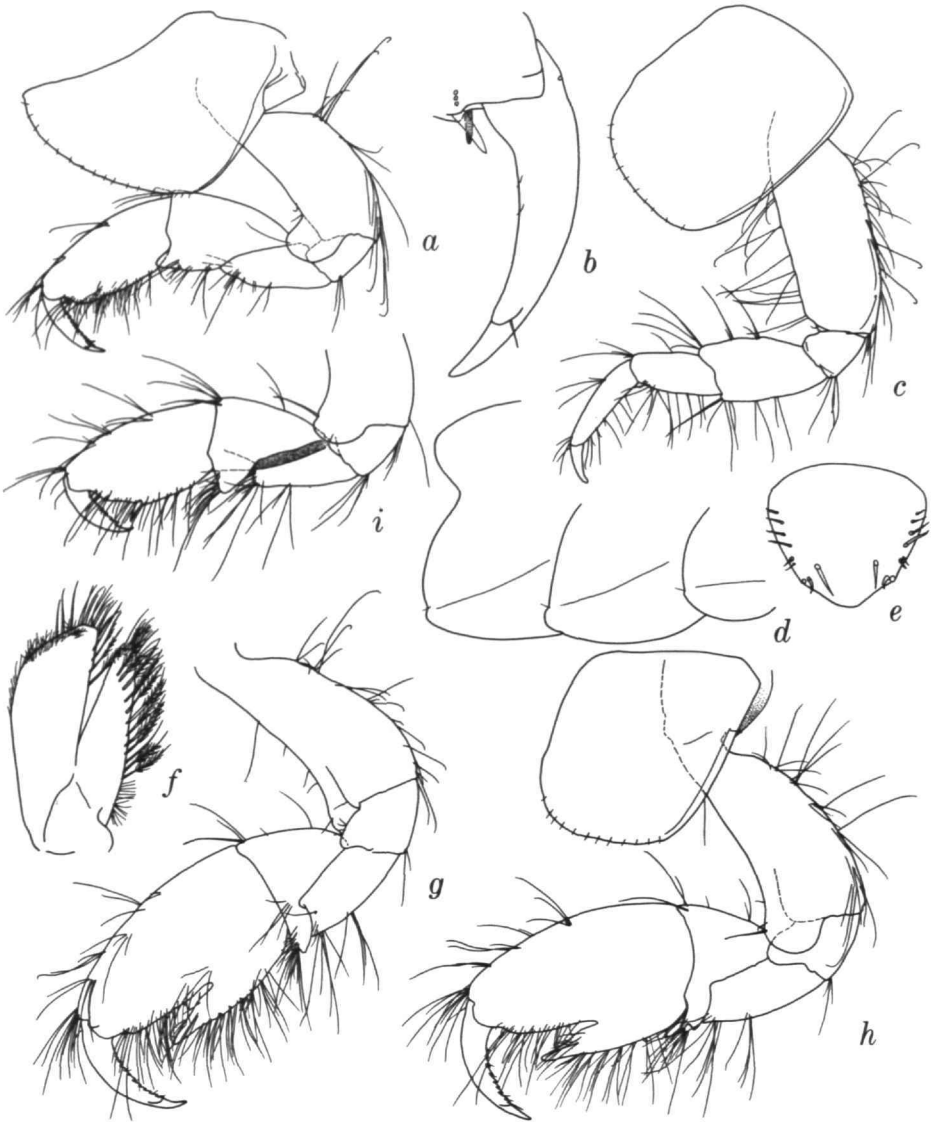

FIGURE 12.—*Ampithoe akuolaka*, new species, holotype, male, 5.6 mm, JLB Hawaii 17: *a*, gnathopod 1; *b*, dactyl of pereopod 5; *c*, pereopod 2; *d*, pleonal epimera 1–3; *e*, telson; *f*, maxilla 2; *g*, *h*, gnathopod 2, medial and lateral views. Female, 6.2 mm: *i*, lateral gnathopod 2.

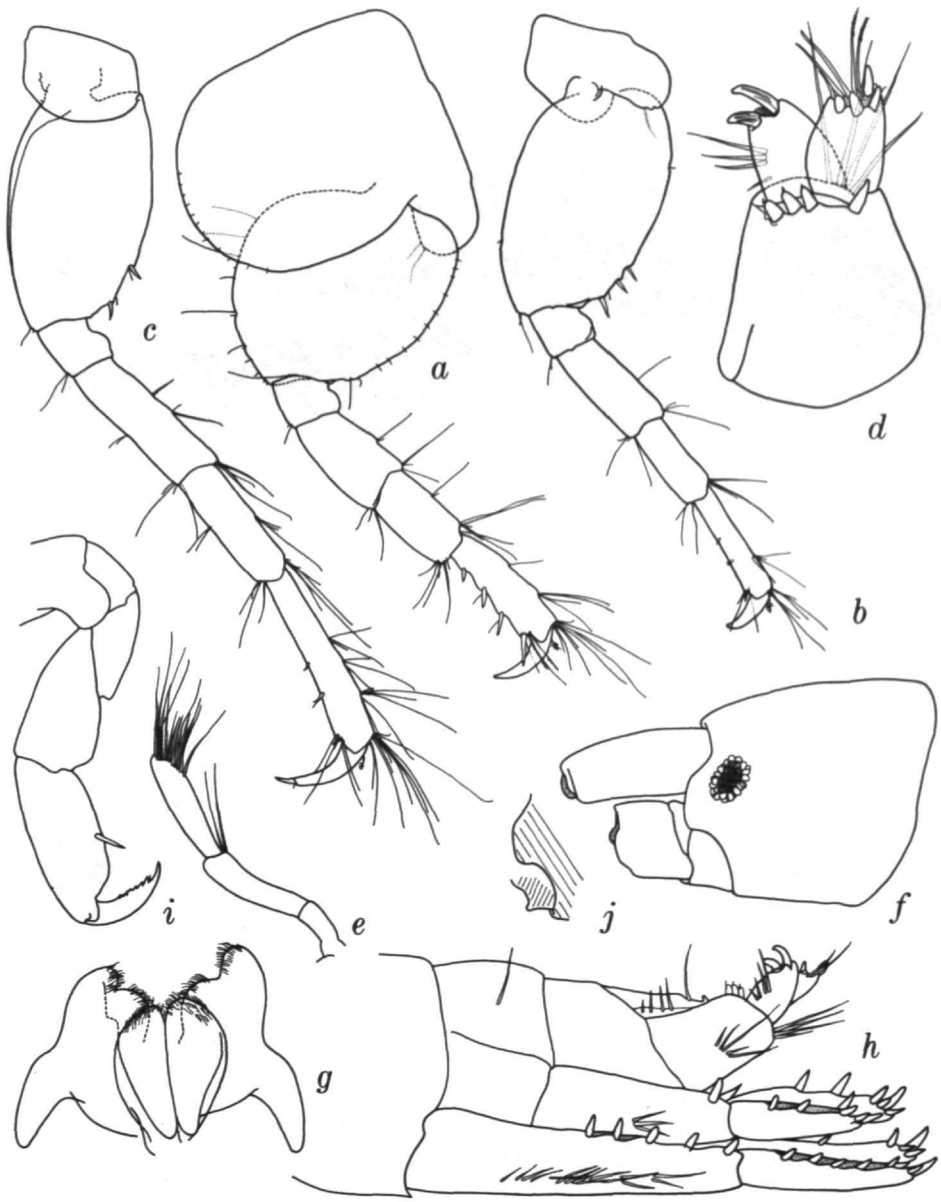

FIGURE 13.—*Ampithoe akuolaka,* new species, holotype, male, 5.6 mm, JLB Hawaii 17: *a, b, c,* pereopods 3, 4, 5; *d,* uropod 3; *e,* mandibular palp; *f,* head; *g,* lower lip; *h,* urosome. Female, 6.2 mm: *i,* gnathopod 2, setae removed; *j,* anteroventral corner of head.

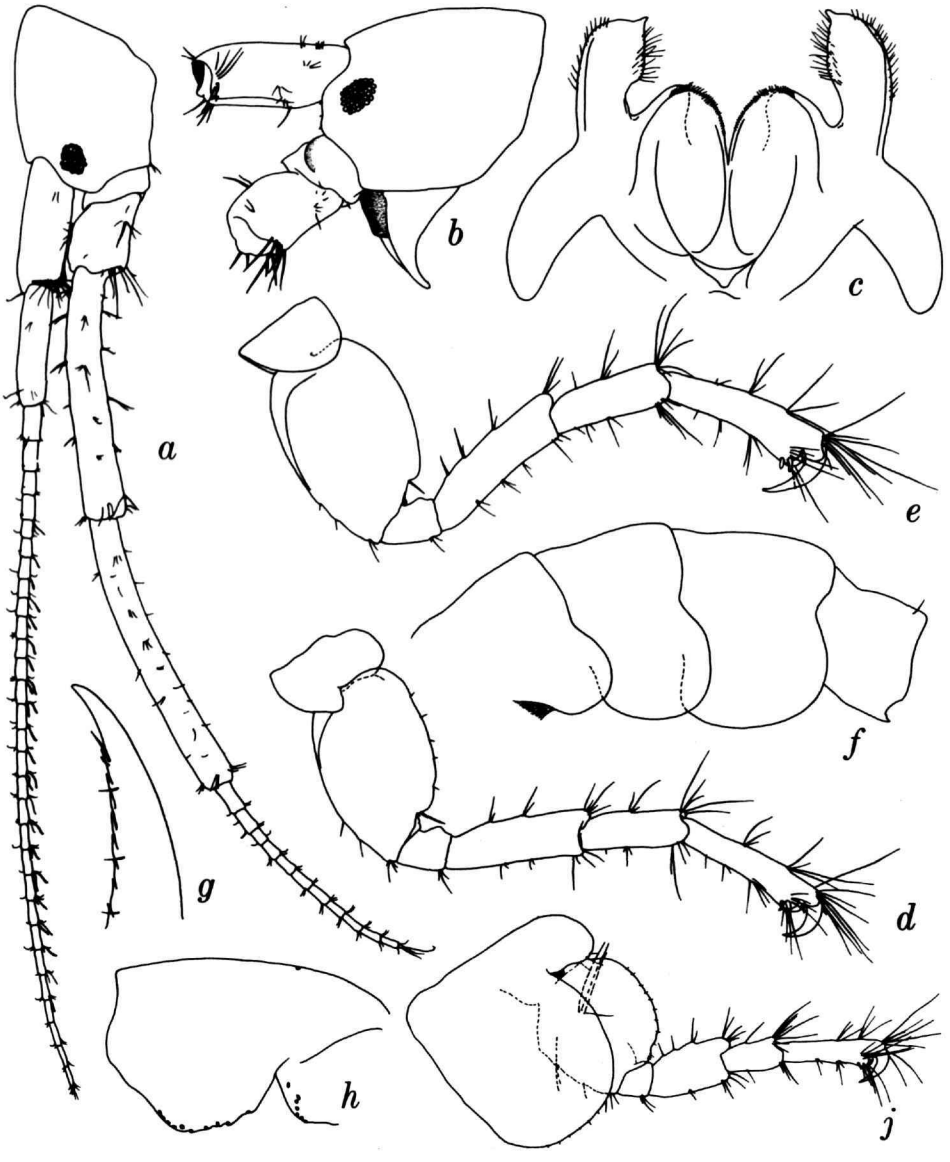

FIGURE 14.—*Ampithoe kaneohe*, new species, male, 6.0 mm, Fee 1: *a*, head and antennae. Holotype, male, 5.4 mm, Waikiki: *b*, head; *c*, lower lip; *d*, *e*, pereopods 4, 5; *f*, pleonites 1–4. Female, 5.2 mm: *g*, dactyl of gnathopod 2; *h*, article 5 of gnathopod 1; *i*, pereopod 3, unflattened; *j*, pereopod 3.

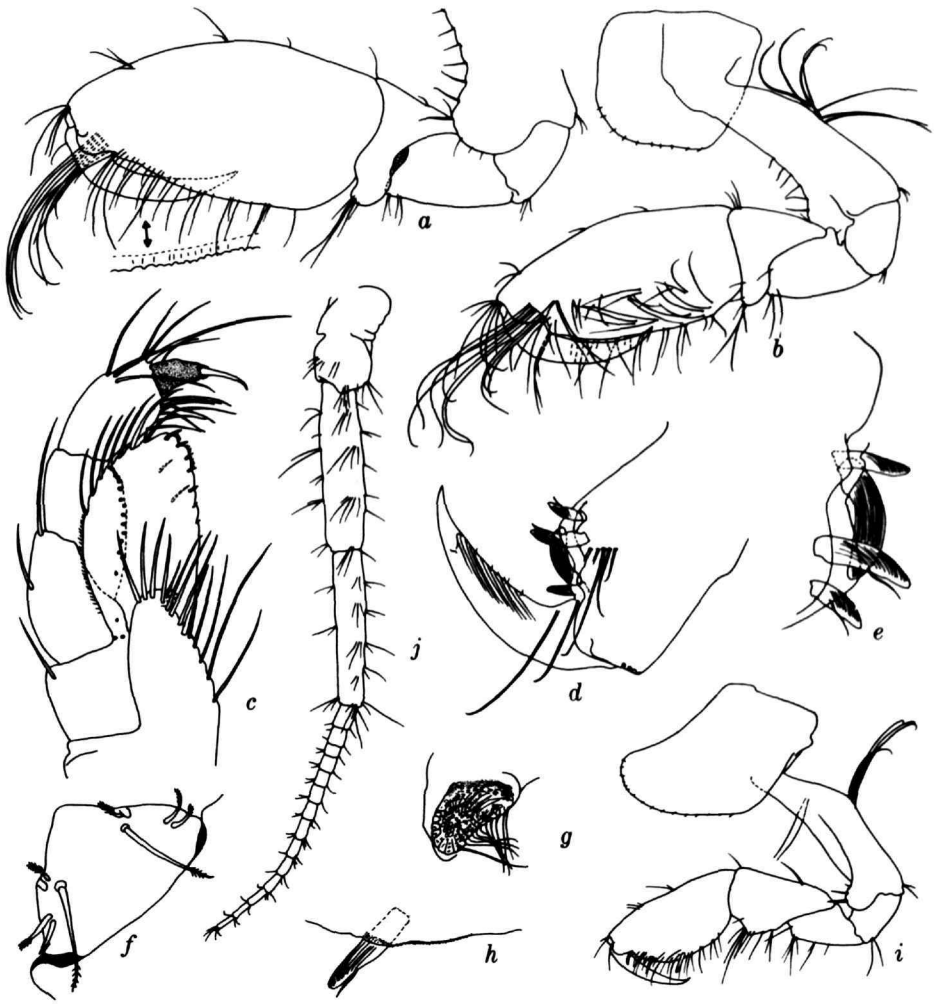

FIGURE 15.—*Ampithoe kaneohe*, new species, holotype, male, 5.4 mm, Waikiki: *a, b*, gnathopod 2, lateral and medial views; *c*, maxilliped; *d, e*, apex of pereopod 4; *f*, telson; *g*, mandibular molar; *h*, palmar spine of gnathopod 1; *i*, gnathopod 1.

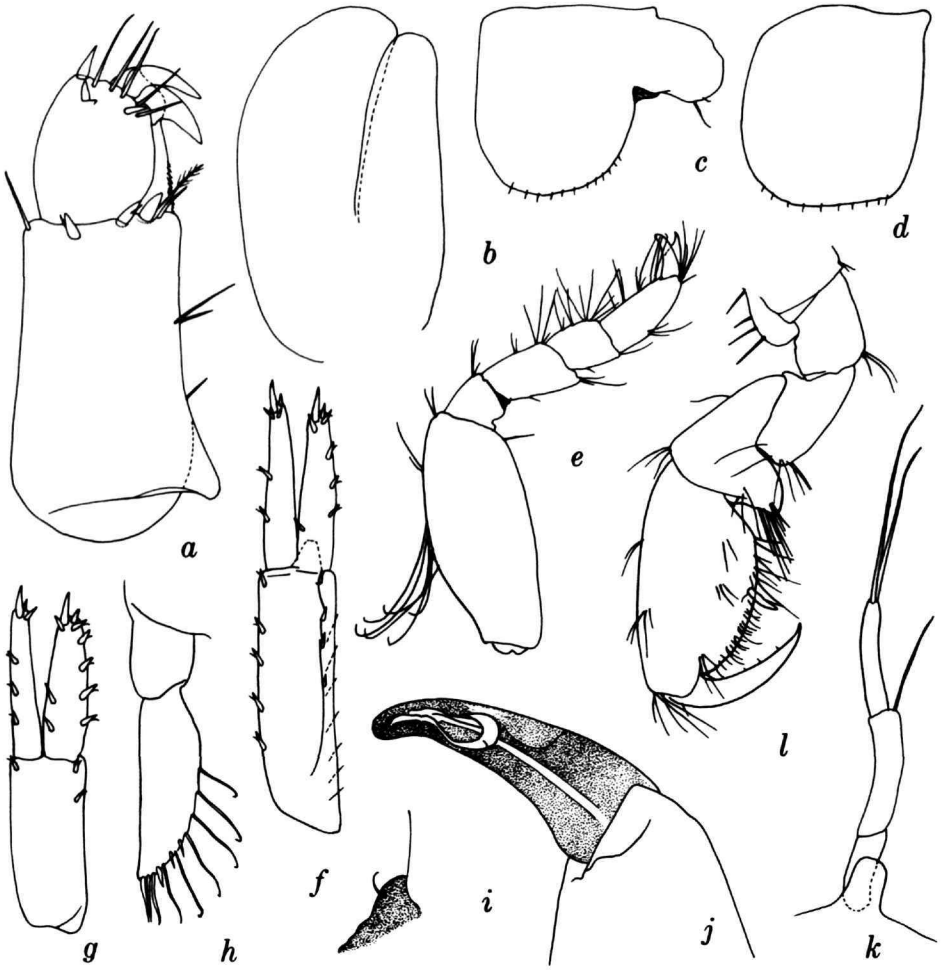

FIGURE 16.—*Ampithoe kaneohe,* new species, holotype, male, 5.4 mm, Waikiki: *a,* uropod 3; *b,* maxilla 2; *c, d,* coxae 5, 3; *e,* pereopod 2; *f, g,* uropods 1, 2; *h,* maxillipedal palp; *i,* maxilla 1, inner plate shaded; *j,* dactyl of pereopod 2; *k,* mandibular palp. Female, 5.2 mm: *l,* medial gnathopod 2.

elongate, tapering article 6, palm and posterior margin congruent, undefined, minutely crenulate, sparsely setose, medioterminal face of article 6 bearing large brush of long, apically turned, stiff setae, article 5 short and bearing strong, slender posterior lobe, article 7 half as long as article 6, distal lobe of article 2 very large; article 2 of pereopods 1–2 more than twice as long as broad; pereopods 3–5 with subprehensile sixth articles, each bearing palm closely guarded by a striate curved spine, 2 other striate spines at palmar corner and 1 small spine near dactylar hinge, dactyls partially striate on pereopods 3–5; antennae 1–2 long and extending equally, antenna 2 peduncle especially long, flagellum scarcely as long as article 5, slender, weakly setose; lateral apical lobule of lower lip much longer than medial and bearing apical nipple; coxa 1 produced forward; peduncular process of uropod 1 short, peduncle with sparse row of ventrolateral setae; eyes very small, clear or with slight posterior dark pigment in alcohol.

FEMALE.—Gnathopods like those of male gnathopod 1, but article 5 lobe of gnathopod 1 truncate, that of gnathopod 2 sharp; antennae shorter than in male, articles 4–5 of antenna 2 shorter and flagellum as long as articles 4–5 together.

HOLOTYPE.—Bishop Museum collections, catalog number 7254, male, 5.4 mm.

TYPE-LOCALITY.—Off Waikiki Marine Laboratory, 11 March 1964, from *Ulva,* shallow water (4 specimens).

MATERIAL.—Hanauma Bay, Oahu, 29 February 1964, from *Acanthophora,* depth unknown. Fee 1 (24). JLB Hawaii 12 (4), 13 (6), 15 (2).

RELATIONSHIP.—The subprehensile pereopods 3–5 give this species the aspect of a *Pleonexes,* but that subgenus should be restricted for those few species also having large cornified lobes or wings on the telson. See *Ampithoe (Pleonexes) poipu* below. *Ampithoe* should include that taxon described by Barnard (1965b) as *Pleonexes* species from Micronesia, which I designate now as *Ampithoe kulafi,* new species. It and *Ampithoe kaneohe* appear to be a closely related pair in terms of subprehensile pereopods, lower lip, gnathopod 1, and uropod 1, but *A. kulafi* (anagram of Ifaluk, its type-locality) has a very different male gnathopod 2, with subcircular article 6 bearing a transverse palm. *Ampithoe kaneohe* is the only known species of the genus with male gnathopod 2 having the palm and posterior margin of the hand congruent and that also has a nonrectangular gnathopod 1 with oblique palm. Thus, it differs from *Ampithoe orientalis* Dana of the Hawaiian Islands in that character plus the subprehensile pereopods 3–5.

DISTRIBUTION.—Hawaiian Islands.

Ampithoe orientalis Dana

FIGURE 17*a-i*

Amphithoe (sic) *orientalis* Dana, 1853, pp. 937–939, pl. 64, fig. 2.

Ampithoe orientalis.—Stebbing, 1906, p. 641.—J. L. Barnard, 1955a, pp. 26–28, fig. 14.

MATERIAL.—JLB Hawaii 17 (1), 18 (1). Fee 1 (7).

DISTRIBUTION.—Philippine and Hawaiian Islands.

See *Ampithoe* species for special notes and comparisons supplementing the description of the Hawaiian population of this species by J. L. Barnard (1955a).

Ampithoe ramondi Audouin

FIGURES 18, 19

Ampithoe ramondi Audouin.—J. L. Barnard, 1955a, pp. 28–29 [with references].

NOTES.—Drawings of this common circumtropical species are presented to establish means for future comparison of the Hawaiian population (or a small portion of it) to others in far parts of the world and with other Hawaiian members of the genus.

Of special interest is the thickening of the setae on the anterodistal lobes of the second articles on gnathopods 1–2. The distal locking spines of pereopods 3–5 in the juvenile are composed of a very small, thin, straight, spirally striate spine, next proximal an erect slightly curved, enlarged, spirally striate spine and next proximal a straight, axially striate spine. On pereopods 3–5 of adults a pair of distal, weakly sabre-shaped, large, semispirally striate spines occurs with the next proximal spine, a nearly straight, axially striate member.

Eyes clear in alcohol or very pale pink.

Uropod 1 has a lateral setal row. The inner plate of maxilla 1 has 4 setae in adults.

MATERIAL.—JLB Hawaii 2 (1), 15 (4). The material reported by Barnard (1955a). Canton Island, February 1958, Drs. Degener (100+).

DISTRIBUTION.—Circumtropical.

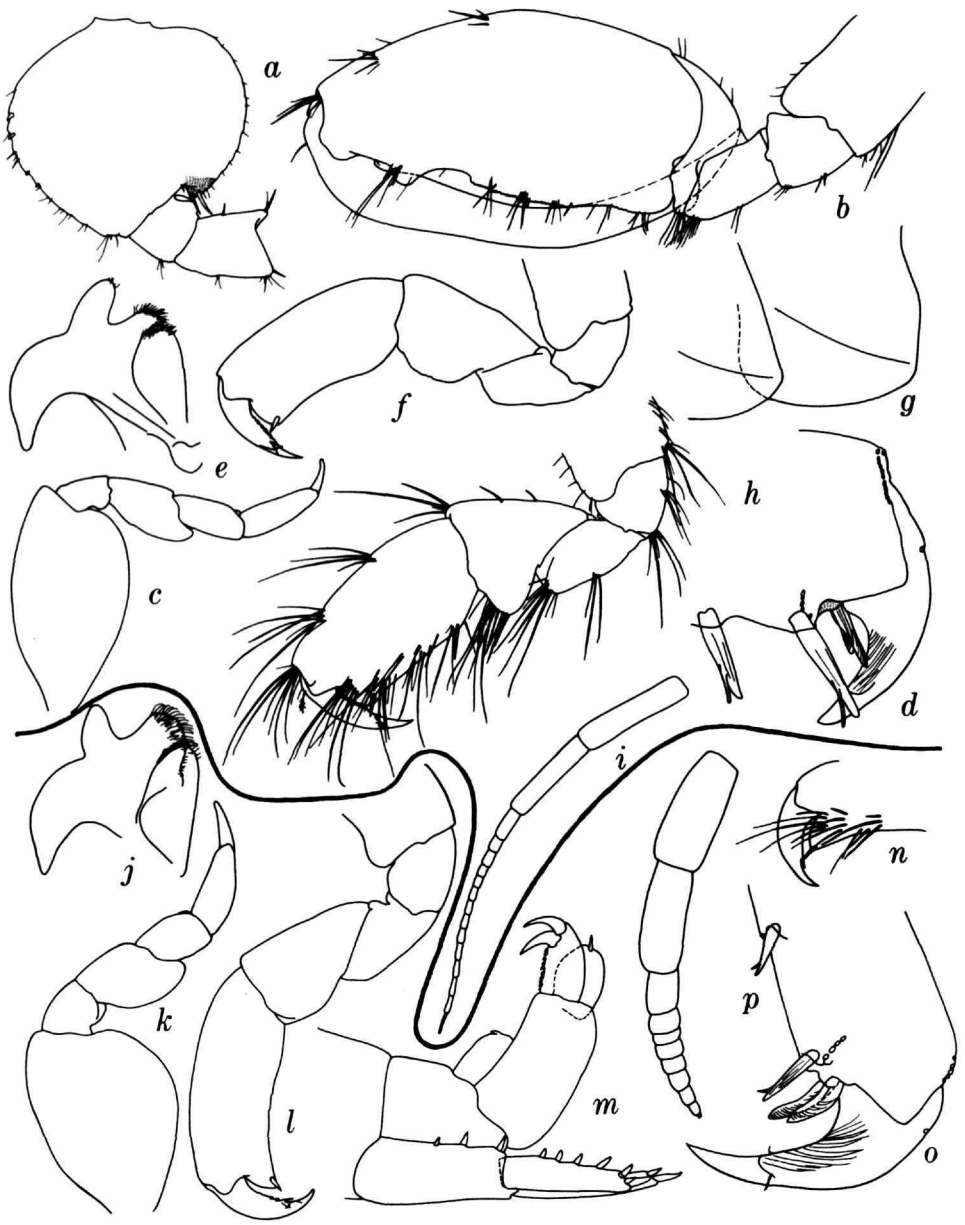

FIGURE 17.—*Ampithoe orientalis* Dana, and *Ampithoe* species; *A. o*, male, Fee 1: *a*, articles 2–4 of lateral pereopod 3; *b*, lateral gnathopod 2; *c*, pereopod 1, setae removed; *d*, apex of pereopod 3. Female, *e*, half of lower lip; *f*, lateral gnathopod 1, setae removed; *g*, pleonal epimera 2–3; *h*, gnathopod 2; *i*, articles 4–5 of peduncle and flagellum of antenna 2. *Ampithoe* species, female, JLB Hawaii 17: *j*, half of lower lip; *k*, pereopod 1, setae removed; *l*, lateral gnathopod 1, setae removed; *m*, uropods 2–3 from lateral view; *n*, apex of gnathopod 1; *o*, apex of pereopod 4. Female, JLB Hawaii 18: *p*, articles 4–5 of peduncle and flagellum of antenna 2.

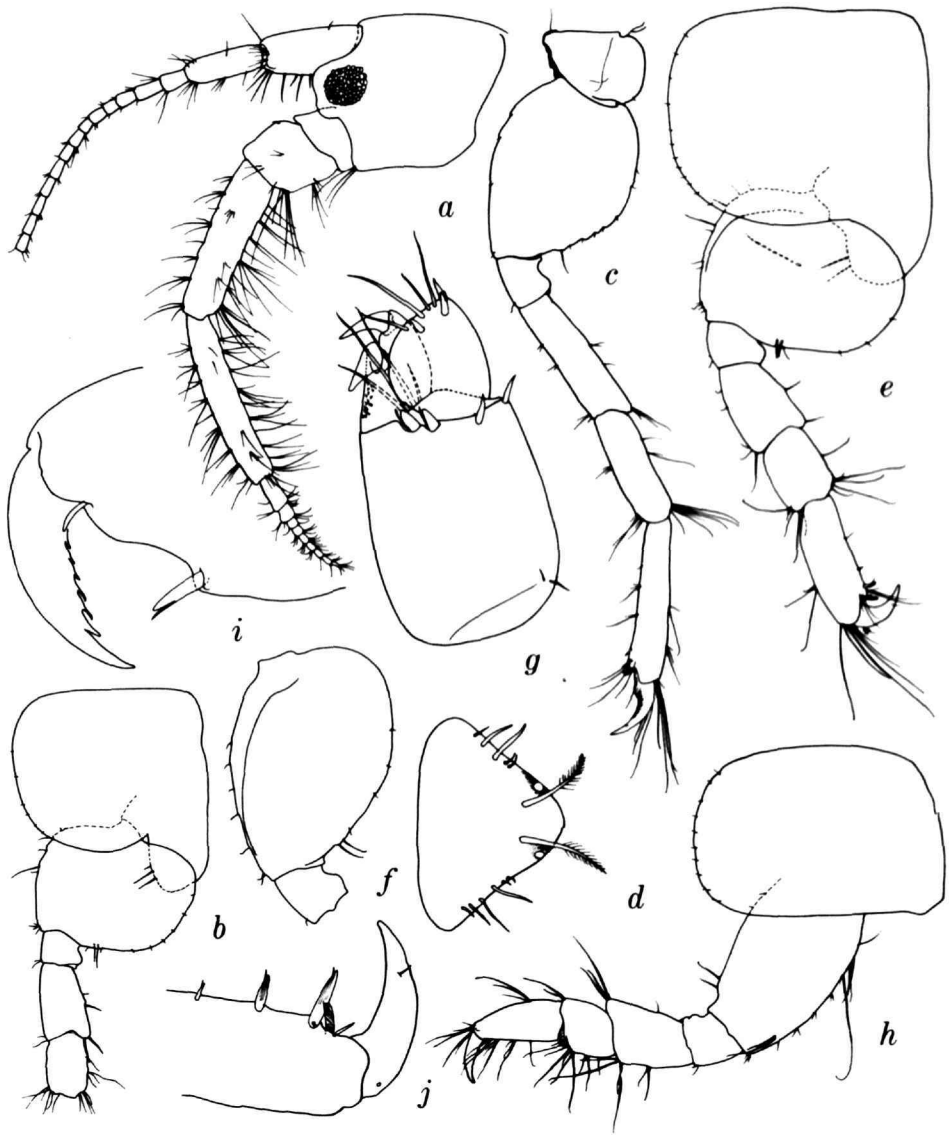

FIGURE 18.—*Ampithoe ramondi* Audouin, male, 6.8 mm, Kawela Bay: *a*, head; *b*, *c*, pereopods 3, 5; *d*, telson. Female, 4.6 mm, JLB Hawaii 15: *e*, *f*, pereopods, 3, 4; *g*, uropod 3; *h*, pereopod 2. Juvenile male, 2.7 mm, JLB Hawaii 2: *i*, palm of gnathopod 2; *j*, apex of pereopod 3.

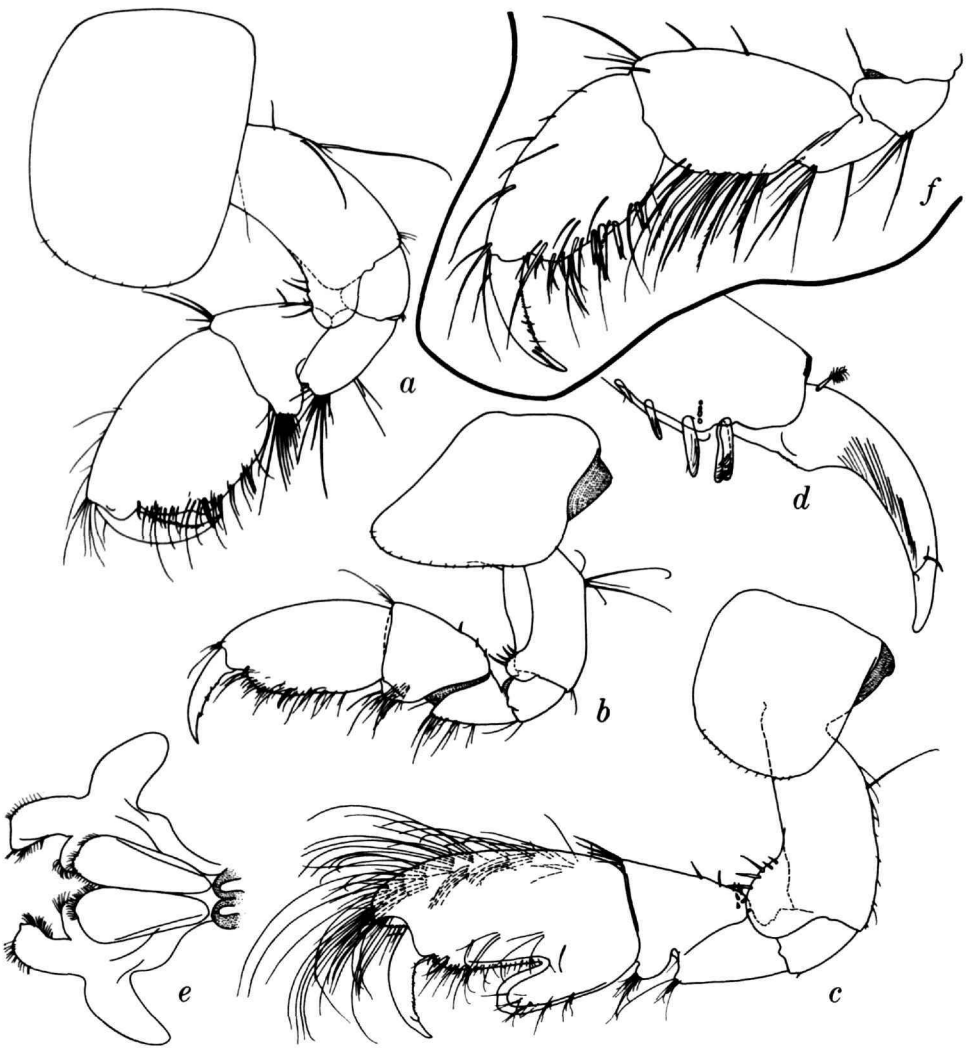

FIGURE 19.—*Ampithoe ramondi* Audouin and *Neomicrodeutopus* (?) *makena*, new species. *A. ramondi*, female, 4.6 mm, JLB Hawaii 15: *a*, gnathopod 2. Male, 6.8 mm, Kawela Bay: *b*, *c*, gnathopods 1, 2; *d*, dactyl of pereopod 5; *e*, lower lip. *N.* (?) *makena*, female, 3.9 mm, JLB Hawaii 18: *f*, lateral gnathopod 1.

Ampithoe waialua, new species

FIGURES 20, 21

DIAGNOSIS OF MALE.—All pleonal epimera rounded posteroventrally; article 6 of gnathopod 1 longer than article 5, latter subtriangular, posterior lobe turned slightly distalward and article 4 broadly extended triangularly to fit posteroproximal oblique margin of article 5, article 2 with large distolateral lobe, article 6 subrectangular, palm short and oblique, excavate, dactyl strongly overlapping palm, large medial-defining spine strongly proximal to apex of defining cusp; gnathopod 2 small, article 2 with mammiliform, sparsely setose distolateral lobe, article 4 slender, posterodistally coniform, article 5 relatively long for genus, bearing asymmetrically triangular posterior lobe, hand expanded, palm oblique and excavate, with defining cusp, dactyl failing to fit palm; article 2 of pereopods

1–2 about twice as long as broad; pereopods 3–5 with simple sixth articles bearing distal pair of striate, nearly straight locking spines and one other striate spine proximal to locking pair, dactyl slightly striate; article 2 of pereopod 3 very broad and bearing 1–2 large anterior notches armed with stout spine; antenna 1 about as long as head and first 8 body segments together, antenna 2 about two-thirds as long as antenna 1, flagellum slender and as long as articles 4–5 of peduncle together; lateral apical lobule of lower lip much longer than medial and bearing apical nipple, inner lobes partially coalesced with medial lobule of outer lobe; coxa 1 produced forward; peduncular process between rami of uropod 1 obsolescent, sharply and obtusely triangular, peduncle with short lateral setae; eyes clear (adult) or with pale purple cores (juveniles) in alcohol.

FEMALE.—Gnathopod 1 with narrower lobe on article 2 than in male, much weaker article 4 with small process, article 5 longer and with broader posterior lobe, palm not excavate; gnathopod 2 with narrower article 6 bearing slightly S-shaped palm defined by spine, dactyl slightly overlapping palm; peduncle of antenna 2 more slender than in male, peduncle of antenna 1 reaching only to end of article 4 on peduncle of antenna 2.

JUVENILE.—Uropod 1 with a few lateral setae and pereopod 3 with 1–2 notches; palm of gnathopod 2 on young male smooth like that of female.

HOLOTYPE.—Bishop Museum collections, catalog number 7255, male, 4.0 mm.

TYPE-LOCALITY.—JLB Hawaii 14, 1 mi N of Kualoa Point, Oahu, intertidal, algae, dead coral heads, 23 May 1967.

MATERIAL.—JLB Hawaii 5(36), 6(8), 8(3), 12(3), 14(13), 15 (7).

RELATIONSHIP.—*Ampithoe waialua* resembles the adolescent stages of *A. simulans* Alderman (J. L. Barnard, 1965b) from Pacific America. The resemblance occurs in various gross similarities such as antennae and gnathopods, but *A. waialua* has a much broader article 2 on pereopod 3 with an anterior notch and spine. The palm of male gnathopod 2 in *A. waialua* apparently does not pass through a stage of deep notching and splitting off of a tooth as the male ages, but gnathopod 2 remains relatively small, the palm becomes excavate, and a small defining cusp develops. The hand expands so that the dactyl fails to fit the full palmar length. Article 4 of gnathopod 2 maintains a posterodistal protrusion and the gnathopod generally remains in a juvenoid condition. The spines on uropods 1–2 of *A. simulans* are very stout and short and the palm of male gnathopod 1 is not excavate.

Ampithoe waialua also has a strong relationship to *A. ramondi* Audouin, the only circumtropical ampithoe. Gnathopod 2 is close to that of *A. ramondi* except for the absence of the anterodistal protrusion on article 6, and gnathopod 1 of *A. waialua* is, of course, a small edition of gnathopod 2 in the excavate palm. The lobe on article 2 of gnathopod 2 in male *A. waialua* is smaller than that on *A. ramondi*, and the hand of gnathopod 1 in both sexes of *A. ramondi* is very weakly developed and scarcely subchelate. Californian populations of *A. ramondi* resemble *A. waialua* in the partial coalescence of the inner lobes on the lower lip with the medial lobules of the outer lobes; that condition may be a result of preservation, however, as Chevreux and Fage (1925) show the inner lobes as free in Mediterranean material and Hawaiian members of *A. ramondi* have free lobes.

DISTRIBUTION.—Hawaiian Islands.

Ampithoe species

FIGURE 17*j-p*

MATERIAL.—JLB Hawaii 17 (1), 18 (1).

NOTES.—Two females of a species belonging to the same group as *A. orientalis* differ from *A. orientalis* in the parachelate palms of the gnathopods, slightly longer hands, with gnathopod 2 of the same slenderness as gnathopod 1 in contrast to gnathopod 2 on *A. orientalis* female that is much stouter and bears a distinct lobe on article 5; gnathopod 2 has article 5 about 10 percent shorter and article 6 about 10 percent longer than shown for the figured gnathopod 1; articles 2 and 4 of pereopods 1–2 are even more tumid than those on *A. orientalis;* antenna 2 is extremely short and stout in comparison to that of *A. orientalis,* the flagellum slightly longer than article 5 of the peduncle; uropod 3 is enlarged like small individuals of the American *A. lacertosa* Bate (J. L. Barnard, 1965b); the apical lobules of the lower lip are short and extend subequally in contrast to those of *A. orientalis.*

Pereopods 1–5 have locking spines and dactyls like those of *A. orientalis* and Figure 17*o* represents both species; the distal locking spines are formed of a pair of weak, striate sabres, the next proximal spine being straight and axially striate.

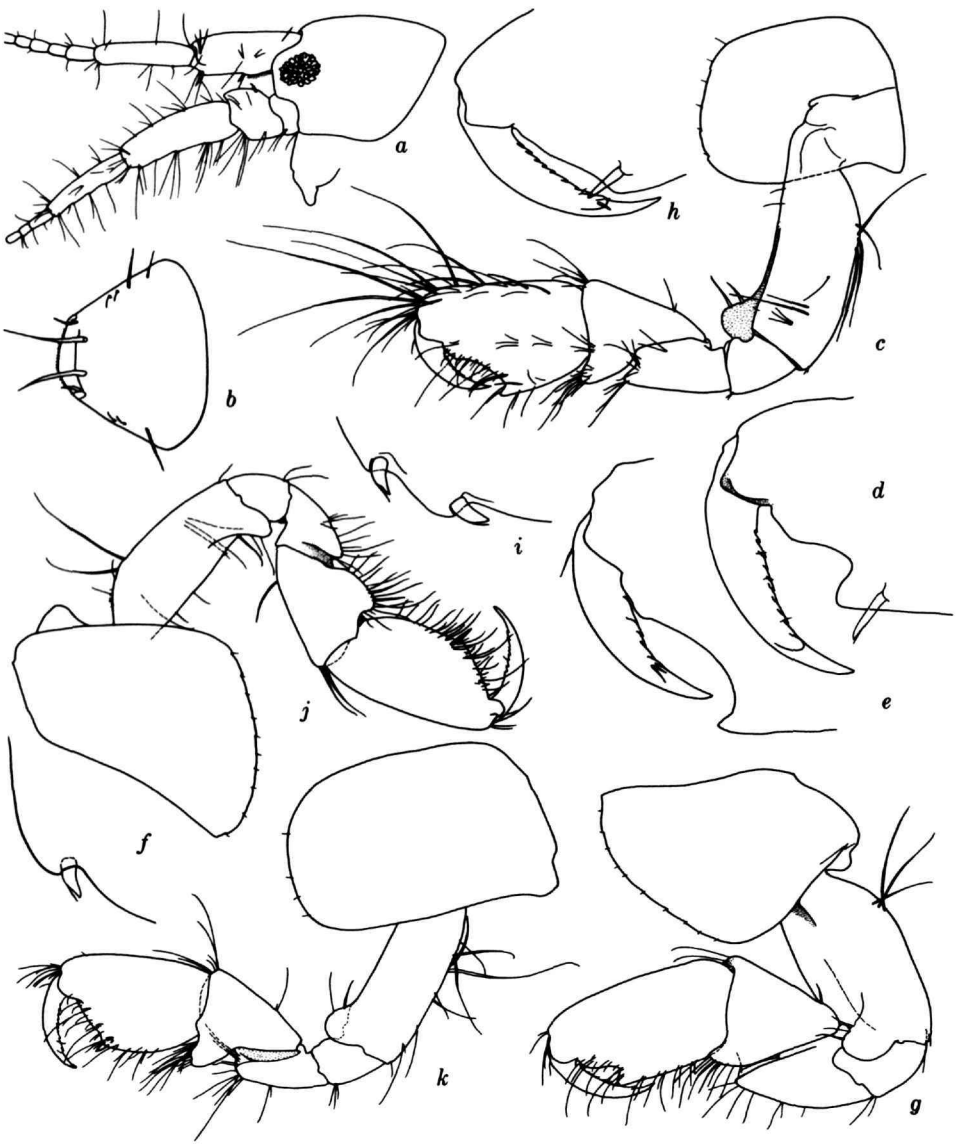

FIGURE 20.—*Ampithoe waialua*, new species, holotype, male, 4.0 mm, JLB Hawaii 14: *a*, head; *b*, telson; *c*, medial gnathopod 2; *d*, apex of medial gnathopod 1; *e*, apex of gnathopod 2, medial; *f*, anterior notch on article 2 of pereopod 3; *g*, gnathopod 1. Female, 4.9 mm: *h*, apex of medial gnathopod 2; *i*, anterior notches on article 2 of pereopod 3; *j*, gnathopod 1; *k*, gnathopod 2.

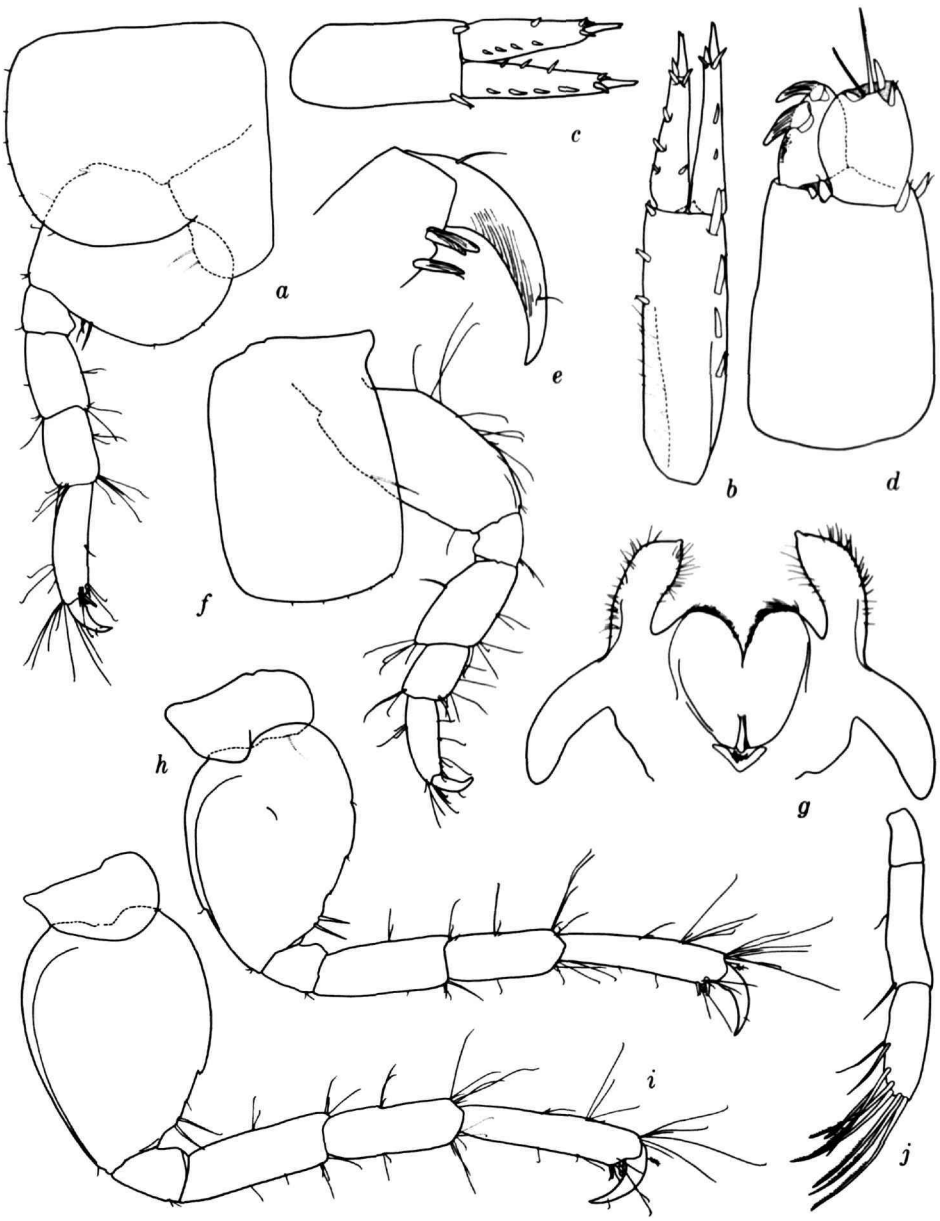

FIGURE 21.—*Ampithoe waialua*, new species, holotype, male, 4.0 mm, JLB Hawaii 14: *a*, pereopod 3; *b*, *c*, *d*, uropods 1, 2, 3; *e*, apex of pereopod 5; *f*, pereopod 2; *g*, lower lip; *h*, *i*, pereopods 4, 5; *j*, mandibular palp.

Uropod 1 has a large peduncular tooth like that of *A. orientalis,* and the tooth of uropod 2 is obsolescent. The eyes are medium in size, with faint purple cores and small ommatidia, whereas the eyes of *A. orientalis* are large, clear in alcohol, and have large ommatidia. Pleonal epimera, like those of *A. orientalis,* are rounded posteroventrally but bear lateral ridges.

Head with weak anteroventral excavation in *Ampithoe* species and strong in *A. orientalis.*

Anterior notches and spines on article 2 of pereopod 3 are large like those of *A. waialua.* Those of *A. orientalis* are smaller.

REMARKS.—This species is obviously distinct from any other in the Hawaiian Islands but whether it is new cannot be decided until males are collected. It apparently has relationships to the boreal North Pacific group with thin, transverse (or parachelate) palm of gnathopod 1, but Hawaiian *A. orientalis* also has the same boreal aspect even though it, or a species like it, was described originally from the Philippine Islands. Whether the Hawaiian *A. orientalis* is indeed the same species as the type described by Dana from Manila is now debatable in view of the strong endemicity found in Hawaiian Gammaridea. One also may wonder if the early collecting labels were highly accurate as several cases of incorrect labeling have been noted or suspected in Amphipoda.

No North Pacific *Ampithoe* with parachelate gnathopod 1 has yet been described (J. L. Barnard, 1965b and Gurjanova, 1951), and the Hawaiian *Ampithoe* species probably is a new, endemic species.

Ampithoe (Pleonexes) poipu, new species

FIGURES 22, 23, 24*a-k*

DIAGNOSIS OF MALE.—All pleonal epimera posteroventrally rounded, lacking lateral ridges; article 6 of gnathopod 1 much longer than article 5, posterior lobe of article 5 very narrow and slightly hooked, article 4 with small posterodistal lobe, article 6 rectangular, moderately thin, palm oblique, weak, defined by striate spine occurring almost on posterior margin of hand; gnathopod 2 like gnathopod 1 and not strongly enlarged, distal lobe on article 2 of medium size; article 2 of pereopods 1–2 more than twice as long as broad; pereopods 3–5 with subprehensile sixth articles similar to but not as strong as those of *A. kaneohe,* new species, large striate sabre spine not guarding smaller palm as closely as in *A. kaneohe,* other member of distal pair very small and nearly straight, next proximal spine large and next to that one of medium size, dactyls strongly striate; antenna 1 much shorter than 2, peduncle of antenna 2 short and stout, flagellum heavily armed with setular brushes and nearly as long as peduncle; lateral apical lobules of lower lip much longer than medial; coxa 1 weakly produced forward; peduncular process of uropod 1 short and blunt, that on uropod 2 obsolescent and bluntly triangular, peduncle of uropod 1 with lateral setal row; eyes small (clear in alcohol but specimens old); telson with pair of large reverted dorsal hooks formed from normal nobs of other ampithoes.

FEMALE.—Gnathopods 1–2 like male gnathopod 1; antenna 2 with slightly thinner peduncle and flagellum than on male and flagellum only as long as articles 3–5 of peduncle.

HOLOTYPE.—Bishop Museum collections, catalog number 7256, male, 9.0 mm.

TYPE-LOCALITY.—Poipu Beach, Kauai, 17 September 1959, IV. 4. d, *Chir. haw.,* collection H. Caspers.

MATERIAL.—Eleven specimens from the type-locality.

REMARKS.—*Pleonexes* Bate now seems to have been an artificial genus composed of members of *Ampithoe* with dorsal telsonic hooks as extensions of the normal nobs plus subprehensile pereopods 3–5. This is well demonstrated with *A.* (*P.*) *poipu* in its affinities with *A. kaneohe,* new species, that has stronger palms on the pereopods but no dorsal hooks and with *A. kulafi,* new species (*Pleonexes* species of J. L. Barnard 1965a), that has stronger palms of pereopods but no hooks. The type-species of the genus, *P. gammaroides* Bate (Sars, 1895, pl. 207) from the Atlantic Ocean has the same overall aspect of *A.* (*P.*) *poipu,* but the gnathopodal palms are better developed, the lower lip has no medial lobules, the antennae are more strongly subequal to each other, the palmar spines on pereopods 3–5 are weaker but of similar aspect, and uropod 3 is slightly enlarged in the female (like that of *Ampithoe* species herein).

There is undoubtedly some genetic connection among *A.* (*P.*) *gammaroides* and *A.* (*P.*) *poipu* as seen also in the special shape of the peduncular process on uropod 1, but *A. kaneohe* is equally to be considered in this connection, for it resembles *P. gammaroides* in the obsolescence (or concealment) of medial lobules

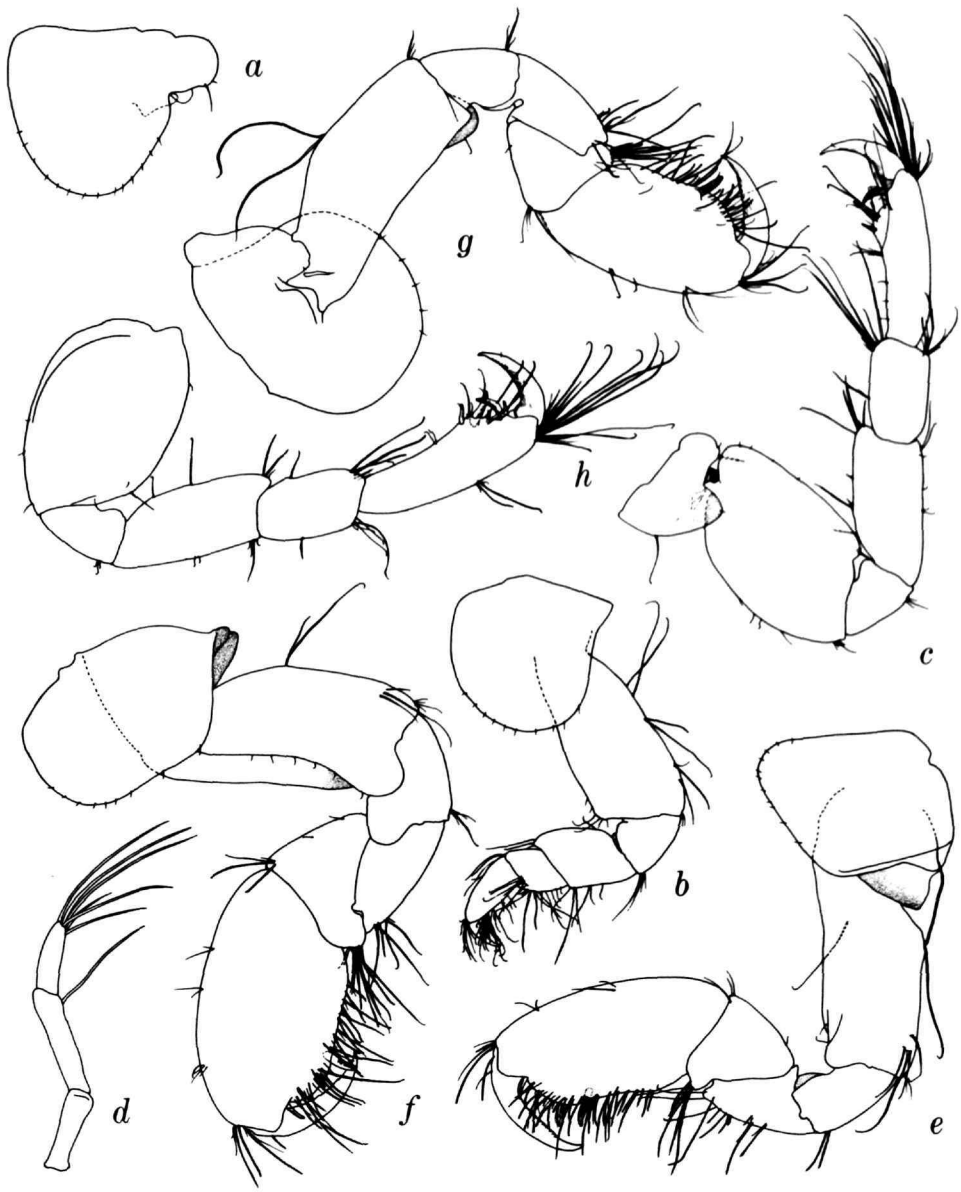

FIGURE 22.—*Ampithoe* (*Pleonexes*) *poipu*, new species, holotype, male, 9.0 mm, Poipu Beach, Kauai: *a*, coxa 5; *b*, *c*, pereopods 1, 4; *d*, mandibular palp; *e*, *f*, gnathopods 1, 2. Female, 7.0 mm: *g*, gnathopod 2; *h*, pereopod 3.

FIGURE 23.—*Ampithoe (Pleonexes) poipu*, new species, holotype, male, 9.0 mm, Poipu Beach, Kauai: *a, b*, head; *c*, posteroventral corner on article 2 of pereopod 4; *d*, mandible; *e*, uropod 3; *f*, maxilliped; *g*, maxillipedal palp article 4; *h, i*, maxillae 1, 2; *j*, inner plate of maxilliped; *k*, lower lip.

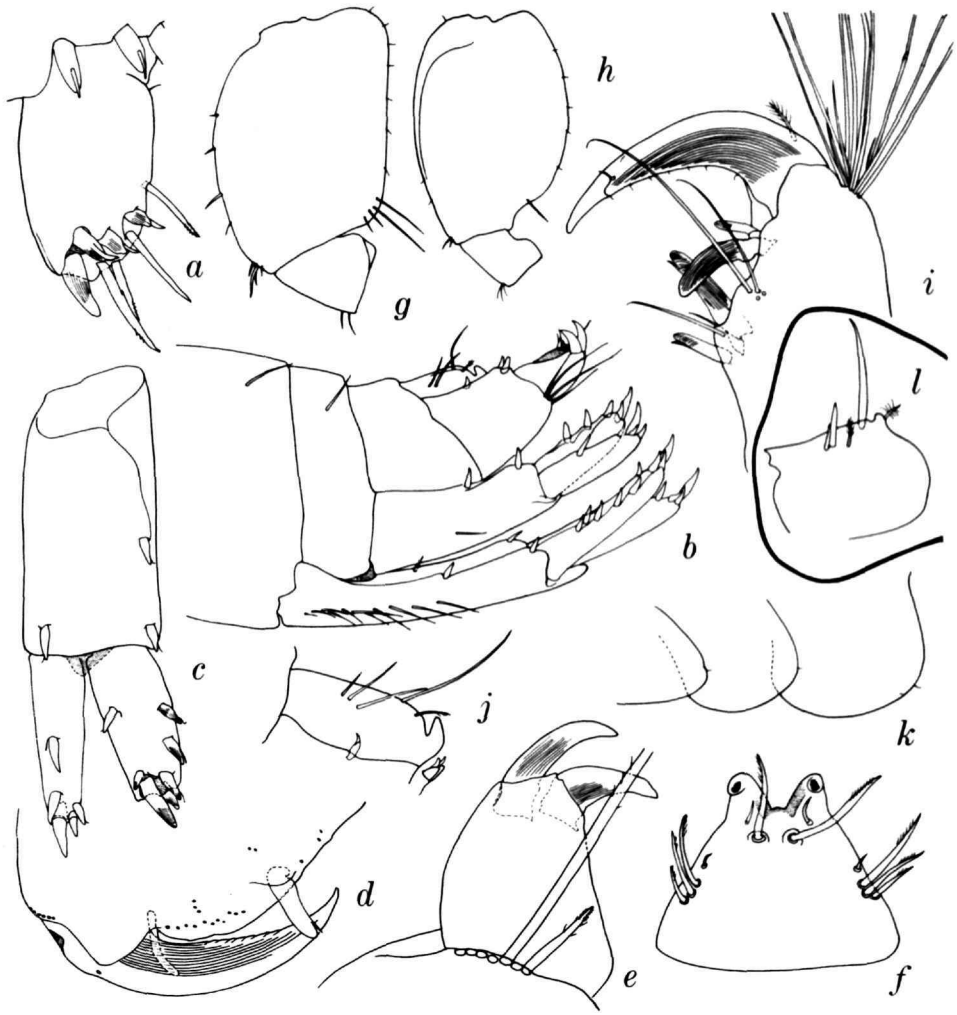

FIGURE 24.—*Ampithoe* (*Pleonexes*) *poipu*, new species and *Ampithoe* (*Ampithoe*) *kaneohe*, new species. *A.* (*P.*) *poipu*, holotype, male, 9.0 mm, Poipu Beach, Kauai: *a*, inner ramus of uropod 3; *b*, urosome; *c*, uropod 2; *d*, palm of medial gnathopod 2; *e*, outer ramus uropod 3; *f*, telson. Miscellaneous loose pereopods in this sample, possibly of this species: *g*, *h*, ?pereopods 4, 5. Female, 7.0 mm: *i*, dactyl of pereopod 3; *j*, left side of telson (compare with 24 *l*); *k*, pleonal epimera 1–3. *A. kaneohe: l*, left side of telson (compare with 24 *j*).

on the lower lip unlike *A.* (*P.*) *poipu* and also shares the same uropod 1 process.

Pleonexes lessoniae Hurley (1954a) is a member of the group of ampithoes bearing thin hands of gnathopod 1 with transverse palm. The palms of pereopods 3–5 resemble those of gnathopod 1. The outer rami of uropods 1–2 lack dorsal spines and the outer lobes of the lower lip are scarcely modified apically, bearing only one small nipple instead of two lobes.

DISTRIBUTION.—Hawaiian Islands.

Cymadusa filosa Savigny

Cymadusa filosa Savigny.—J. L. Barnard, 1955a, pp. 29–30, fig. 15 [with references]; 1965a, p. 540.

MATERIAL.—JLB Hawaii 2 (3), 12 (1), 13 (8), 14 (4), 15 (5). Fee 1 (3).

DISTRIBUTION.—Circumtropical.

Cymadusa hawaiensis (Schellenberg)

FIGURES 25, 26

Grubia hawaiensis Schellenberg, 1938, pp. 88–90, fig. 45.

DIAGNOSIS OF MALE.—Pleonal epimera 1–2 with lateral ridges, all with small rounded posteroventral tooth, notch and setule; gnathopods 1–2 elongate, articles 5–6 of gnathopod 1 equal to each other in length, article 4 with large conical posterodistal extension partly guarding article 5, latter with truncate, setose posterior lobe with quadrate corner, article 6 about as broad as 5 but basally constricted, palm very oblique, shorter than posterior margin of hand, defined by spine, dactyl overlapping palm, article 2 with broadly triangular anterodistal lobe; gnathopod 2 larger than 1, lobe on article 2 low and obtuse, extension on article 4 smaller than on gnathopod 1, article 5 shorter than 6, posterior lobe slightly convex, article 5 of same size as on gnathopod 1 but less setose, article 6 large, similar in shape to that of gnathopod 1, palm slightly more prominent, defined by large spine, dactyl overlapping palm and closing across medial face of hand; article 2 of pereopods 1–2 about 3 times as long as broad; pereopods 3–5 with simple sixth articles bearing pair of straight locking spines, full lengths of anterior margins bearing more spines in tandem, dactyl with a few striations; article 2 of pereopod 3 of medium breadth, pyriform, with stout posterodistal spine and not lobate, pereopods 4–5 with narrower, pyriform article 2 bearing row of several posterodistal marginal spines, anterior margin of article 2 of pereopods 3–5 lined with stout short spines; antenna 1 as long as head and first 8 body segments, antenna 2 as long as head and first 5 body segments, accessory flagellum 2-articulate, article 2 on peduncle of antenna 1 slightly longer than article 1, article 3 short, flagellum of antenna 2 nearly as long as peduncular articles 4–5 together; apical lobules on lower lip of medium tumidity but lateral lobules projecting much farther than medial; coxa 1 produced forward, peduncular process between rami of uropod 1 long, that on uropod 2 obsolescent, sharp and leaflike, peduncle of uropod 1 with several ventrolateral setae, uropod 3 with many peduncular spines, outer ramus slightly shorter than inner, latter with 2 or more medial spines; eyes ochraceous, clear in alcohol.

FEMALE (from Schellenberg, 1938).—Gnathopods weaker than in male, article 4 angular but not produced, gnathopod 2 like gnathopod 1, article 4 triangular.

ABERRATION.—Male, 10.3 mm, with right uropod 3 bearing extra, blunt apical spine on outer ramus considerably shorter than inner.

MATERIAL.—Hanauma Bay, Oahu, 15 May 1946 (3 males); Waikiki Marine Laboratory, from *Padina,* 11 March 1964 (1 male).

DISTRIBUTION.—Schellenberg: "North Islands"; Kaneohe Bay, Oahu.

Paragrubia vorax Chevreux

FIGURE 32*h-m*

Paragrubia vorax Chevreux, 1901, pp. 427–431, figs. 50–55.—J. L. Barnard, 1955a, pp. 31–34, fig. 17 [with references]; 1965a, pp. 541–542, fig. 33.

A few figures of Hawaiian specimens supplementing those of Barnard (1955a) are presented.

MATERIAL.—JLB Hawaii 14 (3). Fee 1 (1). Hanauma Bay, Oahu, 15 May 1946 (1). Molokai, 1959, Algen, collector H. Caspers (2).

DISTRIBUTION.—Indo-Pacific.

Family ANAMIXIDAE

Anamixis stebbingi Walker

FIGURE 27

Anamixis stebbingi Walker, 1904, pp. 259–261, pl. 3, fig. 18.—J. L. Barnard, 1965a, pp. 488–489, fig. 4.

MATERIAL.—JLB Hawaii 6 (1), 10 (2), 12 (1), 13 (2), 15 (1).

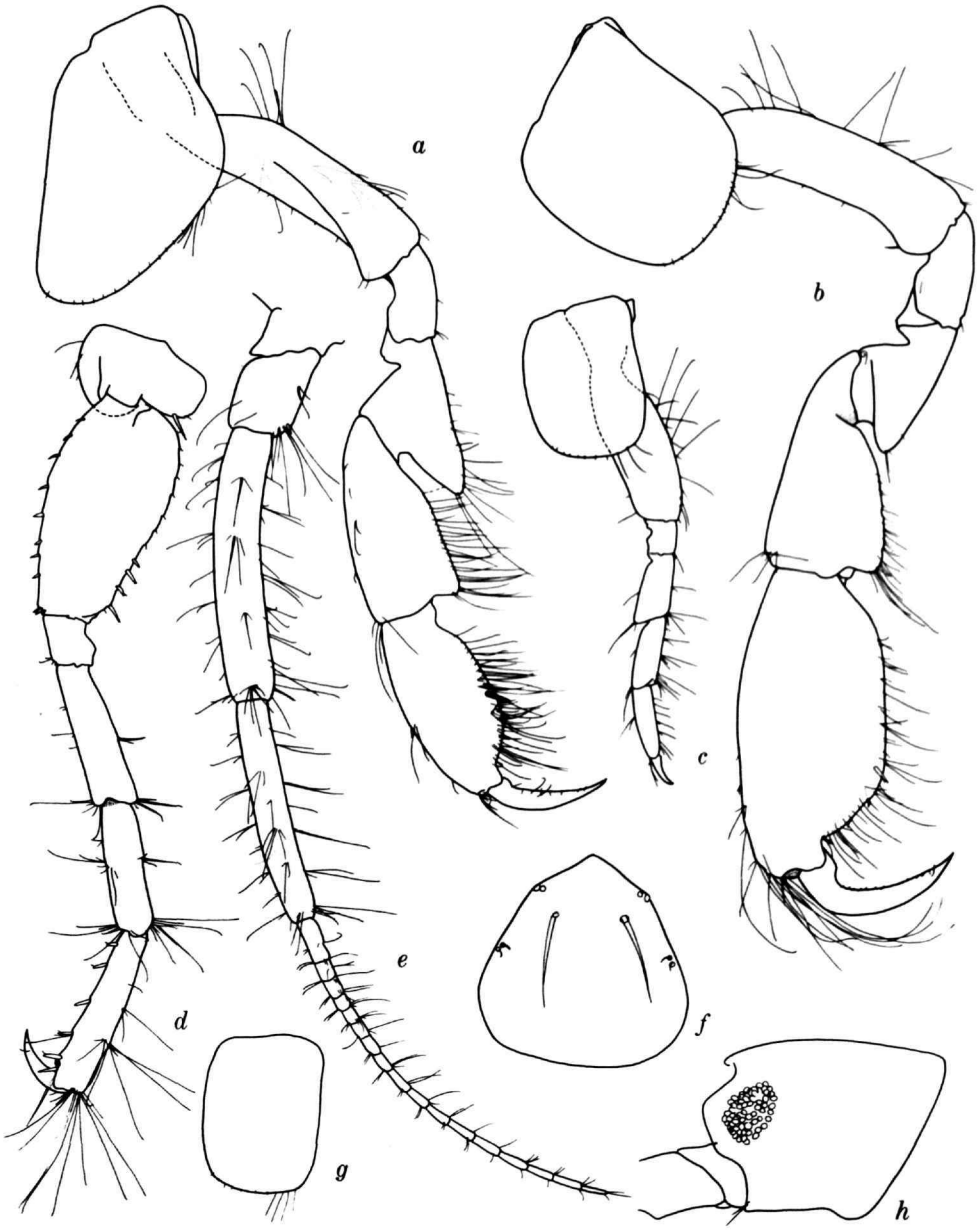

FIGURE 25.—*Cymadusa hawaiensis* Schellenberg, male, 10.3 mm, Hanauma Bay: *a, b,* gnathopods 1, 2; *c, d,* pereopods 1, 4; *e,* antenna 2; *f,* telson; *g,* coxa 4. Male, 8.2 mm, Waikiki, *Padina: h,* head.

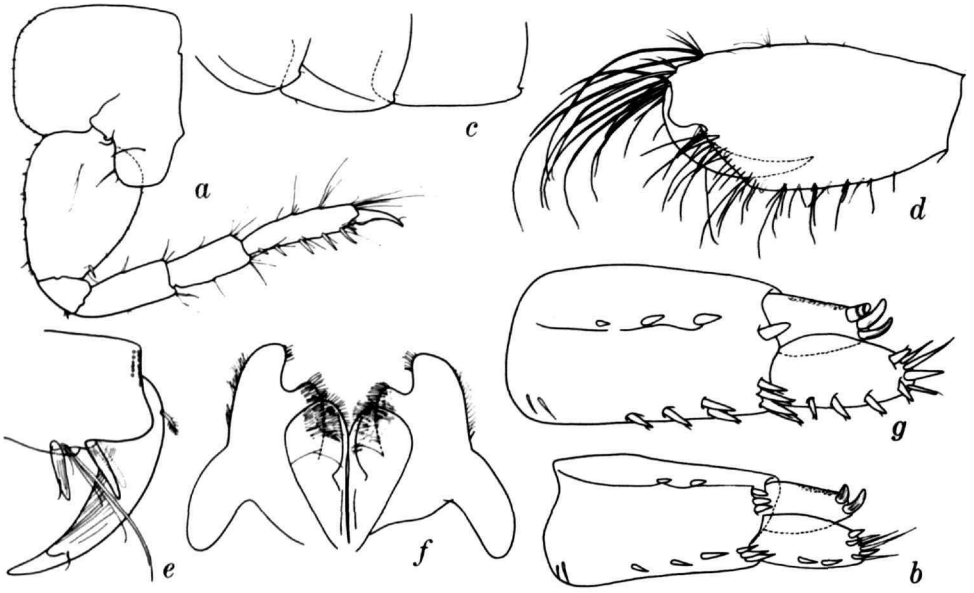

FIGURE 26.—*Cymadusa hawaiensis* Schellenberg, male, 10.3 mm, Hanauma Bay, *a*, pereopod 3; *b*, uropod 3, normal. Male, 8.2 mm, Waikiki, *Padina: c*, pleonal epimera 1–3; *d*, lateral apex of gnathopod 2; *e*, dactyl of pereopod 4; *f*, lower lip; *g*, uropod 3, abnormal.

REMARKS.—The anteroventral cephalic corner is either typical of Micronesian individuals, with a small sharp tooth at the corner, or it is perfectly quadrate. The material is in superior condition and one may see in better detail than heretofore that the mouthparts normally said to have become vestigial or absent have a recognizable structure; 3 pairs of tiny vestiges possibly representing mandible and maxillae 1–2 occur on either side of the ventral keel. The presumed mandible appears as a tiny "palp" with a long terminal seta, maxilla 1 appears as a small lobe dorsolateral to a larger lobe presumed to be maxilla 2.

COLOR IN 2-DAY FORMALDEHYDE.—Either white with ruby eye or body with wide vertical pink-red stripes on middle of each of pereonites 1–7, becoming paler posteriorly on pereon.

DISTRIBUTION.—Indo-Pacific tropics from Ceylon to Hawaii.

Family AORIDAE

Aloiloi, new genus

DIAGNOSIS.—Antennae equal in length, as long as head and 5.5 pereonites, accessory flagellum multiarticulate, article 3 of antenna 1 as long as article 1, recessment of head for antenna 2 moderate; epistome unproduced anteriorly; mandibular palp stout, dominating mandibular body; inner plate of maxilla 1 lined medially with setae; maxillipedal palp article 4 very short, bearing long apical spine; article 4 of gnathopod 1 not produced, article 5 short, broad, cup-shaped, article 6 broad and long, broader than article 5, bearing oblique palm, gnathopod 1 lacking any teeth; gnathopod 2 smaller than 1 but large for family, similar to but thinner than gnathopod 1, poorly setose anteriorly on article 5; rami of uropod 3 equal to each other in length and slightly shorter than peduncle.

TYPE-SPECIES.—*A. nenue*, new species.

RELATIONSHIP.—This genus superficially resembles *Lembos* Bate, but the structure of its gnathopods, antennae, and maxillae suggest that it may represent a species with affinities to the genus *Gammaropsis* Liljeborg of the Isaeidae. Gnathopod 2, though smaller than gnathopod 1, has all the characters typical of many members of *Gammaropsis*, including the excavate palm and giant medial spine, maxilla 1 has setae on the medial edge of the inner plate like many species of *Gammaropsis*, and article 3 of antenna 1 is elongate.

One would have to assume that an axial reversal in gnathopodal dominance has produced the enlarged gnathopod 1. It also has the appearance of a gnatho-

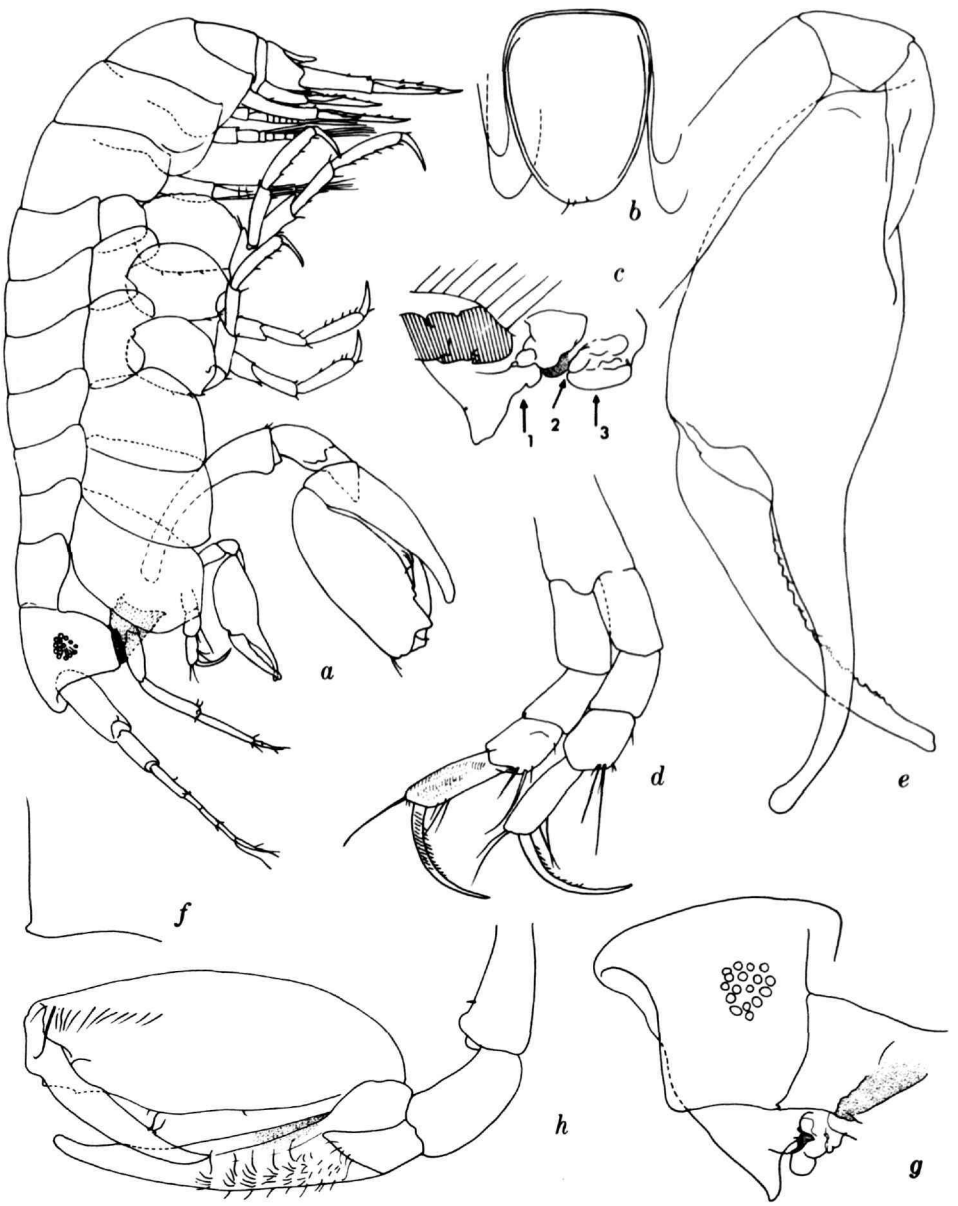

FIGURE 27.—*Anamixis stebbingi* Walker, specimen 1.8 mm, JLB Hawaii 10: *a*, lateral view of body. Male, 2.2 mm, JLB Hawaii 12: *b*, telson and lateral wings of pleonite 6; *c*, lateral view of ventral cephalic margin: 1=mandible, 2=maxilla 1, 3=maxilla 2; *d*, maxillipeds; *e*, gnathopod 1; *f*, lateral lobe of head; *g*, head; *h*, gnathopod 2.

pod 2 on various members of *Gammaropsis*. A strong resemblance to *Gammaropsis pali,* new species, occurs in *Aloiloi.*

This genus may assist in demonstrating that various aorids have had diverse origins from isaeids (photids) and do not represent a fundamental line of evolution with a common ancestor.

Aloiloi nenue, new species

FIGURES 28, 29, 30

DIAGNOSIS.—With the characters of the genus.

DESCRIPTION.—Head with medium-sized trapezoidal lobe bearing ovatocircular eye light purple in alcohol, a few ommatidia with pigment; anteroventral corner of head quadrate; gland cone large and sharp; right mandibular molar with flake; coxa 1 broad, short, slightly extended and angular anteroventrally; palm of gnathopod 1 with shallow excavation posterior to obtusely conical process near dactylar base, palmar defining corner quadrate and bearing minute ridges, posteromedial face of hand bearing submarginal stout spine proximal to palmar corner, spine smaller than

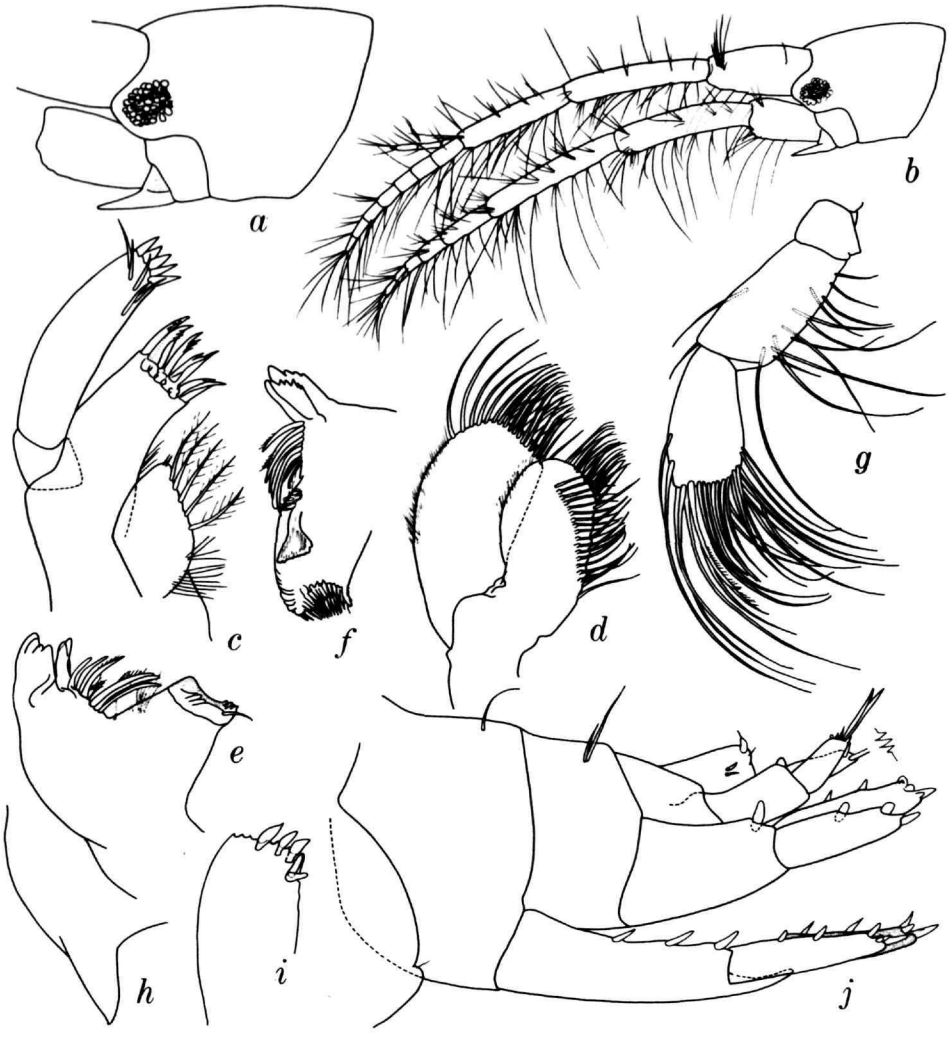

FIGURE 28.—*Aloiloi nenue,* new genus, new species, holotype, male, 4.4 mm, JLB Hawaii 13: *a, b,* head; *c, d,* maxillae 1, 2; *e, f,* mandibles; *g,* mandibular palp; *h,* mandibular lobe on lower lip; *i,* outer plate of maxilliped; *j,* urosome.

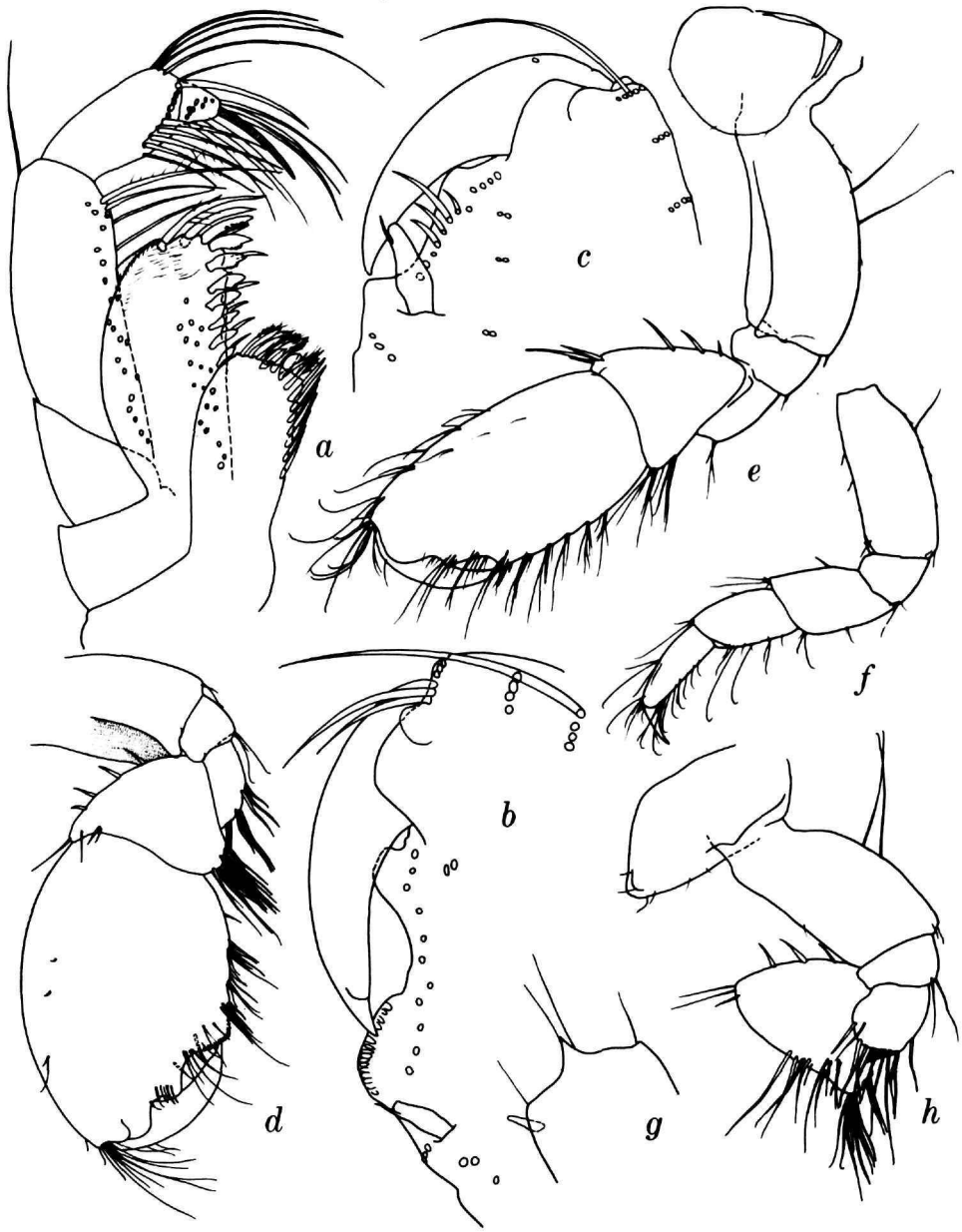

FIGURE 29.—*Aloiloi nenue*, new genus, new species, holotype, male, 4.4 mm, JLB Hawaii 13: *a*, maxilliped; *b*, *c*, medial apices of gnathopods 1, 2; *d*, *e*, lateral gnathopods 1, 2; *f*, pereopod 2; *g*, ventral peduncular tooth on uropod 2; *h*, proximal part of medial gnathopod 1.

on gnathopod 2, dactyl shorter than palm, article 5 of gnathopods 1–2 anteriorly spinose, hand of both gnathopods with groups of stout anteromedial setae, gnathopod 2 similar to 1 but smaller, thinner, and with spine on hand larger and more strongly submarginal, article 2 of gnathopods 1–2 with sharp anterodistal, lateral cusp; pereopods 3–5 with rectangular article 2, bearing seta or weak spine on unlobate posteroventral corner, lacking facial spines on article 5, locking spines straight, dactyl bearing one distal facial setule; pleonal epimeron 1 strongly bulging posteriorly, with slightly posteroventral tooth, epimeron 2 weakly bulging and with obsolescent tooth, epimeron 3 with medium bulge, strong notch and rounded posteroventral cusp; outer rami of uropods 1–2 slightly shorter than inner, uropod 1 bearing large ventral peduncular tooth, uropod 2 with obsolescent sharp tooth, uropod 3 bearing peduncular spines and small barrel-shaped article 2 on outer ramus; telson with apical nipple and 1 dorsolateral spine and nob on each side; sternites lacking teeth.

COLOR.—Eyes garnet in formaldehyde (faint purple in alcohol), article 3 of antenna 1 and terminal 4 articles of antennal flagella bright pink.

HOLOTYPE.—Bishop Museum collections, catalog number 7257, male, 4.4 mm. Unique.

TYPE-LOCALITY.—JLB Hawaii 13, Kaneohe Bay,

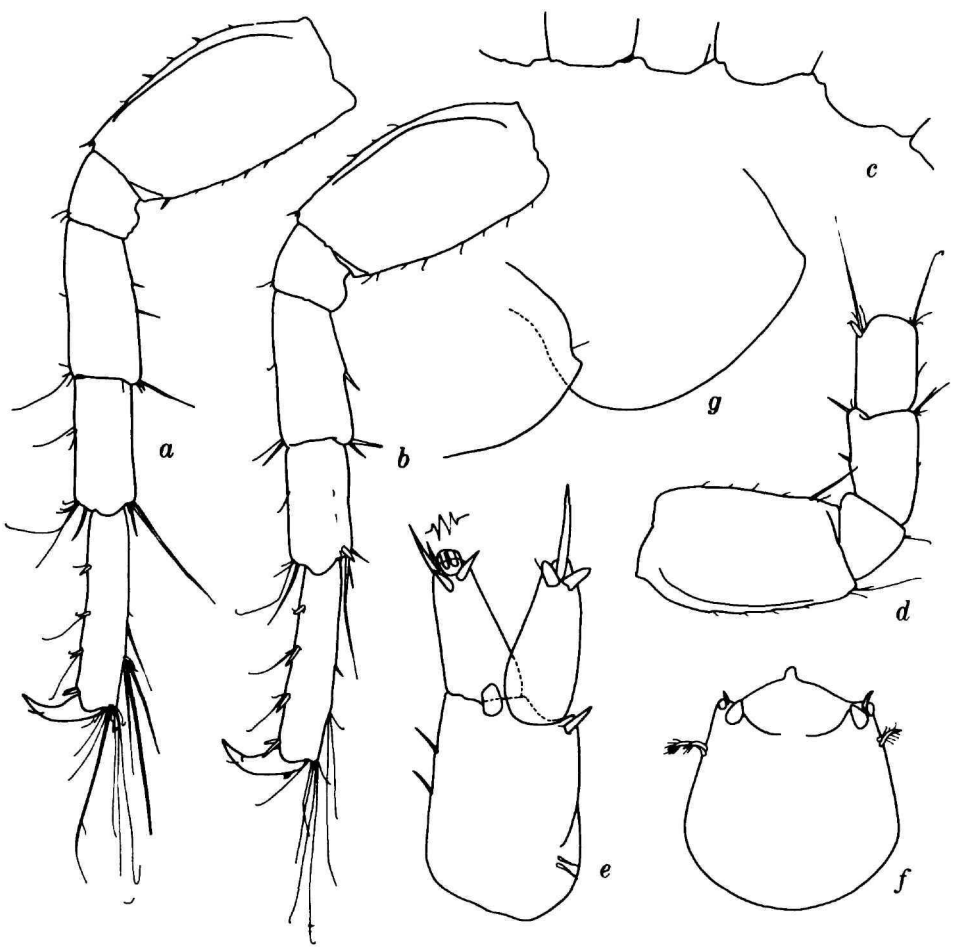

FIGURE 30.—*Aloiloi nenue*, new genus, new species, holotype, male, 4.4 mm, JLB Hawaii 13: *a, b*, pereopods 5, 4; *c*, thoracic sternites; *d*, part of pereopod 3; *e*, uropod 3; *f*, telson; *g*, pleonal epimera 1–2.

Oahu, 3–4 m, corals, fleshy algae, corallines, 8 April 1967.

DISTRIBUTION.—Hawaiian Islands.

Aoroides ?columbiae Walker

FIGURES 31, 32*a-g*

?Aoroides columbiae Walker, 1898, p. 285, pl. 16, figs. 7–10.—Thorsteinson, 1941, pp. 83–84, pl. 6 figs. 65–66.—J. L. Barnard, 1954a, pp. 24–26, pl. 22.
?Aoroides californica Alderman, 1936, pp. 63–66, figs. 33–38.

DESCRIPTIVE NOTES.—Article 3 of antenna 1 slightly more than half as long as article 1; medium-sized and terminal males with large spine on coxa 1, young males lacking a coxal spine but on gnathopod 1 bearing spine on article 6 subsequently lost by terminal males, subapex of dactyl with several stout spinules besides setae; gland cone apically truncate; maxillipedal palp article 3 with apical protrusion; inner plate of maxilla 1 with one long curved seta; uropods 1–2 with long, acute peduncular cusp on ventral side; outer ramus of uropod 3 with small barrel-shaped article 2.

COLOR IN 2-DAY FORMALDEHYDE.—Body white with a few splotches of faded brown-purple pigment, eyes bright orange or brownish orange, remaining pale orange in alcohol.

MATERIAL.—JLB Hawaii 3 (3), 5 (5), 6 (2), 12 (2), 13 (9), 14 (?2).

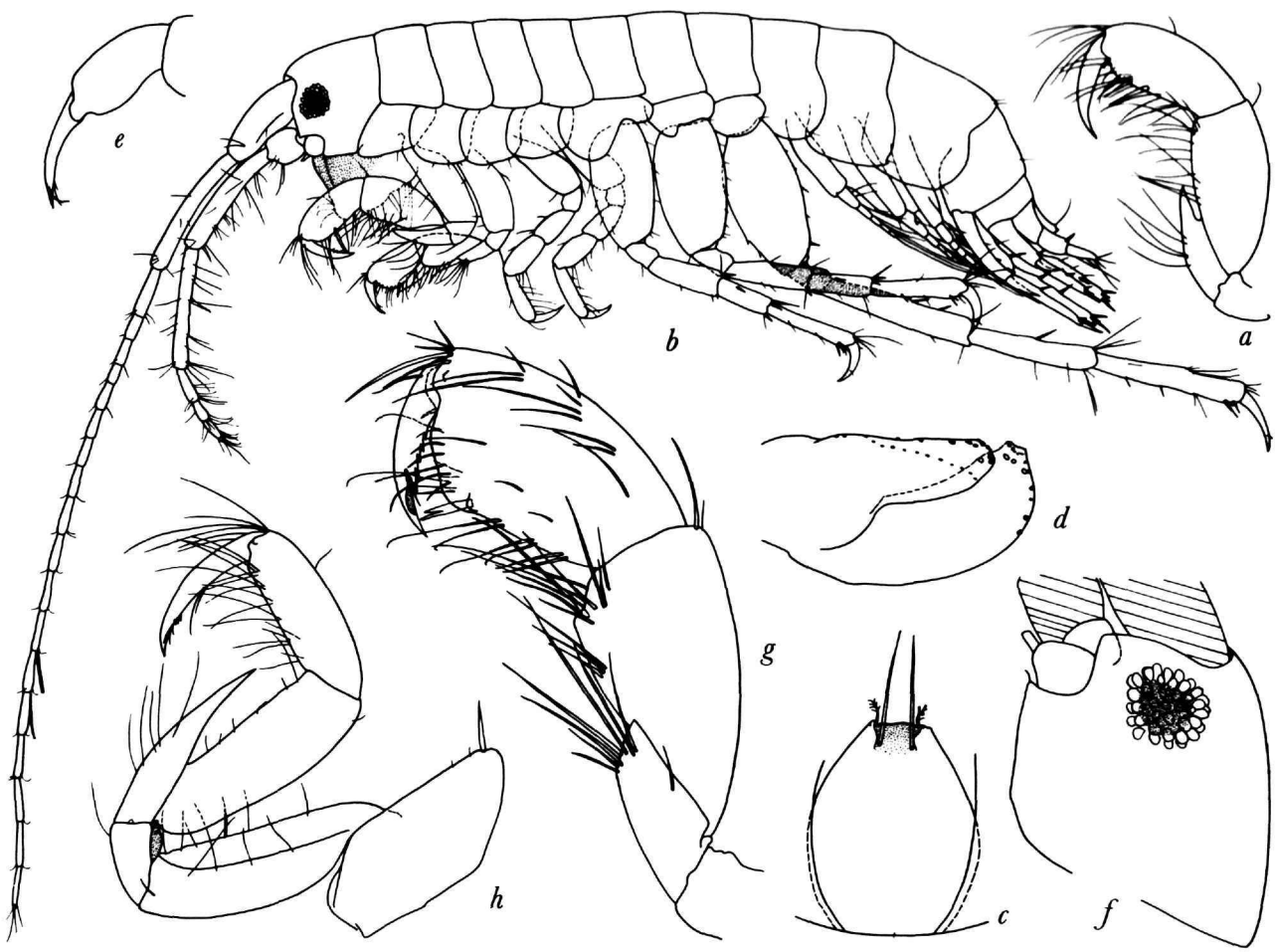

FIGURE 31.—*Aoroides columbiae* Walker, male, 2.1 mm, JLB Hawaii 12: *a*, gnathopod 1; *b*, body; *c*, telson; *d*, maxilla 2, setae removed and marked with pits; *e*, apex of maxillipedal palp, setae removed. Male, 2.3 mm: *f*, head; *g*, gnathopod 2, enlarged; *h*, gnathopod 1.

FIGURE 32.—*Aoroides columbiae* Walker and *Paragrubia vorax* Chevreux. *A. columbiae*, male, 2.3 mm, JLB Hawaii 12: *a*, uropod 3; *b*, apex of uropod 2; *c*, inner plate of maxilliped. Male, 2.4 mm, JLB Hawaii 3: *d*, gnathopod 1; *e*, mandibular palp. Female, 2.2 mm, JLB Hawaii 3: *f*, gnathopod 1. Male, 2.1 mm, JLB Hawaii 12: *g*, pleonal epimera 1, 2, 3. *P. vorax*, male, 10.0 mm, JLB Hawaii 13: *h*, head; *i*, apex of pereopod 3; *j*, apex of pereopod 5; *k*, uropod 3; *l*, apex of outer ramus on uropod 3; *m*, apex of pereopod 5.

REMARKS.—The Hawaiian population has minor differences from any stages so far described from the cold and warm-temperate regions of Pacific North America, but it is pointless to attach any nomenclatural significance to these minor differences until the life history of the species can be thoroughly examined. The largest male at hand (2.4 mm long) is not as fully developed as that described by J. L. Barnard (1954a), but coxa 1 has undergone the expected terminal modification, article 4 of gnathopod 1 is attenuate, but articles 5 and 7 are shorter and article 6 stouter than in the cold-temperate male; thus, the Hawaiian male resembles the younger stages of the cold-temperate populations. Young Hawaiian males lack the dense brushes of setae on article 2 of gnathopod 1 seen in mainland juvenile males.

DISTRIBUTION.—Cold and warm-temperate Pacific America and the Hawaiian Islands.

Aoroides nahili, new species

FIGURE 33

DIAGNOSIS.—Similar to *Aoroides columbiae* Walker but differing in the presence of eyes retaining black or brownish-purple pigment in alcohol, the asymmetrically and obtusely coniform lateral lobes on the head, the short palp article 4 of the maxilliped and thin spines on the inner plate, the less divergent plates of maxilla 2, the thinner articles 5–6 of male gnathopod 2 and female gnathopods 1–2; in the terminal male gnathopod 2 the anteroproximal turgidity of article 5; uropod 2 lacking a peduncular tooth between the rami; the fully developed uropod 3 with 1 spine in the middle of the outer ramus and only 1 terminal seta on article 2.

Pereonite 5 retaining diffuse brownish-purple pigment in alcohol.

HOLOTYPE.—Bishop Museum collections, catalog number 7258, male, 2.3 mm.

TYPE-LOCALITY.—JLB Hawaii 17, Kawela Bay, Oahu, intertidal, *Sargassum*, other algae, corals, 24 May 1967.

MATERIAL.—JLB Hawaii 12 (2), 13 (7), 14 (2), 17 (16).

REMARKS.—The diagnosis contains only the gross morphological differences from *A. columbiae* and thus describes the relationship. This species occurs in shallow waters from intertidal to about 5 m, whereas. *A columbiae* occurs in waters from about 4 to 30 m.

DISTRIBUTION.—Hawaiian Islands.

Konatopus, new genus

DIAGNOSIS.—Article 3 of antenna 1 as long as article 1, accessory flagellum short, 2-articulate; head elongate and deeply recessed ventrally for attachment of antenna 2; article 3 of mandibular palp stout, clavate; inner plate of maxilla 1 with medial setae; male gnathopod 1 like that of *Microdeutopus* Costa, with elongate article 5 bearing short posterodistal tooth, article 6 shorter and more slender than article 5, nearly simple; gnathopod 2 much smaller than gnathopod 1, weakly subchelate, article 5 longer than 6 and scarcely setose anteriorly; coxae touching or overlapping serially; rami of uropod 3 only slightly longer than peduncle, outer with small barrel-shaped article 2; telson broader than long, posteroventrally pointed, scarcely excavate dorsally; male pereonite 1 and coxa 1 becoming extremely elongate anteroposteriorly in terminal stage.

TYPE-SPECIES.—*Konatopus paao*, new species.

RELATIONSHIP.—The species on which this genus is based might fit either *Neomegamphopus* Shoemaker (1942) or *Amphideutopus* J. L. Barnard (1959) if those monotypic genera were broadened for its inclusion, but in so doing one would have to join together the two monotypic genera with the species at hand as a third species. *Konatopus paao* clearly stands between the other two genera by sharing characters of both and may stand somewhere on the evolutionary pathway. One might visualize *Neomegamphopus* coming to Hawaii from the warm-temperate of North America, eventually differentiating and returning to North America as an organism something like *Konatopus* that later differentiated into *Amphideutopus*. The converse pathway is perhaps even more probable. *Konatopus* has a strongly enlarged coxa 1 in terminal males, a character of rudimentary development in *Neomegamphopus* and not occurring in *Amphideutopus*. *Konatopus* has the short uropod 3 of *Neomegamphopus*, but male gnathopod 1 is of the short simplified kind seen in *Amphideutopus*. In fact, gnathopod 1 of *Konatopus* has exceeded both of the other genera in the obsolescence of the tooth on article 5 while developing a palmar protrusion on article 6. *Neomegamphopus* has gnathopod 2 nearly simple in males and females, and gnathopod 1 in the female is very weak, whereas *Konatopus* has a stronger gnathopod 2 in males and females, while *Amphideutopus* has a large stout gnathopod 2 in males, with articles 5 and 6 equal in length and strongly setose.

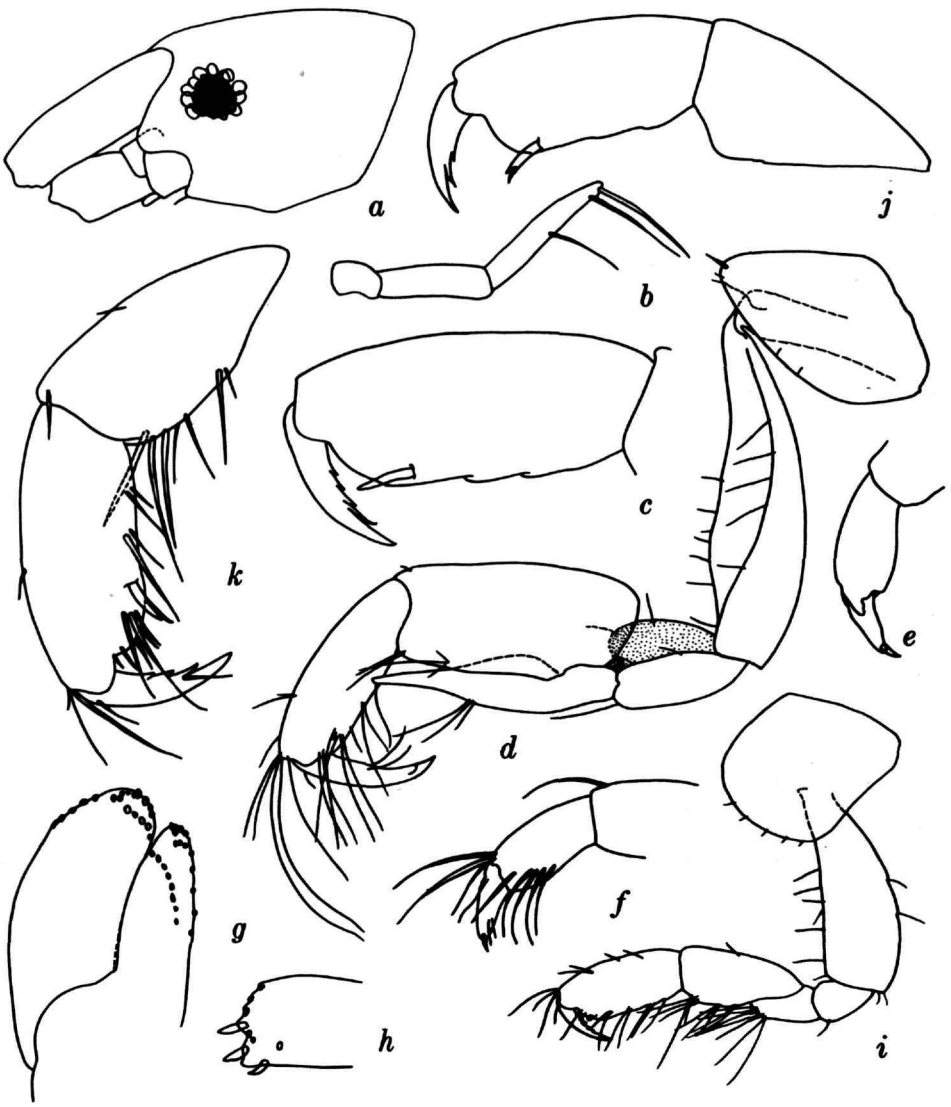

FIGURE 33.—*Aoroides nahili*, new species, male, 2.2 mm, JLB Hawaii 17: *a*, head; *b*, mandibular palp; *c*, apex of medial gnathopod 2; *d*, lateral gnathopod 1; *e*, *f*, apex of maxillipedal palp; *g*, maxilla 2, setae marked with pits; *h*, inner plate of maxilliped, setae marked with pits; *i*, gnathopod 2. Female, 2.0 mm: *j*, *k*, apices of gnathopods 2 and 1.

The three genera form a group of aorids distinguished from *Microdeutopus* and most other aorids by the deeply recessed ventral cephalic margin and the medial placement of maxillary setae on the inner plate plus the clavate stout mandibular palp article 3 and elongate maxillipedal palp with clavate article 4. The geographic "triangulation" of the three genera suggests the extremity of their characteristics is of only specific value, but in the sense of aorid classification as it now stands the characters mark good genera.

Shoemaker has already pointed out how these characters as seen in *Neomegamphopus* are uncharacteristic of aorids and recall characters of certain genera of isaeids. One might suggest that a megamphopal isaeid has undergone axial reversal of gnathopods parallel to those of normal aorids derived from nonmegamphopal isaeids.

The elongate article 1 of the mandibular palp distinguishes *Grandidierella* Coutière from *Microdeutopus, Neomicrodeutopus,* and *Konatopus.*

Konatopus paao, new species

FIGURES 34, 35

DIAGNOSIS.—With the characters of the genus.

DESCRIPTION.—Eyes ovate vertically, a dark core surrounded by pale ommatidia (in alcohol), lateral lobes of medium forward extent but thick and solid from side to side as in *Amphideutopus* and *Neomegamphopus;* antennae equal in projection; epistome rounded anteriorly; mouthparts generally as in *Neomegamphopus;* coxa 1 of terminal male with medial papilla, article 2 of gnathopod 1 grossly swollen, article 4 with slight distal process, palm of article 6 with protrusion, dactyl thick; coxae 3–4 slightly excavate posteriorly; article 2 of pereopods 3–5 slender but not completely linear, pereopod 3 of terminal male with article 2 proximally expanded (only one pereopod 3 of a terminal male at hand, possibly aberrant); female gnathopods 1–2 indistinguishable from each other in general size but article 5 of gnathopod 1 longer than that of gnathopod 2; uropod 1 with long ventral peduncular cusp, absent on uropod 2; pleonal epimera 1–3 with bulging posterior margins, posteroventral corners with notch and rounded protrusion to ventral margin, pleonite 4 with dorsal seta on either side marking dorsal terminus of lateral margin extension (as in *Gammaropsis atlantica*), pleonite 5 with only dorsolateral seta.

COLOR IN 2-DAY FORMALDEHYDE.—Eyes dirty orange or brownish-orange, body generally clear or occasionally pereonite 5 with wide vertical brownish-purple stripe; in alcohol cores of eyes retaining brownish-orange, turning darker than in life, or rarely eyes turning pale orange.

HOLOTYPE.—Bishop Museum collections catalog number 7259, male, 2.5 mm.

TYPE-LOCALITY.—JLB Hawaii 13, Kaneohe Bay, Oahu, 3–4 m, corals, algae, corallines, 8 April 1967.

MATERIAL.—JLB Hawaii 2 (13), 3 (5), 6 (11), 8 (1), 10 (4), 12 (2), 13 (43), 14 (1), 15 (1).

DISTRIBUTION.—Hawaiian Islands.

Lembos ?aequimanus Schellenberg

FIGURE 36*a-e*

?Lembos (Bemlos) aequimanus Schellenberg, 1938, pp. 76–77, fig. 39.

Not *Lembos (Bemlos) aequimanus.*—J. L. Barnard, 1955a, p. 34.

DIAGNOSIS OF FEMALE.—Lateral lobes of head strongly extended forward but narrow and mamilliform, anteroventral cephalic excavation weakly concave, anteroventral corner quadrate, scarcely extended; eyes circular, purple cores surrounded by half row of clear ommatidia; inner plate of maxilliped with normal terminal spines; gnathopod 1 narrow, especially elongate, rectangular article 6 with oblique, excavate palm bearing weak distal protrusion and strong defining cusp armed with spine, appendage weakly setose for *Lembos,* article 2 with strong, sharp anterodistal cusp; gnathopod 2 like that figured for male *L. pualani,* article 2 lacking anterodistal process, palm very oblique, setation moderate; pleonal epimera 1–3 with bulging posterior margins, all with lateral ridge, slight notch and tooth at posteroventral corner, ventral setae absent; uropod 3 with very short peduncle and long rami as figured for *L. kamanu,* inner ramus twice as long as peduncle and longer than outer ramus, latter with small article 2 present.

DESCRIPTION.—Antennae and pereopods 3–5 missing; epistome rounded anteriorly; mouthparts generally like those for *L. leapakahi,* new species, but left mandibular molar lacking "shark-tooth"; urosome and uropods appearing similar to those of *L. leapakahi,* but spines thinner, peduncle of uropod 1 with basolateral spine and distolateral seta but not lateral setae; peduncular tooth between rami of uropod 1 shorter than

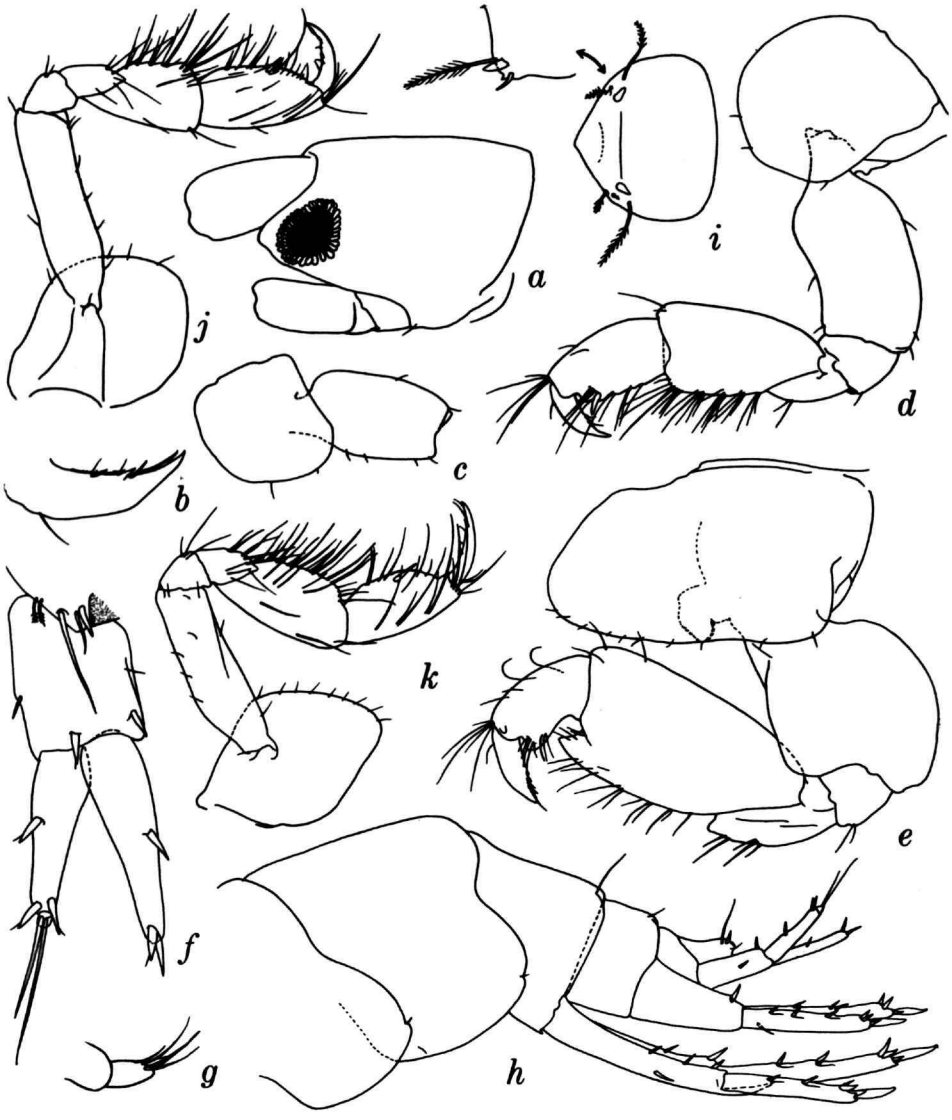

FIGURE 34.—*Konatopus paao*, new genus, new species, holotype, male, 2.5 mm, JLB Hawaii 13: *a*, head; *b*, dactyl of gnathopod 1; *c*, articles 1–3 of pereopod 1; *d*, *e*, gnathopods 2, 1; *f*, uropod 3; *g*, maxillipedal palp articles 3–4; *h*, pleonites 2–6, left to right. Female, 2.3 mm: *i*, telson with lateral view of one side offset; *j*, *k*, gnathopods 2, 1.

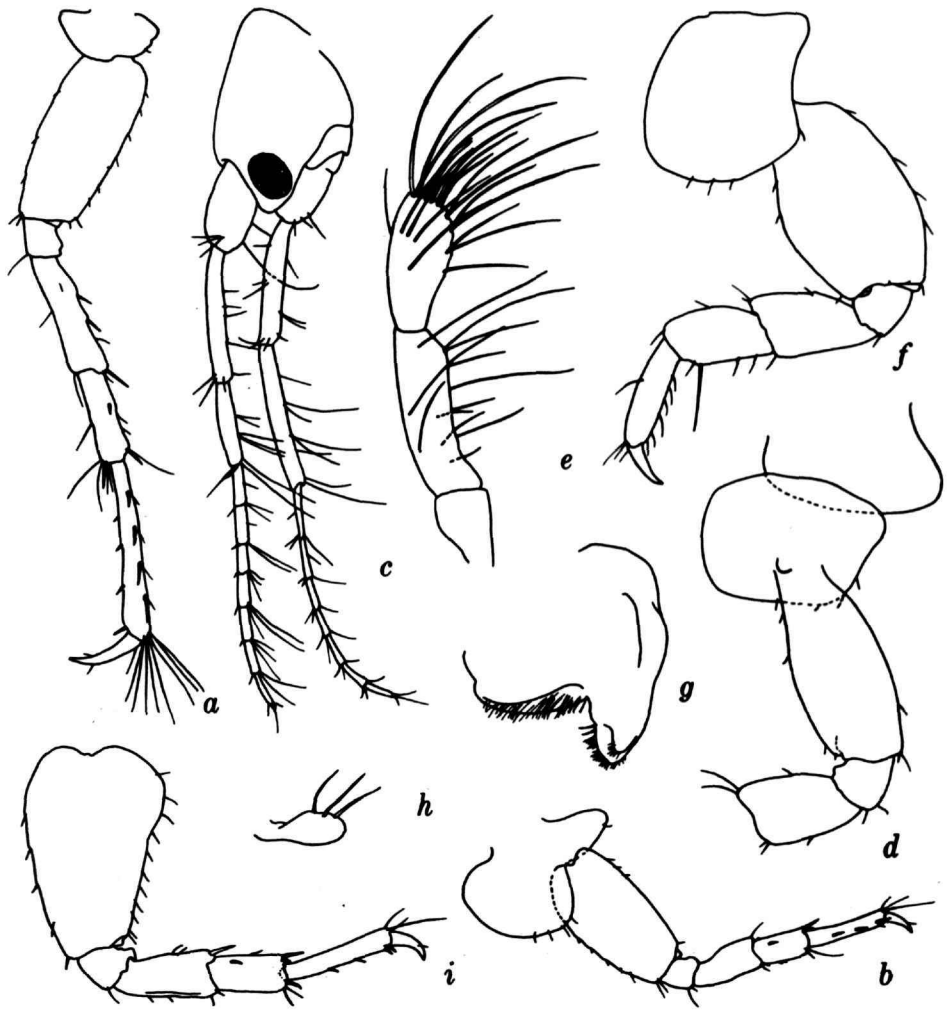

FIGURE 35.—*Konatopus paao*, new genus, new species, female, 3.0 mm, JLB Hawaii 13: *a*, pereopod 5; *b*, pereopod 3. Female, 2.3 mm: *c*, head; *d*, articles 1–4 of pereopod 2. Male, holotype, 2.5 mm: *e*, mandibular palp; *f*, pereopod 2; *g*, epistome and labral complex from right lateral view; *h*, inner plate of maxilla 1; *i*, pereopod 3, less coxa.

in other species of Hawaiian *Lembos* and tooth of uropod 2 obsolescent; telson large, strongly elevated, moderately excavate dorsally, with small pair of distolateral nobs, deep slit from lateral view and pair of long dorsal setae (appearance like that figured for *L. kamanu*). Urosomites as figured for *L. pualani* (see figure group for *L. macromanus*).

COLOR IN ALCOHOL.—Body dull white.

MATERIAL.—JLB Hawaii 17 (1).

REMARKS.—My former identification of this species (1955a) from Hawaii was erroneous and that material is referred to *L. pualani*, new species, based now on fully adult specimens. The female at hand has gnathopod 1 like that figured by Schellenberg; its configuration is unusual for the genus in the presence of an excavation and weak distal protuberance. The species is clearly distinct from all other Hawaiian members of the genus but many characters cannot be compared with Schellenberg's Gilbertian-Fijian species as the material at hand has no antennae or pereopods 3–5 and

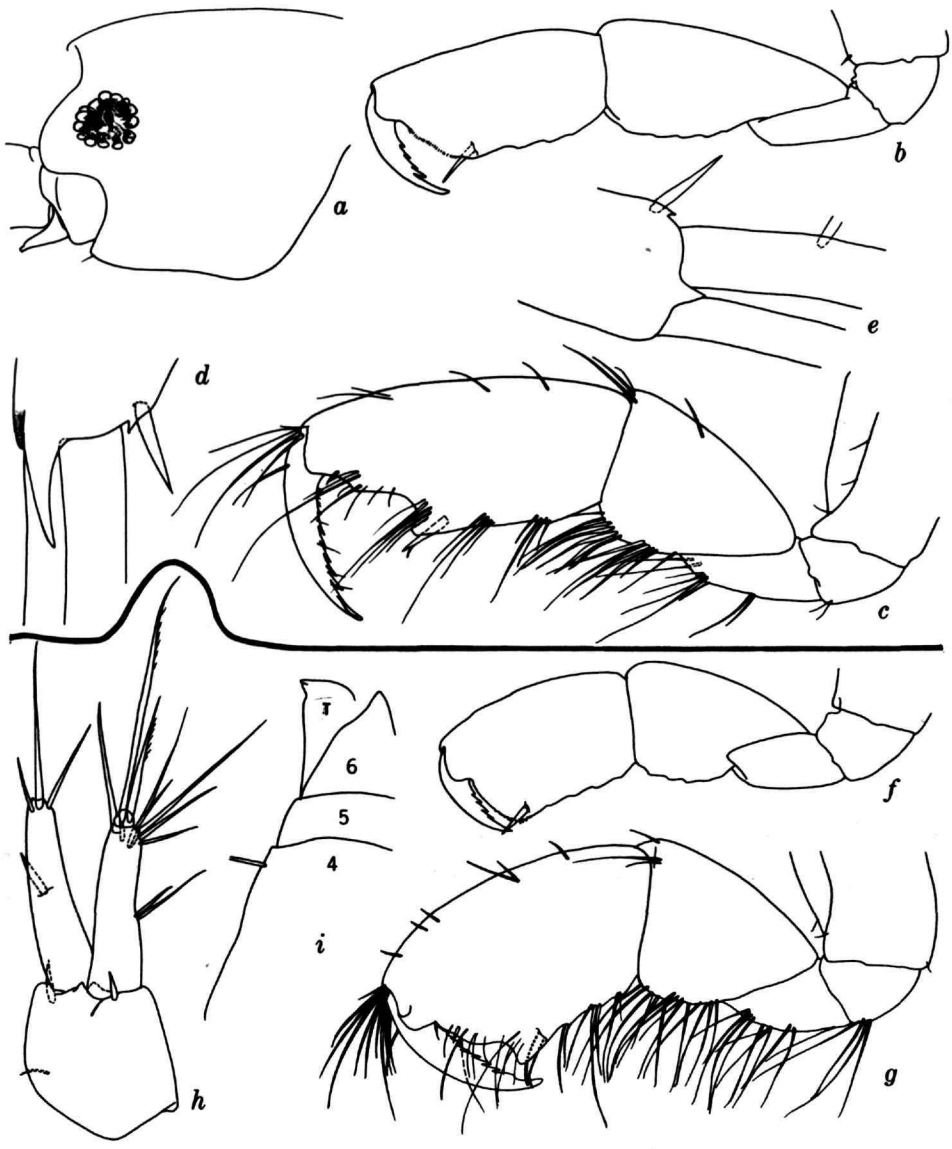

FIGURE 36.—*Lembos aequimanus* Schellenberg and *Lembos* species. *Lembos aequimanus*, female, 4.2 mm, JLB Hawaii 17: *a*, head; *b*, lateral gnathopod 2, setae removed; *c*, lateral gnathopod 1; *d*, *e*, peduncular tooth of uropods 1, 2. *Lembos* species, female, 4.4 mm, Fee 1: *f*, medial gnathopod 2, setae removed; *g*, lateral gnathopod 2; *h*, uropod 3; *i*, dorsal margin of urosome.

360-034 O—70——6

Schellenberg made no notes on the unique character of uropods 1–2 as described herein.

DISTRIBUTION.—Gilbert, Fiji, and possibly the Hawaiian Islands.

Lembos intermedius Schellenberg

FIGURE 37

Lembos intermedius Schellenberg, 1938, pp. 77–78, fig. 40.—J. L. Barnard, 1955a, p. 34.

DIAGNOSIS OF MALE.—Lateral cephalic lobes strongly extended forward and truncate, anteroventral margin of head excavate, nearly flat-bottomed, then produced to weak, obtuse anteroventral cusp; eyes subcircular, brownish purple cores in alcohol surrounded by 1–2 layers of clear ommatidia; coxa 1 short and broad, rectotrapezoidal, with slight extension and almost sharp anteroventral corner; 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, moderately setose medially, palm very oblique, bearing deep incision separating 2 processes, unarmed defining process short, thus making palm oblique, dactyl slender and scarcely overlapping palm; article 2 of gnathopod 2 with large anterodistal lobe similar to that of gnathopod 1, remainder of appendage like figure of *L. pualani,* article 4 with distal point not free, articles 5 and 6 equal to each other in length, palm nearly transverse, defined by spine and slight protuberance, setation dense; thoracic sternites 2–5 each with low, broad, obtusely bifid ventral tooth, sternite 1 with single obtuse tooth, sternite 6 with small single cusp; pleonal epimera 1–3 with bulging posterior margins, weak lateral ridges and slight notch and tooth at posteroventral corners; ventral setae absent or epimeron 2 with 1 seta; uropod 3 much smaller than in other Hawaiian species of *Lembos,* with extension on outer ramus appearing like that of a second article but apparently coalesced with and as broad as article 1, peduncle with large spine.

FEMALE.—Coxa 1 slightly longer and less pointed anteroventrally than in male; gnathopod 1 of normal kind in *Lembos,* anterodistal corner of article 2 lacking process, otherwise like that of *L. pualani,* but palm slightly more transverse and dactyl slightly shorter; article 2 of gnathopod 2 with anteroventral corner sharply quadrate, not lobate; sternites unkeeled; pleonal epimeron 2 with several midventral setae and one posterior seta besides normal setule in posteroventral notch, setae absent in smallest juveniles.

DESCRIPTION.—Antenna 1 at least as long as head and pereon together (thereafter broken off in all specimens), antenna 2 much shorter and stouter than in *L. waipio,* new species, but similar to *L. pualani,* new species; epistome slightly rounded anteriorly, remainder of mouthparts like those of *L. leapakahi,* new species, but shark-tooth of left mandibular molar weakly developed; article 2 of pereopod 3 with small posteroproximal extension, pereopods 4–5 missing on all material; urosome and uropods 1–2 appearing similar to figure of *L. leapakahi,* but uropod 3 small, spines thinner, but peduncle of uropod 1 bearing basolateral spine and distolateral setae, no basolateral setae on uropods 1–2, both with long tooth between rami, peduncle of uropod 3 with 2 basolateral setae; telson especially large, not strongly elevated, scarcely excavate dorsally, with pair of posterolateral nobs forming slit from lateral view.

COLOR IN ALCOHOL.—Posterior part of head, anterior part of pereonite 1, and posterior part of pereonite 6 deeply purple-brown.

MATERIAL.—JLB Hawaii 10 (5), 12 (4), 13 (13), 15 (9).

REMARKS.—The male is characterized by the bidentate sternal teeth, not described by Schellenberg; by the oblique palm of gnathopod 1 with scarcely overlapping dactyl; by the small uropod 3 lacking a second article on the outer ramus and is recognizable by the color pattern.

J. L. Barnard (1965a) suggested that *L. intermedius* might be synonymous with *L. processifer* (Pirlot, 1938) (not J. L. Barnard, 1965a), but *L. intermedius* is now shown to be clearly distinct. The bifid sternal teeth of the male are a major difference, but the heavy medioterminal setation on male gnathopod 1 article 6 is also noticeable. Male and female gnathopod 2 of *L. intermedius* are much smaller, thinner, and more densely setose than in *L. processifer,* antenna 2 is thinner, article 2 of pereopods 3–5 has a sharp posteroproximal extension, and the eyes are dark. The identification of Indonesian *L. processifer* by J. L. Barnard (1965a) is erroneous and probably should be associated as a subspecies with *L. waipio,* new species, from Hawaii.

Coxa 1 of male *L. intermedius* is neither as sharp

FIGURE 37.—*Lembos intermedius* Schellenberg, male, 4.7 mm, JLB Hawaii 12: *a*, uropod 3; *b*, gnathopod 1; *c*, anterior outline of head; *d*, apex of outer ramus on uropod 3; *e*, left mandibular molar; *f*, pereopod 3; *g*, lobe on article 2 of gnathopod 2; *h*, telson; *i*, sternal teeth. Female, 4.1 mm, JLB Hawaii 13: *j*, pleonal epimeron 2; *k*, part of urosome; *l*, gnathopod 1, setae removed.

nor bears as elongate setae as represented by Schellenberg (1938), but no other species at hand fits *L. intermedius* as well as this one.

DISTRIBUTION.—Hawaiian Islands.

Lembos kamanu, new species

FIGURE 38

DIAGNOSIS OF FEMALE.—Lateral lobes of head strongly extended forward and truncate or slightly convex, anteroventral margin of head hemispherically excavate and bearing broad, conical, obtuse anteroventral corner; eyes circular, pale purple cores surrounded by 1 layer of clear ommatidia; inner plate of maxilliped with very broad spines on inner plate in comparison to most other Hawaiian species of *Lembos:* gnathopod 1 of normal female kind in *Lembos* but article 6 sharply quadrate distally, palm with weak scallops, moderately setose, article 2 lacking anterodistal process; gnathopod 2 like that figured for male

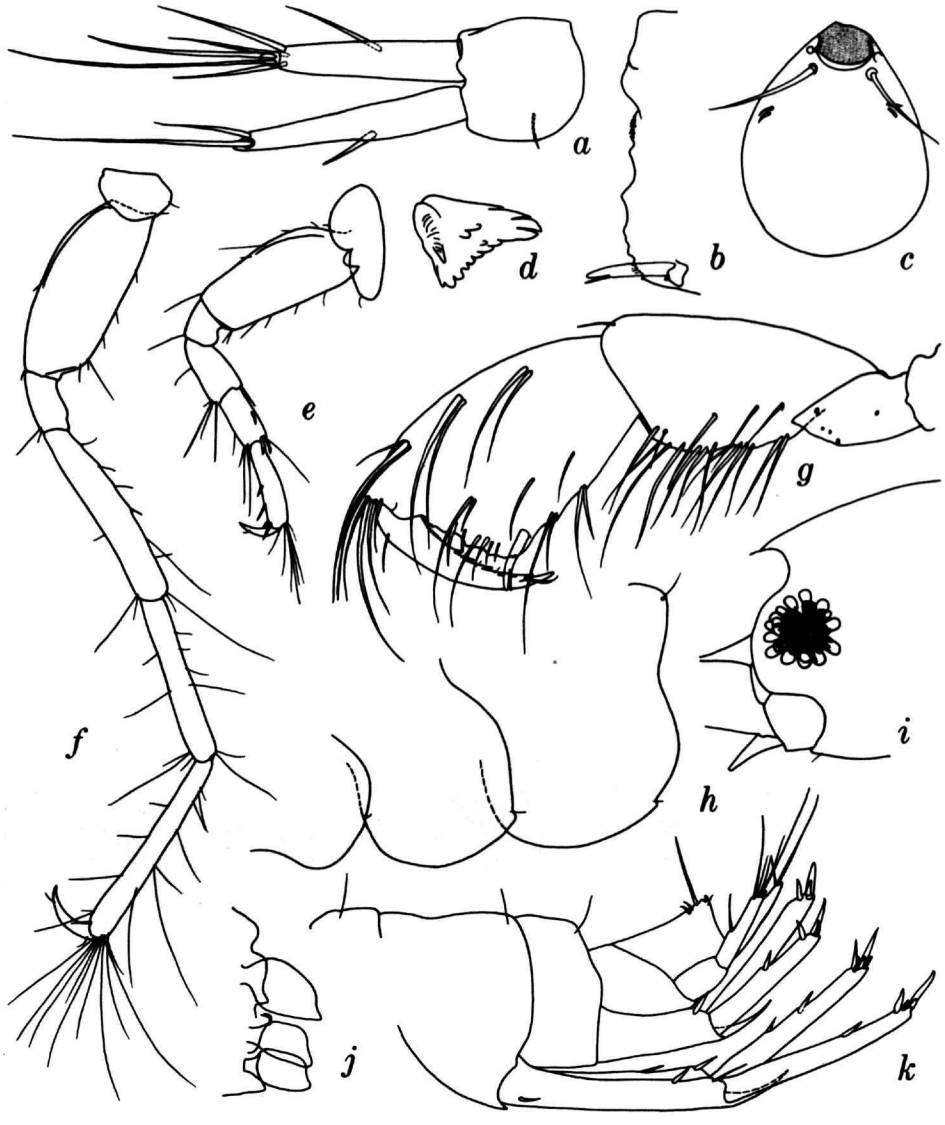

FIGURE 38.—*Lembos kamanu*, new species, holotype, female, 3.6 mm, JLB Hawaii 15: *a*, uropod 3; *b*, palm of medial gnathopod 1; *c*, telson; *d*, "shark-tooth" of left mandibular molar; *e*, *f*, pereopods 3, 5; *g*, medial gnathopod 1; *h*, pleonal epimera 1–3; *i*, head; *j*, spines on inner plate of maxilliped; *k*, urosome.

L. pualani, article 2 lacking anterodistal process, setation moderate and setae very stout; pleonal epimera 1–3 with bulging posterior margins, no lateral ridges and slight notch and tooth at posteroventral corners, ventral setae absent; uropod 3 with very short peduncle and long rami, inner ramus twice as long as peduncle and longer than outer ramus, latter with small article 2 present.

DESCRIPTION.—Antenna 1 as long as head and first 7 body segments, antenna 2 as long as head and first 5 body segments, flagellum of antenna 2 with 4 articles and shorter than article 5 of peduncle, accessory flagellum with 4 articles; epistome rounded anteriorly; mouthparts except inner plate of maxilliped generally like those of *L. leapakahi,* new species, including presence of "shark-tooth" on left mandibular molar; urosome and uropods appearing similar to those of *L. leapakahi* but spines thinner, peduncle of uropod 1 with basolateral spine and distolateral seta but no lateral setae; telson large, strongly elevated, weakly excavate dorsally, with small pair of distolateral nobs, deep slit from lateral view and pair of long dorsal setae. Urosomite 3 very deeply depressed in relationship to urosomite 2 and unique for Hawaiian species of *Lembos;* urosomite 2 with long dorsal surface as in *L. pualani* but in contrast to *L. macromanus.*

COLOR IN ALCOHOL.—Ground color of body white and weakly spotted with faint brownish-purple dots.

HOLOTYPE.—Bishop Museum collections catalog number 7260, female, 3.6 mm. Unique.

TYPE-LOCALITY.—JLB Hawaii 15, 1 mi N of Kualoa Point, Oahu, intertidal, coral block with ascidians, 23 May 1967.

RELATIONSHIP.—As known in the female stage only, this species is impossible yet to relate to extrinsic members of *Lembos,* but in the Hawaiian fauna it stands out as a sibling of *L. pualani* in which gnathopod 1 has a weakly scalloped palm, urosomite 3 strongly drops below the dorsal line of urosomite 2, the main spines on the inner plate of the maxilliped are elephantine, the rami of uropod 3 are slightly longer, and the anteroventral cephalic tooth is thicker.

DISTRIBUTION.—Hawaiian Islands.

Lembos leapakahi, new species

FIGURES 39, 40

DIAGNOSIS OF MALE.—Lateral lobes of head strongly extended forward and truncate, anteroventral margin of head excavate, flat-bottomed, then produced to strong anteroventral cusp; eyes obliquely pyriform, brownish-purple cores in alcohol surrounded by 1–2 layers of clear ommatidia; coxa 1 rounded at anteroventral corner; gnathopod 1 very large, article 2 extremely thick, anteroventral corner unproduced, article 4 with distal point not free, article 5 very wide and nearly 80 percent as long as article 6, latter almost subcircular, palm equal in length to posterior margin of article 6, palm simple, convex, defined by spine and slight protuberance, dactyl slender and curved, fitting palm, medial face of hand strongly setose anteriorly, posterior margin of hand setose; article 2 of gnathopod 2 with small anteroventral mammilliform cusp, article 4 with distal point not free, article 5 longer than 6, palm of latter scarcely oblique, defined by spine and slight protuberance, palm much shorter than posterior margin of article 6, articles 5 and 6 densely setose medially and marginally except for anteroproximal end of article 5; thoracic sternites with keel formed of spiniform tooth on segments 2–3, obtuse keel on segments 4–5 and obsolescent or obsolete on segments 6–7, segment 1 with tiny obtuse point; pleonal epimeron 1 with a few ventral setae and small posteroventral notch with setule, epimeron 2 ventrally setose, rounded posteroventrally, epimeron 3 shortened on posterior margin, rounded posteroventrally; uropod 3 lacking article 2 on outer ramus.

FEMALE.—Generally like male even as to gnathopods but latter slightly smaller and gnathopod 2 not as strongly setose, ventral thoracic keel absent.

DESCRIPTION.—Antenna 1 about 95 percent as long as head and body together, antenna 2 much shorter; epistome flat in front, remainder of mouthparts like those of *L. websteri* (Bate) (Sars, 1895, pl. 194), but mandibular lobes of lower lip more attenuate, palp of mandible slightly longer, left mandibular molar with complex flat, sharklike tooth on trituration face (see figure), base of left molar with small cuspidate rugosity, right molar normal, rugosity at base obsolescent, inner plate of maxilla 1 smaller but its one seta longer; article 2 of pereopod 3 with posteroproximal triangular extension, pereopods 4–5 missing on all material; uropods 1–2 with long ventral peduncular tooth between rami; telson large, strongly elevated,

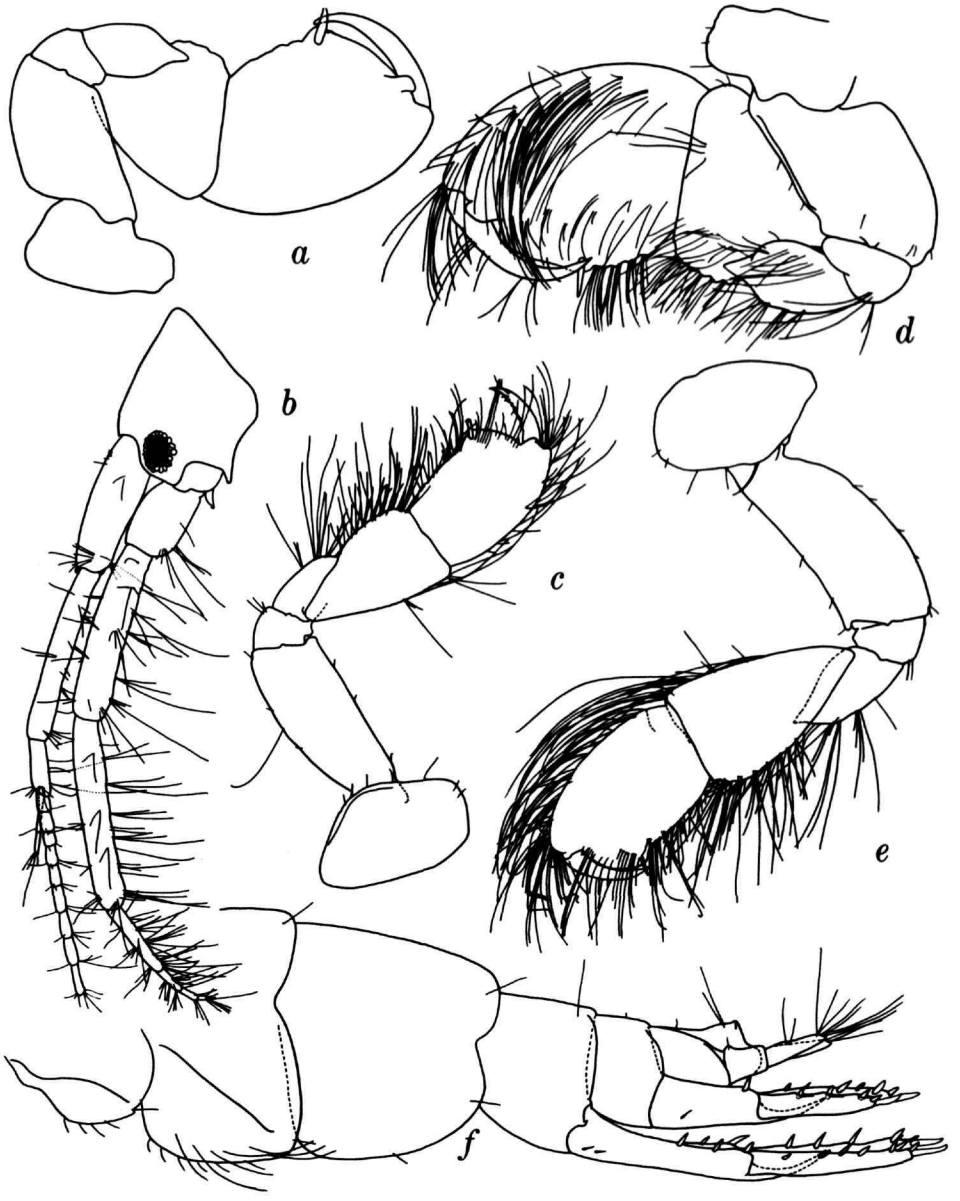

FIGURE 39.—*Lembos leapakahi*, new species, female, 5.0 mm, JLB Hawaii 17: *a*, medial gnathopod 1, setae removed; *b*, head; *c*, gnathopod 1. Holotype, male, 6.0 mm: *d*, gnathopod 1; *e*, gnathopod 2; *f*, pleon.

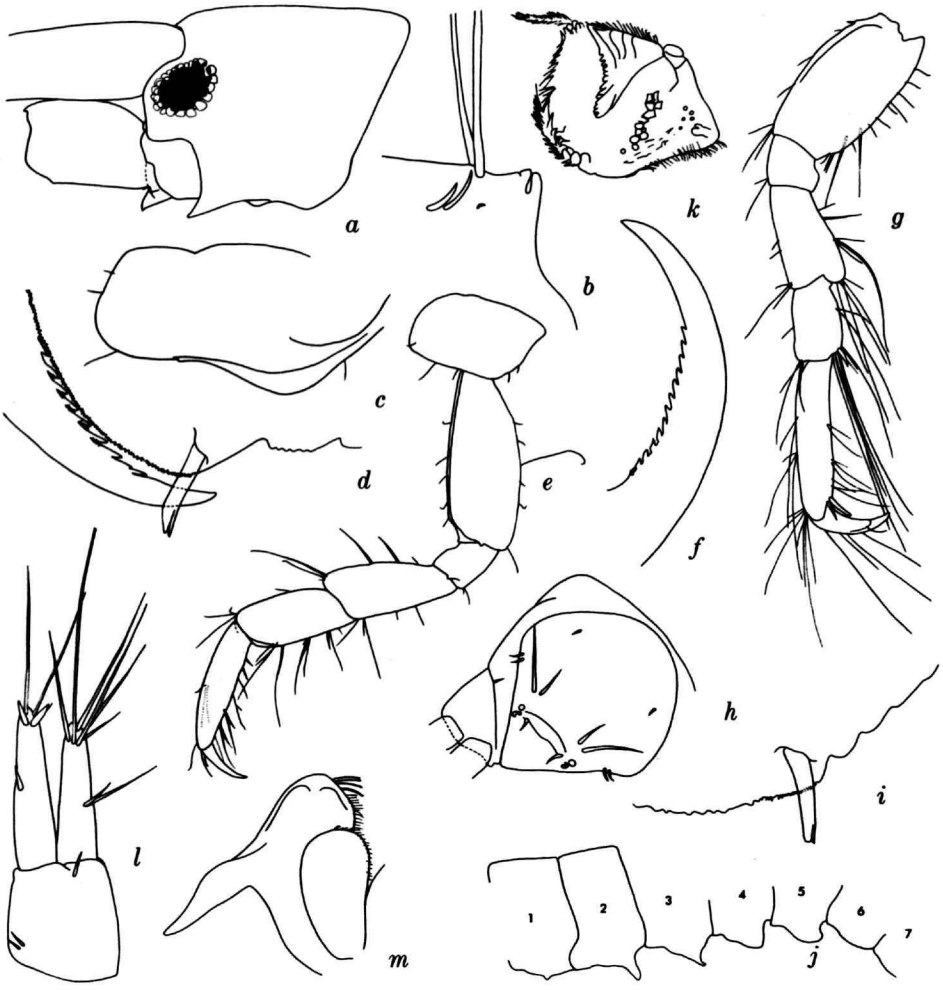

FIGURE 40.—*Lembos leapakahi,* new species, holotype, male, 6.0 mm, JLB Hawaii 17: *a,* head; *b,* side of telson; *c,* anterior portion of coxa 1; *d,* palm of gnathopod 2; *e,* pereopod 1; *f,* dactyl of gnathopod 1; *g,* pereopod 3; *h,* telson; *i,* palm of gnathopod 1; *j,* ventral processes of pereonites. Female, 5.0 mm: *k,* left mandibular molar; *l,* uropod 3; *m,* half of lower lip.

with pair of small lateral processes on each side, appressed to each other so as to form deep slit from lateral view; juvenile epimeron 2 with setae reduced or absent.

COLOR IN 2-DAY FORMALDEHYDE.—Body completely white or very rarely with weak brownish-purple dots.

HOLOTYPE.—Bishop Museum collections catalog number 7261, male, 6.0 mm.

TYPE-LOCALITY.—JLB Hawaii 17, Kawela Bay, Oahu, intertidal, *Sargassum,* other algae, rocks, 24 May 1967.

MATERIAL.—JLB Hawaii 5 (1), 10 (3), 11 (7), 15 (7), 17 (8).

RELATIONSHIP.—This species has affinities with the west African *L. francanni* Reid (1951) and the Micronesian *Lembos* species (J. L. Barnard, 1965a), but differs from both in the presence of an anteroventral cephalic cusp. Male gnathopod 2 of *L. francanni* also has the dactyl strongly overlapping the palm, not characteristic of *L. leapakahi.*

DISTRIBUTION.—Hawaiian Islands.

Lembos macromanus (Shoemaker)

FIGURES 41, 42*a-m, o*

Bemlos macromanus Shoemaker, 1925, pp. 36–41, figs. 10–13.
Lembos macromanus.—J. L. Barnard, 1962a, p. 9, fig. 3.

DIAGNOSIS OF MALE.—Lateral lobes of head strongly extended forward and truncate, anteroventral margin of head excavate, nearly flat-bottomed, then produced to medium-sized anteroventral cusp; eyes subcircular, brownish-purple cores in alcohol, surrounded by 1–2 layers of clear ommatidia; coxa 1 quadratiform, anteroventral corner softly quadrate; gnathopod 1 very large, article 2 stout, anterodistal corner produced downward conically, article 4 with distal point not free, article 5 broad and short, article 6 very broad, rectangular, anterior margin bulging, poorly setose, palm transverse, bearing deep incision separating 2 processes, defining process slender and unarmed, main process rounded or mammilliform, in terminal stage marked with basal suture, dactyl slender and slightly overlapping palm in terminal stage, more so in medium age male; article 2 of gnathopod 2 with weak anterodistal cusp, article 4 with distal point not free, article 5 much longer than 6, densely setose medially and anteriorly, palm oblique but short, defined by spine and slight protuberance, setation dense; thoracic sternites with short sharp tooth on segments 2–3, small nipple on 1; pleonal epimera 1–3 with bulging posterior margins, lateral ridges and notch and tooth at posteroventral corners, ventral setate absent; uropod 3 with article 2 on outer ramus and latter shorter than inner ramus, peduncle with large spines.

FEMALE.—Gnathopod 1 of normal female kind in *Lembos,* but especially tumid in terminal stage, article 5 about two-thirds as long as 6; article 2 of gnathopod 2 lacking anterodistal lobe and article 5 not strongly setose anteriorly; sternal keel absent.

DESCRIPTION.—Antenna 1 nearly as long as head and body together, antenna 2 much shorter; epistome flat in front, remainder of mouthparts like those of *L. leapakahi,* new species, including left mandibular molar "shark-tooth"; article 2 of pereopods 4–5 especially setose; urosome and uropods appearing similar to figures for *L. leapakahi,* but spines thinner and peduncles of uropods 1–2 lacking small basolateral setae, uropods 1–2 with long peduncular tooth between rami and distolateral peduncle of uropod 1 with 1 seta, no distal spine and 1 basolateral spine, peduncle of uropod 3 with 2 basomedial setae; telson large but not strongly elevated, with weak pair of posterolateral nobs forming slit from lateral view.

COLOR IN ALCOHOL.—Body background pale buff with numerous splotches and spots of brown, eyes caramel brown, especially bright.

MATERIAL.—JLB Hawaii 2 (2), 8 (1), 11 (28), 12 (1), 13 (6), 15 (7), Oahu, Coconut Island, 7 September 1959, species 24, collector, H. Caspers (4).

REMARKS.—In Hawaii this species compares very strongly with the fine original figures of Shoemaker except that the male sternal teeth are smaller. The slightly darker body background color in alcohol with more numerous and larger body blotches and spots helps one in separating females and juveniles from those of other species all having a pure white body background with or without spots. The pale fawn-colored pigment on pereonites 2–6 of *L. waipio* is a strong contrast to the dark appearance of *L. macromanus,* and male *L. waipio* has 3 sternal teeth. *Lembos pualani* differs from both *L. macromanus* and *L. waipio* in the relatively smooth dorsal margin of the urosome and relatively long dorsal margin of urosomite 2; the stairstep appearance of the urosome in *L. macromanus* and *L. waipio* is easy to see under low-power magnification.

Uropod 3 and the telson are especially setose in terminal stages of *L. macromanus,* the telson bearing 4 dorsal setae in a row on each side but several other Hawaiian species have at least 3 setae in each row; the apex of the outer ramus on uropod 3 is densely setose but only relatively more so than in two other Hawaiian species; the dense setae on article 2 of pereopods 4–5 are only slightly more abundant than those found in the terminal stage of *L. pualani.*

DISTRIBUTION.—Warm-temperate Pacific America, Hawaiian Islands, and reported from the Philippine Islands.

Lembos pualani, new species

FIGURES 42*n*, 43

Lembos (Bemlos) aequimanus.—J. L. Barnard, 1955a, p. 34 [not Schellenberg, 1938].

DIAGNOSIS OF MALE.—Lateral lobes of head strongly extended forward and truncate, anteroventral margin of head excavate, nearly flat-bottomed, then produced to medium-sized anteroventral cusp; eyes subcircular, brownish-purple cores in alcohol, surrounded by 1–2

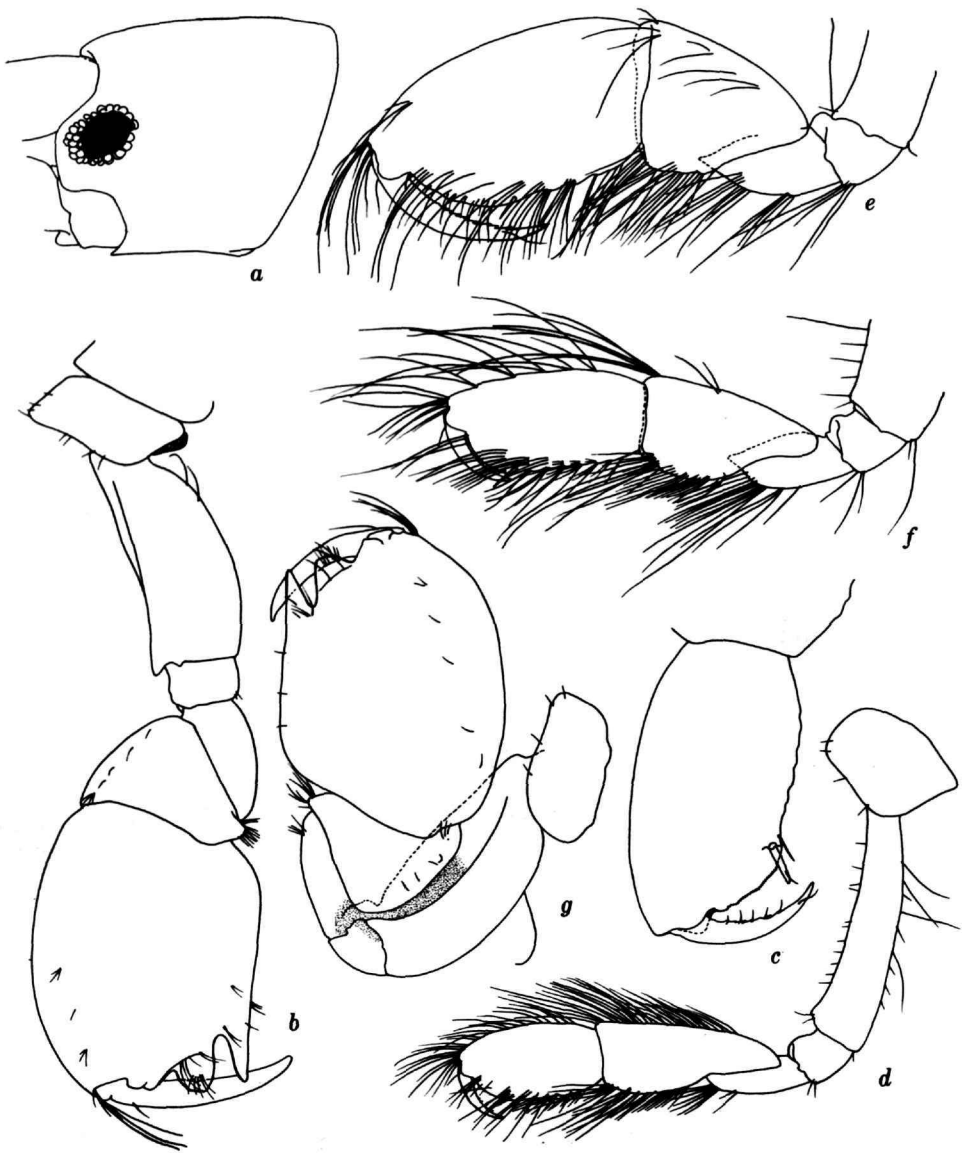

FIGURE 41.—*Lembos macromanus* (Shoemaker), male, 6.3 mm, JLB Hawaii 13: *a*, head; *b*, gnathopod 1; *c*, medial gnathopod 2, setae removed; *d*, lateral gnathopod 2. Female, 6.1 mm, Coconut Island, Oahu, 1959, Caspers: *e*, *f*, lateral gnathopods 1, 2. Male, 5.0 mm: *g*, gnathopod 1.

FIGURE 42.—*Lembos macromanus* (Shoemaker) and *L. pualani,* new species. *L. macromanus,* male, 6.4 mm, JLB Hawaii 13: *a,* apex on outer ramus of uropod 3; *b,* thoracic sternites 1–4; *c,* gland cone, shaded. Male, 6.3 mm: *d,* uropod 3; *e,* palmar bulge of gnathopod 1; *f,* telson; *g,* urosomites 1–3 (compare with 42 *n*); *h,* apex of telson; *i, j, k,* pleonal epimera 1, 2, 3; *l,* side of telson; *m,* aberrant outer ramus of uropod 3; *n, Lembos pualani,* new species, holotype, male, 4.3 mm, JLB Hawaii 14, urosomites 1–3, compare with 42 *g. o,* pereopod 5 from Coconut Island, Oahu, 1959, Caspers, specimen unknown, presumed terminal male.

layers of clear ommatidia; coxa 1 quadratiform, anterior and ventral margins excavate, anteroventral corner sharply attenuate; gnathopod 1 of medium enlargement, article 2 of normal stoutness, anterodistal corner with medium-sized mammilliform lobe, article 4 with distal point not free, article 5 of medium breadth, about 70 percent as long as article 6, latter rectangular, very strongly setose medially, palm slightly oblique, bearing deep incision separating 2 processes, defining process slender but unarmed, dactyl of medium stoutness and strongly overlapping palm; article 2 of gnathopod 2 with strongly projecting, thin mammilliform anterodistal lobe, article 4 with distal point not free, articles 5 and 6 equal to each other in length, palm nearly transverse, defined by spine and slight protuberance, setation dense medially but not anteriorly; thoracic sternites lacking keel or teeth; pleonal epimera 1–3 with bulging posterior margins, weak lateral ridges and slight notch and tooth at posteroventral corners, ventral setae absent; uropod 3 bearing article 2 on outer ramus, rami equal to each other in length, peduncle with large spine.

FEMALE.—Coxa 1 evenly quadrate, with softly rounded anteroventral corner; gnathopod 1 of normal female kind in *Lembos,* but slightly stouter than in *L. waipio,* new species, article 5 distinctly shorter than 6; gnathopod 2 with no anterodistal lobe on article 2.

DESCRIPTION.—Antenna 1 as long as head, pereon, and metasome combined, exceeding antenna 2 by only 3 (female) to 6 (male) flagellar articles; epistome slightly rounded anteriorly, remainder of mouthparts like those of *L. leapakahi,* new species, but left mandibular molar lacking "shark-tooth"; article 2 of pereopods 3–5 with small posteroproximal extension; urosome and uropods appearing similar to those of *L. leapakhai,* but spines thinner and peduncles of uropods 1–2 lacking lateral setae, uropods 1–2 with long peduncular process between rami, peduncle of uropod 1 with 1 basolateral spine, and distolateral seta, no distal spine, peduncle of uropod 3 with 2 basolateral setae; telson large but not strongly elevated, deeply excavate dorsally, with weak pair of posterolateral nobs, weakly to strongly slit from lateral view.

COLOR IN ALCOHOL.—Head and pereonites 2–6 with several small, bright, dorsolateral brownish-purple spots on white background, or occasionally with large blotches.

HOLOTYPE.—Bishop Museum collections, catalog number 7262, male, 4.3 mm.

TYPE-LOCALITY.—JLB Hawaii 14, 1 mi N of Kualoa Point, Oahu, intertidal, algae, dead coral heads, 23 May 1967.

MATERIAL.—JLB Hawaii 12 (17), 13 (24), 14 (7), 15 (17), 17 (7).

RELATIONSHIP.—This species differs from *L. waipio,* new species, in coxa 1, the more strongly setose gnathopods of both sexes, the stouter male gnathopod 1 with shorter article 5, stouter female gnathopod 1, palm of gnathopod 2 in both sexes shorter relative to posterior margin of hand, rami of uropod 3 shorter and equal in length to each other, article 2 of pereopod 5 slightly spinier, article 6 with spines proximal to locking pair, antenna 2 slightly stouter, mandibular molar lacking shark tooth, and the absence of a spiniform sternal keel on the male.

Lembos pualani differs from the Gilbertian-Fijian *L. aequimanus* Schellenberg (1938) in the unmodified palm of female gnathopod 2, the highly modified male coxa 1, the complete absence of male sternal teeth, and the elongate article 5 on gnathopod 1 of the female.

The Hawaiian species appears most closely related to but differs from Californian *"Lembos concavus* Stout" (J. L. Barnard, 1962a) by the weakness of anterior setation on article 6 of gnathopod 1 and article 5 of gnathopod 2 in males and the more highly modified coxa 1.

American *L. macromanus* (Shoemaker, 1925) differs from *L. pualani* in the strongly setose article 2 of pereopods 4–5, the presence of sternal teeth in the male, the weak anterodistal lobe on article 2 of male gnathopod 2, the much stouter male gnathopod 1 with short article 5, and the weakly overlapping dactyl.

DISTRIBUTION.—Hawaiian Islands.

Lempos waipio, new species

FIGURES 44, 45

DIAGNOSIS OF MALE.—Lateral cephalic lobes strongly extended forward and truncate, anteroventral margin of head excavate, nearly flat-bottomed, then produced to weak obtuse anteroventral cusp; eyes subcircular, brownish-purple cores in alcohol surrounded by 1–2 layers of clear ommatidia; coxa 1 rounded at anteroventral corner; gnathopod 1 of medium enlargement, article 2 of normal stoutness, anterodistal corner scarcely produced, article 4 with distal point not free, article 5 broad, but only half as long as article

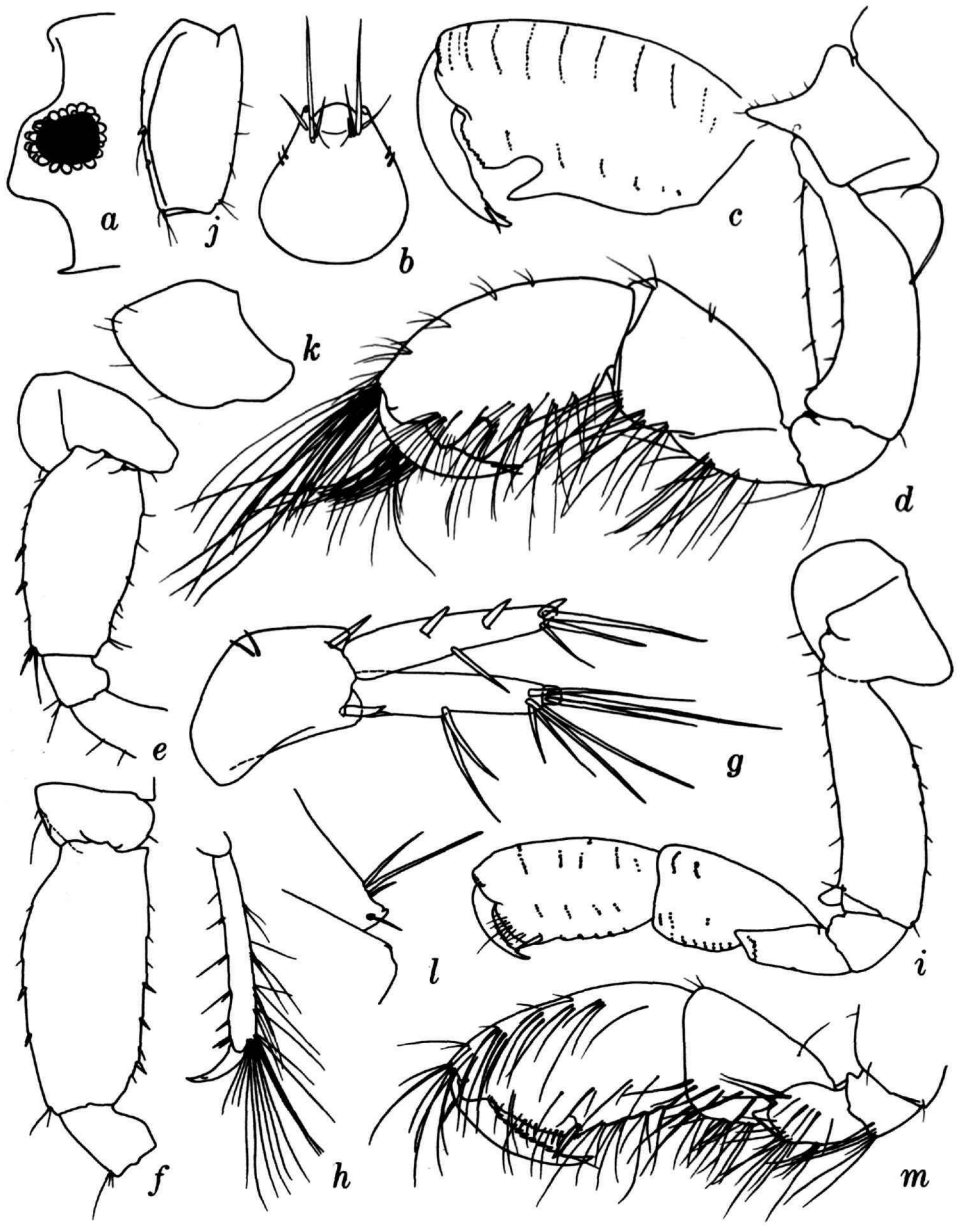

FIGURE 43.—*Lembos pualani,* new species, holotype, male, 4.3 mm, JLB Hawaii 14: *a,* head; *b,* telson; *c,* apex of medial gnathopod 1, setae represented by pits; *d,* gnathopod 1; *e, f,* portions of pereopods 3, 5, medial; *g,* uropod 3; *h,* apex of pereopod 5; *i,* gnathopod 2, setae represented by pits. Female, 4.2 mm: *j,* lateral pereopod 3; *k,* coxa 1; *l,* side of telson; *m,* apex of medial gnathopod 1.

6, latter slightly expanded, subrectangular but slightly tapering distally, anterior margin bulging, poorly setose, palm slightly oblique, bearing deep incision separating 2 processes, defining process slender and armed with basoposterior stout spine, dactyl slender and strongly overlapping palm; article 2 of gnathopod 2 with weak or medium anterodistal cusp, article 4 with distal point not free, article 5 longer than 6, palm oblique but short, defined by spine and slight protuberance, setation moderate; thoracic sternites with spiniform tooth on segments 2–4, obtuse keel on 5, weaker on 1; pleonal epimera 1–3 with bulging posterior margins, weak lateral ridges and slight notch and tooth at posteroventral corners, ventral setae absent; uropod 3 with article 2 on outer ramus and latter shorter than inner ramus, peduncle lacking large spine.

FEMALE.—Gnathopod 1 of normal female kind in *Lembos,* article 5 nearly as long as 6; gnathopod 2 article 2 lacking anterodistal lobe or that lobe obsolescent; sternal keel absent.

DESCRIPTION.—Antenna 1 as long as head and body together, antenna 2 much shorter; epistome flat in front, remainder of mouthparts like those of *L. leapakahi,* new species, including left mandibular molar "shark-tooth"; article 2 of pereopods 3–5 with small posteroproximal extension; urosome and uropods appearing similar to figures for *L. leapakahi,* but spines thinner and peduncles of uropods 1–2 lacking small basolateral setae, uropods 1–2 with long peduncular tooth between rami, and distolateral peduncle of uropod 1 with 1 seta, no spine, and 1 basolateral spine, peduncle of uropod 3 with 1 basolateral seta; telson large but not strongly elevated, with weak pair of posterolateral nobs, with lateral slit only in terminal stages.

COLOR IN ALCOHOL.—Body white except for weak brown dorsal stripes on pereonites 3–6 or 3–5, eyes brown.

HOLOTYPE.—Bishop Museum collections, catalog number 7263, male, 6.1 mm.

TYPE-LOCALITY.—JLB Hawaii 6, off Barbers Point, Oahu, 30 m, "coralline footballs," 29 January 1967 .

MATERIAL.—JLB Hawaii 3 (10), 5 (1), 6 (14), 14 (2).

RELATIONSHIP.—This species differs from *L. intermedius* Schellenberg (1938) in the strongly overlapping dactyl on male gnathopod 1, the rounded, asetose anteroventral corner of coxa 1, and the presence of simple instead of bidentate sternal teeth on the male.

It differs from *L. aequimanus* Schellenberg (1938) in the presence of sternal teeth on more than one segment in the male, in the rounded palm of female gnathopod 1, the obtuse anteroventral corner of coxa 1, and the stouter hands of the gnathopods in both sexes.

Lembos waipio differs from American *L. macromanus* (Shoemaker, 1925) in the longer dactyl of male gnathopod 1 and the presence of the posterior spine on the hand, the stouter, shorter, less setose gnathopod 2, the sparseness of setae on article 2 of pereopods 4–5, the thinner female gnathopod 1, and the presence of more than 2 sternal teeth on the male.

The Hawaiian species differs from Indonesian *L. processifer* (Pirlot, 1938) in the strongly overlapping dactyl on male gnathopod 1, the thinner peduncle of antenna 2, the presence of 3 strong sternal teeth in the male (instead of 2), the dark eyes, slender article 2 of gnathopod 2 lacking a strong anterolateral excavation, the thinner articles 5–6 of gnathopod 2 in both sexes, the small female gnathopod 1, and the lack of a strong anterodistal cusp on article 2 of female gnathopod 1.

J. L. Barnard (1965a) identified *L. processifer* from Micronesia, but that identification may now be seen to be erroneous and the Micronesian specimens should be associated with *L. waipio,* perhaps as a subspecies distinguished by the presence of only 2 sternal processes on the male and a smaller cusp on article 2 of male gnathopod 2. My 1965a identification was supported by a supposition that young males of *Lembos* might have dactyls fitting palms whereas terminal males might have dactyls overlapping palms but that circumstance does not justify the Micronesian identification of *L. processifer* in light of the high diversity of species in Hawaii that suggests other parts of the tropics may also have a higher than now expected diversity in this genus. There seems to be little doubt now that Pirlot's and J. L. Barnard's materials were both comprised of terminal males.

DISTRIBUTION.—Hawaiian Islands.

Lembos species

FIGURE 36*f-i*

DIAGNOSIS OF FEMALE.—Lateral lobes of head strongly extended forward and truncate, anteroventral margin of head excavate, flat-bottomed or slightly concave, then produced to strong anteroventral cusp (like

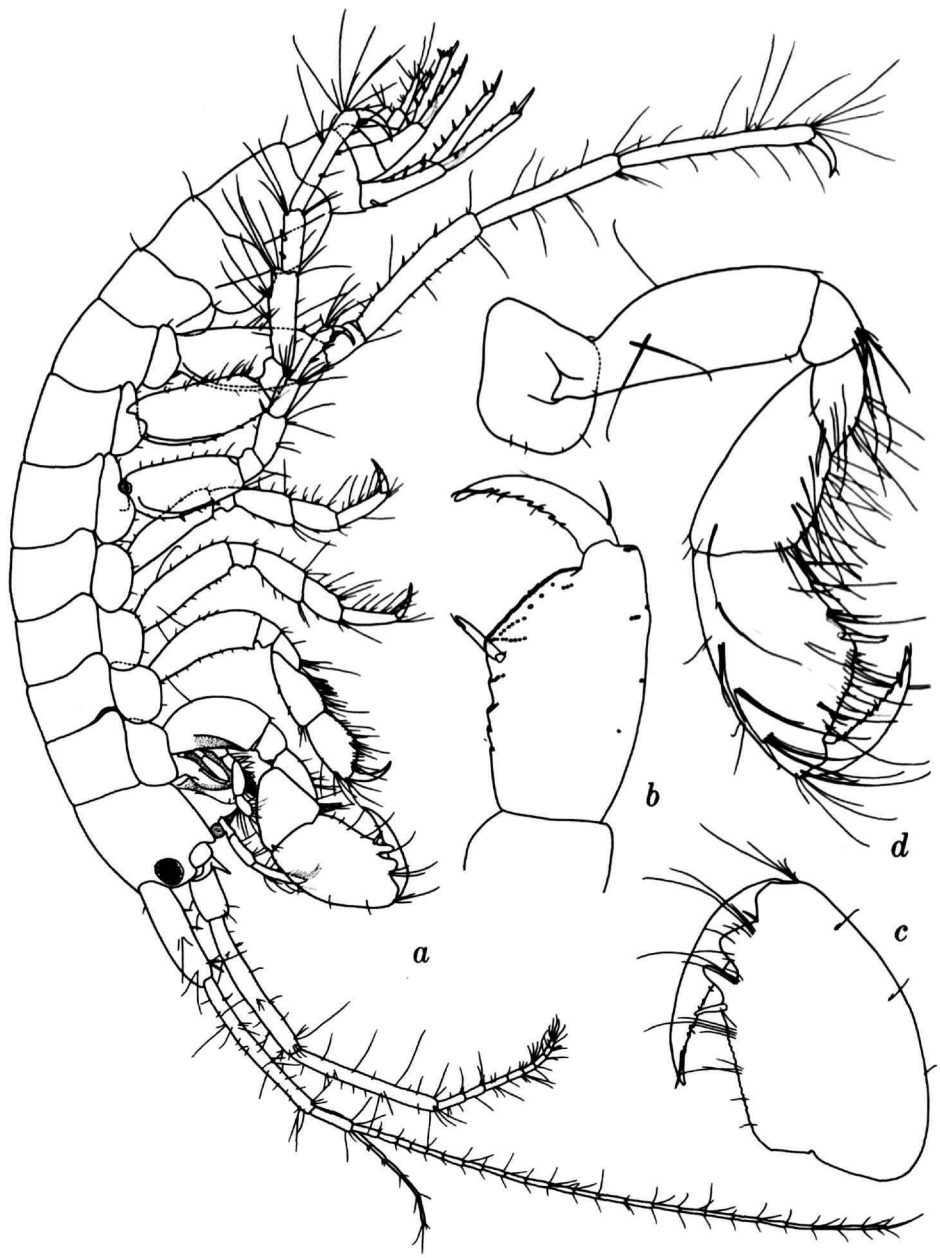

FIGURE 44.—*Lembos waipio*, new species, holotype, male, 6.1 mm, JLB Hawaii 6: *a*, body; *b*, *c*, apices of gnathopods 2, 1. Female, 3.8 mm: *d*, gnathopod 1.

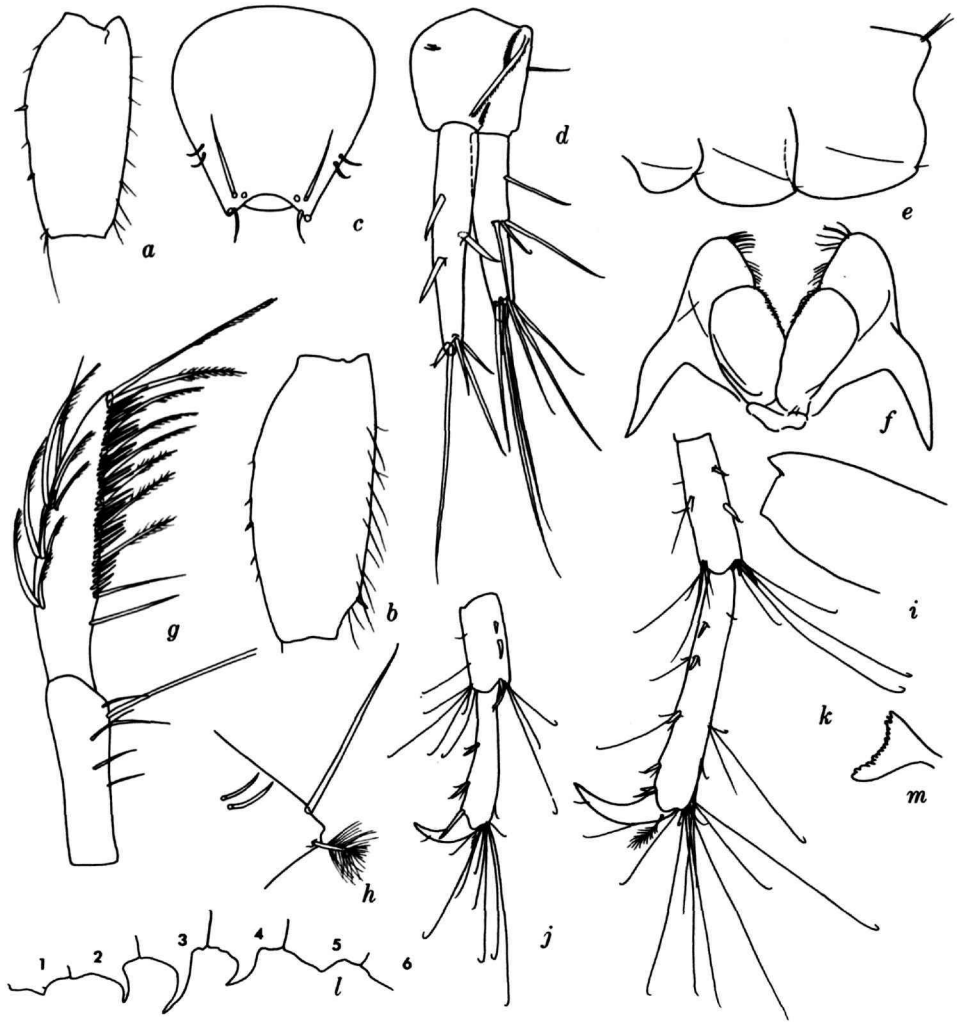

FIGURE 45.—*Lembos waipio,* new species, holotype, male, 6.1 mm, JLB Hawaii 6: *a, b,* article 2 of pereopods 3, 5; *c,* telson; *d,* uropod 3; *e,* pleonal epimera 1–3; *f,* lower lip; *g,* mandibular palp articles 2–3; *h,* side of telson; *i,* article 2 of pereopod 4; *j, k,* articles 5–7 of pereopods 3, 4; *l,* sternites of pereon. Female, 3.8 mm: *m,* tooth of left mandibular molar.

figure for *L. leapakahi*); eyes circular, dark purple cores surrounded by a layer of clear ommatidia; inner plate of maxilliped with very broad spines in comparison to other species of Hawaiian *Lembos* (like those of *L. kamanu*); gnathopod 1 of normal female kind in *Lembos,* but palm with weak excavation near posterior side, forming weak defining cusp armed with spine, appendage moderately setose, article 2 with weak anterodistal process; gnathopod 2 like that figured for male of *L. pualani,* article 2 with quadrate anterodistal corner, setation moderate; pleonal epimera 1–3 with bulging posterior margins, all with lateral ridge and small notch and tooth at posteroventral corner, ventral setae absent; uropod 3 with short peduncle and short rami about 1.3 times as long as peduncle, outer slightly shorter than inner and bearing small article 2.

DESCRIPTION.—Antennae and perepods 3–5 missing; epistome rounded anteriorly; mouthparts except inner plate of maxilliped generally like those for *L. leapakahi,* new species, but left mandibular molar lacking "shark-

tooth"; urosome and uropods appearing similar to those for *L. leapakahi* but spines thinner, peduncle of uropod 1 with basolateral spine, distolateral seta but no lateral setae; telson large, strongly elevated, deeply excavate dorsally, with weak pair of posterolateral nobs, deep slit from lateral view and generally appearing as in figure for *L. pualani;* urosomal dorsal margin normal as in *L. pualani.*

MATERIAL.—Fee 1 (1).

REMARKS.—This individual differs from *L. pualani* in the slightly excavate palm of female gnathopod 1, but the palm is not scalloped as in *L. kamanu.* The specimen may be an aberrant member of *L. pualani.*

DISTRIBUTION.—Hawaiian Islands.

Neomicrodeutopus (?)*makena,* new species

FIGURES 19*f*, 46, 47

DESCRIPTION OF MALE.—Head with truncate, trapezoidal ocular lobe bearing subcircular eye with broad dark core; head poorly recessed for attachment of antenna 2; mandibular palp very stout, articles 1–3 almost all subequal to each other in length, article 3 broadly clavate; epistome rounded anteriorly; lower lip and maxilla 1 like those of *Microdeutopus anomalus* (Rathke) (Sars, 1895, pl. 191), maxilliped also like that species, inner plate with 3 blade-spines and 2 coupling hooks on back, outer plate with short blade-like semiserrate (3–4 serrations) spines, becoming longer apically as plumose, blunt spine setae (2), palp article 4 unguiform but partially formed of 1 stout and 2 slender setae (antennae missing); coxae short, rectangular or rounded-quadrate, coxa 1 rounded anteroventrally, gnathopod 1 like that of *Microdeutopus,* article 2 without distal lobes, article 5 very broad and long and bearing double posteroventral tooth, most posterior tooth longest, article 5 short, stout, posterior margin bulging but truncate, palm very short and undefined, dactyl shorter than article 6; gnathopod 2 of medium stoutness and length, article 5 longer than 6, unlobate, weakly setose anteriorly or posteriorly, article 6 rectangular, palm nearly transverse but much shorter than posterior margin of hand, defined by pair of spines and posterior margin of hand with 2 more spines in tandem, dactyl fitting palm; pereopods 1–2 of medium slenderness, but article 2 more than twice as long as broad, articles 5–6 about subequal in length and longer than article 4, dactyl shorter than article 6; pereopods 3–5 slender, coxa 5 broadly rounded anteroventrally but coxae 5–7 very short and 6–7 almost equally and weakly bilobate, article 2 rectangular or tending toward ovateness in pereopod 5, article 5 with 2 or 3 lateral spines; pleonal epimera 1–3 with protuberant but truncate posterior margins and slight posteroventral incision bearing stout seta, ventral margins naked; uropods 1–2 with short stout spines on all rami and peduncles, outer ramus of uropod 2 significantly shorter than inner ramus, uropod 1 with ventral peduncular tooth between rami; uropod 3 uniramous, peduncle medially expanded and very thin, ramus 1.3 times as long as peduncle, 2-articulate; telson with strong dorsal protrusion on each side, quadratocircular from dorsal view, posteriorly truncate.

FEMALE.—Gnathopod 1 not strongly enlarged, hand narrow, palm with angular protrusion and defined by 1 large spine, with 2 proximal and 1 distal adjacent spines in tandem.

HOLOTYPE.—Bishop Museum collections, catalog number 7264, male, 4.7 mm.

TYPE-LOCALITY.—Makapuu Point, Oahu, April 1967, on *Zoanthus,* collector, Dr. Jerry Welch.

MATERIAL.—The type-locality and JLB Hawaii 18 (2).

RELATIONSHIP.—This species differs in numerous points from the type-species of the genus, *N. cabindae* Schellenberg (1925), from west Africa and may not be phyletically connected to that genus, but several points about both cannot be compared owing to missing parts on *N. makena* and descriptive omissions on *N. cabindae.* The antennae of *N. makena* are missing, and we do not know the state of articles 1–3 and the accessory flagellum; in *N. cabindae* the accessory flagellum is vestigial and 1-articulate and article 3 of antenna 1 is half as long as the interequal articles 1–2; antennae 1–2 are subequal in length to each other. The extent of ventral cephalic recession for the attachment of antenna 2 is unknown in *N. cabindae* and may be a significant generic character.

Neomicrodeutopus (?) *makena* differs from *N. cabindae* in the stout mandibular palp with equal articles 2–3, the slender gnathopod 2, the narrow article 2 of pereopods 3–5, the configuration of pleonal epimera and their nakedness, the short dactyl of gnathopod 1, and the short ramus of uropod 3, bearing 2 articles.

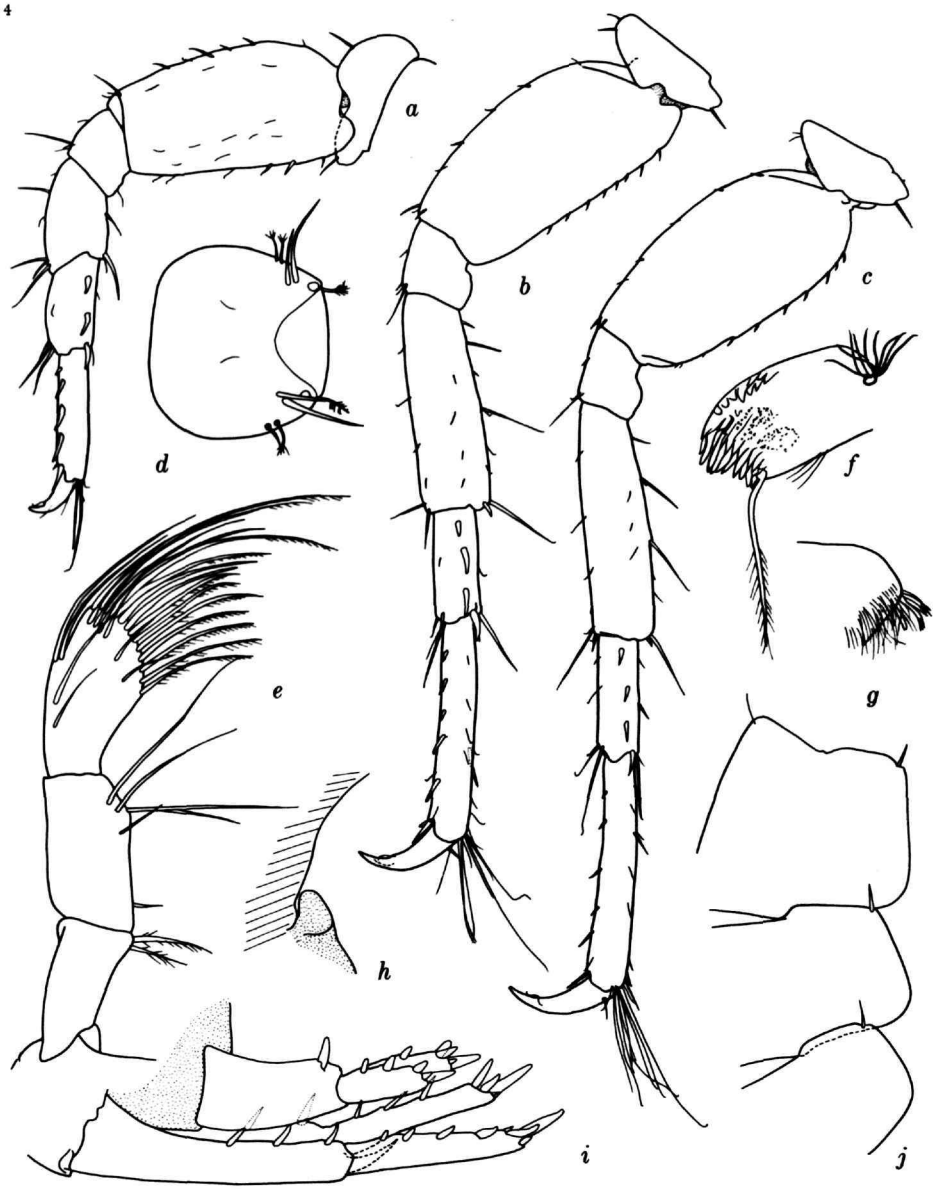

FIGURE 46.—*Neomicrodeutopus* (?) *makena*, new species, holotype, male, 4.7 mm, Makapuu Point, Oahu, 1967: *a, b, c*, pereopods 3, 4, 5; *d*, telson; *e*, mandibular palp; *f*, right mandibular molar; *g*, apex of outer lobe on lower lip (tilted on its side); *h*, inner plate of maxilla 1, shaded; *i*, uropods 1–2; *j*, pleonal epimera 1–3.

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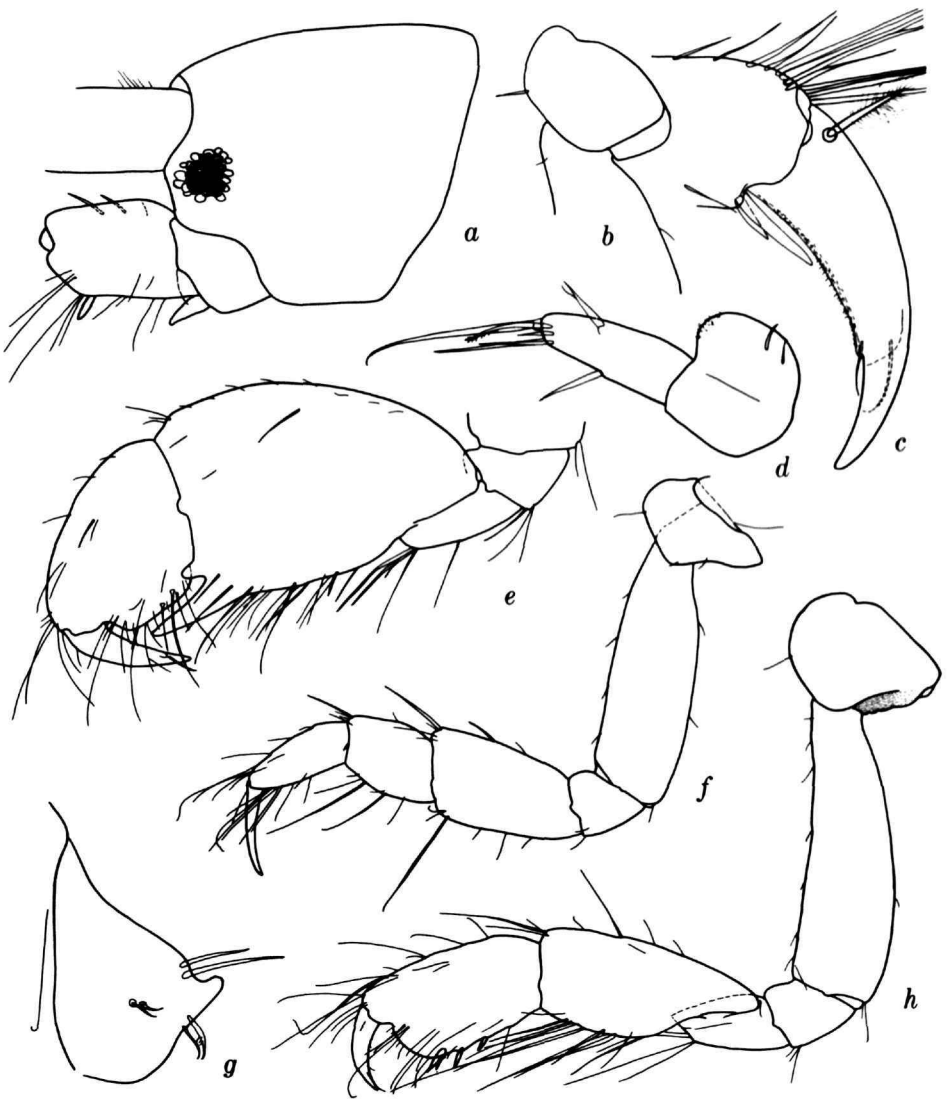

FIGURE 47.—*Neomicrodeutopus* (?) *makena*, new species, holotype, male, 4.7 mm, Makapuu Point, Oahu, 1967: *a*, head; *b*, coxa 1; *c*, apex of pereopod 5; *d*, uropod 3; *e*, gnathopod 1; *f*, pereopod 1; *g*, lateral view of telson (tilted on its side); *h*, gnathopod 2.

Neomicrodeutopus elongata (Chevreux), formerly in the genus *Grandidierella* Coutière but shifted to *Neomicrodeutopus* by Schellenberg (1938), differs from *N. makena* in the narrower ocular lobe, the very weak, nearly naked mandibular palp, and elongate ramus on uropod 3; again, there may be generic differences not now known. The condition of the mandibular palp in both of the Atlantic species is strong indication of that proposition.

If this is a genus distinct from *Neomicrodeutopus*, it does appear simply to be a species of *Microdeutopus* without inner ramus on uropod 3 rather than having gone through an intermediate stage such as that represented by *Acuminodeutopus* J. L. Barnard that has a shortened inner ramus on uropod 3. *Neomicrodeutopus makena* does not appear to have any direct relationship to *Acuminodeutopus*.

DISTRIBUTION.—Hawaiian Islands.

Family ATYLIDAE [11]

Atylus Leach

Kamehatylus, new subgenus

DIAGNOSIS.—*Atylus* with small atylid rostrum and dorsal sculpture of *A. levidensus* J. L. Barnard (1956); all segments of urosome coalesced; mandibular molar triturative but palp absent; accessory flagellum vestigial; lower lip lacking inner lobes; inner plate of maxilla 1 with 2 terminal setae and no apical cusp, outer plate normally spinose, palp 2-articulate; maxilla 2 normal; maxilliped normal; gnathopods small but subchelate and atylid; pereopods simple; anterior coxae intersimilar in length and surface area, none grossly enlarged; uropods normal, uropod 3 with short peduncle, rami of medium elongation; telson of medium length and deeply cleft.

TYPE-SPECIES.—*Kamehatylus nani*, new species.

RELATIONSHIP.—The breadth of the diagnosis reflects the problem that *Kamehatylus* is, by definition, a member of the family Dexaminidae. The loss of the mandibular palp is the major distinction between atylids and dexaminids. There seems to be little point in maintaining a distinction between these families except at the subfamilial level, for *Kamehatylus* is not the only genus to bridge the familial concepts. *Anatylus* Bulycheva (Anatylidae, later Anatylinae in the Dexaminidae) and *Atylus japonicus* Nagata (1961a) also form intergrades, the former having a nontriturative mandibular molar and the latter possibly having lost the mandibular palps like *Kamehatylus*.

One might presume from the congruity of appearance that *Kamehatylus nani* is a descendent of either, or is a member of a species complex including the Japanese *Atylus japonicus* and the Oregonian *A. levidensus* J. L. Barnard (1956). The latter has mandibular palps, whereas Nagata notes "broken" palps of *A. japonicus;* they are a closely interrelated group that may also include *A. collingi* Gurjanova (see 1951).

Kamehatylus nani appears to be more closely related to *A. japonicus* than to the other species in the fact that fewer gross differences occur between those two species than among the others. If *A. japonicus* has indeed lost the mandibular palps then the sequence seems eminently clear, for *K. nani* differs only in these other characters: (1) the short peduncle of antenna 1; (2) the loss of one seta and the apical cusp on the inner plate of maxilla 1 (*A. japonicus* has 3 setae and a cusp); (3) the short telson; (4) the development of 2 lateral spines on the urosome (like many dexaminids); and (5) the complete coalescence of all urosomites (in all other atylids and dexaminids only urosomites 2–3 are coalesced). *Kamehatylus nani* also resembles *A. japonicus* in the tapering coxa 1 but also differs in a slightly smaller rostrum.

Kamehatylus nani differs from *A. levidensus* in characters 2–5 but differs in addition by: (6) the slightly more elongate article 3 of antenna 1; (7) the slightly shorter article 4 of antenna 2; (8) the apical tapering of coxa 1; (9) the slight elongation and narrowing of article 2 on pereopods 3–5; (10) the loss of a small cusp on article 2 of pereopod 5; (11) the loss of a conical protuberance on coxa 3. Thus, the connections between *A. levidensus* and the other two species are more remote than between *A. japonicus* and *K. nani*. A logical progression of events would be the occurrence of a common ancestor to *A. japonicus* and *A. levidensus* with *K. nani* descending from *A. japonicus*. Neither *A. japonicus* nor *A. levidensus* could be the precursor to the other, but *A. levidensus* could be a remote ancestor of *K. nani* (but not vice versa.)

Atylus japonicus has one character of complete divergence, the elongate peduncle of antenna 1 that is reflected weakly in the slightly elongate article 3 on *K. nani*, but the latter otherwise has a short peduncle. Gnathopods of *A. japonicus* also are more slender than in the other two species, and this damages the concept of a direct progression between *A. japonicus* and *K. nani*.

Atylus (*Kamehatylus*) *nani*, new species

FIGURES 48, 49

DIAGNOSIS.—With the characters of the subgenus.

COLOR IN 2-DAY FORMALDEHYDE.—Body mottled with orange, rust, and ochre on a buff-yellow background, eyes red.

HOLOTYPE.—Bishop Museum collections, catalog number 7265, female, 2.8 mm. Unique.

TYPE-LOCALITY.—JLB Hawaii 17, Kawela Bay, Oahu, intertidal, *Sargassum*, algae, rocks, corals, 24 May 1967.

REMARKS.—This species has undergone changes analogous to those seen in Micronesian *Beaudettia palmeri* J. L. Barnard (1965a) that also represents a case

[11] See footnote on page 26.

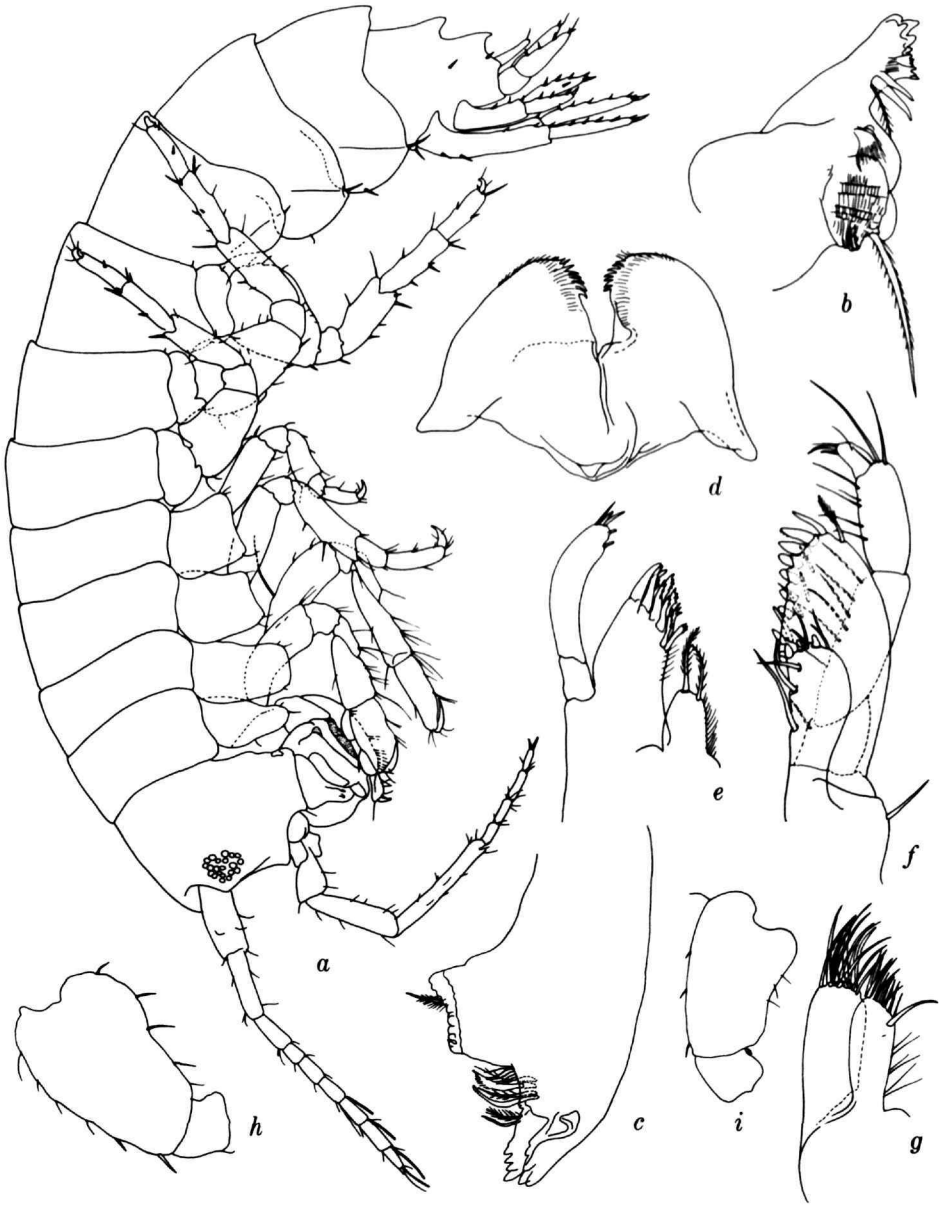

FIGURE 48.—*Atylus* (*Kamehatylus*) *nani*, new subgenus, new species, holotype, female, 2.8 mm, JLB Hawaii 17: *a*, body; *b*, *c*, mandibles, left normal view, right obverse; *d*, lower lip; *e*, maxilla 1; *f*, maxilliped; *g*, maxilla 2; *h*, *i*, articles 2–3 of pereopods 4, 3.

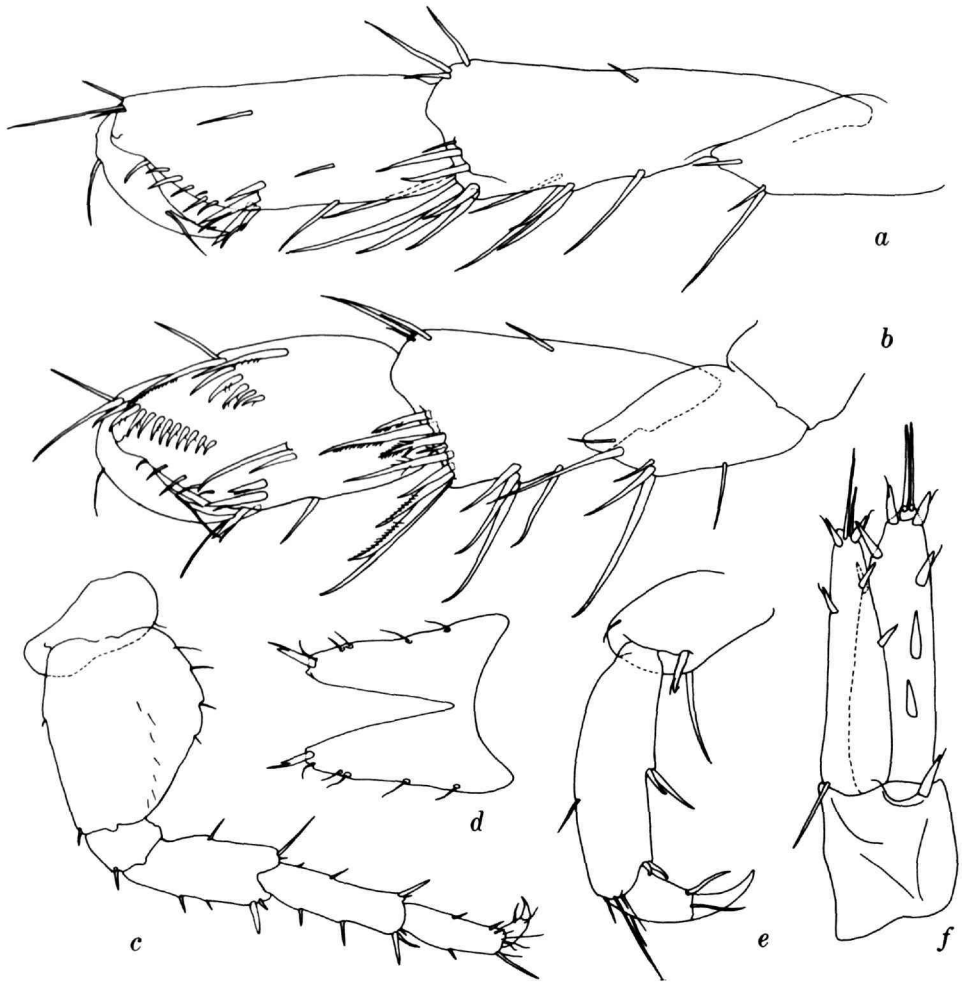

FIGURE 49.—*Atylus* (*Kamehatylus*) *nani*, new subgenus, new species, holotype, female, 2.8 mm, JLB Hawaii 17: *a*, medial gnathopod 2; *b*, medial gnathopod 1; *c*, medial pereopod 5; *d*, telson; *e*, apex of lateral pereopod 1; *f*, uropod 3.

of radical change in characters of familial importance. Those characters therefore lose such value by themselves in a typological framework, but the cases are of considerable interest in viewing the incipience of changes that in other phyletic lines have resulted in presumably old, diversified, and genetically remote complexes. *Beaudettia palmeri* is believed to be a relatively direct descendent of a species of *Elasmopus* in which the mandibular palp has been lost and various changes in uropod 3 and the telson have occurred. The two cases demonstrate a thesis that certain changes occurring in the evolution of Amphipoda do not necessarily involve a slow transformation from one state to another; thus a mandibular palp may either be present (and 3-articulate) or absent, and a telson either deeply cleft or entire. In some families (Stenothoidae) the mandibular palp may be lost in stages, one article at a time, but *Beaudettia* and *Kamehatylus* seem to demonstrate that a radical loss also occurs. That such species are not simply blind alleys of evolution appears to be supported by a diverse occurrence of dexaminids that are simply atylids without mandibular palp, which

then have become partially adapted to an inquilinous life. The bright colors of *Kamehatylus,* that blend together as a camouflage resembling the background color of *Sargassum,* suggest that the Hawaiian subgenus, like its atylid precursors, is living freely rather than in an inquilinous niche.

DISTRIBUTION.—Hawaiian Islands.

Family COLOMASTIGIDAE

Colomastix kapiolani, new species

FIGURE 50

DIAGNOSIS OF MALE.—Epistome bluntly conical, head with large conical anterior keel between antennae as seen from ventral view; eyes medium in size, red in formaldehyde, and clear or slightly pink-rust in alcohol; lateral cephalic lobe rounded; antenna 1 weakly spinose and cuspidate, flagellum with 4 articles, latter 2 articles vestigial, antenna 2 with medial spines on articles 3–4 of peduncle, flagellum 4-articulate; mandibular spine row simple and normal, molar typical of *C. pusilla,* maxilla 1 similar to that of *C. subcastellata* Hurley, maxilla 2 strongly bilobate; inner plates of maxilliped split deeply, remainder of maxilliped like that of *C. lunalilo,* new species; coxae simple, ovato-rectangular, lacking points; gnathopod 1 normal, with article 5 slightly longer than 6, but article 2 strongly swollen anterodistally; article 2 of gnathopod 2 with small anteroventral hump, article 5 with narrow, setose posterior lobe, setae simple, article 6 very elongate, palm occupying entire posterior margin of article 6, dactyl overlapping palm and reaching back to proximal margin of lobe on article 5, palm with hump near dactylar hinge, deep excavation and large conical cusp, then long flat margin defined proximally by small cusp, dactyl simple; pereopods 1–5 normal, each bearing one locking spine on article 6; pleonal epimera 1–3 broadly rounded ventrally and posteroventrally; uropods 1–3 extending subequally, outer ramus of uropod 1 slightly shorter than inner ramus, outer ramus of uropod 2 about two-thirds as long as inner ramus, and outer ramus of uropod 3 about three-fourths as long as inner ramus; telson unequally trilobate apically, of medium length.

JUVENILE MALE.—Article 6 of gnathopod 2 with short dactyl fitting palm and weak defining cusp, palmar process near dactylar hinge quadrate, undivided; some setae of lobe on article 5 suddenly narrowed in middle like setae shown by Hurley (1954b). Female unknown.

HOLOTYPE.—Bishop Museum collections, catalog number 7267, male, 1.3 mm.

TYPE-LOCALITY.—JLB Hawaii 5, off Ewa Beach, Oahu, 30 m, *Pocillopora,* 29 January 1967.

MATERIAL.—JLB Hawaii 5 (1), 6 (1), 10 (2).

RELATIONSHIP.—According to Hurley's (1954b) key to the species of this genus, *C. kapiolani* has its closest affinities with *C. fissilingua* Schellenberg (1926) (K. H. Barnard, 1932), but the latter differs from *C. kapiolani* in the equal trilobation of the telson, the anteriorly pointed coxae 1, 3, 4, and 5, the posteriorly pointed coxae 6–7, the equal rami of uropod 1, and the extremely thin article 2 of pereopods 3–5.

Colomastix subcastellata Hurley (1954b), from New Zealand, also closely resembles *C. kapiolani,* but has lateral scallops on the telson, a smaller hump on article 2 of gnathopod 1, and equal rami of uropod 1. These differences may be of subspecific value only.

Colomastix castellata K. H. Barnard (1932) has a multicastellate telson and equal rami on uropods 1 and 2.

DISTRIBUTION.—Hawaiian Islands.

Colomastix lunalilo, new species

FIGURES 51, 52

DIAGNOSIS OF PRESUMED MALE.—Epistome conical, head with large conical anterior keel between antennae, eyes large, brown in formaldehyde and alcohol, lateral cephalic lobe rounded; antenna 1 with lateral and medial, ventral edges spinose on articles 1, 2, and 3, distoventral apex on lateral side pointed on articles 1, 2, and 3, flagellar article 1 cuspidate distodorsally, article 2 of flagellum vestigial; antenna 2 also with spines and cusps on articles 3–5 (see figures), flagellum 4–5 articulate and attached asymmetrically to article 5 of peduncle; mandibular spine row simple and normal, molar typical of *C. pusilla,* maxillae 1–2 relatively typical of *C. subcastellata* Hurley, inner plates of maxilliped coalesced fully, outer plates each with apical spine, article bearing outer plate not broadly alate laterally, basal article shell-like, forming immense posteriorly directed envelope, remainder of maxilliped attached to basal article in geniculate fashion; coxae 1–5 with nipple-like anterior points; gnathopod 1 normal, with elongate article 3, article 6 subequal in length to article 6 and apically setose

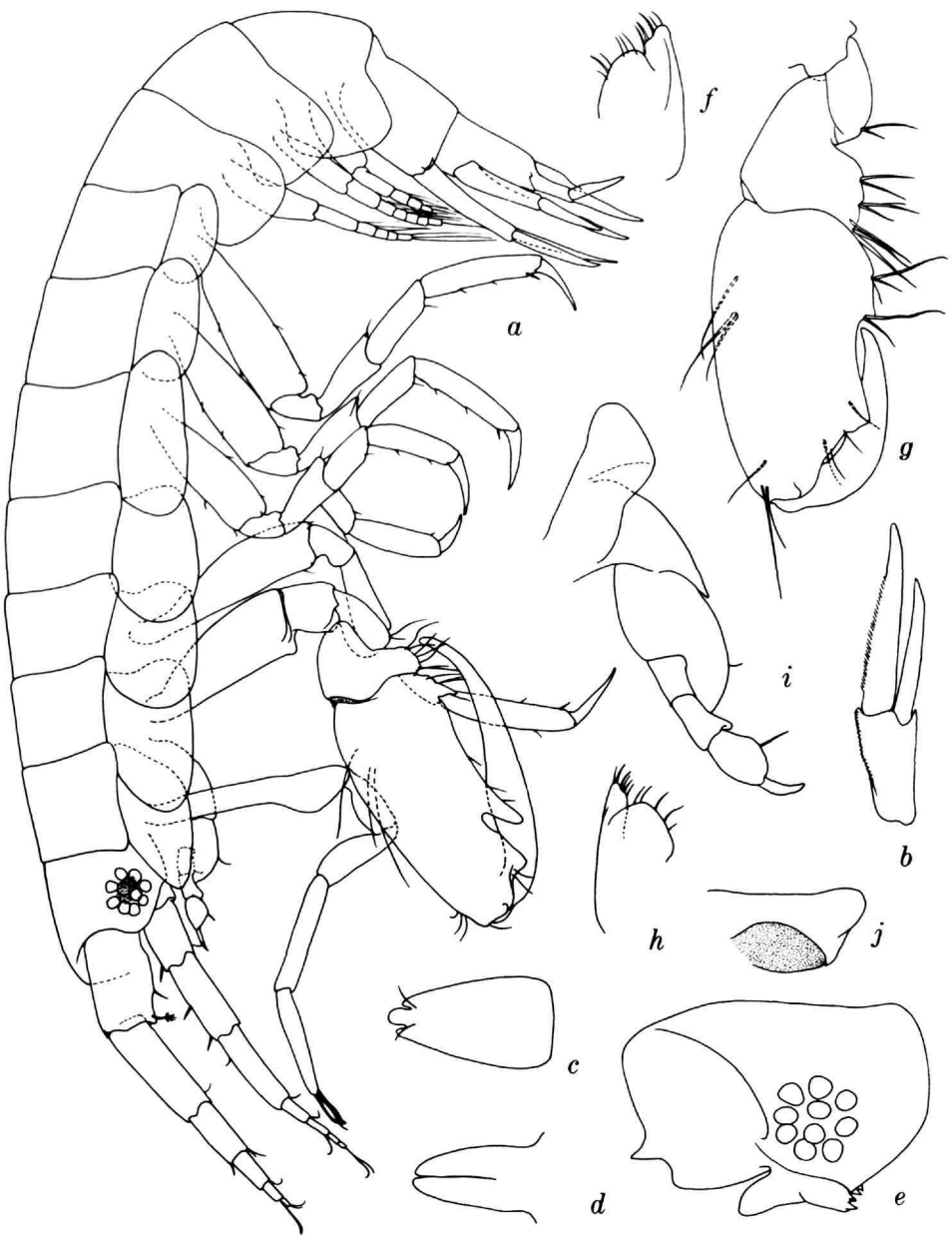

FIGURE 50.—*Colomastix kapiolani,* new species, holotype, male, 1.3 mm, JLB Hawaii 5: *a,* body; *b,* uropod 3; *c,* telson; *d,* inner plate of maxilliped; *e,* head. Male 1.0 mm: *f,* maxilla 2; *g,* lateral gnathopod 2; *h,* maxilla 2. Specimen from JLB Hawaii 10: *i,* lateral view of maxilliped; *j,* basal shell of maxilliped.

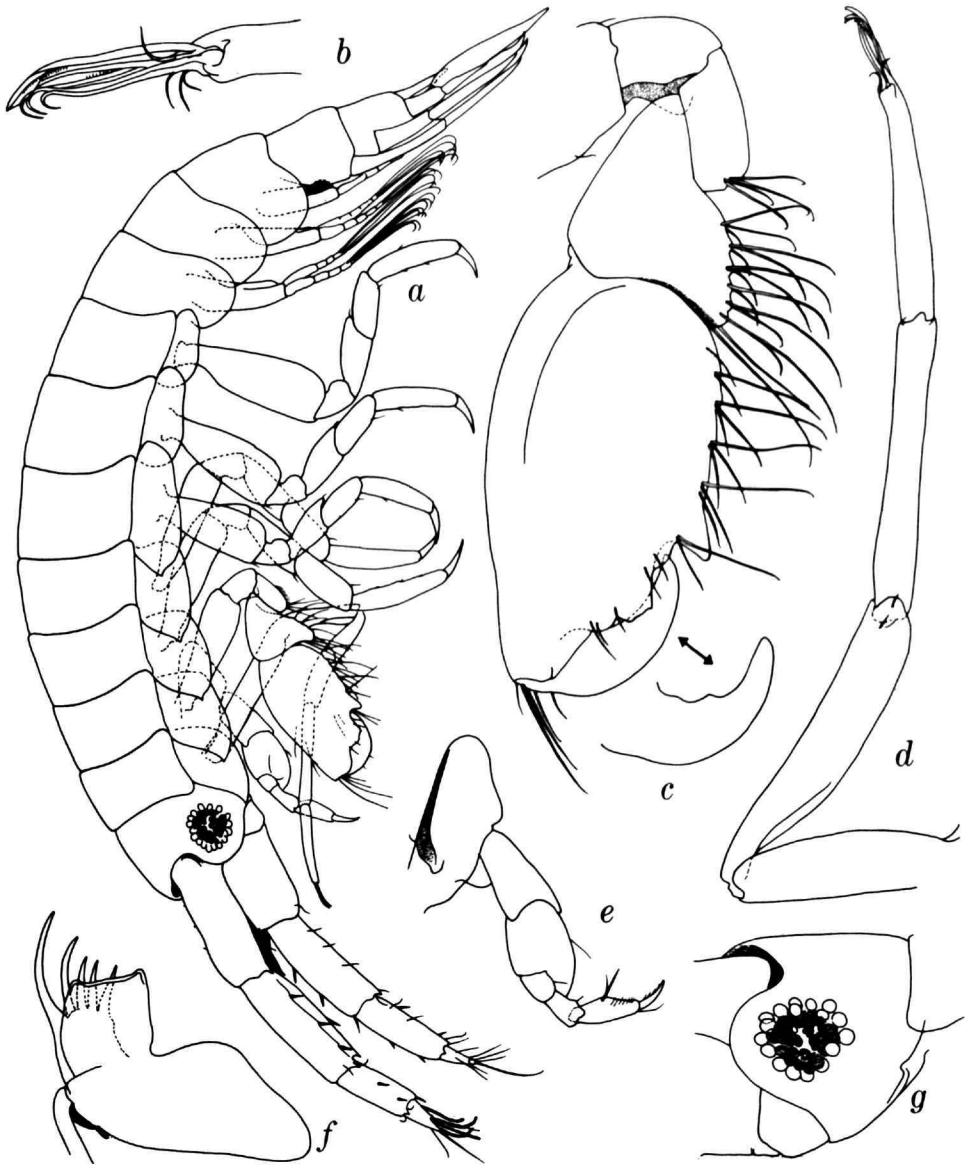

FIGURE 51.—*Colomastix lunalilo*, new species, holotype, male, 1.9 mm, JLB Hawaii 13: *a*, body; *b*, apex of gnathopod 1; *c*, gnathopod 2; *d*, gnathopod 1; *e*, lateral view of maxilliped; *f*, mandible; *g*, head.

FIGURE 52.—*Colomastix lunalilo,* new species, holotype, male, 1.9 mm, JLB Hawaii 13: *a,* outer plate and palp of maxilla 1; *b,* edge of inner ramus of uropod 3; *c,* mandible with molar turned to left; *d,* telson and uropod 3, dorsal; *e, f,* medial antennae 1 and 2; *g,* apex of telson; *h,* maxillipedal palp articles 3 and 4; *i,* uropod 3, offset to left are high power and oil immersion views of outer ramus edge sculpture; *j,* maxilla 2; *k,* mandibular molar; *l,* ventral view of head. Male, 1.8 mm: *m,* maxilla 1; *n,* maxilliped; *o,* articles 6–7 of gnathopod 2 from right side.

(dactyl not distinguished from setae); article 5 of gnathopod 2 with broad setose posterior lobe, setae simple, article 6 elongate, dactyl shorter than palm, palm shorter than posterior margin of article 6 and defined by large cusp, palm with low truncate process, dactyl with obtuse inner cusp; pereopods 1–2 unornamented; pleonal epimera 1–3 broadly rounded ventrally and posteroventrally; uropods 1–2 extending equally, rami all equal to each other in length, uropod 3 extending slightly beyond uropods 1–2, outer ramus about one-third as long as inner (variable, from slightly less than in juvenile to slightly more than one-third in adult); telson triangular, of medium length, exceeding in length peduncle of uropod 3.

JUVENILE MALE.—Gnathopod 2 of normal undifferentiated morphology (see figure).

DESCRIPTION.—Palp of maxilla 1 uniarticulate, with deep midterminal notch defined by sharp distolateral extension, medial margin finely but deeply serrate, outer plate with 1 apical and 2 proximal simple spines, between those, 2 ridges or spines with flabellate, serrate and beaded margins, inner plate subrectangular; maxilla 2 shriveled, but lobes weakly separated.

HOLOTYPE.—Bishop Museum collections, catalog number 7266, ?male, 1.9 mm.

TYPE-LOCALITY.—JLB Hawaii 13, Kaneohe Bay, Oahu, 3–4 m, corals, algae, corallines, 8 April 1967.

MATERIAL.—Three specimens from the type-locality.

RELATIONSHIP.—*Colomastix brazieri* Haswell (1880) from east Australia and *C. magnirama* Hurley (1954b) are the only other members of the genus with a strongly reduced outer ramus on uropod 3. Pereopods 1–2 of *C. magnirama* have a large cusp on article 5, complex mandibular spines, a much shorter outer ramus of uropod 3 than seen on *C. lunalilo,* a broader telson, unequal rami of uropod 1 in both sexes, a shorter article 5 and narrower lobe on gnathopod 2, and no points on the coxae.

Colomastix brazieri has article 5 of gnathopod 1 much longer than article 6, an outer ramus of uropod 3 half as long as the inner ramus and a shorter article 5 and narrower lobe of gnathopod 2 than in *C. lunalilo.* The latter appears to be closer to *C. brazieri* than to any other species, but *C. brazieri* needs further elucidation.

Colomaxtix pusilla Grube, a cosmopolitan sympatriot of *C. lunalilo* in Hawaii, differs from the latter in its red eyes changing to colorless in alcohol, in the absence of sharp and narrow nipple-like points on the coxae, the shorter telson, the blunter epistome, the shorter gnathopod 1, and in males a distinctly different gnathopod 1 than occurs in female *C. pusilla* and males of *C. lunalilo.* The rami of uropod 3 in *C. pusilla* are equal to each other in length.

DISTRIBUTION.—Hawaiian Islands.

Colomastix species

MATERIAL.—JLB Hawaii 6 (1).

REMARKS.—This undissected individual, with gnathopod 2 in juvenile condition, is distinguished from other Hawaiian species in (1) the presence of only 1 apically hooked setal spine on the apex of gnathopod 1; (2) the absence of a hump on article 2 of gnathopod 1; (3) uropod 1 is shortened, the inner ramus reaching only to the middle of the rami of uropod 2 and the outer ramus being about two thirds as long as the inner ramus; (4) the rami of uropod 2 extend equally; (5) the outer ramus of uropod 3 is about three fourths to four fifths as long as the inner ramus; (6) the telson appears simple (not adequately seen); (7) pereopods 1–5 lack a locking spine; (8) the eye has 9 ommatidia but 3 of the middle ones are extremely tiny.

The individual fits *C. pusilla* more closely than it does the other Hawaiian species but differs in the unequal rami of uropods 1 and 3. The unusual condition of gnathopod 1 may represent a stage of transformation from the normal setal brush to the advanced male stage like that of *C. pusilla* in which a distinct, stubby dactyl occurs on a shortened gnathopod 1.

Family COROPHIIDAE

Corophium ?baconi Shoemaker

FIGURE 53

?Corophium baconi Shoemaker, 1934, pp. 356–359, fig. 1; 1949, p. 82, fig. 5g, h.

MATERIAL.—JLB Hawaii 11 (4).

REMARKS.—No adult male is available but female characters match those of *C. baconi,* the only Pacific species of the genus in which the segments of the urosome are coalesced and formed into a shallow cup-like plate with upturned rims bearing a slit to mark the junction between urosomites 1 and 2, with uropods 1–2 attached ventrally rather than in lateral notches. Dactyls of gnathopods 1–2 have only 1 and 2 inner teeth.

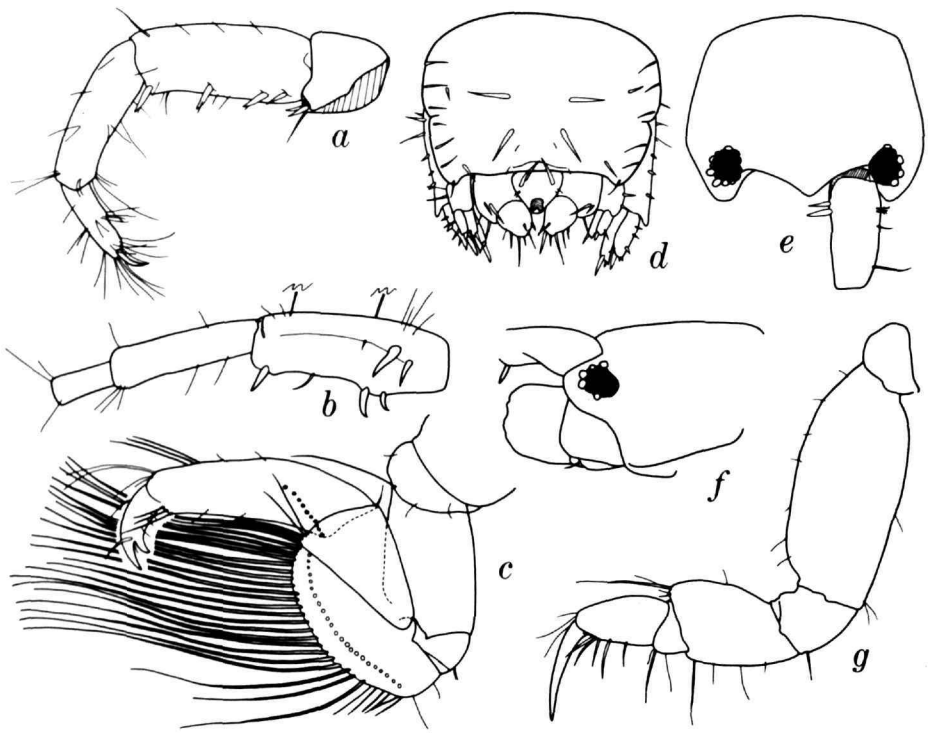

FIGURE 53.—*Corophium baconi* Shoemaker, female, 2.3 mm, JLB Hawaii 11: *a*, medial antenna 2; *b*, medial antenna 1; *c*, gnathopod 2. Female, 1.5 mm: *d*, dorsal urosome; *e*, dorsal head; *f*, lateral head; *g*, pereopod 1.

Young females and the ovigerous female have a spine-seta pattern on the urosome similar to that shown by Shoemaker (1934), but the spines are very stout in Hawaiian specimens. Antenna 2 of the large female has an extra proximal ventral spine on article 4 adjacent to the normal spine, for a total of 4 spines instead of 3 in normal individuals. The short article 5 of pereopods 1–2 and the elongate posteriorly straight and poorly armed article 6 of gnathopod 2 are illustrated.

DISTRIBUTION.—Bering Sea to Peru.

Corophium insidiosum Crawford

FIGURE 54

Corophium insidiosum Crawford, 1937, p. 615, fig. 2a–g.—Shoemaker, 1947, p. 53, figs. 6, 7.

MATERIAL.—Hilo, Hawaii, 20 June 1959, Clunio-Polster, collector H. Caspers (70+).

Besides the normal male and female phenotypes at least a dozen other phenotypes are present in a single collection of this species from Hilo. The normal male antenna 2 (Figure 54*c*) lacks large ventral spines on articles 4 and 5, but males occur with a single proximoventral spine on article 4 and none on article 5 or with a pair of midventral spines on article 4 and one ventral spine on article 5. The medioproximal margin of article 1 of antenna 1 (from dorsal view) typically would have 2–3 spines, but males in the Hilo collection have either 2, 1, or no spines, occasionally one of the spines being extremely and abnormally proximal. Females also have these kinds of antenna 1 except that they occasionally have 3 of those spines, one of which is extremely proximal. The ventral margin of article 1 of antenna 1 typically would have 2 ventral and 1 ventrodistal spines and this is typical for Hilo females, but males often lack the 2 ventral spines. Individuals often have one formula on the left antennae and another formula on the right antennae.

Female antenna 2 is often typical (Figure 54*e*), but frequently either right or left antennae 2 of adult ovigerous females look like those of males with the

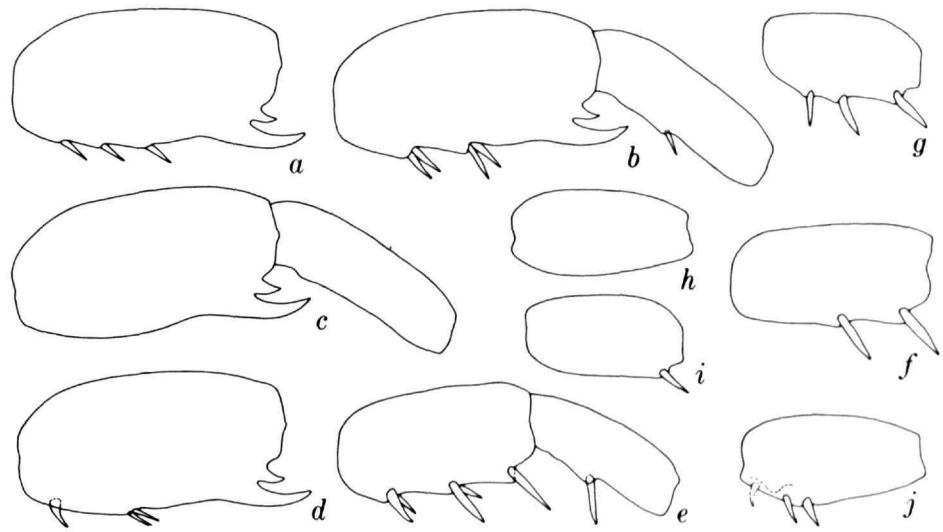

FIGURE 54.—*Corophium insidiosum* Crawford, Hilo. Antenna 2: *a*, abnormal female; *b*, abnormal female; *c*, normal male; *d*, abnormal male; *e*, normal female; *f*, abnormal female. Antenna 1: *g*, male and female lateral; *h*, male dorsal; *i*, male lateral; *j*, female, dotted spine infrequent, male occasionally with only 1 spine.

large and small distal cusps in place of a single spine. The ventral surface of article 4 may carry 3 single spines, 2 single spines, or 2 pairs of spines. Female antennae 2 without the male configuration may also vary, sometimes having a single ventral spine, sometimes 2, occasionally 3, but usually having the normal 2 pairs and a single.

Some of the female aberrancies equivocate the conditions typical of *Corophium uenoi,* from Japan and California, in which female antenna 2 has spines occurring only singly instead of in pairs. Nevertheless, I identify these specimens with *C. insidiosum.* Apparently, *C. insidiosum,* a widely distributed and transported species, has become highly variable in the Hawaiian Islands, typical of other species having reached island niches or special environments. Another example is the masculine females of *Gammaropsis* in Micronesia (J. L. Barnard, 1965a).

DISTRIBUTION.—Cosmopolitan, especially in harbors.

Family DEXAMINIDAE

Paradexamine Stebbing

Wailele, new subgenus

DIAGNOSIS.—Antenna 1 much longer than antenna 2; mandibles with spine row and lacinia mobilis on both sides, molar triturative; lower lip with well-developed separate inner lobes and strong mandibular processes on outer lobes; inner plate of maxilla 1 naked, short, palp 1-articulate and short, only reaching halfway along outer plate, bearing 1 long apical seta; outer plate of maxilla 2 much longer than inner plate, latter with 2 apical setae; maxillipedal palp 4-articulate, not exceeding outer plate, article 4 not unguiform, instead short, stout, and bearing 2 apical setae, inner plates obsolescent, scarcely evident, outer plates very large and spinose; gnathopods with article 5 shorter than article 6 and cupshaped, palms transverse; pereopods with long dactyls but not subchelate; coxa 5 with surface area greater but plate not longer than anterior coxae; telson cleft to base.

TYPE-SPECIES.—*Paradexamine* (*Wailele*) *maunaloa.*

RELATIONSHIP.—*Paradexamine* (*Wailele*) *maunaloa* has been compared with 7 species of *Paradexamine* studied in Australian and New Zealandian collections (paper in preparation). The variability in mouthparts is higher than previously elucidated in this genus and suggests that *Dexaminoides* Spandl is a synonym of *Paradexamine.* The Micronesian identification of *Dexaminoides orientalis* Spandl by J. L. Barnard (1965a) apparently represents a distinct, new species of *Paradexamine* and to some extent connects the Hawai-

ian *Paradexamine* to the mainstream of the genus in Australia. *Wailele* is thus described as a subgenus of *Paradexamine* rather than being accorded full generic rank. *Wailele* differs from the type-species of *Paradexamine* and from most of the known species of that genus in the strong reduction of the palp on maxilla 1 and in the complete obsolescence of the inner plates of the maxilliped. The Micronesian *Paradexamine* (=*Dexaminoides*) lessens the categorical importance of the differences in *Wailele* because of the partial reduction of the inner plate of the maxilliped. A new species of *Paradexamine* from New Zealand (in press) also has a reduced inner plate of the maxilliped.

Wailele maunaloa, new species

FIGURES 55, 56

DIAGNOSIS.—With the characters of the genus.

DESCRIPTION.—Lateral cephalic lobe rounded, eye black-brown in formaldehyde and alcohol; article 1 of antenna 1 with anteroventral setose hump; distal spines on pereopods 1–5 blunt; article 2 of pereopod 3 with posteroventral lobe, absent on pereopods 4–5; article 2 of pereopod 5 broader than on pereopods 3–4, but pereopod 5 otherwise shorter than 4; pleonal epimera 1–2 with slight lateral ridges, posteroventral corners of all epimera sharply produced, least on epimeron 1, posterior edges raggedly and minutely serrate, most evenly on the epimeron 3; pleonites 1–4 with small sharp dorsal tooth, pleonites 3–4 with dorsolateral tooth also; rami of uropod 1 equal in length to each other, outer ramus of uropod 2 shorter than inner.

HOLOTYPE.—Bishop Museum collections, catalog number 7268, female, 1.7 mm.

TYPE-LOCALITY.—JLB Hawaii 15, 1 mi N of Kualoa Point, Oahu, intertidal, block of ascidians, 23 May 1967.

MATERIAL.— Five specimens from the type-locality.

DISTRIBUTION.—Hawaiian Islands.

Family EOPHLIANTIDAE

Biancolina mauihina, new species

FIGURES 57, 58

DIAGNOSIS.—Eyes composed of about 14–18 ommatidia, red in formaldehyde, yellow or clear in alcohol; antenna 1 about as long as head and pereon together, flagellum with about 10 articles, antenna 2 short, flagellum and peduncle not readily distinct from one another, flagellum with about 3 articles; maxillipedal palp article 4 very short, hemispherical, bearing a large terminal spine, mediodistal end of article 2 obtusely conical, outer plate with 3 very stout apical spines, inner plate with 2 elongate spine-setae; pereopods 3–5 prehensile, article 6 strongly widened, bearing sinuous palm armed and lined with 1 curved striate spine, palm defined by minute spine and setule; outer rami of uropods 1–2 about 60 percent as long as inner rami, peduncles strongly setose; rami of uropod 3 relatively stout; telson short and apically notched.

HOLOTYPE.—Bishop Museum collections, catalog number 7269, ?sex, 1.8 mm.

TYPE-LOCALITY.—JLB Hawaii 17, Kawela Bay, Oahu, intertidal, *Sargassum*, other algae, rocks, corals, 24 May 1967.

SPECIMEN NO. 2.—In general agreement with the holotype but uropods 1–2 very distinct: uropod 1 with outer ramus grotesquely gnarled (perhaps from preservative) ventrally bearing a flat hyaline lobe adjacent to a long shovel-spine and apparently its distal half formed of a flat but sharp spine, thus outer ramus exceeding inner ramus; outer ramus of uropod 2 with long, hooked distal spine reaching almost to apex of inner ramus, latter with medium-sized spine and small spine. Fee 1 (1 individual, 1.6 mm long).

REMARKS.—The two specimens may belong to different species or may be the opposite sexes of a single species; I have not been able to determine sex in either specimen; neither specimen has brood lamellae; penial processes are not evident.

The holotype differs from *B. australis* Nicholls (1939) in the short outer rami of uropods 1–2, the stouter and shorter article 4 of the maxillipedal palp, the relatively longer antenna 1 and relatively thinner antenna 2, stouter rami of uropod 3, and the prehensile pereopods 3–5.

In the short outer rami of uropods 1–2 the holotype resembles *B. algicola* Della Valle (1893, from the Mediterranean Sea) but differs in the prehensile pereopods 3–5 and in the distal notch on the telson.

Uropods 1–2 of specimen no. 2 are uniquely distinct. I have searched in vain for more individuals of this genus through thousands of intertidal amphipods.

Gnathopod 1 of *B. mauihina* has one giant midposterior seta and one medial seta on article 2. Gnathopod 2 lacks either seta.

DISTRIBUTION.—Hawaiian Islands.

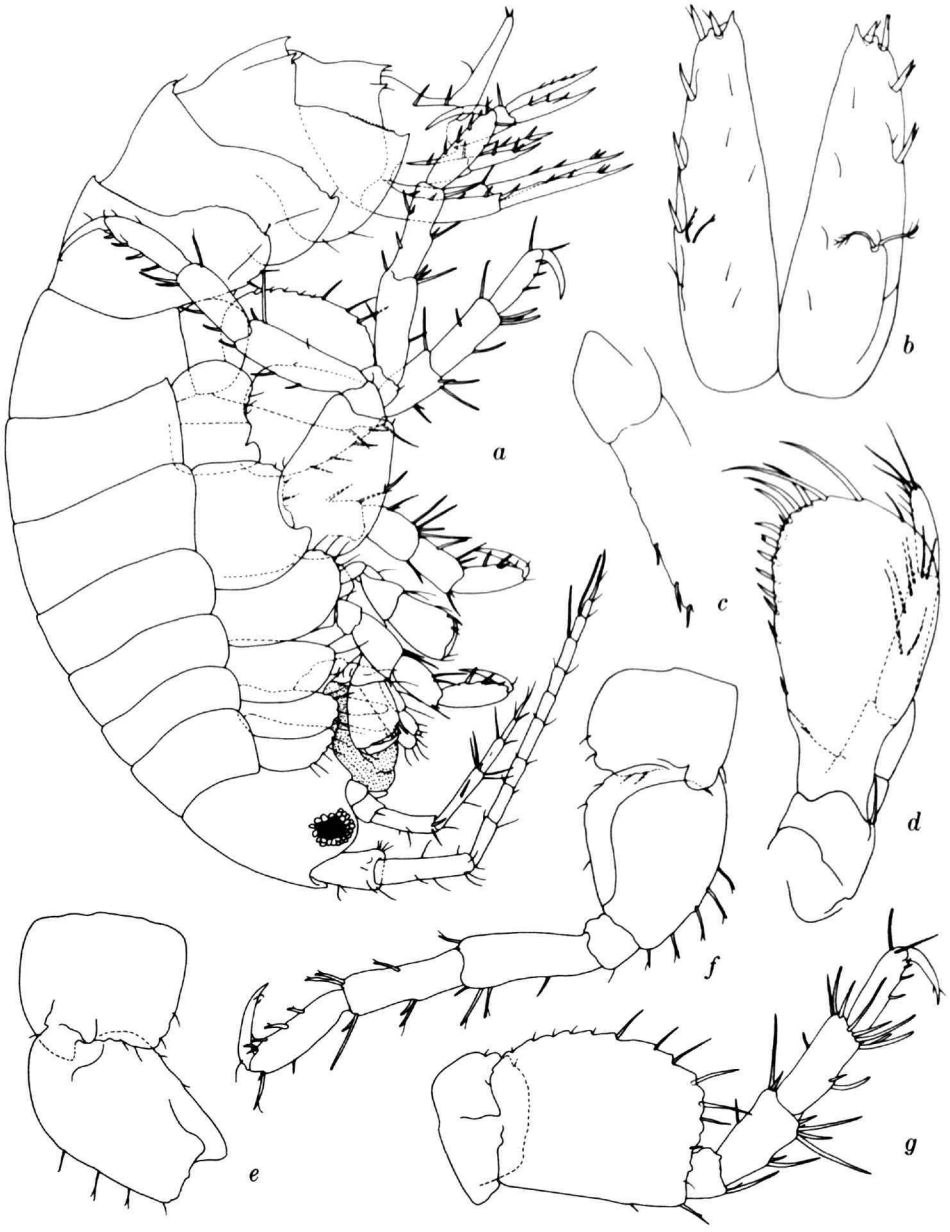

FIGURE 55.—*Paradexamine (Wailele) maunaloa,* new subgenus, new species, holotype, female, 1.7 mm, JLB Hawaii 15: *a,* body; *b,* telson; *c,* inner and outer plates of maxilliped, side opposite to *d; d,* maxilliped; *e, f, g,* pereopods 3, 4, 5.

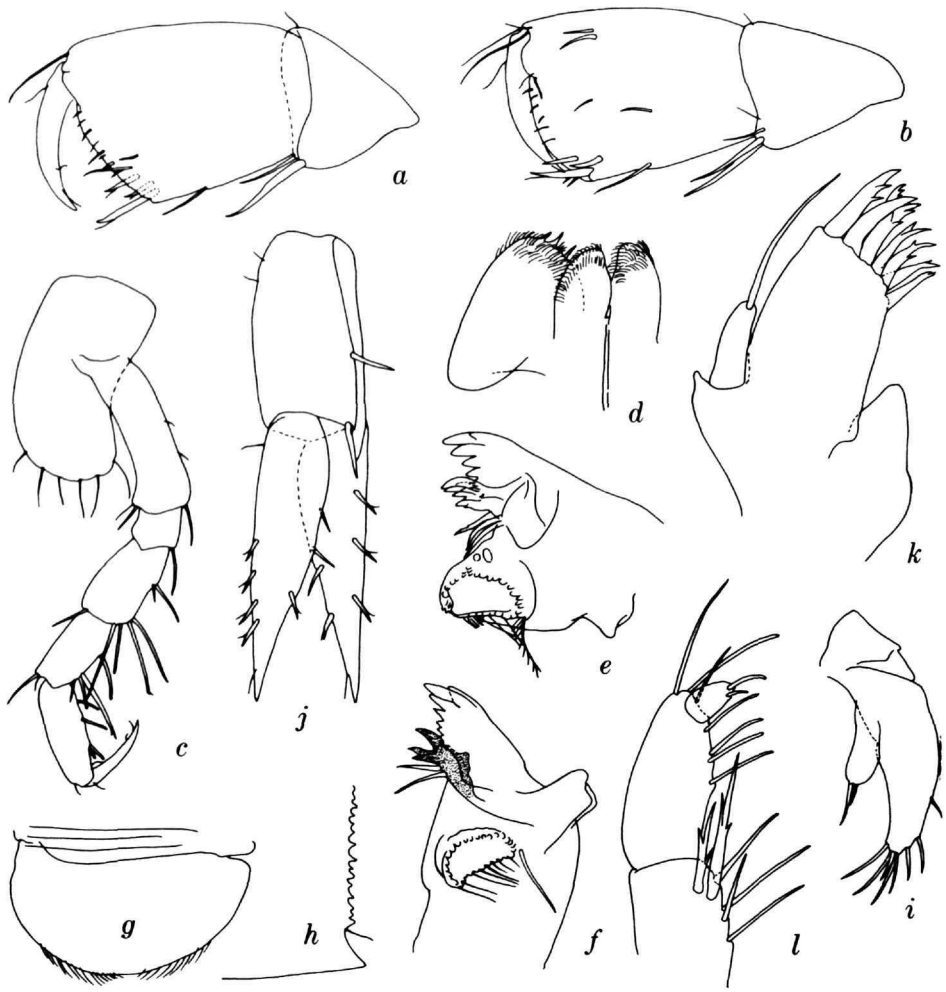

FIGURE 56.—*Paradexamine* (*Wailele*) *maunaloa*, new subgenus, new species, holotype, female, 1.7 mm, JLB Hawaii 15: *a, b,* distal ends of gnathopods 1, 2; *c,* pereopod 2; *d,* lower lip less right outer lobe; *e,* left mandible from obverse side; *f,* right mandible; *g,* upper lip; *h,* pleonal epimeron 3, posterior margin: *i,* maxilla 2. Juvenile, 1.0 mm: *j,* uropod 3. Juvenile, 1.3 mm: *k,* maxilla 1; *l,* maxillipedal palp articles 2, 3, 4.

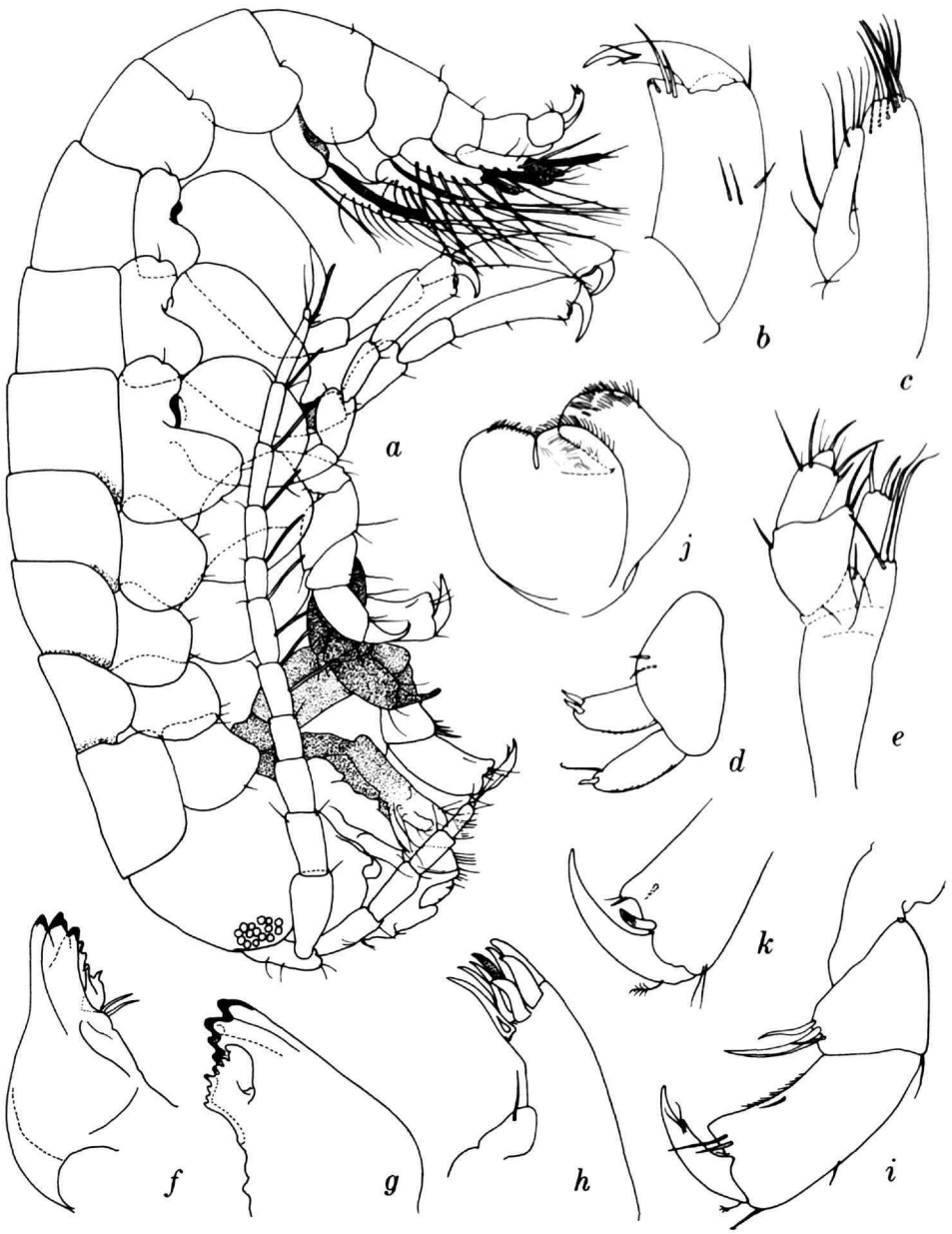

FIGURE 57.—*Biancolina mauhina,* new species, holotype, ?sex, 1.8 mm, JLB Hawaii 17: *a,* body; *b,* apex of gnathopod 1, *c,* maxilla 2; *d,* uropod 3; *e,* maxilliped; *f, g,* right and left mandibles, obverse sides; *h,* maxilla 1; *i,* apex of gnathopod 2. ?Sex, 1.6 mm, Fee 1: *j,* lower lip; *k,* apex of pereopod 5.

FIGURE 58.—*Biancolina mauhina,* new species, ?sex, 1.6 mm, Fee 1: *a,* head, anterodorsal view; *b,* anteroventral view of upper lip in middle embraced by mandibles; *c,* uropod 2; *d,* uropod 1, dorsal; *e,* uropod 1, ventral. Holotype, ?sex, 1.8 mm, JLB Hawaii 17: *f,* urosome, dorsal; *g,* apex of pereopod 5; *h,* maxilliped; *i,* upper lip (on side); *j,* coxa 6; *k,* coxa 1.

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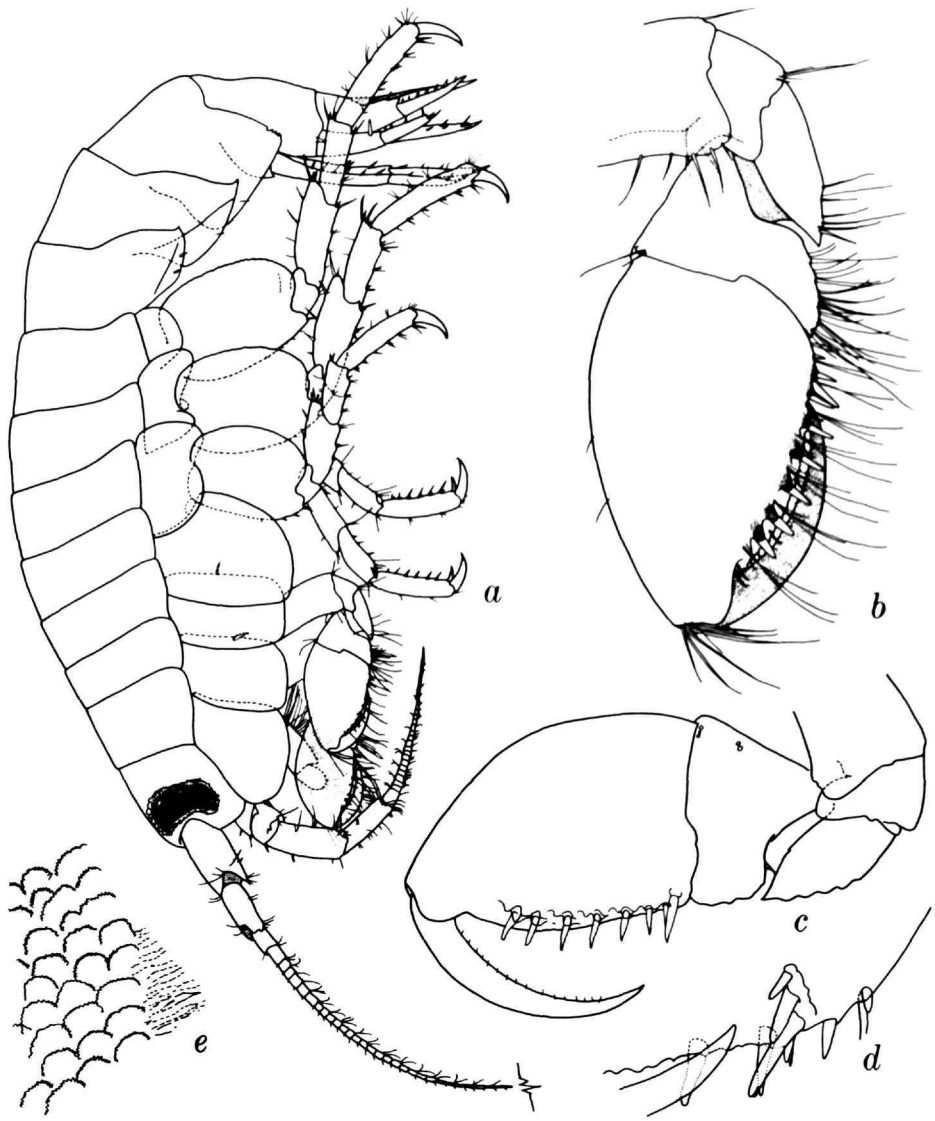

FIGURE 59.—*Eusiroides diplonyx* Walker, female, 6.2 mm, JLB Hawaii 14: *a*, body; *b*, lateral gnathopod 2; *c*, lateral gnathopod 1; *d*, palm of medial gnathopod 2; *e*, sculpture on articles 4–6 of pereopods 3–5.

Family EUSIRIDAE

Eusiroides diplonyx Walker

FIGURES 59, 60, 61

?*Eusiroides Caesaris* Steb., var. Walker, 1904, p. 264, pl. 4, fig. 22.

Eusiroides diplonyx Walker, 1909, pp. 333–334, pl. 43, fig. 4.—Pirlot, 1936, pp. 302–303, figs. 126–128.—Schellenberg, 1938, p. 35.

NOTES ON HAWAIIAN MATERIAL.—Only Pirlot has adequately described his Indonesian material. Walker's (1904) Ceylonese material and Seychellesian (1909) type were accompanied with a few notes and figures sufficient only to recognize this species grossly by the low number of serrations on epimeron 3 and the sabre-shaped, striate locking spine of pereopods 1–2.

The Hawaiian material differs from that of Pirlot in the stronger setation on mandibular palp article 3, the inner plate of maxilla 2, and the apex of the outer plate on the maxilliped. Palp article 2 on the maxilliped has a ventrally pointing linear crest produced apically as a subfalcate lobe not definitely shown on Pirlot's drawing. Article 2 of pereopods 3–5 is slightly

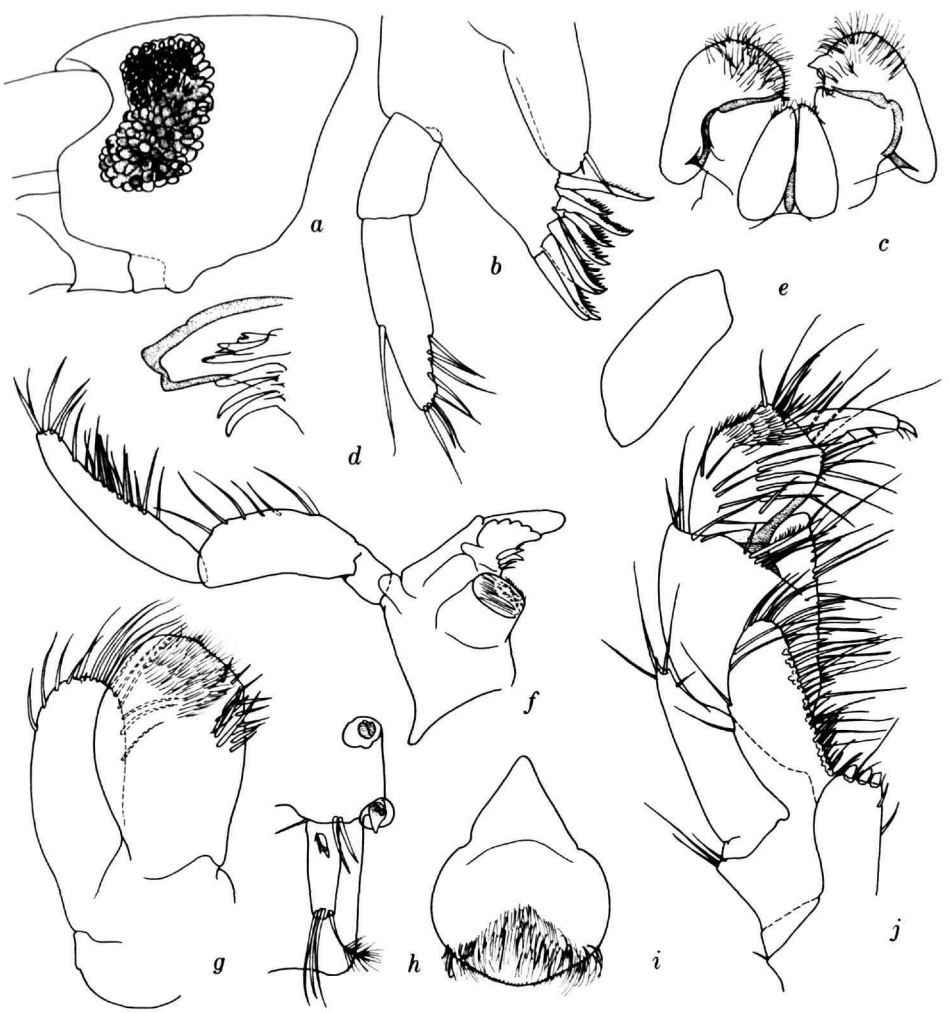

FIGURE 60.—*Eusiroides diplonyx* Walker, female, 6.1 mm, JLB Hawaii 14: *a*, head; *b*, maxilla 1. Female, 6.2 mm: *c*, lower lip; *d*, right mandibular incisor; *e*, article 2 of mandibular palp, flattened; *f*, mandible; *g*, maxilla 2; *h*, accessory flagellum and calceoli; *i*, upper lip; *j*, maxilliped.

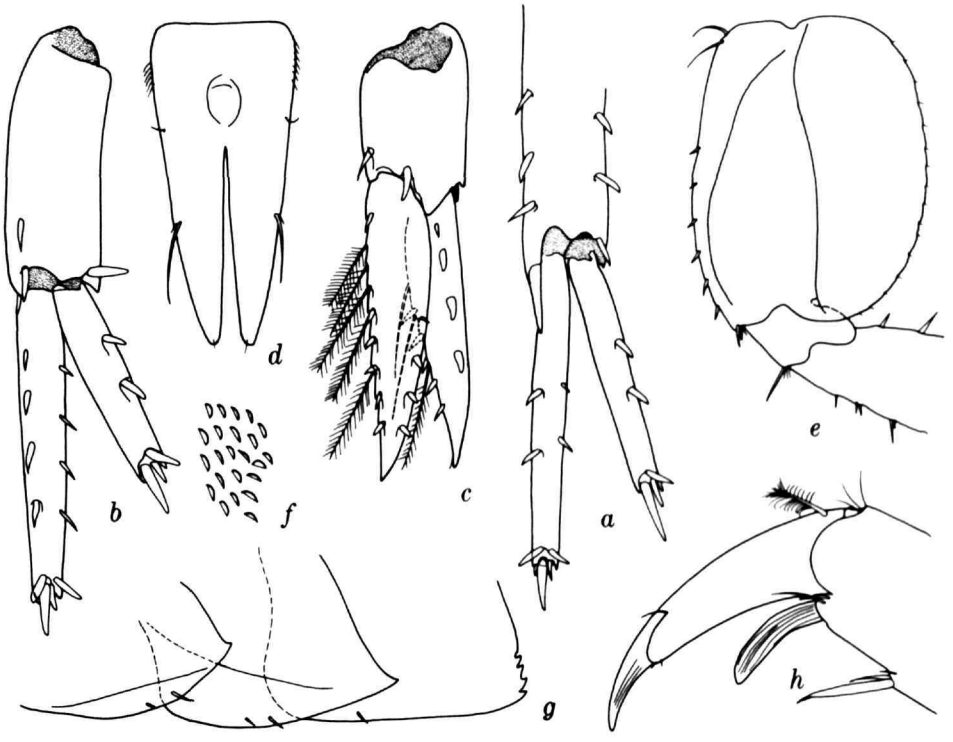

FIGURE 61.—*Eusiroides diplonyx* Walker, female, 6.2 mm, JLB Hawaii 14: *a, b, c,* uropods 1, 2, 3; *d,* telson; *e,* lateral pereopod 5; *f,* sculpture on medial side of article 4 on gnathopod 1; *g,* pleonal epimera 1–3; *h,* apex of pereopod 1.

more slender but slightly more lobate posteroventrally than in Pirlot's material.

MATERIAL.—JLB Hawaii 5 (2), 6 (2), 13 (2), 14 (6).

Notes on *Ronco* J. L. Barnard (1965a): This genus was erected for a Micronesian species resembling *Eusiroides* but having cleft upper lip and a few thin palmar spines on the gnathopods. *Ronco sosa* appears to be a derivative of *Eusiroides diplonyx* with poorly developed gnathopods, incised upper lip, and smooth epimeron 3. The stout locking spine of pereopods 1–2 is a strong clue to this relationship, plus the condition of the telson. The inner plate of maxilla 2 on *Ronco* has lost all but a few of the numerous setae occurring on *E. diplonyx*. I consider the changes that have occurred in *Ronco sosa* to be of the magnitude as those found in *Atylus* (*Kamehatylus*) *nani* and suggest the reduction of *Ronco* to subgeneric status under *Eusiroides*.

DISTRIBUTION.—Indo-Pacific.

Pontogeneia pacifica Schellenberg

FIGURES 62, 63, 64

Pontogeneia pacifica Schellenberg, 1938, pp. 35–37, fig. 17.—J. L. Barnard, 1955a, p. 5.

This species seems to form part of a triad with the Caribbean *P. longleyi* Shoemaker (1933a) and the Californian *P. "minuta"* of J. L. Barnard (1959), with characters of each of those species appearing in *P. pacifica*. The rostrum and article 2 of pereopod 5 of *P. longleyi* and the long coxae of *P. "minuta"* are combined in *P. pacifica*. The posterior lobe on article 5 of gnathopod 2 in *P. pacifica* is intermediate in size between the weak lobe of *P. longleyi* and the strong lobe of *P. "minuta."* Mandibular palp article 3 of *P. pacifica* is much better developed than in the other species.

Uropod 3 is similar in both sexes but the antennae differ considerably. Male antenna 1 is as long as the head and first 7.5 body segments, that of the female

only as long as the head and first 6 body segments. Male antenna 2 is as long as the head and first 9 body segments, that of the female only as long as the head and first 8 segments. Male antennal peduncles have stairstep notches and both antennae bear calceoli not found in females.

Eyes are dark purple in formaldehyde but become pale purple broad cores surrounded by a layer or two of clear ommatidia in alcohol.

MATERIAL.—JLB Hawaii 14 (2), 15 (17), 17 (2). Fee 1 (32).

DISTRIBUTION.—Hawaiian Islands.

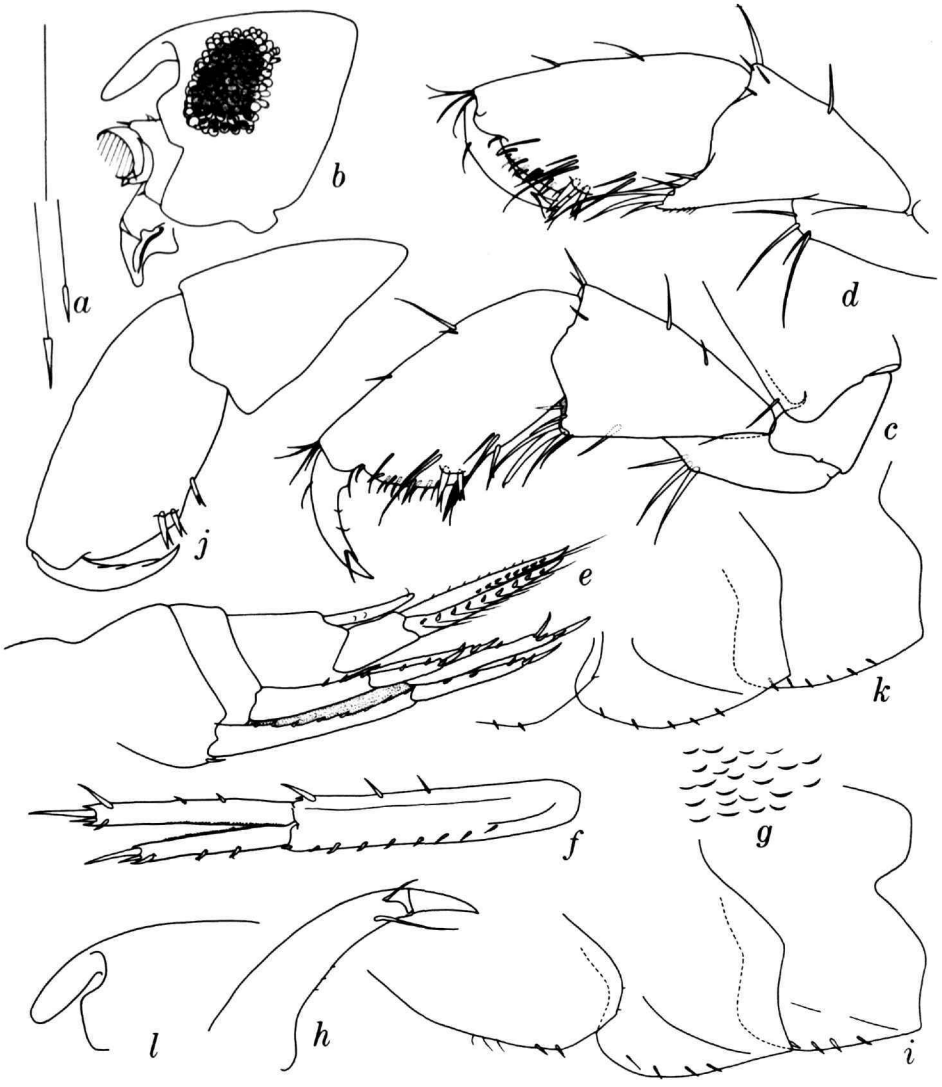

FIGURE 62.—*Pontogeneia pacifica* Schellenberg, female, 5.0 mm, Fee 1: *a*, proportions of uropod 2; *b*, head; *c*, *d*, apices of lateral gnathopods 1, 2; *e*, urosome; *f*, uropod 1; *g*, microscopic skin texture; *h*, dactyl of pereopod 5; *i*, pleonal epimera 1–3. Male, 4.7 mm: *j*, apex of gnathopod 1, setae removed; *k*, pleonal epimera 1–3; *l*, outline of head.

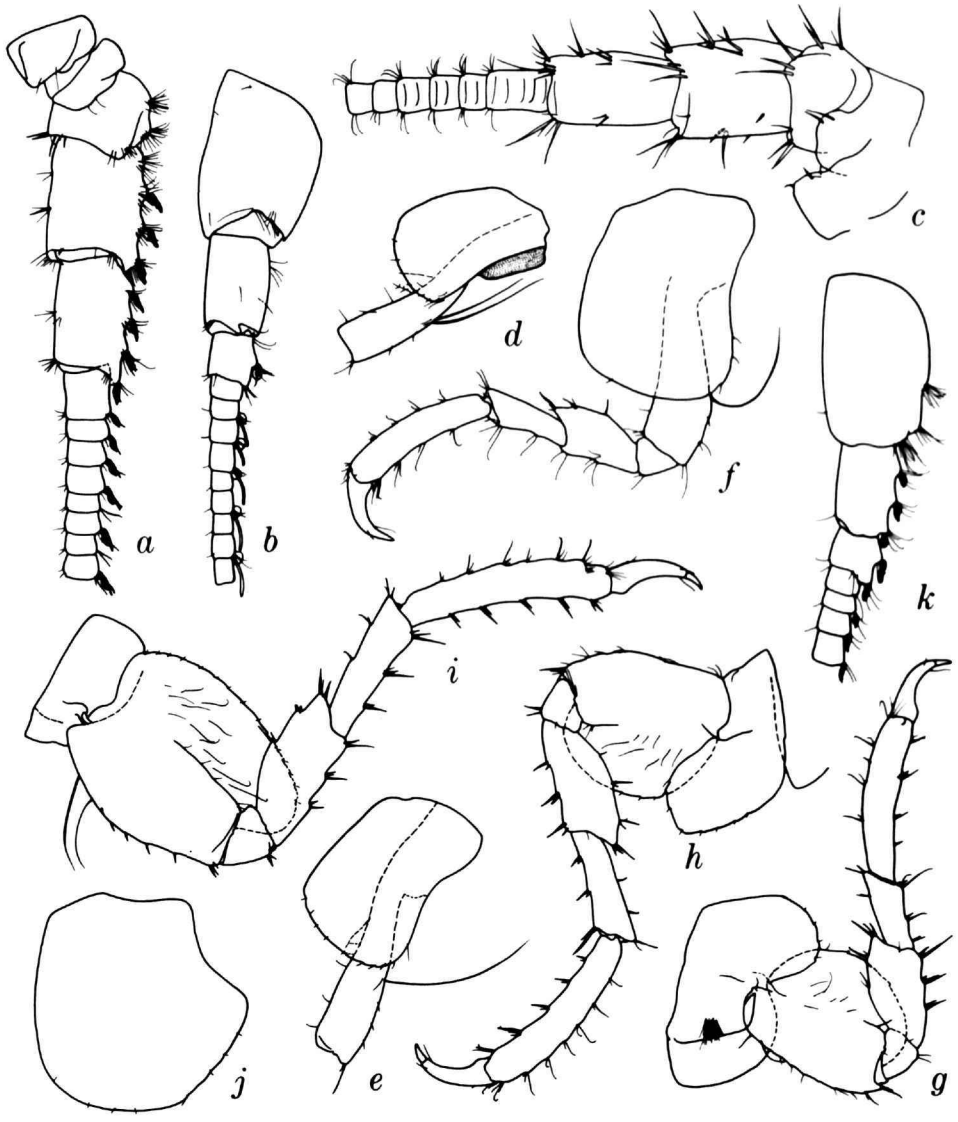

FIGURE 63.—*Pontogeneia pacifica* Schellenberg, male, 4.7 mm, Fee 1: *a*, base of antenna 2, lateral; *b*, base of antenna 1, lateral. Female, 5.0 mm: *c*, base of antenna 2, medial; *d*, *e*, coxa and article 2 of gnathopods 1, 2; *f*, *g*, *h*, *i*, pereopods 1, 3, 4, 5; *j*, coxa 4. Male, 4.1 mm: *k*, base of antenna 1, medial.

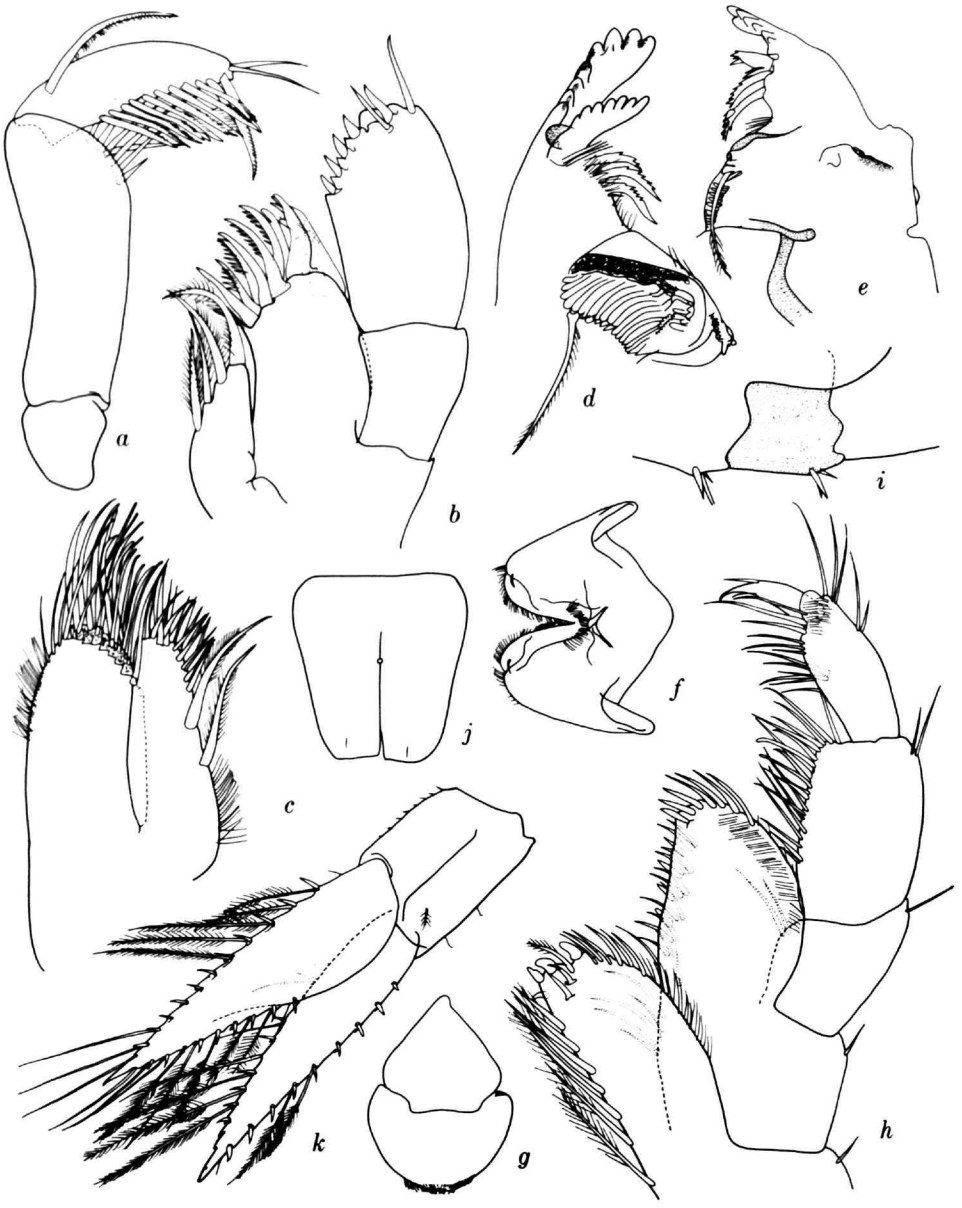

FIGURE 64.—*Pontogeneia pacifica* Schellenberg, male, 4.7 mm, Fee 1: *a*, mandibular palp; *b*, *c*, maxillae 1, 2; *d*, *e*, mandibles; *f*, lower lip; *g*, upper lip; *h*, maxilliped. Female, 5.0 mm: *i*, article 2 of pereopod 5, shaded; *j*, telson; *k*, uropod 3.

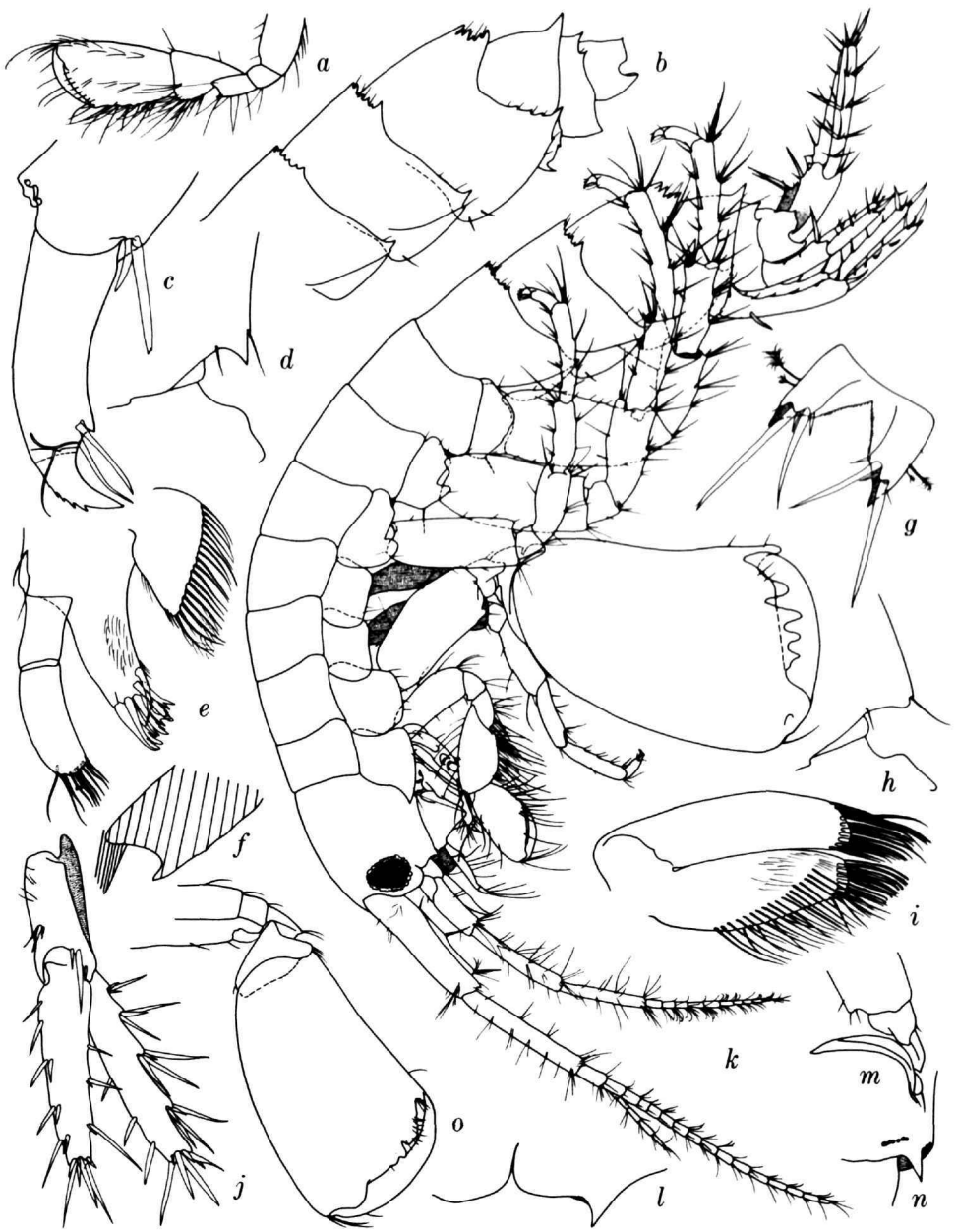

FIGURE 65.—*Ceradocus hawaiensis* J. L. Barnard, male, 5.0 mm, JLB Hawaii 6: *a*, small kind of gnathopod 2; *b*, pleon; *c*, dactyl of pereopod 4; *d*, posteroventral corner on article 2 of pereopod 5; *e*, maxilla 1; *f*, article 4 of gnathopod 2; *g*, telson; *h*, posteroventral corner on article 2 of pereopod 3; *i*, maxilla 2; *j*, uropod 3; *k*, body; *l*, anteroventral corner of head; *m*, articles 2, 3, 4, 5, of medial gnathopod 2; *n*, article 3 of antenna 2 peduncle. Juvenile 3.3 mm: *o*, lateral gnathopod 2.

Family GAMMARIDAE

Ceradocus hawaiensis J. L. Barnard

FIGURE 65

Ceradocus hawaiensis J. L. Barnard, 1955a, pp. 5–8, figs. 2, 3.

MATERIAL.—JLB Hawaii 6 (9).

REMARKS.—Excellent material of this species permits figuring a whole specimen.

DISTRIBUTION.—Hawaiian Islands.

Elasmopus calliactis Edmondson

FIGURE 66

Elasmopus calliactis Edmondson, 1951, pp. 189–191, fig. 3.—J. L. Barnard, 1955a, p. 8.

Elasmopus rapax.—J. L. Barnard, 1955a, p. 11, specimens from Honolulu Aquarium only, not Costa.

DIAGNOSIS OF TERMINAL MALE.—Accessory flagellum 3–4 articulate; eyes large and clear in alcohol, ommatidia all distinct, eyes red in life, lacking black pigment; mandibular palp article 3 long and weakly falcate; articles 5–6 of gnathopod 1 equal to each other in length; article 2 of gnathopod 2 not distally lobate, anterodistal corner setose and slightly protuberant, article 3 with normal lobe, article 6 elongate, palm oblique and equal to posterior margin of article 6, palm defined by large tooth and bearing middle tooth and spinose adze-shaped process near dactylar hinge, margin between defining and middle process flat, rounded between middle and distal process, posterodistal end of article 6 on pereopods 1–2 with 1 irregularly shaped chisel spine, slightly pointed or bifid apically, other locking spine slightly curved, dactyl with subapical constriction bearing 1 seta and 2 setules; locking spines of pereopods 3–5 normal; pereopods 3–5 bearing long setae on articles 2–6, posterior margin of article 2 of regular dimensions and weakly serrate; pleonal epimera 1–2 with lateral ridge, posteroventral corners sharply produced, posterior margins sparsely serrate, epimeron 3 quadrate, slightly serrate posteriorly, ventral margins of epimera with pairs of spines; urosomal segments simple; rami of uropods 1–2 with terminal spines of medium length; inner ramus of uropod 3 extending nearly as far as outer ramus, broadly truncate and spinose, outer ramus also broadly truncate, spinose and bearing small article 2 concealed from dorsal view; telson long, each apex broadly and deeply excavate, but excavation hidden by subterminal row of 5–6 spines.

FEMALE.—Gnathopod 1 slightly stouter than in male, gnathopod 2 a miniature edition of male gnathopod 2.

JUVENILE MALE AND JUVENILE.—Palmar humps on gnathopod 2 very weak, telson similar to adult but less spinose (4 spines per lobe), inner ramus of uropod 3 slightly shortened; epimera similar to adult.

MATERIAL.—The type material: on *Calliactis*, 20 April 1949. Honolulu Harbor, with *Calliactis* on *Dolium*, 4 October 1948 (3). Honolulu Aquarium, on hermit crab, 26 October 1949 (25). Ewa, off Oahu, 9 August 1950, *Dolium-Calliactis* with *Dardanus asper* association, 75–100 feet, collection, Tinker (10+). Honolulu Aquarium, from cement overflow gutter exit of fish tanks, 28 February 1950 (16, this sample misidentified as *E. rapax* by J. L. Barnard, 1955a).

REMARKS.—My comments (1955a) on the alternate variety of *E. rapax* are erroneous; that material belongs with *E. calliactis* and is readily identified by the clear eyes, absence of the fourth tooth on the palm of gnathopod 2, and the shape of the telson. The black eyes of *E. rapax* do not bleach clear in alcohol. The distal process on the palm of gnathopod 2 in *E. calliactis* is strongly spinose in terminal adults and thus my (1965a) key is in error. Besides relationships with *E. holgurus* J. L. Barnard (1962b), *E. rapax* and *E. piikoi*, *Elasmopus calliactis* has a resemblance to *E. pseudaffinis* Schellenberg (1938) (J. L. Barnard, 1965a) from Micronesia. That species has black eyes, very weak armament on the palm of gnathopod 2, a female with normal gnathopod 2, and a telson like adult *E. rapax*, with apically extended medial lobes bearing small terminolateral spines.

DISTRIBUTION.—Oahu, apparently found exclusively with a hermit-crab, sea-anemone association.

Elasmopus ?diplonyx Schellenberg

FIGURES 67, 68

? *Elasmopus diplonyx* Schellenberg, 1938, p. 54, fig. 26.

DIAGNOSIS OF MALE.—Accessory flagellum 3-articulate; eyes of medium size, brown in formaldehyde, turning purplish-brown in spirit, ommatidia distinct though middle ones partially covered by pigment or darkened; mandibular palp article 3 short and deeply falcate; articles 5 and 6 of gnathopod 1 subequal in length; article 2 of gnathopod 2 not lobate, article 3 weakly lobate, article 6 elongate, palm oblique, strongly setose, bearing small, spinose distal protuberance, palm

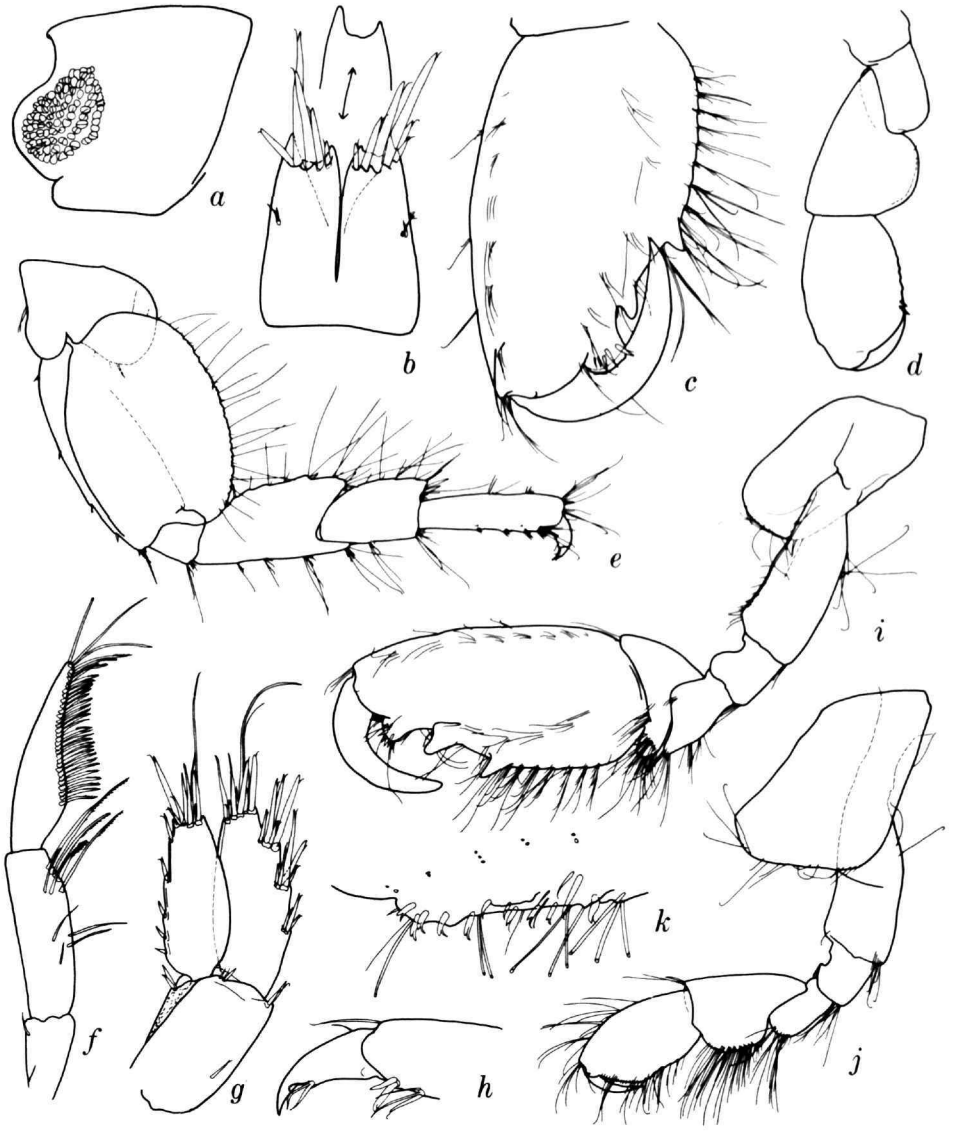

FIGURE 66.—*Elasmopus calliactis* Edmondson, female, 7.4 mm, Oahu, 20 April 1949: *a*, head; *b*, telson; *c*, apex of medial gnathopod 2; *d*, gnathopod 1, minus setae; *e*, pereopod 4; *f*, mandibular palp; *g*, uropod 3; *h*, apex of pereopod 1. Male, 8.8 mm: *i*, medial gnathopod 2; *j*, gnathopod 1. Juvenile, 5.2 mm: *k*, palm of medial gnathopod 2.

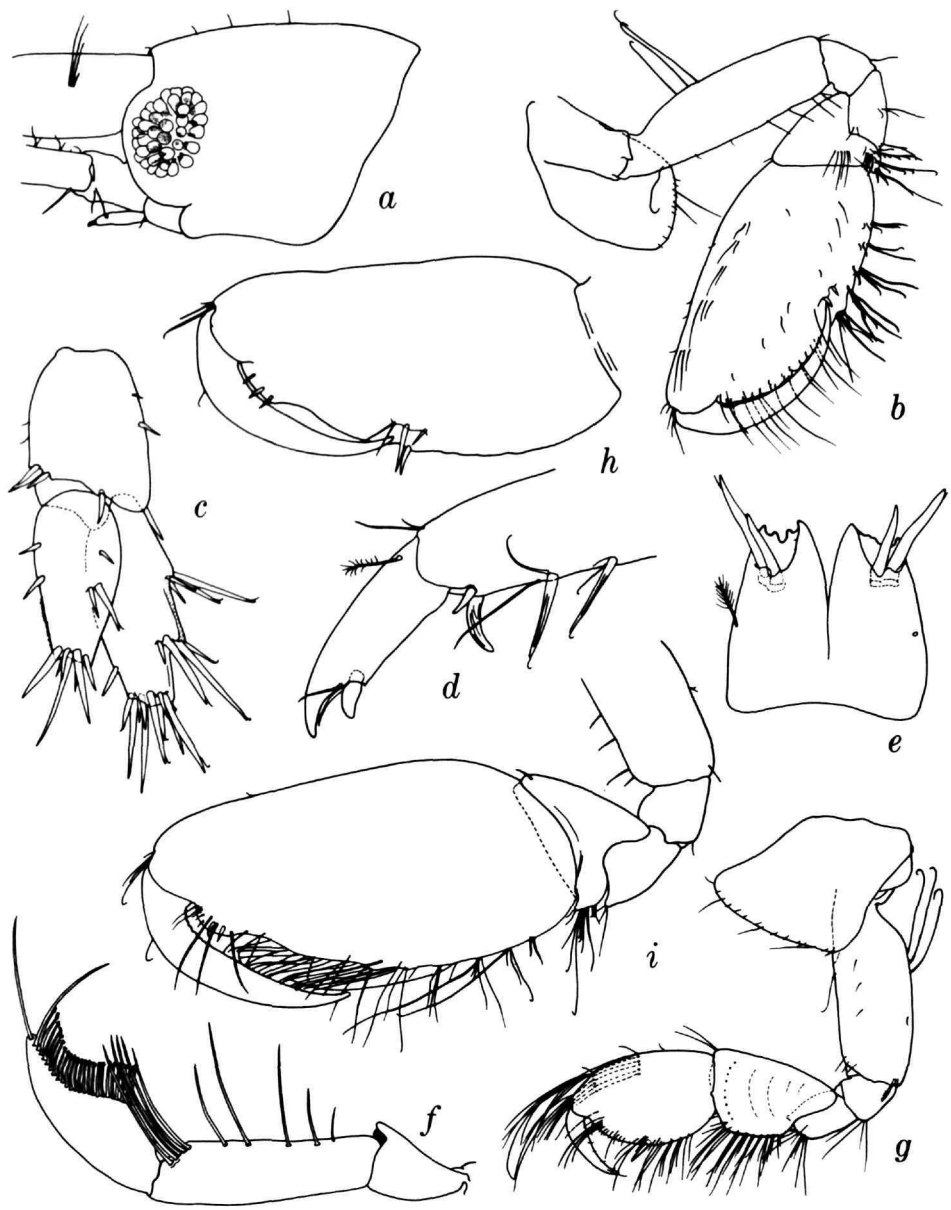

FIGURE 67.—*Elasmopus diplonyx* Schellenberg, female, 4.6 mm, Devaney 1: *a*, head; *b*, medial gnathopod 2; *c*, uropod 3; *d*, apex of pereopod 2; *e*, telson; *f*, mandibular palp; *g*, gnathopod 1. Male, 3.3 mm: *h*, medial gnathopod 2; *i*, lateral gnathopod 2.

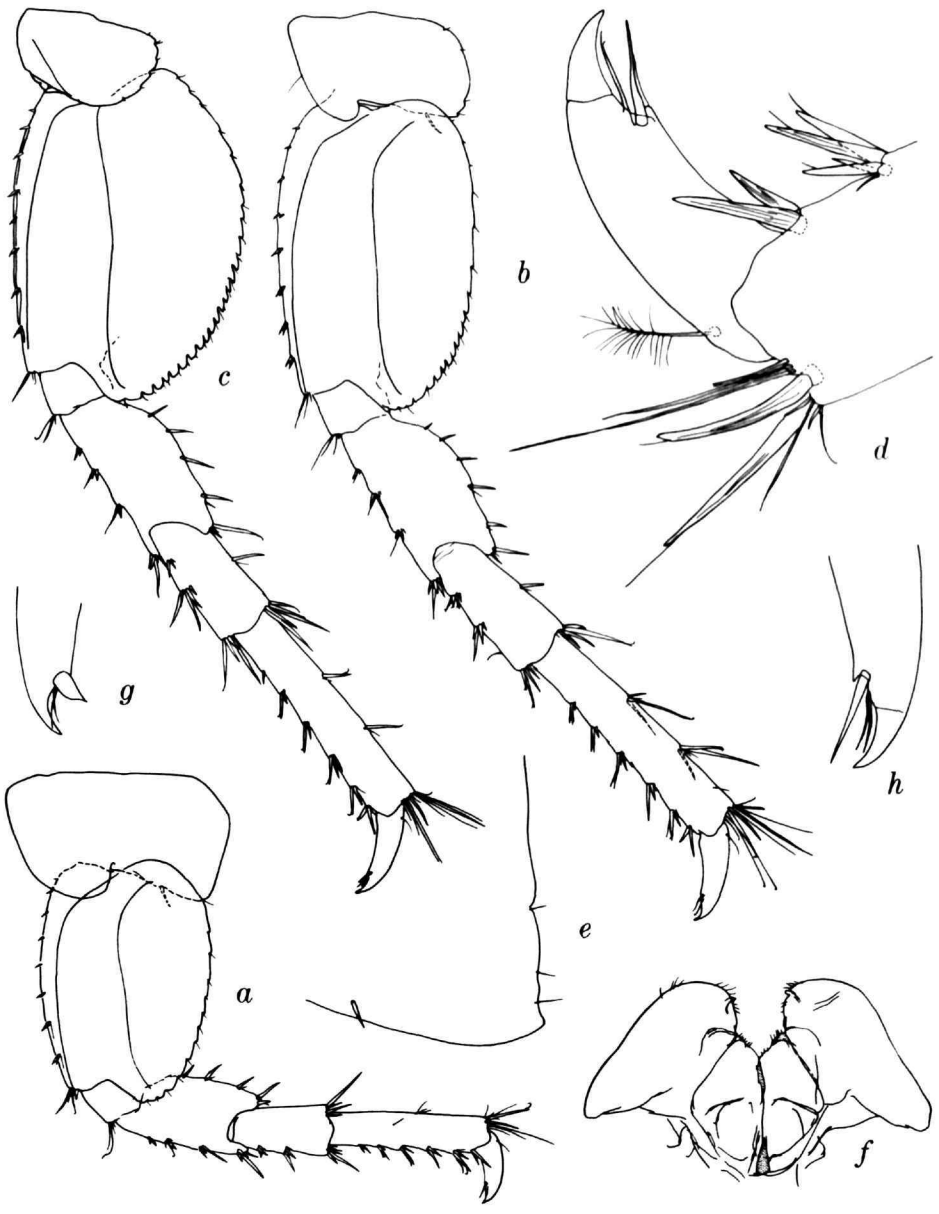

FIGURE 68.—*Elasmopus diplonyx* Schellenberg, female, 4.6 mm, Devaney 1: *a, b, c,* pereopods 3, 4, 5; *d,* apex of pereopod 3; *e,* pleonal epimeron 3; *f,* lower lip. Juvenile male: *g, h,* apices of pereopods 2, 4.

scarcely defined by acclivity and spines, inner face of article 6 with locking ridge for end of dactyl, ridge with 2 spines and 2 setae, dactyl slender and slightly overriding palmar face; posterodistal end of article 6 on pereopods 1–2 with one striate, slightly sabre-shaped spine and 1 small, normal spine, dactyl constricted and bearing a very stout blunt spine and 2 setules; locking spines of pereopods 3–5 straight but striate, main dactylar spines inserted into dactyl but also joined basally to dactyl margin by chitinous membrane; pereopods 3–5 lacking long setae, article 2 of pereopods 3–5 ovate, but posteroventral margin strongly sloping on pereopod 5, pereopod 3 with normal serrations, but pereopods 4–5 deeply castelloserrate almost as strongly as on pereopod 4 of *E. pectenicrus;* pleonal epimera 1–2 with lateral ridge and sharply produced posteroventral corners, posterior margins sparsely serrate, epimeron 3 quadrate but with slight, sharp protrusion posteroventrally and weak posterior serrations, epimera lacking setae, ventral spines occurring singly; rami of uropods 1–2 with long terminal spines; inner ramus of uropod 3 about 80 percent as long as outer ramus, apex truncate and spinose, outer ramus beveled and truncate, spinose and bearing small hidden article 2; telson of medium length, apices excavate and sinuous or raggedly serrate, each subapex with 2 spines.

FEMALE.—Gnathopod 2 like male but palm lacking distal spinose protuberance and not as strongly setose.

JUVENILES.—Posteroventral tooth of pleonal epimera 1–3 slightly more protuberant than in adult, lacking spines; eye small; major spine of dactyl on pereopods 1–2 sharp but stout, major locking spine of article 6 more strongly sabre-shaped than in adult; accessory flagellum 2-articulate, membrane of spine on dactyl of pereopods 3–5 scarcely evident; palm of juvenile male with fewer setae than adult and armed with short stout spine-setae; each lobe of telson with only 1 spine; inner ramus of uropod 3 tapering, with one long apical seta, article 2 of outer ramus relatively large; serrations of pereopods 4–5 fewer and smaller than in adult but relatively deep even on youngest individuals having only 2–3 notches per article 2.

MATERIAL.—Devaney 1 (8).

REMARKS.—Schellenberg did not mention castellations on article 2 of pereopods 4–5; if they do not occur in the Micronesian material than the Hawaiian populations should be described as a new species.

DISTRIBUTION.—Marshall, Gilbert, and Hawaiian Islands.

Elasmopus ecuadorensis hawaiensis Schellenberg

FIGURE 69

Elasmopus ecuadorensis hawaiensis Schellenberg, 1938, pp. 54–55, fig. 27.

DIAGNOSIS OF MALE.—Accessory flagellum 2-articulate; eyes medium in size, as dark as those of *E. pocillimanus;* mandibular palp normally falcate (as figured for *E. piikoi*); article 5 of gnathopod 1 subequal to article 6 in length; articles 2 and 3 of gnathopod 2 lacking lobes, article 5 short, bearing narrow but relatively short, setose posterior lobe, article 6 elongate and strongly tapering, palm and posterior margin of hand confluent, densely setose, distal end of palm bearing strong, obtuse protrusion, medial face of hand with ridge defined proximally by spine near end of dactyl, latter reaching less than halfway along palm; posterodistal end of article 6 on pereopods 1–2 with 1 striate sabre-spine and one unstriate nearly straight smaller spine, dactyl subapically constricted and bearing 1 stout free spine and 2 weak setules, locking spines of pereopods 3–5 normal; pereopods 3–5 lacking long setae, their lengths in same proportion to figures for *E. diplonyx,* article 2 of pereopod 3 similar to that species but article 2 of pereopod 4 with oblique and straight posterior edge and subquadrate posteroventral corner, article 2 of pereopod 5 narrowly lobate posteroventrally, posterior margins weakly serrate; coxa 6 with unusually broad and slightly truncate anterior lobe; pleonal epimera 1–2 with lateral ridge, posteroventral corners sharply but weakly produced, posterior margins sparsely serrate (notched), epimeron 3 with weakly quadrate posteroventral corner bearing small notch and several posterior notches, epimera with single spines and no setae; urosomal segments simple; rami of uropods 1–2 with elongate spines but not unusually so; inner ramus of uropod 3 nearly three-fourths as long as outer, apices of both rami truncate and spinose, outer with very small article 2 hidden among spines; telson very short, as broad as long, apices slightly concave, with medial portions extended as rounded lobes, bearing a long and short spine laterally on each apex.

FEMALE.—Gnathopod 2 like that shown for *E. molokai;* accessory flagellum 3-articulate.

YOUNG MALE.—Gnathopod 2 bearing distinct palm defined by 1 marginal spine and medial ridge bearing spine similar to adult, setae present mainly on posterior margin of hand, palm slightly excavate and bearing several small spines, distal protrusion present.

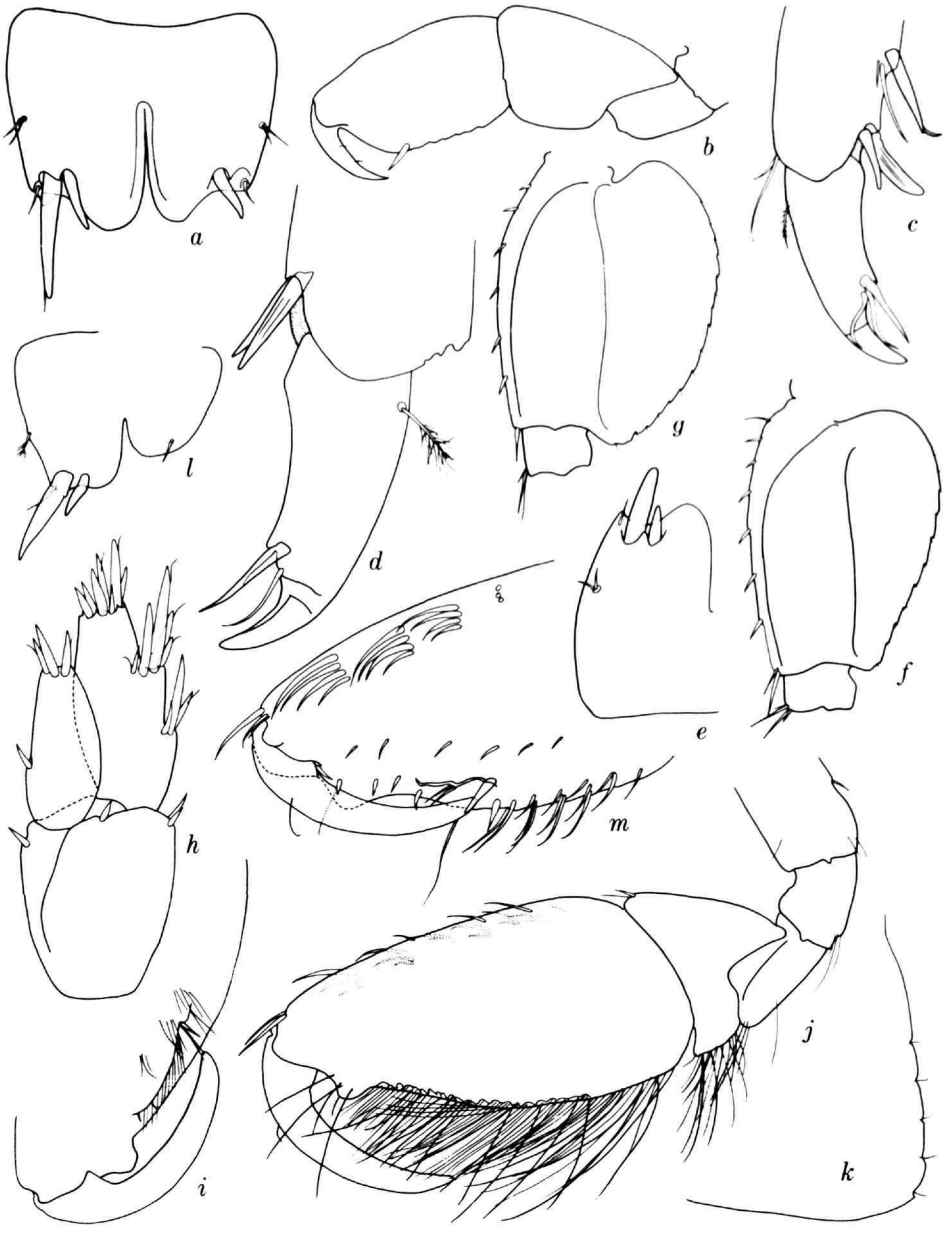

FIGURE 69.—*Elasmopus ecuadorensis hawaiensis* Schellenberg, male, 4.9 mm, Hilo: *a*, telson. Male, 5.0 mm: *b*, lateral gnathopod 1, setae removed; *c*, *d*, dactyls of pereopods 2, 5; *e*, half of telson; *f*, *g*, article 2 of pereopods 4, 5; *h*, uropod 3; *i*, palm of medial gnathopod 2; *j*, lateral gnathopod 2; *k*, pleonal epimeron 3. Female, 3.7 mm: *l*, aberrant telson. Male, 3.6 mm, Molokai: *m*, hand of medial gnathopod 2.

MATERIAL.—Hilo, Hawaii, 20 June 1959, Clunio Polster, collector H. Caspers (10). Molokai, Hawaii, 1959, algae, collector H. Caspers (1).

REMARKS.—This species has the same formula of locking spines on pereopods 1–2 as does *E. hooheno,* one sabre-shaped and one nonsabre-shaped but the nonsabre-shaped spine of *E. hooheno* is of the corkscrew kind; the main locking spine of pereopods 3–5 in *E. hooheno* is a sabre while that of *E. e. hawaiensis* is not.

Male gnathopod 2 resembles that of *E. pectenicrus,* but the locking spines on pereopods 1–5 of the latter are all straight; male pereopod 4 of *E. e. hawaiensis* has a normal article 2.

DISTRIBUTION.—Hawaiian Islands.

Elasmopus hooheno, new species

FIGURE 70

DIAGNOSIS OF MALE.—Accessory flagellum 2-articulate; eyes medium in size, not as dark as in *E. pocillimanus,* with occasional central ommatidium visible, pigment in alcohol brownish-purple; mandibular palp normally falcate (as drawn for *E. piikoi*); article 5 of gnathopod 1 about 80 percent as long as article 6; anterodistal end of article 2 on gnathopod 2 with slightly beveled corner bearing large spine(s), article 3 weakly lobate, article 5 short, bearing narrow but relatively short, setose posterior lobe, article 6 elongate and slightly tapering, palm oblique and about equal in length to posterior margin of article 6, defined by medium-sized conical cusp, distal end bearing spinose, slightly scalloped protrusion, middle of palm with truncate cusp, dactyl slender, normal, fitting palm; posterodistal end of article 6 on pereopods 1–2 with 1 large striate sabre-spine and 1 straight horizontally striate ("corkscrew") spine, dactyl subapically constricted, minutely striate, bearing stout seta and 2 setules; locking spines of pereopods 3–5 consisting of 1 slight sabre and 1 straight axially striate spine, dactylar seta with weak flange; pereopods 3–5 bearing a few long setae on articles 2, 4, 5, posterior margin of article 2 of regular dimensions and weakly serrate; coxa 6 with unusually broad and slightly truncate anterior lobe; pleonal epimera 1–2 with lateral ridge, posteroventral corners sharply produced, posterior margins sparsely serrate, epimeron 3 with small cusp at posteroventral corner similar in size to a few posterior serrations, posterior margin nearly straight and posteroventral corner grossly quadrate, epimera bearing ventral spines or pairs of spines, no setae; rami of uropods 1–2 with elongate terminal spines but not unusually so; inner ramus of uropod 3 about two-thirds as long as outer, apex of inner ramus truncate and spinose, apex of outer spinose and bearing minute article 2; telson short, squamiform, lobes weakly excavate apically, each bearing 1 long, 1 short spine.

FEMALE.—Gnathopod 2 like that of *E. molokai,* but article 6 slightly stouter and palm with several small stout spines, occasionally posteroventral corner of epimeron 3 with notch obsolescent.

HOLOTYPE.—Bishop Museum collections, catalog number 7270, male 4.3 mm.

TYPE-LOCALITY.—JLB Hawaii 17, Kawela Bay, Oahu, intertidal, *Sargassum,* other algae, rocks, coral, 24 May 1967.

MATERIAL.—Five specimens from the type-locality.

RELATIONSHIP.—This species has approximately the same locking spine formula on pereopods 1–2 and telson as does *E. spinidactylus* Chevreux, but the dactyls lack castellae and the second articles of pereopods 3–5 are of the regularly ovate, unnotched kind. Male gnathopod 2 is very different from that of *E. spinidactylus.*

Perhaps this species has its closest relationship to *E. molokai* because of the total number of similarities (pereopods, telson, e.g.), but the main locking spine on pereopods 1–2 of *E. molokai* is not a sabre, the eyes are more weakly pigmented, the palm of male gnathopod 2 has no middle tooth, and article 2 lacks large spines.

Terminal males of *E. hooheno* probably have not been described and may, by indicative relationships, have more strongly serrate and setose pleonal epimera than seen in the present subterminal males.

DISTRIBUTION.—Hawaiian Islands.

Elasmopus molokai, new species

FIGURES 71, 72

DIAGNOSIS OF MALE.—Eyes dark but ommatidia distinct throughout, large and few in number, pigment weak and purple to light brown in alcohol; mandibular palp article 3 normally falcate; article 5 of gnathopod 1 about 80 percent as long as article 6; article 2 of gnathopod 2 with large distolateral lobe, article 3 broadly lobate, article 5 short, bearing narrow, poorly setose posterior lobe, article 6 elongate, subrec-

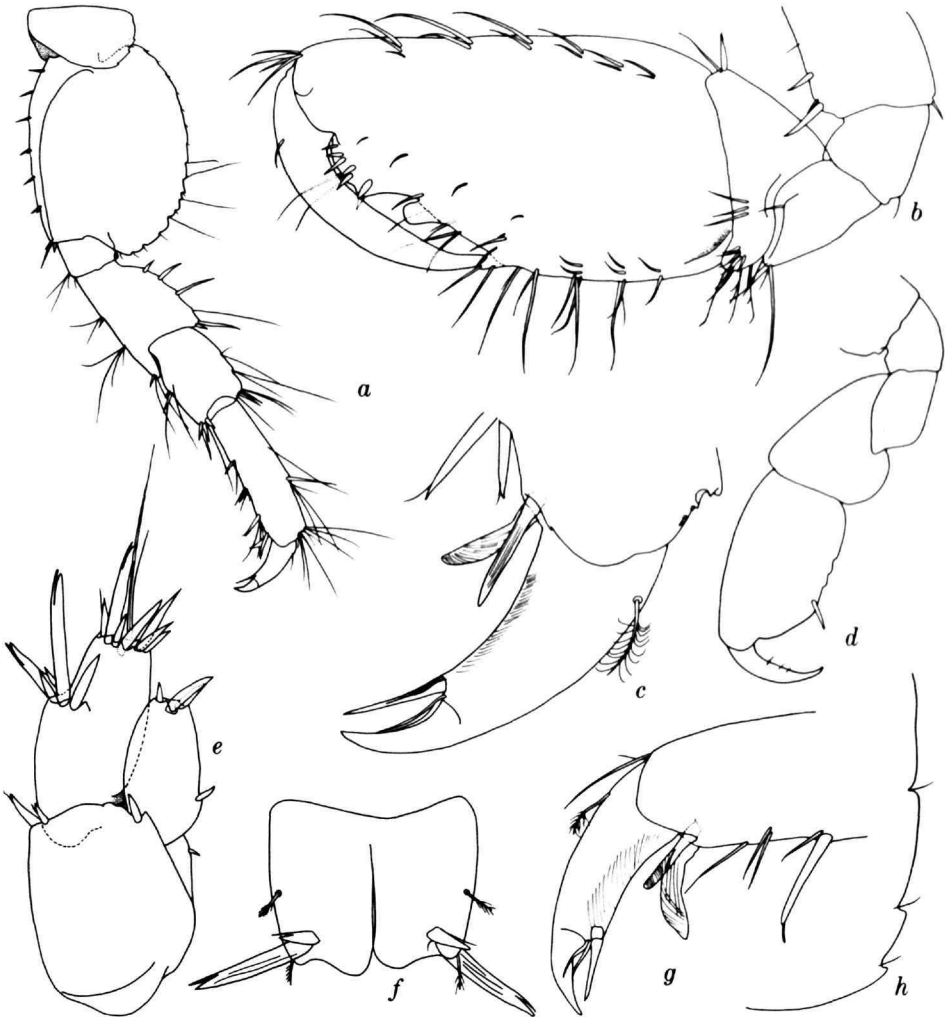

FIGURE 70.—*Elasmopus hooheno*, new species, holotype, male, 4.3 mm, JLB Hawaii 17: *a*, pereopod 5; *b*, medial gnathopod 2; *c*, dactyl of pereopod 5; *d*, medial gnathopod 1, setae removed; *e*, uropod 3; *f*, telson; *g*, dactyl of pereopod 1; *h*, pleonal epimeron 3.

tangular but slightly tapering distally, palm oblique, equal in length to posterior margin of article 6, defined by large cusp and bearing sharp, subfalcate protrusion near dactylar hinge armed with 1–2 spines, margin between processes flat and excavate, dactyl slender, curved, fitting palm; posterodistal end of article 6 on pereopods 1–2 with 1 irregularly shaped chisel spine, slightly bifid apically or with small point, other locking spine small, slightly sabre-shaped, dactyl subapically constricted and bearing one stout free spine and 1–2 weak setules; locking spines of pereopods 3–5 normal; pereopods 3–5 bearing a few long setae on articles 3–5 and on article 2 of pereopods 4–5, posterior margin of article 2 of regular dimensions and weakly serrate; pleonal epimera 1–2 with lateral ridge, posteroventral corners sharply produced, posterior margins sparsely serrate, epimeron 3 with strong ventroposterior serrations, ventral margins of epimera bearing pairs composed of a spine and long seta; urosomal segments simple; rami of uropods 1–2 with unusually elongate terminal spines; inner ramus of uropod 3 about as broad and three-fourths as long as outer ramus, apex

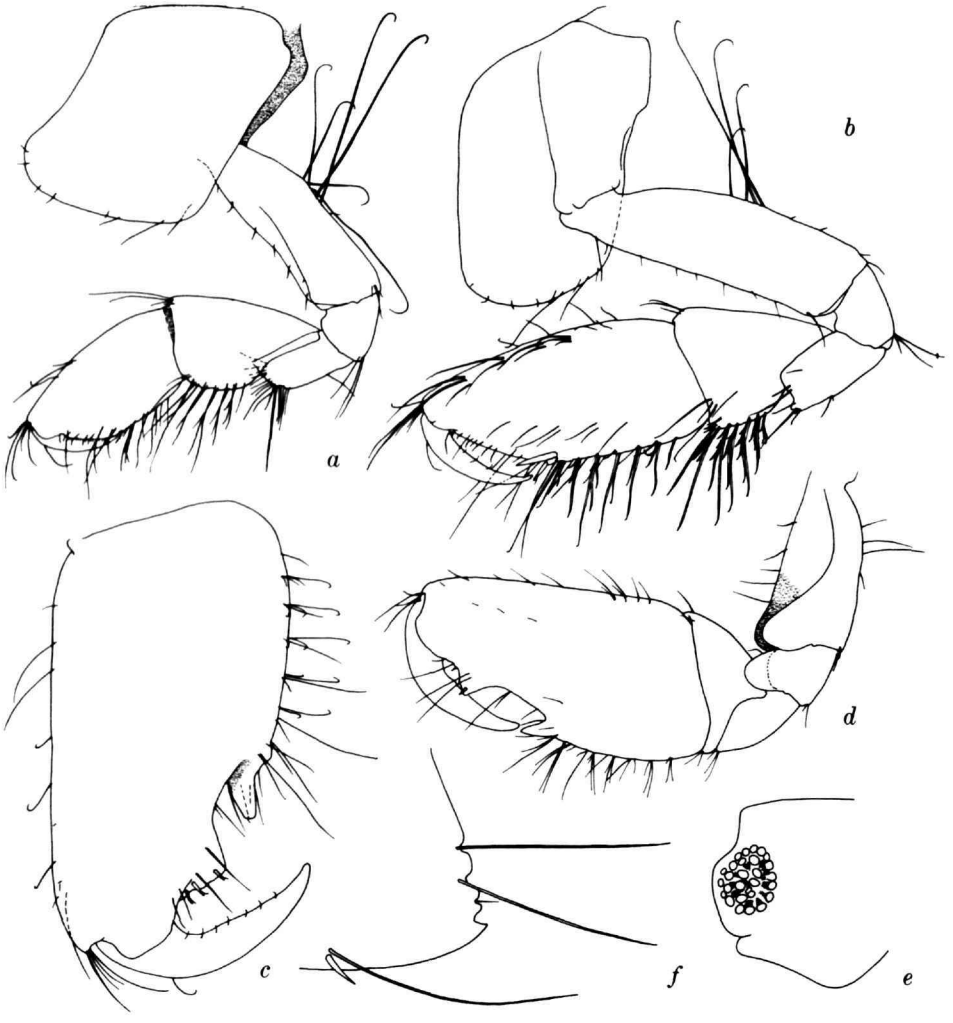

FIGURE 71.—*Elasmopus molokai,* new species, female, 3.3 mm, JLB Hawaii 6: *a, b,* gnathopods 1, 2. Male, 2.9 mm: *c,* gnathopod 2. Holotype, male, 3.1 mm: *d,* gnathopod 2; *e,* head. Male, 2.5 mm: *f,* pleonal epimeron 3.

of inner ramus with 2–3 spines, apex of outer ramus with 3–4 spines and small article 2; telson short, apices broadly sinuous, armed with 2–4 apical and subapical spines and 1 pair of lateral setules on each side.

FEMALE.—Gnathopod 2 typical of the genus and other characters like those of male.

JUVENILE MALE.—Distal palmar process of gnathopod 2 less falcate than in terminal male, defining cusp occurring more distally with dactyl overlapping it, excavation narrower and a subsidiary defining cusp occurring proximally, this cusp gradually disappearing in adult; otherwise like adult but with fewer spines and setae elsewhere.

JUVENILE (2.0 mm).—Setae on article 2 of pereopods and epimera absent; epimeral spines when occurring set in pairs or singly; articles 3–4 of pereopods 3–5 with only a few setae; article 1 of antenna 1 with long stout ventrodistal spine; accessory flagellum 2-articulate; inner ramus of uropod 3 with either 1 or 2 stout spines, 1 elongate; telson with 2–3 spines on each lobe.

HOLOTYPE.—Bishop Museum collections, catalog number 7271, male, 3.1 mm.

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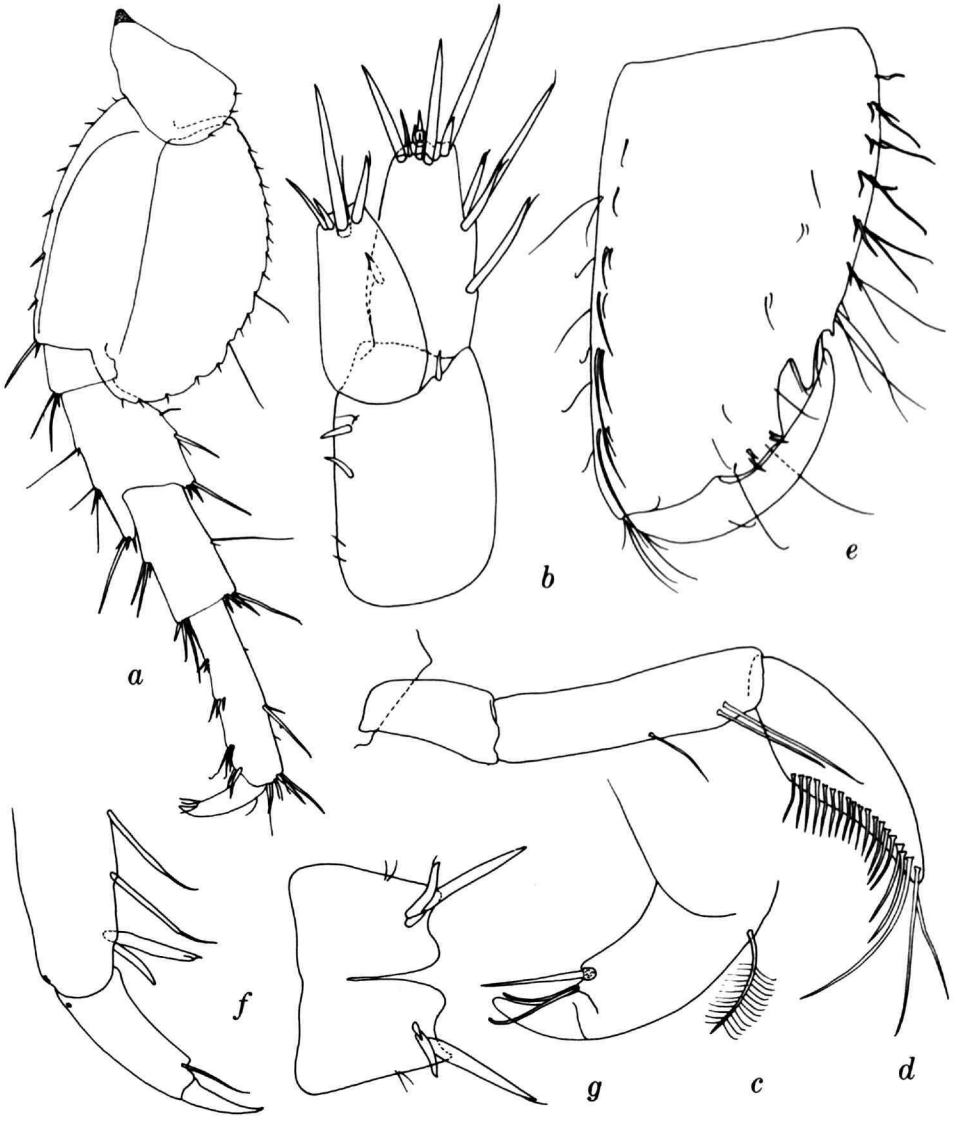

FIGURE 72.—*Elasmopus molokai,* new species, holotype, male, 3.1 mm, JLB Hawaii 6: *a,* pereopod 5; *b,* uropod 3; *c,* dactyl of pereopod 3; *d,* mandibular palp. Male, 2.5 mm: *e,* gnathopod 2; *f,* dactyl of pereopod 1. Female, 3.3 mm: *g,* telson.

TYPE-LOCALITY.—JLB Hawaii 6, off Barbers Point, Oahu, 30 m, coralline footballs, 29 January 1967.

MATERIAL.—JLB Hawaii 3 (15), 5 (25), 6 (22), 8 (6), 10 (6), 11 (1), 12 (2), 13 (3), 14 (1). Fee 1 (?1).

RELATIONSHIP.—This species has sympatric relationships with *E. pocillimanus* (Bate) and in juvenile stages superficially might be confused with that species except for the following differences: (1) in all stages *E. pocillimanus* eyes are so darkly pigmented that in alcohol only peripheral ommatidia are visible, whereas they show through the lighter pigment centrally in *E. molokai;* occasionally the pigment of *E. molokai* appears very dark but microscopic examination demonstrates the appearance of central ommatidia; (2) the short telson with sinuotruncate apices bearing

slightly subapical spines; (3) the presence of a few setae on epimera and pereopods 3–5 in adults; (4) the replacement of striate sabre-spines on pereopods 1–2 with a chisel-shaped and a simple spine.

Distinction in juvenile stages from *E. piikoi,* new species, are very difficult to make and are discussed under the latter heading.

Allopatric relationships occur with *E. minimus* Chevreux (1908); *E. molokai* may be synonymous with *E. minimus* from Gambier Archipelago; the latter is based on a male resembling the juvenile male of *E. molokai.* The telson of *E. minimus* appears also to be shortened from Chevreux's lateral drawing.

Elasmopus molokai differs from *E. rapax* in the same characters mentioned for *E. piikoi.*

DISTRIBUTION.—Hawaiian Islands.

Elasmopus pectenicrus (Bate)

FIGURES 73, 74

Moera pectenicrus Bate, 1862, p. 192, pl. 34, fig. 8.
Elasmopus serrula Walker, 1904, pp. 277–278, pl. 8, fig. 37.
Elasmopus pectenicrus.—J. L. Barnard, 1955a, pp. 8–10, fig. 4 [with references].

DIAGNOSIS OF MALE.—Accessory flagellum about 4-articulate; eyes medium in size, clear in alcohol; mandibular palp normally falcate; article 5 of gnathopod 1 longer than article 6, latter softly rectangular, palm nearly transverse, medial faces of articles 5–6 and posterior margin of article 5 densely setose; article 2 of gnathopod 2 not lobate, article 3 normally lobate, article 5 short, bearing narrow, setose posterior lobe, article 6 elongate and tapering, palm fully oblique and not marginally defined from posterior edge of article 6, palm S-shaped, medial face with small cusp defining palmar extent, distal end with small protuberance at posterior end of transverse margin, small process at medial hinge line near base of dactyl, one short ridge on medial face near end of dactyl, latter slender, evenly curved, not reaching medioproximal cusp, palm densely setose its full length; posterodistal end of article 6 on pereopods 1–2 with long straight, and short straight spine, long spine slightly twisted and bent distally, sharp, dactyl stout, distal constriction bearing normal stout seta and 2 curved setules, basal part of constriction with small sharp, distally angular keel; locking spines of pereopods 3–5 normal; pereopod 3 with stout, subrectangular article 2 with minute posterior serrations, posteroventral lobe scarcely extended, pereopod 4 with posteroventral margin excavate along strongly extended lobe and deeply castelloserrate, pereopod 5 with broadly hemispherical, minutely serrate posterior margin scarcely extended ventrally, pereopods 3–5 with a few short setae on articles 3–6, none on article 2 (except setules); pleonal epimera 1–2 with lateral ridge and small sharp posteroventral tooth, posterior margins with several normal serrations, epimeron 3 bluntly quadrate, posteroventral tooth absent or obsolescent, posterior margin with several normal serrations, ventral margins of all epimera with spines in groups of 1, 2, and 3, no setae; urosomal segments simple; rami of uropods 1–2 with medium to elongate terminal spines; inner ramus of uropod 3 only two-thirds as long as outer ramus, both relatively short for genus, truncate, apically spinose, outer lacking article 2; telson of medium length, lobes apically truncate and armed with 5–6 spines each.

FEMALE.—Pleonal epimeron 3 with 2 sharp medium serrations on posteroventral corner; gnathopod 2 of medium size, palm even, oblique, lined with short stout spines, defined by 1 marginal and 1 medial spine, inner margin of dactyl wavy; article 2 of pereopod 5 slightly narrower than in male, posteroventral margin slightly beveled on pereopod 4, not excavate, castelloserrations slightly smaller than in male; setae of pereopods rare; article 6 of gnathopod 1 relatively longer and larger than in male.

JUVENILE (smallest available, 5.3 mm).—Pleonal epimeron 3 like that of female; article 2 of pereopods 4–5 unmodified except for presence of coarse castelloserrations, much coarser on pereopod 5 than in adult; ommatidia dispersed, few in number, distinctly bigeminate, eye otherwise of size similar to adult; each telsonic lobe with only 4 spines; gnathopod 2 lacking marginal defining spine seen in female, dactyl strongly castelloserrate on inner margin; major locking spine of pereopods slightly sharper than in adult, apex slightly curved.

MATERIAL.—Same as in Barnard (1955a); material herein figured or analyzed again: Pearl Harbor, drydock, 15 April 1948, collector C. H. Edmondson; Oahu, 24 January 1944, 5-foot depth (also Pearl Harbor, and forming part of Station 2 material reported in Barnard, 1955a).

REMARKS.—The strong castelloserrations occur on pereopod 4, not pereopod 5 of the adult male; my (1955a) statement was in error; juveniles, however, have strong serrations on pereopod 5.

DISTRIBUTION.—Tropicopolitan.

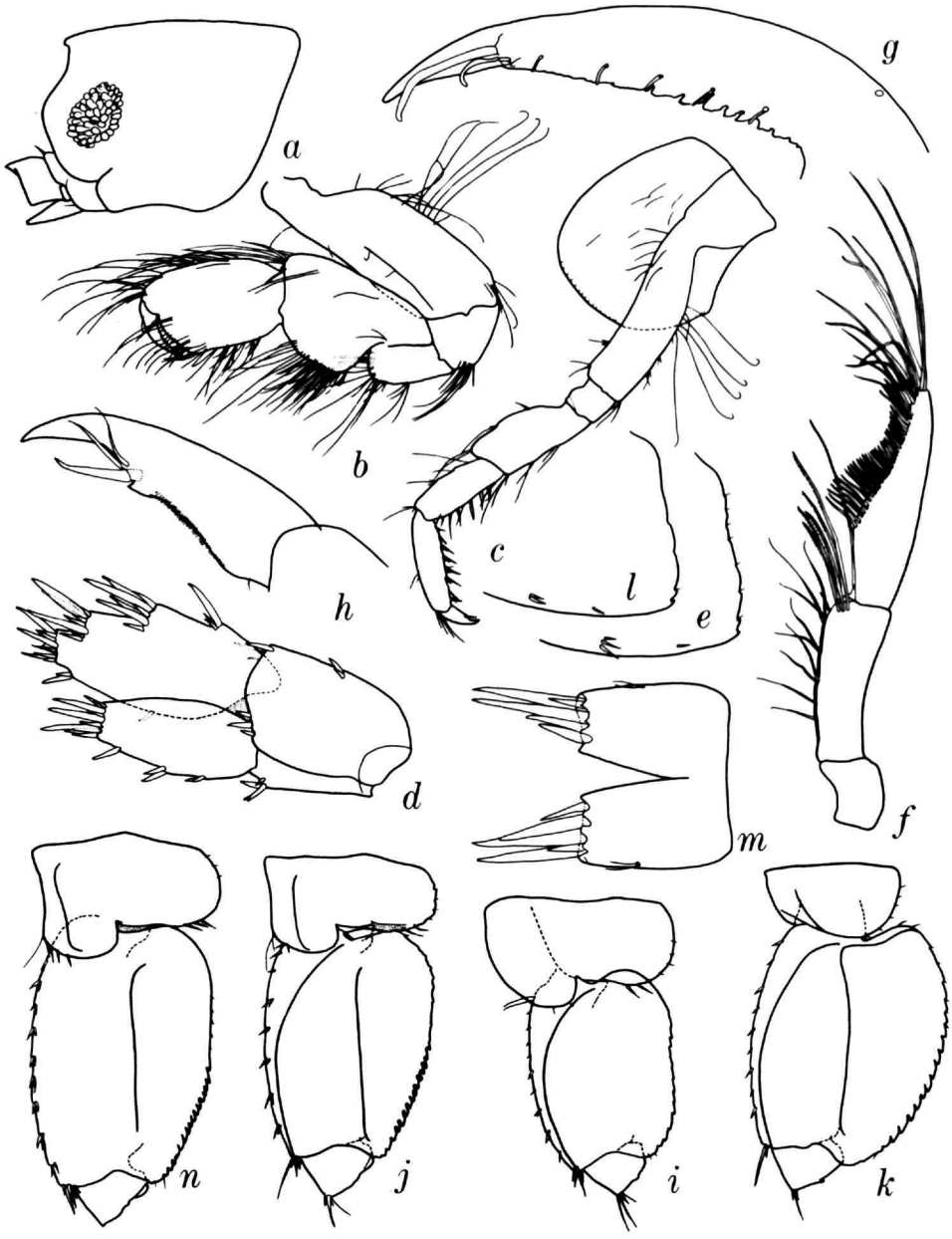

FIGURE 73.—*Elasmopus pectenicrus* (Bate), male, 10.6 mm, Oahu, 5′, 24 January 1944: *a*, head; *b*, gnathopod 1, lateral; *c*, pereopod 2; *d*, uropod 3; *e*, pleonal epimeron 3; *f*, mandibular palp. Juvenile female, 5.3 mm: *g*, dactyl of gnathopod 2; *h*, dactyl of pereopod 2; *i*, *j*, *k*, bases of pereopods 3, 4, 5. Female, 6.3 mm: *l*, pleonal epimeron 3; *m*, telson; *n*, base of pereopod 4.

FIGURE 74.—*Elasmopus pectenicrus* (Bate), male, 10.6 mm, Oahu, 5′, 24 January 1944: *a*, apex of pereopod 5; *b*, gnathopod 2, medial; *c*, gnathopod 2, lateral; *d*, *e*, *f*, pereopods 3, 4, 5; *g*, palmar processes and inner edge of dactyl on gnathopod 2; *h*, coxa 1; *i*, apex of pereopod 2.

Elasmopus piikoi, new species

FIGURES 75, 76

DIAGNOSIS OF MALE.—Accessory flagellum about 3-articulate; eyes medium in size, not as dark as in *E. pocillimanus*, with occasional central ommatidium visible, pigment in alcohol often turning to dark purple or brownish purple; mandibular palp normally falcate; article 5 of gnathopod 1 about 87 percent as long as article 6; anterodistal end of article 2 on gnathopod 2 with pendant lobe on medial and lateral side, slight anterior protrusion above lobe, article 3 broadly lobate, article 5 short, bearing narrow but relatively short, setose posterior lobe, article 6 elongate and strongly tapering, palm very oblique and much longer than posterior margin of article 6, defined by

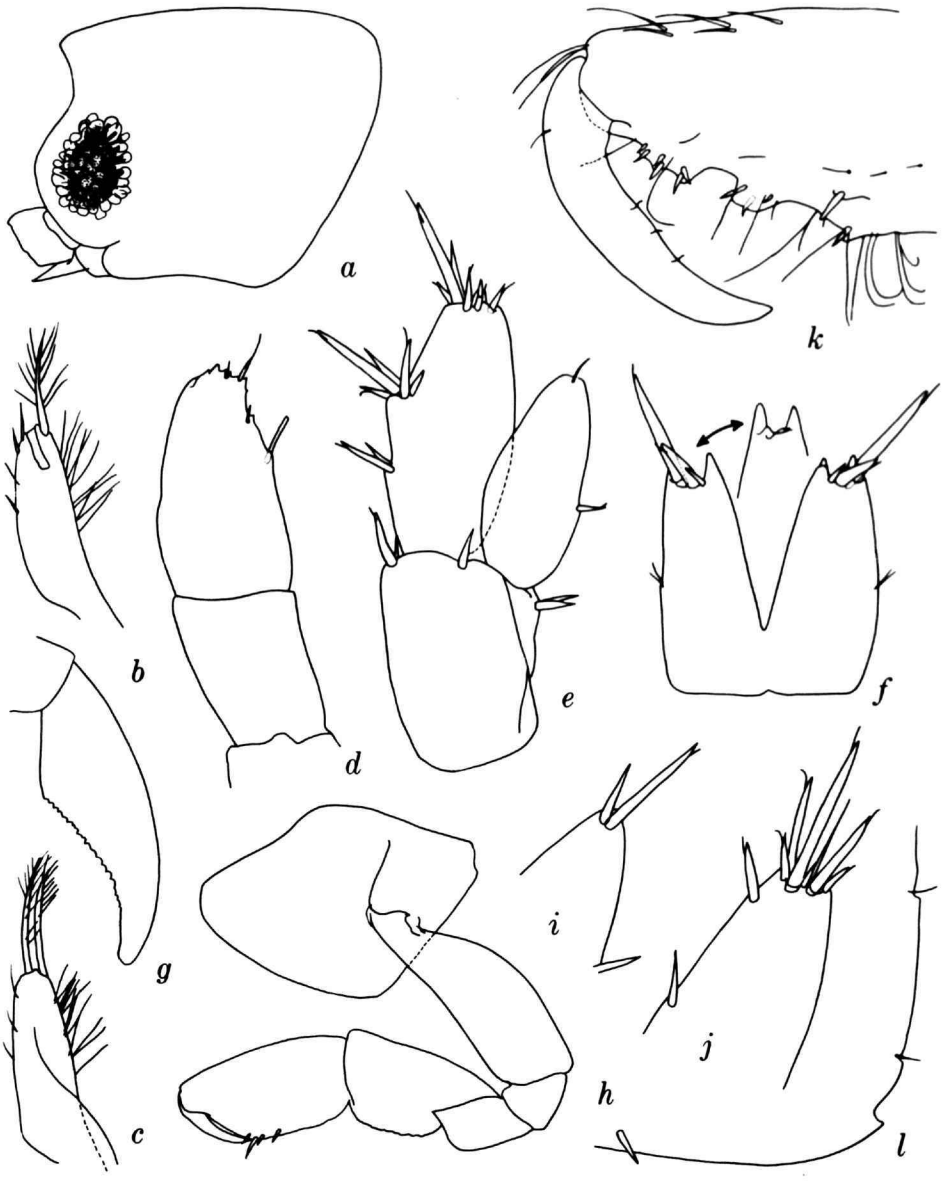

FIGURE 75.—*Elasmopus piikoi*, new species, holotype, male, 5.0 mm, JLB Hawaii 13: *a*, head; *b*, *c*, inner plates of maxillae 1; *d*, left palp of maxilla 1; *e*, uropod 3; *f*, telson; *g*, mandibular palp article 3, setae removed; *h*, gnathopod 1, setae removed; *i*, *j*, apices of inner and outer rami on uropod 3. Male, 4.1 mm: *k*, gnathopod 2, medial; *l*, pleonal epimeron 3.

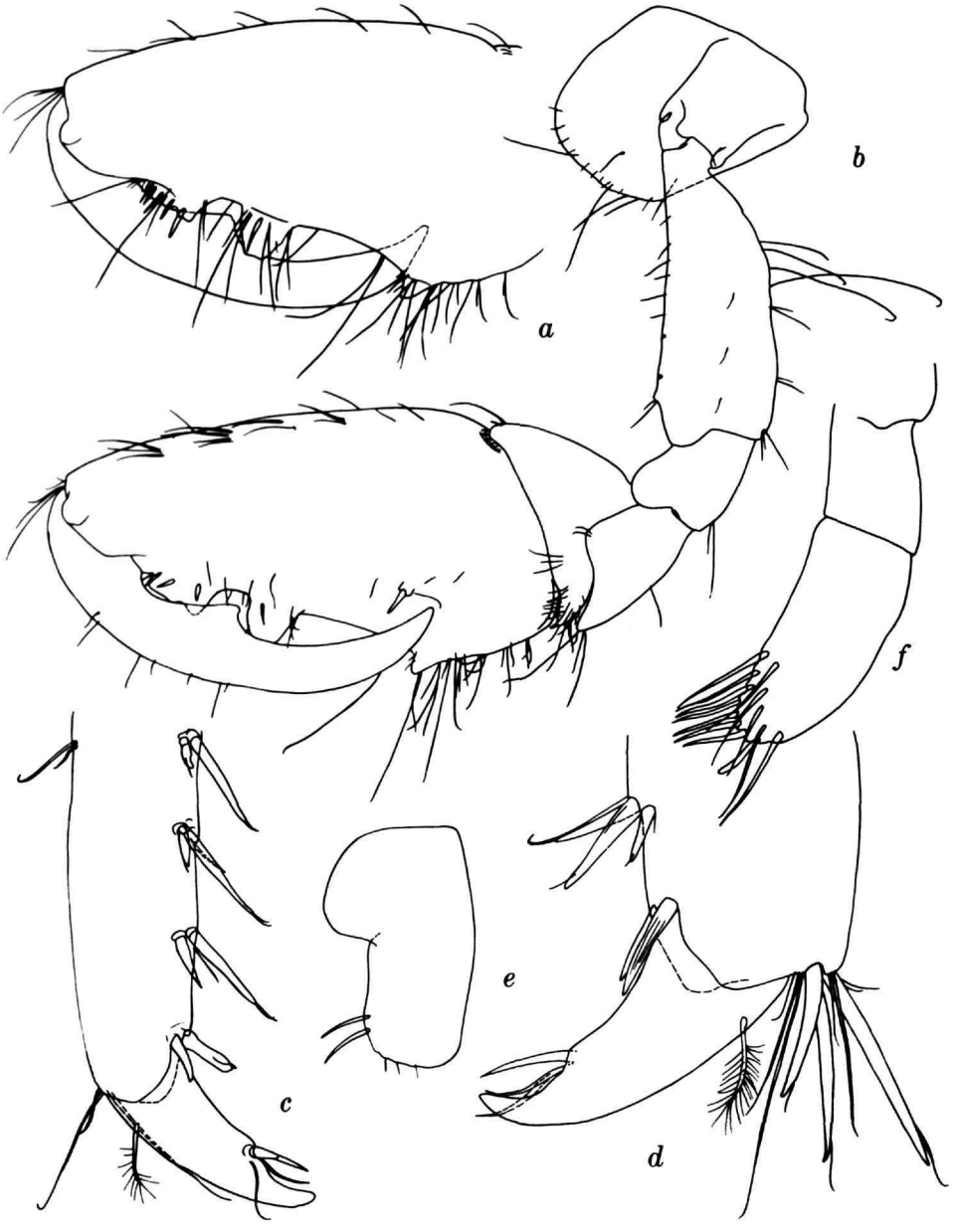

FIGURE 76.—*Elasmopus piikoi*, new species, holotype, male, 5.0 mm, JLB Hawaii 13: *a*, *b*, gnathopod 2, lateral and medial views; *c*, *d*, apices of pereopods 2, 3; *e*, coxa 6 (tilted on its side); *f*, right palp of maxilla 1.

small cusp, distal end with truncate or slightly bilobate process bearing a few spines, midpalmar margin with large truncatoconiform process, dactyl slightly overriding palm and fitting facial recess defined by spine, inner margin of dactyl with large process, margin thus bisinuate, dactyl tending to be stout; posterodistal end of article 6 on pereopods 1–2 with 1 irregularly shaped chisel spine, slightly bifid apically or with small point, other locking spine small, slightly sabre-shaped, dactyl subapically constricted and bearing one stout free spine and 1–2 weak setules; locking spines of pereopods 3–5 normal; pereopods 3–5 bearing several long setae on articles 3–5 and on article 2 of pereopods (3) 4–5, posterior margin of article 2 of regular dimensions and weakly serrate; coxa 6 with unusually broad and slightly truncate anterior lobe; pleonal epimera 1–2 with lateral ridge, posteroventral corners sharply produced, posterior margins sparsely serrate, epimeron 3 with evenly quadrate posteroventral corner, ventral margins of epimera bearing pairs of short spines, no setae; urosomal segments simple; rami of uropods 1–2 with elongate terminal spines but not unusually so; inner ramus of uropod 3 about three-fourths as long as outer ramus, apex of inner ramus slightly tapering and bearing 1 small seta or several spines (right and left differing on same animal occasionally), apex of outer ramus spinose and bearing small article 2; telson elongate, lobes apically excavate and bearing 3 terminal spines each.

FEMALE.—Gnathopod 2 like that of *E. molokai;* pleonal epimeron 3 like that of young male; inner ramus of uropod 3 broadly truncate and spinose; pereopods 3–5 lacking setae (no female at hand nearly as large as males).

YOUNG MALE.—Gnathopod 2 with more spines on middle and distal palmar processes than in adult but processes smaller, dactyl weakly sinuate; pleonal epimeron 3 with posteroventral tooth like epimera 1–2, spines on ventral margin occurring singly in each set; inner ramus of uropod 3 with strongly spinose apex; telson with 2 spines on each lobe.

JUVENILE.—Pleonal epimera like young male but often lacking spines; inner ramus of uropod 3 like adult male, tapering and bearing one apical seta or one seta and one spine; telson with 2 spines on each apex.

HOLOTYPE.—Bishop Museum collections, catalog number 7272, male, 5.0 mm.

TYPE-LOCALITY.—JLB Hawaii 13, Kaneohe Bay, Oahu, 3–4 m, corals, algae, corallines, 8 April 1967.

MATERIAL.—JLB Hawaii 2 (32), 3 (1), 12 (12), 13 (14), 14 (25), 17 (2).

RELATIONSHIP.—A sympatric resemblance occurs with *E. pocillimanus* (Bate) and *E. molokai,* new species, and differentiation of juveniles from similar stages of the latter species is difficult, except for the short telson of *E. molokai.* A judgment of this character is difficult to make without dissection until considerable experience with the material has been obtained. Gnathopods of the adult male are clearly different, and the presence of epimeral setae on adult female *E. molokai* is characteristic. The pair of sabre-spines on pereopods 1-2 of *E. pocillimanus* is definitive of that species in all stages.

Elasmopus piikoi gnathopod 2 of the young male resembles that of *E. calliactis* Edmondson, but the eyes devoid of black pigment distinguish all stages of the latter species.

Adult males of *E. piikoi* differ from *E. rapax* Costa (J. L. Barnard, 1962b) in the absence of the fourth palmar process on gnathopod 2 that forms a long conical lateral tooth. Males, females, and large juveniles of *E. rapax* have several sharp serrations on epimeron 3. The telson of *E. rapax* has spines only on the apicolateral notch, and the medial projecting portion is smooth. Article 2 on the outer ramus of uropod 3 is absent in *E. rapax.*

Elasmopus holgurus J. L. Barnard (1962b) from California differs from *E. piikoi* in the absence of a defining tooth on the palm of male gnathopod 2, although the facial ridge and spine into which the dactylar apex fits are present in both species.

DISTRIBUTION.—Hawaiian Islands.

Elasmopus pocillimanus (Bate)

FIGURES 77, 78

Moera pocillimanus Bate, 1862, p. 191, pl. 34, fig. 7.

Elasmopus pocillimanus.—Stebbing, 1906, pp. 443–444; Chevreux and Fage, 1925, p. 246, fig. 257.—Schellenberg, 1938, p. 56, fig. 28.

DIAGNOSIS OF TERMINAL MALE.—Accessory flagellum about 3-articulate; eyes very large, only peripheral ommatidia visible through heavy black pigment; mandibular palp article 3 extremely falcate for genus; article 5 of gnathopod 1 about 80 percent as long as article 6; articles 2 and 3 of gnathopod 2 not lobate,

article 5 short, bearing narrow, setose posterior lobe, article 6 very elongate, subrectangular, palm and posterior margin of article 6 confluent but defined by weak, obtuse cusp, palm near dactyl with slight protrusion bearing several marginal and submarginal spines, medial palmar face bearing deep hollow defined proximally by weak spine, dactyl stout, curved, overlapping palm to close into recess; posterodistal end of article 6 on pereopods 1–2 with 2 large, sabre-shaped, striate locking spines, dactyl constricted very distally, bearing 1 large, sharp straight seta and 2 strap-shaped thinner setae; locking spines of pereopods 3–5 composed of one sabre and one normal, both slightly striate; pereopods 3–5 lacking any long setae, posterior margin of article 2 of regular dimensions and weakly serrate; pleonal epimera 1–2 with lateral ridge, posteroventral corners sharply produced, posterior margins sparsely serrate, epimeron 3 with evenly quadrate posteroventral corner, ventral margins of epimera bearing pairs of short spines, no setae; urosomal segments simple; rami of uropods 1–2 with unusually elongate terminal spines; inner ramus of uropod 3 as broad and about seven-eighths as long as outer ramus, apex of inner ramus with 3 spines, apex of outer ramus spinose and bearing small article 2; telson slightly elongate, lobes apically extended into subovate unarmed plates, each lobe with one midlateral spine and pair of setules.

YOUNG MALE.—Gnathopod 1 stouter than in terminal stage, article 5 shorter; palmar margin of gnathopod 2 with palmar protrusion poorly defined but equally spinose, medial hollow rudimentary, dactyl thin; pleonal epimeron 3 with strong posteroventral tooth like epimera 1–2.

FEMALE.—Not in Hawaiian collections.

JUVENILES.—Inner ramus of uropod 3 shortened and bearing 1 apical seta, article 2 of outer ramus relatively much larger than in adult, apparently remaining same size in juvenile and adult while article 1 increasing in size; pleonal epimeron 3 with small posteroventral tooth, ventral spines on epimera when present occurring singly; each telsonic lobe with asymmetrical apical extensions, medial point reaching farthest, spine on each lobe essentially terminal; eyes nearly as dark as in adult, but slightly smaller relative to head; pereopods 1–2 also bearing 2 striated sabre-spines as in adult and pereopods 3–5 with one such spine; terminal spines of uropods 1–2 relatively as long as in adult.

MATERIAL.—JLB Hawaii 5 (2), 6 (1), 17 (1).

REMARKS.—Article 3 of the maxillipedal palp has a distal protrusion ornamented like a pin cushion.

DISTRIBUTION.—Cosmopolitan in warm seas.

Elasmopus rapax Costa

FIGURES 79, 80

Elasmopus rapax Costa.—J. L. Barnard, 1955a, pp. 10–12, fig. 5 [in part, not figs. 5b, g, material from Honolulu Aquarium=*E. calliactis*] [with references]; 1962b, pp. 94–96, figs. 16, 17.

DIAGNOSIS OF HAWAIIAN MALE.—Accessory flagellum about 4-articulate; eyes medium in size, not as dark as in *E. pocillimanus,* with occasional central ommatidium visible through purplish-brown pigment in alcohol; mandibular palp normally falcate; article 5 of gnathopod 1 as long as article 6, latter heavily setose medially; articles 2–3 of gnathopod 2 not lobate, article 5 short, bearing narrow setose posterior lobe, article 6 elongate and tapering, palm very oblique and longer than posterior margin of article 6, extent defined by small tooth on medial face, distal end of palm with large lateral tooth, short truncate medioproximal tooth and broad shallow spinose distomedial protrusion, dactyl slender but shorter than palm and strongly bent basally; posterodistal end of article 6 on pereopods 1–2 with one nearly straight unstriate spine minutely constricted and/or pointed distally and one short normal spine, dactyl slender, distal constriction bearing 1 stout seta and 2 curved setules; locking spines of pereopods 3–5 normal; pereopods 3–5 bearing long setae on articles 2–6, posterior margin of article 2 of regular dimensions and weakly crenulate; pleonal epimera 1–2 with lateral ridge and small sharp, posterodistal tooth, posterior margins densely serrate but serrations of normal depth, epimeron 3 deeply serrate ventroposteriorly, one strong serration forming quadrate posteroventral corner; ventral margins of epimera with mixture of spines and long setae occasionally occurring as singles or triads, frequently as pairs; urosomal segments simple; rami of uropods 1–2 with long terminal spines; inner ramus of uropod 3 subequal to outer ramus in length, both broad and flat, apices broadly truncate and spinose, outer ramus lacking article 2; telson of medium length, apices extended as medial lobes, bluntly coniform, laterally each lobe carrying 3 spines in notch.

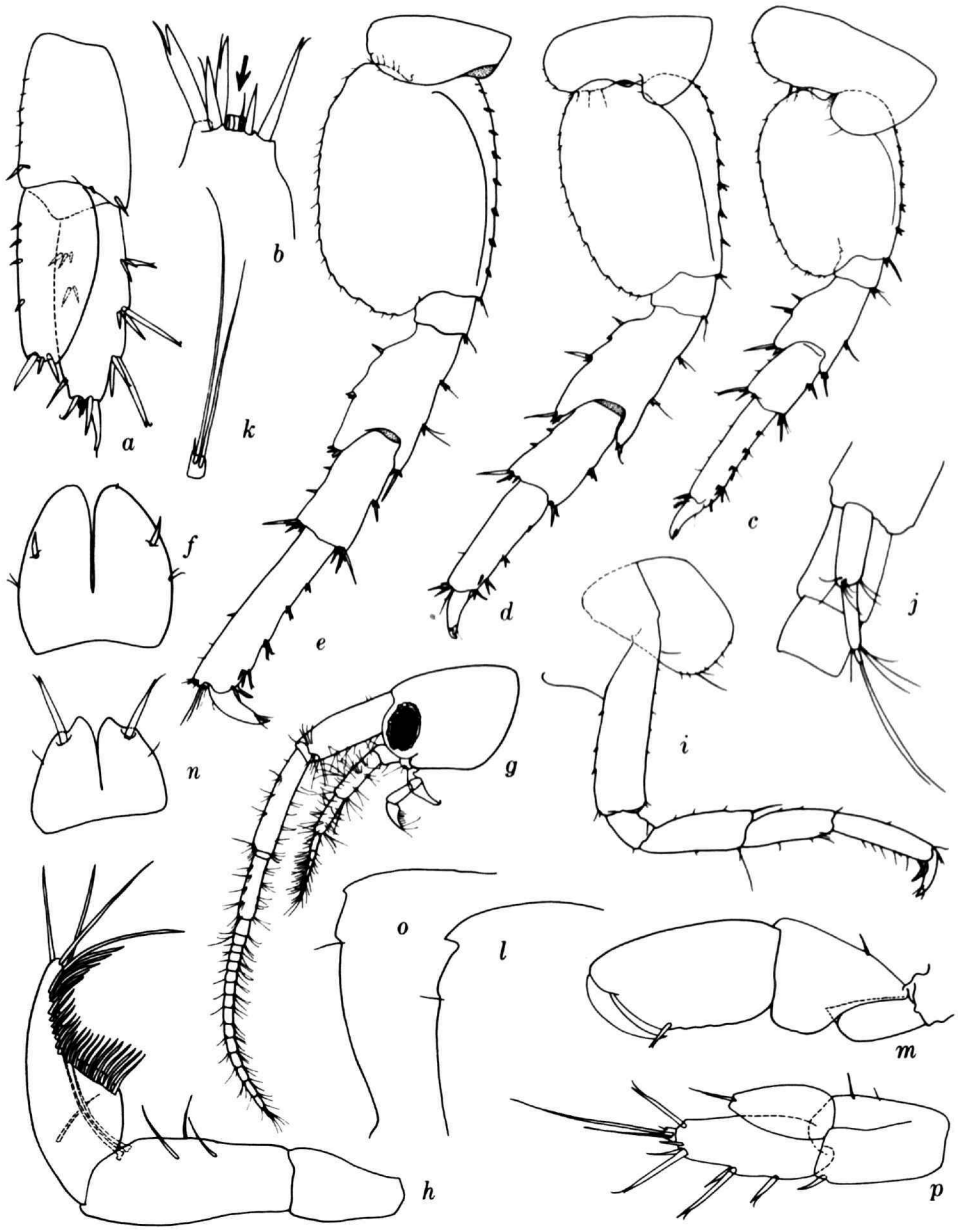

FIGURE 77.—*Elasmopus pocillimanus* (Bate), male, 5.1 mm, JLB Hawaii 6: *a*, uropod 3; *b*, apex of outer ramus on uropod 3; *c*, *d*, *e*, pereopods 3, 4, 5; *f*, telson; *g*, head; *h*, mandibular palp; *i*, pereopod 1; *j*, accessory flagellum. Male, 3.3 mm: *k*, article 2 on outer ramus of uropod 3; *l*, pleonal epimeron 3 (upside down); *m*, lateral gnathopod 1, setae removed. Juvenile, 1.7 mm: *n*, telson; *o*, pleonal epimeron 3 (upside down); *p*, uropod 3.

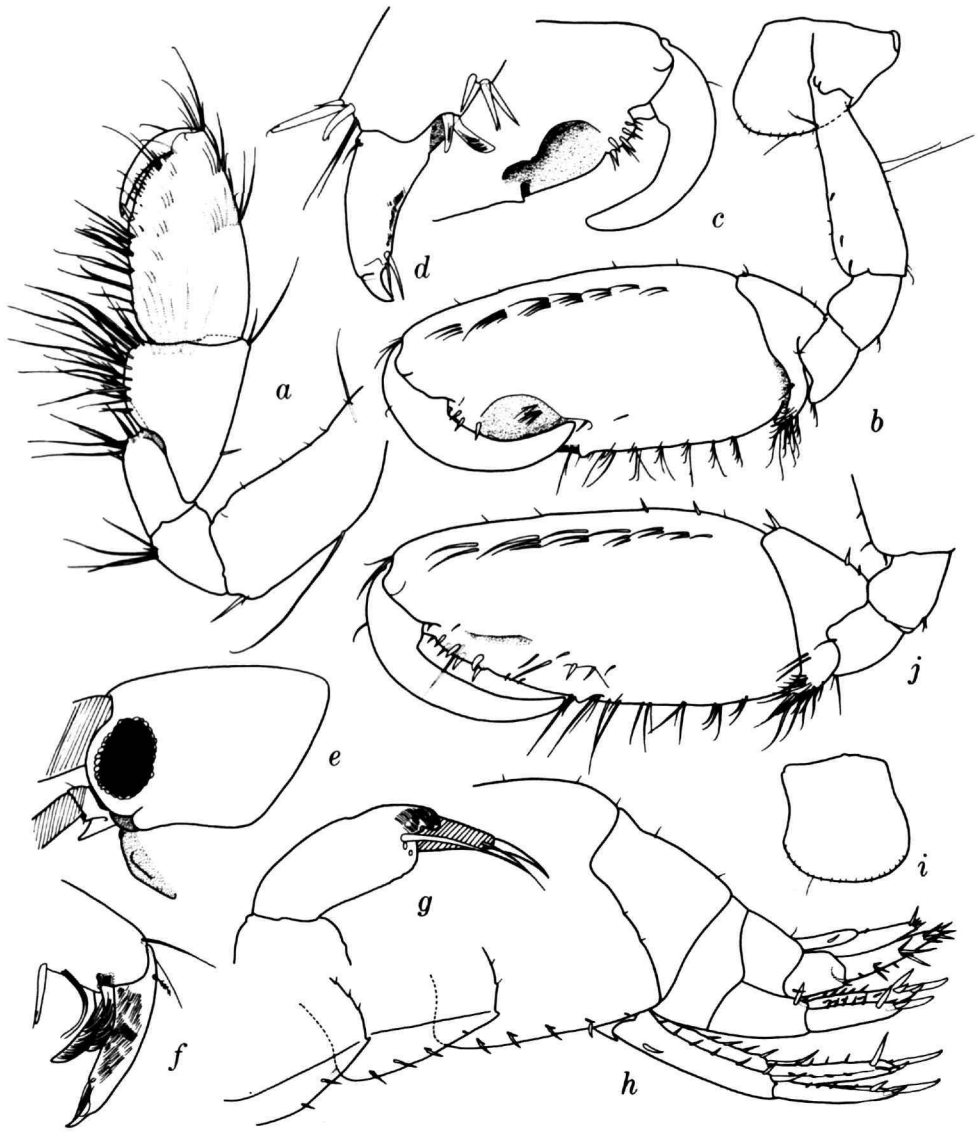

FIGURE 78.—*Elasmopus pocillimanus* (Bate), male, 5.1 mm, JLB Hawaii 6: *a*, lateral gnathopod 1; *b*, *c*, medial gnathopod 2; *d*, apex of pereopod 4; *e*, head; *f*, apex of pereopod 1; *g*, apex of maxillipedal palp; *h*, pleon; *i*, coxa 4. Male, 3.3 mm: *j*, medial gnathopod 2.

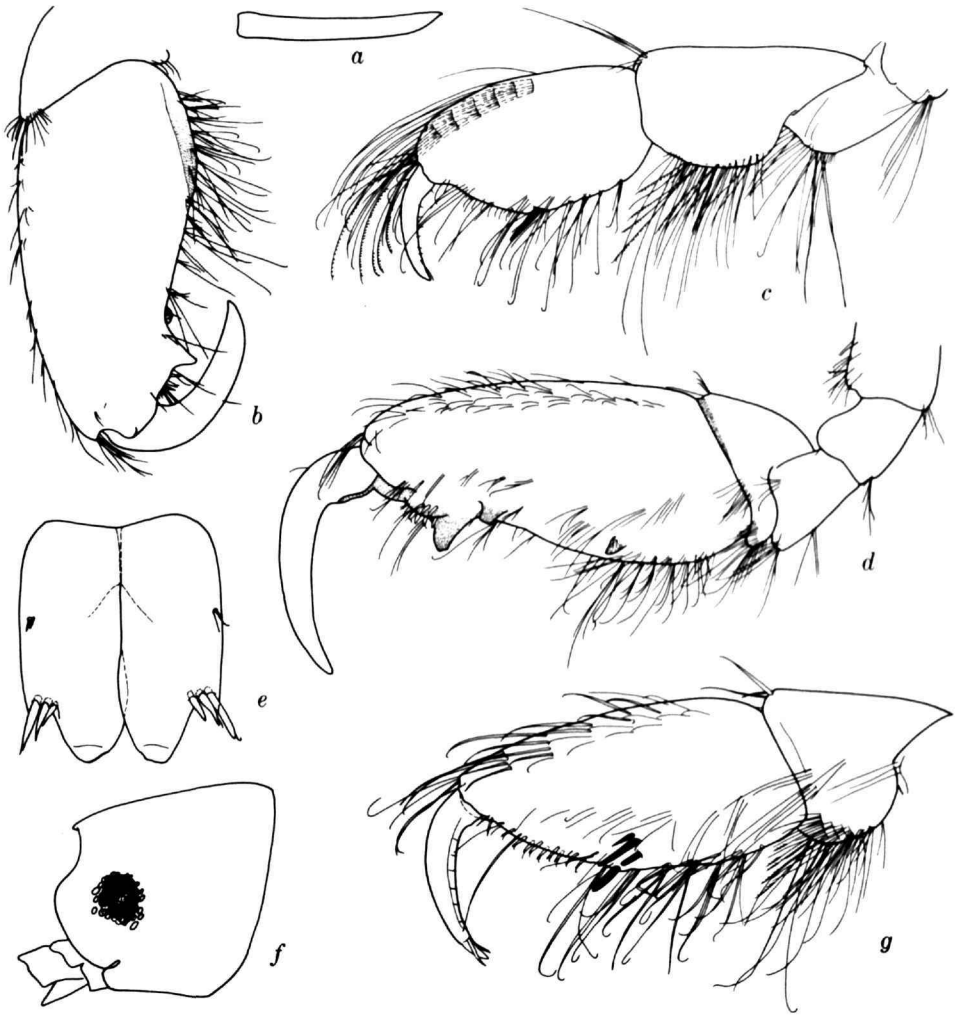

FIGURE 79.—*Elasmopus rapax* Costa, juvenile, 3.8 mm, Pearl Harbor, 1948: *a*, spine on article 6 of pereopod 1. Male, 8.3 mm: *b*, lateral gnathopod 2; *c*, lateral gnathopod 1; *d*, medial gnathopod 2; *e*, telson. Female, 6.0 mm: *f*, head; *g*, medial gnathopod 2.

FEMALE.—Gnathopod 2 small, palm even, bearing small spines and defined by medial triad and 1 marginal stout spine, each telsonic lobe with 2–3 spines, apices sharp; pereopods and epimera lacking setae.

JUVENILE (smallest available, 3.8 mm).—Each telsonic lobe with 2 spines, apices sharp, epimera with only short spines as singles, pairs and occasional triads, but epimeron 3 already strongly serrate as in adult; rami of uropod 3 narrower than in adult, but truncate apex of inner ramus already with 7 spines.

MATERIAL.—Same as J. L. Barnard (1955a), minus material from Honolulu Aquarium; material figured herein: Pearl Harbor, 28 April 1948, collector C. H. Edmondson.

REMARKS.—Distinguished in various stages by absence of article 2 on outer ramus of uropod 3 and sharply serrate epimeron 3, but smallest juveniles unstudied.

DISTRIBUTION.—Cosmopolitan in warm seas and occasionally in cold-temperate regions.

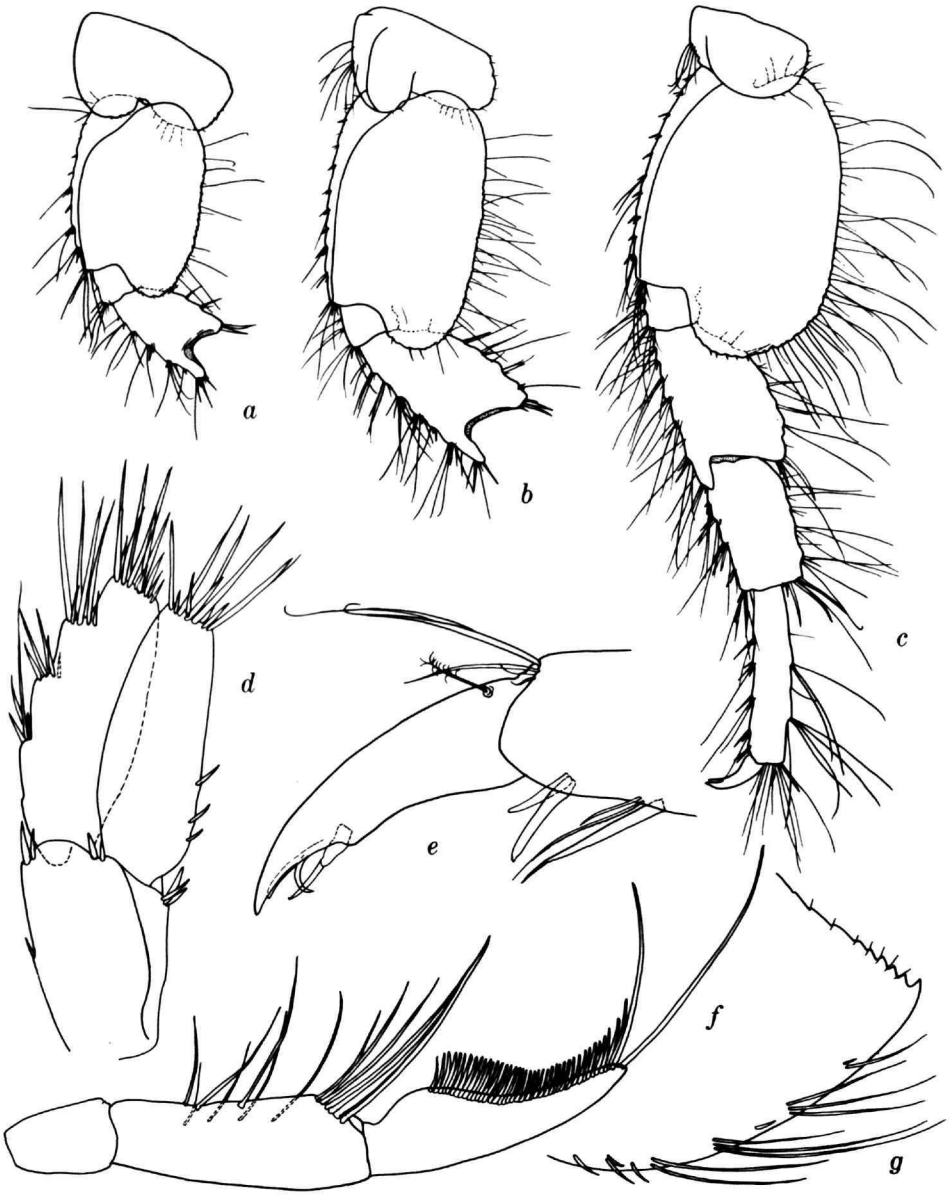

FIGURE 80.—*Elasmopus rapax* Costa, male, 8.3 mm, Pearl Harbor, 1948: *a, b, c,* pereopods 3, 4, 5, in whole or part; *d,* uropod 3; *e,* apex of pereopod 1; *f,* mandibular palp; *g,* pleonal epimeron 3.

Elasmopus spinidactylus Chevreux

FIGURES 81, 82

Elasmopus spinidactylus Chevreux, 1908, pp. 486–489, figs. 9–10.—Walker, 1909, pp. 336–337.—Schellenberg, 1938, p. 55.—Shoemaker, 1942, p. 13.—J. L. Barnard, 1965a, p. 504.

DIAGNOSIS OF HAWAIIAN FEMALE AND MEDIUM-AGED MALE.—Accessory flagellum about 3-articulate; eyes medium in size, not as dark as those of *E. pocillimanus*, with occasional central ommatidium visible, pigment in alcohol often turning to dark purple or brownish purple; mandibular palp article 3 normally falcate; article 5 of gnathopod 1 about 80 percent as long as article 6; articles 2 and 3 of gnathopod 2 without anterodistal lobes, article 5 short, bearing narrow posterior lobe, article 6 elongate and scarcely tapering, palm and posterior margin of article 6 confluent, palm

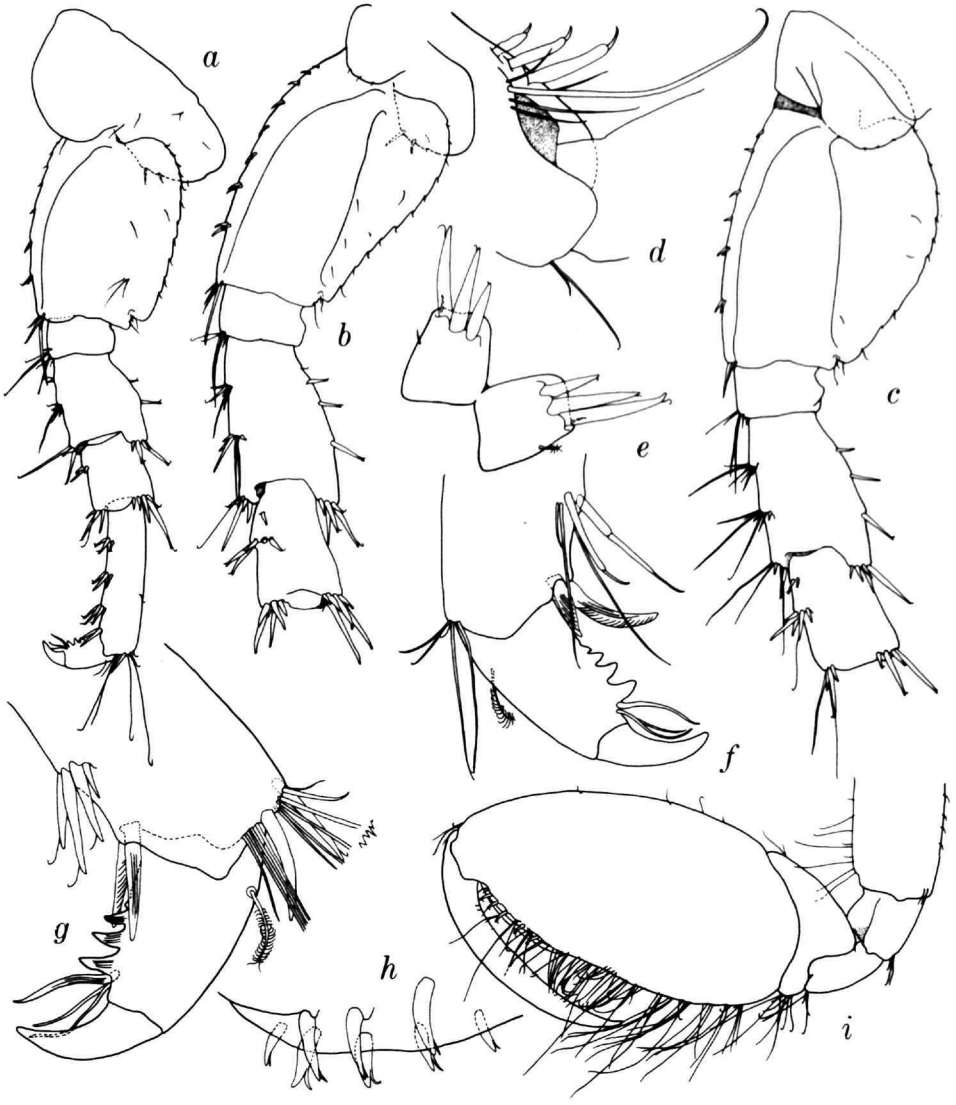

FIGURE 81.—*Elasmopus spinidactylus* Chevreux, female, 4.3 mm, Molokai: *a, b, c,* pereopods 3, 4, 5, in whole or part; *d,* distolateral end of article 5 on pereopod 1; *e,* telson; *f,* apex of pereopod 1; *g,* apex of pereopod 3; *h,* palm of gnathopod 2, mediolateral view; *i,* lateral gnathopod 2.

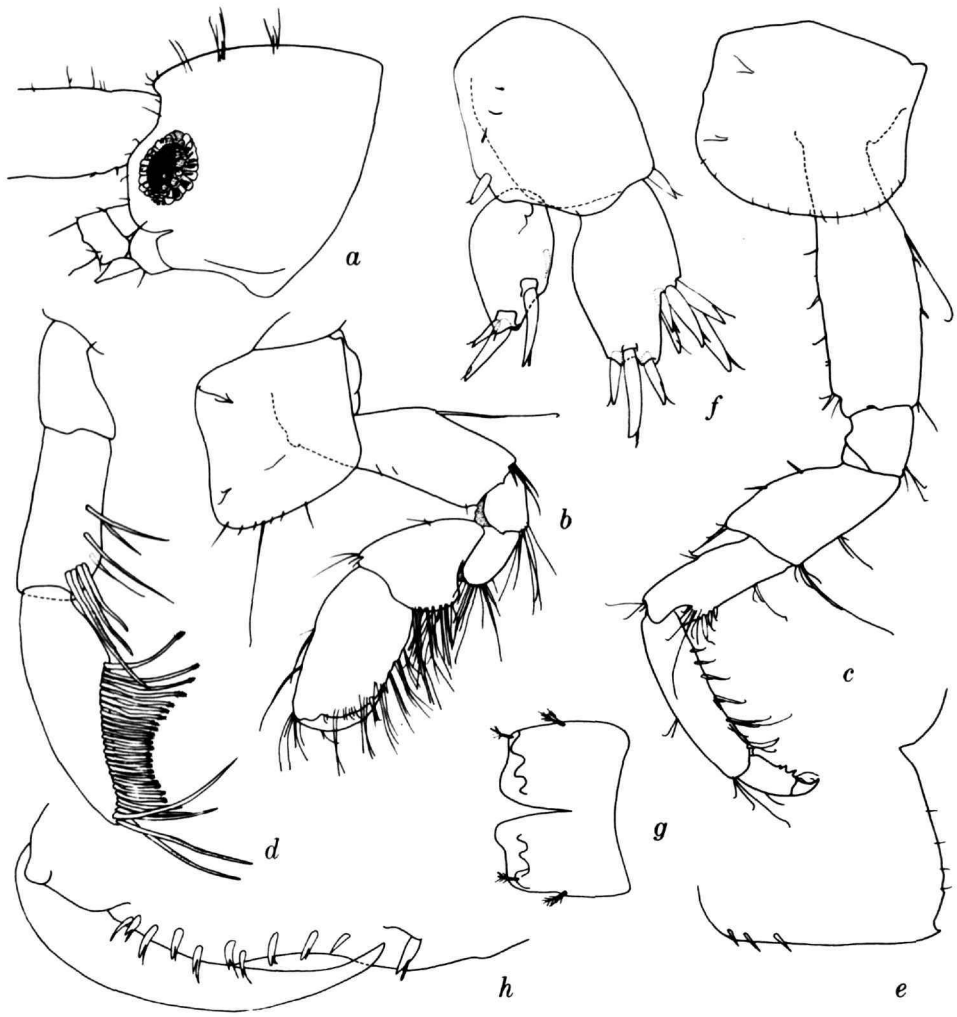

FIGURE 82.—*Elasmopus spinidactylus* Chevreux, female, 4.3 mm, Molokai: *a*, head; *b*, gnathopod 1; *c*, pereopod 2; *d*, mandibular palp; *e*, pleonal epimeron 3. Another female: *f*, uropod 3; *g*, telson. Juvenile, 2.3 mm: *h*, palm of gnathopod 2, medial view.

undefined, distal end slightly protuberant and bearing 3–5 pairs of spines, remainder of palm and posterior half of medial surface of article 6 strongly setose, dactyl slender; posterodistal end of article 6 on pereopods 1–2 with 1 large, striate sabre-spine and 1 small normal spine, dactyl constricted and bearing stout seta and 2 setules, proximal inner margin with 2 (juveniles) to 4, occasionally 5, large to small sharp, broad teeth; locking spines of pereopods 3–5 normal but dactyls like pereopods 1–2; article 2 of pereopods 3–5 narrow, subrectangular, that of pereopod 5 becoming slightly ovate, posterior margins weakly serrate and posteroventral corners each with deep quadrate notch, article 2 lacking long setae and only distal articles of pereopod 5 with several long setae; pleonal epimera 1–2 with lateral ridge and sharply produced posteroventral corners, posterior margins sparsely serrate, epimeron 3 also with sharp posteroventral tooth, ventral margins of epimera with a few single spines, rarely paired; urosomal segments simple; rami of uropods 1–2 with medium-length terminal spines; inner ramus of uropod 3 small, rami gaping, inner ramus reaching only about halfway along outer ramus, apex with 2 spines, outer edge with 2 more singles, outer ramus deeply stair-

stepped, apically truncate, article 2 not observed; telson short, apices broadly truncate, each armed with 3 long spines.

JUVENILE.—Inner ramus of uropod 3 pointed, with 2 apical setules, telson with 2 spines on each lobe; palm of gnathopod 2 shorter than posterior margin of article 6, weakly sinuous, broad distal protusion spinose, proximal sinuosity distinct from posterior margin of article 6 and defined by medial spine on ridge; pereopods 1–5 with as few as 2 accessory teeth on dactyls.

Terminal male with large palmar protrusion on gnathopod 2, as described by Chevreux, not present in Hawaiian collections at hand.

MATERIAL.—Hanauma Bay, Oahu, on *Microdictyon*, 29-3-64 (4); USNM 262506, Molokai (?"Haleolone P1 (Caspers)"? ix 59 Algen Prob (6) (place name unknown and date illegible).

REMARKS.—The gross teeth on the pereopodal dactyls distinguish this species from all others in Hawaii. Probably various races of this species throughout its range, like many other Hawaiian species, will be found but cannot be distinguished at present.

DISTRIBUTION.—Chagos Islands, eastward through Micronesia, Hawaii, Clipperton Island, SE Polynesia; and in the Caribbean Sea on the shores of Venezuela.

Eriopisa Stebbing

This genus, *Eriopisella* Chevreux and *Netamelita* J. L. Barnard appear to represent a polyphyletic group of species possibly derived from melita ancestors by reduction in size and complexity of male gnathopod 2 but at one extreme (type-species of *Eriopisa*), article 2 of the outer ramus on uropod 3 becomes very elongate and flat and in the other extreme (type-species of *Netamelita*) the article is lost as it is in most species of *Melita*. The eriopisella line generally has species with small article 2 on the outer ramus, like 2 species of *Eriopisa*, and the medial setae on the inner plates of the maxillae have been lost. *Netamelita* may not be distinct from *Eriopisella*, even though article 2 of the outer ramus on uropod 3 is lost, and gnathopod 2 is very strongly reduced to a size scarcely larger than gnathopod 1. The importance of these characters is difficult to evaluate in view of the alternative presence of article 2 on the outer ramus of uropod 3 in *Melita* and the diversity of other character differences among the various species of the 3 eriopisa genera. Thus, article 3 of the mandibular palp in *Eriopisa capensis* K. H. Barnard (1916) has become reduced, *E. garthi* J. L. Barnard (1952) has maxillae with intermediate setation, and *E. elongata* (Bruzelius, see Sars, 1895) has extremely reduced coxae and retains a lateral cephalic notch.

When European taxonomists established and refined the concepts of *Eriopisa* and *Melita*, the various tropical and warm-temperate species were unknown. Numerous gradations are now seen between the two extremes. The new Hawaiian species to be described confuses the generic classification further. It has normal *Eriopisa-Melita* mandibular bodies and maxillae, but has the short article 2 on the outer ramus of uropod 3 and resembles *Netamelita* more than the other genera in the transverse anterolateral cephalic margins. It is as clearly distinct phyletically from the type-species of *Eriopisa* as are *Netamelita* and most members of *Eriopisa* and *Eriopisella;* but it is retained in *Eriopisa* as a matter of convenience on the basis of maxillae 1–2.

We are thus in a position of recognizing defects in the present classification before more than a fraction of the known species has been discovered; further alignment should be reserved until exploration has revealed a majority of the species (Gurjanova, 1965).

Eriopisa (?) *hamakua*, new species

FIGURES 83, 84

DIAGNOSIS OF MALE.—Eyes represented by 8–9 clear facets weakly resembling ommatidia in front of light orange pigment splotch in alcohol; lateral cephalic lobes weakly protruding and lacking anteroventral notch; antenna 1 as long as head and body together, accessory flagellum 2-articulate, flagellum of antenna 2 as long as peduncular article 5 and three-fourths of article 4 together; mandibular palp long, article 3 subfalcate and strongly setose on concave margin; inner plates of maxillae 1–2 medially setose; coxae overlapping each other, coxae 1–2 longer than broad, 3–4 about as broad as long, coxa 1 rectangular, not produced or extended anteroventrally; article 4 of gnathopod 1 not inflated, article 5 much longer than broad, very densely setose posteriorly and laterally but unlobate, article 6 slender, rectangular, palm nearly transverse, dactyl short but fitting spinose palm; gnathopod 2 much larger than 1, article 5 short, stout, slightly inflated, article 6 very elongate and slender, palm from lateral view appearing to occupy entire posterior margin of hand, densely setose, dactyl about half as long

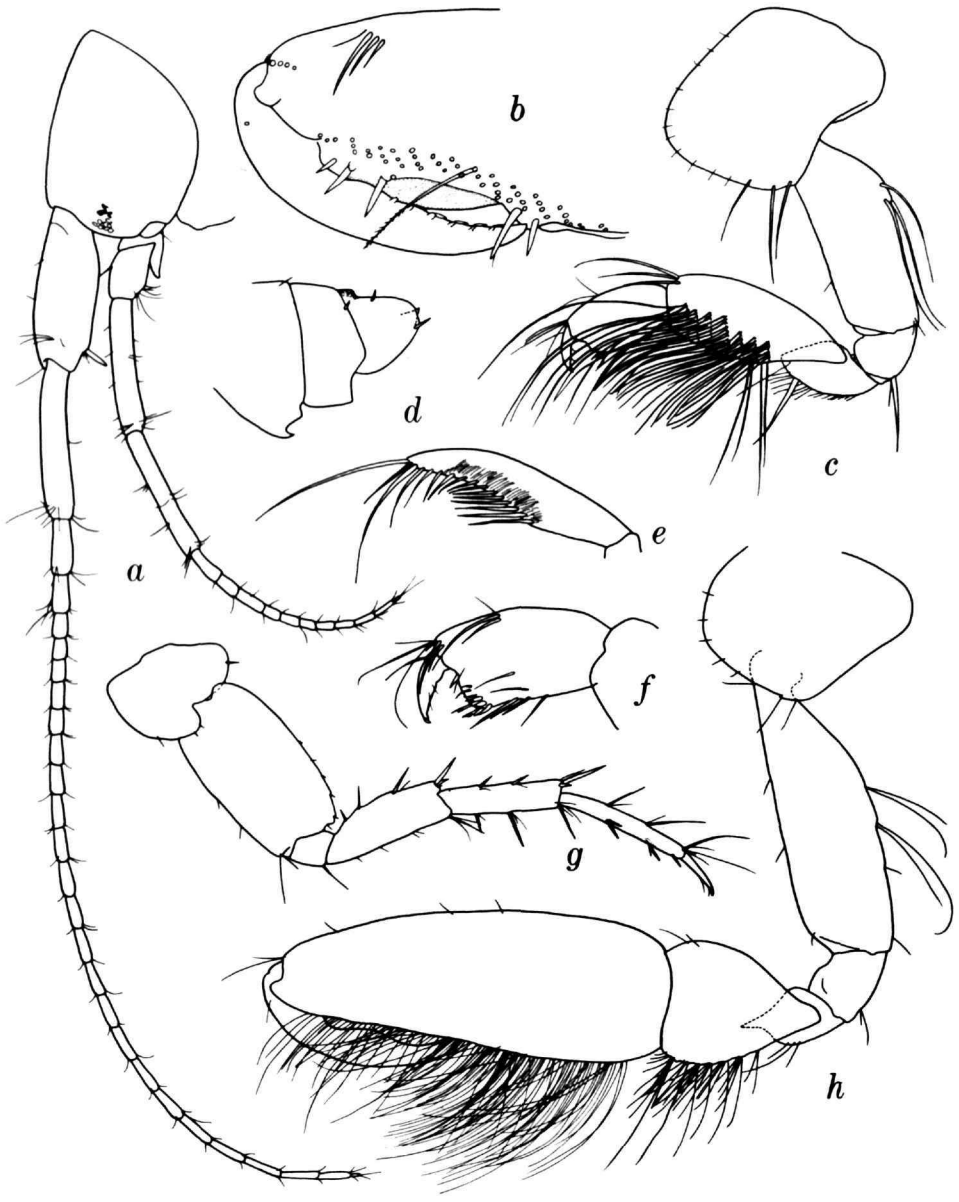

FIGURE 83.—*Eriopisa hamakua*, new species, holotype, male, 4.0 mm, JLB Hawaii 2: *a*, head; *b*, medial gnathopod 2; *c*, lateral gnathopod 1; *d*, left lateral urosome, uropods removed; *e*, mandibular palp article 3; *f*, apex of medial gnathopod 1; *g*, pereopod 3; *h*, lateral gnathopod 2.

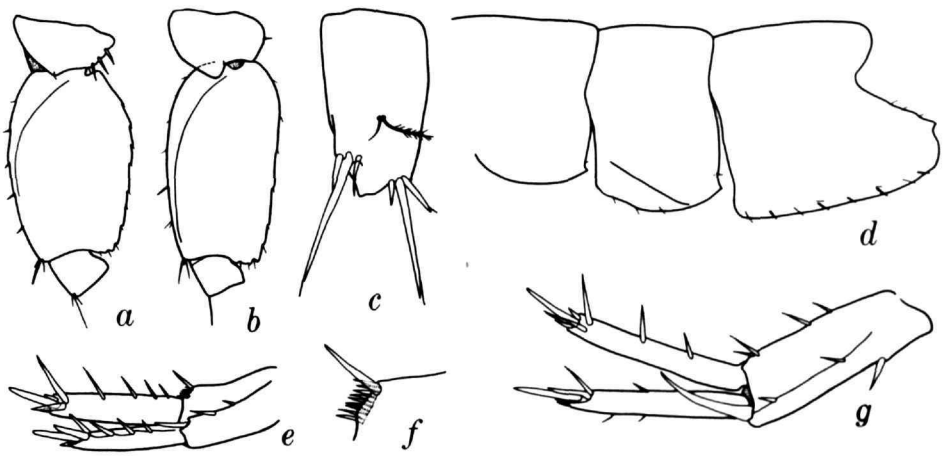

FIGURE 84.—*Eriopisa hamakua*, new species, holotype, male, 4.0 mm, JLB Hawaii 2: *a*, part of pereopod 5; *b*, part of pereopod 4; *c*, half of telson; *d*, pleonal epimera 1–3; *e*, uropod 2; *f*, comb-row of uropod 2; *g*, uropod 1.

as hand and slightly sinuous along inner margin, palm mediodistally with 3 spines and bearing defining bulge with 2 spines at apical extent of dactyl, palm medially with weak excavation; pereopods 1–2 with slender article 2; article 2 of pereopods 3–5 rectangular and relatively slender, posteroventral corners with sharp tiny cusp but not lobate, remainder of pereopodal articles slender; uropod 1 with large distolateral peduncular spine, outer ramus of uropod 2 slightly shorter than inner ramus, peduncle of uropod 2 with comb-row of spines on mediodistal end; (uropod 3 unknown); pleonal epimera 1–2 with small sharp posteroventral tooth and nearly straight posterior margins, epimeron 3 with large obtusely rounded posterior extension bearing sharp cusp on posterodorsal corner, oblique upper margin with 3 setules, ventral margin spinose; pleonite 4 with small dorsolateral setule, 5 with dorsolateral spinule on each side; telson thin dorsoventrally, of medium length but slightly broader than long, fully cleft, lobes less tilted than in *E. laakona*, new species, each apex with obtusely conical projection guarded on each side by 3 spines, middlemost spine of each triad longest; branchiae broadly ovate and pyriform, with narrow necks.

HOLOTYPE.—Bishop Museum collection, catalog number 7273, male 4.0 mm. Unique.

TYPE-LOCALITY.—JLB Hawaii 2, open sea off W end of Pearl Harbor, Oahu, 4–5 m, sand, encrustations, 29 January 1967.

RELATIONSHIP.—The absence of uropod 3 does not seriously detract from the placement of this species in *Eriopisa*, but relationships with several other species are clouded; however, the shape of pleonal epimeron 3 is so far unique in the genus.

Gnathopods have a slight relationship to those of *E. philippensis* (Chilton) and *E. seurati* Gauthier, but article 4 of gnathopod 1 is not swollen.

The right mandibular molar of *E. hamakua* has a seta and a flake.

DISTRIBUTION.—Hawaiian Islands.

Eriopisa laakona, new species

FIGURES 85, 86

DIAGNOSIS OF ?MALE.—Eyes absent, lateral cephalic lobes nearly vertically truncate and not protruding, lacking anteroventral notch; antenna 1 as long as head and pereon together, accessory flagellum 2-articulate, flagellum of antenna 2 as long as article 5 and half of article 4 together; mandibular palp long, slightly thickened, article 3 subfalcate and strongly setose; inner plates of maxillae 1–2 medially setose; coxae overlapping each other, coxae 1–2 longer than broad, 3–4 broader than long, coxa 1 rectangular, not produced or extended anteroventrally; article 4 of gnathopod 1 not inflated, article 5 longer than broad, posteriorly setose but unlobate, article 6 stout, rectangular, palm nearly transverse, dactyl short but fitting spinose palm;

gnathopod 2 larger than 1, article 5 of similar shape, but article 6 elongate, palm extremely oblique and defined from posterior margin of article 6 by 2 spines, 1 of them medial, dactyl slightly overlapping palm; pereopods 1–2 with slender article 2; article 2 of pereopods 3–5 changing from rectangular to ovatopyriform consecutively, but relatively slender, posteroventral corners with tiny sharp cusp but not lobate, remainder of pereopodal articles slender; uropod 1 with large distolateral peduncular spine, outer ramus of uropod 2 slightly shorter than inner, mediodistal peduncular margin of uropod 2 with comb-row of spines, article 2 of outer ramus on uropod 3 about 40 percent as long as article 1, forming slender cone lacking spines, inner ramus with sharp apex; pleonal epimera 1–2 with small, sharp posteroventral tooth and nearly straight posterior margins, epimeron 3 with large posteroventral tooth and slightly bulging posterior margin; pleonites 4–5 with 1 dorsolateral articulate spine on each side; telson thick dorsoventrally, short, broader than long, fully cleft, lobes slightly tilted away from horizontal axis to form tent as in *Hyale,* each apex with obtuse

FIGURE 85.—*Eriopisa laakona,* new species, holotype, ?male, 2.0 mm, JLB Hawaii 17: *a,* head; *b,* coxa 1 (tilted on its side); *c,* coxa 2; *d,* side view of telson; *e,* half of telson, dorsal; *f,* medial antenna 1; *g,* mandibular palp; *h,* apex of pereopod 1; *i,* pleonal epimeron 3 and urosome; *j,* inner plate of maxilliped; *k,* pleonal epimera 1–3. Specimen from JLB Hawaii 12: *l,* anterior margin of head.

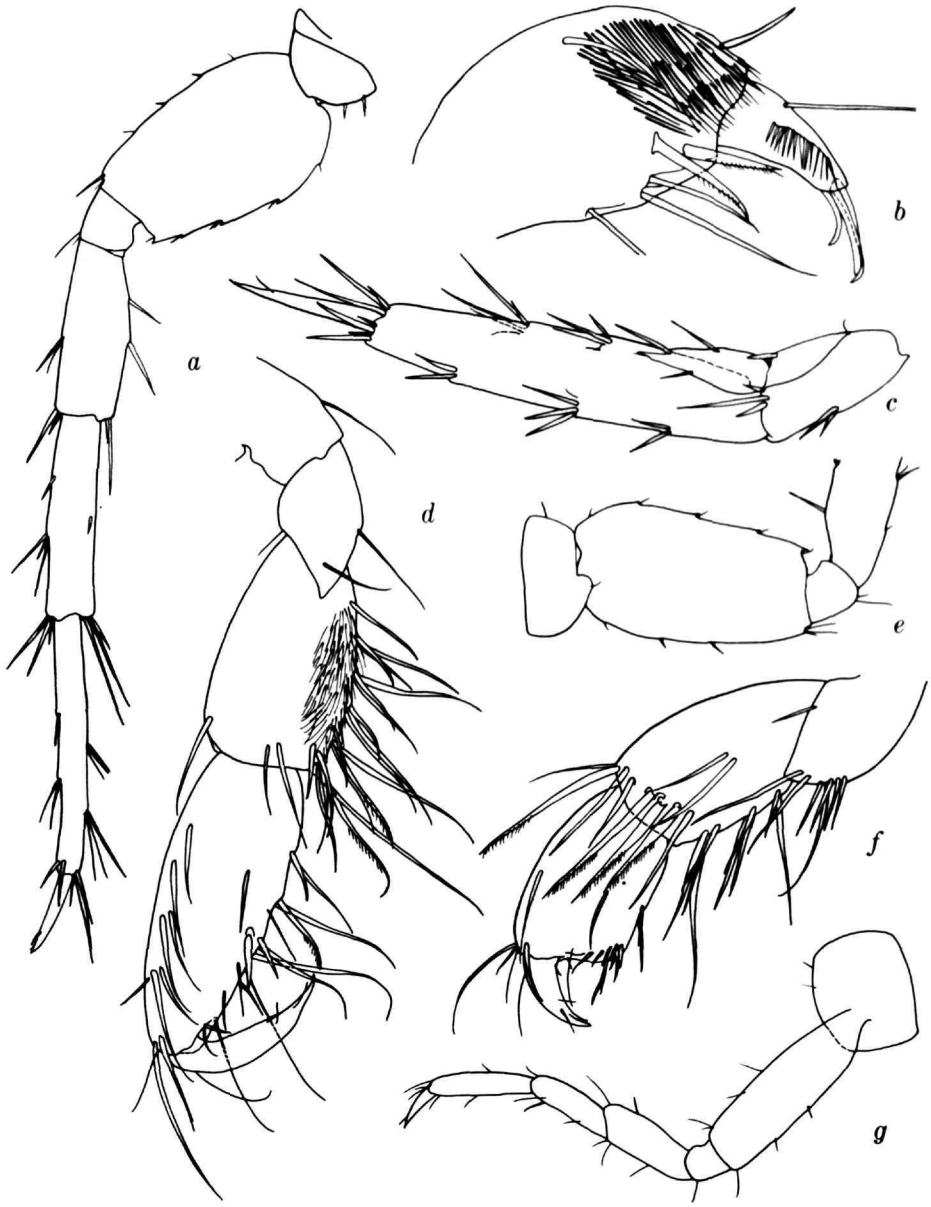

FIGURE 86.—*Eriopisa laakona*, new species, holotype, ?male, 2.0 mm, JLB Hawaii 17: *a*, pereopod 5; *b*, apex of maxillipedal palp; *c*, uropod 3; *d*, medial gnathopod 2; *e*, part of pereopod 4; *f*, medial gnathopod 1; *g*, pereopod 1.

projection guarded by spine on each side, lateral spine shortest; branchiae ovate and pyriform, with narrow necks.

HOLOTYPE.—Bishop Museum collections, catalog number 7274, ?male, 2.0 mm.

TYPE-LOCALITY.—JLB Hawaii 17, Kawela Bay, Oahu, intertidal, *Sargassum,* algae, rocks, corals, 24 May 1967.

MATERIAL.—JLB Hawaii 12 (1), 17 (3).

RELATIONSHIP.—*Eriopisa seurati* Gauthier, from Tunisia, also has the short article 2 on the outer ramus of uropod 3 like the Hawaiian species, but has numerous differences in mandibular palp, pereopods, gnathopods, head, telson, and otherwise on uropod 3.

Eriopisa garthi J. L. Barnard from Baja California, *E. elongata* (Bruzelius) from the North Atlantic, and the subterranean *E. philippensis* (Chilton) have the elongate kind of article 2 on the outer ramus of uropod 3. *Eriopisella capensis* (K. H. Barnard, 1916) (see Gurjanova, 1965) from South Africa has a short article 2 on uropod 3, but has rounded epimera, acutely produced coxa 1, blunt inner ramus on uropod 3, a short, rectolinear, apically setose article 3 on the mandibular palp, and a stout, lobate article 5 on gnathopod 2.

The four known species of *Eriopisella* differ from *E. laakona* in the absence of medial setae on the inner plates of the maxillae, but resemble it, like *Eriopisa seurati,* in the shortness of article 2 on the outer ramus of uropod 3. Each of them has numerous other differences from *E. laakona.* Those species are *Eriopisella pusilla* Chevreux, *E. sechellensis* Chevreux, *E. nagatai* Gurjanova, and *E. capensis* (K. H. Barnard).

Eriopisa laakona differs from *E. chilkensis* Chilton (1921) in the subfalcate palp article 3 of the mandible, the shorter article 2 on the outer ramus of uropod 3, the larger tooth on epimeron 3, the narrower article 2 of pereopod 5, and the narrower hand of gnathopod 1.

Eriopisella nagatai Gurjanova (1965) has a very broadly inflated palm on gnathopod 1, normally narrowed telsonic lobes, a further shortened article 2 on the outer ramus of uropod 3, trapezoidal and anteroventrally extended coxa 1, and a grossly lobate article 2 on pereopod 5.

DISTRIBUTION.—Hawaiian Islands.

Eriopisella sechellensis upolu, new subspecies

FIGURES 87, 88

DIAGNOSIS.—Male and female similar; eyes of medium size, brownish-purple in alcohol and with several clear peripheral ommatidia; lateral cephalic lobes scarcely protruding and rounded anteroventrally, lacking anteroventral notch; antenna 1 as long as head and first 9 body segments together, accessory flagellum short, 1 or 2-articulate, article 2 very small; antenna 2 about 40 percent as long as antenna 1; mandibular palp long, article 3 longer than 2, rectolinear and bearing 2 apical setae; inner plates of maxillae 1–2 setose only apically, inner plate of maxilla 1 with only 3 setae, palp article 1 elongate; coxae overlapping each other, coxae 1–2 broader than long, coxae 3–4 about as broad as long, coxa 1 strongly extended forward anteroventrally; article 4 of gnathopod 1 not inflated, article 5 longer than broad, weakly setose posteriorly but unlobate, article 6 rectangular, palm oblique, slightly convex, defined by 3 long marginal spines in tandem and 1 submarginal medial spine, dactyl fitting palm; gnathopod 2 scarcely larger than 1, article 5 longer than 6, bearing posterior lobe sloping distally and extended slightly along article 6, latter like that of gnathopod 1; pereopods 1–2 with slender article 2, middle of article 6 bearing compact group of posterior spines, dactyl with small accessory tooth; article 2 of pereopods 3–5 changing from rectangular to slightly pyriform consecutively, posteroventral corners unproduced, quadrate or subquadrate, remainder of pereopodal articles slender, dactyl not bifid, but with hooked distal nail and with constriction bearing seta and sharp guarding process; uropod 1 with large distolateral peduncular spine, outer ramus of uropod 2 shorter than inner ramus, peduncle of uropod 2 with comb-row of spines on distomedial end; article 2 of outer ramus on uropod 3 about 30 percent as long as article 1, rectangular, inner ramus with blunt apex armed with 2 spines; pleonal epimera 1–3 each with sharp posteroventral tooth and bulging or straight posterior margins, epimeron 2 with several ventrolateral setae in stepped row; pleonite 4 with dorsolateral setule on each side; telson thin dorsoventrally, of medium length, as broad as long, lobes scarcely tilted from flat plane, each lobe with obtuse distolateral apex bearing spine and setule on medial slope; branchiae ovate and pyriform, with narrow necks.

HOLOTYPE.—Bishop Museum collections, catalog number 7275, male, 2.4 mm.

TYPE-LOCALITY.—JLB Hawaii 12, Kaneohe Bay, Oahu, 3–4 m, corals, algae, corallines, 4 March 1967.

MATERIAL.—JLB Hawaii 6 (1), 12 (7).

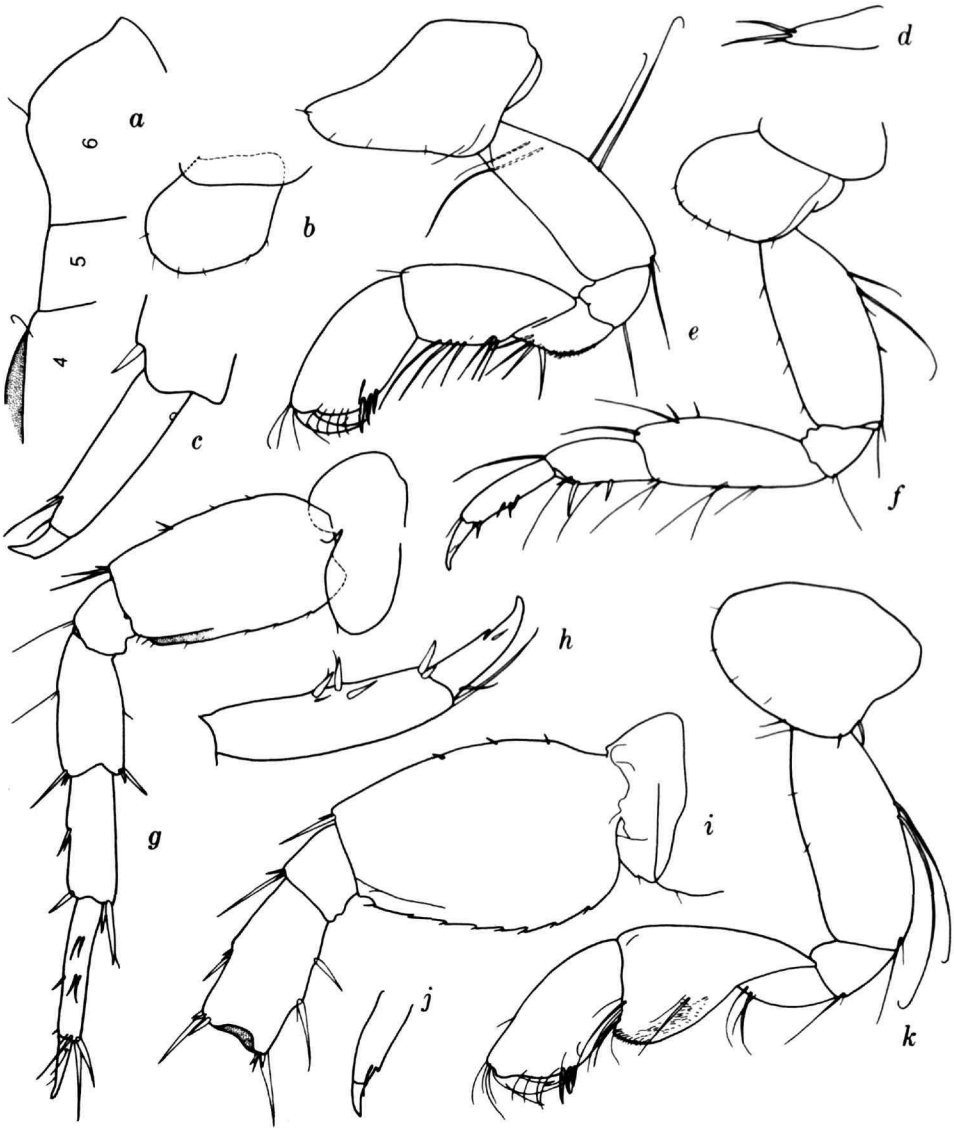

FIGURE 87.—*Eriopisella sechellensis upolu,* new subspecies, holotype, male, 2.4 mm, JLB Hawaii 12: *a,* dorsal edge of urosomites 1–3; *b,* coxa 3; *c,* apex of pereopod 4; *d,* inner plate of maxilla 1; *e,* gnathopod 1; *f,* pereopod 2; *g,* pereopod 3; *h,* apex of pereopod 2; *i,* pereopod 5; *j,* apex of pereopod 1; *k,* gnathopod 2.

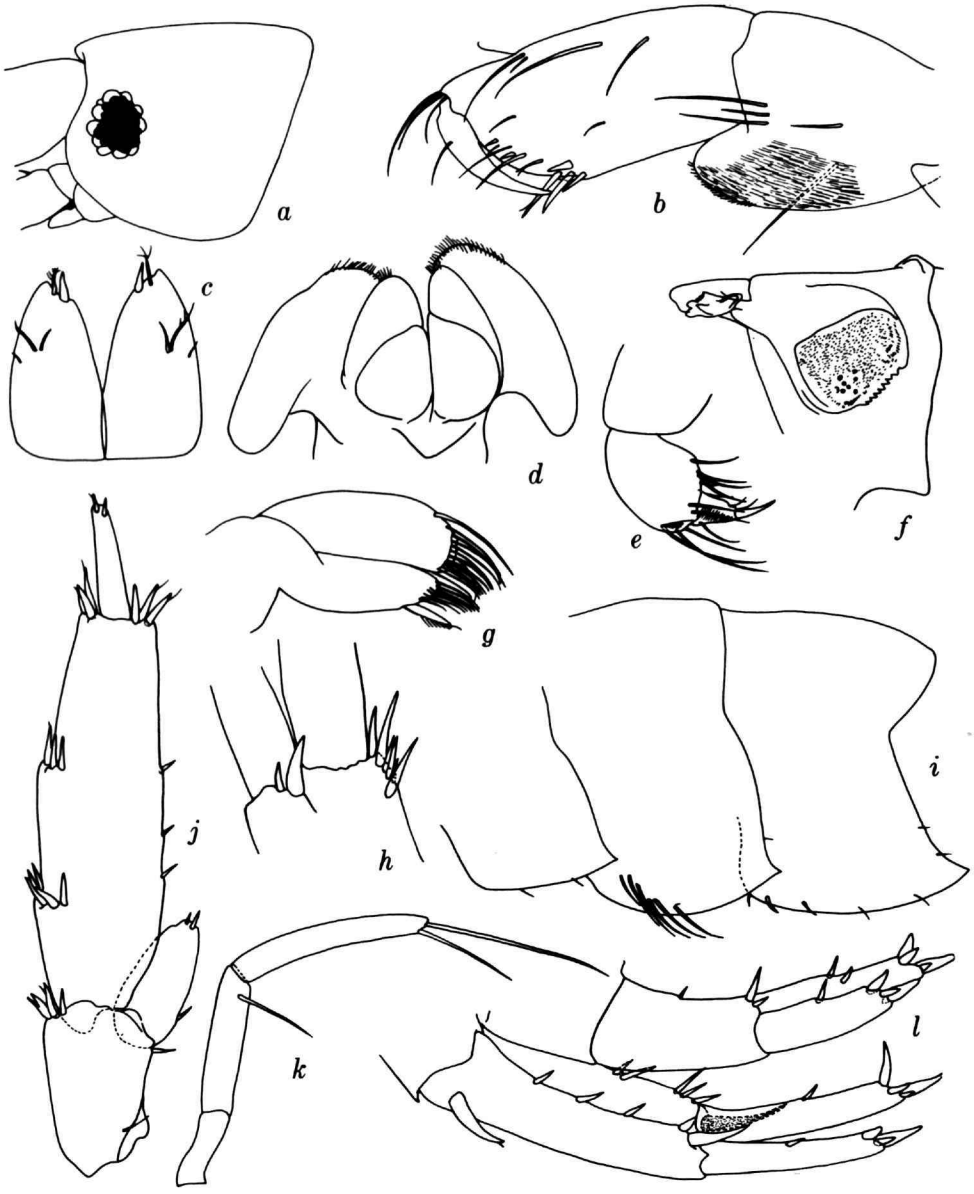

FIGURE 88.—*Eriopisella sechellensis upolu*, new subspecies, holotype, male, 2.4 mm, JLB Hawaii 12: *a*, head; *b*, apex of medial gnathopod 2; *c*, telson; *d*, lower lip; *e*, apex of maxillipedal palp; *f*, part of right mandible; *g*, maxilla 2; *h*, apex of peduncle on uropod 2 to show comb-row; *i*, pleonal epimera 1–3; *j*, uropod 3; *k*, mandibular palp; *l*, uropods 1–2.

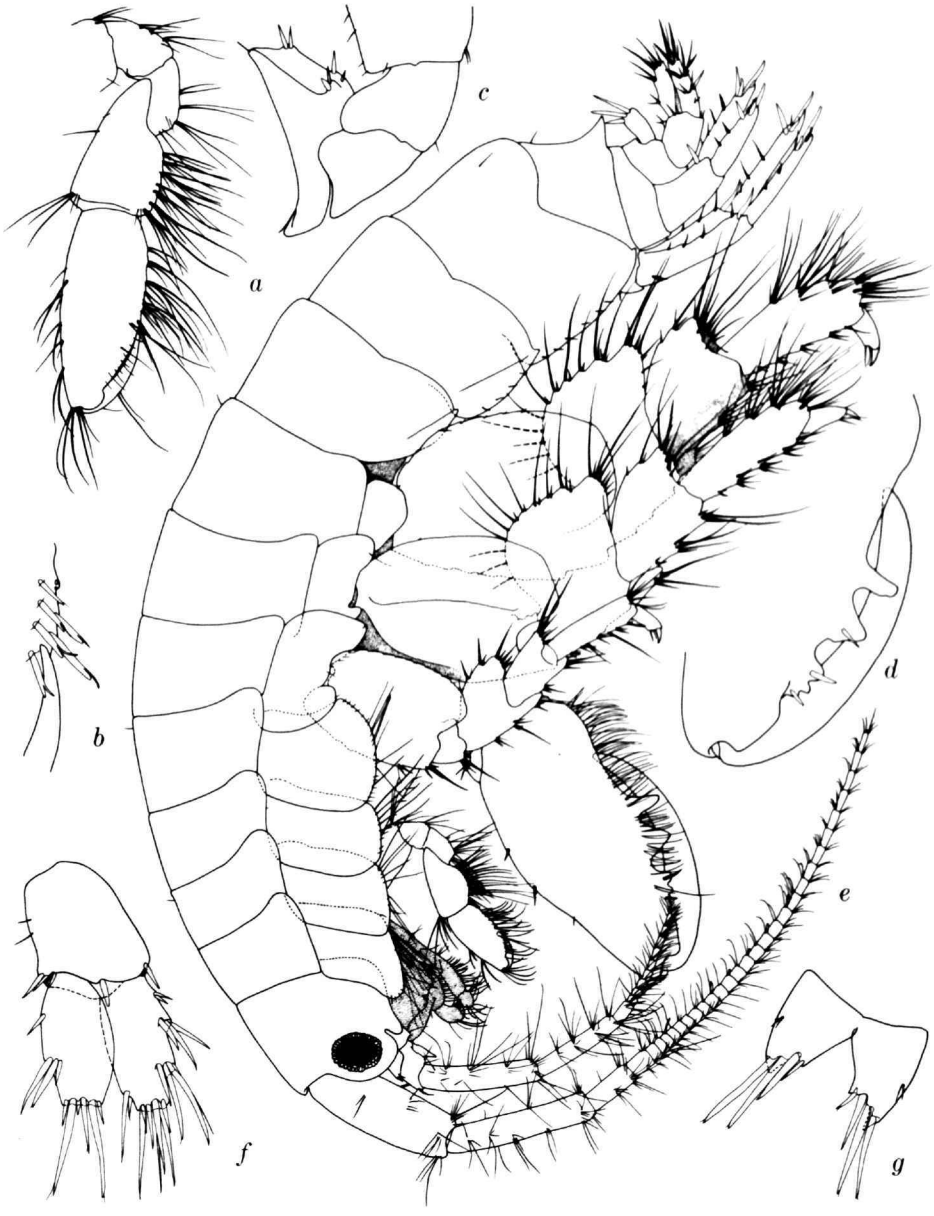

FIGURE 89.—*Maera insignis* (Chevreux), female, 6.8 mm, JLB Hawaii 12: *a*, lateral gnathopod 2; *b*, palm of medial gnathopod 2. Male, 7.7 mm: *c*, articles 2–5 of medial gnathopod 2; *d*, palm of lateral gnathopod 2; *e*, body; *f*, uropod 3; *g*, telson.

RELATIONSHIP.—This subspecies resembles closely the typical subspecies *Eriopisella s. sechellensis* (Chevreux, 1901), but the hands of the gnathopods are slightly narrower, less ovate and more rectangular, the lateral cephalic lobes are more strongly rounded, and the dactyls of pereopods 3–5 are not bifid.

Eriopisella pusilla Chevreux (see Chevreux and Fage, 1925), from the Mediterranean Sea, though resembling *E. sechellensis* in many ways, has a more strongly hemicircular cephalic lobe and vestigial eye dot, noncontiguous coxae 5–7, slender body, and imperfectly bifid dactyl on pereopod 5.

Eriopisella capensis (K. H. Barnard, 1916) has article 3 of the mandibular palp shorter than article 2, a much elongate palm on gnathopods 1–2, more evenly triangular article 5 on gnathopod 2, rounded pleonal epimera 1–3, shorter antenna 1, and narrower anterior process on coxa 1.

Affinities with *Eriopisella* (*Netamelita*) *cortada* (J. L. Barnard, 1962b) are strong, but *E. s. upolu* differs from that Californian species in the presence of article 2 on the outer ramus of uropod 3, the sharp, not rounded apices of the telsonic lobes, the presence of a posteroventral tooth on pleonal epimeron 1, the narrow article 2 of pereopod 5, and strongly extended coxa 1.

DISTRIBUTION.—Hawaiian Islands.

Maera insignis (Chevreux)

FIGURE 89

Elasmopus insignis Chevreux, 1901 pp. 406–412, figs. 24–31.
Maera insignis.—Schellenberg, 1938, pp. 50–52, fig. 24.—J. L. Barnard, 1955a, pp. 12–13.

MATERIAL.—JLB Hawaii 8 (1), 12 (23), 13 (7), 14 (9+), 15 (18+), 17 (5+), 18 (1). Fee 1 (27).

DISTRIBUTION.—Indo-Pacific.

Maera kaiulani, new species

FIGURES 90, 91

DIAGNOSIS OF FEMALE.—Lateral cephalic lobes softly quadrangular, anterolateral cephalic corner produced as narrow sharp tooth, eyes subreniform, orange in alcohol; upper lip lobate as in *"Linguimaera"* (Pirlot, 1936); coxa 1 weakly extended and sharp anteroventrally, anterior coxae lacking posteroventral notch; gnathopod 1 of medium stoutness, article 6 ovatorectangular, palm oblique and convex, slightly shorter than posterior margin of article 6, defined by tiny sharp cusp and 3 spines, article 5 with several medial rows of diverse setal spines, article 4 lacking posterodistal cusp; gnathopod 2 occasionally of different sizes on either side, very large, article 2 with medium-size anterodistal lobe, article 3 with similar lobe, article 4 weakly extended posterodistally on large gnathopod, sharp on small gnathopod, article 5 very short, with long tumid posterior lobe or less tumid on small gnathopod, article 6 very large, subrectangular, slightly expanded distally, palm nearly transverse, but weakly rounded and defined by large, sharp tooth-bearing spine, tooth next to small sinus, palm spinose and slightly scalloped and with one slight excavation near anterior end, dactyl fitting palm, small gnathopod with smooth but spinose palm and weak defining tooth; article 2 of pereopods 3–5 changing from narrowly ovatorectangular on pereopod 3 to subovate on pereopod 5, posteroventral lobes of medium extent; dactyls of pereopods 1–5 with strong distal constriction bearing sharp defining corner and armed with stout seta-bearing flange, sharp nail with large acute accessory tooth, facial setule, constriction also bearing stout setule appressed to margin of nail, locking spines straight and slightly pectinate; pleonal epimera 1–3 with rounded posterior margins and small to medium-sized posteroventral tooth, ventrally spinose, epimera 1–2 with lateral ridge, pleonites dorsally smooth; uropod 3 scarcely exceeding extent of uropods 1–2, rami flat, of medium breadth, apically truncate and spinose, inner ramus slightly shorter than outer, latter with thin article 2; telson deeply but not fully cleft, lobes with strongly fixed medial gap, each apex deeply and sharply bifid and bearing 2 spines nearly as long as telson.

MALE.—Gnathopod 2 slightly larger than largest of female, equal to each other on either side of animal.

JUVENILE DEVELOPMENT, 1.9 MM.—Accessory flagellum with 2 very long and 1 short articles, flagellum of antenna 2 with 4 articles; inner plate of maxilla 1 with 3 long and 2 short setae, same as adult; gnathopod 2 with large cusp on article 4, article 5 long and poorly setose, palm oblique, smooth, spinose, defined by slight protrusion and several spines and setae; article 2 of pereopods 3–4 slender, that of pereopod 5 basally expanded and tapering distally; inner ramus of uropod 2 reaching only two-thirds along outer ramus of uropod 3; outer ramus of uropod 3 over twice as long as peduncle, inner ramus slightly less than half as long as outer ramus, thus resembling *Melita*, uropod 3 exceeding extent of uropods 1–2 by more than length of

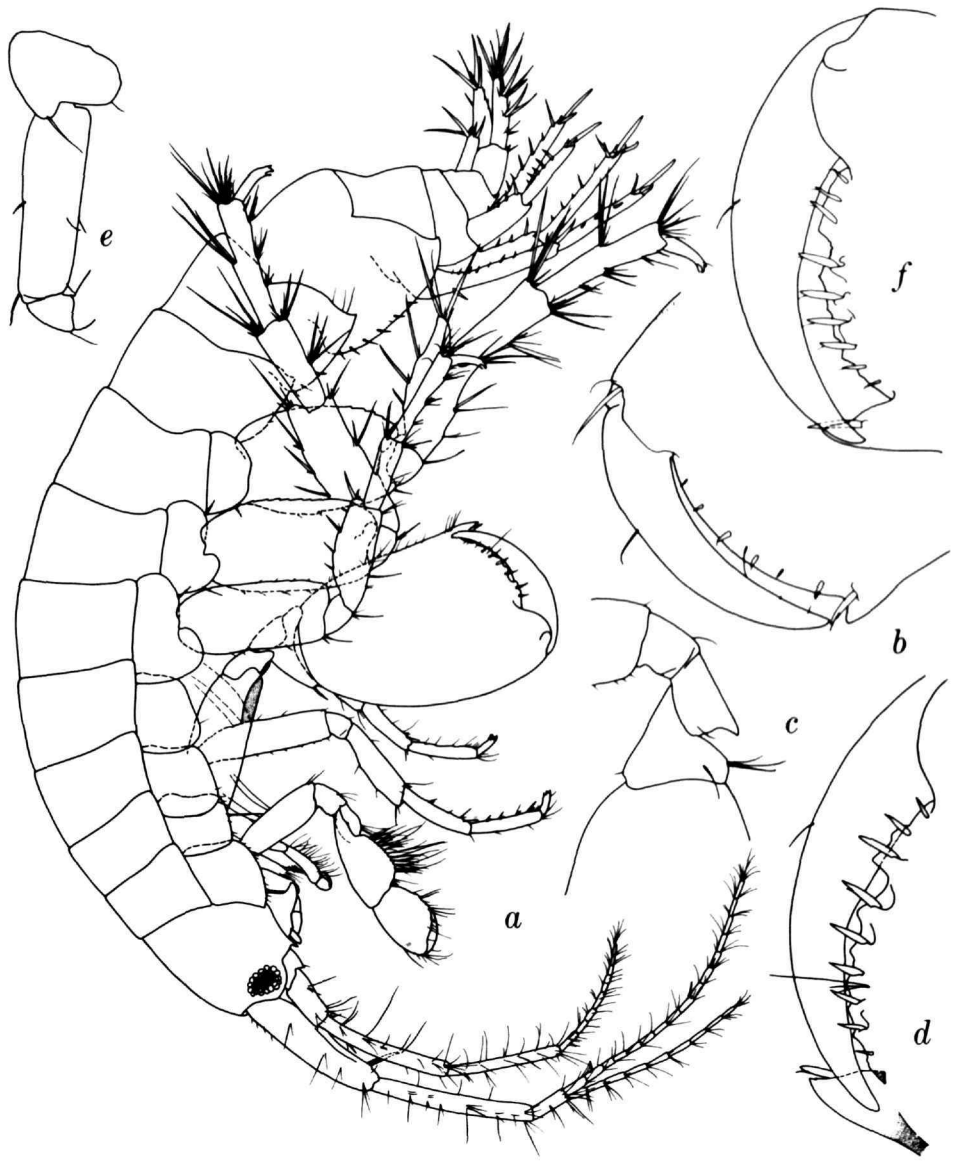

FIGURE 90.—*Maera kaiulani*, new species, holotype, female, 6.3 mm, JLB Hawaii 2: *a*, body; *b*, palm of medial gnathopod 2 (right member); *c*, cusp on article 4 of right gnathopod 2; *d*, palm of lateral gnathopod 2 (left member). Juvenile, 1.9 mm: *e*, base of pereopod 4. Male: *f*, palm of lateral gnathopod 2.

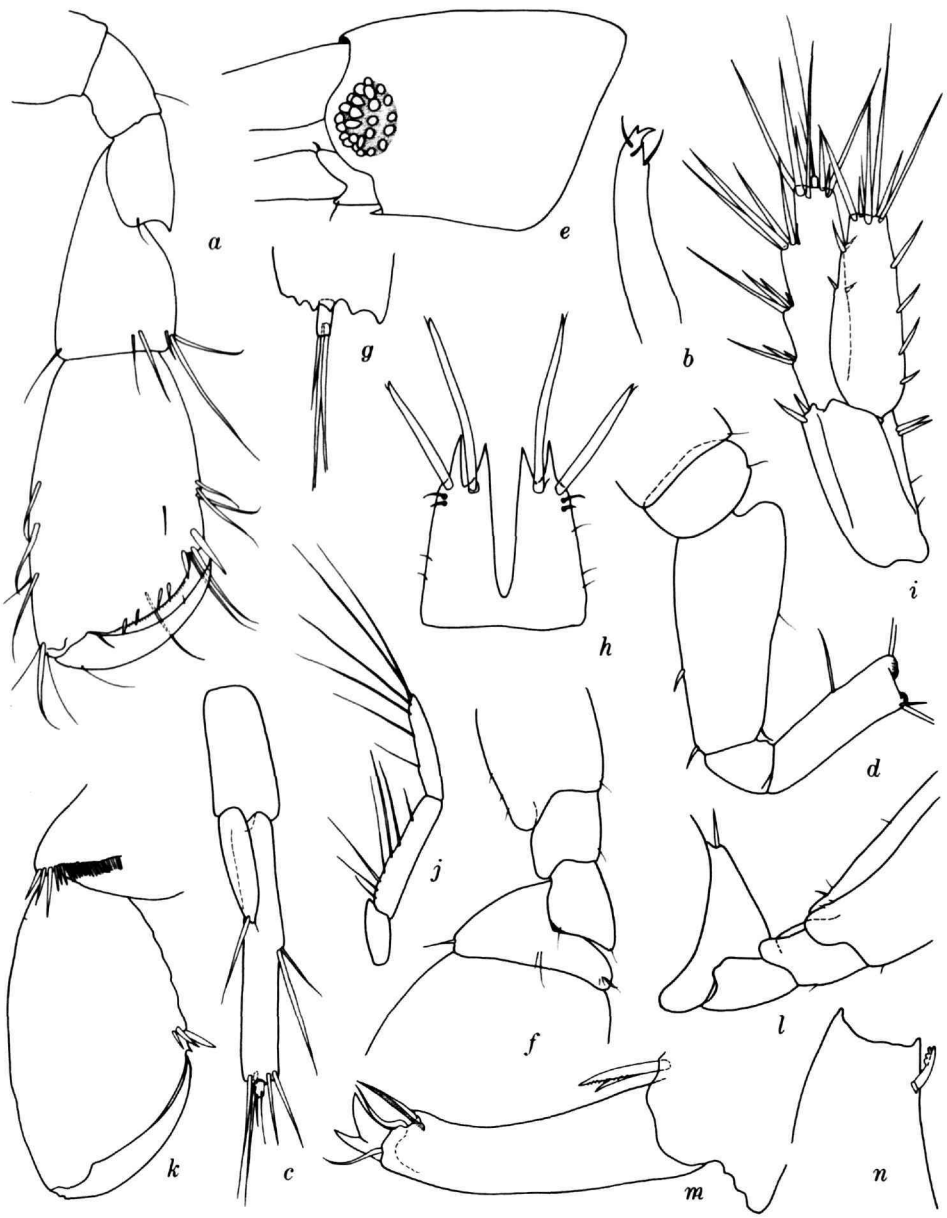

FIGURE 91.—*Maera kaiulani*, new species, juvenile, 1.9 mm, JLB Hawaii 2: *a*, medial gnathopod 2; *b*, dactyl of pereopod 5; *c*, uropod 3; *d*, base of pereopod 5. Male: *e*, head; *f*, articles 2–6 of medial gnathopod 2. Holotype, female, 6.3 mm: *g*, apex on outer ramus of uropod 3; *h*, telson; *i*, uropod 3; *j*, mandibular palp; *k*, hand of medial gnathopod 1, setae mostly removed; *l*, articles 2–5 of lateral gnathopod 2; *m*, dactyl of pereopod 3; *n*, inner plate of maxilliped, setae removed.

telson; telson with only middle spine present on each apex.

JUVENILE, 2.5 MM.—Inner ramus 80 percent as long as outer ramus on uropod 3 but rami exceeding uropod 2 by more than length of telson, lateral telsonic spine about half as long as medial, article 2 of pereopod 3 slender, but that of pereopods 4–5 becoming expanded.

YOUNG ADULT, 4.5 MM.—Rami of uropod 3 like those of adult, with inner ramus nearly as long as outer, uropod 3 exceeding uropod 2 by half length of telson.

HOLOTYPE.—Bishop Museum collections, catalog number 7276, female, 6.3 mm.

TYPE-LOCALITY.—JLB Hawaii 2, off W end of Pearl Harbor, Oahu, 4–5 m, encrustations from sand reef, 29 January 1967.

MATERIAL.—Twelve specimens from the type-locality.

REMARKS.—This species has its closest affinites with *M. pacifica* Schellenberg, a species known from the Gilbert, Fiji, and Hawaiian Islands. *Maera kaiulani* differs from *M. pacifica* in the absence of dark ocular pigment, the deeply and sharply bifid telsonic lobes, the slightly shorter defining tooth on gnathopod 2, the scalloped palms, narrower article 2 of pereopods 3–4 in adults, and the absence of a small inner acclivity on male gnathopod 2 dactyl (mostly absent in *M. pacifica* from Hawaii).

The developmental steps undergone by uropod 3 during maturation of this species are remarkable, for in early stages this species resembles the genus *Melita* in having a short inner ramus. The mouthparts of *M. kaiulani* and *M. pacifica* are almost indistinguishable; the mandibular body and molar are very massive, and the inner plates of the maxillipeds bear apicolateral cusps giving the distal end an excavate appearance.

DISTRIBUTION.—Hawaiian Islands.

Maera pacifica Schellenberg

FIGURES 92, 93

Maera pacifica Schellenberg, 1938, pp. 42–45, figs. 19, 20.—J. L. Barnard, 1965a, p. 511.

DIAGNOSIS OF MALE.—Lateral cephalic lobes softly rounded, scarcely quadratiform, anteroventral cephalic corner produced as narrow sharp tooth; eyes subcircular, bright to brownish-purple in alcohol; upper lip lobate as in "*Linguimaera*" (Pirlot, 1936); coxa 1 weakly extended, setose and rounded anteroventrally, coxa 2 very narrow anteroposteriorly, anterior coxae lacking posteroventral notch; gnathopod 1 of medium stoutness, article 6 ovatorectangular, palm oblique and convex, equal to posterior margin of article 6, defined by tiny sharp cusp and spine, article 5 with several medial rows of diverse setal spines, article 4 lacking posterodistal cusp; gnathopod 2 occasionally of slightly different size on each side, very large, article 2 with medium-sized anterodistal lobe, article 3 with similar lobe, article 4 unextended 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 small sinus, palm spinose and very weakly scalloped and with 1 medium-sized excavation near middle, dactyl fitting palm and occasionally with inner acclivity fitting excavation; article 2 of pereopods 3–5 ovate, posteroventral lobes broad; dactyls of pereopods 1–5 with strong distal constriction bearing sharp defining corner and armed with stout seta-bearing flange, sharp nail with large acute accessory tooth, facial setule, constriction also bearing stout setule appressed to margin of nail, locking spines straight and slightly pectinate; pereopods 4–5 stout, article 4 of pereopod 3 very tumid; pleonal epimera 1–3 with slightly convex posterior margins and small to medium-sized posteroventral tooth, that of epimeron 1 especially sharp, epimera ventrally spinose, 1–2 with lateral ridge; pleonites dorsally smooth; uropod 3 not or slightly exceeding extent of uropods 1–2, rami flat, of medium breadth or narrow, apically truncate and spinose, inner ramus very slightly shorter than outer, latter with thin article 2; telson deeply but not fully cleft, with strongly fixed medial gap, lobes with medium-sized or small medial cusp but not bifid, armed with 3–5 spines on each lobe, at least 3 spines as long as telson.

FEMALE.—Gnathopod 2 slightly smaller than in male, palm lacking incision and slightly more strongly scalloped; coxa 2 of normal dimensions.

VARIATIONS.—Occasional individuals have one or two of the six members of pereopods 3–5 with narrow article 2 like *M. quadrimana*, but most of these appear to be the result of regeneration of legs accidentally lost.

MATERIAL.—JLB Hawaii 6 (?2), 13 (4), 14 (6), 17 (4). Fee 1 (2).

REMARKS.—The Hawaiian population of this species has a stronger anteroventral cephalic tooth,

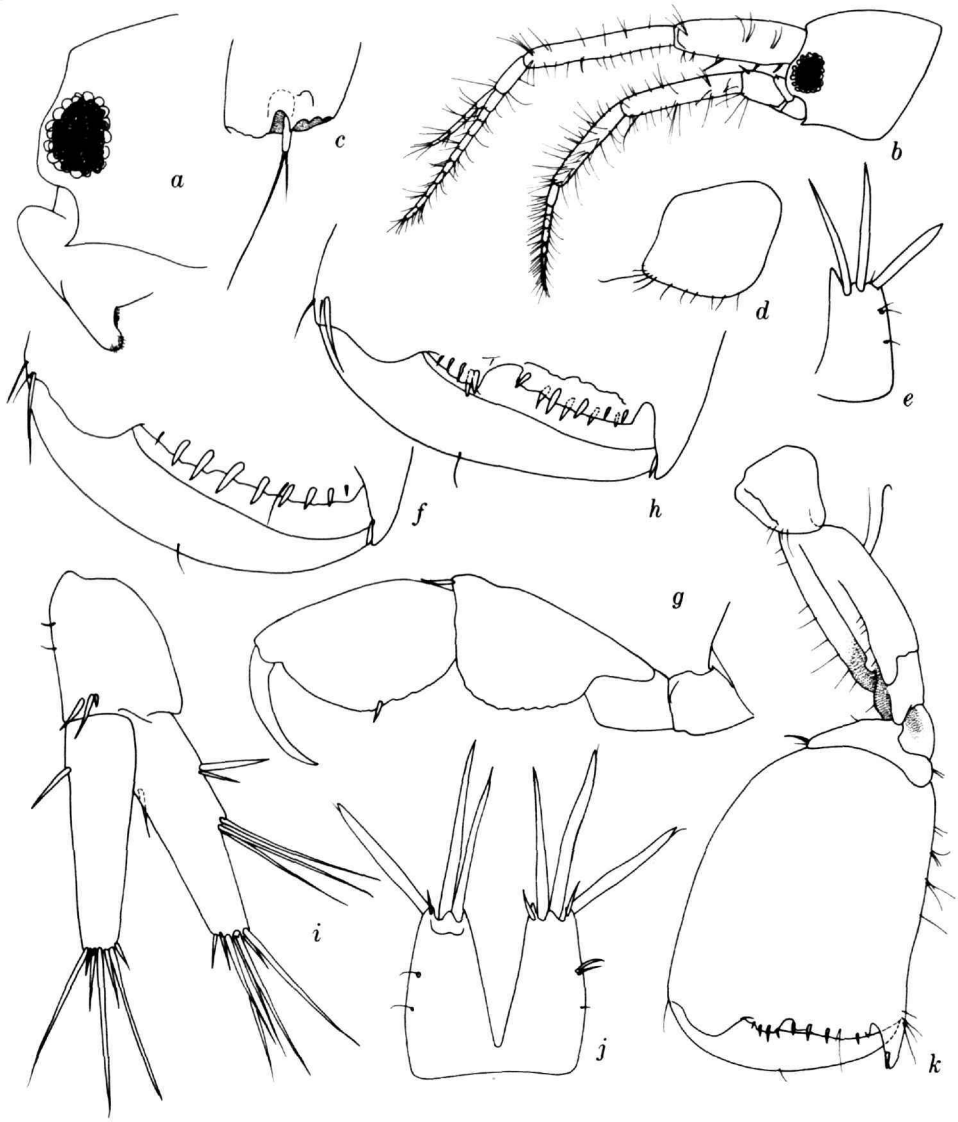

FIGURE 92.—*Maera pacifica* Schellenberg, female, 5.7 mm, Fee 1: *a, b,* head; *c,* apex of outer ramus on uropod 3; *d,* coxa 1; *e,* half of telson; *f,* palm of gnathopod 2; *g,* gnathopod 1, setae removed. Male, 5.0 mm: *h,* palm of gnathopod 2; *i,* uropod 3; *j,* telson; *k,* gnathopod 2.

smaller incision adjacent to defining tooth on gnathopod 2 palm, stronger medial telsonic cusps in small males and large females, longer telsonic spines and a more tumid article 4 of pereopod 3 than in the materials from southern Polynesia and Micronesia.

Several characters comparable to or slightly different from the figures of *M. kaiulani,* new species, are the presence of only 1 defining spine on the palm of gnathopod 1, the more strongly setose coxae, the additional sets of spines on articles 5–6 of pereopods 1–2, the similar dactyls of pereopods 1–5, and the shorter antennae 1–2. Maxilla 2 of *M. pacifica* in Hawaii has setae occurring as far down the inner margin as one-third of its length, the mandibular palp is more tumid and more setose than in *M. kaiulani,* and the maxillipeds are similar between the two species.

DISTRIBUTION.—Southern Polynesia, Micronesia, Hawaiian Islands.

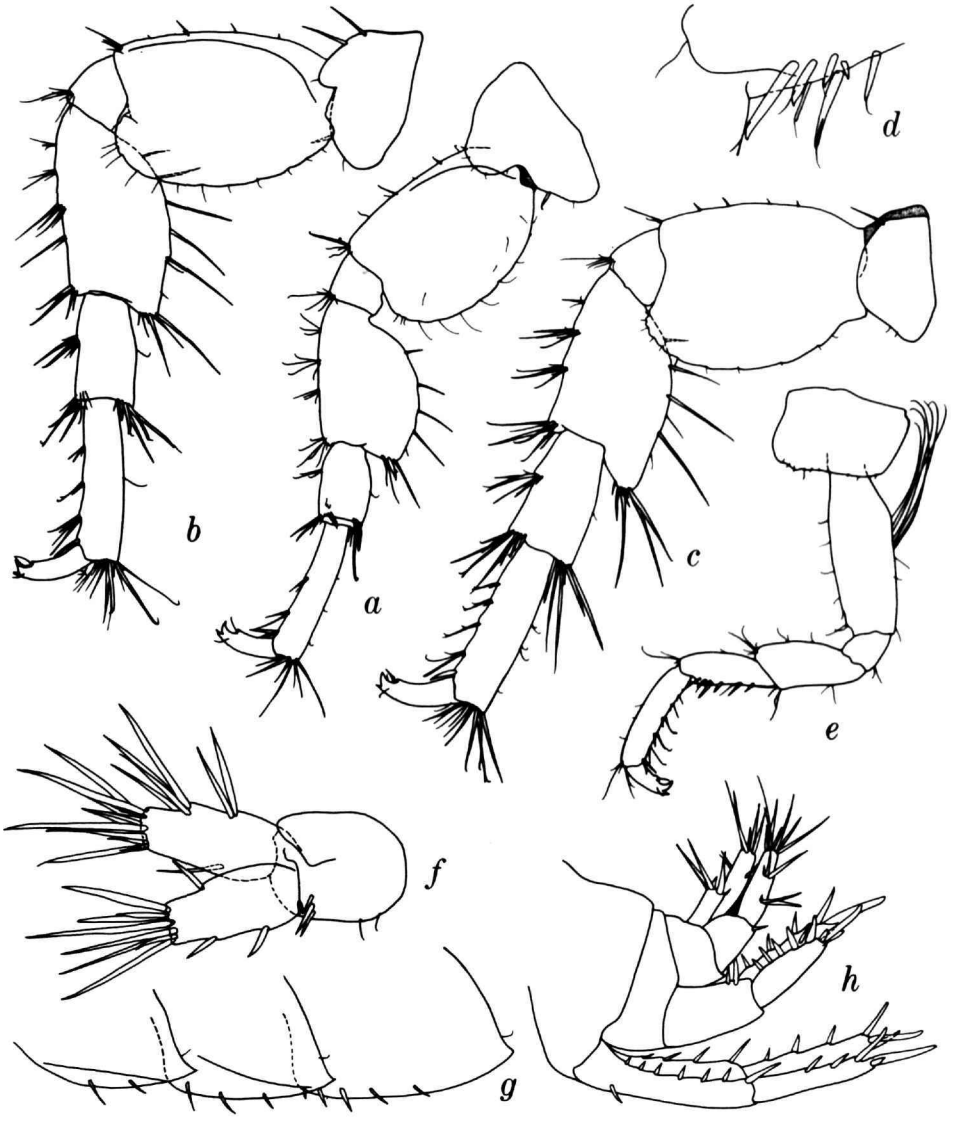

FIGURE 93.—*Maera pacifica* Schellenberg, female, 5.7 mm, Fee 1: *a, b, c,* pereopods 3, 4, 5; *d,* lateral apex of article 5 on pereopod 2; *e,* pereopod 2; *f,* uropod 3; *g,* pleonal epimera 1–3; *h,* urosome.

Maera quadrimana (Dana)

FIGURES 94, 95

Gammarus quadrimanus Dana, 1853, pp. 955–956, pl. 65, fig. 9.

Maera quadrimana.—Schellenberg, 1938, pp. 45–48, figs. 21–22.—J. L. Barnard, 1955a, p. 13; 1965a, pp. 511–512, fig. 17.

DIAGNOSIS OF HAWAIIAN MALE.—Lateral cephalic lobes softly quadrate, anteroventral corner of head produced as narrow sharp tooth; eyes subcircular, brownish-purple in alcohol; upper lip anteriorly lobate as in "*Linguimaera*" (Pirlot, 1936); coxa 1 weakly extended, setose and rounded anteroventrally, coxa 2 very narrow anteroposteriorly, anterior coxae 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 tiny cusp and spine, article 5 with several medial

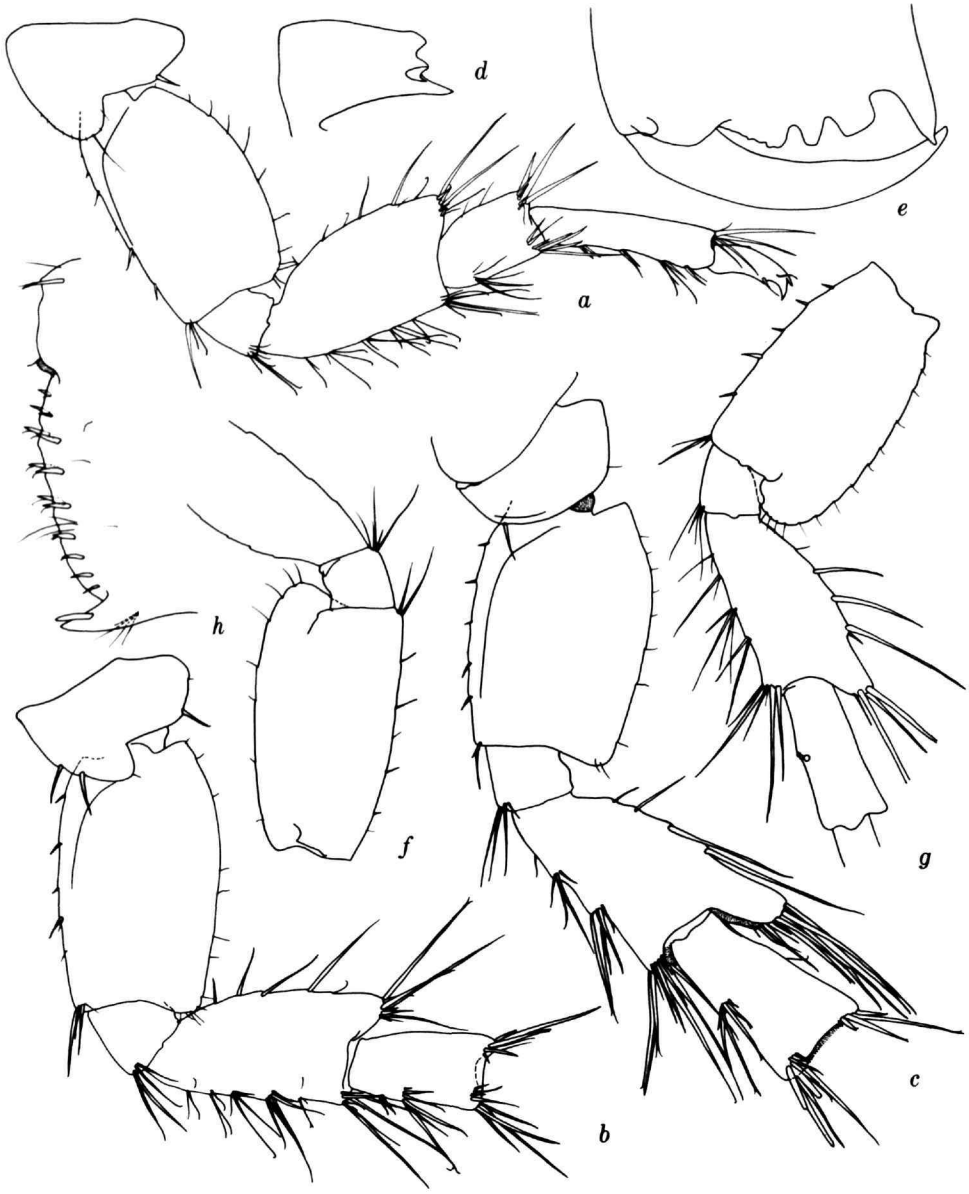

FIGURE 94.—*Maera quadrimana* (Dana), male, 6.4 mm, Waimanalo, Oahu, 17 April, 1951: *a, b, c,* pereopods 3, 4, 5. Male, 3.3 mm, JLB Hawaii 5: *d,* half of telson; *e,* palm of lateral gnathopod 2; *f, g,* parts of pereopods 4, 5. Female, 5.0 mm, Waimanalo: *h,* palm of medial gnathopod 2.

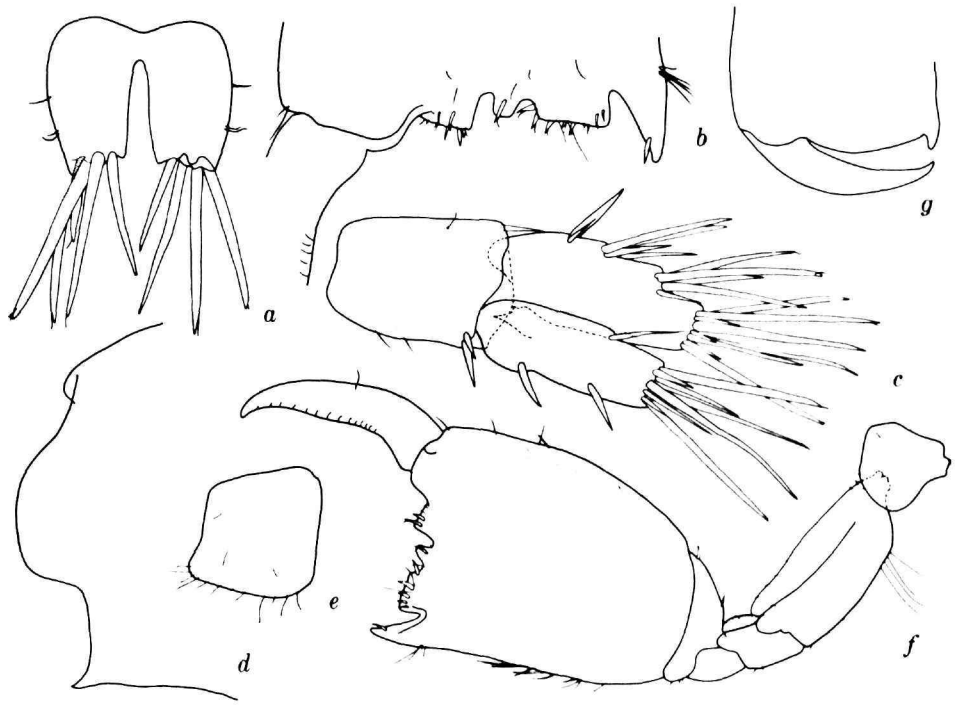

FIGURE 95.—*Maera quadrimana* (Dana), male, 6.4 mm, Waimanalo, Oahu, 17 April, 1951: *a*, telson; *b*, palm of medial gnathopod 2; *c*, uropod 3; *d*, anterior outline of head; *e*, coxa 1; *f*, gnathopod 2. Male, 3.3 mm, JLB Hawaii 5: *g*, palm of right gnathopod 2.

rows of diverse setal spines, article 4 lacking posterodistal cusp; gnathopod 2 very large, article 2 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 sharp sinus, palm divided into 3 diverse truncate, spinose processes separated by 2 sinuses, dactyl fitting palm and lacking acclivity; article 2 of pereopods 3–5 narrowly ovatorectangular, with slightly extended, angular posterodistal corners, each with posteroproximal extension; dactyls of pereopods 1–5 with strong distal constriction bearing sharp defining corner and armed with stout seta-bearing flange, sharp nail with large acute accessory tooth, facial setule, constriction also bearing stout setule appressed to margin of nail, locking spines straight and slightly pectinate; articles 4–6 of pereopods 3–5 as in *M. pacifica,* article 4 of pereopod 3 tumid, of pereopod 4 but especially of pereopod 5 grossly extended posterodistally; pleonal epimera 1–3 with slightly convex posterior margin and small to medium-sized, sharp posteroventral tooth, epimera ventrally spinose, 1–2 with lateral ridges; pleonites dorsally smooth; uropod 3 not exceeding extent of uropods 1–2, rami flat, of medium breadth, apically truncate and spinose, inner ramus very slightly shorter than outer, latter with thin article 2 hidden among spines; telson deeply but not fully cleft, with strongly fixed medial gap, lobes with mediodistal corner unproduced, armed with 4–5 spines, mostly spines as long as or longer than telson.

FEMALE.—Gnathopod 2 slightly smaller than in male, palm slightly scalloped and convex, bearing only incision next to defining tooth; coxa 2 like that of male.

SMALL MALE OF JLB HAWAII 5.—With left male gnathopod 2 like that originally figured by Dana and Schellenberg in which palmar teeth all projecting equally except defining tooth and largest middle palmar teeth only about twice (instead of thrice) as broad as smallest; pereopods 4–5 like those of *M. pacifica* and not the original *M. quadrimana,* but pereopods 4–5 slightly more slender than in *M. pacifica;* telson with strong medial cusp on each lobe; inner

ramus of uropod 3 only two-thirds as long as outer ramus, right gnathopod 2 small and plain as if undergoing regeneration.

YOUNG INDIVIDUAL OF JLB HAWAII 14.—Rami of uropod 3 elongate, equal to each other in length.

MALE OF KAWELA BAY.—Article 2 of gnathopod 2 with anterior spines instead of setules, pereopod 5 like pereopod 4 of *M. pacifica,* with broadly rounded posteroventral corner of article 2.

MATERIAL.—JLB Hawaii 5 (3), 14 (1). Waimanalo, Oahu, 17 April 1951 (4). Kawela Bay, Oahu, 2–7 September 1948 (4).

REMARKS.—The material at hand is insufficient to link the small form of JLB Hawaii 5, with "normal" gnathopods and abnormal pereopods, to the large form of Waimanalo having abnormal gnathopods and normal pereopods.

DISTRIBUTION.—Micronesia, southern Polynesia, Hawaii.

Maera serrata Schellenberg

FIGURES 96, 97

Maera inaequipes serrata Schellenberg, 1938, pp. 41–42, fig. 18.—J. L. Barnard, 1965a, p. 510.

NOMENCLATURE.—Schellenberg described this taxon as a subspecies of *M. inaequipes,* but it and the latter are sympatric and should either be recognized as conspecific phenotypes/ecotypes or recognized as distinct species. Though one may presume one phenotype of a species and not the other may exist in a geographic area, the absence so far of any record typical of *M. i. inaequipes* in Hawaii suggests that *M. serrata* is a distinct species occurring both in southern Polynesia and in Hawaii. Because the *M. serrata* of Hawaii probably has a distinct character worthy of subspecific appellation, a quadrinomial would be required to signal that distinction. For the present, I hesitate to establish the Hawaiian population as subspecifically distinct from the population in southern Polynesia, but such trinomial procedure would now be simplified in that *M. serrata* is elevated to full specific rank. If the males described below are fully terminal then the Hawaiian population should be recognized nomenclaturally.

DIAGNOSIS OF MALE.—Lateral cephalic lobes softly rounded, anteroventral cephalic tooth sharp and thin; eyes subcircular, pale purple cores in alcohol; upper lip lobate as in *"Linguimaera"* (Pirlot, 1936); coxa 1 sharply but weakly extended anteroventrally, coxa 2 narrow anteroposteriorly, anterior coxae lacking posteroventral notch; gnathopod 1 of medium stoutness, article 6 ovatorectangular, palm oblique and convex, palm slightly shorter than posterior margin of article 6, defined by sharp acclivity and spine, article 6 with several medial rows of diverse setal spines, article 4 lacking posterodistal cusp; gnathopod 2 very large, article 2 with large downward pointing process of medium breadth, article 3 weakly lobate, article 4 sharply 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 small sinus, palm spinose and weakly scalloped and bearing weak excavation in middle, dactyl fitting palm and bearing strong inner acclivity fitting excavation; article 2 of pereopods 3–5 narrowly ovatorectangular, posterior margins nearly straight, posteroventral lobes narrow, short, sharply cuspidate; dactyls of pereopods 1–5 with strong distal constriction bearing sharp defining corner and armed with thin seta, sharp but stunted nail bearing small acute accessory tooth, facial setule, constriction also bearing stout setule partially appressed to margin of nail, locking spines small, straight or slightly curved; pleonal epimera 1–3 with slightly convex posterior margins, each with sharp posteroventral tooth, ventrally spinose, epimeron 2 with 1 accessory serration and 1 notch; pleonites dorsally smooth; uropod 3 slightly exceeding extent of uropods 1–2, rami flat, narrow, apically truncate and spinose, equal to each other in length, outer with tiny article 2 hidden among spines; telson deeply but not fully cleft, with strongly fixed medial gap, lobes thin, apically bifid, lateral cusp longer than medial, each lobe with 2 long spines not fully as long as telson and 1 short spine; posterior margin of urosomite 3 very sharp in comparison to other species of Hawaiian *Maera.*

FEMALE.—Gnathopod 2 similar to that of male but excavation in middle weaker.

JUVENILE.—Article 4 of gnathopod 2 with sharp posterodistal cusp; pleonal epimeron 3 with sharp posteroventral corner and 1 or 2 weak posterior serrations marked with setule; rami of uropod 3 very thin and elongate but inner shorter than outer; each telsonic lobe with only 2 spines, one spine as long as telson.

MATERIAL.—JLB Hawaii 12 (5), 13 (3), 14 (3), 15 (2).

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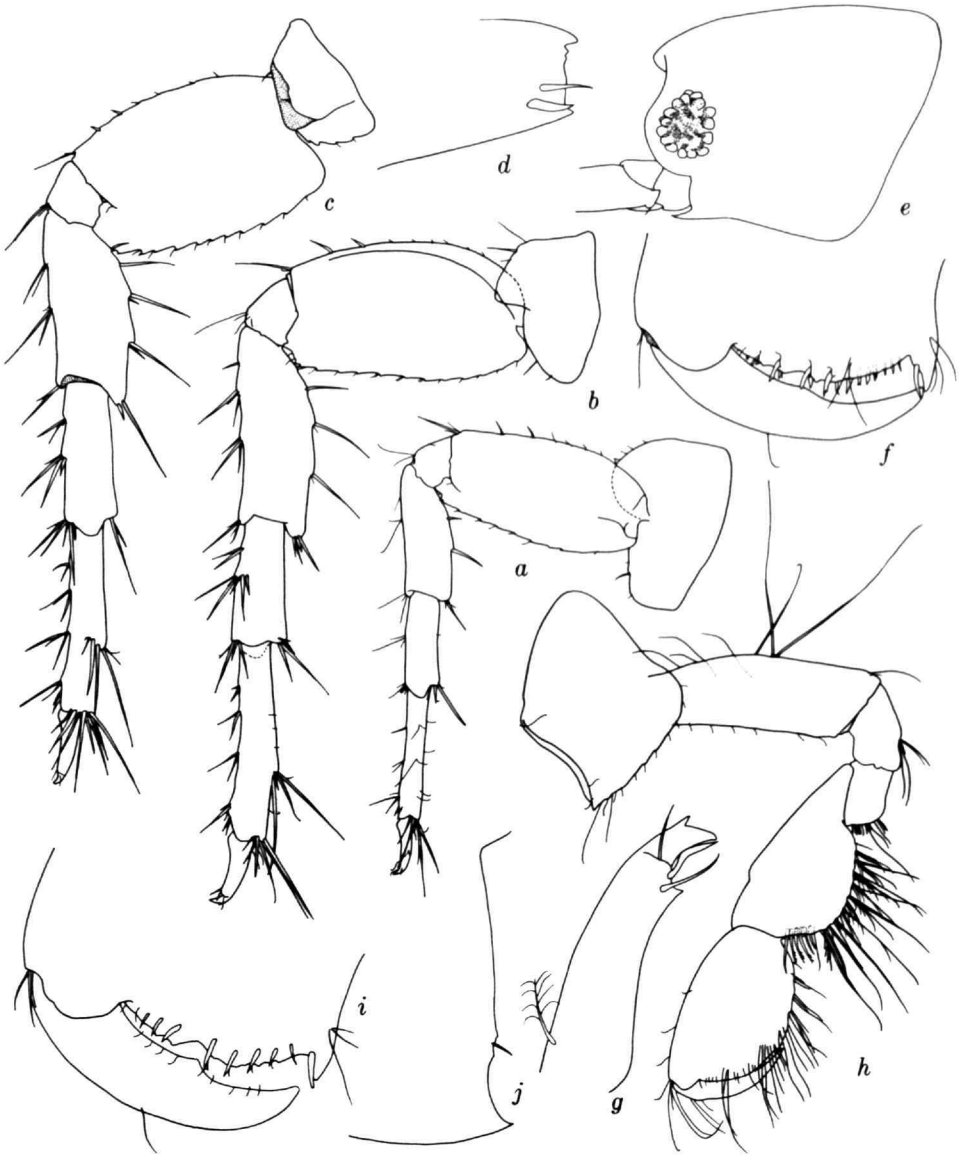

FIGURE 96.—*Maera serrata* Schellenberg, female, 5.4 mm, JLB Hawaii 12: *a, b, c,* pereopods 3, 4, 5; *d,* inner plate of maxilliped; *e,* head; *f,* palm of gnathopod 2; *g,* dactyl of pereopod 3; *h,* gnathopod 1. Male, 4.3 mm, JLB Hawaii 13: *i,* palm of gnathopod 2. Juvenile, 2.9 mm, JLB Hawaii 12: *j,* pleonal epimeron 3.

REMARKS.—Male gnathopod 2 of Schellenberg's material has a much deeper excavation in the middle of the palm separating off a strong subquadrate tooth between it and the sinus near the defining tooth.

DISTRIBUTION.—Southern Polynesia, Micronesia, and the Hawaiian Islands.

Maera species A

FIGURES 98, 99

A single female has affinities with *M. hamigera* Haswell as represented by J. L. Barnard (1965a) from Micronesia, but gnathopod 2 is so much better de-

FIGURE 97.—*Maera serrata* Schellenberg, female, 5.4 mm, JLB Hawaii 12: *a*, posterior corner of urosomite 3 (upside down); *b*, *c*, *d*, posteroventral corners of article 2 on pereopods 3, 4, 5; *e*, uropod 3; *f*, telson. Juvenile, 2.9 mm: *g*, gnathopod 2; *h*, uropod 3; *i*, half of telson.

veloped than in the Micronesian population that a name is reserved until the male can be found and described.

DIAGNOSIS.—Head with normal anteroventral notch; eye narrowly triangular, pigment in alcohol blood red but dense and appearing very dark from distance; coxa 1 sharply extended forward and slightly attenuate at anteroventral corner; anterior coxae with posteroventral notch; gnathopod 1 slender, article 6 thin, subrectangular but slightly expanded distally, palm oblique and defined on medial surface with 5 spines, medial surface of slightly swollen article 5 with many rows of diverse setal spines; article 4 with posterodistal cusp; gnathopod 2 elongate, slender, article 4 with posterodistal cusp, 5 with broad, setose posterior margin, article 6 slightly tapering distally, palm short, oblique, deeply excavate proximally and bearing protrusion with large spine near distal end, defined by

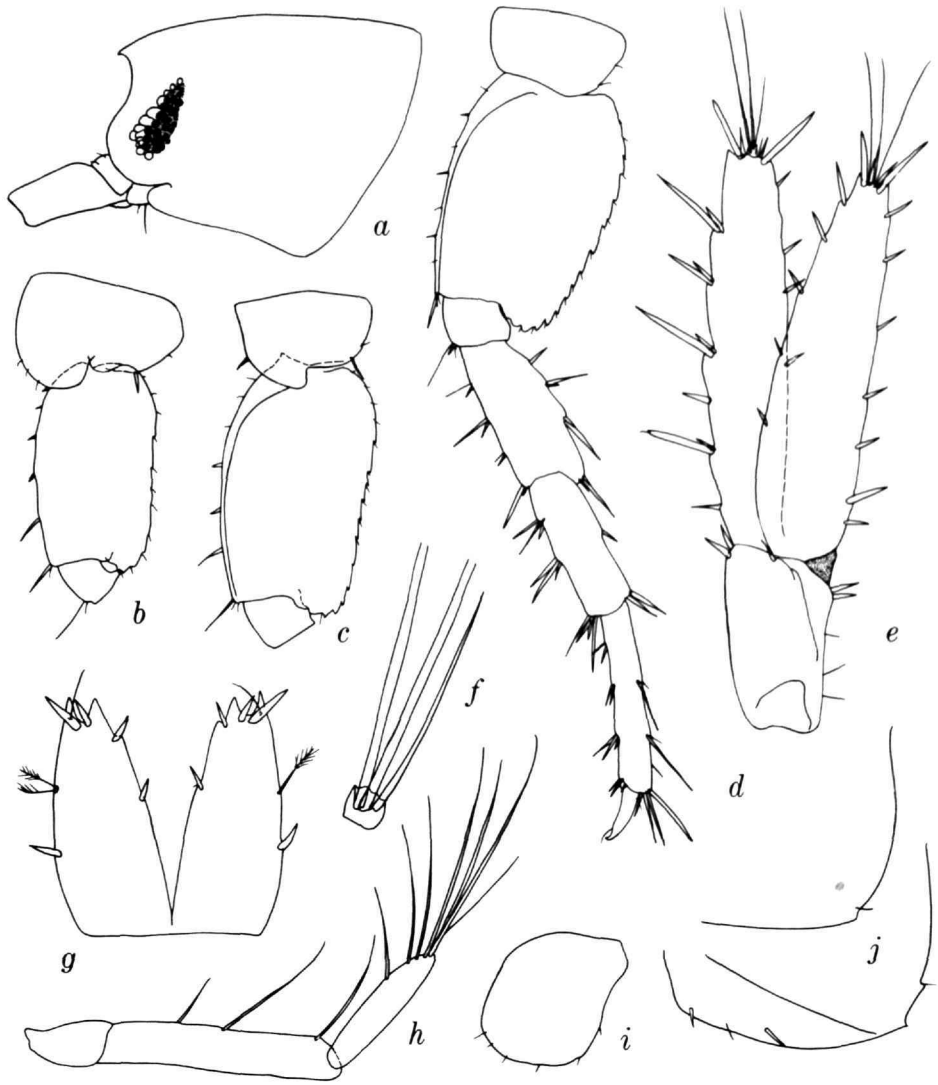

FIGURE 98.—*Maera* species A (cf. *M. hamigera*), female, 6.5 mm, JLB Hawaii 5: *a*, head; *b*, *c*, *d*, pereopods 3, 4, 5, in whole or part; *e*, uropod 3; *f*, article 2 on outer ramus of uropod 3 with setae apically cut off; *g*, telson; *h*, mandibular palp; *i*, coxa 4; *j*, pleonal epimera 2, 3.

small cusp and medium spine, bearing large and medium medial spine and medium lateral spine on proximal portion of palmar hollow, dactyl slender, fitting palm; article 2 of pereopods 3–5 rectangular to subrectangular, of medium expansion, posterior margins with weak but regular serrations, posteroventral lobes shallow, pereopods otherwise of normal thinness; dactyls of all pereopods constricted distally, apical nail marked with suture, dactyl bearing one long, and one short setal-spine at constriction and one facial seta; pleonal epimera 1–2 weakly bulging and bearing small, posteroventral cusp, epimeron 2 with one posterior serration, epimeron 3 nearly straight posteriorly and deeply and sharply serrate; pleonites dorsally smooth; uropod 3 elongate and greatly exceeding extent of uropods 1–2, rami flat, narrow, apically truncate, spinose, outer ramus with small article 2 bearing 1 short and 2 long setae; telson long, fully cleft, each lobe with 2 spines

FIGURE 99.—*Maera* species A (cf. *M. hamigera*), female, 6.5 mm, JLB Hawaii 5: *a*, medial gnathopod 1; *b*, apex of gnathopod 2, medial; *c*, pleonal epimeron 3 and urosome; *d*, apex of pereopod 5; *e*, medial gnathopod 2.

on medial margin, distal spine at deep notch, each apex deeply excavate, with sharp bordering cusps and bearing 2 spines and setule, lateral margins each with 2 setules and 1 basal spine.

MATERIAL.—JLB Hawaii 5 (ovigerous female, 6.5 mm).

Maera species B

FIGURE 100

A single female differs from other species of Hawaiian *Maera* notably in the absence of a lateral cephalic notch and in other characters, but the lack of a male

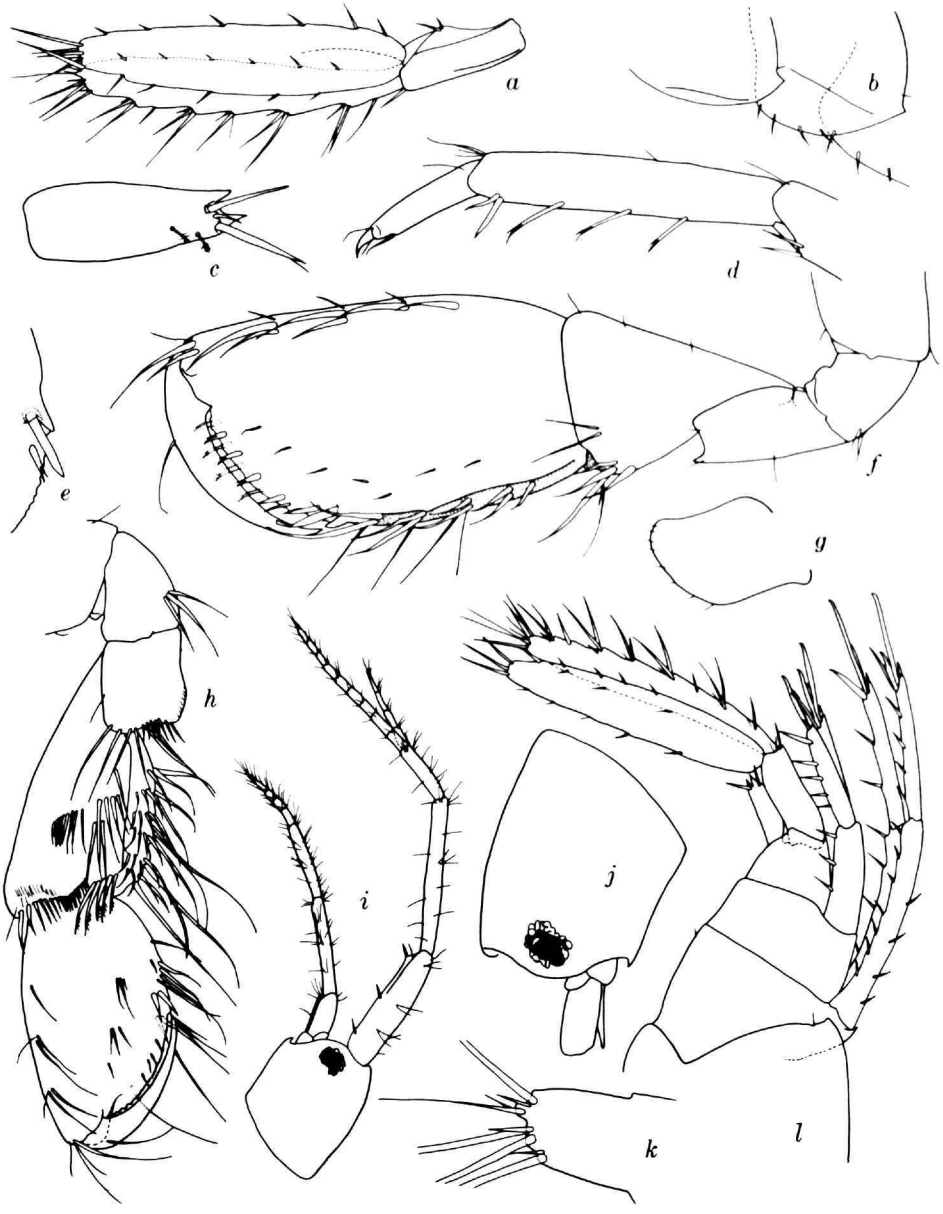

FIGURE 100.—*Maera* species B, female, 3.8 mm, JLB Hawaii 17: *a*, uropod 3; *b*, pleonal epimera 1–2 and part of 3; *c*, half of telson; *d*, apex of pereopod 1; *e*, defining corner of gnathopod 2 palm; *f*, medial gnathopod 2; *g*, coxa 1; *h*, medial gnathopod 1; *i*, *j*, head; *k*, apex of outer ramus on uropod 3; *l*, pleonal epimeron 3 and urosome.

prevents appellation; affinities may be with *M. othonides* Walker.

DIAGNOSIS.—Head lacking normal anteroventral notch, lateral cephalic lobe broadly convex and produced as cusp at anteroventral corner; eye irregularly subcircular, brownish-purple in alcohol; coxae short, coxa 1 obtusely extended anteroventrally, anterior coxae lacking posteroventral notch; gnathopod 1 of medium stoutness but long, article 6 ovate, palm oblique and defined by slight acclivity and marked with pair of submarginal medial spines, article 5 with several medial rows of diverse setal spines, article 4 lacking posterodistal cusp; gnathopod 2 elongate, of medium stoutness, article 4 with posterodistal cusp, 5 with medium-broad, poorly setose posterior margin, article 6 broad, margins nearly parallel, palm short, oblique, evenly convex, armed with numerous short spines, defined by weak cusp and stout submarginal spine, dactyl slender, fitting palm; pereopods 3–5 unknown, missing; dactyls of pereopods 1–2 constricted distally, apical nail marked with suture, dactyl bearing one seta at sutural margin, one facial setule and one proximosutural seta in notch; pleonal epimera 1–3 weakly bulging posteriorly, each with small posteroventral cusp, 1–2 with lateral ridge; pleonites dorsally smooth; uropod 3 elongate and greatly exceeding extent of uropods 1–2, rami flat, narrow, apically truncate and spinose, but outer ramus with small protrusion representing vestigial article 2 coalesced with article 1; telson long, fully cleft, medial and lateral margins of each lobe smooth, apices deeply excavate, points sharp, excavation with one spine, lateral apex with spine, setule between spines.

MATERIAL.—JLB Hawaii 17 (female, 3.8 mm, bearing one giant embryo filling brood pouch).

Melita appendiculata (Say)

FIGURES 101, 102

Gammarus appendiculatus Say, 1818, p. 374.
Gammarus fresnelii Audouin, 1826, p. 93, pl. 11, fig. 3.
Melita fresneli.—J. L. Barnard, 1955a, pp. 13–14 [with references].

MATERIAL.—J. L. Barnard Hawaii 3 (1), 5 (1), 6 (3), 13 (42).

DISTRIBUTION.—Cosmopolitan in warm seas.

Melita pahuwai, new species

FIGURES 103, 104

DIAGNOSIS OF MALE.—Head with deep lateral slit below subnasiform lateral lobes; eyes narrowly ovatopyriform, retaining brownish-purple pigment in alcohol; flagellum of second antenna 1.3 times as long as article 5; coxa 1 not anteroventrally produced; article 6 of gnathopod 1 distally expanded, anterior margin swollen, palm short and oblique, bearing 3 stout medial spines and 5–6 thin lateral spines, then distally excavate for reception of large dactylar bulge, beyond that produced again, dactyl thick, bulging basally, fitting palm, distally unguiform and bearing accessory setal spine; gnathopod 2 with unlobed articles 2–3, article 4 with posterodistal cusp, article 5 with narrow, setose posterior lobe, article 6 elongate, expanding distally like young male *M. palmata*, dactyl longer than palm and overriding medial face, palm short and scarcely oblique, but rounding onto posterior margin of article 6 and minutely spinose, medial face of hand with axial channel toward posterior side, channel defined anteriorly by sharp ridge bearing distal spines and by shorter sharp ridge proximally; channel filled with pectinoplumose setae; all pereopodal dactyls with distal double constriction and nail, with stout marginal seta and small facial setule, locking spines simple; pereopods 3-5 of regular form but relatively short and thick, dactyls also thick; outer ramus of uropod 3 with 1 article only; telson with sharp apices, lobes gaping, each lobe with 2 medial spines, one long subterminal medial spine guarded by sharp cusp, small apicolateral spine, and 3 basolateral spines, plus setules subapically; pleonal epimera 1–3 each with small posteroventral tooth, no other serrations; only urosomite 2 with small lateral cusp guarding 2 spines, cusp obtusely angular. Mouthparts like *M. palmata* as figured by Sars (1895, pl. 179).

FEMALE.—Gnathopod 1 with simple bulging palm, unbulging article 6, basally unthickened dactyl; gnathopod 2 small, palm evenly oblique and defined by 2 spines on medial face and bearing several slender marginal spines; posteroventral teeth of epimera blunter than in male; cusp on urosomite 2 sharply attenuate, bearing 2 spines (or 1 in juvenile); telson with few spines in slightly different arrangement (see figures); coxa 6 with anterior hook bearing gland.

HOLOTYPE.—Bishop Museum collections, catalog number 7277, male, 4.5 mm.

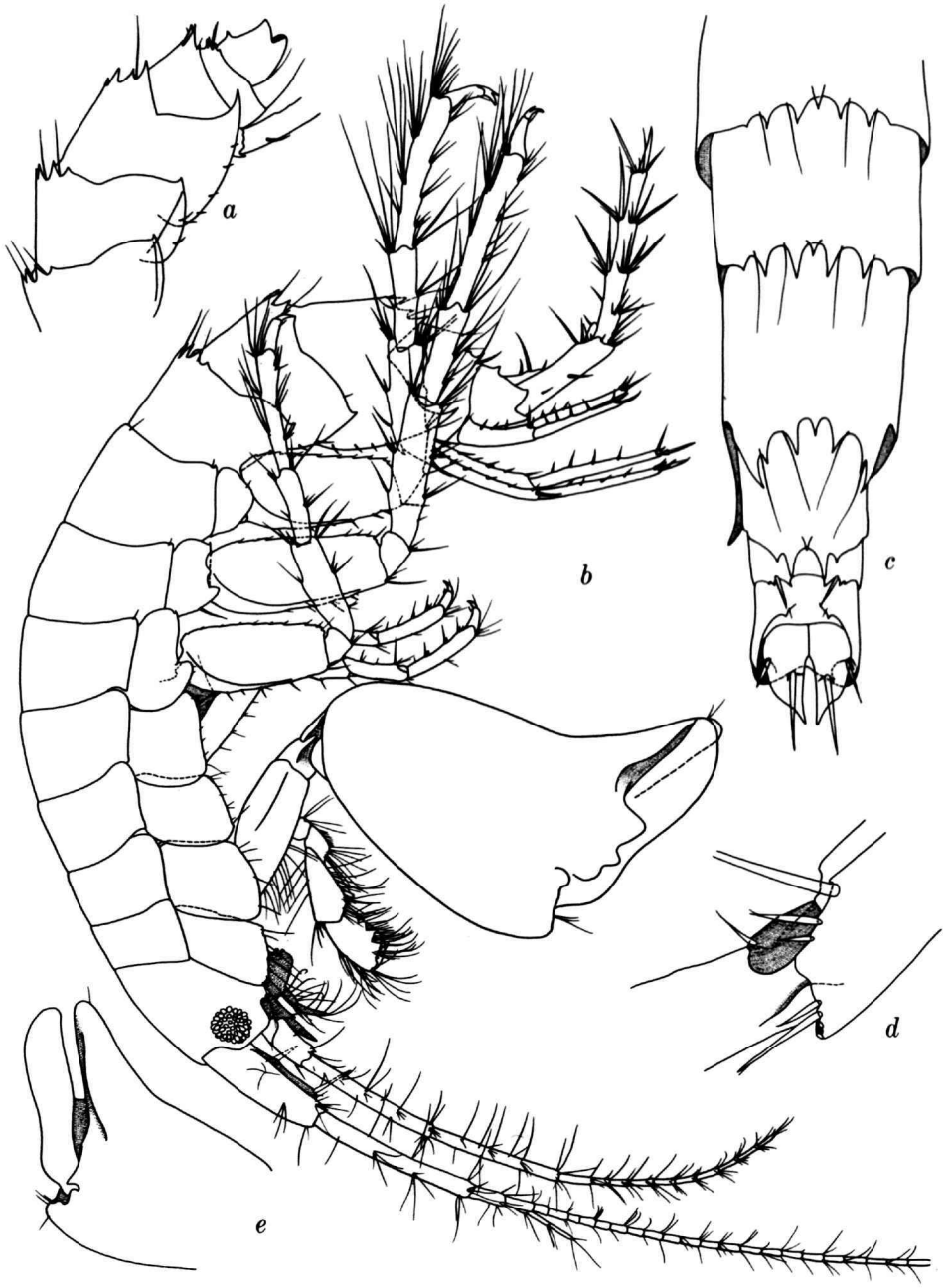

FIGURE 101.—*Melita appendiculata* (Say), male, 4.8 mm, JLB Hawaii 6: *a*, lateral pleon; *b*, body, *c*, dorsal pleon; *d*, inner ramus of uropod 3, shaded; *e*, medial side of apex of gnathopod 2.

FIGURE 102.—*Melita appendiculata* (Say), female, 4.7 mm, JLB Hawaii 6: *a*, articles 2–3 of pereopod 5; *b*, anteroventral corner of head; *c*, medial gnathopod 1. Male, 4.8 mm, JLB Hawaii 6: *d*, *e*, dactyls of pereopods 3, 2; *f*, anteroventral corner of head; *g*, *h*, maxillae 1, 2; *i*, posteroventral corner of article 2 on pereopod 3; *j*, right gnathopod 2.

TYPE-LOCALITY.—JLB Hawaii 17, Kawela Bay, Oahu, intertidal, *Sargassum*, algae, rocks, corals, 24 May 1967.

MATERIAL.—JLB Hawaii 17(3), 18(2).

RELATIONSHIP.—Closely related to *Melita koreana* Stephensen (1944), a species with similar male gnathopod 2 palm lacking a distinct channel on medial face of hand but strongly setose thereon. *Melita koreana* has 3 spines but no cusp on each dorsolateral side of pleonite 4, and male gnathopod 1 dactyl is a stout, short coniform piece not reaching the end of the palm, the latter simply convex. The telson lacks mediobasal spines and articles 3–6 of pereopods 3–5 are more slender than in *M. pahuwai*.

Melita laevidorsum Stephensen (1944), from Japan, also has 3 spines and no cusp on each side of pleonite 4, no basomedial spines on the telsonic lobes, slender pereopods 3–5, and a longer flagellum on antenna 2 than does *M. pahuwai*, but gnathopod 1 is more like that of the Hawaiian species than is gnathopod 1 of *M. koreana*. Gnathopod 2 of the male, possibly not fully developed, has a simple, sloping, spinose palm with many medial setae and a spinose medial defining ridge.

Melita pahuwai has its closest affinities with *M. zeylanica* Stebbing (1904) from Ceylon. The latter has a similar gnathopod 2, apparently similar ornaments on pleonite 4, has medial spines on the telsonic lobes but has larger coxae than does *M. pahuwai*, and male gnathopod 1 article 6 is evenly rectangular, not distally expanded and has a simple palm like the female of *M. pahuwai*. Article 4 of pereopods 3–5, especially pereopod 5 of *M. zeylanica*, is much stouter than in *M. pa-*

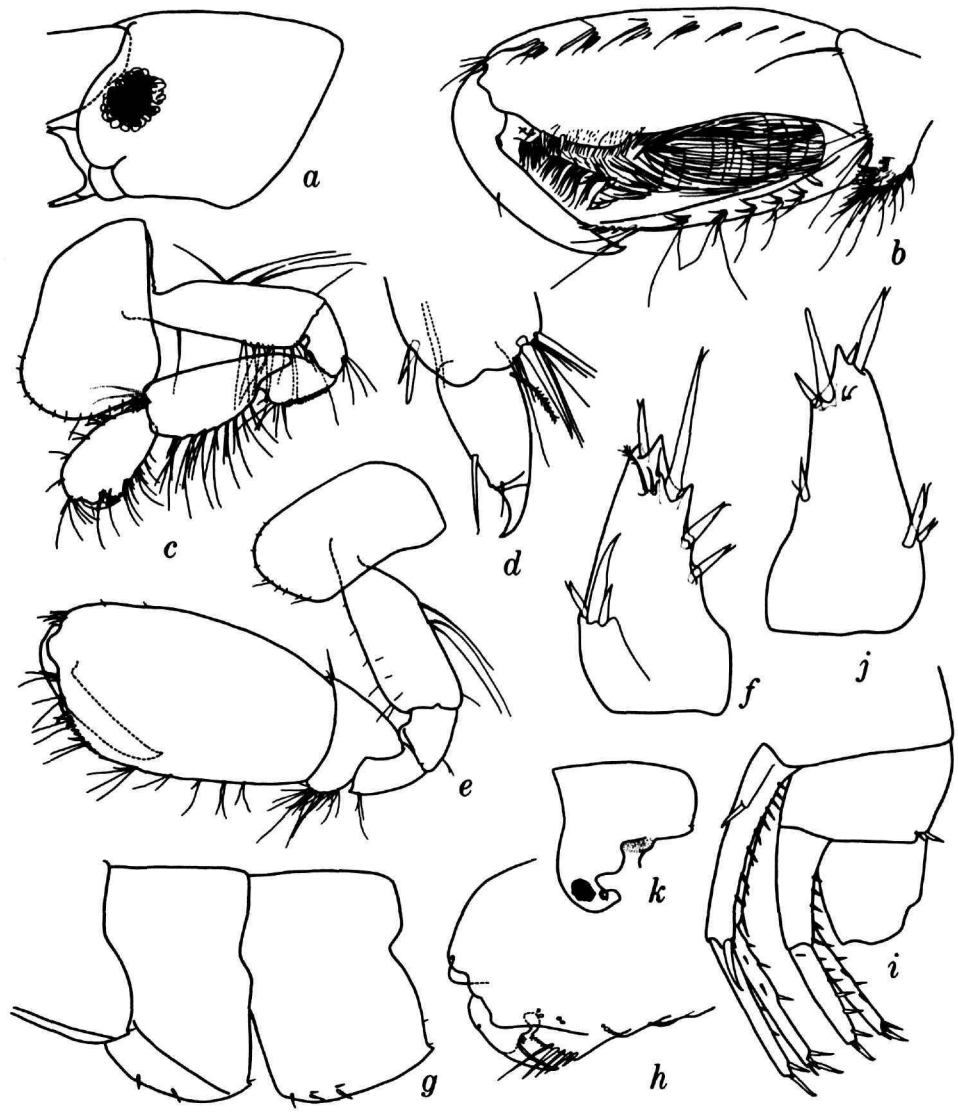

FIGURE 103.—*Melita pahuwai*, new species, holotype, male, 4.5 mm, JLB Hawaii 17: *a*, head; *b*, apex of gnathopod 2, medial; *c*, gnathopod 1; *d*, apex of pereopod 5; *e*, gnathopod 2; *f*, half of telson; *g*, pleonal epimera 1–3; *h*, apex of gnathopod 1; *i*, uropods 1–2 and part of urosome. Female, 3.7 mm: *j*, half of telson; *k*, coxa 6.

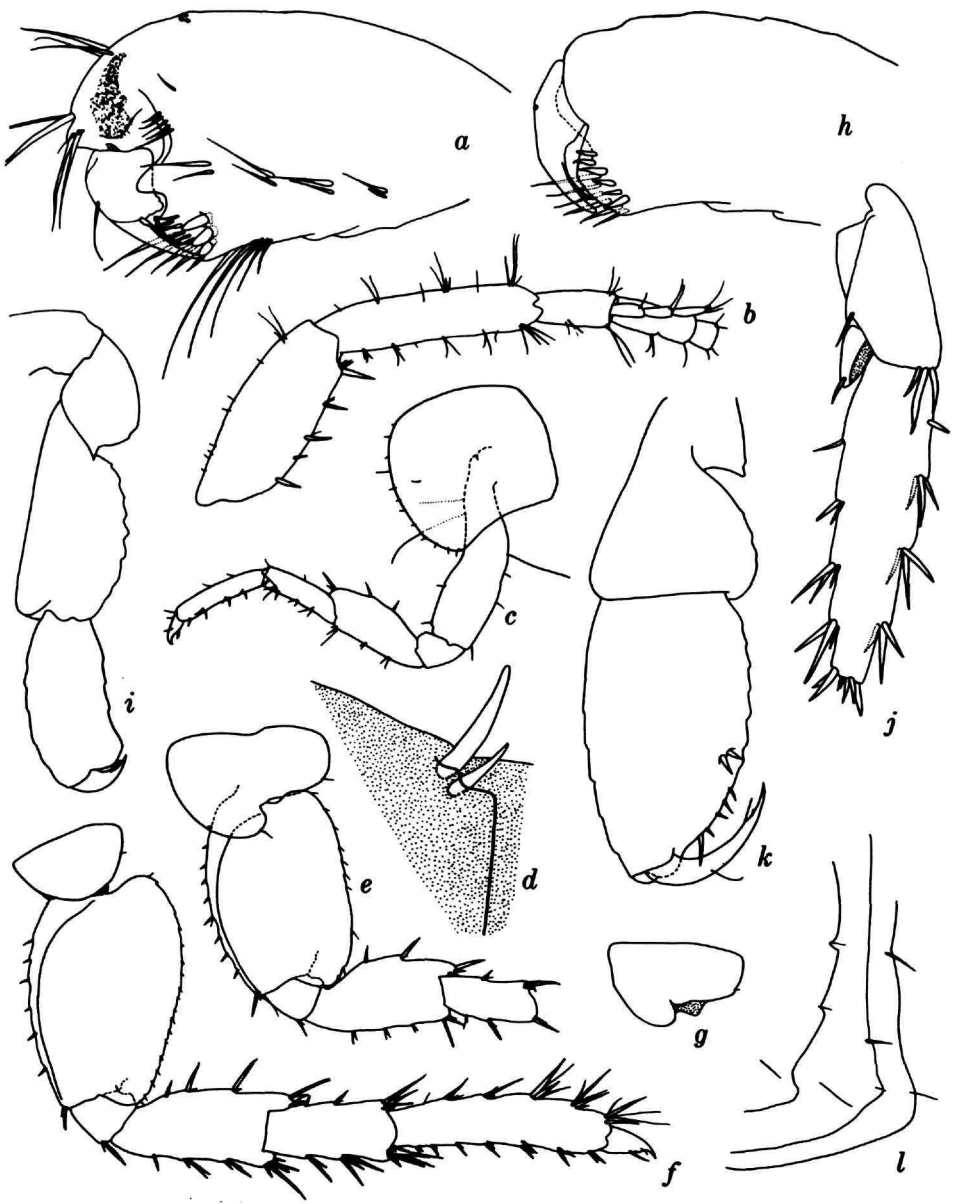

FIGURE 104.—*Melita pahuwai*, new species, holotype, male, 4.5 mm, JLB Hawaii 17: *a*, apex of gnathopod 1, medial; *b*, peduncle and accessory flagellum of antenna 1; *c*, pereopod 2; *d*, ornamentation of pleonite 4; *e*, *f*, pereopods 3, 5, whole or part; *g*, coxa 6. Female, 3.7 mm: *h*, apex of gnathopod 1; *i*, gnathopod 1, setae removed; *j*, uropod 3; *k*, medial gnathopod 2, setae removed; *l*, posteroventral corners of pleonal epimera 1–3.

huwai and article 6 is very short on pereopod 5 but not on pereopods 3–4.

The west American representatives of *M. nitida* Smith (Shoemaker, 1935b) have long coxae, a simple palm on male gnathopod 1 and a weak, poorly setose gnathopod 2, palm very oblique, but with dactyl overriding the surface to close against a spinose locking ridge. Pleonite 4 has only 3 dorsolateral spines on each side.

DISTRIBUTION.—Hawaiian Islands.

Nuuanu, new genus

DIAGNOSIS.—Eyes weakly developed; lateral cephalic lobe with deep notch; antenna 1 geniculate between articles 1 and 2, accessory flagellum 3-articulate; mandibular palp article 3 subfalcate, strongly setose and longer than article 1, molar triturative; lower lip apparently lacking inner lobes, inner plates of maxillae 1–2 densely setose medially, palp of maxilla 1 with 2 articles; maxillipeds basic; gnathopod 1 small and slender but subchelate, palm nearly transverse; gnathopod 2 of male large (female unknown); coxa 4 strongly excavate posteriorly; second articles of pereopods 3–5 with strong castelloserrations; metasome with weak dorsal teeth, urosome with a few dorsal spines not in bundles, urosomites separate; uropod 3 short, scarcely extending beyond uropods 1–2, inner ramus short and scalelike, outer with 2 articles, article 2 short; telson short, deeply cleft.

TYPE-SPECIES.—*Nuuanu amikai*, new species.

RELATIONSHIP.—This genus belongs in the *Eriopisa-Melita* group with shortened and scalelike inner ramus of uropod 2. It differs from *Eriopisella* Chevreux and *Netamelita* J. L. Barnard in the medially setose inner plates of the maxillae, from *Melita* Leach in the short uropod 3, from *Melitoides* Gurjanova and *Netamelita* in the absence of inner lobes on the lower lip, the 2-articulate outer ramus of uropod 3, and from *Eriopisa* Stebbing in the short uropod 3 and presence of weak dorsal sculpture. The geniculate antenna 1, with article 2 bending strongly past the lateral extension of article 1, is also a character distinguishing *Nuuanu* from other Gammaridae mentioned above, the telson apparently is unusually short for this group, and the conspicuous castelloserrations of pereopods 3–5 are signficant. The 3-articulate accessory flagellum exceeds that of the other genera except *Melita* by at least 1 article.

The dorsal sculpture, though weak, and the long coxae suggest closest affinities with *Melita* more than with *Eriopisa* and mandibular palp article 3 is scarcely more swollen than in *M. palmata* (Montagu) (Sars, 1895, pl. 179).

Nuuanu amikai, new species

FIGURES 105, 106

DIAGNOSIS.—With the characters of the genus.

DESCRIPTION.—Lateral cephalic lobe broad, strongly squared off and bearing deep notch, eyes composed of about 9 widely scattered ommatidia weakly stained orange in alcohol and formaldehyde; article 5 of gnathopod 1 elongate, palm defined by 2 series of stout spines, one series apically bifid, dactyl stout, short, curved; gnathopod 2 with sharp cusp on article 4, article 5 cup-shaped, posterior lobe of medium breadth, article 6 large and elongate, palm scarcely defined from setose posterior margin of article 6, dactyl less than half as long as article 6, slipping over finely setose medial face of article 6 and locked by mediodistal ridge bearing 2 spines, lateral palmar margin protuberant and spinose; article 2 of pereopods 3–4 similar, weakly concave posteriorly, articles 4–6 of pereopod 4 stouter than on pereopod 3, article 2 of pereopod 5 very broad, posteriorly convex and slightly concave ventrally, pereopod 5 shorter than pereopod 4; uropod 2 with distomedial comb-row on peduncle; pleonal epimeron 1 with sharp posteroventral corner, epimeron 2 strongly extended ventrally and posteroventrally attenuate, epimeron 3 of more regular form, with straight posterior margin and weak posteroventral tooth; metasomites 1–2 each with small posterodorsal tooth, metasomite 3 smooth, urosomite 1 with weakly frilled dorsal margin, urosomites 2–3 each with 1 dorsolateral spine and urosomite 3 with sharp but small posterolateral wings.

HOLOTYPE.—Bishop Museum collections, catalog number 7278, male, 4.2 mm. Unique.

TYPE-LOCALITY.—JLB Hawaii 3, off Ewa Beach, Oahu, 18 m, *Pocillopora*, bryozoans, 29 January 1967.

Family ISAEIDAE (=PHOTIDAE)

Chevalia aviculae Walker

FIGURE 107

Chevalia aviculae Walker, 1904, pp. 288–290, pl. 7, fig. 50, pl. 8, fig. 50.—J. L. Barnard, 1962a, pp. 17–20, fig. 5 [with references].

MATERIAL.—JLB Hawaii 2 (5), 3 (17), 5 (8), 6 (10), 8 (150+), 15 (3), 17 (3).

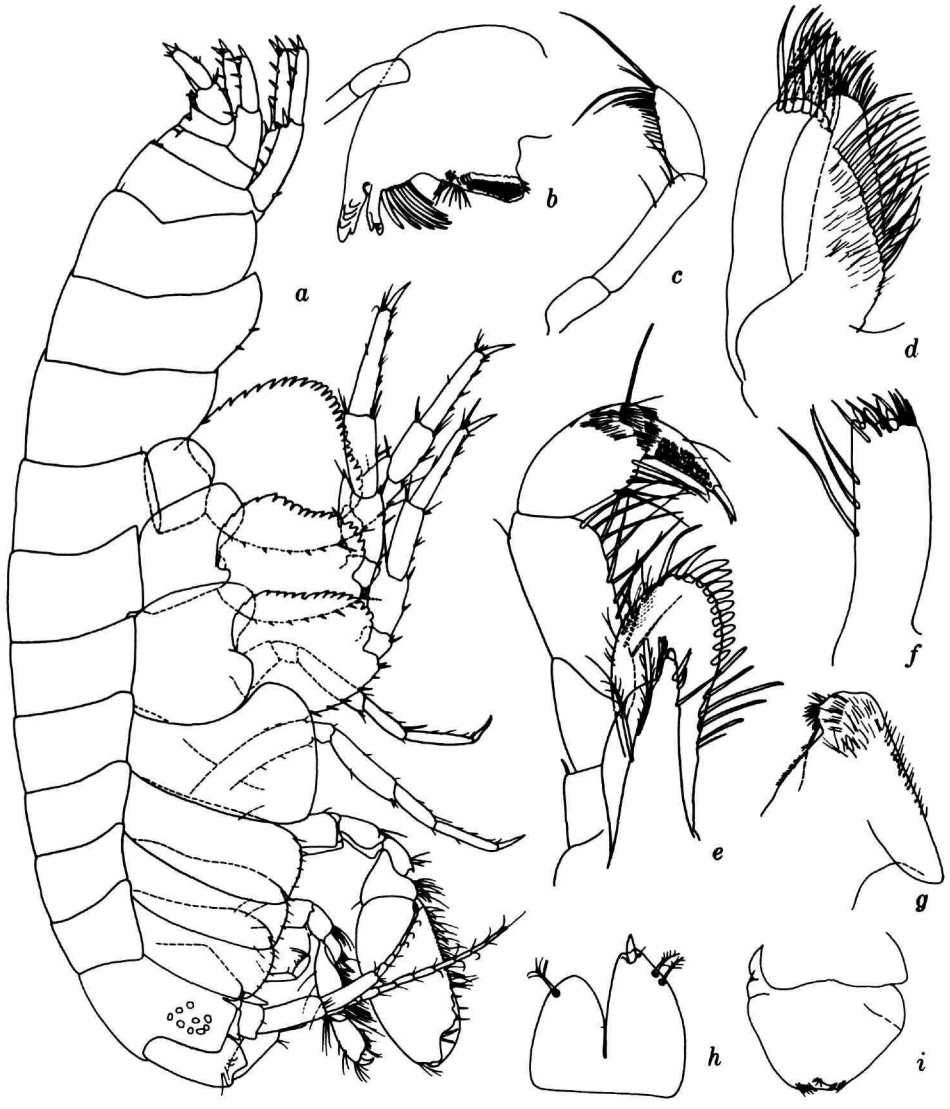

FIGURE 105.—*Nuuanu amikai*, new genus, new species, holotype, male, 4.2 mm, JLB Hawaii 3: *a*, body; *b*, mandible; *c*, mandibular palp; *d*, maxilla 2; *e*, maxilliped; *f*, inner plate of maxilliped; *g*, half of lower lip; *h*, telson; *i*, upper lip.

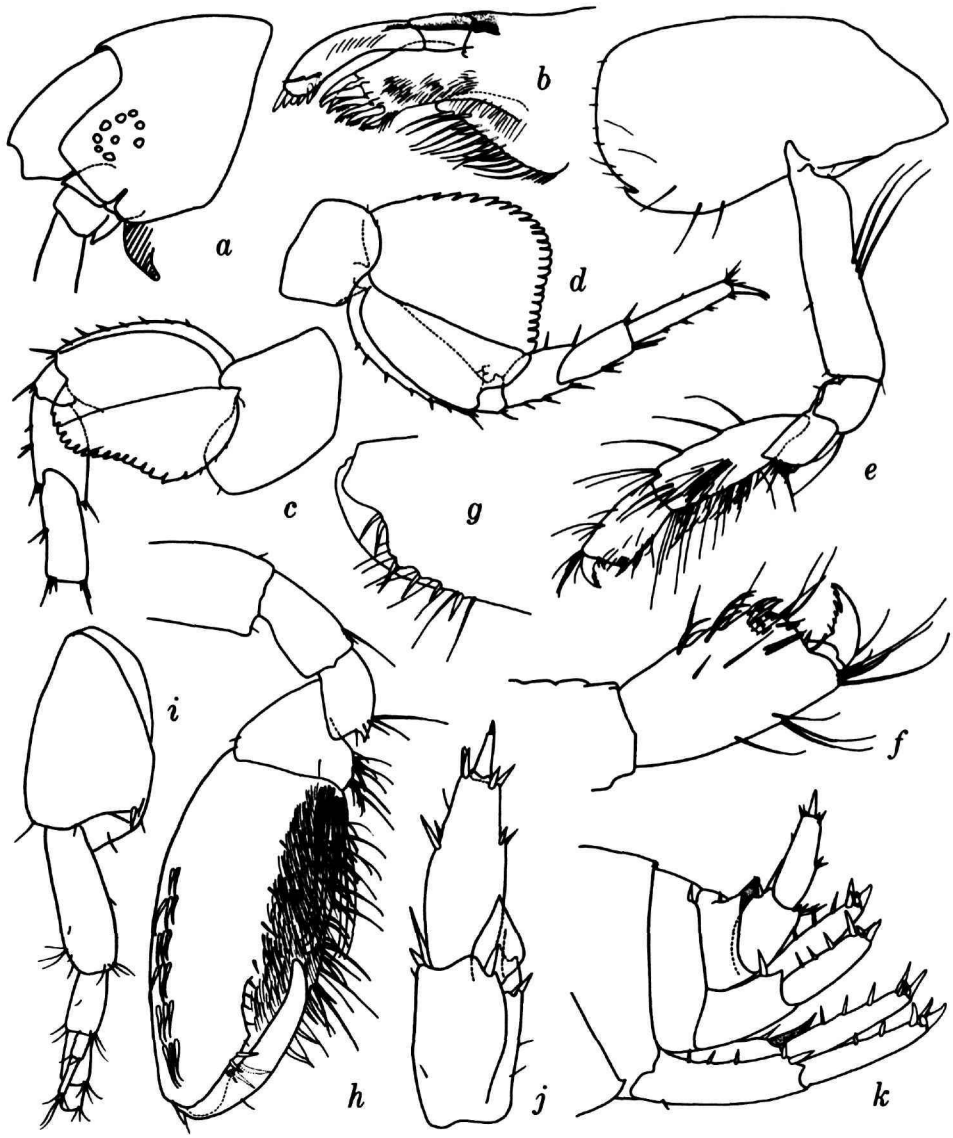

FIGURE 106.—*Nuuanu amikai*, new genus, new species, holotype, male, 4.2 mm, JLB Hawaii 3: *a*, head and epistome-labral complex below (shaded); *b*, maxilla 1; *c*, part of pereopod 4; *d*, pereopod 5; *e*, *f*, gnathopod 1; *g*, *h*, gnathopod 2; *i*, medial antenna 1; *j*, uropod 3; *k*, urosome and pleonal epimeron 3.

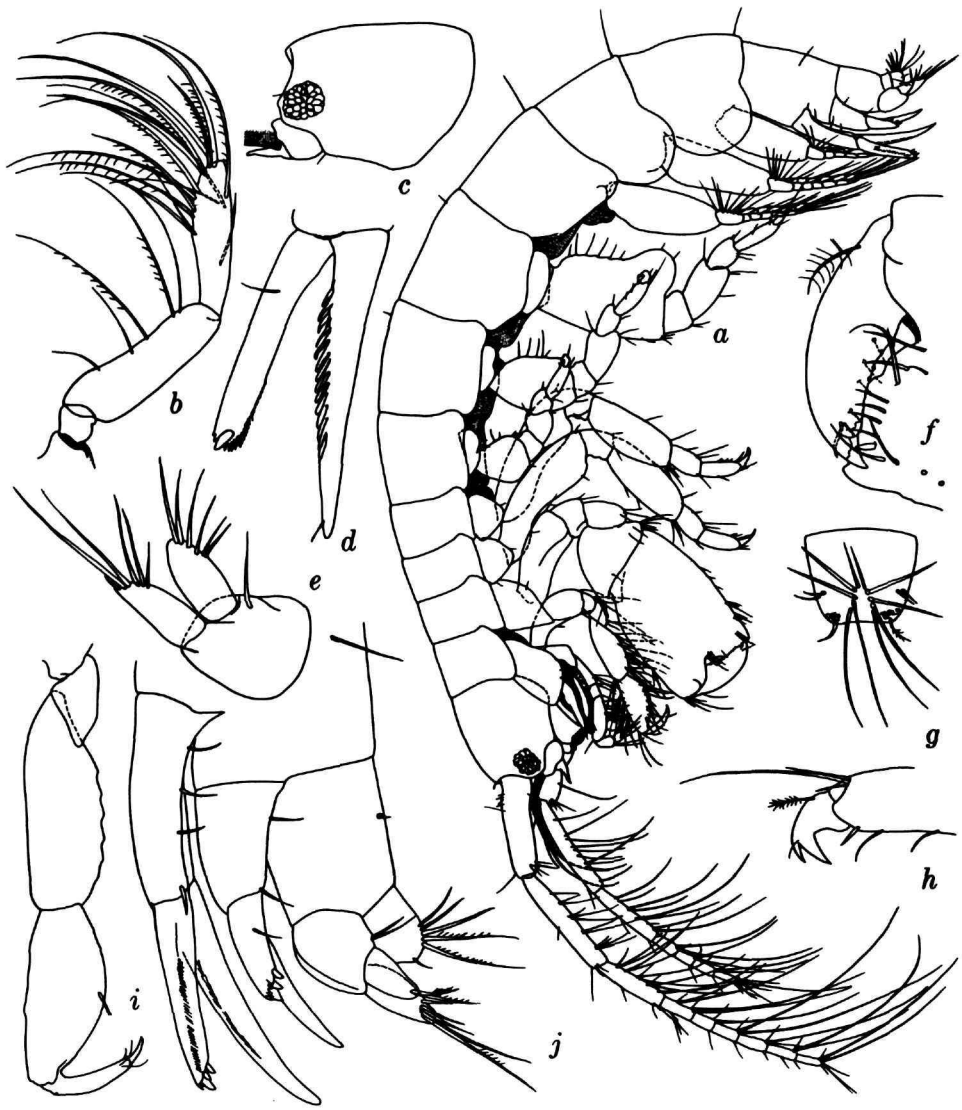

FIGURE 107.—*Chevalia aviculae* Walker, male, 3.1 mm, JLB Hawaii 3: *a*, body; *b*, mandibular palp; *c*, head; *d*, rami of uropod 1; *e*, uropod 3; *f*, palm of right gnathopod 2; *g*, telson; *h*, apex of pereopod 5; *i*, right gnathopod 1, setae removed; *j*, urosome.

REMARKS.—The right mandibular molar has a large smooth accessory flake and a long seta. Eyes are red in formaldehyde and clear in alcohol. The palm of gnathopod 2 is transverse and nearly protuberant in Hawaiian individuals.

DISTRIBUTION.—Circumtropical.

Gammaropsis Liljeborg (=*Eurystheus* Bate)

REMARKS.—Members of this genus in Hawaii demonstrate a meeting ground of cold-temperate and tropical pathways. *Gammaropsis atlantica, G. afra,* and *G. pokipoki* represent the tropical members having an article 2 on the outer ramus of uropod 3 and the absence of a molarial flake. *Gammaropsis alamoana,* with obvious derivation from the cold-temperate Pacific *G. thompsoni* Walker, lacks article 2 on the outer ramus of uropod 3 like other cold-temperate species (of the North Atlantic Ocean), but has a molarial flake on the right mandible. *Gammaropsis pali* represents the intermediate condition, a molarial flake combined with an article 2 on the outer ramus of uropod 3, and the tropical *G. digitata* from Canton Island, the reverse condition.

Gnathopod 1 usually has a defining spine except in *G. pali,* and uropod 2 lacks a ventral peduncular tooth between the rami except for a small tooth in *G. digitata* and a large one in *G. haleiwa.*

Gammaropsis afra Stebbing

FIGURE 108

Gammaropsis afra Stebbing, 1888, p. 1097, pl. 113.

Eurystheus afer.—Stebbing, 1906, p. 612.—?K. H. Barnard, 1916, pp. 249–250, pl. 28, fig. 11.—K. H. Barnard, 1937, pp. 165–166, fig. 12.—Pillai, 1957, pp. 55–56, fig. 13.—J. L. Barnard, 1961, pp. 113–114, fig. 79.

DIAGNOSIS (relative to forms of *G. atlantica*).—Lateral cephalic lobes poorly projecting, eye weakly reniform, but not distinctly lageniform or ovate; accessory flagellum thick and 3-articulate in adults (1.9 mm); gnathopod 2 with palmar axis less oblique than in form A of *G. atlantica,* with small subquadrate palmar concavity, large defining tooth, palmar bulge with 2 humps, dactyl especially short and thick compared with form B of *G. atlantica,* and proximal inner margin with 2 small conical processes, article 6 about 1.75 times as long as broad, articles 2 and 6 with very few setae. Female gnathopod 2 of the fully developed condition as in form A of *G. atlantica* and spine of palm especially enlarged.

COLOR IN 2-DAY FORMALDEHYDE.—Body white, eyes brown.

MATERIAL.—JLB Hawaii 5 (15). Devaney 1 (19).

Hybrid or form intermediate with *G. atlantica*: Eye slightly more reniform than in typical individuals; palm much less oblique than any form of *atlantica* or *afra,* concavity narrowest, palmar bulge quadrate, proximal inner margin of dactyl with low quadrate process; color as in form B of *G. atlantica;* body length reaching 4 mm in contrast to 2.2 mm maximum size of *G. afra.*

MATERIAL.—JLB Hawaii 5 (10).

REMARKS.—The metasome, urosome, uropods, and telson resemble those of *G. atlantica* (Figure 111), but owing to the small size of the adults of the typical form the spines are less frequent. Thus, the outer ramus of uropod 3 lacks the subterminal marginal spine and article 2 of the outer ramus is relatively much larger than in *G. atlantica* or in the "hybrid" form. The outer ramus of uropod 2 is shortened as it is on uropod 1 of *G. atlantica* and has only 1 marginal spine; the outer ramus of uropod 2 has 2 marginal spines. Mouthparts are less setose than in *G. atlantica.*

Gammaropsis afra and *G. atlantica* are linked through form B of *G. atlantica* and the hybrid form here assigned for convenience to *G. afra;* gnathopods are almost perfectly intergraded but the hybrid form has them more extremely coarsened than in any other form and *G. atlantica* form A has them occurring in the most graceful condition.

DISTRIBUTION.—East Atlantic Ocean, eastward to Hawaii.

Gammaropsis alamoana, new species

FIGURES 109, 110

DIAGNOSIS.—Lateral cephalic lobes weakly extended, apex in adults obtaining sharp cusp; eyes ovate in young, pigment core small, clear ommatidia fully surrounding pigment, eyes subreniform in adult, pigment core large, posteriorly lacking clear marginal ommatidia; epistome with long acute cusp; right mandibular molar with flake; inner plate of maxilla 1 conicovermiform, bearing setular wisps but otherwise naked; gnathopod 1 with article 6 subovate, palm poorly defined; gnathopod 2 with article 5 broadly conical and elongate, increasingly so in adults, lacking posterior lobe, posterior margin flat, anterior margin

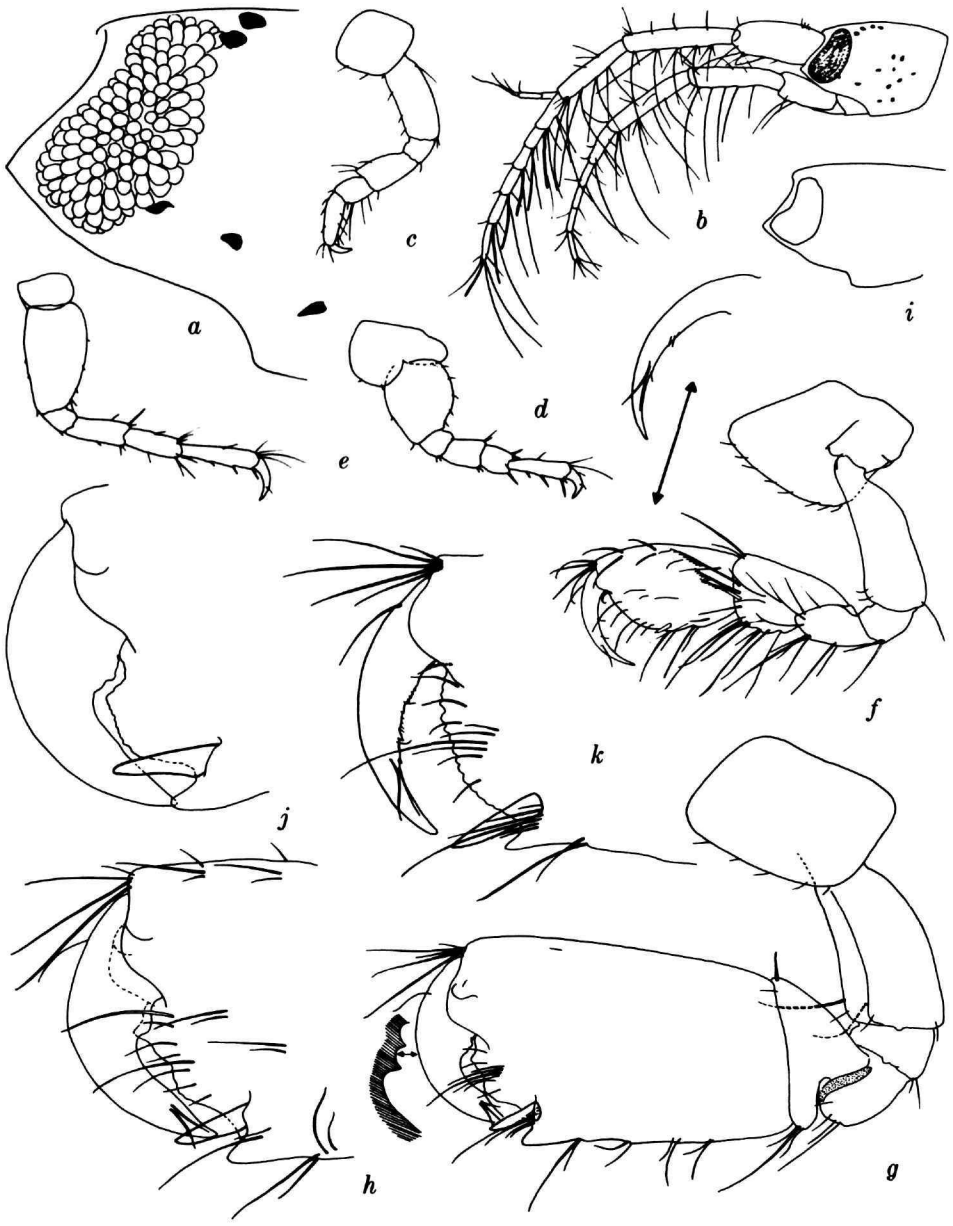

FIGURE 108.—*Gammaropsis afra* Stebbing, male, 1.9 mm, JLB Hawaii 5: *a, b,* head; *c, d, e,* pereopods 1, 3, 5; *f,* gnathopod 1; *g, h,* gnathopod 2, lateral and medial views. Male hybrid, 2.5 mm: *i,* head. Male, hybrid, 3.0 mm: *j,* gnathopod 2. Female, 2.1 mm: *k,* gnathopod 2.

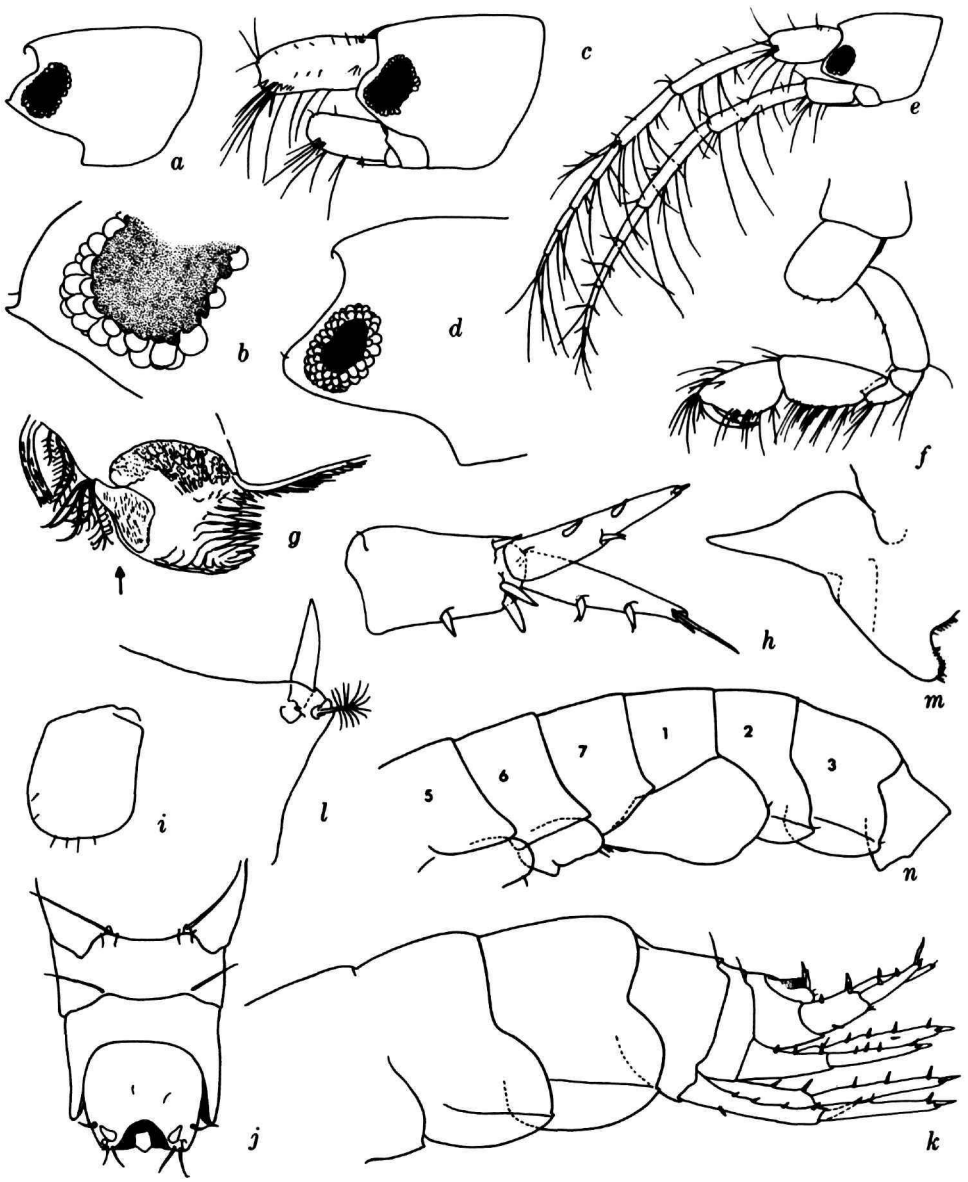

FIGURE 109.—*Gammaropsis alamoana*, new species. Heads and eyes: *a*, *b*, male, holotype, 3.2 mm, JLB Hawaii 13; *c*, male, 3.6 mm; *d*, *e*, female, 2.2 mm, JLB Hawaii 8. Male holotype: *f*, gnathopod 1; *g*, right mandibular molar, arrow pointing to flake; *h*, uropod 3; *i*, coxa 3; *j*, telson and dorsal view of urosomites 1–3; *k*, pleon. Male, 3.6 mm: *l*, lateral view of telsonic apex; *m*, epistome; *n*, pereonites 5–7 and pleonites 1–4.

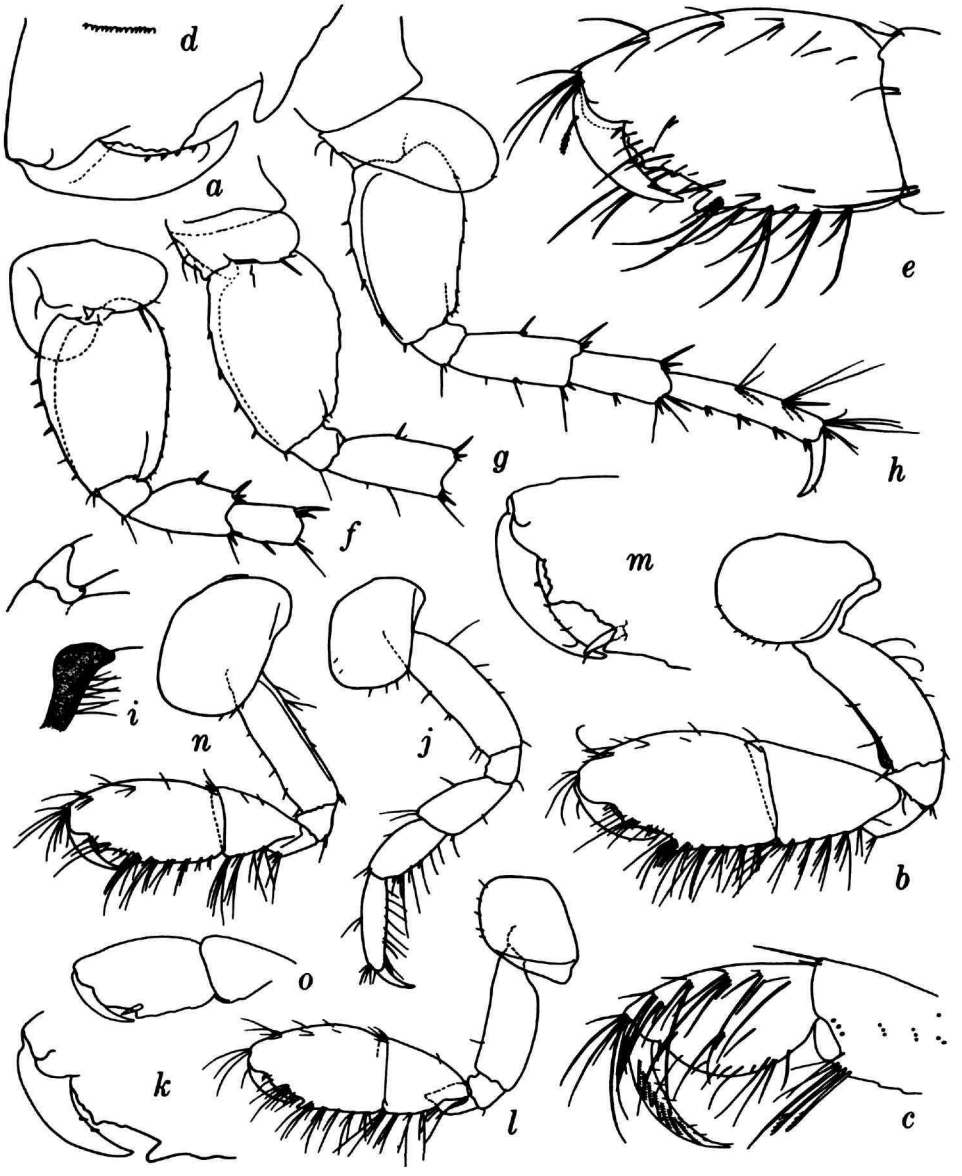

FIGURE 110.—*Gammaropsis alamoana* new species, male, 3.6 mm, JLB Hawaii 13: *a*, gnathopod 2, medial; *b*, gnathopod 2; *c*, gnathopod 1; *d*, palmar sculpture of gnathopod 1. Holotype, male, 3.2 mm, *e*, gnathopod 2, medial; *f*, *g*, *h*, pereopods 3, 4, 5; *i*, inner plate of maxilla 1, shaded; *j*, pereopod 2; *k*, *l*, gnathopod 2. Female, 4.5 mm: *m*, *n*, gnathopod 2. Juvenile, 1.5 mm: *o*, gnathopod 2.

lacking spines, palm oblique with strong defining tooth, excavation flat and shallow, protrusion near finger simple in juvenile, acquiring one or two major protuberances in adults, dactyl fitting palm in juveniles and females, but becoming shortened in adult males, large spine of palm lost in adult males; article 2 of pereopods 3–5 ovate, coxa 7 becoming enlarged enormously in terminal male, coxa eventually hiding pleonal epimeron 1; epimera 1–3 with evenly convex posterior margins, small incision and tooth at posteroventral corners; outer ramus of uropod 3 lacking article 2; telson nearly square, dorsoventrally excavate; urosomite 1 with broad shallow dorsal excavation bordered on each side by blunt protrusion, each side of excavation bearing 1 large seta and 2 minute setules, urosomite 2 with slight dorsal excavation but lateral protrusions obsolescent, 1 seta present on each side.

COLOR IN 2-DAY FORMALDEHYDE.—Eyes black-brown, body almost clear white.

HOLOTYPE.—Bishop Museum collections, catalog number 7279, male, 3.2 mm.

TYPE-LOCALITY.—JLB Hawaii 13, Kaneohe Bay, Oahu, 3–4 m, corals, algae, corallines, 8 April 1967.

MATERIAL.—JLB Hawaii 2 (6), 3 (1), 5 (3), 8 (26), 10 (13), 12 (1), 13 (10), 14 (5).

RELATIONSHIP.—This species is a cognate of *Gammaropsis thompsoni* (Walker) of the cold and warm-temperate northeastern Pacific Ocean (Shoemaker, 1931, 1942, 1955 and J. L. Barnard, 1959). *Gammaropsis alamoana* differs from its cognate in the weaker bulge of epimeron 3, the shorter spines of the telson, the weaker dorsal armaments of the urosome, the presence of a distinct defining cusp on gnathopod 2 of females, and the shortening of the dactyl on gnathopod 2 of terminal males.

DISTRIBUTION.—Hawaiian Islands.

Gammaropsis atlantica Stebbing

FIGURES 111, 112, 113

Gammaropsis atlantica Stebbing, 1888, p. 1101, pl. 114.
Gammaropsis zeylanicus Walker, 1904, pp. 282–283, pl. 6, fig. 41; 1909, p. 339.
Gammaropsis Gardineri Walker, 1905, pp. 929–930, pl. 88, figs. 11–14, 16, 17.
Eurystheus atlanticus.—Stebbing, 1906, p. 611; 1908, pp. 86–87, pl. 40B.—Tattersall, 1922, pp. 10–11, pl. 1, figs. 17–20.—K. H. Barnard, 1937, p. 164.—Pillai, 1957, pp. 56–57, fig. 14.—J. L. Barnard, 1965a, pp. 534–535, fig. 29.

DIAGNOSIS OF MALE FORM A.—Lateral cephalic lobes projecting to medium extent, eye lageniform in juveniles and adults from 1.8 to 4.5 mm in body length, juveniles of 1.2 mm with vertically oriented ovate eye lacking dorsoposteriorly extended ommatidia; accessory flagellum thin and 6-articulate in adults; gnathopod 2 with palmar axis oblique, large palmar concavity near defining corner, with large spine on medial surface near concavity, palmar bulge near finger hinge forming 3 low humps each minutely undulate, palmar defining corner scarcely produced, dactyl slightly shorter than palm, article 6 of gnathopod 2 about 1.5 times as long as broad; terminal male with heavy setation on anteromedial margins of articles 2 and 6.

FEMALE.—Gnathopod 2 fully developed as in Figure 112*f*, with crenulate palm and slight process at defining corner. Juveniles lacking process at corner.

COLOR IN 2-DAY FORMALDEHYDE.—Eyes red or orange, head purple or white but bleaching white in alcohol.

DIAGNOSIS OF MALE FORM B.—Lateral cephalic lobes projecting very strongly, coniform, eyes in youthful members (3.1 mm) ovate horizontally and confined to ocular lobe, in terminal adults ommatidia proliferating in dorsoposterior direction toward forehead and eye becoming lageniform; accessory flagellum thick and not exceeding 4 articles; gnathopod 2 with palm less oblique than form A, concavity shallower and narrower but defining cusp much larger, palmar bulge with 1 or 2 humps only, articles 2 and 6 with very few setae.

FEMALE.—Frequently maintaining juvenile gnathopod 2 into old age (4.0 mm), but accessory flagellum slender and often 5-articulate.

COLOR.—Same as form A but majority of specimens maintaining purple-pink head and anterior body stain in alcohol.

MATERIAL.—JLB Hawaii 2 (14), 3 (23), 5 (6), 6 (10), 8 (1), 10 (20), 12 (4), 13 (18). Makapuu Point, Oahu, April 1967, *Zoanthus* (1), collectors Ralph Bowers and Dr. Jerry Welch.

DISCUSSION.—Form B is like materials reported on by Walker (1905), Pillai (1957), and J. L. Barnard (1965a), whereas form A represents material in the other references. If the two forms are indeed phenotypes of a single species, they are readily distinct in Hawaii in the male at all stages. Young males and females of form B are recognizable by the horizontally ovate eyes, and adult males are recognizable by the gnathopod 2 palm and the lack of a dense brush of setae on article 2. Form A appears to be the more advanced in that juvenile eyes are vertically ovate

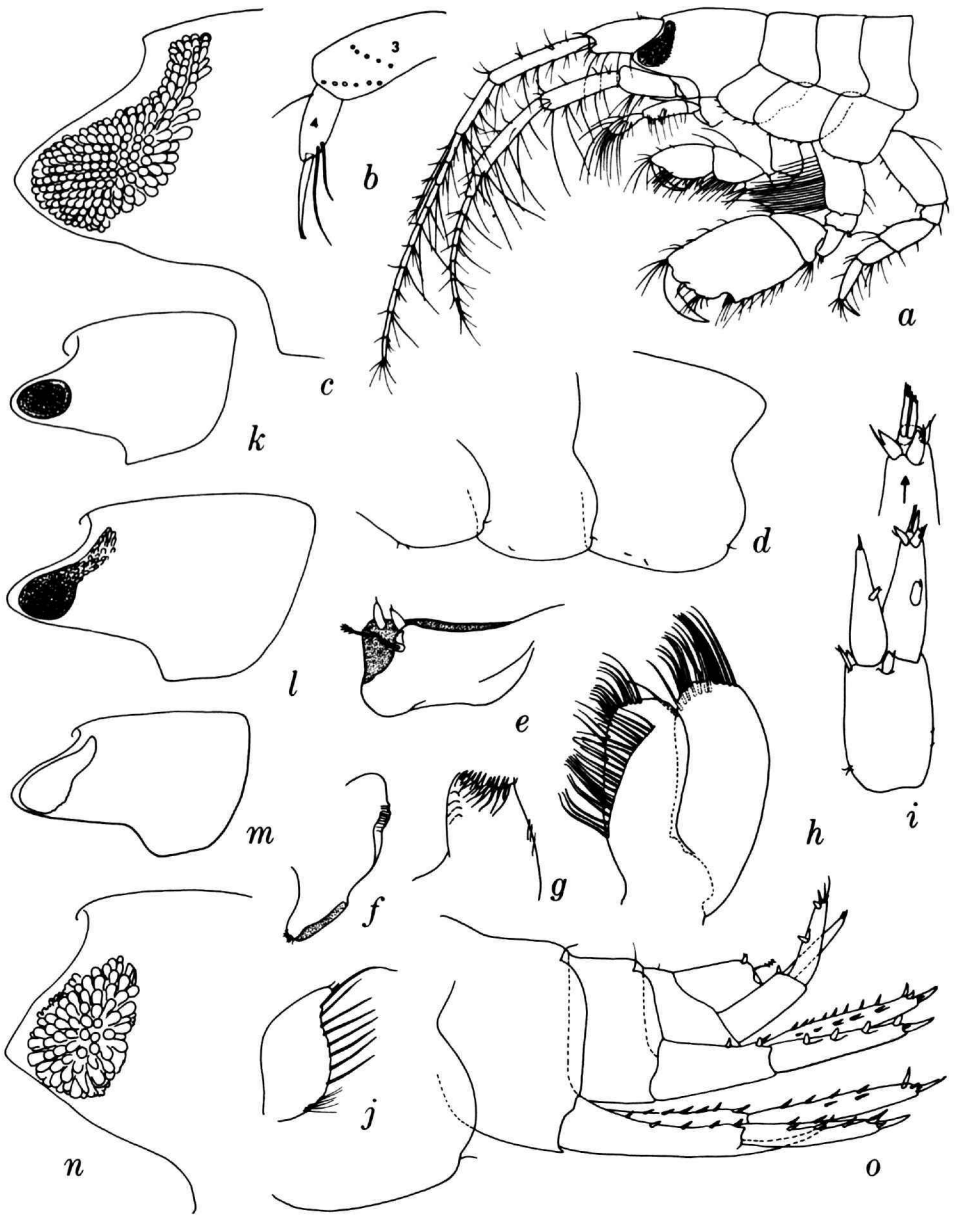

FIGURE 111.—*Gammaropsis atlantica* Stebbing, male, 4.0 mm, JLB Hawaii 10: *a*, anterior end of body; *b*, palp article 3 of maxilliped, sockets with setae removed; *c*, head; *d*, pleonal epimera 1–3, left to right; *e*, right lateral view of telson; *f*, right lateral view of epistome and upper lip complex; *g*, obverse view of right mandibular molar; *h*, maxilla 2; *i*, uropod 3; *j*, inner plate of maxilla 1. Heads, *k*, *l*, *m*, *n*: *k*, male 3.1 mm, form B, Hawaii 2; *l*, male 4.4 mm, form B, Hawaii 2; *m*, intersex, 3.4 mm, Hawaii 3; *n*, juvenile, 1.2 mm, Hawaii 5. Female, 4.5 mm, Hawaii 10: *o*, urosome.

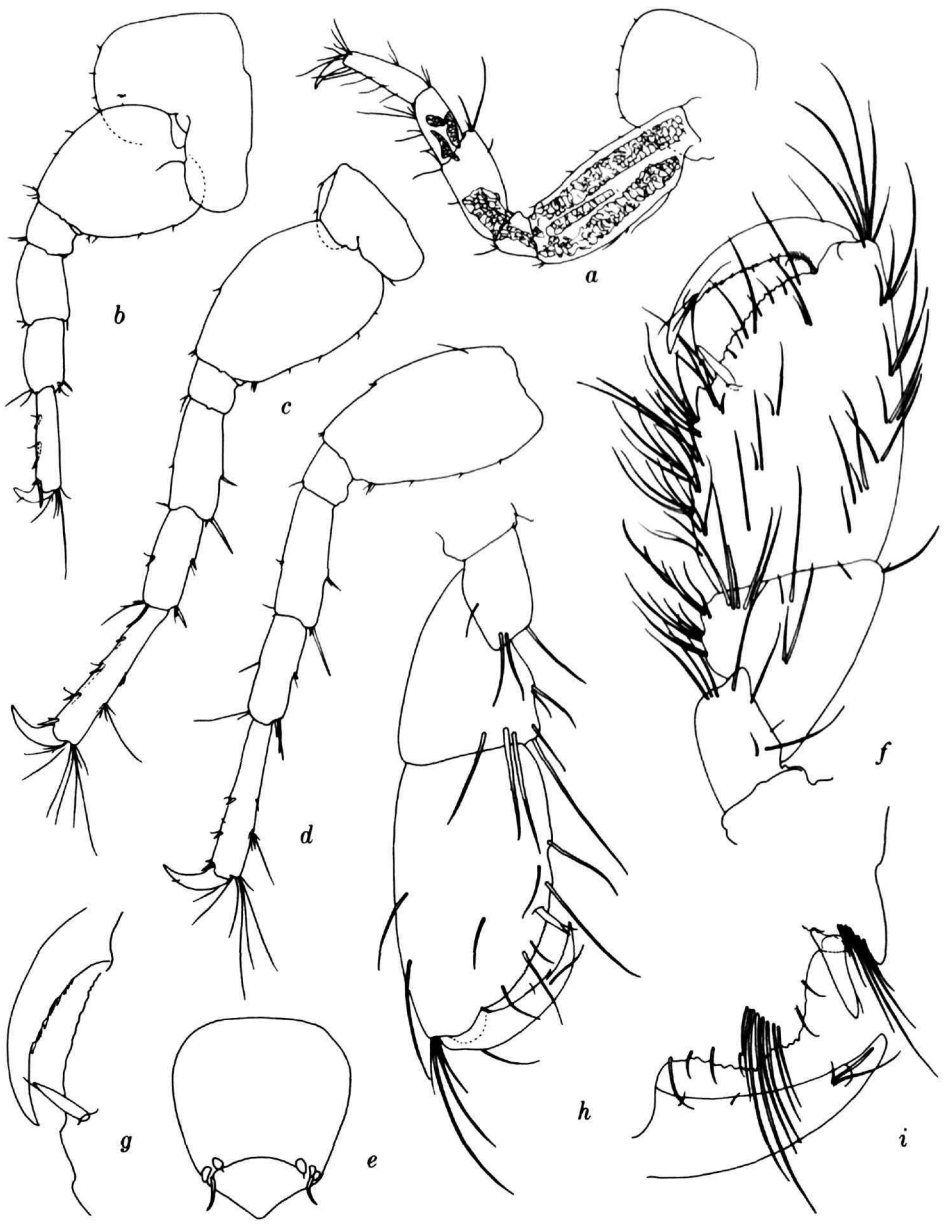

FIGURE 112.—*Gammaropsis atlantica* Stebbing, male, 4.0 mm, JLB Hawaii 10: *a, b, c, d,* pereopods 1, 3, 4, 5; *e,* telson. Female, 4.5 mm: *f,* medial gnathopod 2. Juvenile, 2.6 mm: *g,* gnathopod 2. Juvenile, 1.8 mm: *h,* gnathopod 2. Male, 4.4 mm, Hawaii 2, form B: *i,* gnathopod 2.

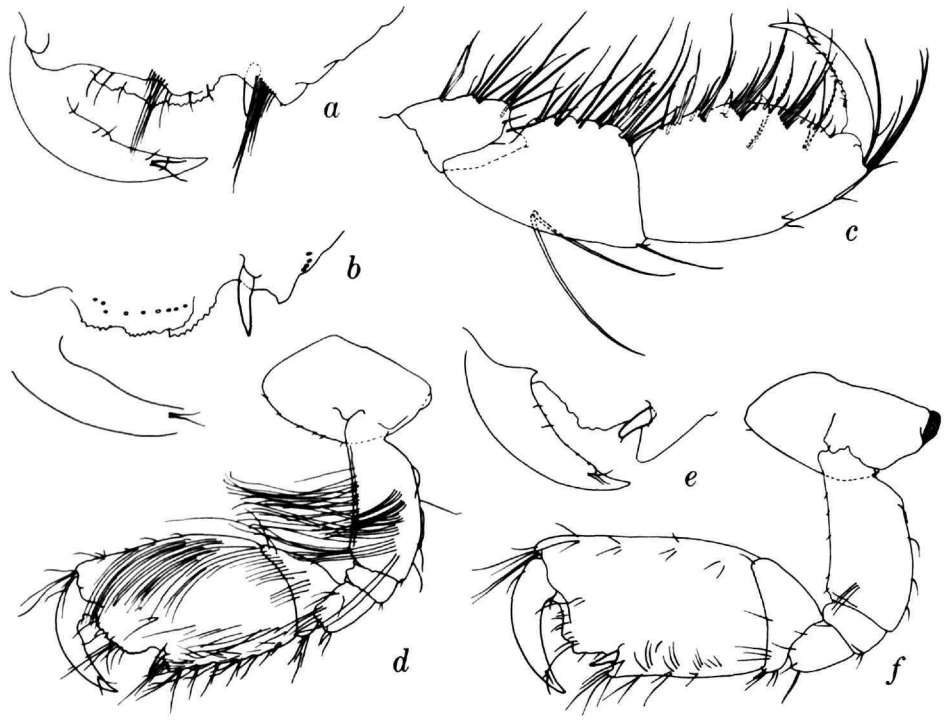

FIGURE 113.—*Gammaropsis atlantica* Stebbing, male, 4.0 mm, JLB Hawaii 10: *a, b,* gnathopod 2, lateral and medial views; *c,* gnathopod 1; *d,* medial gnathopod 2. Male, 3.1 mm, form B, JLB Hawaii 2: *e,* gnathopod 2, setae removed. Male, 4.4 mm, form B, JLB Hawaii 2: *f,* medial gnathopod 2.

and transformation to lageniform state occurs very early. Form B may represent a retarded phase or holding stage in the maturation cycle, whereas form A may be a "pelagic phase" with early and continuous reproduction. But form A may be one kind of hybrid of *G. atlanticus* with *G. afra*. Another hybrid-like form is reported under the latter species.

If the two forms represent sibling species, they are unusual in that they occur throughout the tropical Indo-Pacific together, from at least India to Hawaii. At every locale each form has a minutely to grossly distinct morphology from its nearest neighbors, and they might be accorded subspecific appellations. Strangely, *G. afra* must also be a sibling species as gnathopod 2 is often almost identical to various allopatriots of *G. atlantica* (e.g., *afra* of South Africa and *atlantica* of India). But in each locale the two species may be distinguished as their morphologies shift in various directions so as not to overlap sympatrically.

Gammaropsis pacifica (Schellenberg, 1938) from various islands in Micronesia and southern Polynesia appears to be distinct from *G. atlantica* in the dactyl of male gnathopod 2 overlapping the palmer defining corner, but Barnard (1965a) found definite individuals of *G. atlantica* in the same islands (Marshalls) as Schellenberg found his *G. pacifica*. Also, Barnard's female *G. pacifica* from Micronesia probably is referable to *G. atlantica* or to the "hybrid" *afra-atlantica* mentioned under *G. afra*. The diversity in Hawaiian collections suggests to me that *Megamphopus abbotti* Barnard (1965a) from Micronesia also belongs with the *G. afra-atlantica* complex; it has gnathopod 2 of *afra,* but the eyes are of intermediate character, and the accessory flagellum is reduced to 2 articles. The latter is the criterion for the *Megamphopus* "concept," but Barnard (1962a and elsewhere) has already questioned the validity of that slim difference. *Megamphopus abbotti* should be brought into the *Gammaropsis* complex but retained as a distinct species. Undoubted-

ly, the widely scattered archipelagos of Micronesia and Polynesia provide fertile ground for speciation or at least strong differentiation by founder populations enjoying less stressful competition than that occurring in more diverse environments. Unfavorable mutations recurrent in populations inhabiting diverse environments may be better suited for and become dominant in the small scale and poorly diverse environments of isolated atolls or small island groups.

Hawaiian populations of both *G. afra* and *G. atlantica* have the inner plate of maxilla 1 fully setose on the medial edge; the tiny individuals of *G. afra* have only 3 setae but they fully embrace the medial margin.

DISTRIBUTION.—Eastern Atlantic Ocean eastward to Hawaii.

Gammaropsis digitata (Schellenberg) from Canton Island

FIGURE 114

Eurystheus digitatus Schellenberg, 1938, pp. 84–86, fig. 44.—J. L. Barnard, 1965a, pp. 535–536, fig. 30.

DIAGNOSIS OF MALE.—Lateral cephalic lobes strongly extended, narrow, antenna 2 moderately recessed along ventral margin; eyes obliquely ovate and elongate, rusty pink in alcohol; epistome unproduced; right mandibular molar with strong flake and seta; inner plate of maxilla 1 with about 5 long medial and 2 short terminal setae; antennae 1–2 equal to each other in length, relatively stout, nearly as long as head and pereon together, flagella nearly 40 percent as long as peduncles, accessory flagellum 4-articulate; coxa 1 bluntly angular at anteroventral corner, coxae otherwise normal and not enlarged; article 6 of gnathopod 1 ovate, not expanded, article 5 bearing 1 thin anterior seta; palm of gnathopod 2 basically transverse, with large tooth becoming split off posterior margin of article 6 and becoming more strongly gaped with increase in age, crotch of tooth with large articulate spine, reduced to a seta and finally lost in adults, distal end of palm with stout falciform protuberance, dactyl strongly curved at base and maintained in a transverse position; article 2 of pereopods 3–5 slender and weakly ovatopyriform, not rectangular; pleonal epimera 1–3 with slight posteroventral notch and tooth, posterior bulges of medium extent; urosomites 1–2 each with 1 dorsolateral seta on each side but otherwise simple; outer ramus of uropod 2 lacking article 2; telson deeply excavate dorsally; uropod 2 with slight peduncular tooth between rami.

FEMALE.—Palm of gnathopod 1 evenly convex and not bearing slight sinuosity seen in male; gnathopod 2 small, palm unexcavate, bearing stout spines.

MATERIAL.—Canton Island, February 1958, Drs. Degener (4).

DISTRIBUTION.—Micronesia, Southern Polynesia, and the Hawaiian Islands.

Gammaropsis haleiwa, new species

FIGURE 115

DIAGNOSIS OF YOUNG MALE.—Lateral cephalic lobes long and narrow, anteroventral margin of medium recessment for antenna 2, lobes rounded-subconical apically; eyes small, subcircular, a black core surrounded by clear, small ommatidia; epistome rounded anteriorly; right mandibular molar with flake; inner plate of maxilla 1 bearing 1 long apical seta and 1 small setule; maxilliped differing from Hawaiian congeners in flabellate expansion of apical spines on inner plate of maxilliped, presence of adz-shaped process on article 3 of palp and in elongation of article 4, subunguiform and bearing short nail and 2 or 3 setules all shorter than article 4; antennae slender, antenna 1 as long as head plus first 9.5 body segments, antenna 2 three-fourths as long as 1, accessory flagellum 4-articulate; coxa 1 obtuse anteroventrally, coxae otherwise normal and not enlarged; article 6 of gnathopod 1 ovatorectangular, not expanded, palm defined by small spine and bearing large spine like that of gnathopod 2, article 5 of gnathopods 1–2 lacking anterior spines; gnathopod 2 small, scarcely broader than gnathopod 1, palm oblique, even, defined by medium spine and bearing large medial spine in middle, dactyl slender and fitting palm; pereopods 3–4 (5 unknown) like those of *Aoroides columbiae* figured herein including presence of stout, slightly hooked submarginal spine on article 5, article 2 thus thin but weakly ovatopyriform; pleonal epimera 1–3 with moderately bulging posterior margins and weak posteroventral notch and tooth; urosomite 1 with 1 dorsolateral seta on each side marking slight anterior turn in lateral margin, urosomite 2 similar but dorsal part of lateral margin with 3 nobs, dorsolateral margin of urosomite 3 also nobbed; both uropods 1 and 2 with long ventral peduncular tooth between rami, uropod 1 also with distomedial sharp tooth on peduncle; rami of uropod 3 about 1.5 times as long as short peduncle, outer with small article 2; telson moderately excavate

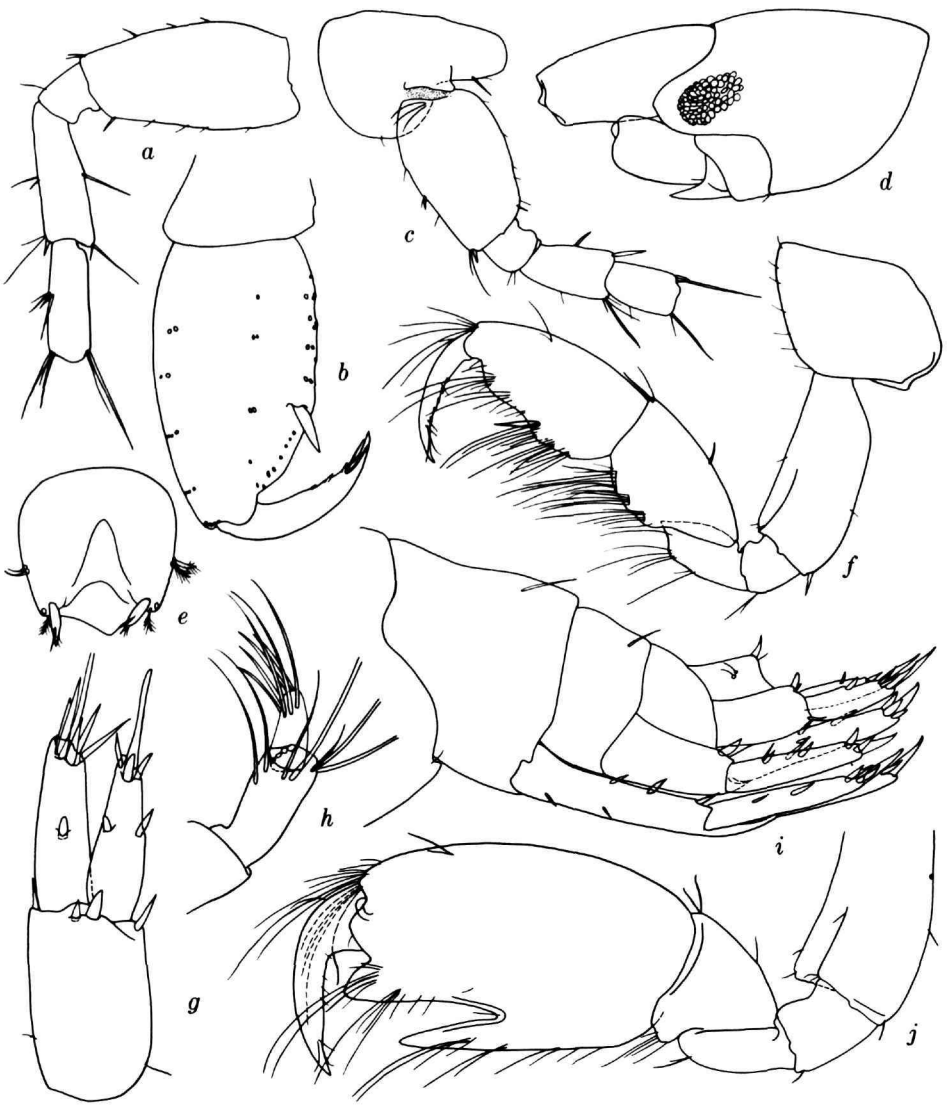

FIGURE 114.—*Gammaropsis digitata* (Schellenberg), female, 3.5 mm, Canton Island: *a*, part of pereopod 5; *b*, gnathopod 2, setae marked by pits; *c*, part of pereopod 3. Male, 4.0 mm: *d*, head; *e*, telson; *f*, gnathopod 1; *g*, uropod 3; *h*, apex of maxillipedal palp; *i*, pleonal epimeron 3 and urosome; *j*, part of gnathopod 2.

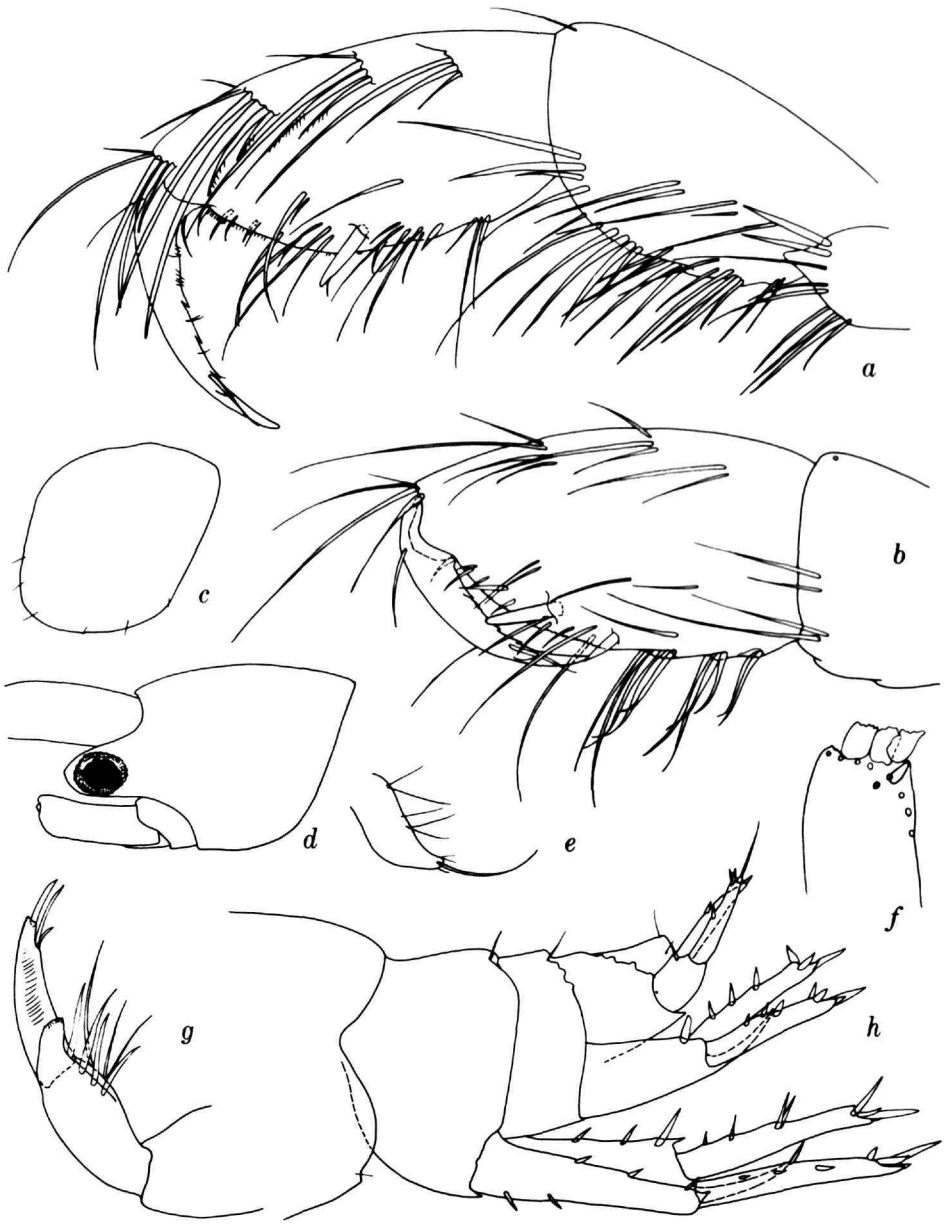

FIGURE 115.—*Gammaropsis haleiwa,* new species, holotype, ?male, 3.5 mm, JLB Hawaii 10: *a, b,* gnathopods 1, 2, medial; *c,* coxa 1; *d,* head; *e,* inner plate of maxilla 1; *f,* inner plate of maxilliped; *g,* apex of maxillipedal palp; *h,* pleonal epimeron 3: *i,* urosome, lateral.

dorsally and bearing only 1 lateral seta on each side, no spine.

HOLOTYPE.—Bishop Museum collections, catalog number 7280, ?male, 3.5 mm. Unique.

TYPE-LOCALITY.—JLB Hawaii 10, Kaneohe Bay, Oahu, 2 m, *Pocillopora,* 23 February 1967.

REMARKS.—The mandibular palp is slender like that of *G. maculatus* (Johnston) (=*G. erythrophthalmus* (Liljeborg) in Sars, 1895, pl. 198) and the lobes of maxilla 2 are broader than in Sars' representation.

Affinities of this species outside of Hawaii cannot be determined until we are certain that adult males have been described. In Hawaiian waters this species differs from its congeners in numerous characters, some of possible generic value such as those of the maxillipeds, but it differs in nongeneric characters by a combination of narrow cephalic lobes, small, circular eyes with black core, elongate rami of uropod 3 with 2-articulate outer ramus, the presence of a long peduncular tooth on uropod 2, and the occurrence of nobs on urosomal margins.

DISTRIBUTION.—Hawaiian Islands.

Gammaropsis kaumaka, new species

FIGURE 116

DIAGNOSIS OF YOUNG MALE.—Lateral cephalic lobes of medium elongation, anteroventral margin of medium recessment for antenna 2, lobes rounded-subconical apically; eyes of moderate size, irregularly ovate, slightly tilted from horizontal plane, a black core surrounded by clear ommatidia; epistome rounded anteriorly; right mandibular molar appearing to lack flake but possibly bearing rugosity; inner plate of maxilla 1 bearing 2 short apical setae and 2 long medial setae; maxillipedal palp and inner plate of normal condition for genus, major spine-teeth of inner plate short conical sabres, palp article 3 lacking process, article 4 short, with long apical setal spines; antennae short and stout, equal to each other in length, accessory flagellum 2-articulate; coxa 1 obtuse anteroventrally, coxae otherwise normal and not enlarged; article 6 of gnathopod 1 subrectangular, not expanded, palm defined by small spine, article 5 of gnathopods 1–2 lacking anterior spines; gnathopod 2 of medium size, possibly in juvenile condition, palm oblique, rounding onto posterior margin of hand and defined by stout spine, dactyl fitting palm; pereopods 3–4 (5 unknown) like those of *Aoroides columbiae* figured herein, second articles stouter and subpyriform; pleonal epimera 1–3 with moderately bulging posterior margins and weak posteroventral notch and tooth; urosomites simple; both uropods 1 and 2 with long ventral peduncular tooth between rami; outer ramus of uropod 3 as long as peduncle, with barrel-shaped article 2, inner ramus slightly shorter and much thinner than outer ramus, bearing 1 apical spine; telson moderately excavate dorsally and bearing stout spine and nob on each side.

HOLOTYPE.—Bishop Museum collections, catalog number 7281, ?male, 1.7 mm. Unique.

TYPE-LOCALITY.—JLB Hawaii 17, Kawela Bay, Oahu, intertidal, *Sargassum,* other algae, rocks, corals, 24 May 1967.

RELATIONSHIP.—Affinities of this species outside of Hawaii cannot be determined until definitely adult males have been described, but in its juvenile condition, *G. kaumaka* is clearly distinct from all other Hawaiian species of *Gammaropsis.* The presence of a peduncular tooth on uropod 2 links this species with *G. haleiwa,* new species, the only other *Gammaropsis* in Hawaii so far having that character, but *G. kaumaka* differs from *G. haleiwa* in the normal articles 3–4 of the maxillipedal palp, the slightly shorter lateral cephalic lobes with more irregular eyes, the smooth margins of the urosomites, the short rami of uropod 3, the medially setose inner plate of maxilla 1, the normal spines on the inner plate of the maxilliped, and the presence of stout spines on the telson.

Gammaropsis kaumaka also resembles *G. pokipoki,* new species, but has shorter rami on uropod 3, less deeply inserted antenna 2, an unexcavate palm of gnathopod 2, short article 5 on gnathopod 2, a normally rounded and broad pleonal epimeron 3, and the process on uropod 2.

Gammaropsis kaumaka also is difficult to distinguish superficially from *G. pali,* new species, but differs in the presence of the peduncular process on uropod 2, the blunter spines on uropods 1–2, the broader article 2 of pereopods 3–4 (?5), the unexcavate palm of gnathopod 2, the slightly more deeply inserted antenna 2, the shorter inner ramus of uropod 2 with its single apical spine, and the absence of anterior spines on article 5 of gnathopods 1–2.

Antenna 1 bears 4 long and 1 short flagellar articles and antenna 2 bears 3 flagellar articles.

DISTRIBUTION.—Hawaiian Islands.

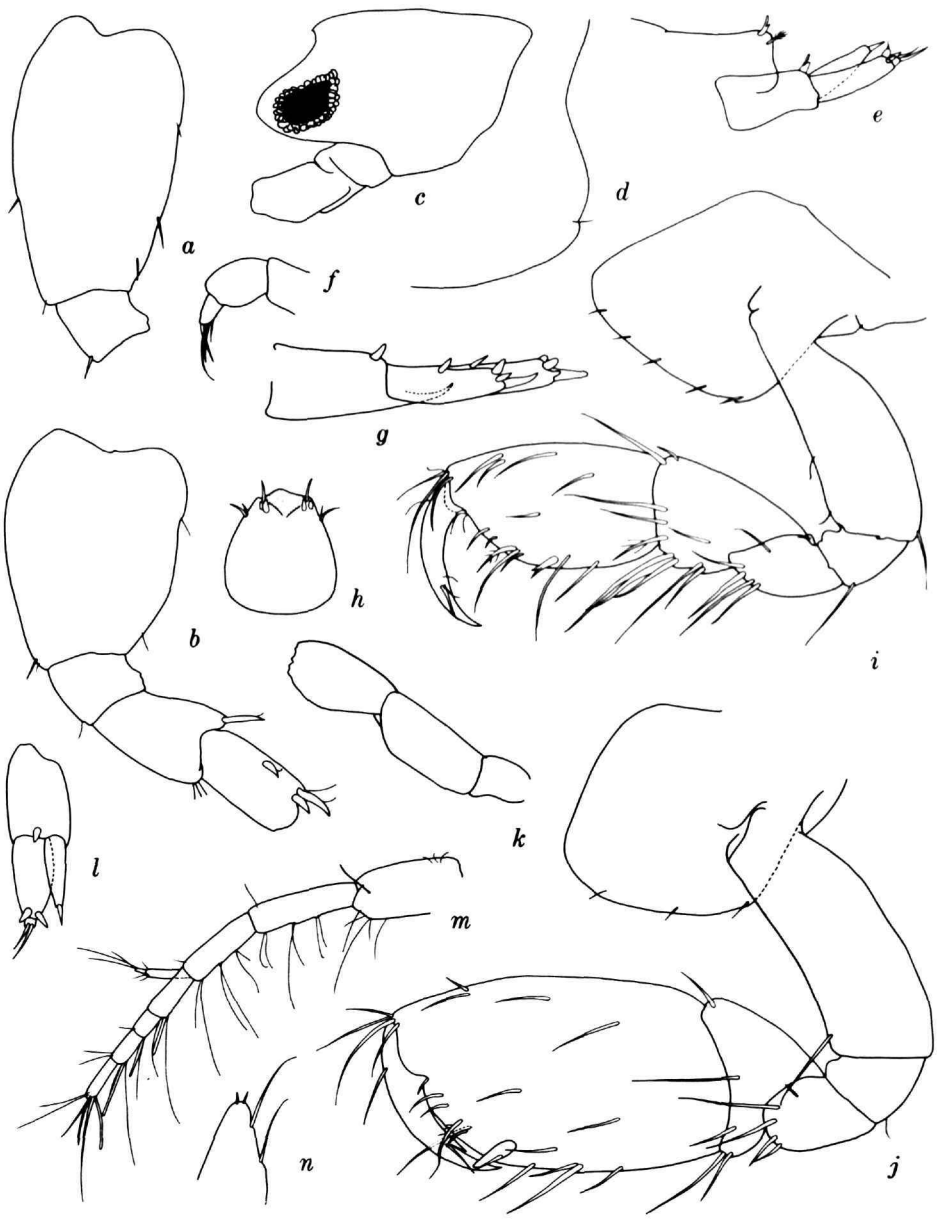

FIGURE 116.—*Gammaropsis kaumaka*, new species, holotype, male, 1.7 mm, JLB Hawaii 17: *a*, *b*, parts of pereopods, 4, 3: *c*, head; *d*, pleonal epimeron 3; *e*, telson and uropod 3 from lateral aspect; *f*, apex of maxillipedal palp; *g*, lateral uropod 2; *h*, telson; *i*, *j*, medial gnathopods 1, 2; *k*, mandibular palp, setae removed; *l*, uropod 3; *m*, antenna 1; *n*, inner plate of maxilla 1.

Gammaropsis pali, new species

FIGURES 117, 118

DIAGNOSIS OF FEMALE AND JUVENILE MALE.—Lateral cephalic lobes of medium extension, narrow, anteroventral margin slightly insinuate; eyes dark in alcohol, irregularly oval or trapezoidal, set obliquely in ocular lobes, anterior and ventral margins clear of pigment; epistome unproduced; right mandibular molar with flake; inner plate of maxilla 1 with about 5 long medial setae; antennae 1–2 subequal to each other in length, about as long as head and pereonites 1–6 together, flagella about half as long as peduncles, accessory flagellum about 4-articulate; coxa 1 sharply angular at anteroventral corner, coxae otherwise normal and not enlarged; article 6 of gnathopod 1 subrectangular, not expanded, palm lacking defining spine, article 5 of gnathopods 1–2 with 2–3 stout anterior spines; palm of gnathopod 2 oblique and short, dactyl overriding palm, palm with locking bulge near finger, then slightly excavate and with slight protrusion before becoming widely excavate, defining corner scarcely projecting,

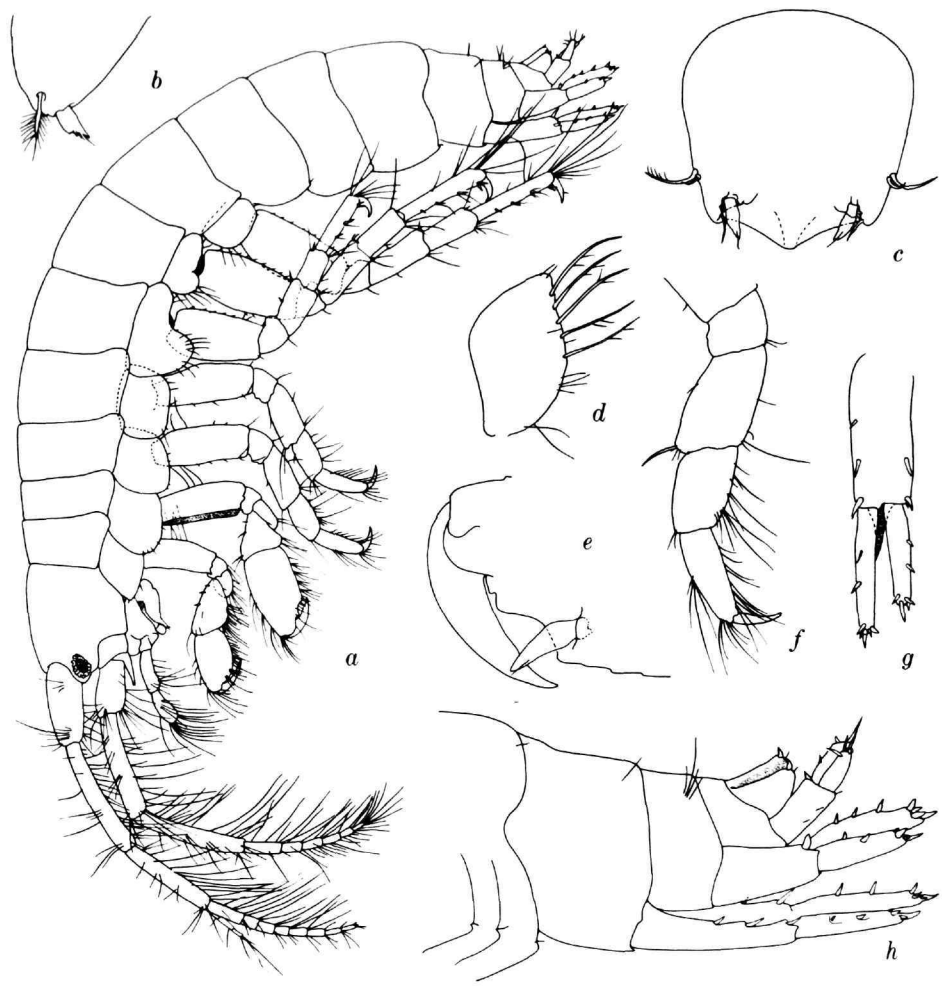

FIGURE 117.—*Gammaropsis pali,* new species, holotype, female, 4.3 mm, JLB Hawaii 10: *a,* lateral view of body; *b,* lateral view of telson; *c,* telson; *d,* inner plate of maxilla 1; *e,* apex of gnathopod 2; *f,* apex of pereopod 1; *g,* uropod 1; *h,* urosome and margins of pleonal epimera 1–3, to left.

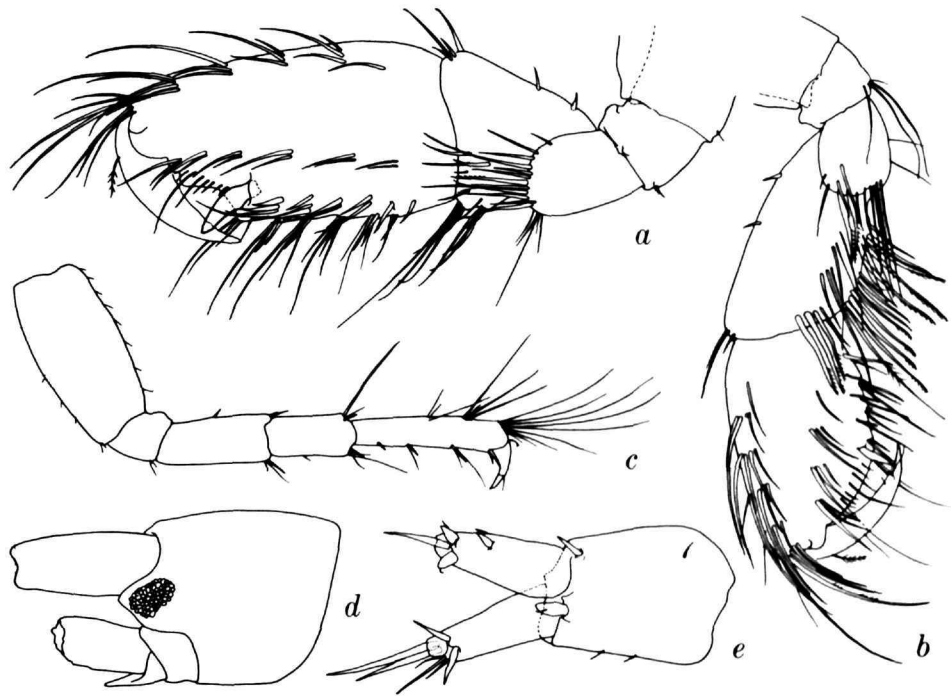

FIGURE 118.—*Gammaropsis pali*, new species, holotype, female, 4.3 mm, JLB Hawaii 10: *a*, medial gnathopod 2; *b*, medial gnathopod 1; *c*, pereopod 4; *d*, head; *e*, telson.

medial surface with enormous spine; article 2 of pereopods 3–5 slender and subrectangular; pleonal epimera 1–3 with slight posteroventral notch and tooth, not bulging strongly; urosomite 1 with one lateral seta, urosomite 2 with about 4 submarginal lateral setae, no teeth or notches; outer ramus of uropod 3 with a small article 2; telson only weakly excavate dorsally.

COLOR IN 2-DAY FORMALDEHYDE.—Eyes bright garnet-ruby, head with similar red spots, antennae dark garnet splotchy, a few body segments with brown vertical stripes.

HOLOTYPE.—Bishop Museum collections, catalog number 7282, ovigerous female, 4.3 mm.

TYPE-LOCALITY.—JLB Hawaii 10, Kaneohe Bay, Oahu, 2 m, *Pocillopora*, 23 February 1967.

MATERIAL.—JLB Hawaii 10 (11), 14 (1).

RELATIONSHIP.—This species belong with the *G. afra-atlantica* group of the genus because the outer ramus of uropod 3 has a minute second article, but because few species of *Gammaropsis* have been decidedly examined for this character, one cannot determine how extensively distributed is the character nor what relationships it may signify. No male of *G. pali* is as mature as, nor as well developed as, the adult females collected, so that relationships with males of other species are cloudy.

Gammaropsis pali differs from *G. afra* and *G. atlantica* in the shapes of the eye and cephalic lobe, in the simple urosomites 1–2 having only submarginal setae, in the presence of a large molarial flake on the right mandible, the thin rectangular article 2 of pereopods 3–5, and in the stout anterior spines on the wrists of the gnathopods.

The new species resembles females of *G. semidentatus* (K. H. Barnard, 1916) from South Africa but differs in the narrow article 2 of pereopods 3–5.

Affinities with *G. japonica* (Nagata, 1961b) occur in view of the narrow article 2 of pereopods 3–5 on females and the shape of gnathopod 2, but *G. pali* differs from *G. japonica* in the absence of small teeth on urosomites 1–2, the nearly straight, unbulging posterior margin of epimeron 3, and in the unproduced epistome.

DISTRIBUTION.—Hawaiian Islands.

Gammaropsis pokipoki, new species

FIGURES 119, 120

DIAGNOSIS.—Lateral cephalic lobes strongly extended and thick, bluntly triangular in front, antenna 2 deeply recessed along ventral cephalic margin; eyes large, subcircular, with a black core surrounded by clear ommatidia; epistome rounded anteriorly; right mandibular molar with long seta, both molars with basal rugosities but no flakes; inner plate of maxilla 1 with 4–5 medial setae; antenna 1 slightly longer than antenna 2, about as long as head and first 8 body segments together, flagella more than three-fourths as long as peduncles, accessory flagellum 3-articulate; coxa 1 bluntly angular at anteroventral corner, coxae otherwise normal and not enlarged; article 6 of gnathopod 1 an elongate trapezoid, not expanded, article 5 of both pairs of gnathopods smooth anteriorly; gnathopod 2 small, palm oblique in both sexes, short, deeply excavate in male and aberrant females, bearing enormous spine, palm defined by conical protrusion and excavation bounded distally by similar protrusion, dactyl slender and overextending palm, female palm normally scarcely excavate; article 2 of pereopods 3–5 expanded and pyriform; pleonal epimera 1–3 with slight posteroventral tooth, posterior margins strongly bulging; urosomites 1–2 each with 1 dorsolateral seta, otherwise simple; rami of uropod 3 about 1.5 times as long as peduncle, outer with small article 2; telson only weakly excavate dorsally.

HOLOTYPE.—Bishop Museum collections, catalog number 7383, female, 2.6 mm.

TYPE-LOCALITY.—JLB Hawaii 6, off Barbers Point, Oahu, 30 m, coralline footballs, 29 January 1967.

MATERIAL.—JLB Hawaii 5 (4), 6 (2), 10 (6), 12 (?1).

RELATIONSHIP.—This species has its closest affinities with the *G. atlantica-afra* complex and *G. pali*, for it differs from Hawaiian *G. alamoana* in the setose inner plate of maxilla 1 and in the presence of a second article on the outer ramus of uropod 3. *Gammaropsis pokipoki* has few qualitative characters to distinguish it from the 3 species mentioned above, but nevertheless stands out sharply when encountered in various samples. The body and antennae are long and thin, the head shallow and very smooth, and the large circular eye with black core surrounded by clear ommatidia immediately marks the species from all its congeners except *G. haleiwa*, new species, (which see for relationships). *Gammaropsis atlantica* and *G. afra* have no dark pigment in the eyes and have more complex and larger gnathopods and weakly ornamented urosomites 1–2.

Gnathopod 2 of *G. pokipoki* resembles that of *G. pali* very closely but the head, eyes, and antennae are very different and *G. pali* has a distinct molarial flake, thicker body, shorter rami of uropod 3, and narrow second articles on pereopods 3–5.

Female and juvenile individuals of *G. pokipoki* closely resemble their counterparts of *Konatopus paao*, for the heads and eyes have strong similarities, but careful examination shows gnathopod 1 of *Konatopus* to be very slightly larger than gnathopod 2, and the eyes retain reddish or pale brown pigment instead of black.

DISTRIBUTION.—Hawaiian Islands.

Photis aina, new species

FIGURES 121, 122

DIAGNOSIS OF MALE.—Head with long, nearly clavate ocular lobes; eyes round or horizontally subovate, located terminally in ocular lobes, clear in formaldehyde and alcohol, composed of small, spherical, tightly packed ommatidia; antennae equal to each other in length, as long as head and pereon together, article 3 of antenna 1 equal to article 1, article 2 about 1.5 times longer than either; coxa 1 elongate, rectangular, with slightly protuberant anteroventral corner, coxae 2–4 also of similar elongate rectangular condition, coxa 5 with narrow, slightly tapering anterior lobe (abnormal for majority of species in *Photis*), posterior lobe thus relatively wide compared with anterior lobe, all coxae strongly setose ventrally and lacking stridulation ridges; gnathopod 1 with articles 5 and 6 equal to each other in length, article 5 broadly truncate posteriorly, article 6 of normal ovateness, palm with strong medial submarginal spine not precisely at defining corner, palm minutely crenulate, dactyl long and slender, with small teeth and crenulations on inner edge; gnathopod 2 small, article 2 lacking anteroventral lobe, article 2 small, thick, article 4 not produced posterodistally, article 5 of medium breadth, cup-shaped, narrowly lobate posteriorly; article 6 broad, about 80 percent as broad as long, palm slightly oblique, bisinuate, defined by quadrangular corner, bearing weak hump near defining corner and weak hump distally near base of dactyl, medioproximal face of hand with large spine,

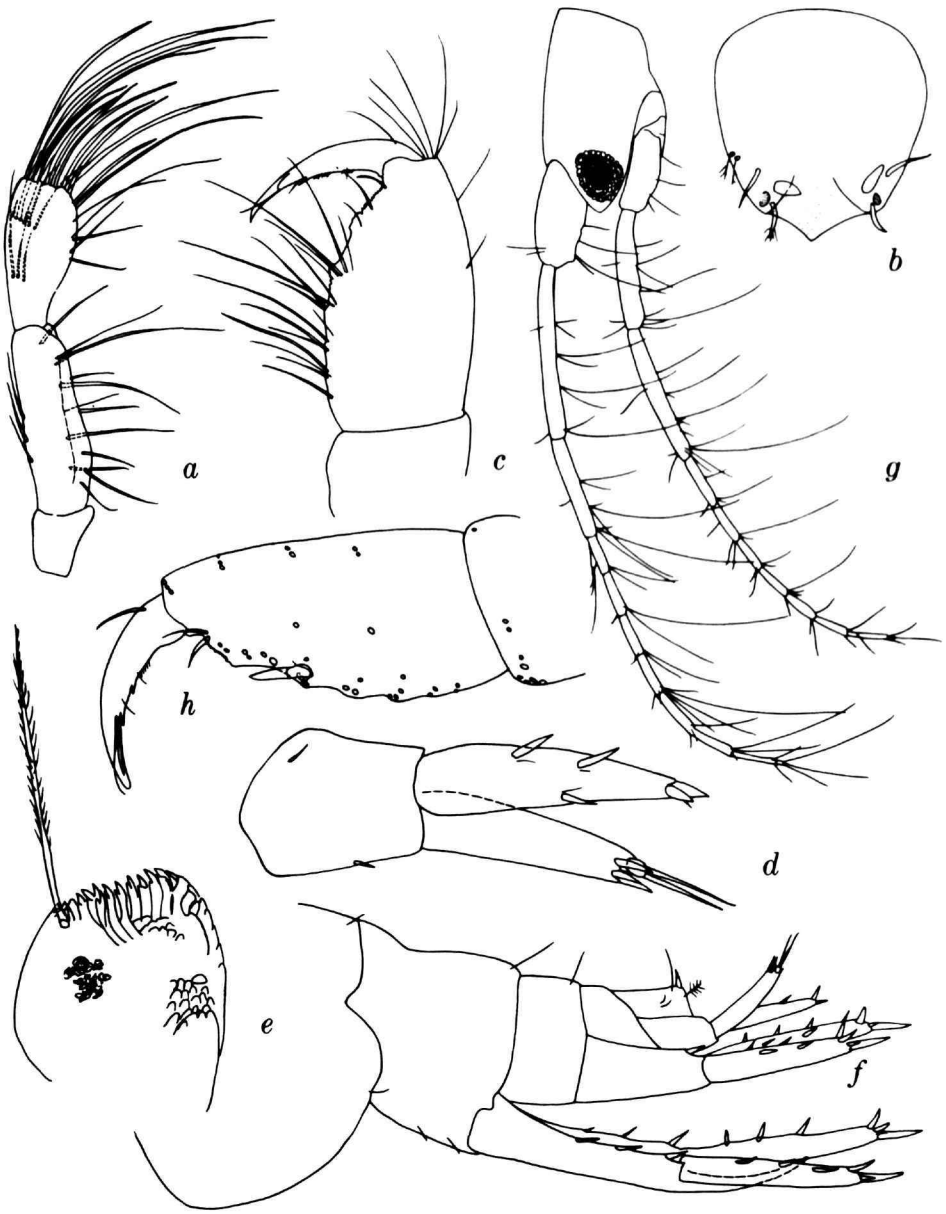

FIGURE 119.—*Gammaropsis pokipoki*, new species, holotype, female, 2.6 mm, JLB Hawaii 6: *a*, mandibular palp; *b*, telson; *c*, apex of gnathopod 2; *d*, uropod 3; *e*, right mandibular molar; *f*, pleonal epimeron 3 and urosome. Male, 2.2 mm: *g*, head. Female, 3.2 mm, JLB Hawaii 10: *h*, apex of gnathopod 2, medial.

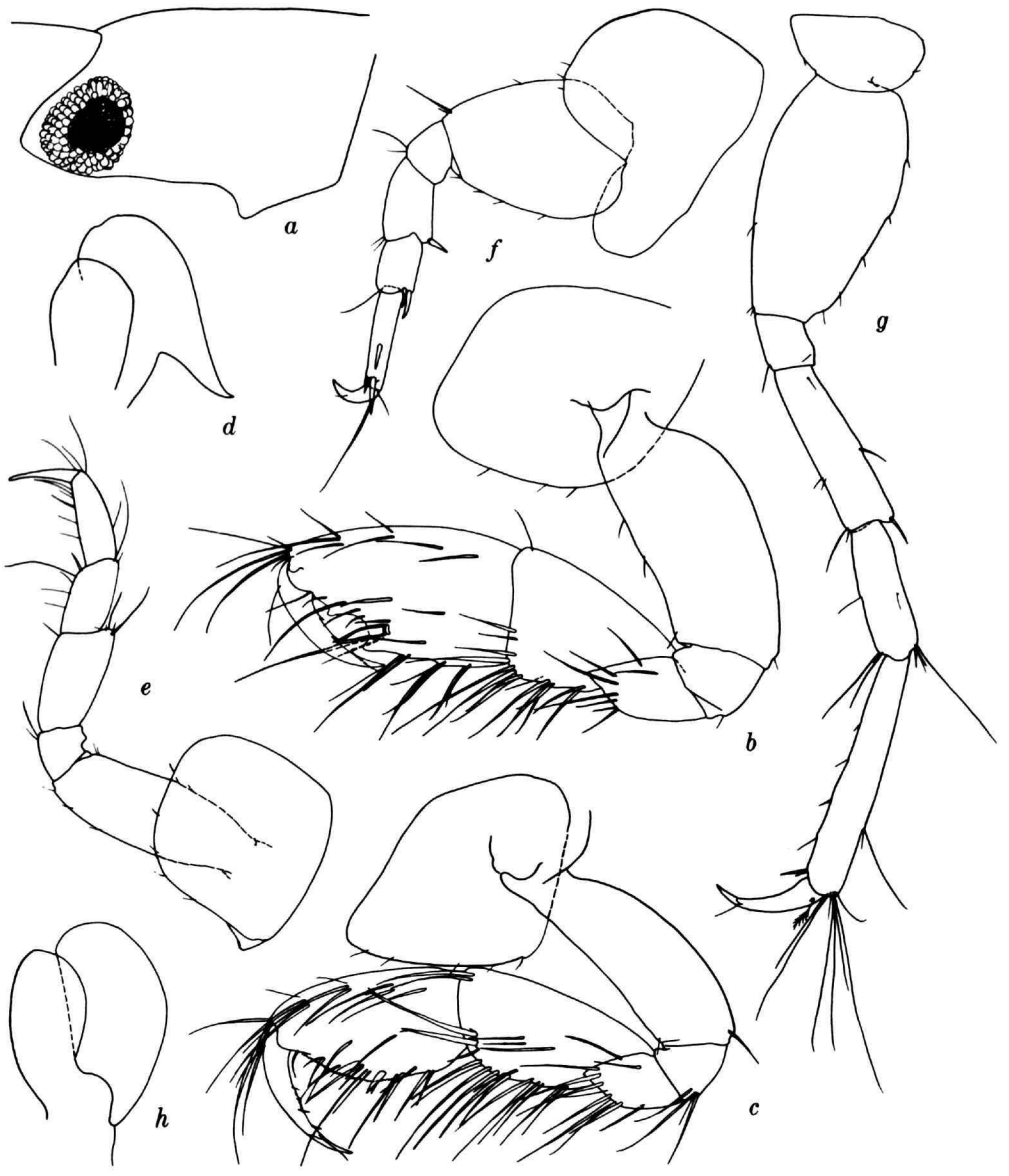

FIGURE 120.—*Gammaropsis pokipoki,* new species, male, 2.2 mm, JLB Hawaii 6: *a,* head; *b, c,* medial gnathopods 2, 1. Holotype, female, 2.6 mm: *d,* half of lower lip; *e, f, g,* pereopods 2, 3, 5; *h,* lobes of maxilla 2, setae removed.

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dactyl fitting palm in medium male, much shorter than palm in terminal male, dactyl stout, bearing 3–4 medium-sized teeth on inner margin, pereopods 3–5 relatively short and stout for genus, article 2 of pereopod 3 very broadly pyriform, anteriorly and posteriorly setose, article 5 almost quadrate, article 4 with similar appearance but obliquely cut proximally, article 6 stout, rectangular, bearing 1 large stout and 1 small stout distal spines, dactyl geniculate, armed with bilateral pair of sharp accessory cusps, pereopod 4 very similar to pereopod 3 but article 2 narrower, articles 4–6 slightly longer, dactyl also with accessory cusp, pereopod 5 with small posteroproximal cusp on article 2, articles 4 and 6 elongate, article 5 short, bearing weak distal locking spine and setule, dactyl straight, but bearing 2 setules and slight tooth on inner margin and pair of small accessory cusps on outer; uropods 1–2 lacking ventrodistal peduncular tooth, inner ramus of uropod 1 lacking marginal spines, otherwise rami and peduncles with a few spines; outer ramus of uropod 3 about 60 percent as long as peduncle, thus, peduncle elongate and outer ramus short for genus, article 2 well developed and barrel-shaped, apical spines long, inner ramus half as long as outer, thus, as long as that of subgenus *Cedrophotis;* telson subtriangular, apically obtuse, bearing dorsolateral nob on each side plus various setae and setules; epimeron 1 with several anteroventral setae, posteroventral corner rounded, epimeron 2 with 1 posteroventral notch, and epimeron 3 with 2 notches above rounded, protruding, posteroventral corner.

Mouthparts like those of *P. reinhardi* Krøyer (Sars, 1895, pl. 202), but mandibular palp longer, right molar with flake and seta, and maxillipedal palp article 4 armed with numerous apical setal-spines.

FEMALE.—Gnathopod 2 slightly smaller than in male, palmar defining corner rounded, palm with 1 weak smooth sinus, palm otherwise minutely crenulate.

HOLOTYPE.—Bishop Museum collections, catalog number 7284, male, 2.5 mm.

TYPE-LOCALITY.—JLB Hawaii 3, off Ewa Beach, Oahu, 18 m, *Pocillopora,* bryozoans, 29 January 1967.

MATERIAL.—JLB Hawaii 2 (34), 3 (88), 5 (11), 6 (40), 8(180).

RELATIONSHIP.—This species resembles those members of *Photis* with long ocular lobes like *P. dolichommata* Stebbing (1910) and *P. lamellifera* Schellenberg (1928). The latter species is distinguished by the shorter article 5 of gnathopod 1, being only half as long as article 6. *Photis aina* differs from *P. dolichommata* in the slightly stouter pereopods 3–5, shorter antennae, longer article 5 of gnathopod 2, broader article 6, lack of spines on the inner ramus of uropod 1, and the slightly longer inner ramus of uropod 3. *Photis aina* and *P. dolichommata* resemble each other in the unusual shape of coxa 5.

Photis aina has weak affinities with *P. longicaudata* (Bate and Westwood) (Sars, 1895, pl. 203, fig. 1) as gnathopod 2 has approximately the same outline, but this general shape is fairly common in the genus, especially in juveniles of various species with stronger ornamentation in terminal stages. The ocular lobes are much shorter and/or broader in *P. longicaudata* than in *P. aina,* but several decades ago those ocular lobes of the former species were considered extreme. Coxa 5 of *P. aina* is distinct from the normal shape in *P. longicaudata.*

The so-called *P. longicaudatus* (Bate and Westwood) of Walker (1904) and K. H. Barnard (1916), which probably represents a distinct species, also apparently has the normal coxa 5, and *P. longimanus* Walker has a normal coxa 5, presumably. Gnathopod 2 of the male is far more ornamented in those Ceylonese-South African species than it is in *P. aina;* perhaps the terminal male of *P. aina* has not been discovered.

Photis species of Pirlot (1938) from the Celebes has a normal coxa 5, slender articles 2–6 of pereopods 3–5, a strong anteroventral lobe on article 2 of gnathopod 2, and weak coxal setation.

In Hawaii, this species differs from *P. hawaiensis* J. L. Barnard (1955a) and *P. kapapa* new species, in the strong setation of the coxae, the long inner ramus, and, relative to the peduncle, the short outer ramus of uropod 3, and the stoutness of pereopods 3–5. Male gnathopod 2 of *P. hawaiensis* has a very oblique palm and large mammilliform process on article 2, and the oval eyes fully occupy the lateral cephalic lobes. Male gnathopod 2 of *P. kapapa* has a much broadened palm, a process on article 2, and like *P. hawaiensis,* but unlike *P. aina,* has stridulation ridges on one or more coxae and on article 2 of gnathopod 2.

Photis aina resembles the deep-water eastern Pacific subgenus *Cedrophotis* (J. L. Barnard, 1967) in the long inner ramus of uropod 3 and the relatively long peduncle, but the upper lip of *Cedrophotis* is much more deeply incised, and the inner lobes of the lower lip are partially coalesced. Probably, *P. aina* shows the unsuitability of the *Cedrophotis* concept and demonstrates

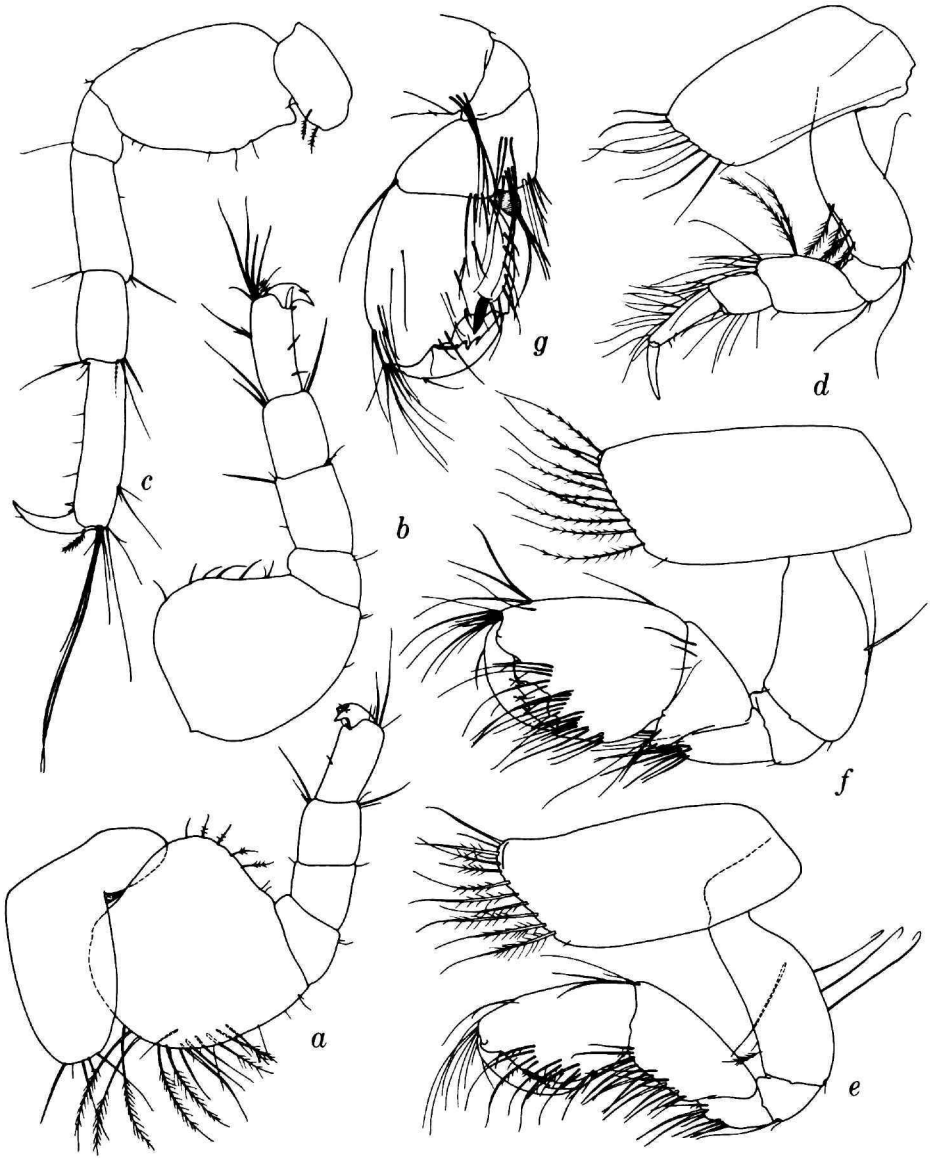

FIGURE 121.—*Photis aina*, new species, holotype, male, 2.5 mm, JLB Hawaii 3: *a*, *b*, *c*, *d*, pereopods 3, 4, 5, 1; *e*, gnathopod 1; *f*, lateral gnathopod 2; *g*, medial gnathopod 2.

FIGURE 122.—*Photis aina*, new species, holotype, male, 2.5 mm, JLB Hawaii 3: *a, b*, head, lateral and dorsal; *c*, palm of medial gnathopod 2; *d*, palm of medial gnathopod 1; *e, f*, dactyls of pereopods 5, 3; *g*, urosome; *h*, pleonal epimera 1–3. Male, 3.0 mm, JLB Hawaii 2: *i*, palm of lateral gnathopod 2. Female, 2.6 mm, JLB Hawaii 3: *j*, mandibular palp minus setae; *k*, coxa 4; *l*, medial gnathopod 2; *m*, apex of maxillipedal palp; *n*, uropod 3 and telson.

that in isolated environments, various species of *Photis* independently develop simplifications or aberrations.

DISTRIBUTION.—Hawaiian Islands.

Photis hawaiensis J. L. Barnard

FIGURE 123

Photis hawaiensis J. L. Barnard, 1955, pp. 35-37, figs. 18, 19.

DIAGNOSIS OF MALE.—Head with medium-sized ocular lobes, eyes horizontally ovate, filling ocular lobe and projecting into head proper, ommatidia much larger than in other Hawaiian photises and partially discontiguous, all not perfectly spherical, eyes pale eosin in alcohol when viewed under high power; antennae 1–2 as long as head and pereon together, article 3 of antenna 1 equal to article 1 or slightly shorter, article 2 scarcely longer than either; coxa 1 elongate-rectangular and with 1 long and several short setae, coxae 2–4 broader than 1 and thus relatively less elongate, essentially asetose, coxae 3–4 with ventrolateral stridulating ridges, coxa 3 with set of ventromedial ridges also, coxae weakly rounded ventrally, coxa 5 with normally broad anterior lobe; gnathopod 1 with

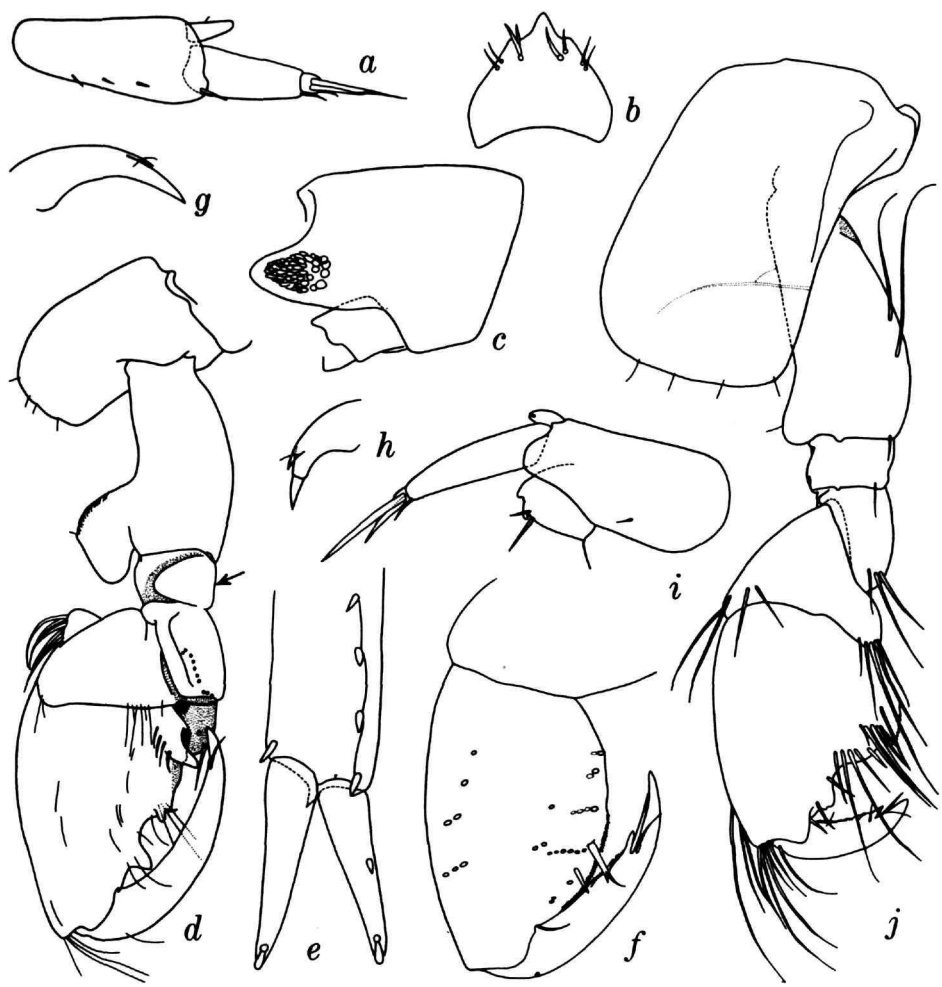

FIGURE 123.—*Photis hawaiensis* J. L. Barnard, male, 3.3 mm, Kaneohe Bay, 1937: *a*, uropod 3; *b*, telson; *c*, head; *d*, medial gnathopod 2; *e*, uropod 1; *f*, medial gnathopod 1, setae marked with pits. Female, 2.2 mm: *g*, *h*, dactyls of pereopods 5, 4; *i*, uropod 3 and telson from lateral view (upside down); *j*, gnathopod 2.

articles 5 and 6 equal to each other in length, article 5 broadly truncate posteriorly, article 6 normally but broadly ovate, palm weakly convex (drawing of Barnard, 1955a, poor), undefined, bearing 1 medial spine near middle, dactyl long, fitting palm theoretically, with small teeth and crenulations on inner edge; gnathopod 2 very large, article 2 with immense anterodistal mammilliform hump armed with stridulating ridges, article 3 quadrate from lateral view and bearing medial keel projecting mediad (shown folded down in drawing), article 4 medially setose (setae shown by pits only in figure), article 5 very broad, unlobate medioposteriorly, but bearing large, setose posterolateral lobe and anterior rounded setose keel, setae very heavy, article 6 broad but tapering distally, palm occupying full posterior margin of hand and defined by medioproximal tooth, palm distally with 2 sinuses and 2 cusps, dactyl as long as hand, inner edge smooth except for weak distal tooth and setae; pereopods 1–2 with article 4 especially turgid anterodistally; pereopod 3 fairly stout for genus but not as stout as that of *P. aina,* new species, dactyl with 1 sharp accessory cusp, pereopod 4 similar to 3 but article 2 narrower, pereopod 5 dactyl with 1 slender accessory cusp; uropods 1–2 with very small sharp leaflike ventrodistal tooth between rami, inner ramus of uropod 1 lacking marginal spines, otherwise rami of uropods 1–2 with 1 marginal spine each, apices of each with jewel-like nails; outer ramus of uropod 3 of variable length relative to peduncle, but about three-fourths as long as that peduncle, article 2 well developed and barrel-shaped, apical spines long, inner ramus 20–25 percent as long as outer ramus; telson triangular, bearing deep anterolateral notch on each side to form shape of leaf, the 2 acclivities of the notches apparently representing nobs normally found in females or juveniles; pleonal epimera all with softly rounded posteroventral corners, epimeron 2 with 2 weak ventral setae.

FEMALE.—Gnathopod 2 smaller than that of male, article 2 with medium-sized mammilliform lobe, article 5 with narrower posterior lobe, article 6 expanded, palm slightly oblique, with weak sinus near dactyl, then cusp bordered by deep sinus followed by transverse sinuous margin with quadrate defining corner and bearing small, medial, submarginal spine, dactyl slightly shorter than palm, with 2 inner teeth.

MATERIAL.—Same as J. L. Barnard (1955a).

DISTRIBUTION.—Hawaiian Islands.

Photis kapapa, new species

FIGURES 124, 125

DIAGNOSIS OF MALE.—Head with long narrow ocular lobes, eyes round or horizontally ovate, with black, brown, or purplish-brown core in formaldehyde or alcohol, eyes occupying distal ends of ocular lobes, ommatidia small and closely packed; antennae 1–2 equal to each other in length, as long as head and pereonites 1–5 together, article 2 equal to article 1, article 2 about 1.3 times longer than either; coxa 1 of medium elongation, subrectangular, anteroventral corner not protuberant, coxae 2–4 broadly rectangular, coxae 1–2 with weak stridulation ridges on posterior margin, coxa 3 with ridges on anteroventral margin, 4 with small lateral ones posteroventrally and large medial ones ventrally, coxae all scarcely setose, coxa 5 with normally broad anterior lobe; gnathopod 1 with articles 5 and 6 equal to each other in length, article 5 broadly truncate posteriorly, article 6 of normal ovateness, palm lacking any special thick spine but bearing short setal spine in expected position, this spine similar to neighboring palmar spines (and relatively large in juveniles only), palm minutely crenulate, dactyl long and slender, with small teeth and crenulations on inner edge; gnathopod 2 small, article 2 with very large, saclike anterodistal lobe bearing stridulation ridges, article 4 unproduced posterodistally, article 5 of medium breadth, cup-shaped but with tumid posterior lobe, article 6 expanded, about 80 percent as broad as long, palm slightly oblique, defined by large blunt, gaping tooth, palm weakly bisinuate, with small obtuse cusp near dactylar base and medial spine on low hump near defining tooth, medial palmar face with quadrate tooth anterior to main spine, dactyl much shorter than palm, with crenulations and 2 inner teeth; pereopods 3–5 normal in stoutness for genus, article 2 of pereopod 3 pyriform, scarcely setose, article 6 with 1 large and 1 small distal spines, dactyl slightly geniculate, with bilateral pair of accessory cusps, pereopod 4 similar to 3, but article 2 much narrower, articles 4 and 6 slightly longer, dactyl also with 2 accessory cusps, pereopod 5 with weak posteroproximal projection, articles 4 and 6 not strongly elongate and article 5 not strongly shortened, article 6 bearing 2 weak distal locking spines, dactyl nearly straight and with only 1 thin, appressed accessory cusp and 1 setule; uropods 1–2 lacking ventrodistal peduncular cusps between rami,

inner ramus of uropod 1 naked, outer ramus with 1–2 spines, spines thinner than in *P. aina,* rami with jewel-like apical nails, outer ramus of uropod 3 nearly 90 percent as long as peduncle, article 2 well developed and barrel-shaped, apical spines weak, inner ramus about one-third as long as outer; telson nearly hemicircular, apex obtusely convex, each side with small nob; posteroventral corner of pleonal epimera 1 and 3 rounded, that of epimeron 2 rounded-quadrate.

Mouthparts generally similar to those of *P. aina,* new species, but article 4 of maxillipedal palp lacking lateral seta.

FEMALE.—Gnathopod 2 of two kinds, smaller than that of male, palm slightly oblique and either weakly S-shaped and fully crenulate or bearing semicircular smooth excavation in middle, juvenile palm like that of former kind, dactyl failing to fit palm, defined by softly rounded quadrate corner.

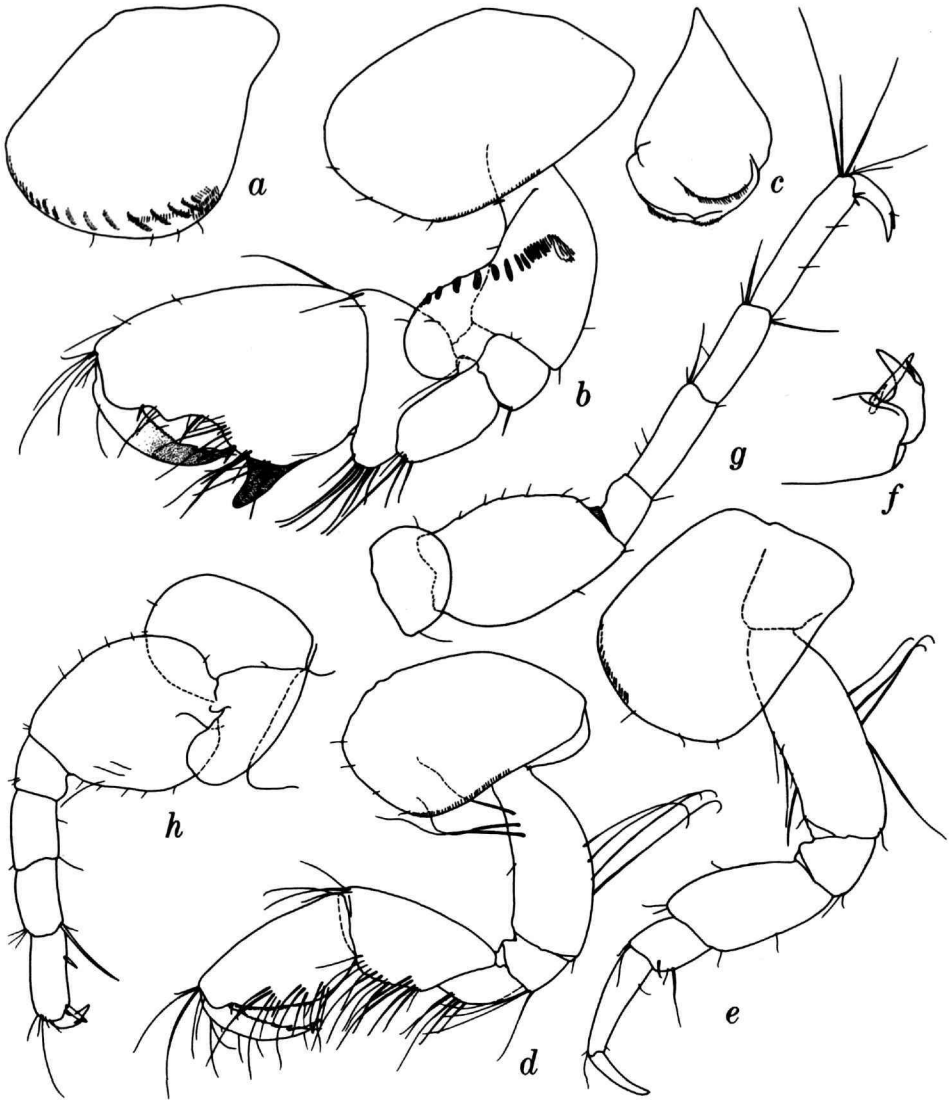

FIGURE 124.—*Photis kapapa,* new species, holotype, male, 2.7 mm, JLB Hawaii 3: *a,* lateral coxa 4; *b,* gnathopod 2; *c,* upper lip; *d,* gnathopod 1; *e,* pereopod 1. Male, 2.4 mm, JLB Hawaii 2: *f,* apex of pereopod 3; *g, h,* pereopods 5, 3.

JUVENILE MALE.—Dactyl fitting palm and defining tooth small, hand not strongly expanded and distal palmer tooth small and narrow.

ABERRANT FEMALE.—Large, 3.3 mm ovigerous female from JLB Hawaii 13, with noticeably small gnathopods in juvenile state, dactyl as long as palm but palm like that figured for 2.6 mm female of JLB Hawaii 3 and with much larger quadrate tooth on medial palmar face.

HOLOTYPE.—Bishop Museum collections, catalog number 7285, male 2.7 mm.

TYPE-LOCALITY.—JLB Hawaii 3, off Ewa Beach,

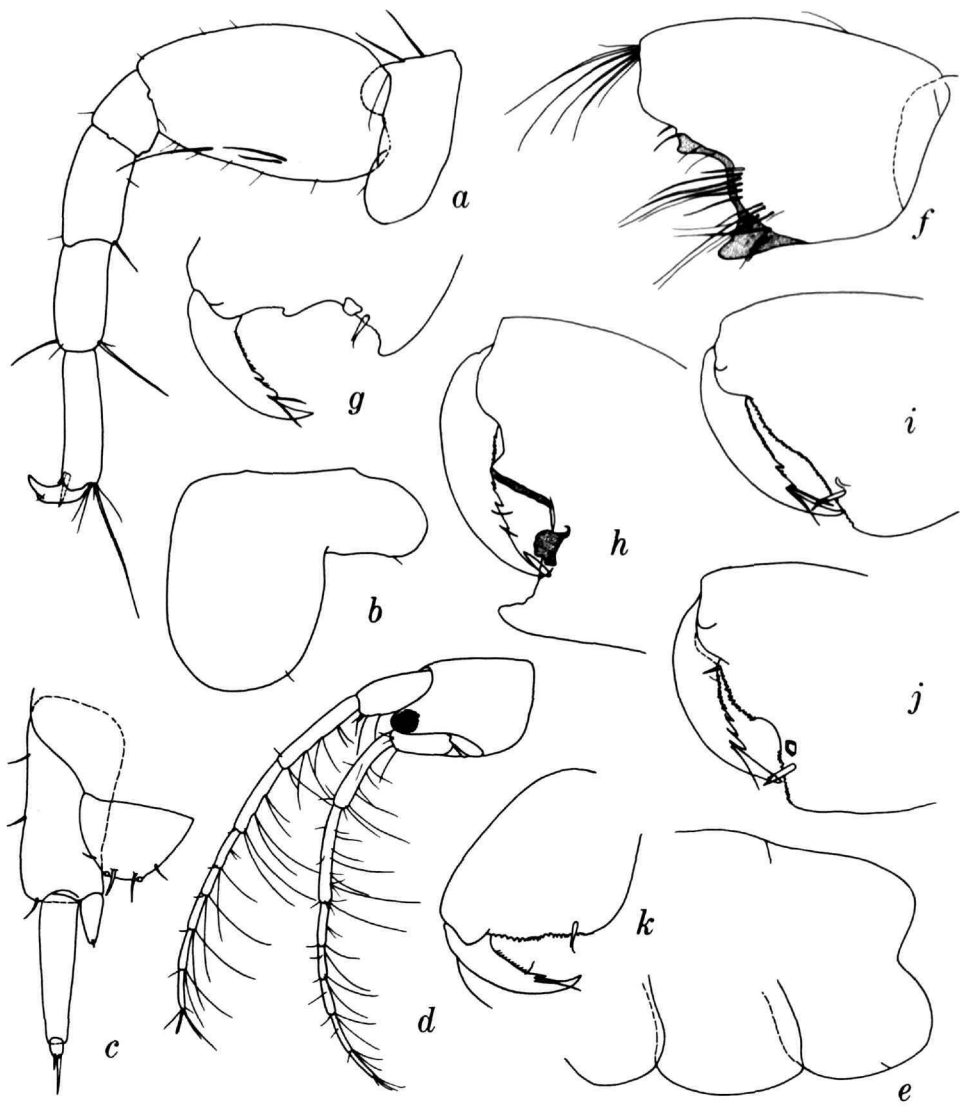

FIGURE 125.—*Photis kapapa*, new species, holotype, male, 2.7 mm, JLB Hawaii 3: *a*, pereopod 4; *b*, coxa 5; *c*, telson and uropod 3; *d*, head; *e*, pleonal epimera 1–3. Male, 2.3 mm: *f*, hand of lateral gnathopod 2. Male, 2.4 mm, JLB Hawaii 13: *g*, palm of medial gnathopod 2. Male, 2.4 mm, JLB Hawaii 2: *h*, palm of medial gnathopod 2. Female, 3.8 mm, JLB Hawaii 5: *i*, palm of medial gnathopod 2. Female, 2.6 mm, JLB Hawaii 3: *j*, palm of medial gnathopod 2. Juvenile, 1.7 mm, JLB Hawaii 3: *k*, hand of medial gnathopod 2.

Oahu, 18 m, *Pocillopora,* bryozoans, encrustations, 29 January 1967.

MATERIAL.—JLB Hawaii 2 (13), 3 (38), 5 (4), 6 (6), 8 (7), 10 (9), 12 (4), 13 (3).

RELATIONSHIP.—This species appears similar to *Photis* species of Pirlot (1938) from the Celebes, a taxon that Pirlot considered synonymous with Walker's (1904) so-called *P. longicaudata* (Bate) from Ceylon. Adult males of *Photis kapapa* have a more strongly extended defining tooth on the palm of gnathopod 2, and weaker and less sharp distal protrusion near the base of the dactyl than does *Photis* species, and bear stridulating ridges on gnathopod 2 and coxae.

DISTRIBUTION.—Hawaiian Islands.

Family ISCHYROCERIDAE

Ischyrocerus (?) *kapu,* new species

FIGURE 126

DESCRIPTION.—Aspect generally like that of *Jassa lilipuna,* new species, but coxae all shorter, coxa 1 as long as 2 and coxa 5 as long as 4, thus, assignable provisionally to *Ischyrocerus;* eyes, head, mandible, maxillae, maxillipeds, uropods 1–2, telson all similar to those of *J. lilipuna;* pereopods 3–5 and antennae unknown, missing from all specimens; gnathopod 1 with only one defining spine on palm, dactyl very long and slender, overlapping palm; coxa 1 trapezoidal, coxae 2–4 much shorter than broad; male gnathopod 2 with broadly lobate articles 2–3, article 4 immensely produced posterodistally to form substitute palmar defining tooth, article 5 triangular and enclosed posteriorly by article 4, article 6 elongate, apically broadened, lacking defining tooth on palm, latter occuping entire posterior margin of article 6, distal end of palm with 2 large processes separated by deep, flat-bottomed excavation, proximal tooth subconical, distal process spinose and asymmetrically triangular, dactyl very long and strongly overlapping palm and process of article 4; article 6 of pereopods 1–2 longer and more slender than article 6 of *J. lilipuna,* bearing only 2 posterior setae, no locking spines, dactyl long and simple; rami of uropod 3 much longer than on *J. lilipuna,* outer with about 12 very minute serrations visible generally on oil immersion lens only, inner ramus longer than outer and bearing 1 apical spinule.

HOLOTYPE.—Bishop Museum collections, catalog number 7286, male, 1.4 mm.

TYPE-LOCALITY.—JLB Hawaii 10, Kaneohe Bay, Oahu, 2 m, *Pocillopora,* 23 February 1967.

MATERIAL.—JLB Hawaii 3 (1), 6 (1), 10 (male, 1.4 mm, figured).

REMARKS.—The immense process of article 4 on gnathopod 2 distinguishes this species from other members of *Ischyrocerus,* although several species of that primarily boreal genus have small processes occurring on that article. Perhaps the process has generic value and this species would represent an endemic Hawaiian genus derived from a boreal member of *Ischyrocerus.* The coxae do not correspond to those of *Microjassa,* and the absence of material with pereopods and antennae prevents me from establishing the true affinities of the species.

DISTRIBUTION.—Hawaiian Islands.

Ischyrocerus oahu, new species

FIGURE 127

DESCRIPTION.—Following characters like *Jassa lilipuna,* new species; head, eyes, antennae, uropods 1–2, mandible and stout palp, maxillae, maxillipeds, telson; coxae of male very short, especially coxae 3–4 broader than long, but coxa 2 enlarged and longer than either 1 or 3, ventral margins straight, coxa 1 nearly quadrate anteroventrally, coxa 5 as long as 4 or slightly longer; gnathopods of female like those of *Jassa lilipuna,* new species, but lacking comb-row on dactyls; article 5 of gnathopod 1 about three-fourths as long as article 6, latter slightly more broadened than in *J. lilipuna;* gnathopod 2 of terminal male with weakly but broadly lobate article 2, article 3 grossly lobate and spinose, article 4 unproduced, article 5 short but produced to free, blunt posterior lobe unlike other Hawaiian ischyrocerus-jassa species, article 6 greatly elongate and midposteriorly setose its full length, bearing weak bilobate distal process, palm and posterior margin of article 6 confluent and slightly concave, dactyl long, about as long as article 6, inner margin trisinuous, with 2 weak basal protrusions; gnathopod 2 of young male with much shorter, simple, stout dactyl, short and relatively stouter article 6 with nearly straight posterior margin, but with weakly bilobate distal protrusion forming palm, article 3 smooth; pereopods 1–2 normally slender compared with *J. lilipuna,* article 6 and dactyl long, but with 3 stout posterior spines and terminal seta, distalmost 2 spines coupled with setule, no locking spines per se; pereopod 4 narrow, scarcely ex-

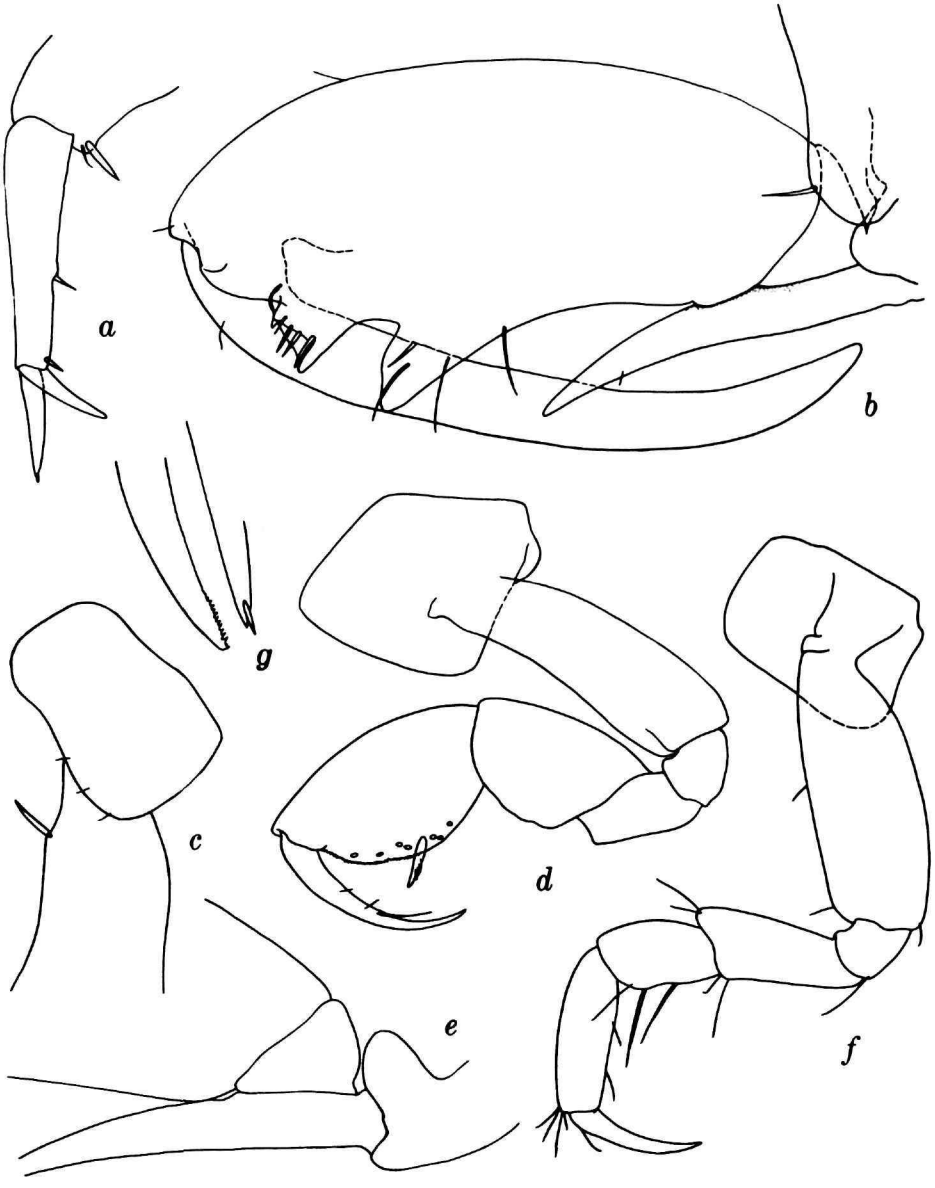

FIGURE 126.—*Ischyrocerus kapu*, new species, holotype, male, 1.4 mm, JLB Hawaii 10: *a*, uropod 3 and telson from lateral view; *b*, lateral gnathopod 2; *c*, coxa and article 2 of gnathopod 2; *d*, medial gnathopod 1; *e*, articles 3–5 and part of 6 on gnathopod 2; *f*, pereopod 2. Specimen, JLB Hawaii 6: *g*, apices of outer and inner rami on uropod 3, left to right.

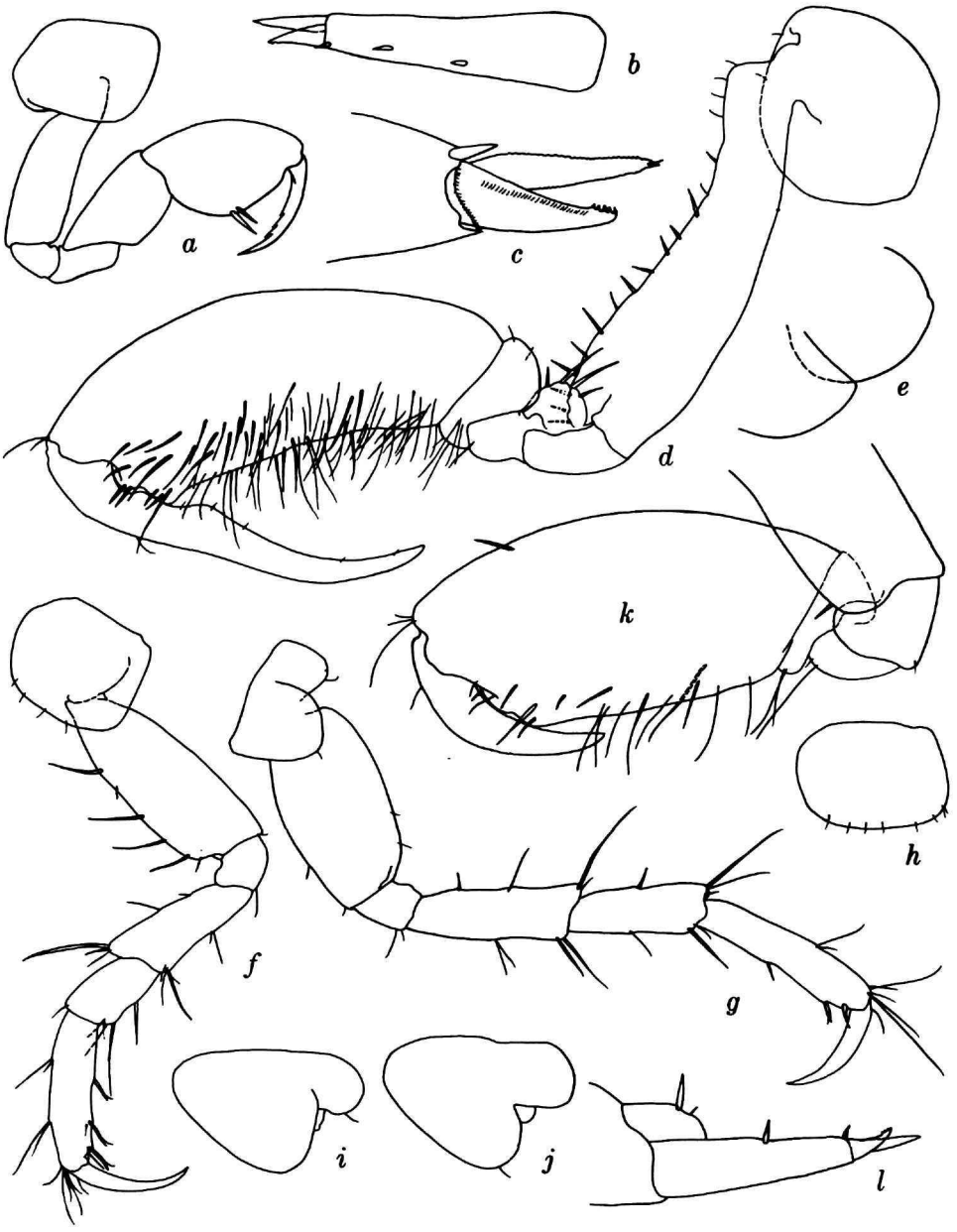

FIGURE 127.—*Ischyrocerus oahu,* new species, holotype, male, 1.2 mm, JLB Hawaii 10: *a,* gnathopod 1; *b, c,* uropod 3; *d,* medial gnathopod 2; *e,* pleonal epimera 2, 3; *f,* pereopod 1; *g,* pereopod 4; *h,* coxa 4; *i, j,* coxae 6, 5. Young male, JLB Hawaii 17: *k,* medial gnathopod 2; *l,* uropod 3 and telson from lateral view.

panded article 2 lacking posteroventral lobe and armament similar to *J. lilipuna,* but dactyl lacking comb-row, anterodistal end of article 6 with 1 subterminal spine and pair of locking spines, medial spine smaller than lateral (only latter drawn in figure); rami of uropod 3 longer than on *J. lilipuna,* but outer ramus often projecting laterally so as to appear even shorter, but outer ramus distinctly shorter than inner, bearing 4–7 small denticles.

Only the slight disproportionate enlargement of coxa 2 suggests a classificatory difference of *I. oahu* from other members of *Ischyrocerus;* in terms of male gnathopod 2 palm and dactyl, *I. oahu* is as close to the very common boreal *I. anguipes* Krøyer as to any other. Male *I. oahu* differs from that species in the slightly shorter coxae 3–4, slightly larger coxa 2, absence of a process on article 4 of gnathopod 2, bifidation of the palmar process, reduction in setosity of pereopods, and decrease in width of article 2 on pereopod 4 (3 and 5 unknown in *I. oahu*), and in the general equalization of male antennae 1–2. A resemblance especially in gnathopod 2 to *I. commensalis* Chevreux, *I. dezhnevi* Gurjanova, *I. kraschenninnikovi* Gurjanova, and *I. chamissoi* Gurjanova occurs, but *I. oahu* differs from all except the latter, according to the key in Gurjanova (1951), by the relatively short rami of uropod 3. The equal antennae in the male of *I. oahu* differentiate it from *I. chamissoi.* One must disregard male gnathopod 2 differences until all of these species have been thoroughly studied and the various stages of development elucidated.

HOLOTYPE.—Bishop Museum collections, catalog number 7287, male, 1.2 mm.

TYPE-LOCALITY.—JLB Hawaii 10, Kaneohe Bay, Oahu, 2 m, *Pocillopora,* 23 February 1967.

MATERIAL.—JLB Hawaii 10(4), 15(1), 17(9).

RELATIONSHIP.—Although gnathopod 2 has more of the characteristics of an *Ischyrocerus* than does that of *Jassa lilipuna* and *Ischyrocerus kapu,* the relative difference between the lengths of coxae 1–2 suggests affinities of *I. oahu* with various species of *Microjassa.* But coxae 3–4 are very short, and coxa 5 is even slightly longer than 4, quite in contrast to the type-species of *Microjassa, M. cumbrensis* (Stebbing and Robertson). *Jassa lilipuna* is not firmly assignable to *Microjassa* for the same reason, even though coxae 2–4 are elongate as in *M. cumbrensis.* But several species of *Ischyrocerus* have coxae 2–4 elongate, with coxa 5 short, even though coxa 4 is not excavate for the reception of coxa 5 as in the type-species of *Microjassa.*

DISTRIBUTION.—Hawaiian Islands.

Jassa (?) *lilipuna,* new species

FIGURES 128, 129, 130

DIAGNOSIS.—Lateral cephalic lobe coniform, ventral margin of lobe and head sinuous; accessory flagellum 2-articulate, article 1 elongate, article 2 very small; article 3 of peduncle of antenna 1 as long as article 1; epistome weakly and bluntly produced; palp article 3 of mandible extremely clavate; inner plate of maxilla 1 simple; maxilla 2 with about 4 setae on distal half of medial margin; palp article 4 of maxilliped stout, apically setose; coxa 1 of male extending ventrally about half as far as coxa 2; latter bilobate in terminal male; coxa 5 nearly as long as coxa 4, coxae 6–7 short; gnathopod 1 of both sexes and gnathopod 2 of female similar, article 5 cup-shaped and shorter than 6, latter ovate, palm and posterior margin about equal, palm defined by 2 spines, dactyl with several flat inner serrations and lateral comb; gnathopod 2 of male initially with article 6 becoming greatly elongate while dactyl remaining short, palm almost simple and confluent with posterior margin of article 6, then posterior margin developing scant cusp bearing spine, finally in adult, dactyl elongating to full posterior length of article 6, midpalmar tooth becoming proximal medium-sized thumb, palm near dactylar hinge formed of 2 processes, 1 of medium size, 1 smaller and hemispherical, articles 2–3 weakly lobate, article 4 swollen, article 5 small, cup-shaped, not reaching free margin; pereopods 1–2 short, moderately stout, article 6 with 4 large, blunt posterior spines, 2 of them forming a locking pair; pereopods 3–5 with anterior margin of article 6 bearing large pair of locking spines and 1 other large distal spine, dactyls all bearing facial comb; outer ramus of uropod 3 with 2–3 terminal, scarcely reverted cusps, inner ramus with 1 partially immersed distal spinule; telson pointed, bearing a pair of stout dorsal spines and a pair of setules.

OTHER FEATURES.—Mandibular molar large but weakly triturative, bearing molarial flake; eyes large and clear in alcohol.

HOLOTYPE.—Bishop Museum collections, catalog number 7288, male, 1.9 mm.

TYPE-LOCALITY.—Waikiki, Oahu, in ocean seaward of aquarium, from *Ulva,* 11 March 1964.

FIGURE 128.—*Jassa lilipuna*, new species, male, 1.8 mm, Waikiki: *a*, mandibular palp; *b*, telson; *c*, uropod 3; *d*, maxilla 1; *e*, mandibular molar showing flake; *f*, prebuccal mass, left lateral; *g*, inner plate of maxilliped; *h*, mandible (palp removed); *i*, urosome; *j*, maxilliped. Female, 1.4 mm: *k*, coxa 5; *l*, lower lip; *m*, maxilla 2.

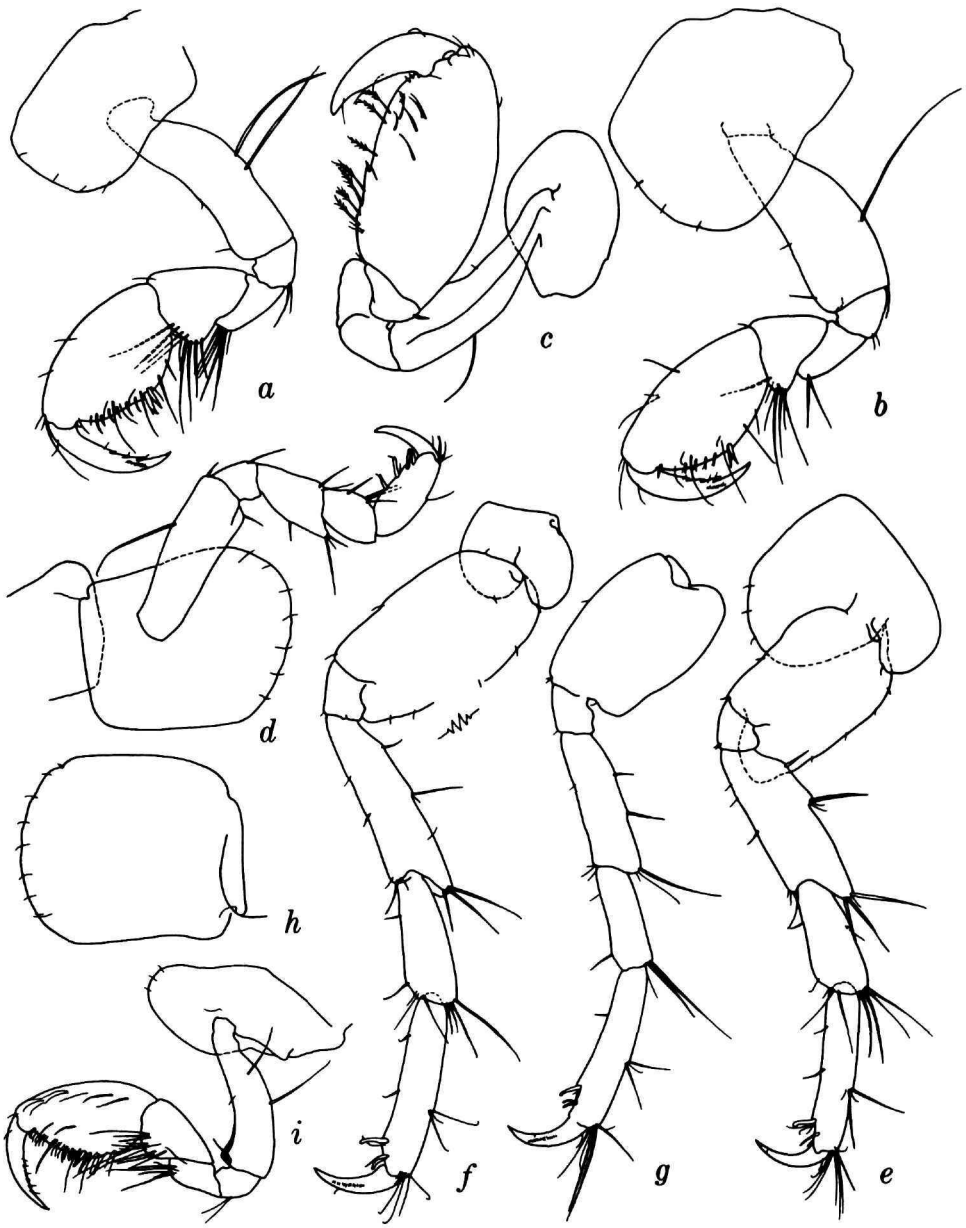

FIGURE 129.—*Jassa lilipuna*, new species, female, 1.4 mm, Waikiki: *a*, *b*, gnathopods 1, 2. Male, 1.3 mm: *c*, gnathopod 2. Male, 1.8 mm: *d*, *e*, *f*, *g*, pereopods 2, 3; 4, 5; *h*, coxa 3; *i*, gnathopod 1.

FIGURE 130.—*Jassa lilipuna*, new species, female, 1.4 mm, Waikiki: *a*, head; *b*, apex of pereopod 5; *c*, pleonal epimera 1–3, left to right, and coxa 7. Male, 1.8 mm: *d*, head; *e*, *f*, antennae 1, 2; *g*, accessory flagellum; *h*, *i*, gnathopod 2, medial and lateral views.

MATERIAL.—Nine specimens from the type-locality on *Ulva* and 20 specimens from *Sargassum* and 4 from *Padina*.

REMARKS.—Females have a maximum of 3 large eggs.

RELATIONSHIP.—*Jassa lilipuna* fits the genus *Jassa* much better than it does *Microjassa* even though coxa 1 is slightly shorter than coxa 2, for coxa 5 is as long as coxa 4, and coxae 2–4 are not greatly enlarged as in the type-species, *M. cumbrensis* (Stebbing and Robertson), *M. macrocoxa* Shoemaker, and *M. litotes* J. L. Barnard. The debatable species is *M. litotes* J. L. Barnard (1954b) that was later shifted to *Ischyrocerus* and then returned to *Microjassa* (J. L. Barnard, 1969a). *Microjassa litotes* may indeed deserve a genus of its own, for it differs from the other microjassas and *Jassa* in the absence of any palmer tooth on male gnathopod 2 and coxa 5 is not as short as originally believed. But *M. litotes* differs from *Ischyrocerus* and *Jassa* in the posterodorsally excavate coxa 4 and from *Parajassa* in the large accessory flagellum.

The presence of the proximal palmar tooth on male gnathopod 2 is a good generic character used by Stebbing (1906) to differentiate *Jassa* and *Ischyrocerus*. Thus, *J. lilipuna* differs from *Parajassa* in accessory flagellum and from *Microjassa* in coxae 2–5.

The description of a new species in *Jassa* poses problems in terms of Sexton and Reid's (1951) lengthy dissertation on the multiform character of *Jassa falcata* (Montagu). They synonymized many species, and one might gather from the diversity of form demonstrated in *J. falcata* that the few remaining species Sexton and Reid did not mention might also fit into the *J. falcata* complex. *Jassa lilipuna* does have its closest relationship with *J. falcata* according to Stebbing's (1906) key if one pursues the necessary synonymy. According to Sexton and Reid's description of general characters in *J. falcata, J. lilipuna* would differ in: the sharp cephalic lobe, the poorly angular coxa 1, the moderately long bilobed coxa 2 in terminal male, the absence of a small cusp on the posteroventral corner of pleonal epimeron 3, the palm of gnathopod 1 lacking angular definition, the smallness of female gnathopod 2, the weakly expanded and poorly produced article 4 of pereopods 1–2 (in *J. falcata* article 4 is so produced as to cover the anterior edge of article 5), and the longer peduncle of uropod 3.

The extremely small size, smooth shiny body, and overall appearance of *J. lilipuna* suggest very little direct relationship with *J. falcata,* but indicate that *J. lilipuna* and *J. falcata* have had diverse phylogenies and simply appear together into the same genus as a result of convergence in a few characters.

Californian populations of *J. falcata* have a partially immersed but articulate spine on the apex of the outer ramus on uropod 3, a character necessarily seen with extremely high power microscopy. Its worldwide presence in all populations of all species of *Jassa* has not been documented, but it may form an important character that would demonstrate the discontinuity between *J. lilipuna* and *J. falcata* and possibly necessitate the removal of *J. lilipuna* from *Jassa*.

DISTRIBUTION.—Hawaiian Islands.

Parajassa angularis Shoemaker

FIGURES 131, 132

Parajassa angularis Shoemaker, 1942, pp. 41–44, figs. 14, 15.—J. L. Barnard, 1962a, p. 58, figs. 26, 27.

Described from Magdalena Bay, Baja California by Shoemaker and recorded by Barnard from the northern margins of southern California, this species extends the full length of the northeastern Pacific warm-temperate province. The specimens described from one end of the range differ from those at the other end significantly, but it is too early to suggest that these extremes, or those populations from Hawaii, deserve any nomenclatural distinction. Specimens from Hawaii fit those from the northern end of the warm-temperate more than those from the southern end. A cline may occur in that range and both northern and Hawaiian specimens are slightly smaller than that specimen figured by Shoemaker from the southern warm-temperate locality.

The Magdalenian types have the palmar defining tooth on gnathopod 2 occurring much farther toward the proximal end of article 6 and standing more erectly at right angles to the axis of the appendage than in Californian specimens. Most Hawaiian individuals resemble Californian specimens in this character, but a few of the largest (3.5 mm) have that tooth approaching the Magdalenian condition. Magdalenian specimens also have a distinct scalelike tooth on the apex of the outer ramus of uropod 2, not seen in other populations.

Ramal apices of uropod 3 in California specimens have one hooked spine each, whereas in Hawaiian

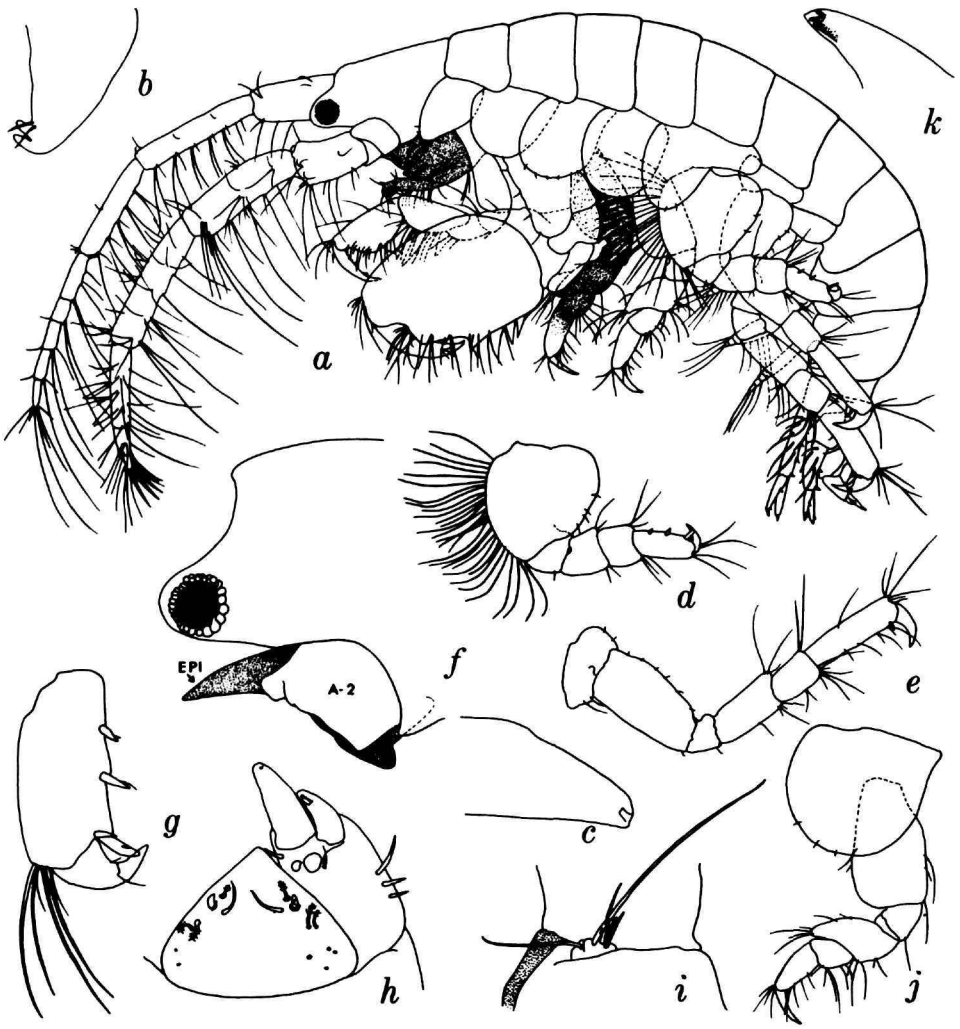

FIGURE 131.—*Parajassa angularis* Shoemaker, male, 2.1 mm, JLB Hawaii 2: *a*, lateral view of body. Female, 3.2 mm: *b*, *c*, outer and inner rami of uropod 3; *d*, *e*, pereopods 3, 5; *f*, head and epistome-labral process (stippled behind antenna 2 base); *g*, apex of pereopod 3; *h*, telson and uropod 3; *i*, accessory flagellum on article 3 of antenna 1; *j*, pereopod 2. Another specimen: *k*, apex of inner ramus on uropod 3.

specimens the outer ramus has 2 nonarticulate hooks and 2 minute setules, and in Magdalenian material the outer ramus has 3 small nonarticulate hooks.

The inner ramus of Hawaiian specimens has a jewel-like spine nearly immersed and coalesced with the apex, and some specimens seem to have only a pit that fits the shape of that jewel spine; possibly the spine has been lost during preservation. The inner ramus of Magdalenian specimens has a thin apical spinule like Californian specimens.

COLOR IN 2-DAY FORMALDEHYDE.—Antennae clear but reflecting brown of body; head and pereonites 1–3 purple, remainder of body brown or gold; gnathopod 2 mostly covered with brown pigment; eggs pale buff.

MATERIAL.—JLB Hawaii 2 (16), 8 (7).

HAWAIIAN FAUNISTICS.—This species and *Ventojassa ventosa* were not suspected to be present in the Hawaiian fauna prior to this study. They are enigmatic. *Ventojassa ventosa*, heretofore put in the Isaeidae as a member of *Eurystheus*, is now shown to

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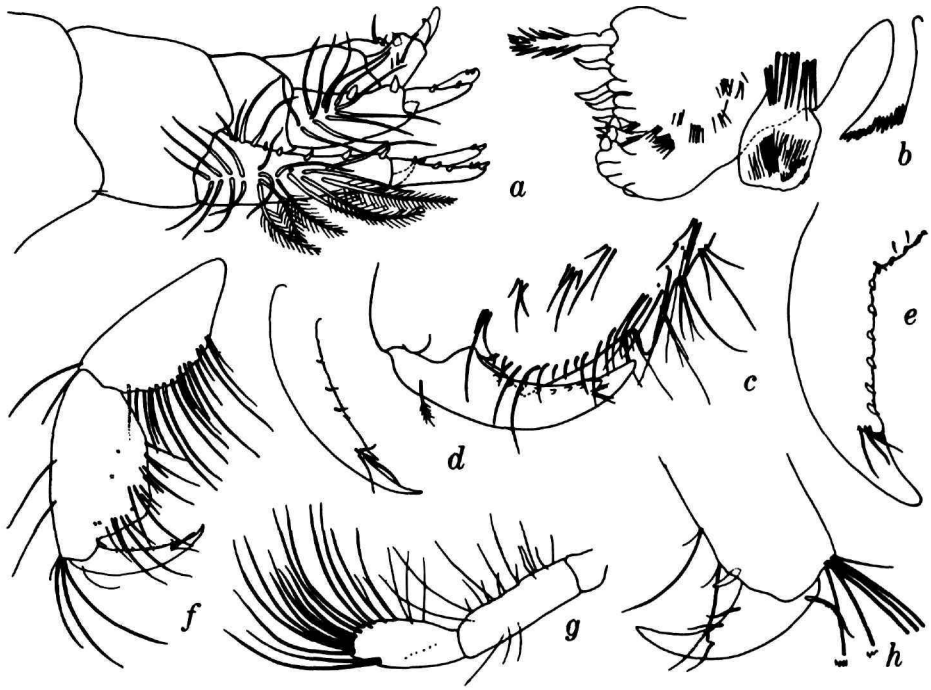

FIGURE 132.—*Parajassa angularis* Shoemaker, female, 3.2 mm, JLB Hawaii 2: *a*, urosome; *b*, mandibular molar enlarged and flattened to show molar flake; *c*, apex of gnathopod 2, medial; *d*, dactyl of gnathopod 1; *e*, dactyl of gnathopod 2; *f*, apex of gnathopod 1; *g*, mandibular palp; *h*, dactyl of pereopod 5.

be a monotypic ischyrocerid with unknown relationships, but *Parajassa angularis* belongs to a genus with 4 species all previously recorded from nontropical shores (Europe, South Georgia Islands, Tristan da Cunha, and the Californias). Unless *Parajassa* has been grossly overlooked in Indo-Pacific tropical waters, it should mark the cool water influence in the Hawaiian fauna. Cool waters would include those of warm-temperate regions in this context.

Parajassa angularis and *Ventojassa ventosa* resemble each other strongly in color and superficial morphology and occur together in gross samples; it is of considerable interest that together they have crossed the wide ocean gap between North America and Hawaii. The direction of this movement is, of course, unknown and could be of complex status. Hawaii could possibly be the evolutionary ground for one of the species which then returned to the mainland—or perhaps both—and finally there is a possibility that *Ventojassa ventosa* is a product of the parajassid line of evolution; they are the only ischyrocerids known to me with any uropodal setae, although *Ventojassa* is a poor example in having only 1–3 week setae on the outer ramus of uropod 3.

DISTRIBUTION.—Hawaii and warm temperate California-Mexico.

Ventojassa, new genus

DIAGNOSIS.—Ischyrocerid with normal-sized overlapping coxae, coxa 1 not reduced, coxa 5 as long as 4 and much longer than coxa 6; gnathopod 2 larger than 1; pereopods 3–5 simple, second articles ovate, trapezoidal or slightly broadened, not narrowly linear; fourth articles of approximately equal breadth; palp articles 5 and 6 gnathopod 1 subequal in length; outer plate of maxilla 1 with 9 or more spines; accessory flagellum elongate, 2 or 3-articulate; gnathopod 2 similar in both sexes with oblique palm defined by a cusp and with 1–2 other palmar teeth, and 2 large palmar spines, but not like that of *Jassa* male with enormous proximal palmar tooth; outer ramus of

uropod 3 in adults with 1–3 mediomarginal setae, apex slightly hooked, and bearing 2 (occasionally 3) immersed setules.

TYPE-SPECIES.—*Eurystheus ventosa* J. L. Barnard (1962a).

RELATIONSHIP.—In juvenile stages, the unique species of this genus resembles *Ischyrocerus* Krøyer and *Jassa* Leach mainly in uropod 3, but in adults the outer ramus acquires 1–3 marginal setae not found in the other 2 genera. Second gnathopods of males are intermediate between those of *Ischyrocerus* and *Jassa*, and the genus has so many resemblances to *Parajassa* Stebbing, especially to *P. angularis* Shoemaker (1942), that one might consider them as morphological mimics. Yet a major character, the vestigial accessory flagellum, distinguishes *Parajassa*, and numerous fine details distinguish *P. angularis* from *V. ventosa*. The latter species is transferred from the family Isaeidae. At the time of its establishment, J. L. Barnard considered it probable that *E. ventosa* should be ranked with the Ischyroceridae, and a study of uropod 3 and the mandibles now indicates its proper position.

Ventojassa ventosa (J. L. Barnard)

FIGURES 133, 134

Eurystheus ventosa J. L. Barnard, 1962a, pp, 20–22, figs. 6, 7.

DIAGNOSIS.—With the characters of the genus.

DESCRIPTIVE NOTES (and see figures).—Lateral cephalic lobes short but triangular, appearing superficially rounded, but anterior margin with sharp flange-like extension becoming sharper in adults; accessory flagellum either 2 or 3-articulate, terminal article very small; gland cone long and sharp; epistome sharp and projecting, of medium length; mandibular molar with typical ischyrocerid flake; article 6 of gnathopod 1 strongly expanded distally; gnathopod 2 palm with 3 short teeth, 1 tooth defining palm; second articles of pereopods 1–2 slender, article 4 slender and unproduced anterodistally, anterior margin of article 2 on pereopod 3 scarcely setose, article 6 with 2 or 3 large spines or sets of spines near dactyl; epimeron 3 with strong posteroventral notch; uropods 1–2 without lateral peduncular setae; lower lip, maxilla 2 and maxilliped like *Ischyrocerus anguipes* Krøyer (Sars, 1895, pl. 209), inner plate of maxilla 1 with 1 seta; sexes alike, gnathopod 2 of female large like that of male; juveniles 1.0–1.5 mm long, lacking setae on outer ramus of uropod 3; telson usually with only 1 pair of lateral hooks even in adult but occasional specimens with 2 pairs or 1 on one side, 1 pair on other.

COLOR IN 2-DAY FORMALDEHYDE.—Antennae reddish-pink; head and pereonites 1–3 muddy purple, remainder of body bronze but fading toward posterior end; gnathopod 2 white, with sparse splotches of brown; embryos in eggs orange; eyes dark brown or black, changing to definite black in alcohol.

MATERIAL.—JLB Hawaii 2 (69), 3 (7), 5 (3), 8 (14). Devaney 1 (1).

REMARKS.—The descriptive notes distinguish this species primarily from *Parajassa angularis* Shoemaker (1942), a sympatriot both in Hawaii and Baja California. The two species resemble each other so much in overall appearance that one might consider them "mimics" if there were not significant morphological differences and color differences. These morphological differences are difficult to see with a stereoscope during the sorting process, but individuals mounted in a depression slide may be rapidly identified by noting the absence of peduncular setae on uropods 1–2 of *Ventojassa*, the sparsity of setae on pereopod 3, the thin article 2 of pereopods 1–2, and the distinctive setae (in adults) on the outer ramus of uropod 3. Lateral cephalic lobes, gnathopods, accessory flagella, primary flagella, and pleonal epimeron 3 also differ between the two species; but pereopods and antennae are often broken.

Hawaiian specimens of this species reach about 3.2 mm in length; adults from California as large as 4 mm have been reported; those adults have 3 pairs of telsonic hooks. No gross differences from Californian material occur in Hawaiian specimens, but careful comparison of microscopic details may show consistent differences in the apex of the outer ramus of uropod 3, the notch of pleonal epimeron 3, and the cuspidorial symmetry on the palm of gnathopod 2.

DISTRIBUTION.—Hawaiian Islands, and warm-temperate California.

Family LEUCOTHOIDAE

Leucothoe hyhelia J. L. Barnard

FIGURE 135

Leucothoe hyhelia J. L. Barnard, 1965a, pp. 489–490, fig. 5.

DIAGNOSIS.—Article 3 of antenna 1 about one-third as long as article 1, article 1 with obsolescent terminal

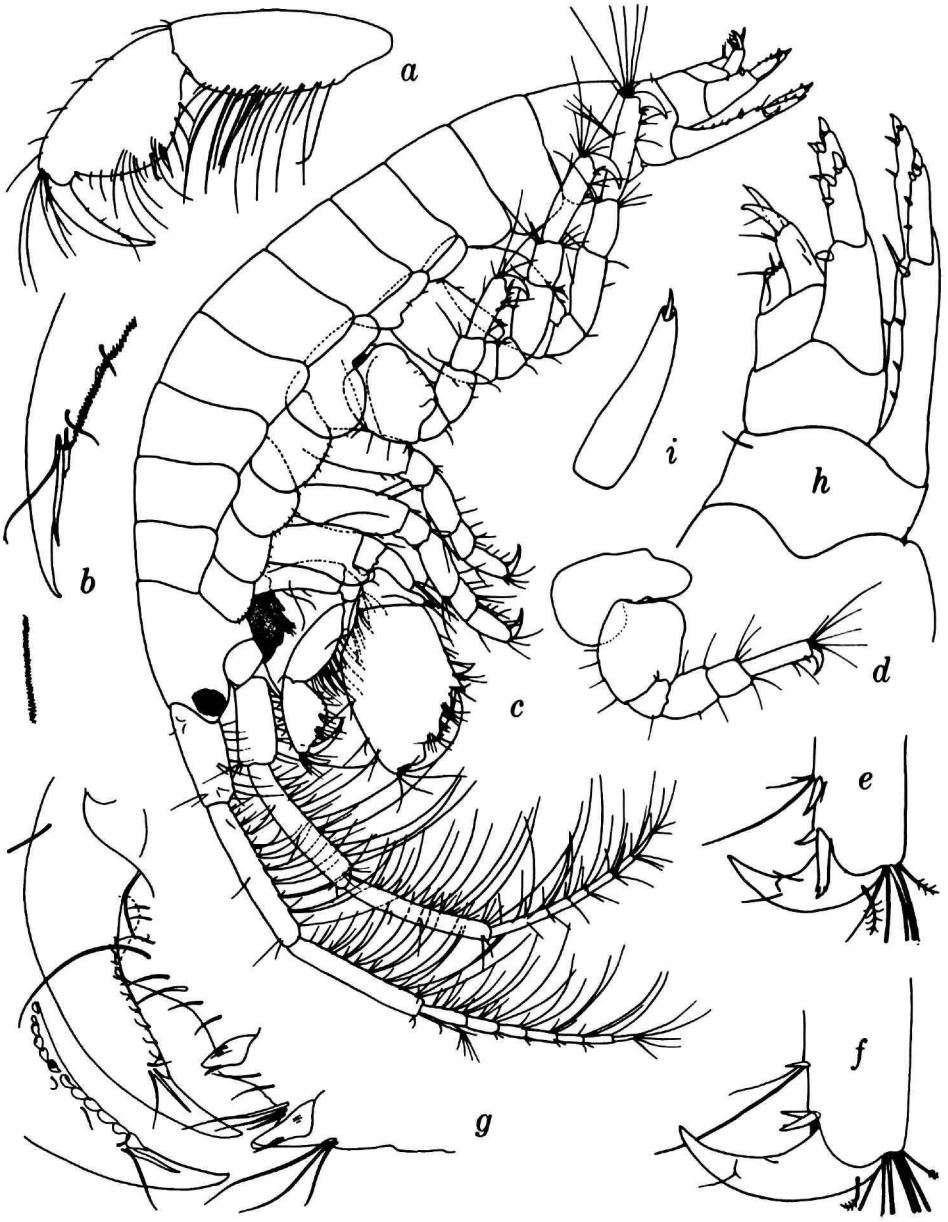

FIGURE 133.—*Ventojassa ventosa* (J. L. Barnard), ovigerous female, 2.8 mm, JLB Hawaii 2: *a*, left gnathopod 1; *b*, dactyl of gnathopod 1 enlarged and palmar serrations enlarged; *c*, body; *d*, medial pereopod 3; *e*, *f*, dactyls of pereopods 3, 5; *g*, apex of gnathopod 2, enlarged, medial, and extra dactyl showing lateral view. Ovigerous female, 2.6 mm: *h*, urosome. Specimen, 2.5 mm: *i*, inner ramus of uropod 3.

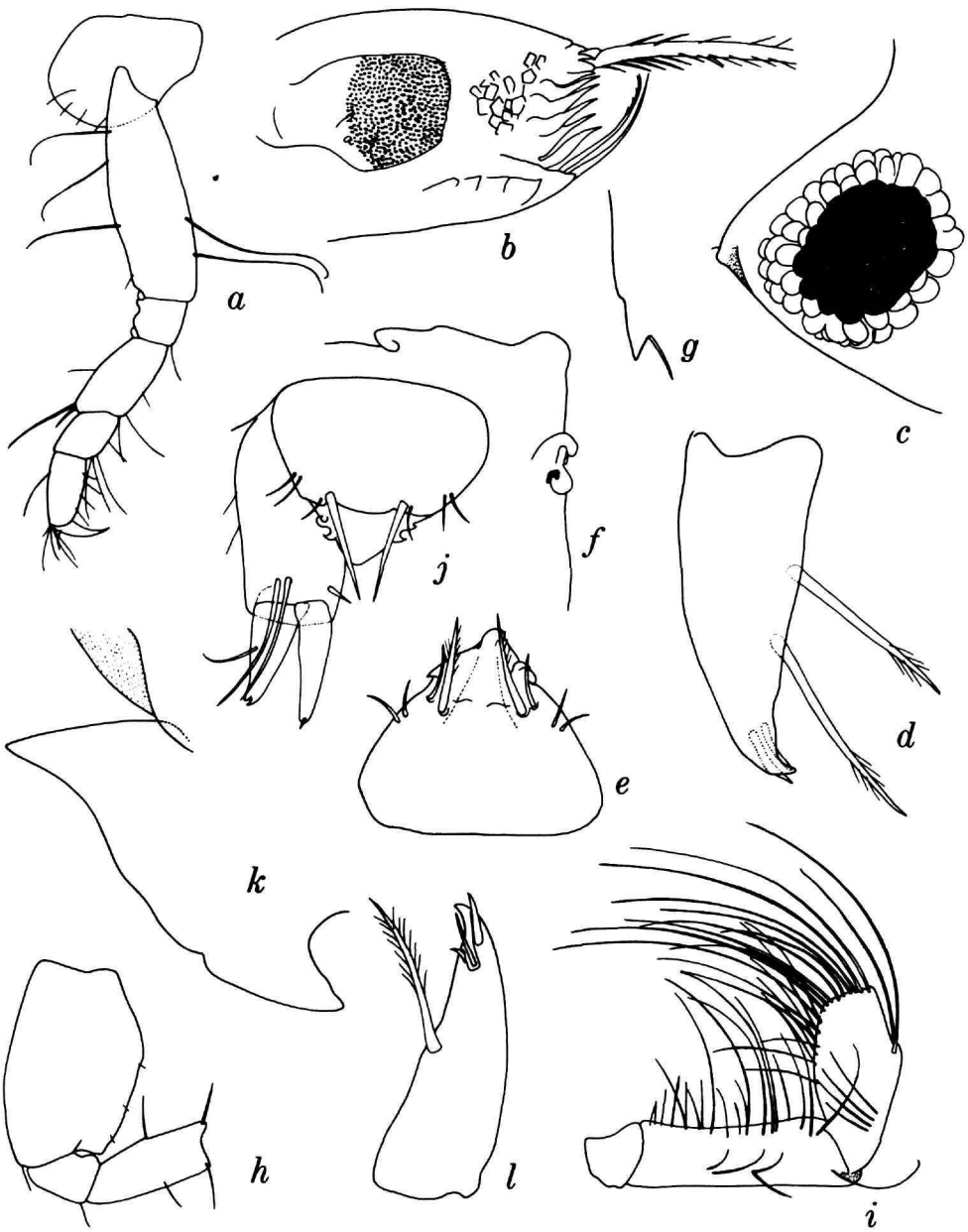

FIGURE 134.—*Ventojassa ventosa* (J. L. Barnard), ovigerous female, 2.8 mm, JLB Hawaii 2: *a*, pereopod 1; *b*, mandibular molar showing flake; *c*, lateral cephalic lobe and eye; *e*, telson; *f*, telsonic edges enlarged; *g*, right hook of telson; *h*, part of pereopod 5; *i*, mandibular palp. Female, 3.2 mm: *d*, outer ramus of uropod 3. Another specimen: *j*, telson and uropod 3; *l*, outer ramus of uropod 3. Ovigerous female, 2.6 mm: *k*, epistome and upper lip, left side.

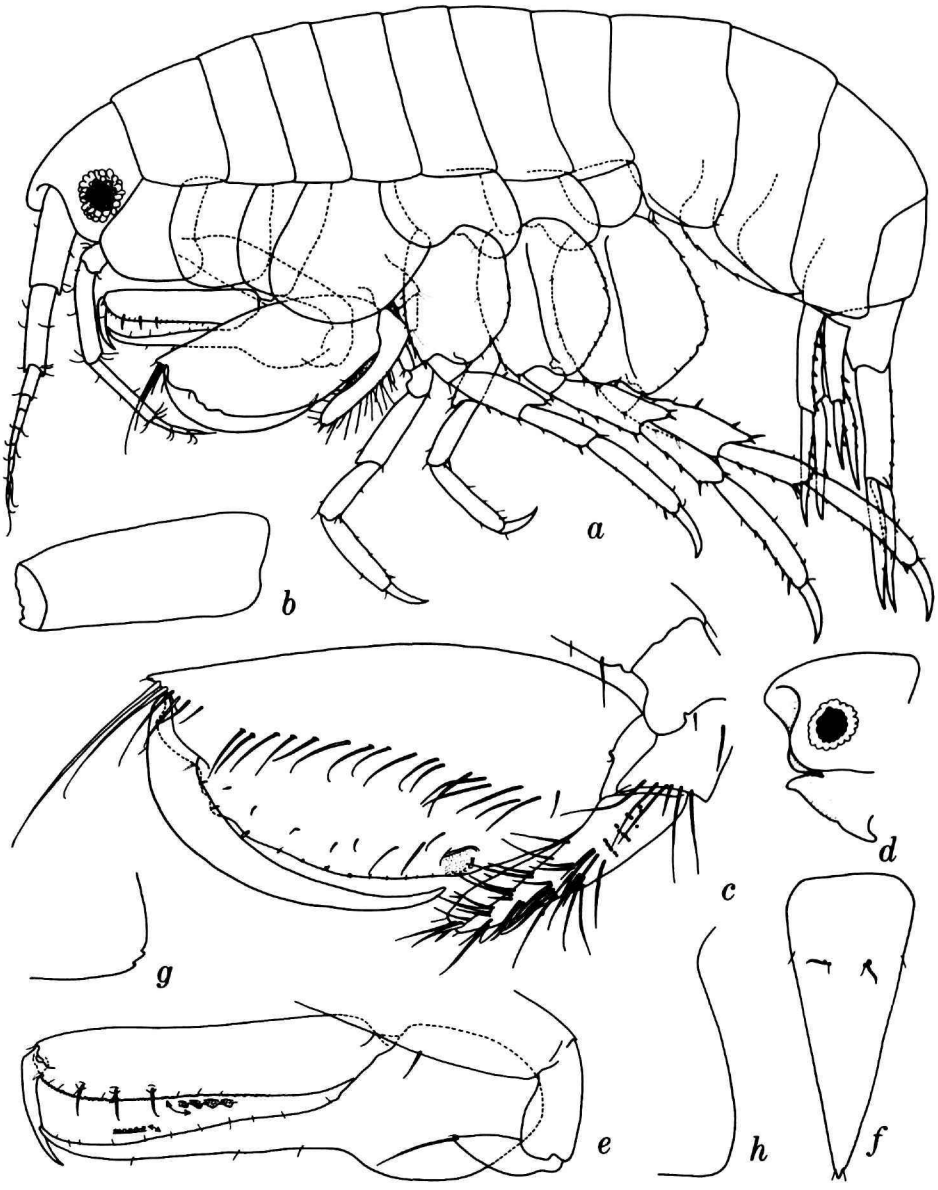

FIGURE 135.—*Leucothoe hyhelia* J. L. Barnard, male, 2.5 mm, JLB Hawaii 3: *a*, lateral view of body; *b*, article 1 of antenna 1, ventral; *c*, medial gnathopod 2; *d*, head; *e*, medial gnathopod 1; *f*, telson. Male, 2.6 mm, JLB Hawaii 5: *g*, *h*, pleonal epimera 1, 3.

cusps; rostrum of medium development, midanterior cephalic keel rounded ventrally, lateral cephalic lobe broadly rounded; eyes of medium size, round; coxa 1 with beveled anteroventral corner, coxae 2–4 longer than wide, anteroventral corners decreasingly beveled, posterior margin of coxa 4 long and deeply excavate dorsally, ventral margin sloping obliquely downward; gnathopod 1 of typical form, with long dactyl, posterior margin of article 6 with wavelike serrations 3 times as large as small round beads of apposing margin on chela of article 5, article 6 otherwise bearing 3–6 marginal setules, article 5 otherwise smooth, gnathopod 2 of typical form, palmar margin of nearly smooth, untoothed variety, weakly undulate near finger hinge, anteromedial face with long row of setae; pereopods 1–2 simple; article 2 of pereopods 3–5 broadened, proximally commencing to be ovate but posteroventral margins strongly beveled and oblique; pleonal epimeron 1 with rounded-quadrate posteroventral corner bearing 2 weak notches in young individuals or 2 large serrations in terminal adults, epimeron 2 with strong sharp tooth, epimeron 3 of two kinds, posterior margin either weakly convex and posteroventral corner rounded-quadrate (as in *L. tridens* Stebbing, herein) or with straight-convex posterior margin and slight posteroventral rounded protrusion; uropod 2 inner ramus extending to end of peduncle on uropod 3; telson elongate, triangular, apex with obsolescent lateral wings of a trilobation.

MATERIAL.—JLB Hawaii 2 (1), 3 (4), 5 (2), 8 (2), 10 (2), 11 (1), 13 (20), 14 (1), 15 (1). Devaney 1 (2).

COLOR IN 2-DAY FORMALDEHYDE.—Either albinid with red eye, or bearing narrow vertical stripes at segmental junctions from head-pereonite 1 to pleonites 2–3, these stripes fading rapidly in alcohol, and eyes fading to a rusty pink central core surrounded by clear ommatidia.

REMARKS.—The Hawaiian populations have at least 2 phenotypes, those with a protuberant posteroventral corner of epimeron 3 or perfectly rounded-quadrate. Three differences of possible subspecific value occur in the Hawaiian material in comparison with the unique male type known from Micronesia but until Micronesian populations are more thoroughly studied I reserve any subspecific appellation. The Micronesian holotype has a shorter dactyl on gnathopod 1, a slightly stronger cusp on epimeron 1, and faint setules on the chela of gnathopod 1. Gnathopods of this species and the otherwise very different *L. tridens* are virtually identical. The diagnoses demonstrate the divergencies in head, anterior keel, coxae, pereopods 3–5, and epimeron.

DISTRIBUTION.—Micronesia and the Hawaiian Islands.

Leucothoe lihue, new species

FIGURE 136

DIAGNOSIS.—Article 3 of antenna 1 about one-third as long as article 1, article 1 with obsolescent terminal cusps; rostrum small, midanterior keel with small, sharp cusp at ventral end, lateral cephalic lobe obtusely angular; eyes medium to large, round, red in formaldehyde; coxa 1 scarcely beveled anteriorly, coxae 2–4 longer than wide, anteroventral corners not beveled, posterior margin of coxa 4 long and deeply excavate dorsally, ventral margin sloping obliquely downward; gnathopod 1 of stout form, short, article 6 only about 130 percent as long as anterior margin of article 5, dactyl very short, apposing margins of articles 5 and 6 macroscopically smooth; gnathopod 2 with widely cusp-shaped article 6 tapering strongly toward distal end, palm with several sinuations and bicastellate distal process, dactyl apically blunt and slightly bent distally, lobe on article 5 with villus-like apical extension, article 2 with mammilliform anteroventral hump, anteromedial face of article 6 with long row of setae; pereopods 1–2 simple; article 2 of pereopods 3–5 broadened, proximally commencing to be ovate but posteroventral margins, especially of pereopods 4–5, strongly beveled and oblique, margin of pereopod 5 concave; pleonal epimeron 1 with rounded-quadrate posteroventral edge bearing 2 widely spaced weak serrations; epimeron 2 with strong, sharp tooth, epimeron 3 rounded-quadrate; (uropod 3 missing, thus relationships of uropod 2 unknown); telson elongate, triangular, apex minutely trilobate.

HOLOTYPE.—Bishop Museum collections, catalog number 7289, male, 3.3 mm.

TYPE-LOCALITY.—Devaney 1, off MokuManu, Oahu, 33 m, stem of black coral, 13 May 1967.

MATERIAL.—Five specimens from the type-locality.

RELATIONSHIP.—In Hawaii, this species is clearly distinguished from the other 2 known species in the form of gnathopod 1 with short articles 6 and 7.

Leucothoe lihue is very close to *L. alata* J. L. Barnard (1959) from California and may exist as a sub-

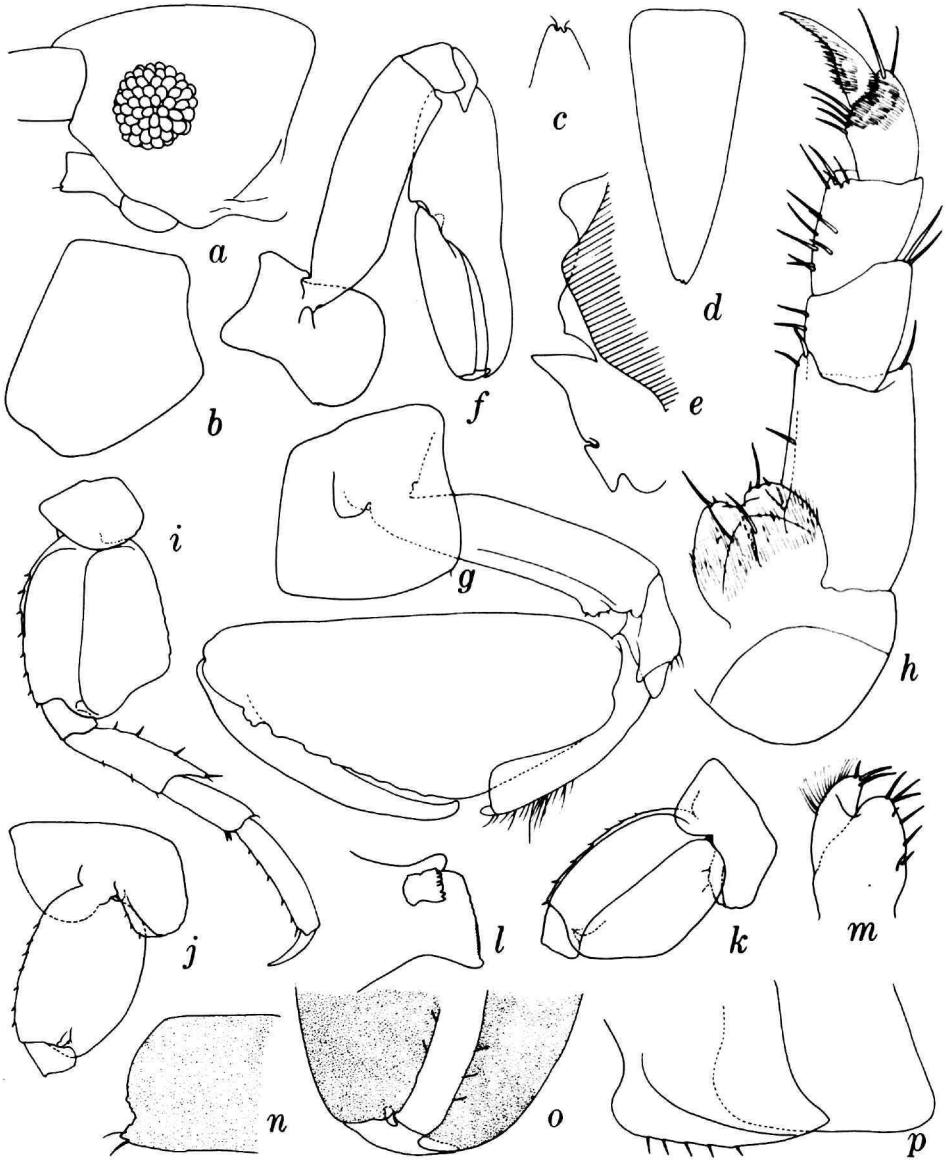

FIGURE 136.—*Leucothoe lihue*, new species, holotype, male, 3.3 mm, Devaney 1: *a*, head; *b*, coxa 4; *c*, apex of telson; *d*, telson; *e*, lateral cephalic lobe (hatched) and epistome-labrum; *f*, *g*, gnathopods 1, 2; *h*, maxilliped; *i*, *j*, *k*, pereopods 5, 3, 4; *l*, left mandibular incisor; *m*, maxilla 2; *n*, article 1 of antenna 1; *o*, apex of gnathopod 1, enlarged; *p*, pleonal epimera 2–3.

species of that entity. There are several differences in the Hawaiian population of a quantitative extent in character expression and one character probably of qualitative value. The article bearing the outer plate on the maxillipeds is not alate as it is in *L. alata*. Other character differences of minor extent in *L. lihue* are: the cephalic lobe is slightly more angular; pleonal epimeron 2 is slightly more protuberant at the posteroventral corner; coxa 1 is less strongly beveled; article 6 of gnathopod 1 lacks the minute beads on the posterior margin; and article 2 of pereopod 5 is broader and distinctly concave on the posteroventral oblique margin.

Leucothoe minuscula Schellenberg (1938) has a grossly ornamented palm on gnathopod 2, coxa 1 is obtusely pointed anteroventrally, and article 2 of pereopod 5 is not excavate.

Leucothoe brevidigitata Miers (see *L. flindersi* Stebbing, 1888) has a very large mandibular palp and narrow incisor, and article 3 of antenna 1 is half as long as article 1.

DISTRIBUTION.—Hawaiian Islands.

Leucothoe tridens Stebbing

FIGURE 137

Leucothoe tridens Stebbing, 1888, pp. 777–779, pl. 47; Schellenberg, 1938, pp. 21–23, fig. 11.

DIAGNOSIS.—Article 3 of antenna 1 about 35 percent as long as article 1, article 1 with strong terminal cusps; rostrum obsolescent, midanterior cephalic keel sharply pointed at ventral end, lateral cephalic lobe with sinuous anterior margin and weak to strong anterior cusp, becoming better developed in terminal adults; eyes of medium size, round; coxa 1 with rounded anteroventral corner, scarcely beveled, coxae 2–4 wider than long, short, anteroventral corners of coxae 2 and 4 almost quadrate and slightly attenuate, corner of coxa 2 rounded, posterior margin of coxa 4 short and nonexcavate, ventral margin sloping obliquely upward; gnathopod 1 of typical form, with long dactyl, posterior margin of article 6 with wavelike serrations 3 times as large as small round beads of apposing margin on chela of article 5, article 6 otherwise bearing 3–6 marginal setules, article 5 otherwise smooth; gnathopod 2 of typical form, palmar margin of nearly smooth, untoothed variety, weakly undulate near finger hinge, anteromedial face with long row of setae; pereopods 1–2 simple; article 2 of pereopods 3–5 evenly ovate; pleonal epimeron 1 with rounded-quadrate posteroventral corner, epimeron 2 with rounded-quadrate or slightly protuberant corner (variable), epimeron 3 with weakly convex posterior margin and rounded-quadrate posteroventral corner; uropod 2, inner ramus extending only two-thirds to three-fourths along peduncle of uropod 3; telson of medium length, ovatoconiform, with weak terminal trilobation.

MATERIAL.—JLB Hawaii 6 (9), 10 (1), 12 (1), 13 (3).

COLOR IN 2-DAY FORMALDEHYDE.—Body a diffuse burnt orange or golden (fading), eye red to bright garnet.

REMARKS.—The Hawaiian populations of this species differ from those of the Gilbert Islands and Philippine Islands (Schellenberg, 1938) and the type-material (Stebbing, locality presumably erroneous) by the strongly projecting middle member of the trilobation on the telson.

DISTRIBUTION.—Tropical Pacific.

Leucothoides ?pottsi Shoemaker

FIGURE 138

?Leucothoides pottsi Shoemaker, 1933a, pp. 249–250, fig. 3.—Schellenberg 1938, pp. 26–28, fig. 13.

MATERIAL.—JLB Hawaii 2 (4), 3 (3), 6 (1), 8 (1), 10 (6), 13 (6), 14 (1).

REMARKS.—Described from Tortugas Islands in the Caribbean Sea, this species was reported by Schellenberg from the Gilbert and Marshall Islands in Micronesia. Schellenberg's figures and description correspond to those of Shoemaker in head, coxae 1, 2, 4, article 6 of gnathopod 2, and vaguely in gnathopod 1. But the anterior margin of article 5 on gnathopod 2 is longer and the posterior lobe of article 5 stouter in Micronesian material than in the type-material. Antennae of Micronesian specimens are subequal in length. Schellenberg did not clearly illustrate the details of the carpal process of gnathopod 1 and Shoemaker may not have clearly delineated the submergence of the distal spines. In material at hand from Hawaii, the apex of that carpal process has 2 partially immersed spines, one long and one medium in length; the long spine has a distal ornament and both are minutely serrate on one edge. Shoemaker illustrated a distal ornament on a short spine, but a declivity on the carpal process in his drawing indicates the possible boundary of the immersed spine. Schellenberg's drawing was not suffi-

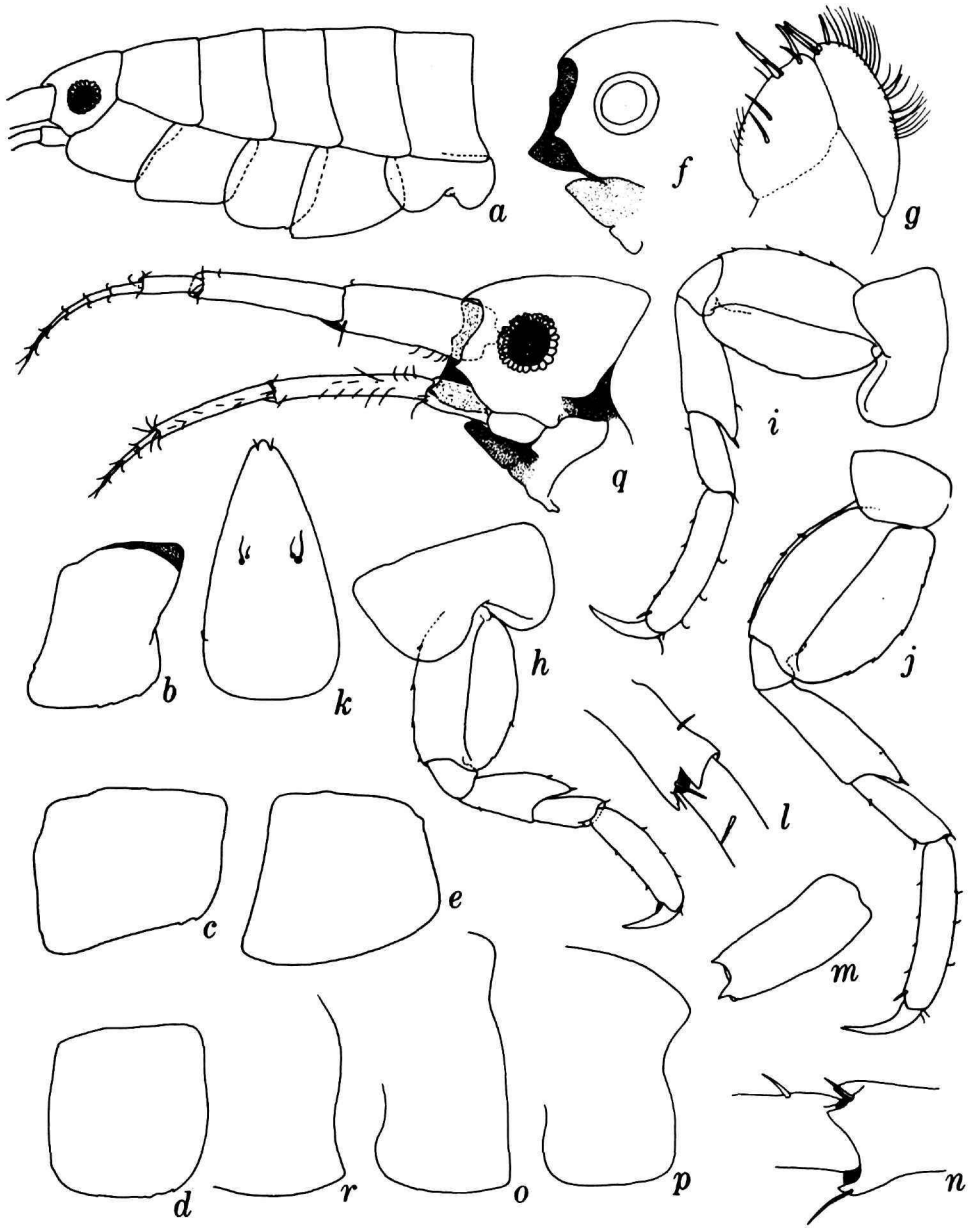

FIGURE 137.—*Leucothoe tridens* Stebbing, male, 4.1 mm, JLB Hawaii 6: *a*, head and 5 pereonites; *b, c, d, e*, left coxae, 1, 2, 3, 4. Another specimen: *f*, head; *g*, maxilla 2; *h, i,j*, pereopods 3, 4, 5; *k*, telson; *l*, articles 3–4 of antenna 2, medial; *m*, article 1 of antenna 1, ventral; *n*, flattened view of fig. 1; *o, p*, pleonal epimera 2, 3. Male, 4.0 mm, JLB Hawaii 12: *q*, head. Adult of JLB Hawaii 10: *r*, pleonal epimeron 2.

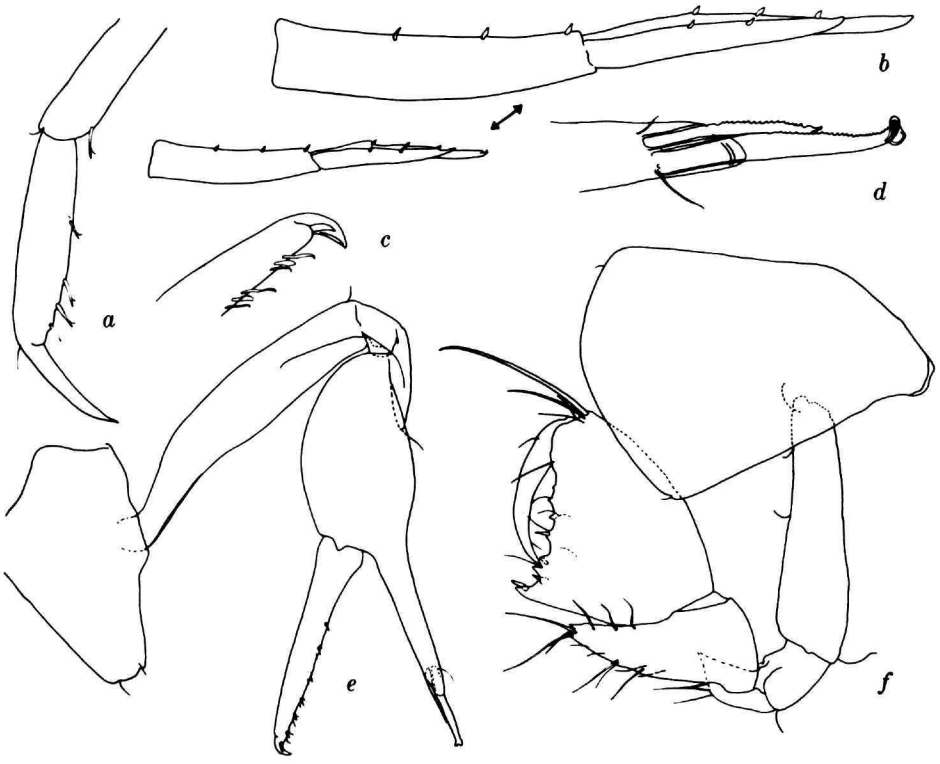

FIGURE 138.—*Leucothoides ?pottsi* Shoemaker, 1.3 mm, JLB Hawaii 3: *a*, apex of pereopod 1; *b*, uropod 3; *c*, apex of gnathopod 1, articles 6 and 7; *d*, apex of gnathopod 1, article 5; *e*, *f*, gnathopods 1, 2.

ciently enlarged to show any of these details. Hawaiian specimens have the fifth article of gnathopod 2 elongated like that of Micronesian material.

Comparison of minute details among the three populations, Caribbean, Micronesian, and Hawaiian probably would demonstrate differences of subspecific magnitude at least. Hawaiian specimens, unlike those from the Caribbean and Micronesian areas, have the distally attenuate portion of coxa 1 broadened.

DISTRIBUTION.—Caribbean Sea, Micronesia, Hawaiian Islands.

Family LILJEBORGIIDAE

Liljeborgia heeia, new species

FIGURES 139, 140

DIAGNOSIS.—Eyes large, black; mandibular palp article 3 shorter than article 1 and half as long as article 2, article 1 shorter than article 2; lateral cephalic lobe long, apically truncate; coxa 1 with small posteroventral notch, coxa 4 projecting ventrally more than in other species of genus, bearing 2–3 posterior serrations; palms of gnathopods evenly convex; dactyl of gnathopod 1 with 3–5 basal teeth, dactyl of gnathopod 2 with 8–14 teeth, gnathopod 1 of medium size for genus; pereopods 1–2 with subprehensile article 6 bearing small palm with weak cusp, posterodistal ends of sixth articles with 2–4 spines; article 2 of pereopods 3–5 weakly serrate posteriorly, posteroventral corners smooth and rounded; telson split nearly to base, each apex with short notch, subapices asymmetrically extended, medial longer than lateral; medial edge of peduncle of uropod 1 with only 1 distal spine; only pleonites 1–2 each with 3 small dorsal cusps; pleonal epimera 1–3 each with small posteroventral tooth, no distinct accessory sinuses.

DESCRIPTION.—Outline of eye truncate anteriorly, nearly quadrate below, tapering dorsally by postero-

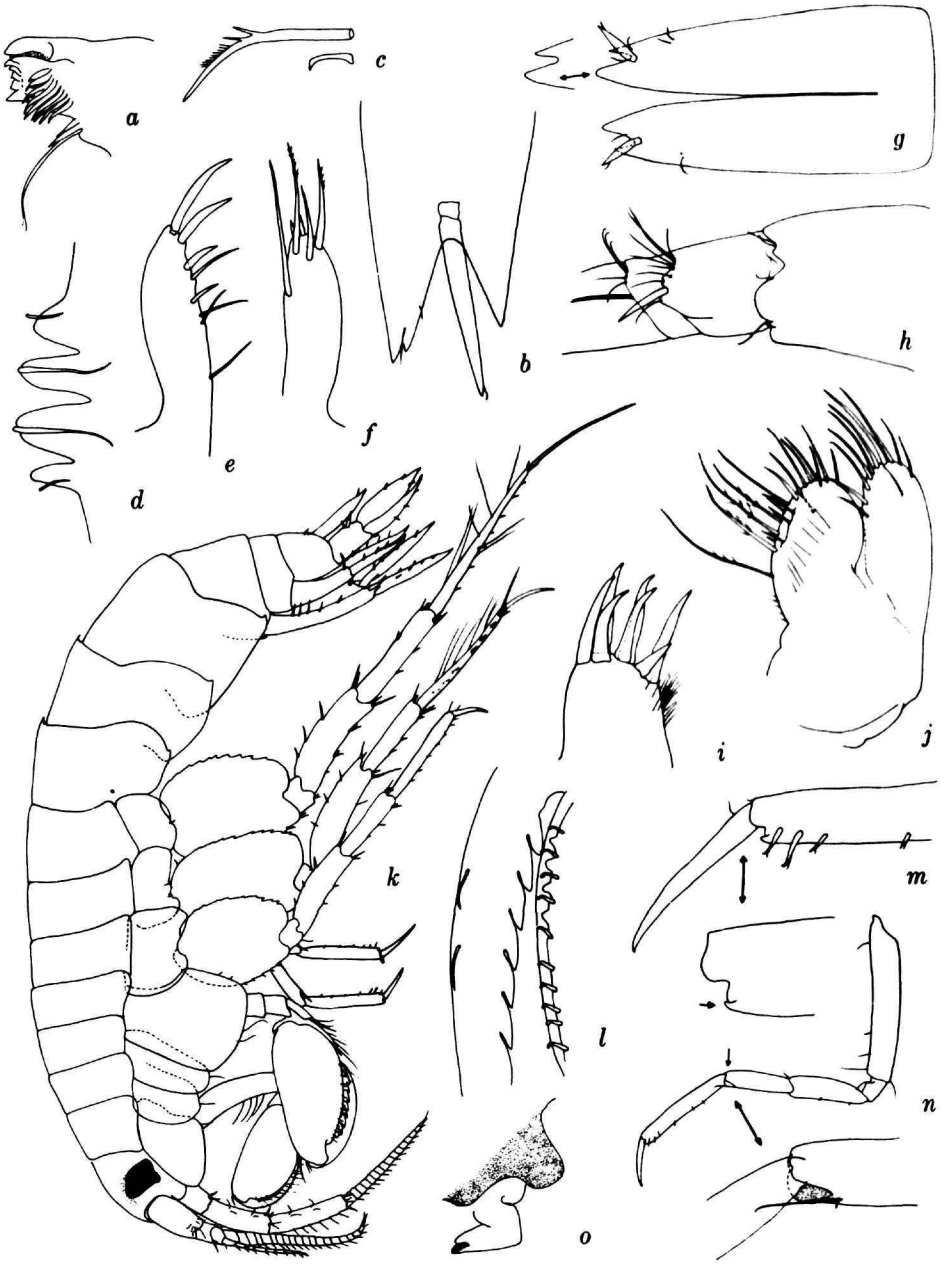

FIGURE 139.—*Liljeborgia heeia*, new species, female, 5.3 mm, JLB Hawaii 6: *a*, apex of left mandible; *b*, apex of one telsonic lobe. Holotype, male, 4.2 mm: *c*, spines of gnathopodal palms, enlarged; *d*, dorsal margin of pleonites 1–2; *e*, *f*, outer and inner plates of maxilliped; *g*, telson; *h*, right medial articles 1–3 of antenna 1, right to left; *i*, outer plate of maxilla 1; *j*, maxilla 2; *k*, lateral view of body; *l*, portions of dactyl and palm on gnathopod 2, enlarged; *m*, apex of pereopod 1; *o*, lateral cephalic lobe (shaded) and prebuccal complex.

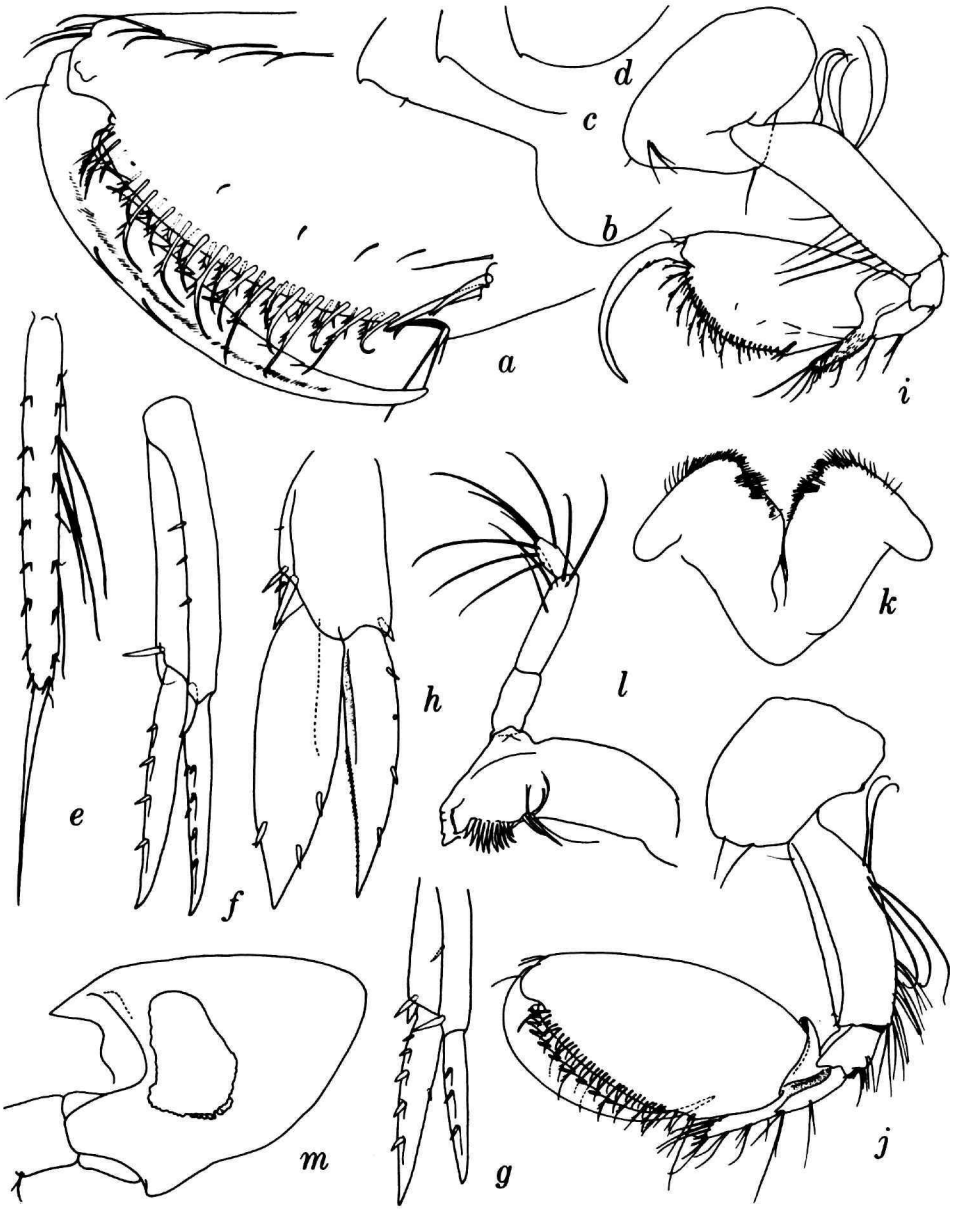

FIGURE 140.—*Liljeborgia heeia*, new species, holotype, male, 4.2 mm, JLB Hawaii 6: *a*, article 6 of gnathopod 2, enlarged; *b*, *c*, *d*, pleonal epimera 1, 2, 3, right outlines; *e*, articles 6–7 of pereopod 5; *f*, *g*, *h*, uropods 1, 2, 3. Ovigerous female, 3.8 mm, JLB Hawaii 5: *i*, *j*, gnathopods 1, 2. Ovigerous female, 5.3 mm, JLB Hawaii 2: *k*, lower lip; *l*, mandible; *m*, head.

dorsal curve; rostrum evenly acute; maxillipedal palp and maxilla 1 like those of *L. brevicornis* (Bruzelius) (Sars, 1895, pl. 187) except for the outer plate of maxilla 1 figured herein; maxillipedal palp article 4 with weak distal nail; dactyl of gnathopod 2 with weak lateral comb-row; midfacial palmar defining area of gnathopod 1 with 1–2 spines, of gnathopod 2 with 2 spines; pereopods 3–5 with numerous setae on article 6 in large individuals (5.0 mm), but setae sparse or absent on individuals 4 mm or smaller.

HOLOTYPE.—Bishop Museum collections, catalog number 7290, male, 4.2 mm.

TYPE-LOCALITY.—JLB Hawaii 6, off Barbers Point, Oahu, 30 m, coralline footballs, 29 January 1967.

MATERIAL.—JLB Hawaii 2(7), 3(10), 5(6), 6(9), 8(2), 10(1), 11(4), 13(1).

RELATIONSHIP.—This is the only species so far described in the genus with 3 dorsal denticules each on pleonites 1–2 and no denticles on other pleonites. Apart from dentations this species has affinities with *L. proxima* Chevreux (1908, and see Schellenberg, 1938) from Gambier Archipelago and the Marshall Islands. That species has one denticle each on pleonites 1–2 and 4, a distinct sinus above the tooth of epimeron 3, no tooth on epimeron 1, and equally extending subapices of the telson.

DISTRIBUTION.—Hawaiian Islands.

Liljeborgia laniloa, new species

FIGURE 141

DIAGNOSIS.—Eyes large, black; mandibular palp article 3 very slightly longer than article 1; lateral cephalic lobe long, apically truncate; coxa 1 with small posteroventral notch, coxa 4 projecting ventrally more than in other species of genus, bearing 3 posteroventral serrations; palms of gnathopods evenly convex, dactyl of gnathopod 1 with 3–4 basal teeth, dactyl of gnathopod 2 with 6–7 teeth, gnathopod 1 large, dactyls of gnathopods apically flagellate; pereopods 1 and 2 simple, posteroventral end of article 6 armed with 7–9 thin short setae; article 2 of pereopods 3–5 weakly serrate posteriorly, posteroventral corners smooth and rounded; telson slit nearly to base, each apex with short notch, subapices asymmetrically extended, lateral longer than medial; medial edge of peduncle of uropod 1 with only 1 distal spine; only pleonites 1–2 each armed with 3 small dorsal cusps; pleonal epimera 1–3 each with 1 small posteroventral tooth, that tooth on epimeron 3 forming part of deep sinus.

DESCRIPTION.—Outline of eye circular; rostrum evenly acute; mandible with spines reduced to 3 serrations, molar apparently absent; maxillipedal palp article 4 with very tiny distal nail; outer plate of maxilla 1 with 7 spines like *L. heeia*, new species, but all spines of equal length; comb-row on dactyl of gnathopod 2 very weak; midfacial palmar defining area of gnathopod 1 with no spines, of gnathopod 2 with 3 spines; articles 2 and 4 of pereopods 3–5 slightly broader than those of *L. heeia;* outer rami of uropods 1–2 with only 1 spine, outer ramus of uropod 2 slightly shorter than inner ramus, rami of uropod 3 very slender.

HOLOTYPE.—Bishop Museum collections, catalog number 7291, male 2.3 mm.

TYPE-LOCALITY.—JLB Hawaii 15, 1 mile north of Kualoa Point, Oahu, intertidal, block of ascidians, 23 May 1967.

MATERIAL.—Two specimens from the type-locality.

RELATIONSHIP.—This species has sculpture similar to that of Hawaiian *L. heeia* but differs in the nonpalmate pereopods 1–2, in the deeper sinus of pleonal epimeron 3, in the terminally flagellate dactyls of the gnathopods, the slender rami of uropod 3, and the circular eyes. Like *L. heeia*, this species also resembles *L. proxima* Chevreux (1908), especially in epimeron 3, the slender rami of uropod 3, and in pereopods 1–2 but differs from *L. proxima* by the longer article 6 of gnathopod 1, the flagellate gnathopodal dactyls, and the presence of teeth on the dactyl of gnathopod 1.

The mandible, with its very weak spine row and absence of molar, differs from any other species of *Liljeborgia* so far described.

DISTRIBUTION.—Hawaiian Islands.

Family LYSIANASSIDAE

Lysianassa ewa, new species

FIGURES 142, 143

DIAGNOSIS OF FEMALE.—Lateral cephalic lobe evenly conical; eyes medium in size; antennae short; upper lip forming medium-sized, apically rounded plate projecting in front of epistome and separated from it by short slit; mandibular molar composed mainly of clusters of sharp blades, very spinose, but remainder of surface around molar not setulose; inner plate of maxilla 1 long, ovovermiform, naked, outer

FIGURE 141.—*Liljeborgia laniloa,* new species, holotype, male, 2.3 mm, JLB Hawaii 15: *a, b,* gnathopods 2, 1, medial views; *c, d,* parts of pereopods 3, 5; *e, f, g,* pleonal epimera 1, 2, 3; *h,* head with outline of eye; *i,* right and left mandibular incisors and spine rows, left to right; *j,* uropod 3; *k,* apex of pereopod 1, enlarged.

plate with set of 3–4 small curved bifid spines and set of 6 or 7 large serrate spines; outer plate of maxilla 2 narrower than inner, but inner not grossly expanded, both lobes with very stout spine-setae; outer plate of maxilliped with weak rugae and marginal beads, with one spine-seta on medial edge, dactyl on palp of normal dimensions; posterior margin of article 6 on gnathopod 1 bearing 4 stout spines in line; dactyl of gnathopod 2 covering half of distal end of article 6; locking spines of pereopods simple; posterior margins of article 2 on pereopods 5–7 straight, unexcavate; pleonal epimera 1 and 3 with rounded-quadrate posteroventral corners, epimeron 2 with slight protrusion; constriction on inner ramus of uropod 2 of medium size; uropod 3 short, rami and peduncle equal to each other, peduncle platelike, rami uniarticulate; telson truncate, largest plumose setal pair near midlateral margins, a pair of weak subterminal spines at lateral margins,

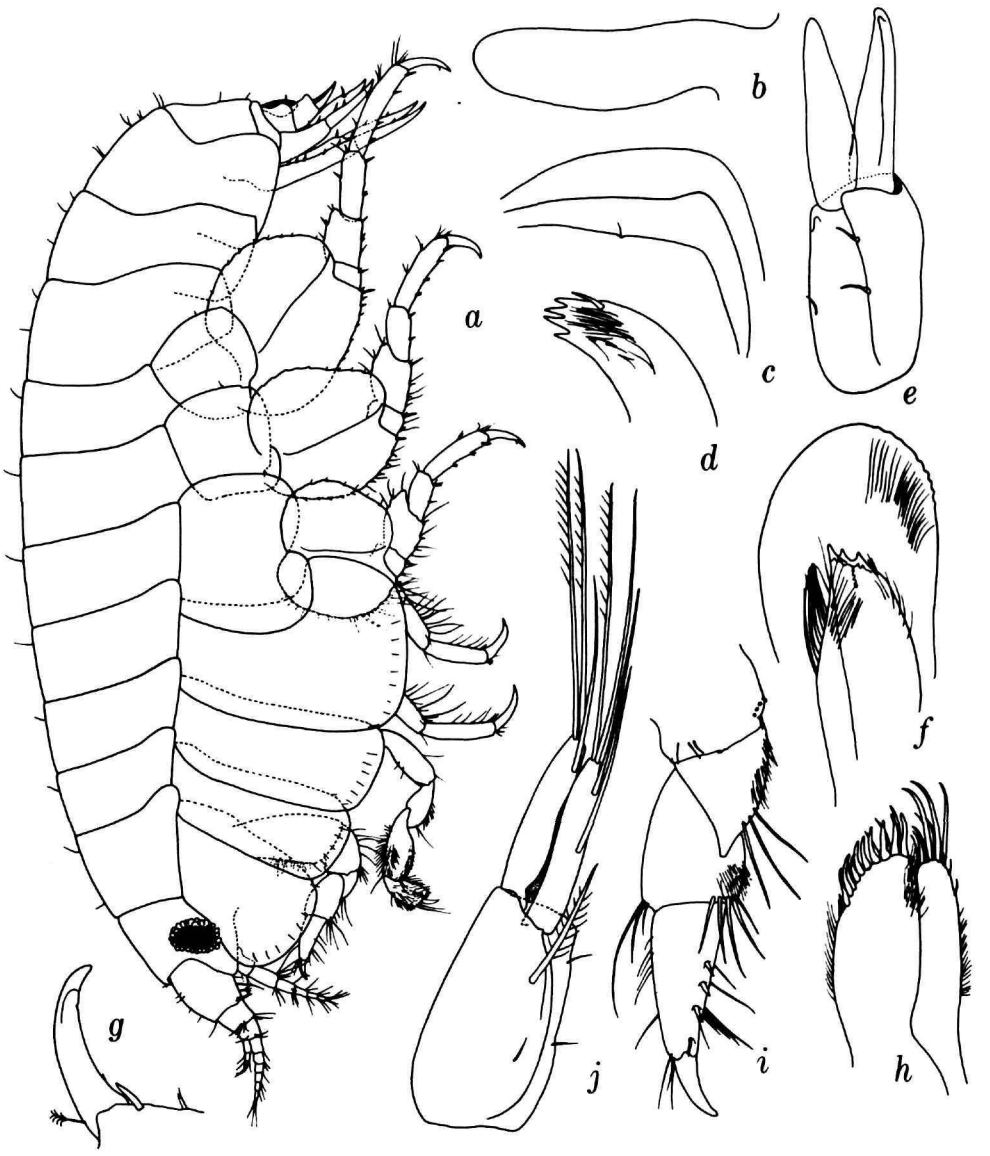

FIGURE 142.—*Lysianassa ewa*, new species, holotype, female, 3.6 mm, JLB Hawaii 13: *a*, body; *b*, inner plate of maxilla 1; *c*, pleonal epimera 1, 2, 3; *d*, palp of maxilla 1; *e*, uropod 3; *f*, inner and outer plates of maxilliped; *g*, dactyl of pereopod 5; *h*, maxilla 2; *i*, medial view of gnathopod 1. Male, 3.3 mm: *j*, uropod 3.

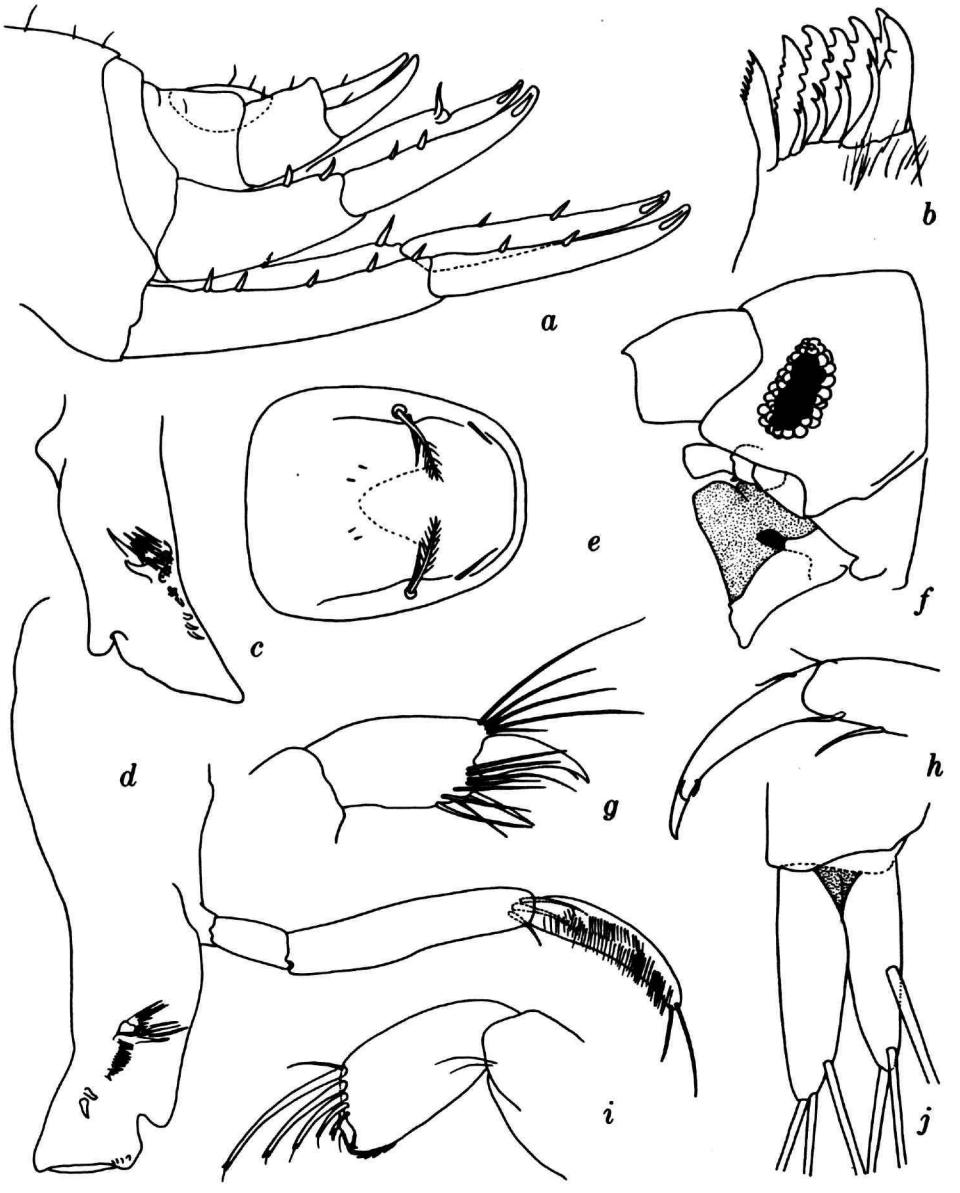

FIGURE 143.—*Lysianassa ewa*, new species, holotype, female 3.6 mm: *a*, urosome; *b*, outer plate of maxilla 1; *c*, *d*, right and left mandibles; *e*, telson; *f*, head; *g*, palp of maxilliped; *h*, dactyl of pereopod 1; *i*, apex of gnathopod 2. Male, 3.3 mm: *j*, rami of uropod 3, flattened.

those margins forming lateral rim, telson thus cup-shaped.

MALE.—Eyes slightly larger than in female, flagellum of antenna 2 elongate, rami of uropod 3 thickened and bearing long setae.

COLOR IN 2-DAY FORMALDEHYDE.—Body white, eyes brown.

HOLOTYPE.—Bishop Museum collections, catalog number 7292, female, ovigerous, 3.6 mm.

TYPE-LOCALITY.—JLB Hawaii 13, Kaneohe Bay, Oahu, 3–4 m, corals, algae, corallines, 8 April 1967.

MATERIAL.—JLB Hawaii 2 (1), 3 (7), 12 (2), 13 (9).

RELATIONSHIP.—This species has close affinities with Indonesian *Lysianassa* (=*Arugella*) *heterodonta* (Pirlot, 1936), but differs by the slightly tuberculate and unragged outer plate of the maxilliped, apparently by the longer dactyl of the maxillipedal palp, the slightly stronger spines in the small set on the outer plate of maxilla 1, the truncate (not rounded) telson, the presence of a slight protrusion on pleonal epimeron 2, and the unexcavate posterior margin on article 2 of pereopod 4.

The Caribbean *L. cubensis* (Stebbing, 1897; see Shoemaker, 1935a and Hurley, 1963) is another closely related species but *L. ewa* differs from it in the slightly larger dactyl of gnathopod 2, the more ovate inner plate of maxilla 1, the slightly narrower inner plate of maxilla 2, the unexcavate posterior margin on article 2 of pereopod 4, the more weakly developed inner ramus on uropod 2, the more strongly spinose mandibular molar, the absence of tiny spinules on the outer plate of the maxilliped, the slight protrusion on pleonal epimeron 2, and the presence of stout spines on article 6 of gnathopod 1. *Lysianassa cubensis* differs from *L. heterodonta* mainly in the truncate telson. These three species form a cohesive triad differing from other members of the genus in gross characters. For instance, the other tropical members of the genus have an elongated peduncle on uropod 3 and *L. holmesi* (J. L. Barnard, 1955b), the next nearest allopatriot to *L. ewa,* has equally wide plates on maxilla 2, a biarticulate outer ramus on uropod 2, and a slightly excavate telson with its armament all terminal. The lower lip of *L. ewa* resembles that of *L. holmesi.*

DISTRIBUTION.—Hawaiian Islands.

Family OCHLESIDAE

Ochlesis alii, new species

FIGURES 144, 145

?Ochlesis innocens.—Pirlot, 1936, pp. 298–300, fig. 124 [not Stebbing, 1910].

DESCRIPTION.—Body strongly compressed, very thin and carinate dorsally, pereonite 7 with small but sharp posterodorsal tooth, pleonites 1–2 dorsally elevated posteriorly but not sharply, pleonite 3 with obtuse dorsal hump, pleonite 4 elongate, pleonites 4–6 all separate; head short, telescoped into pereonite 1, latter extended forward strongly over head but closely appressed to it, rostrum and lateral cephalic lobe equal in extent and size, coniform, eye moruliform, partially covered by thin chitin of pereonite 1; article 1 of antenna 1 longer than 2, 1–2 each with short ventrodistal cusp, cusp of article 2 extending only halfway along short article 3; accessory flagellum absent; primary flagellum 4-articulate, only article 1 elongate, flagellum armed with large aesthetascs; antenna 2 shorter and thinner than antenna 1, article 4 with mediodistal cusp extending more than halfway along article 5, flagellum 3-articulate, only article 1 elongate; gland cone small; upper lip and epistome amalgamated, but epistomal portion with small anterior keel; upper lip almost perfectly triangular; styliform mandibles with simple, pointed incisor and small, 1-serrate lacinia mobilis on left member, molar small, weakly cup-shaped and scarcely triturative, palp articles 1–3 subequal to each other in length, palp 3 with 3 short terminal setae and linear comb-row; lower lip slender, apices extended and bidigitate; maxilla 1 with small inner plate, outer plate styliform, apex with about 7 tooth-ridges, 2-3 reverted cusps and about 4 articulated hooks, palp tiny, uniarticulate, bearing one long seta; maxilla 2 with slender, unequal but strongly setose lobes; inner plates of maxillipeds each with pair of distolateral spine-setae on lateral notch beside acute apex, one more small distal setule, several marginal setae; outer plates of maxillipeds slightly curled orally, distal ends with a few deeply immersed setules; coxae 1–2 with slight proximal excavation, coxa 3 strongly produced forward at base, but remainder of anterior margin straight, posterior margin with midproximal hump fitting excavation in coxa 4, latter broad, with rounded posteroventral process below proximal excavation, ventral margin oblique and concave (called posterior margin by Stebbing, 1910), coxa 5 with ante-

FIGURE 144.—*Ochlesis alii*, new species, holotype, female, 2.3 mm, JLB Hawaii 3: *a*, lateral view of body; *b*, half of lower lip; *c*, *d*, right and left mandibular molars; *e*, palp of maxilla 1; *f*, urosome; *g*, outer plate of maxilliped; *h*, gill (G) and broad lamella (L) of pereopod 2; *i*, coxa (C), gill (G), and brood lamella (L) of gnathopod 2; *j*, left obverse mandibular apex; *k*, apex of mandibular palp; *l*, left mandibular apex; *m*, right mandibular apex, flattened; *n*, right mandibular apex, unflattened.

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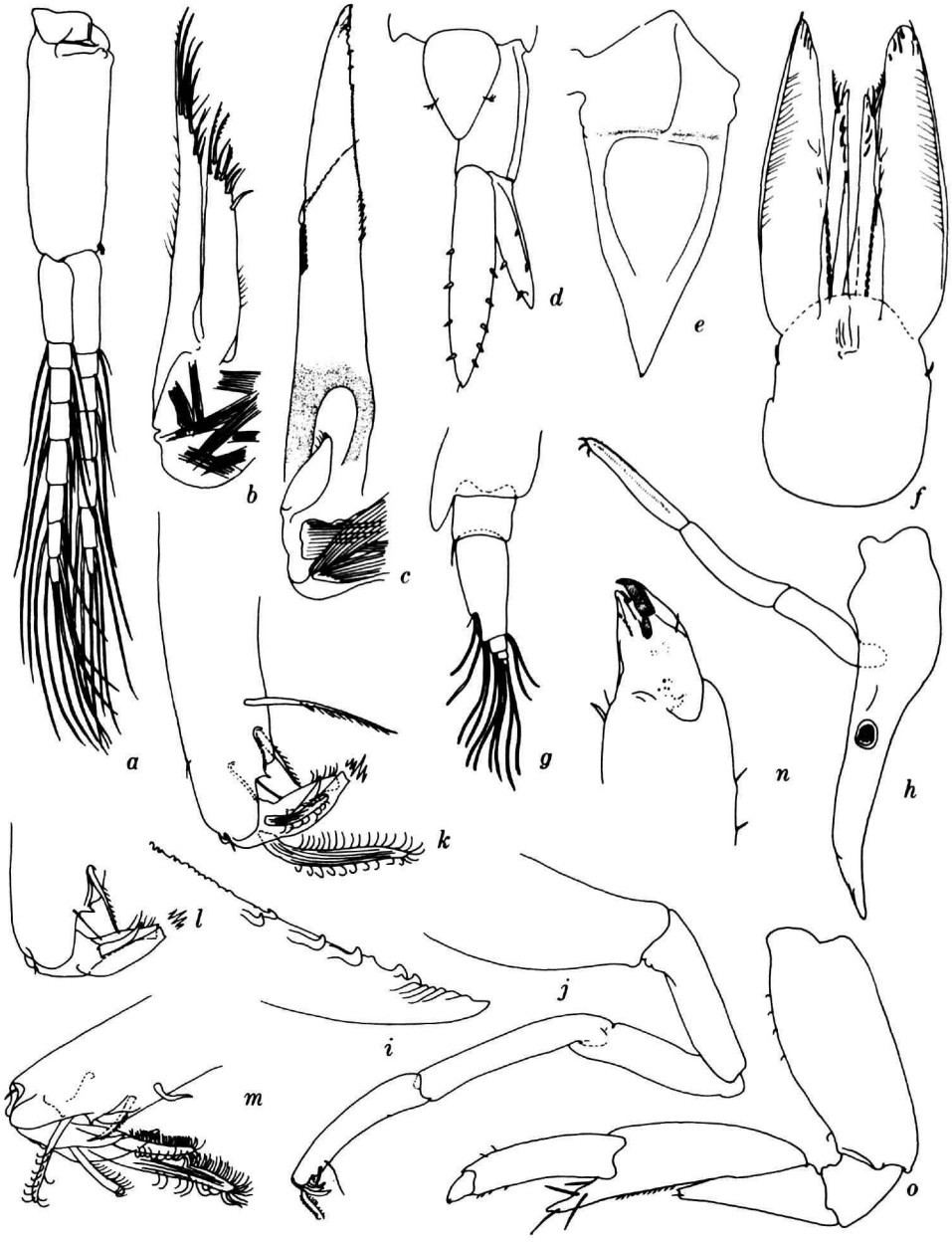

FIGURE 145.—*Ochlesis alii*, new species, holotype, female, 2.3 mm, JLB Hawaii 3: *a*, right pleopod 1; *b*, maxilla 2; *c*, maxilla 1; *d*, telson and uropod 3; *e*, upper lip; *f*, maxilliped; *g*, apex of antenna 1; *h*, mandible; *i*, maxilla 1 apex; *j*, *k*, *l*, *m*, gnathopod 1; *n*, *o*, gnathopod 2.

riorly directed lobe and posterior lobe longer than anterior; coxa 6 narrower than 5 and not anteriorly produced; posterior margin of coxa 7 with deep, oblique concavity; gnathopod 1 with article 2 basally inflated, articles 3 and 4 subequally elongate, articles 5–6 elongate, but 5 longer than 6, latter with weak, oblique palm armed with sharp medial cusp, one immersed feather-seta at defining corner, one feathered strap-seta near hinge; dactyl very complex, clawlike basic portion nearly enveloped by its own 4 feathered strap-setae; gnathopod 2 with subrectangular article 2, short article 3, elongate article 4 obliquely jointed to article 5 and distoventrally extended and distally truncate, article 5 ventrodistally produced (thus carpochelate) along article 6, but only weakly forming a guard, setose, article 6 shorter than 5, simple, dactyl stout, rigid, coniform; pereopods 1–2 with long anterodistal process on article 4 extending more than halfway along article 5 and arising from anterior lobe, article 4 with narrow neck proximal to lobe, dactyls simple but bearing cornified distal nail, article 6 with a few posterior spinules; pereopods 3–5 similar in structure of articles 3–7 as to pereopods 1–2 except article 4 without proximal neck, second articles broadly expanded, posterior margins increasingly excavate and roughly serrate; pleonal epimera 1–2 with midposterior extensions above slightly concave margins, posteroventral corners rounded but protruding, epimeron 3 with very short posterior straight margin and medium-sized posteroventral tooth with accessory ventral serration; outer rami of uropods 1–3 slightly to strongly shortened; telson linguitriangular, with ventral keel.

COLOR IN 1-DAY FORMALDEHYDE.—Body and appendages with dull gray background and texture of concrete, pereonites 1–7 with anterodorsal spots of burgandy color, all other color spots marked in Figure 144 light orange in color, those spots (chromatophores) or diffuse stripes occurring on rostrum, lateral cephalic lobes, antennae, anterior lobe only of epistome, coxae 1, 2, 3, article 2 of pereopod 5, pleonites 1–3 laterally, stripes on articles 5–6 of pereopods 1–5, stripe on article 4 of pereopod 2, spot on article 6 of pereopod 5, eyes orange; antennal stripes occurring on distal halves of article 1 of flagella; other shading in figure represents shadows.

HOLOTYPE.—Bishop Museum collections, catalog number 7293, female, 2.3 mm. Unique.

TYPE-LOCALITY.—JLB Hawaii 3, off Ewa Beach, Oahu, 18 m, *Pocillopora,* bryozoans, 29 January 1967.

RELATIONSHIP.—If Pirlot's identification of *O. innocens* from Iles Aru, 13 m, proves to be erroneous, and if he had in reality another species, perhaps the one at hand, then *O. alii* differs from *O. innocens* not only in the following external characters but also in mouthparts. *Ochlesis alii* has a shorter article 2 on antenna 1 and shorter cusps on articles 1 and 2 than does *O. innocens;* the flagellum is longer; article 4 of antenna 2 has a long cusp; coxa 3 is much more strongly geniculate, coxa 4 is broader, shorter, deeply excavate anteriorly, and the ventral margin less deeply excavate than in *O. innocens;* coxa 7 has a deep posterior excavation; pleonite 3 is less strongly acute dorsally; the pereopodal dactyls are much shorter, the telson lacks a ventral tooth but has a keel. Mouthparts of *O. alii* differ from those of *O. innocens* as described by Stebbing (1910) in the triangular, not lobulate upper lip, the much broader extent over which the ornaments of the first maxilla extend, and the shorter but digitate processes of the lower lip. Stebbing may have overlooked the lacinia mobilis and molar, and there may be differences in the maxilliped not evident from his small figure. The dactyl of gnathopod 2 in *O. alii* seems much stouter and more rigid than that of *O. innocens.*

Ochlesis lenticulosus K. H. Barnard (1940) from the littoral of Simonstown, South Africa, has larger and sharper dorsal teeth on pleonites 1–3 and a smaller epimeron 3 than does *O. alii.* Coxae 1–6 of *O. lenticulosus* resemble those of *O. alii,* but coxa 4 is less strongly excavate anteriorly. Coxa 7 is not posteroventrally excavate in *O. lenticulosus;* the rostrum is thinner, the cephalic lobe blunter, and gnathopod 1 has a simpler morphology than in *O. alii.* Article 5 of gnathopod 1 is longer than 6 in *O. lenticulosus,* the lower lip is not apically bidigitate on either lobe, pereopod 1 has a proximal anterior lobe on article 4 apart from the normal lobe, and article 2 of pereopod 5 has a distal mammilliform lobe projecting posteriorly. Apparently, articles 1–3 of antenna 1 are equal in length, articles 1–2 are scarcely dentiform, the flagellum is very short, and article 4 of antenna 2 is not dentiform in *O. lenticulosus.* No palp occurs on maxilla 1 and apparently neither mandible has a lacinia mobilis in *O. lenticulosus.*

Ochlesis alii differs from *O. levetzowi* Schellenberg (1953) by the strong antennal cusps and the tooth of pleonal epimeron 3.

DISTRIBUTION.—Hawaiian Islands.

Family OEDICEROTIDAE

Kanaloa, new genus

DIAGNOSIS.—Head very massive, with short, stout rostrum, eyes large, yellowish-orange in life, contiguous, occupying dorsal part of head and separated from each other by minute raphus; antennae short, antenna 1 reaching about halfway along flagellum of antenna 2, article 3 of antenna 1 more than half as long as article 1; mandibular incisor slightly projecting and with 1 or 2 teeth, molar large, mostly smooth but edges triturative, palp of medium size, articles 2–3 subequal in length, article 3 falcate; inner lobes of lower lip free; inner plate of maxilla 1 medially setose; maxillipedal palp very stout, scarcely exceeding outer plate, article 4 short, tumid, apically acute, bearing small subapical spine(s); coxa 1 of different shape than coxa 2, expanded midanteriorly, coxa 4 strongly excavate posterodorsally but midposterior lobe not strongly or acutely extended, coxa 5 much shorter than coxa 4; gnathopods 1–2 small, similar to each other in size and general morphology, but gnathopod 2 distinctly larger than 1, palms transverse, article 5 of gnathopod 1 broadly but shallowly lobate, lobe setose, article 6 narrower and shorter than 5, dactyl strongly overlapping simple palm, article 5 of gnathopod 2 truncate and asetose posteriorly, article 6 relatively longer than in gnathopod 1, dactyl fitting palm armed with large tooth-spines each bearing elephantine accessory setule; pereopods 1–2 simple, slender, weakly setose, pereopods 3–5 notably weakly setose, dactyl of pereopod 5 very stout and apically setose; uropods all extending equally, rami on uropods 1–2 bearing long terminal spines; telson square, truncate.

TYPE-SPECIES.—*Kanaloa manoa*, new species.

RELATIONSHIP.—This remarkable oedicerotid appears morphologically as if it had filled both an oedicerotid and a synopiid (tironid) niche in Hawaiian waters. Superficially it has the aspect of a tironid like *Garosyrrhoe* J. L. Barnard in its head and a reduction of pereopodal setae but, of course, the vestigial accessory flagellum, elongate peduncle of uropod 3, and short entire telson mark *Kanaloa manoa* as an oedicerotid. The family is confined to cold waters.

Kanaloa has affinities with Antarctic genera armed with medial setae on the inner plate of maxilla 1 and bearing weak gnathopods. It resembles *Parhalimedon* Chevreux (1906) and *Methalimedon* Schellenberg (1931) in its weak gnathopods, head, mandible, lower lip, maxilla 1, maxillipeds, and spines of uropods 1–2 but differs from those genera by: (1) the transverse palms of the gnathopods and the relative distinctions (not strong) between gnathopods 1 and 2 not occurring in the other genera; (2) the more strongly excavate coxa 4; (3) the equally extending uropods. *Kanaloa* differs more strongly from *Methalimedon* than from *Parhalimedon* in its falcate mandibular palp article 3 and slightly elongate article 3 of antenna 1. But the eyes of the type-species of *Parhalimedon* are supposed to be bilaterally paired and those of *Methalimedon* not, although J. L. Barnard (1961) has described a tropical *Parhalimedon* (Coral Sea, 230 m) with unpaired eyes. Article 2 on pereopod 5 of *Parhalimedon* is constricted ventrally, whereas in *Methalimedon* and *Kanaloa* it has a ventrally extended lobe.

Kanaloa resembles antiboreal *Bathyporeiapus* Schellenberg (1931), but the latter genus has a nearly simple, elongate gnathopod 2 with vestigial dactyl, a short mandibular palp article 3, and no setae on the inner plate of maxilla 1.

Carolobatea Stebbing (1899b) (see *Halimedon schneideri* Stebbing, 1888, pl. 59) from Kerguelen Island also is related to this group of genera and has a transverse palm on gnathopod 2, but the gnathopods are otherwise morphologically equal to each other and have small pendant posterior lobes on the fifth articles, and elongate coxa 5, weakly excavate coxa 4, elongate maxillipedal palp with thin article 4, generally stronger setation on the pereopods, and a mandibular palp typical of *Westwoodilla* Bate.

Exoediceros Stebbing (1899b), with 2 species in southeast Australia, has uropod 2 shortened, no dactyls on pereopods 1–2, and lobed fifth articles on both gnathopods 1–2.

No resemblance of *Kanaloa* exists toward oedicerotid genera occurring in the Northern Hemisphere or toward the one other tropically oriented genus, *Perioculopsis* Schellenberg.

Kanaloa manoa, new species

FIGURES 146, 147

DIAGNOSIS.—With the characters of the genus.

DESCRIPTION.—Pleonal epimera 1–2 each with slightly convex posterior margin and small or large posteroventral point; pleonal epimeron 3 with 3 posteroventral serrations; lateral cephalic lobe weakly and obtusely attenuate; spine row of mandible with 1 coni-

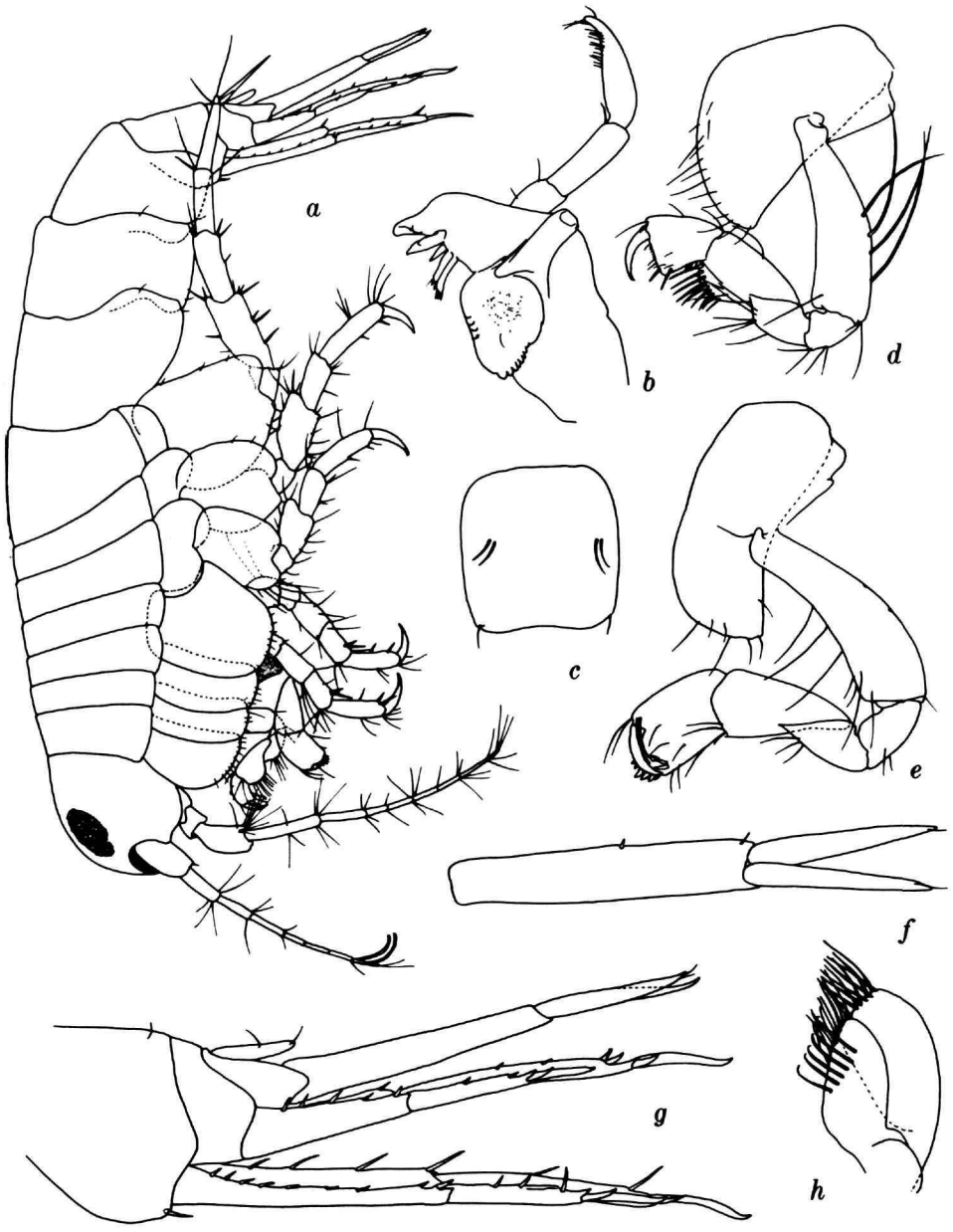

FIGURE 146.—*Kanaloa manoa*, new genus, new species, holotype, female, 1.8 mm, JLB Hawaii 6: *a*, body; *b*, mandible; *c*, telson; *d*, *e*, gnathopods 1, 2; *f*, uropod 3; *g*, urosome; *h*, maxilla 2.

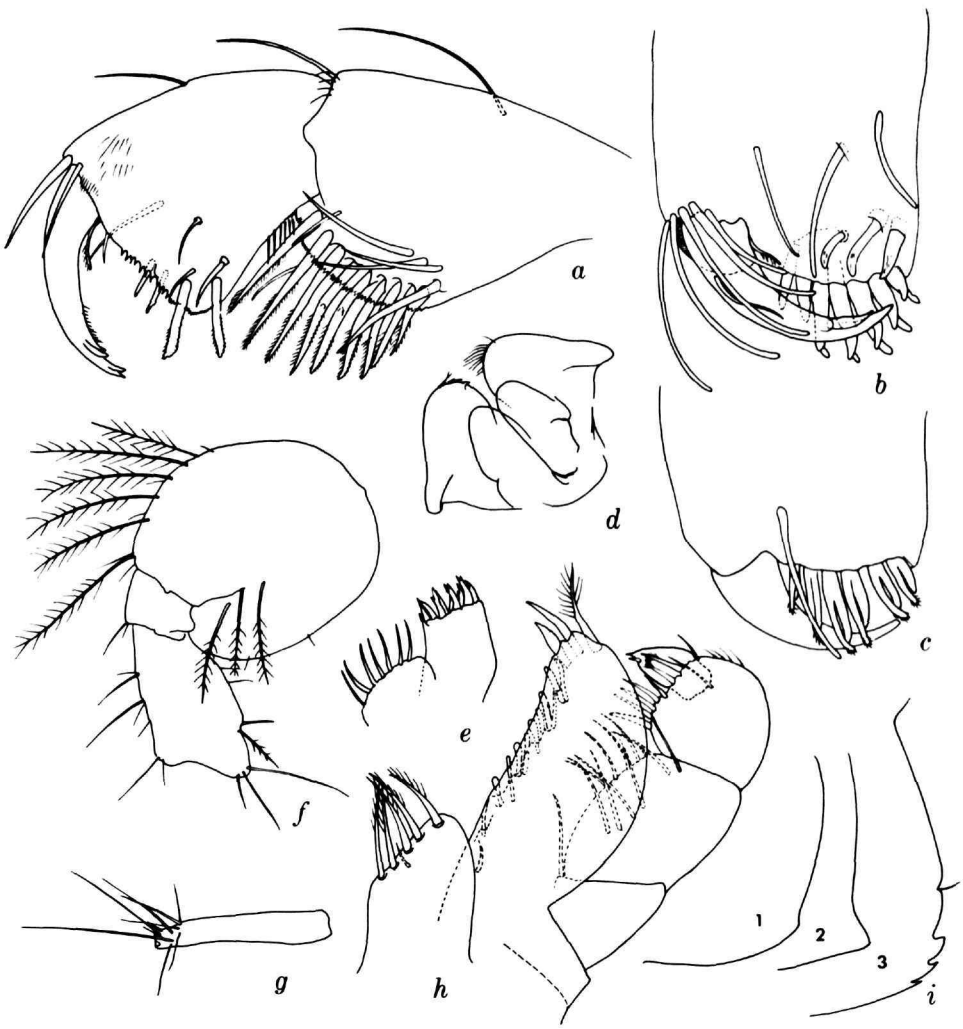

FIGURE 147.—*Kanaloa manoa,* new genus, new species, holotype, female, 1.8 mm, JLB Hawaii 6: *a,* medial gnathopod 1; *b, c,* medial and lateral gnathopod 2; *d,* lower lip; *e,* inner and outer plates of maxilla 1; *f,* medial pereopod 4; *g,* article 7 of pereopod 5; *h,* maxilliped; *i,* pleonal epimera 1–3, posteroventral corners.

cal, unarmed spine and 2 apically frilled spines; majority of spines on outer plate of maxilliped clavate; dactyl of gnathopod 2 simple, but that of gnathopod 1 with subapical clavate setae; margins of palm and lobe on article 5 of gnathopod 1 serrate but smooth on gnathopod 2. Male unkown.

COLOR IN 2-DAY FORMALDEHYDE.—Body white, eye yellow-orange, fading completely in alcohol.

HOLOTYPE.—Bishop Museum collections, catalog number 7294, female, 1.8 mm.

TYPE-LOCALITY.—JLB Hawaii 6, off Barbers Point, Oahu, 30 m, coralline footballs, 29 January 1967.

MATERIAL.—JLB Hawaii 6 (15), 10 (?1 damaged).

DISTRIBUTION.—Hawaiian Islands.

Family PHLIANTIDAE

Palinnotus Stebbing

DIAGNOSIS.—Rostrum a small point; coxa 1 as long as or extending nearly as far ventrally as coxa 2, coxa

4 with posterodistal excavation; maxilla 1 with variable palp, either represented by a spine, possibly absent or formed of a short flat plate, inner plate either absent or unobserved; maxilla 2 with lobes distinct from one another apically but coalesced basally; palp of maxilliped 3-articulate, article 3 blunt and apically setose; gnathopods 1–2 simple; article 2 of pereopod 5 smaller than article 2 of pereopods 3–4; pleopods with subequal rami, only peduncle of pleopod 2 extending medially more or less; uropod 1 biramous; uropod 2 uniramous; uropod 3 represented by a pair of small anal flaps ventral to telson and lacking rami; telson simple and entire.

Palinnotus alaniphlias, new species

FIGURES 148, 149, 150

DIAGNOSIS OF FEMALE.—Article 2 of pereopod 5 ovatoquadrate, very small and scarcely broader than article 3, lacking posterior keel, coxa 7 coalesced with pereonite 7; article 4 of pereopod 3 subquadrate or trapezoidal, article 4 of pereopod 5 subtriangular, thus distally expanded; outer plates of maxilliped large and extending equally with palp; maxilla 1 with small, flat, coniform palp.

DESCRIPTION.—Eyes black in alcohol; pereonites 1–7 with lateral bulges just above coxae, pleonites 1 and 2 with subdorsal bulge, pleonal epimera all rounded-quadrate at posteroventral corners, urosome with 3 segments, but segment 3 not visible dorsally; gnathopods 1–2 nearly equal in size, article 6 on gnathopod 1 medially furnished with asparagoid spines and numerous short prickles, gnathopod 2 lacking these; brood lamellae of female furnished with complex curl-tipped setae.

HOLOTYPE.—Bishop Museum collections, catalog number 7295, female, 3.4 mm.

TYPE-LOCALITY.—Fee 1, Waikiki Beach, Oahu, intertidal, *Ulva lactuca,* 25 April 1967.

MATERIAL.—The type-specimen and a female, 4.2 mm, from JLB Hawaii 17.

REMARKS.—Both specimens are females, the largest with 5 hatched juveniles fully occupying the brood pouch.

HATCHED JUVENILES.—These have the aspect of eophliantids more than of phliantids; body subcylindrical, lacking dorsal and lateral sculpture, head large, tall, broad, long, lateral lobes unprotruding and lateral margins long and weakly convex, eyes small, black; antenna 1 like that of adult, antenna 2 stouter; coxae 1–4 (and coxae 5–7 to some extent) not contiguous, much less broadened than in adult and scarcely splayed, anterior coxae forming elongate rectangles, coxa 4 unexcavate, coxae 5 and 6 unlobed, coxa 7 coalesced with pereonite 7; pereonite 1 a simple cube not encroaching on head; gnathopod 1 lacking medial armature of adult, otherwise gnathopods and pereopods 1–2 with form of adult; article 2 of pereopods 3 and 4 smaller than that of pereopod 5, thus in adult article 2 of pereopods 3–4 becoming enlarged whereas that of pereopod 5 remaining proportionally similar to its condition in juvenile; article 2 of pereopod 3 more nasiform than in adult; pleopods without setae; pleonal epimera scarcely developed; urosome unflattened but broad; uropod 3 relatively much larger than in adult, flaps reaching or exceeding telsonic apex.

RELATIONSHIP.—*Palinnotus alaniphlias* differs from the 3 other known species of the genus in the presence of a flat coniform palp on maxilla 1 and the coalescence of coxa 7 with the body. These characters do not seem to be of generic value if one considers the remarkable conformity of the pleopods, urosome, head, and gnathopods with other members of the genus, plus the general congruence of the other mouthparts except for the outer plates of the maxillipeds, which in *P. holmesi* Gurjanova (1938, 1951) are much smaller than in the other known species. That Japanese species also has a larger article 2 on pereopod 5 than does *P. alaniphlias*.

The type-species, *P. thomsoni* (Stebbing, 1899a), from New South Wales also has a larger article 2 of pereopod 5 and a less quadrate article 2 of pereopod 3.

Palinnotus natalensis K. H. Barnard (1940) from Natal, has a much larger article 2 of pereopod 5 and more strongly nasiform article 4 of pereopod 5 than does *P. alaniphlias*.

DISTRIBUTION.—Hawaiian Islands.

Family PLEUSTIDAE

Parapleustes derzhavini makiki, new subspecies

FIGURES 151, 152

DESCRIPTION.—Head with small rostrum, lateral cephalic lobes mammilliform, anteroventral corner of head sharply angular; eyes large, subcircular, formed of dark-purplish brown core surrounded by clear

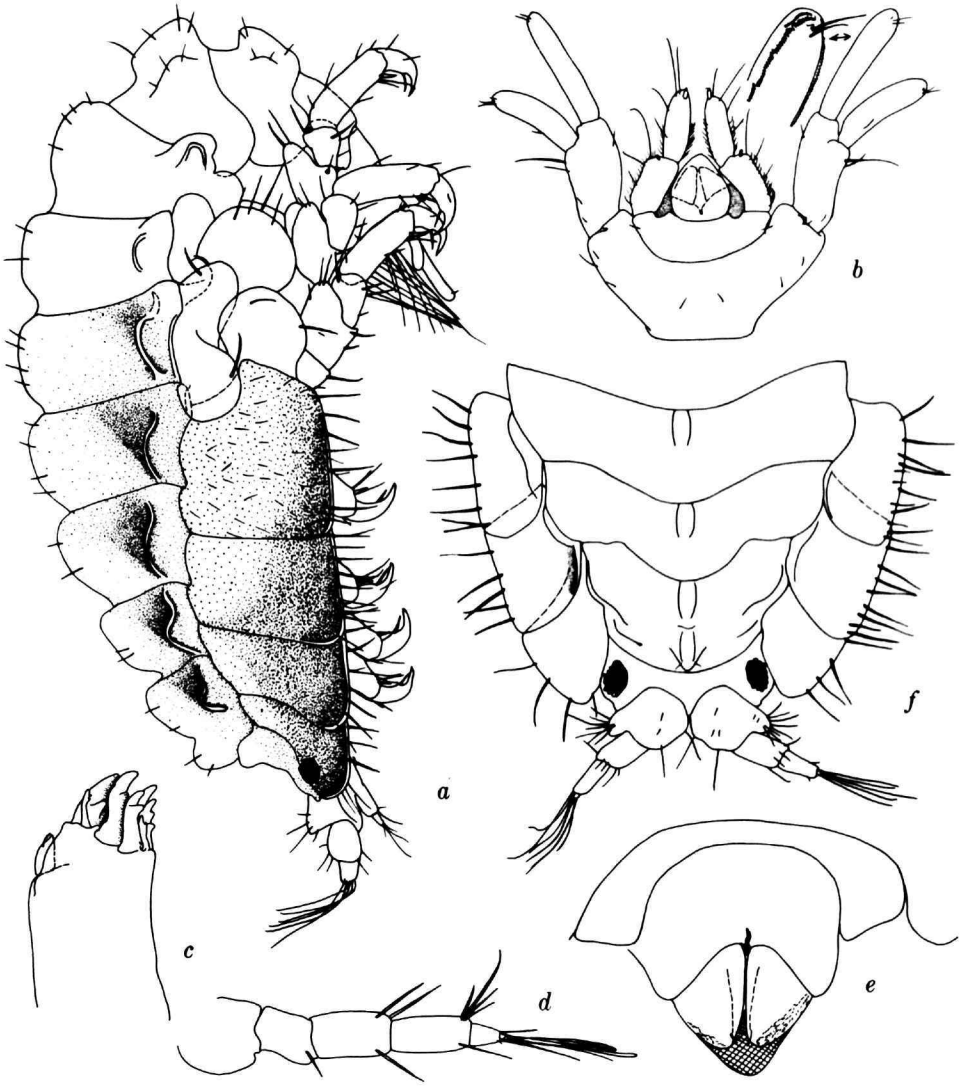

FIGURE 148.—*Palinnotus alaniphlias*, new species, holotype, female, 3.4 mm, Fee 1: *a*, body; *b*, urosome; *c*, maxilla 1; *d*, antenna 2; *e*, ventral urosome showing uropod 3; *f*, dorsal view of head and anterior thorax.

ommatidia; antenna 1 equal to head and 8 body segments, antenna 2 equaling head and 4 body segments, peduncle of antenna 1 reaching to middle of peduncular article 5 on antenna 2; upper lip obtusely projecting anteriorly from lateral view, its ventral plate from anterior view deeply incised; left mandible with large lacinia mobilis more deeply serrate than incisor, spine row with about 8 spines, molar nontriturative but lacking spines, slightly fuzzy on one rim, palp large, article 3 slightly falcate and armed distally and unimarginally with stout spine setae; lower lip normal; maxillae 1–2 generally like those of *Neopleustes pulchella* (Krøyer) (Sars, 1895, pl. 122, fig. 1), but inner plate of maxilla 1 much smaller and bearing only 1 seta; maxillipeds normal structurally but palp broad, 4-articulate; coxa 1 with 1 or 2 posteroventral notches, coxa 2 with 1; gnathopods 1–2 of medium size, tumid, strongly subchelate, article 2 strongly setose anteriorly

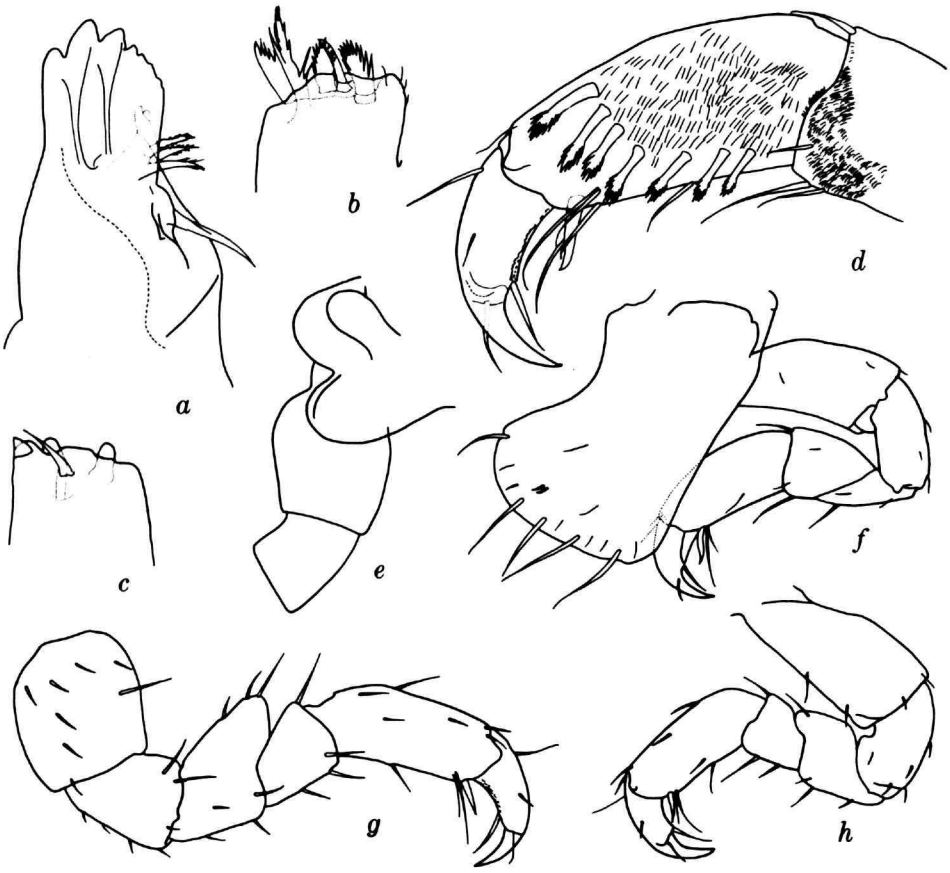

FIGURE 149.—*Palinnotus alaniphlias*, new species, female, 4.2 mm, JLB Hawaii 17: *a*, mandible. Holotype, female, 3.4 mm, Fee 1: *b*, outer plate of maxilla 2, opposite side of 150*d*; *c*, inner plate of maxilliped; *d*, view of gnathopod 1; *e*, right aspect of pereopod 5 articles 2–3 and coxa; *f*, lateral gnathopod 1: *g*, lateral pereopod 5; *h*, lateral pereopod 2.

on gnathopod 1 only, article 4 produced sharply only on gnathopod 2, article 5 long, with thick lobe on gnathopod 1, thinner on gnathopod 2, article 5 with 1 anterior spine, palm as long as posterior margin of article 6, defined by spines and bearing 1 set of palmar spines and obtuse cusp in middle, dactyl fitting palm; pereopods 1–5 of normal size for family, article 2 of pereopods 3–5 broadly ovatorectangular, articles 4–6 slender, article 4 produced nearly halfway along article 5; uropods 1–3 with increasingly shortened outer ramus, rami of uropod 3 of medium length for family, telson long, about 70 percent as broad as long, linguiform, apically rounded, with small, obtuse lateral notch bearing setule on each side; body smooth dorsally; pleonal epimera 1–3 with small posteroventral cusp, 2 with larger, sharply extended tooth, ventral margins of 1 and 3 spinose, 2 with ventrolateral spines, all spines small.

HOLOTYPE.—Bishop Museum collections, catalog number 7297, female, 4.2 mm.

TYPE-LOCALITY.—JLB Hawaii 13, Kaneohe Bay, 3–4 m, corals, corallines, fleshy algae, 8 April 1967.

MATERIAL.—Nine specimens from the type-locality.

RELATIONSHIP.—*Parapleustes d. derzhavini* (Gurjanova, see 1951) from the Japan Sea has the blunt article 4 of gnathopod 1 seen in *P. d. makiki*, and gnathopod 1 has the broad lobe on article 5, but the lobe of article 5 on gnathopod 2 is slightly narrower and article 5 slightly shorter, while article 4 of gnathopod 2 is also blunt; both pairs of gnathopods have

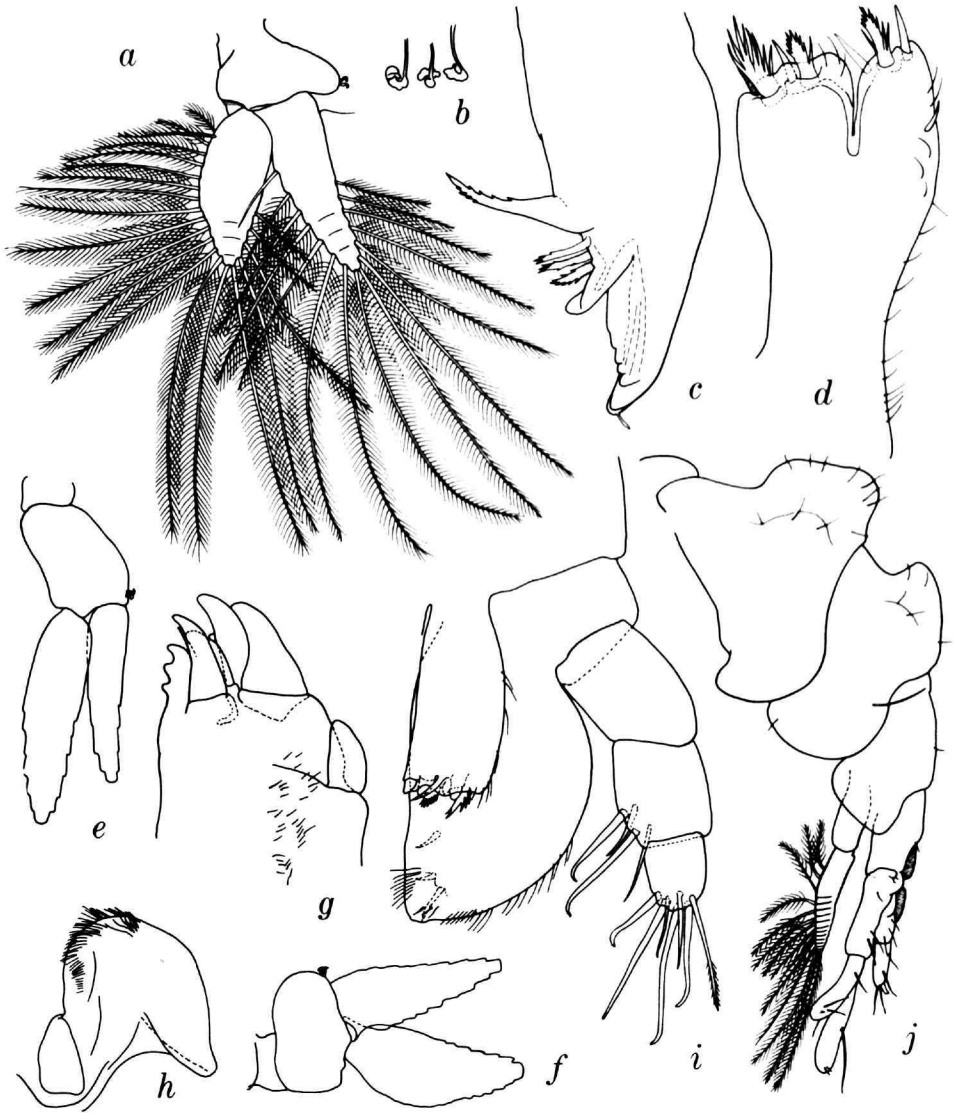

FIGURE 150.—*Palinnotus alaniphlias,* new species, female, 4.2 mm, JLB Hawaii 17: *a, e, f,* pleopods 3, 1, 2; *g,* maxilla 1. Holotype, female, 3.4 mm, Fee 1: *b,* apices of curl-tipped setae on brood plates: *c,* mandible, right obverse; *d,* maxilla 2; *h,* half of lower lip; *i,* maxilliped; *j,* pleon, left lateral.

long setae on article 2. These small differences do not warrant full specific nomenclature for the Hawaiian population at present.

This subspecies from Hawaii has affinities with *P. pugettensis* (Dana) from the cold-warm temperate of Pacific North America, but differs in the longer article 5 of the gnathopods, the stouter posterior lobes, the blunter article 4 of gnathopod 1, and the more strongly convex posterior margin of pleonal epimeron 2.

Parapleustes d. makiki is also closely reated to *P. gracilis* (Buchholz) from boreal waters but differs in the same ways it does from *P. pugettensis,* in addition to the more rounded lateral cephalic lobes and spinier pereopods and uropods.

DISTRIBUTION.—Hawaiian Islands.

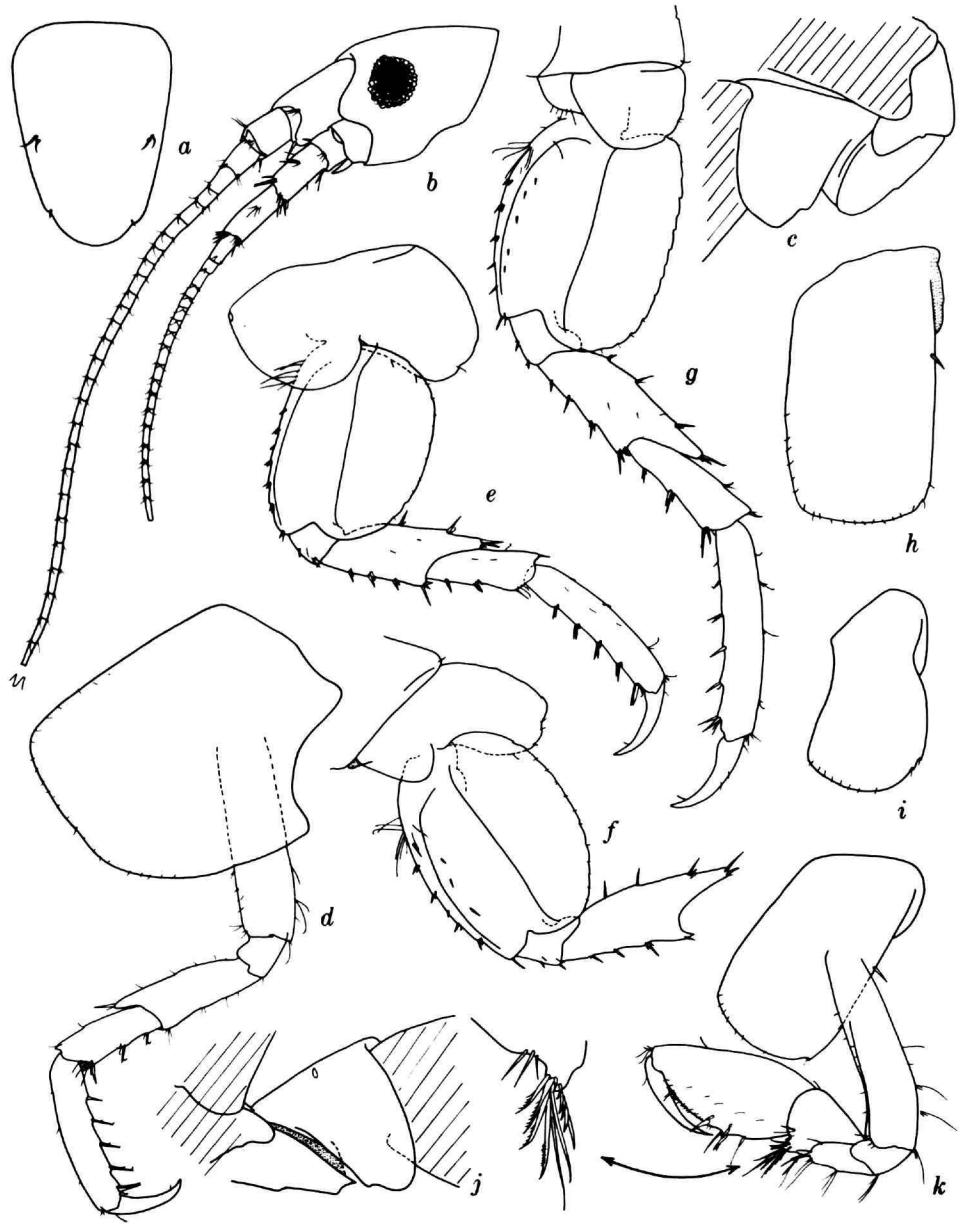

FIGURE 151.—*Parapleustes derzhavini makiki*, new subspecies, holotype, female, 4.2 mm, JLB Hawaii 13: *a*, telson; *b*, head; *c*, articles 3–5 of lateral gnathopod 1; *d*, *e*, *f*, *g*, pereopods 2, 3, 4, 5; *h*, *i*, coxae 3, 1; *j*, articles 3–5 of gnathopod 2, right lateral aspect; *k*, gnathopod 2.

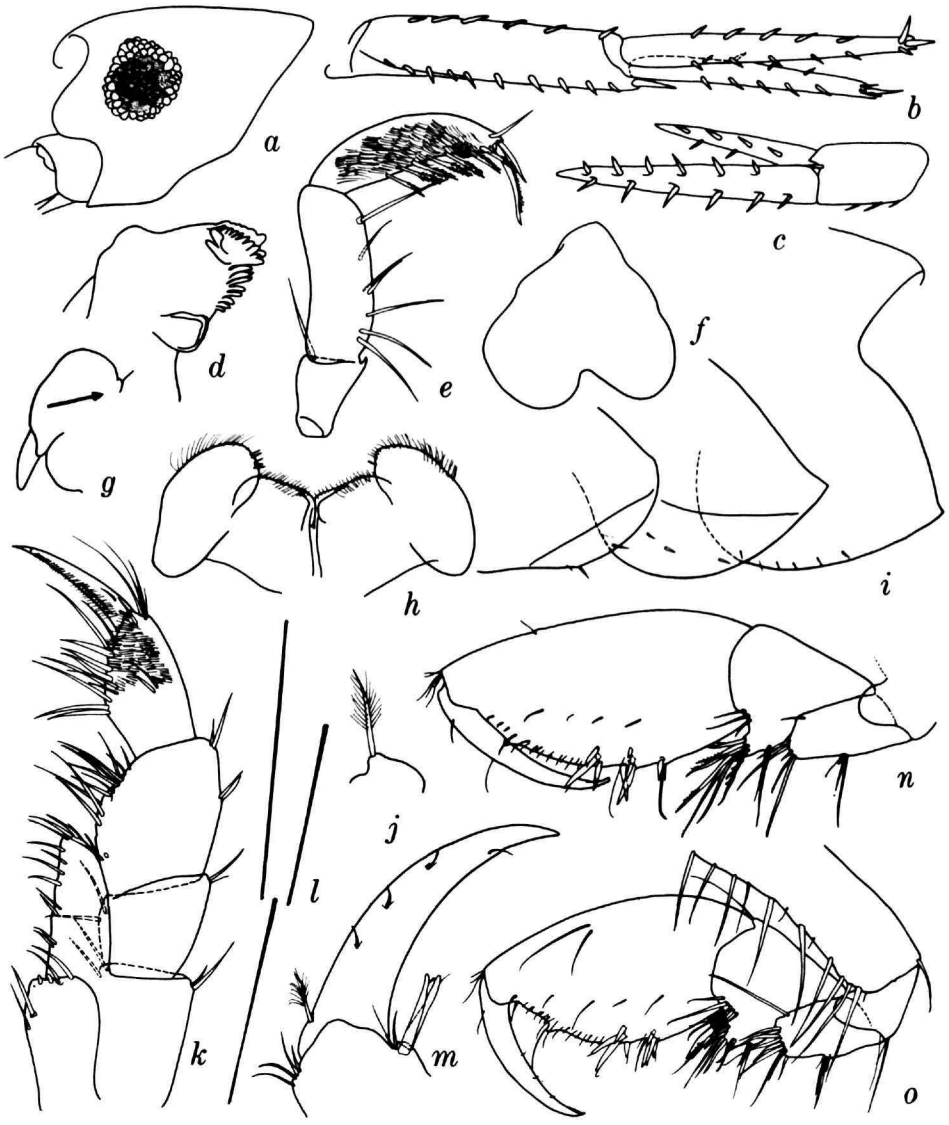

FIGURE 152.—*Parapleustes derzhavini makiki*, new subspecies, holotype, female, 4.2 mm, JLB Hawaii 13: *a*, head; *b*, *c*, uropods 1, 3; *d*, left mandibular body; *e*, mandibular palp; *f*, upper lip; *g*, upper lip protrusion from left lateral view, arrow pointing dorsally; *h*, lower lip; *i*, pleonal epimera 1–3; *j*, inner plate of maxilla 1; *k*, maxilliped; *l*, dimensions of uropod 2; *m*, dactyl of pereopod 4; *n*, *o*, medial gnathopods 2, 1.

Parapleustes (?) *honomu*, new species

FIGURES 153, 154

DESCRIPTION.—Head with medium-sized rostrum, lateral lobe vertically truncate but forming softly rounded right angle marking boundary of ventral quadrate excavation for attachment of antenna 2; eyes very large, ochraceous in alcohol, red in formaldehyde, ovatocircular, composed of tightly packed ommatidia on slight lateral bulge; antennae 1–2 missing; upper lip deeply incised; mandibles with large serrate lacinia mobilis matching incisors, spine-row with 2–3 spines, molar narrow and nontriturative, conically geniculate, bearing apical spinules, palp very large, article 3 clavate and armed distally and unimarginally with stout spine-setae; lower lip, maxillae 1–2 generally like those of *Neopleustes pulchella* (Krøyer) (Sars, 1895, pl. 122, fig. 1), except inner plate of maxilla 1 slightly smaller and with only 1 seta; maxillipedal inner plate armed with 3 small nobs, one of them articulate and 2 apicolateral setae, outer plate slightly hooked, apex with 2 setules, inner margin with 4 spines, palp 3-articulate, article 3 longest and strongly spinose and possibly bearing vestige of article 4; coxae short, 1–4 about as broad as long, 4 weakly excavate posteriorly, posterior lobes of 5 and 6 large; gnathopods 1–2 small, slender, scarcely subchelate, articles 5–6 subrectangular or sublinear, palms with several long and short spines, dactyls long; pereopods 1–5 very large and stout for family, dactyls long, article 6 of pereopods 3–5 elongate, article 2 strongly lobed posteroventrally; uropods 1–3 with shortened outer rami, rami on uropod 3 of medium length for family; telson short, as broad as long, softly triangular; pereonites 6–7 and pleonites 1–2 with posterodorsal hump-keel, pereonite 7 with small posterolateral bulge, pleonites 1–2 with lateral keel continuing to posterior quadrate corner, connected with epimeron directly, pleonite 3 with partial anterolateral keel; pleonal epimera 1–2 with lateral ridge, posteroventral corner formed of small cusp, posterior edge slightly convex and with 1–2 serrations, epimeron 3 rounded and serrate posteriorly.

HOLOTYPE.—Bishop Museum collections, catalog number 7296, male, 2.3 mm. Unique.

TYPE-LOCALITY.—Devaney 1, off Moku Manu Island, Oahu, 33 m, stem of black coral, 13 May 1967.

RELATIONSHIP.—This species obviously will require the erection of a new genus for its reception, but this event should await a firmer foundation in unbroken material of both sexes. *Parapleustes honomu* is apparently derived from boreal pleustids of either the genera *Parapleustes* or *Neopleustes*, but the absence of palp article 4 on the maxilliped obscures the relationship, for the two boreal genera differ from each other in the presence of a process on article 3 that cannot be detected in *P. honomu* because article 4 is absent and the relative relationships between the 2 articles no longer occur.

Parapleustes (?) *honomu* differs from other pleustids generally in the weak lateral cephalic lobe, large eye on slight lateral bulge, the absence of maxillipedal palp article 4, presence of lateral ridges on pleonites 1–3, serrate epimeron 3 (recalling a similar situation in warm-water members of *Pontogeneia*), elongate article 6 of pereopods 3–5, short coxae, stenothoid-like mandibular incisors and lacinia mobili, and the extraordinarily heavy setae of the mandibular palp.

This species resembles *Neopleustes boeckii* (Hansen) (Sars, 1895, pl. 122, fig. 2) in the presence of 3 dorsal teeth and to some extent in the head, but *N. boeckii* has a dorsal crest on the head among the usual differences.

Gnathopods 1–2 of *P. honomu* are very thin and poorly developed, but *Parapleustes oculatus* (Holmes, see Barnard and Given, 1960) also has weak gnathopods and large apical setae on the mandibular palp, but the outer lobes of the lower lip of *P. honomu* are normally broad and *P. oculatus* has no dorsal teeth.

Neopleustes rasmyslovi Gurjanova (1951) also has a thin but elongate gnathopod 1 and *P. johanseni* Gurjanova (1951) has thin but strongly subchelate gnathopods and the lateral cephalic lobes are poorly developed.

DISTRIBUTION.—Hawaiian Islands.

Family PODOCERIDAE

Laetmatophilus hala, new species

FIGURE 155

DIAGNOSIS OF FEMALES AND JUVENILES.—Head with 3 dorsal cusps in transverse row, anteroventral corner with small cusp; pereonite 1 with 2 axial dorsomedial cusps and 2 lateral cusps on each side, pereonites 2, 3, 4, 5, 7 with 1 dorsal and 1 lateral cusp on each side, pereonite 6 with 1 dorsal cusp and 1 very weak ridge on lateral surface, pereonites 5–7 coalesced; lateral margins of pereonites 1–7 with small ridge-

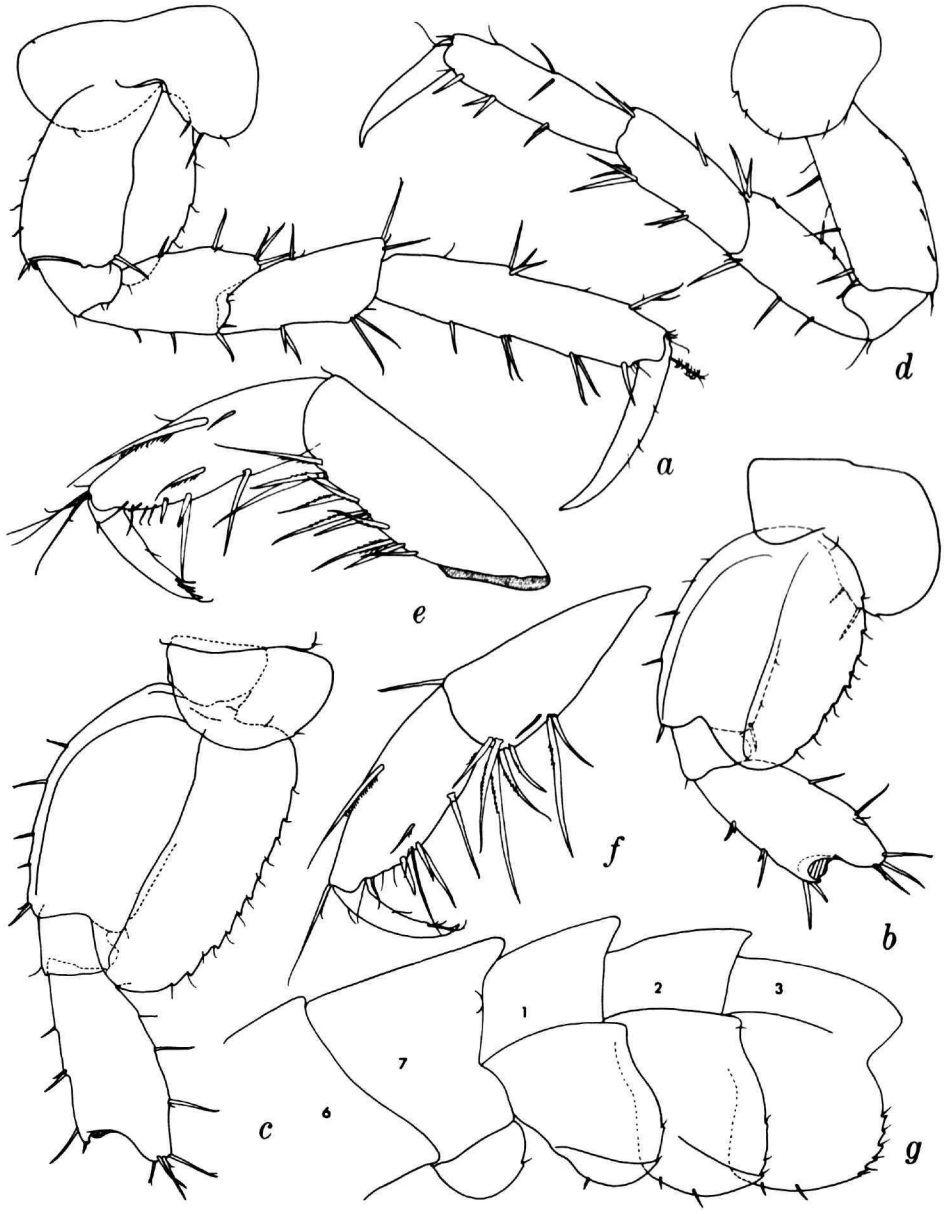

FIGURE 153.—*Parapleustes* (?) *honomu*, new species, holotype, male, 2.3 mm, Devaney 1: *a, b, c, d*, pereopods 3, 4, 5, 1; *e, f*, apices of medial gnathopods 2, 1; *g*, pereonites 6–7 and pleonites 1–3, left lateral.

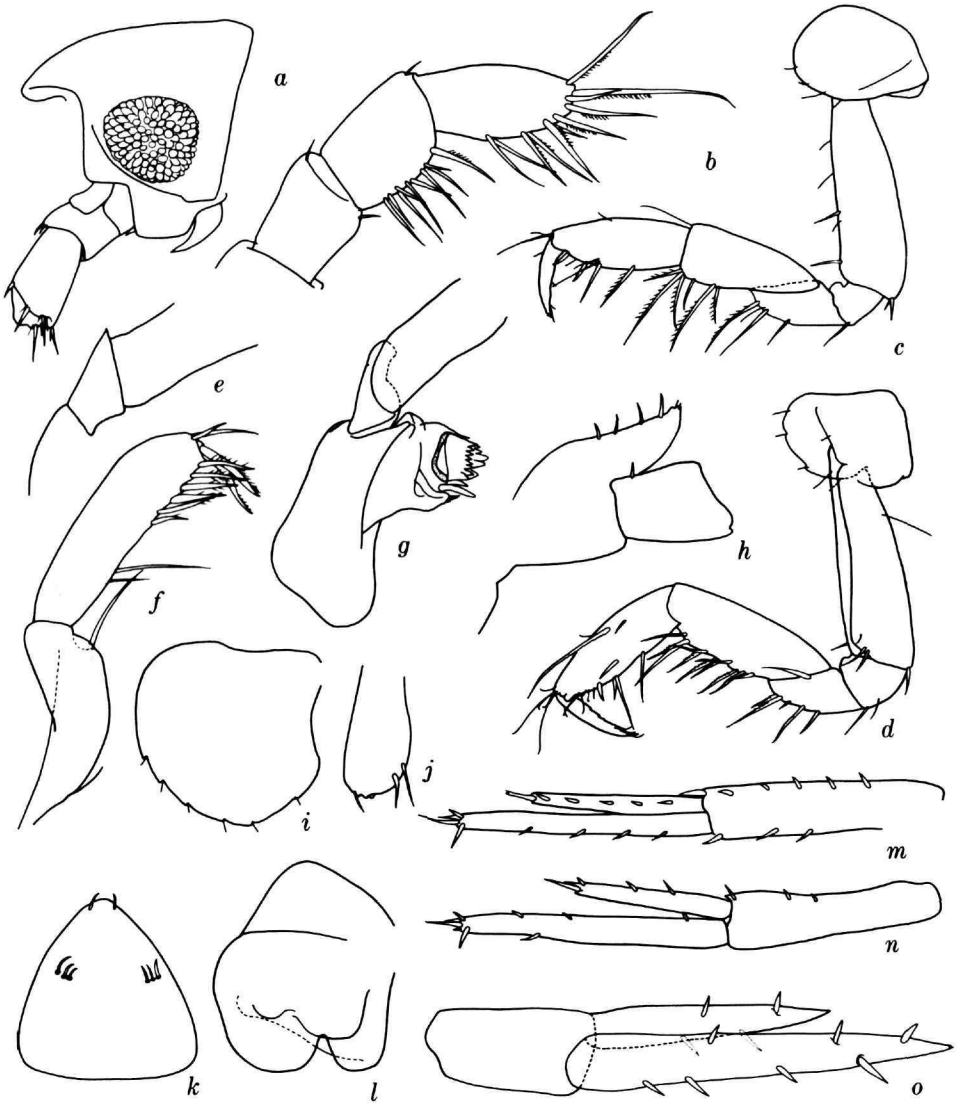

FIGURE 154.—*Parapleustes* (?) *honomu,* new species, holotype, male, 2.3 mm, Devaney 1: *a,* head; *b,* maxillipedal palp; *c, d,* gnathopod 1; *e,* article 1 of mandibular palp; *f,* articles 2–3 of mandibular palp; *g,* mandibular body; *h,* outer plate of maxilliped; *i,* coxa 4; *j,* inner plate of maxilliped; *k,* telson; *l,* upper lip; *m, n, o,* uropods 1, 2, 3.

FIGURE 155.—*Laetmatophilus hala,* new species, holotype, female, 1.8 mm, JLB Hawaii 6: *a,* body; *b,* medial gnathopod 2; *c,* head; *d,* lateral gnathopod 2; *e,* urosome, dorsal; *f,* pleon, lateral; *g,* lateral gnathopod 2; *h,* dactyl of gnathopod 1. Juvenile, 0.9 mm, JLB Hawaii 3: *i,* head, pereon, metasome from right side.

cusp above coxae; pleonites 1–2 each with dorsal cusp and pleonite 1 with small dorsolateral ridge on each side; young specimens with lateral supracoxal ridges and dorsolateral teeth absent, middorsal cusps represented by humps, anteroventral cephalic cusp absent; only coxae 3–4 in adult female with ventral points; article 2 of gnathopod 2 with sharp anterodistal cusp, article 4 with medium-sized posterodistal process; gnathopod 1 palm longer than posterior margin of article 6 and lined with long setae, defined by sharp, slender, short, feathered spine, dactyl slightly longer than palm and distally multifid, lobe of article 5 evenly bulging; outer ramus of uropod 1 half as long as inner.

DESCRIPTION.—Pereopods 2–7 and antennae 1–2 missing from all material except pereopods 3–4 of juvenile in JLB Hawaii 3, generally like those of *L. tuberculatus* Bruzelius (Sars, 1895, pl. 226); mouthparts also like that species but inner plate of maxilla 1 obsolescent, right mandibular molar with large flake and seta, left molar with small flake and no seta; epistome strongly conical; uropod 3 a small flap with medial setule. Specimen of JLB Hawaii 5 lacks lateral cusps on pleonite 1, and the adult of JLB Hawaii 3 has all cusps less produced than on the holotype, and pereonite 1 and pleonite 1 have no lateral cusps.

HOLOTYPE.—Bishop Museum collections, catalog number 7298, female, 1.8 mm.

TYPE-LOCALITY.—JLB Hawaii 6, off Barbers Point, Hawaii, 30 m, coralline footballs, 29 January 1967.

MATERIALS.—JLB Hawaii 3 (2), 5 (1), 6 (1).

RELATIONSHIP.—This species probably has its closest relationships with *L. hystrix* (Haswell, 1880b), but that species has at least one more dorsolateral cusp on each side of pereonites 1–7 and pleonite 1 has 2 dorsal medials, the anteroventral cephalic cusp is larger and coxae 5–6 have ventral cusps. Considerable developmental change occurs in *L. hala,* and perhaps terminal adults develop the characters of *L. hystrix.*

Laetmatophilus armatus (Norman) (Sars, 1895, pl. 227, fig. 1) has fewer dorsal cusps than *L. hala,* the former having primarily a double dorsal spiniform set along the midline of pereonites 2–7 and pleonites 1–2 and lacking an anteroventral cephalic cusp.

Laetmatophilus leptocheir K. H. Barnard (1937) has the outer ramus of uropod 1 about two-thirds as long as the inner, the head and pereonite 1 lack dorsal cusps or keels and the hand of gnathopod 1 is very slender.

DISTRIBUTION.—Hawaiian Islands.

Podocerus Leach

Identifications of the tropical species in this genus have been subject to confusion after 1906 when Stebbing adequately summarized the known species which at that time had limited distributions. Since then, two species, Brazilian *P. brasiliensis* (Dana) and New Zealandian *P. cristatus* (Thomson), have been reported from localities far from tropical waters and *P. brasiliensis* has come to be considered circumtropical.

One of those records identified by J. L. Barnard (1962a, fig. 30) from open-sea southern California is undoubtedly erroneous as his figure shows a head entirely different from that seen in *P. brasiliensis* from Hawaii and vaguely seen in Dana's (1853) drawings of the original establishment of the species. The ocular lobes of *P. brasiliensis* fill the anteroventral corner of the head, whereas in the Californian material they occur behind a sharp corner. The record by J. L. Barnard (1959) from Newport Bay has the correct head although the dactyl of gnathopod 1 is apically multispinose as in the open-sea populations and thus differs from the dactyl in tropical individuals. The Californian open-sea material should be accorded a name different from *P. brasiliensis* but estuarine-lagoonal populations in California may represent a form of *P. brasiliensis* imported by human agencies.

Gnathopod 1 of male *P. brasiliensis* from Hawaii (J. L. Barnard, 1955a) and Ceylon (Walker, 1904, as *P. synaptochir*) has a distal hemispherical lobe on a truncate article 5, whereas Dana's (1855) and J. L. Barnard's (1959) materials have the lobe on article 5 stretching the breadth of the article.

Podocerus brasiliensis (Dana)

FIGURES 156, 157

Platophium brasiliense Dana, 1853, pp. 838–839, pl. 55, fig. 9.
Platophium synaptochir Walker, 1904, pp. 296–297, pl. 8, fig. 52.
Podocerus brasiliensis.—Schellenberg, 1938, p. 94; J. L. Barnard, 1953, p. 87 [with synonymy]; 1955a, p. 39.

DIAGNOSIS OF HAWAIIAN MALE.—Lateral cephalic lobe rounded anteroventrally and filled with red or clear eye in ocular bulge; accessory flagellum 1-articulate, long but thin, antenna 2 very long, antenna 1 reaching slightly beyond article 4 on peduncle of antenna 2; epistome conically produced; coxa 1 weakly extended forward, coxa 2 with large medial stridulating flange; article 5 of gnathopod 1 shorter than article

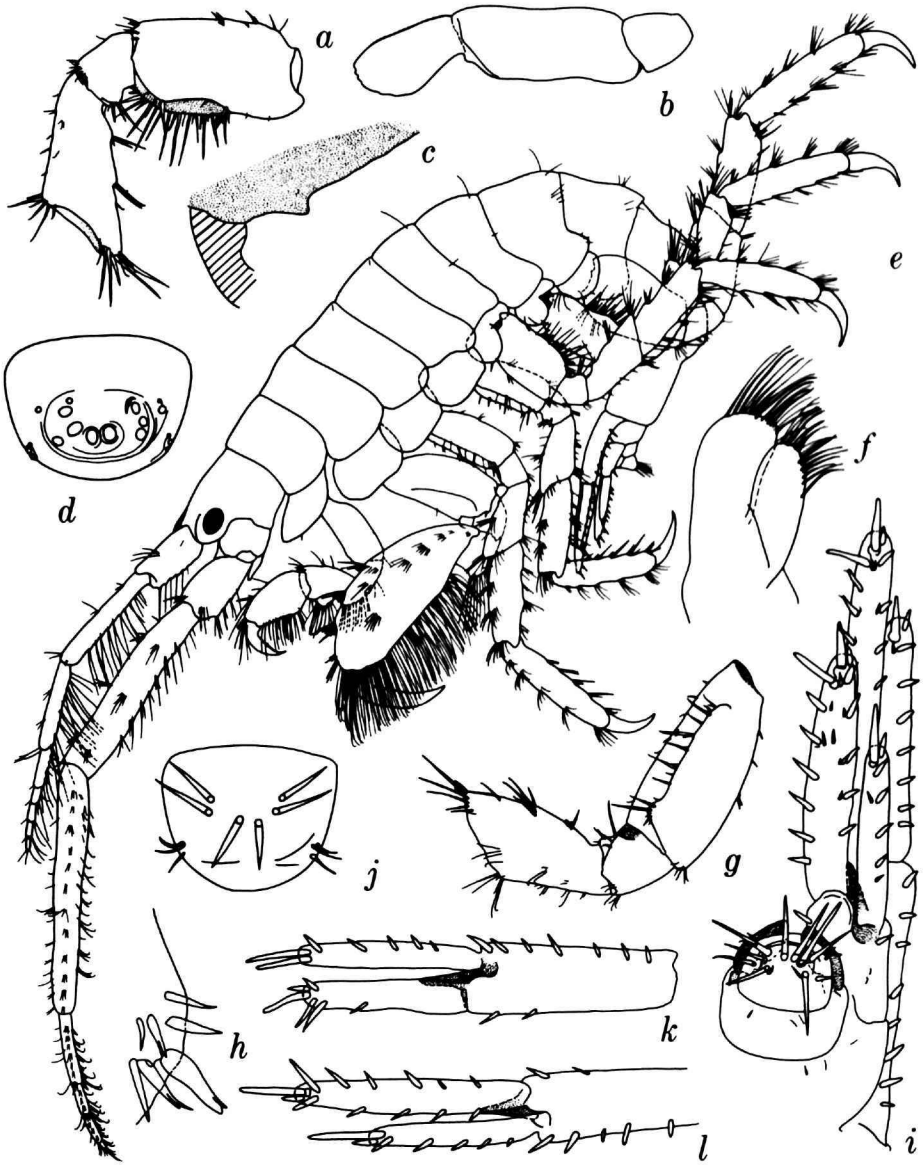

FIGURE 156.—*Podocerus brasiliensis* (Dana), male, 5.3 mm, Pearl Harbor: *a*, part of pereopod 3, medial; *b*, mandibular palp minus setae; *c*, palm of gnathopod 2; *d*, dorsal telson, setae marked with pits; *e*, body; *f*, maxilla 2; *g*, part of lateral pereopod 1; *h*, spines at defining corner of gnathopod 1; *i*, dorsal urosome. Female, 2.9 mm: *j*, dorsal telson; *k*, aberrant uropod 1; *l*, normal uropod 1.

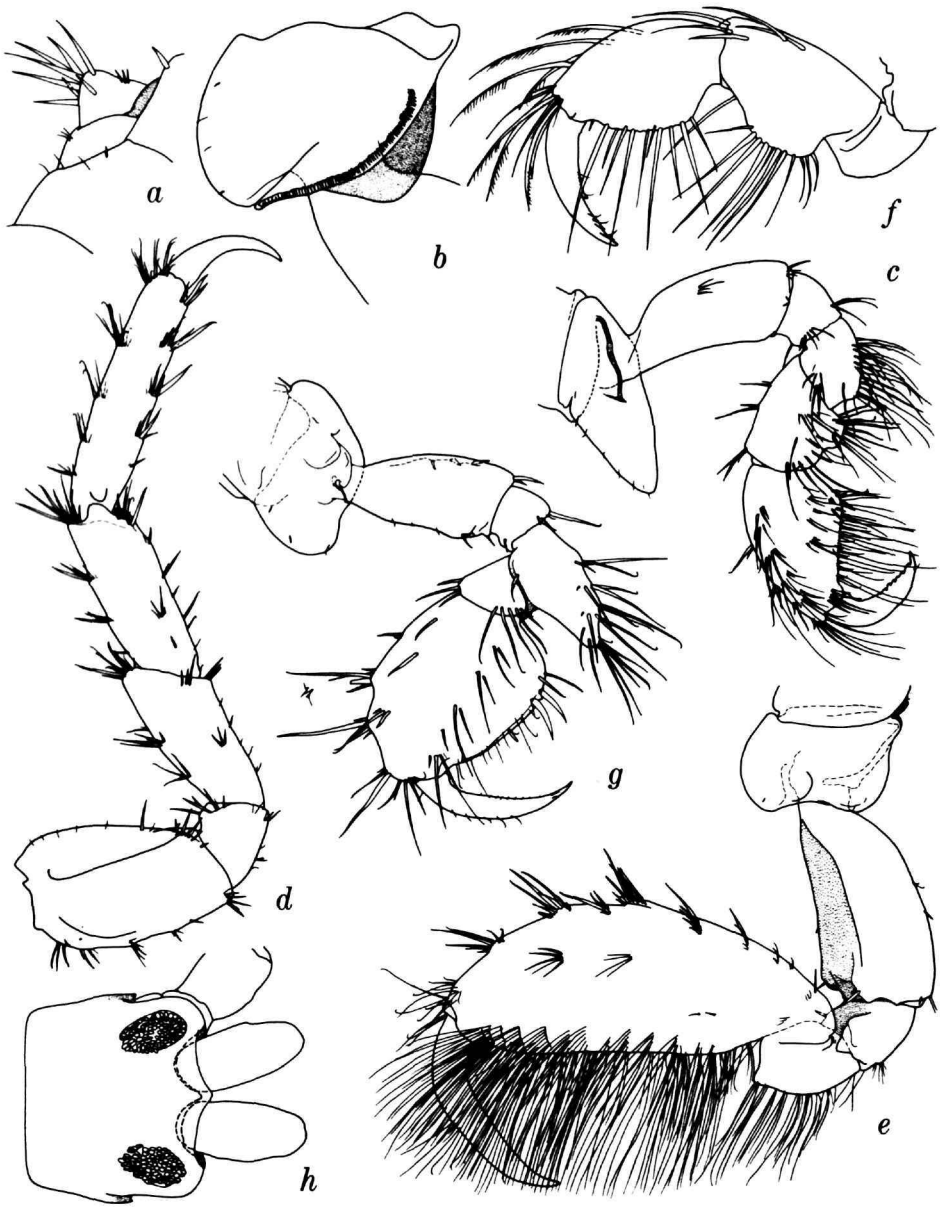

FIGURE 157.—*Podocerus brasiliensis* (Dana), male, 5.3 mm, Pearl Harbor: *a*, lateral telson and uropod 3 (shaded); *b*, coxa 2, medial, showing stridulation flange; *c*, gnathopod 1; *d*, lateral pereopod 5, less coxa; *e*, lateral gnathopod 2. Female, 2.9 mm: *f*, lateral gnathopod 1; *g*, medial gnathopod 2; *h*, dorsal head.

6, slightly cup-shaped and bearing tumid posterior lobe slightly marked off from main part of article, article 6 ovatotriangular, but oblique palm longer than posterior margin of article 6, defined by obtuse corner bearing several short spines, dactyl with weak inner serrations and fitting palm; article 2 of gnathopod 2 with obsolete anterolateral lobe bearing spine, article 4 short and stout, weakly protuberant posterodistally, article 6 elongate, heavily setose, posterior margin bearing all of palm, undefined and with obsolescent distal bulge hidden among setae, dactyl about half as long as article 6, strongly bent basally; article 2 of pereopods 1–5 of medium stoutness, slightly bilobate on pereopod 3 and heavily spinose on pereopods 3–4; uropods 1–2 each with stout peduncular tooth between rami, outer ramus of uropod 1 varying between 67 and 75 percent length of inner ramus, of uropod 2 about 67 percent length of inner ramus, uropod 3 small but with apical and subapical spine; telson quadrotrapezoidal, dorsally produced as large nob armed with 8 or more long setal spines; pleonites 1–2 with obsolescent dorsal hump, pereonite 7 slightly longer than others, all pereonites articulate; pleonal epimera 1–3 evenly rounded below.

FEMALE.—Gnathopod 2 short and stout, article 4 elongate and grossly extended distally, article 5 small, cup-shaped, article 6 subcircular, palm longer than posterior margin of article 6, defined by 2 large spines, dactyl fitting palm; telson with 6 spines; article 5 of gnathopod 1 lobate but lobe not marked off from main article, palmar defining corner without short spines.

MATERIAL.—Same as J. L. Barnard (1955a).

DISTRIBUTION.—Circumtropical.

Podocerus hanapepe, new species

FIGURES 158, 159

DIAGNOSIS OF MALE.—Lateral cephalic lobe quadrate anteroventrally, head extended quadrately forward, lateral ocular bulges of medium extent, divorced from anteroventral corner, red in formaldehyde, ochraceous in alcohol, with weak core of dark pigment; accessory flagellum 1-articulate and very small, antennae 1–2 short; coxa 1 strongly extended forward, article 6 of gnathopod 1 triangular, distally expanded, palm transverse, defined by small spine, dactyl with weak inner serrations, article 6 with extremely stout semipinnate setal spines, article 5 slightly longer than 6, posterior lobe broadly bulging; article 2 of gnathopod 2 with small, distal, anterolateral, obtusely pointed lobe, article 4 long and apically extended as blunt triangle, palm oblique and defined by stout cusp and 2 spines, dactyl almost fitting palm, palm weakly setose and bearing broad, low, castellate distal process and smaller proximal quadrate cusp; article 2 of pereopods 1–5 very short and stout, bilaterally lobate on pereopod 3, outer ramus of uropod 1 about three-fourths as long as inner ramus but appearing shorter from lateral view, uropod 2 very stout, outer ramus about 60 percent as long as inner; uropod 3 small but with 2 apical-subapical spines; telson subcircular-quadratiform, bearing dorsal nob armed with 2 long stout spines; pereonites 1–3 with weak transverse dorsal depressions, pereonites 4–5 shortest of all but pereonite 6 not extremely broadened nor heavily muscularized and all segments clearly articulate; pereonite 7 and pleonites 1–2 scarcely elevated posterodorsally; pleonal epimera 1–3 evenly rounded below.

FEMALE.—Unknown.

HOLOTYPE.—Bishop Museum collections, catalog number 7299, male, 2.4 mm. Unique.

TYPE-LOCALITY.—Fee 1, Waikiki Beach, Oahu, intertidal, *Ulva lactuca*, 21 April 1967.

RELATIONSHIP.—The overall appearance of this species resembles that of *P. mangarevae* Chevreux (1908), but *P. hanapepe* has a slightly more extended and squared-off head, a fully transverse palm on gnathopod 1, no anterior taper on coxa 1, a short accessory flagellum, a strong distal extension on article 4 of gnathopod 2, a slightly stronger defining tooth on the the palm of gnathopod 2, and only 2 telsonic spines that are larger than on *P. mangarevae*. Antenna 2 of *P. mangarevae* is very conspicuously longer than antenna 1, a condition not true of *P. hanapepe*.

Possibly *P. mangarevae* is a synonym of *P. zeylanica* (Walker, 1904), and the same differences are approximately applicable between *P. hanapepe* and *P. zeylanica* as mentioned above except for coxa 1 and the defining tooth of gnathopod 2 palm. Antennal lengths for *P. zeylanica* were not mentioned, and the telson has 1 large and 2 small spines.

Podocerus inconspicuus (Stebbing, 1888), from southeast Australia, but apparently not that taxon identified by Pirlot (1938), is very close to *P. hanapepe*, even though the 2 species are based on opposite sexes and various missing parts of *P. inconspicuus* preclude their description. Gnathopod 1 of *P. inconspicuus* (based on a female) has a very narrow article 5 in comparison to that of *P. hanapepe*.

DISTRIBUTION.—Hawaiian Islands.

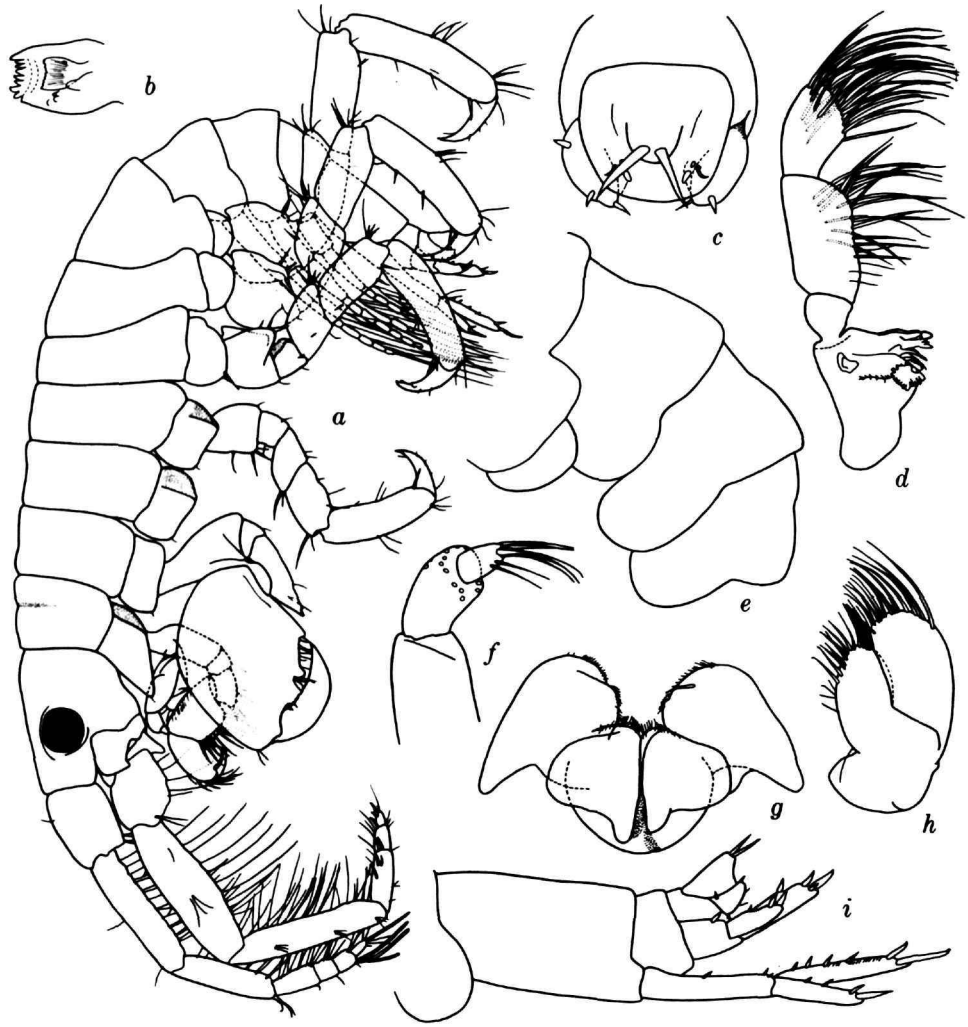

FIGURE 158.—*Podocerus hanapepe,* new species, holotype, male, 2.4 mm, Fee 1: *a,* body; *b,* right mandibular molar; *c,* telson and uropod 3, dorsal; *d,* mandible; *e,* pereonite 7 and pleonal epimera 1–3; *f,* apex of maxillipedal palp, some setae removed; *g,* lower lip; *h,* maxilla 2; *i,* urosome.

Podocerus talegus lawai, new subspecies

FIGURES 160, 161

DIAGNOSIS OF MALE.—Lateral cephalic lobes rounded anteroventrally, eyes on strong lateral bulges divorced from anteroventral corners, red in formaldehyde, ochraceous in alcohol, with weak core of darker ochre; accessory flagellum 1-articulate but thick and elongate, antennae 1–2 long; coxa 1 strongly extended forward; article 6 on gnathopod 1 of normal expansion, slightly longer than article 5, palm about twice as long as posterior margin of article 6, defined by 2 or more spines, one of them thorny, dactyl with long inner serrations near apex, article 6 with long, anteriorly submarginal, semipinnate setal spines, article 5 with evenly bulging posterior lobe; article 2 of gnathopod 2 with quadrate anterodistal lobe, article 4 with small posterodistal cusp, palm undefined, occupying most of posterior margin of article 6, dactyl about two-thirds as long as article 6, palm fringed with long setae and medial face of hand with many stout but long setae, no palmar teeth showing laterally or marginally from

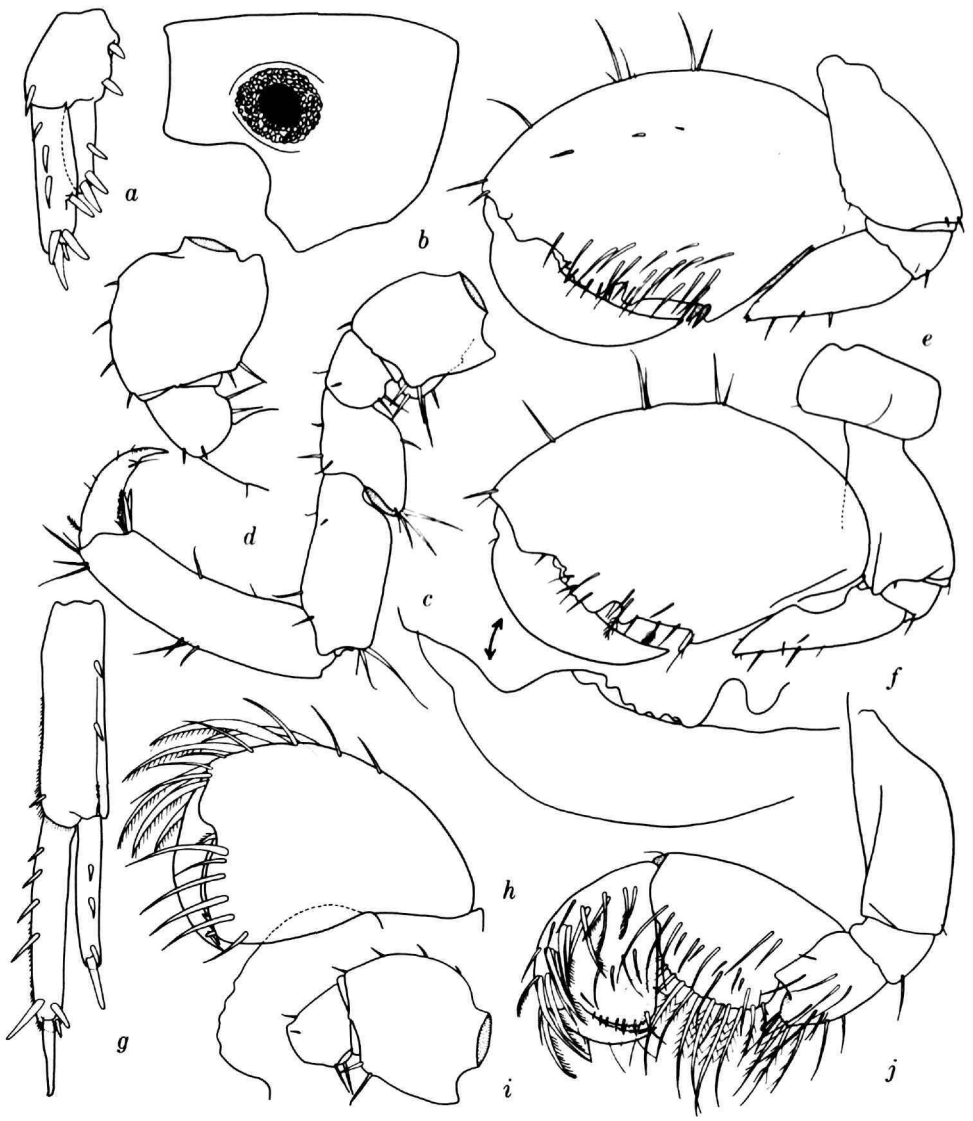

FIGURE 159.—*Podocerus hanapepe,* new species, holotype, male, 2.4 mm, Fee 1: *a,* uropod 2; *b,* head; *c, d,* pereopods 3, 5, in whole or part; *e, f,* gnathopod 2, medial and lateral; *g,* uropod 1; *h,* apex of lateral gnathopod 1; *i,* part of pereopod 4; *j,* medial gnathopod 1.

medial view in young male but bearing mediosubmarginal, low, broad, crenulate distal process, next proximally a rounded smooth process and finally a small or large obtusely conical process, terminal male with these processes much enlarged and medial edge of article 2 heavily setose; article 2 of pereopods 1–5 of medium stoutness; outer ramus of uropod 1 about three-fourths as long as inner ramus, peduncle with ventrodistal sharp tooth of medium length between rami, outer ramus of uropod 2 about two-thirds as long as inner ramus, often appearing shorter from lateral view, uropod 3 small but with 3 apical-subapical spines; telson subcircular, bearing extended dorsal nob armed with 2 long stout spines; pereonites 1–5 with weak transverse dorsal depressions, pereonites 4–5 shortest of all, pereonites 6–7 exceptionally long, articulations be-

tween segments 5–7 and 6–7 incomplete, segments 6–7 heavily muscularized and rigid, pereonite 7 and pleonites 1–2 each with dorsal hump and occasionally weak dorsolateral accessory hump often marked only with setae; pleonal epimera almost evenly rounded below.

FEMALE.—Article 2 of gnathopod 2 lacking anteroventral process, distal cusp of article 4 small, article 6 stout, short, broadly ovate, palm long, strongly defined by 2 stout spines and weak cusp, palm minutely castellate; coxae broader than in male.

HOLOTYPE.—Bishop Museum collections, catalog number 7300, male, 2.6 mm.

TYPE-LOCALITY.—JLB Hawaii 5, off Ewa Beach, Oahu, 30 m, *Pocillopora,* 29 January 1967.

MATERIAL.—JLB Hawaii 2 (2), 5 (1), 12 (3), 13 (3), 17 (1). Fee 1 (5).

RELATIONSHIP.—This subspecies differs from *P. t. talegus* J. L. Barnard (1965a) from Micronesia only in minor ways such as the rounder anteroventral cephalic margin, the shorter and broader article 5 of gnathopod 1, and apparently the slightly longer serrations on the dactyl of gnathopod 1. The terminal male of *P. t. talegus* is unknown.

Podocerus talegus seems to have close affinities with *P. inconspicuus* (Stebbing) and *P. ?lobatus* (Haswell) as identified by Pirlot (1938). There is considerable evidence that Pirlot's materials should be given new or different names than those he applied. Unlike Pirlot's species, *P. talegus* has a strong dorsal hump or keel only on 3 segments and the bulges are thick and not lamellar. A few individuals of those species identified by Pirlot also have only 3 segments keeled. Article 2 of gnathopod 2 on *P. talegus lawai* fits *P. inconspicuus* better than *P. ?lobatus,* but the palm of male gnathopod 2 fits *P. ?lobatus* better than *P. inconspicuus. P. lobatus* (Haswell, 1885) and *P. ?lobatus* of Pirlot have, however, a defining tooth on the palm, whereas, if that tooth is present on *P. talegus,* it has moved distally. *Podocerus talegus* does not fit the original *P. inconspicuus* (Stebbing, 1888) at all.

Poderus fulanus J. L. Barnard (1962a) from California (=*Podocerus* species of J. L. Barnard, 1959) has a few resemblances to *P. talegus,* but also has 4 keeled segments and has only 1 process on male gnathopod 2 palm, weaker ocular bulges, shorter posterior margin of pleonal epimeron 3, fewer spines on uropod 3, and a slightly shorter ventrodistal peduncular cusp on uropod 1, larger segment 6 of the pleon, and longer palm on gnathopod 1 than does *P. talegus.*

The so-called *P. cristatus* (Thomson) of California, as identified by J. L. Barnard (1962a), has 5 dorsally keeled segments and dorsolateral humps, but gnathopod 2 has only 2 palmar processes, 1 of them very thin, and article 2 of gnathopod 2 has a weak, mammilliform anteroventral lobe unlike that of *P. talegus* and the species of Pirlot; coxa 1 is less extended, epimeron 3 short posteriorly, the palm of gnathopod 1 is longer, lacks an anterodistal process on article 2 of gnathopod 2, and the cephalic lobes are sharp.

The Hawaiian specimens of *P. talegus* resemble *Cyrtophium dentatum* Haswell (1880a, p. 342) in dorsal keel. That species has been synonymized with *P. cristatus.* Chilton (1926) has drawings of an identification of *P. cristatus* from New Zealand (type-area) and *P. talegus* differs from those in the absence of a distinction between the thin palmar setae and 5–6 thick spines radiating around the defining corner of gnathopod 1 palm plus slight differences in the shape and arrangement of teeth on the palm of male gnathopod 2; Chilton does not show anterodistal lobes on article 2 of gnathopod 2.

Thomson's (1881) second paper on *Cyrtophium cristatum* has a figure with a dorsal keel similar to several specimens of *P. talegus* with 4 weak dorsal humps, but the eyes of the New Zealand species appear weak, and he mentions 3–4 spines defining the palm of gnathopod 1.

Haswell's (1885) *Dexiocerella dentata* (=*Cyrtophium dentatum* of 1880a) is shown to have uropods 1–2 similar to those of *P. talegus,* but both pairs have a ventral peduncular tooth instead of one as in *P. talegus.* Perhaps, that is an error.

The identity of Haswell's *Dexiocerella laevis* by Walker (1904) (as *Platophium laeve*) seems to fit the Hawaiian species very closely. The palm of gnathopod 2 has no processes but that of young males in *P. talegus* also shows no processes from marginal view, and they might have been overlooked in Walker's material. The fringing palmar setae of Walker's material however, are very short whereas they are long in *P. talegus.* Walker's material has similarities to *P. talegus* in dorsal ornamentation, telson, ocular lobe, gnathopod 1, the small proximal palmar acclivity on gnathopod 2, but coxa 1 is not as strongly extended forward, uropod 3 is less spinose, and the rami of uropods 1–2 are not clearly described as to length.

DISTRIBUTION.—Hawaiian Islands.

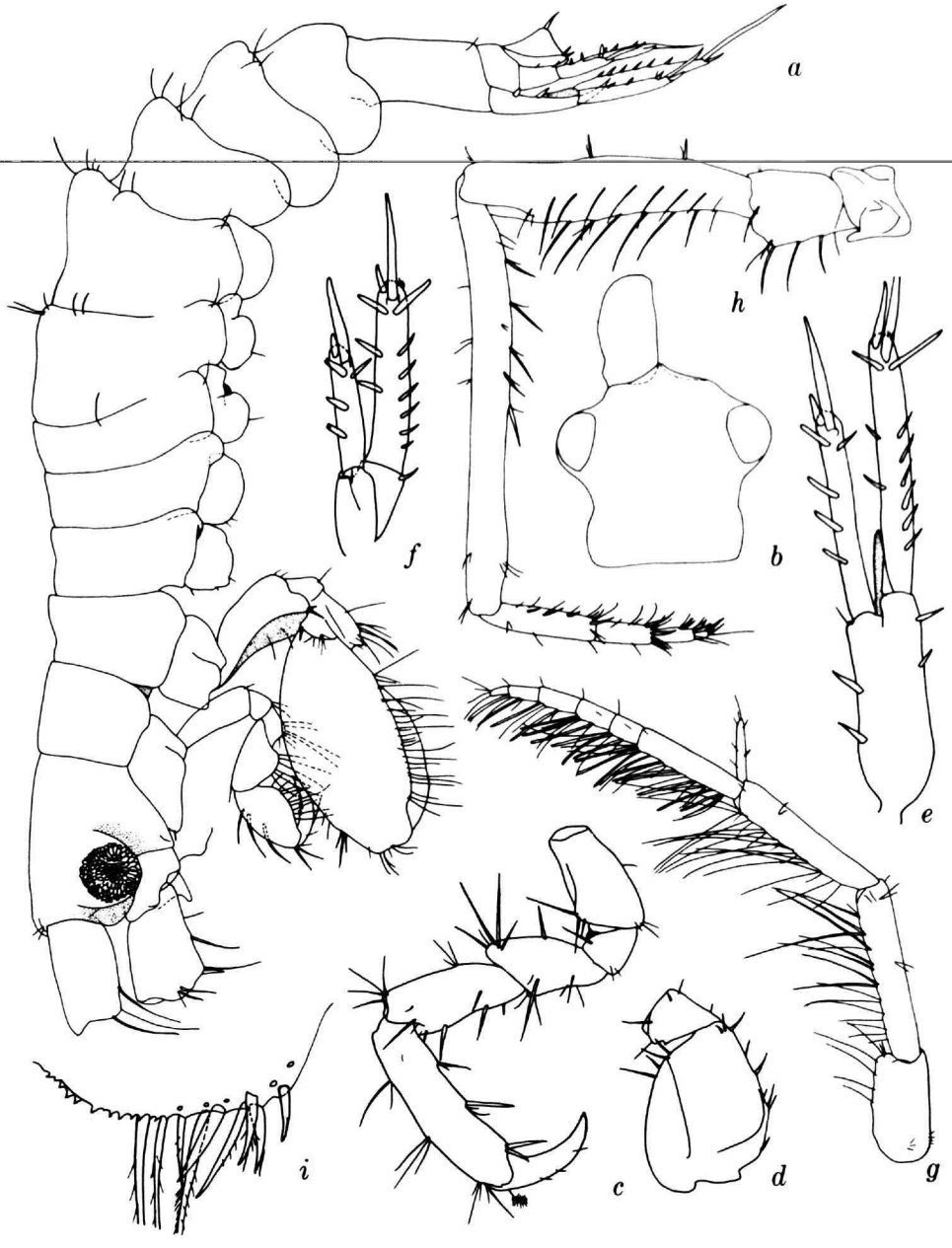

FIGURE 160.—*Podocerus talegus lawai,* new subspecies, holotype, male, 2.6 mm, JLB Hawaii 5: *a,* body; *b,* head, dorsal; *c, d,* pereopods 2, 4, in part. Male, 3.7 mm, Fee 1: *e, f,* uropods 1, 2; *g, h,* antennae 1, 2; *i,* palm of gnathopod 1.

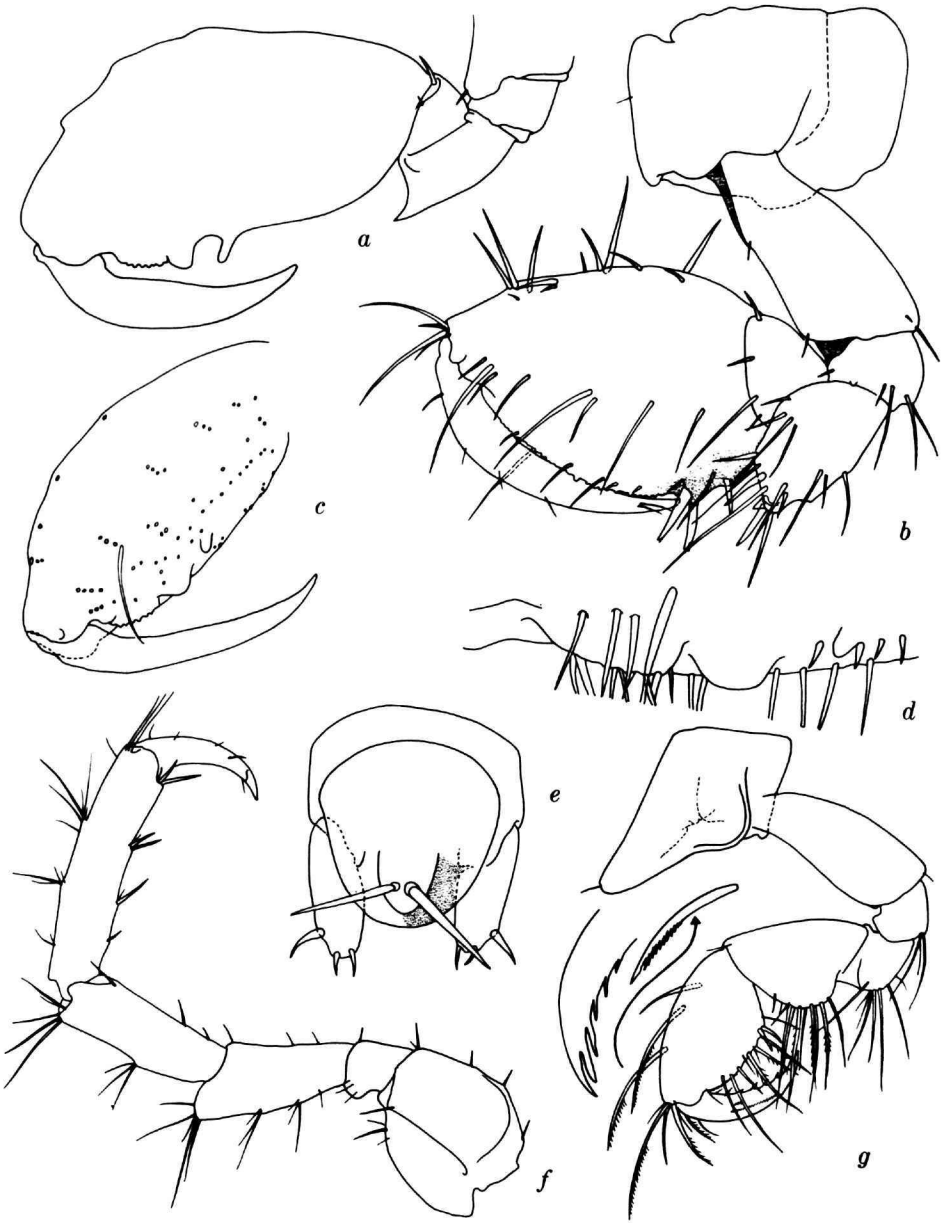

FIGURE 161.—*Podocerus talegus lawai,* new subspecies, male, 3.7 mm, Fee 1: *a,* gnathopod 2, lateral, setae removed. Female, 3.0 mm: *b,* medial gnathopod 2. Holotype, male, 2.6 mm, JLB Hawaii 5: *c,* medial gnathopod 2, setae removed; *d,* palm of gnathopod 2, enlarged; *e,* telson and uropod 3, dorsal; *f,* lateral pereopod 5; *g,* gnathopod 1, with enlarged dactyl and spine offset to left.

Family SEBIDAE

Seba ekepuu, new species

FIGURES 162, 163

DIAGNOSIS.—Anterior coxae evenly rectangular, lacking sharp extensions; gnathopod 1 of the normal chelate form lacking palmar ornaments, posterior margin of article 6 with setose declivity; article 6 of gnathopod 2 much longer than article 5; article 2 of pereopods 3–5 broadly expanded and increasingly so on pereopod 5, latter with smooth posterior margin and long, oblique, sparsely notched posteroventral margin; fourth articles of pereopods 3–5 very slender and weakly produced posterodistally; pleonal epimeron 1 with small sinuosity at posteroventral corner, epimeron 2 with sharp tooth, epimeron 3 with quadrate posteroventral corner; outer ramus of uropods 1 and 2 shorter than inner rami, rami naked; uropod 3 with distal spines on the single ramus; telson short and ovate.

DESCRIPTION.—Eyes apparently absent, but ocular region with subcircular mass of dense granular tissue, similar tissue occurring in other cephalic patches and in article 2 of pereopods 3–5; accessory flagellum long and 2-articulate; antenna 1 with 5 articles, ultimate minute, antenna 2 with 3 flagellar articles; inner ramus of pleopods 2-articulate, outer ramus 3-articulate.

HOLOTYPE.—Bishop Museum collections, catalog number 7301, ?sex, 1.4 mm.

TYPE-LOCALITY.—J. L. Barnard Hawaii 17, Kawela Bay, Oahu, intertidal, *Sargassum*, algae, rocks, corals, 24 May 1967.

MATERIAL.—Two specimens from the type-locality.

RELATIONSHIP.—Relationships among the 7 other species of this unique genus are unclear owing to polymorphism in gnathopod 1 and variation in the extent of flabellation on articles of the pereopods. Several minute characters shown in drawings herein have not been described for all of the species. *Seba ekepuu* appears to have closest affinities with *S. typica* (Chilton, 1884), from New Zealand, but differs in having a narrower article 4 of pereopods 3–5 and a broader and characteristically shaped article 2 of pereopod 5. That shape appears not to occur in any other species of the genus. *Seba antarctica* Walker (1907) and *S. subantarctica* Schellenberg (1931) have, in adult stages, broadly inflated fourth articles of pereopods 3–5, and article 5 of gnathopod 2 is longer than article 6. *Seba saundersi* Stebbing (1888) has an evenly ovate article 2 on pereopod 5, conspicuous marginal spines on the ramus of uropod 3, and a sharp posteroventral extension on coxa 2. *Seba innominata* Bate (1862) has a large tooth on the posteroventral corners of pleonal epimera 1–3. *Seba armata* Chevreux (see Chevreux and Fage, 1925) has an elongate-oval article 2 on pereopod 5 and apparently has urosomites 2 and 3 freely articulate.

Seba dubia Schellenberg (1926) has an ovate article 2 on pereopod 5.

DISTRIBUTION.—Hawaiian Islands.

Family STENOTHOIDAE

Stenothoe haleloke, new species

FIGURE 164

DIAGNOSIS OF FEMALE.—Lateral cephalic lobe broadly truncate, eyes medium in size, red in formaldehyde, clear in alcohol; antennae 1–2 extending equally, peduncles short; article 6 of gnathopod 1 strongly dominating articles 4 and 5 in size, latter with narrow posterior lobe, palm and posterior margin of article 6 equal to each other in length, article 2 thick; article 2 of gnathopod 2 with medial and lateral sharp distal lobes, lobe of article 3 sharp, articles 4–6 of regular form, palm oblique, simple, and equal to posterior margin of article 6, defined by 2 pairs of large spines; locking spines of pereopods 1–5 simple; posterodistal corner of article 2 on pereopod 3 angular, pereopods otherwise of medium stoutness, fourth articles poorly expanded and weakly extended posterodistally; pleonal epimera 1–3 of regular form; urosomite 2 strongly telescoped into urosomite 1; uropod 1 with 2 spines on each ramus, uropod 2 with 1 spine on each ramus; peduncle of uropod 3 shorter than article 1 of ramus, bearing 2 sets of spine(s), article 1 of ramus with 2 sets of spine(s), article 2 of ramus simple, equal in length to article 1; telson with 2 spines on each side.

HOLOTYPE.—Bishop Museum collections, catalog number 7302, female, 2.0 mm. Unique.

TYPE-LOCALITY.—Fee 1, Waikiki Beach, Oahu, intertidal, *Ulva lactuca*, 25 April 1967.

RELATIONSHIP.—The female of this species has its closest known affinities with, but differs from *S. mono-*

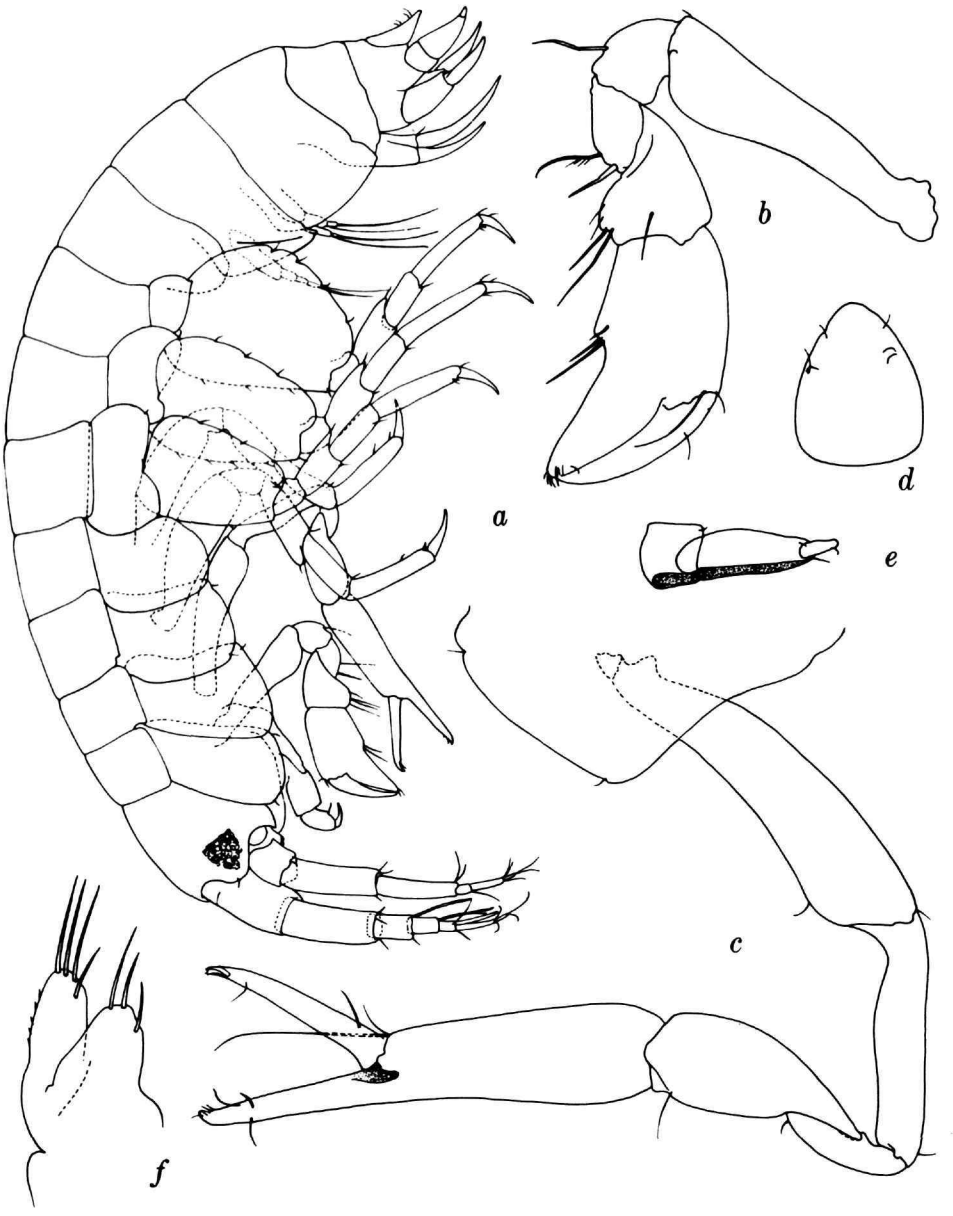

FIGURE 162.—*Seba ekepuu*, new species, holotype, ?sex, 1.4 mm, JLB Hawaii 17: *a*, body; *b*, *c*, gnathopods 1, 2; *d*, telson; *e*, uropod 3, dorsal view, unflattened; *f*, maxilla 2.

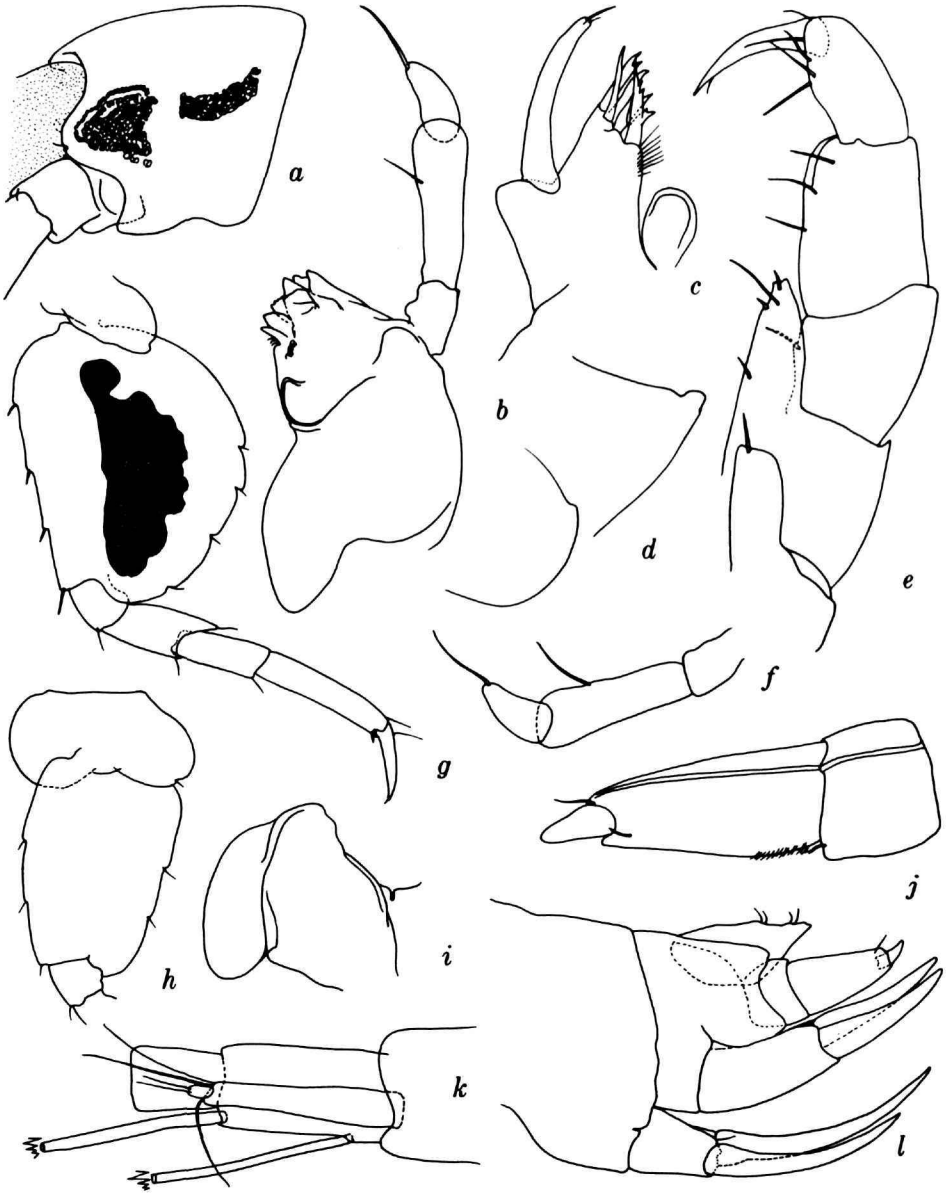

FIGURE 163.—*Seba ekepuu*, new species, holotype, ?sex, 1.4 mm, JLB Hawaii 17: *a*, head, with patches of glandular tissue, no eyes; *b*, mandible; *c*, maxilla 1; *d*, pleonal epimera 1–2; *e*, maxilliped; *f*, mandibular palp; *g*, pereopod 5, with gland; *h*, pereopod 3; *i*, half of lower lip; *j*, uropod 3, dorsal view, unflattened; *k*, accessory flagellum on antenna 1; *l*, lateral view of urosome.

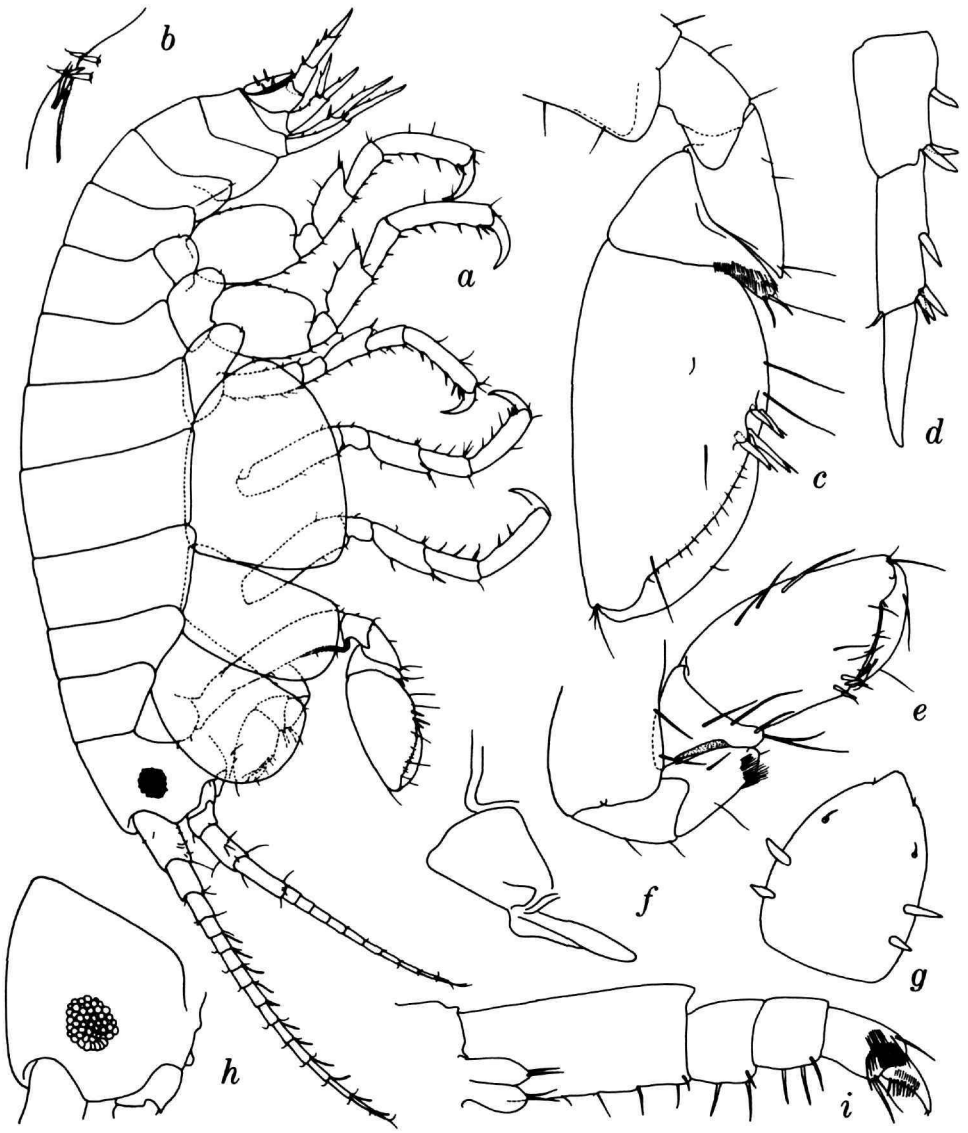

FIGURE 164.—*Stenothoe haleloke*, new species, holotype, female, 2.0 mm, Fee 1: *a*, body; *b*, palmar defining area of gnathopod 1; *c*, medial gnathopod 2; *d*, uropod 3; *e*, medial gnathopod 1; *f*, upper lip and epistome; *g*, telson; *h*, head; *i*, maxilliped.

culoides (Bate) (Sars, 1895, pl. 82, fig. 1), in the truncate cephalic lobe, and the presence of a few spines on the inner ramus of uropod 1, both rami of uropod 2 and on article 1 of the ramus on uropod 3 (the middle segment), and on the telson.

The sympatriot *S. gallensis* Walker (J. L. Barnard, 1955a) differs in its female from *S. haleloke* in the longer peduncle of uropod 3, the weak gnathopod 1 with thin article 2, and the relatively large size of article 4 compared with article 6 and in the smallness of the lobe on article 5. Male *S. gallensis* has a distinctive gnathopod 2 and uropod 3, but male *S. haleloke* is unknown.

DISTRIBUTION.—Hawaiian Islands.

Stenothoe ?valida Dana

FIGURE 165

?Stenothoe validus Dana, 1853, pp. 924–925, pl. 63, figs. 1 a-o.

?Stenothoe valida.—Stebbing, 1906, p. 194.—J. L. Barnard, 1953, pp. 83–87 [with synonymy].

MATERIAL.—Devaney 1 (84).

REMARKS.—These specimens differ from J. L. Barnard's (1953) representation of the species from California in the much more slender article 4 of pereopods 3–5 in both sexes. Female palms of gnathopod 2 are short and have defining spines like those of *S. gallensis*, but a terminal female may not be present in these collections.

In Hawaii, *S. gallensis* Walker (J. L. Barnard, 1955a) differs from *S. valida* and extrinsic populations of *S. gallensis* (like *S. crenulata* Chevreux, 1908) in the nonexcavate posteroventral margin of coxa 2 in both sexes, a condition occurring in *S. valida* of Hawaii and California. It thus appears that neither species is

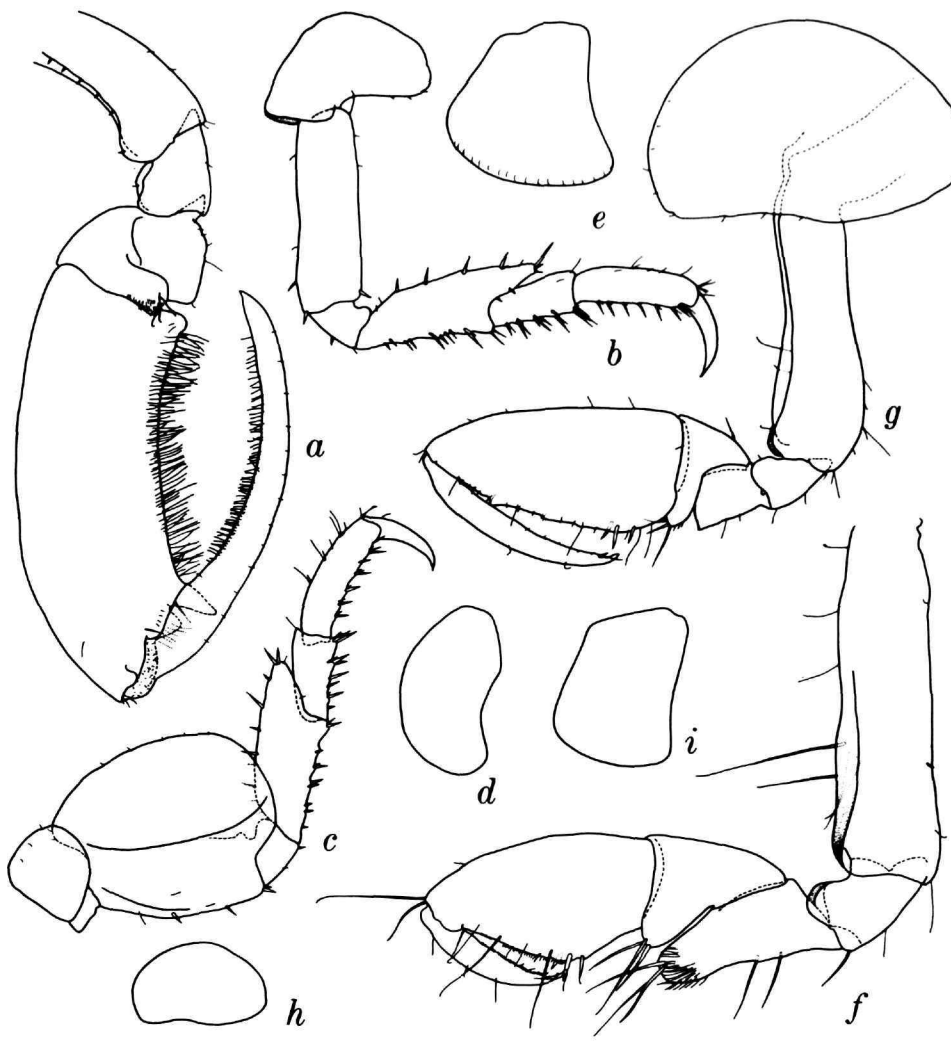

FIGURE 165.—*Stenothoe valida* Dana, male, 4.2 mm, Devaney 1: *a*, medial gnathopod 2; *b*, *c*, pereopods 3, 5; *d*, *e*, coxae 2, 3. Female, 2.8 mm: *f*, *g*, lateral gnathopods 1, 2; *h*, *i*, coxae 2 (sideways), 3.

of typical condition in Hawaiian waters, *S. gallensis* differing in coxa 2 and *S. valida* differing in article 4 of pereopods. Males of *S. gallensis* continue to exhibit the rugose apex of uropod 3 and even projectings of the bifid tooth on gnathopod 2 and males of *S. valida* continue to exhibit a simple apex of uropod 3 and uneven projections of the bifid tooth on gnathopod 2.

DISTRIBUTION.—Cosmopolitan in low latitudes.

Stenothoe species A

FIGURE 166*a-i*

DESCRIPTION.—Lateral cephalic lobe rounded, eyes large; antennae extending equally, article 3 of antenna 1 as long as article 2; mouthparts and pereopods of form in genus *Stenothoe;* article 5 of gnathopod 1 scarcely lobate, palm oblique, longer than posterior margin of article 6, minutely crenulate, defined by long spine and short spine, dactyl fitting palm and with accessory tooth on inner margin, gnathopod 2 of juvenile condition, palm with small cusp in middle; dactyls of pereopods 1–5 with accessory claw, sixth articles stout and almost prehensile; rami of uropods 1–2 naked, outer ramus of uropod 2 slightly shorter than inner ramus, inner ramus exceeding uropod 3; peduncle of uropod 3 with 1 spine, ramus slightly longer than peduncle, articles 1 and 2 equal in length, naked; telson naked.

MATERIAL.—JLB Hawaii 3 (1 juvenile, less than 1.0 mm long).

REMARKS.—The form of articles 6 and 7 on pereopods 1–5 distinguish this species from other Hawaiian stenothoids.

Stenothoe species B

FIGURE 166*j*

DESCRIPTION.—Lateral cephalic margins broadly rounded, scarcely extended forward, eyes large; mouthparts and pereopods in form of genus *Stenothoe;* gnathopod 1 like *Stenothoe* species A, but palm slightly shorter and less oblique and defined by 1 spine, palm bearing 1 other lateral spine adjacent to defining spine and 3 medial spines, all evenly spaced for about half of palm length (proximal end), dactylar accessory tooth smaller than in *Stenothoe* species A; gnathopod 2 also like that of species A, thus juveniliform, defining spine of palm short, middle cusp obsolescent; pereopods 1–5 lacking spines, of normal slenderness, dactyls simple, fourth articles slender and produced one-fourth to one-third along article 5 on pereopods 3–5; expansion of article 2 on pereopods 4–5 narrow for genus (see figure), of equal form on both pairs of pereopods, posteroventral lobe obsolescent; rami of uropod 1 extending equally, outer ramus with 2 spines, inner with 1; outer ramus of uropod 2 about two-thirds as long as inner ramus, latter reaching end of uropod 3, inner ramus with 2 spines, outer with 1; uropod 3 long and slender, lacking spines, peduncle, articles 1 and 2 of ramus all equal in length to each other; telson lacking lateral spines.

MATERIAL.—JLB Hawaii 10 (3 specimens, largest 1.4 mm).

REMARKS.—The spineless pereopods with simple dactyls and relatively narrow article 2 of pereopods 4–5 distinguish this species in Hawaii. Juveniles of *S. gallensis* and *S. valida* have a few spines on the pereopods.

Superfamily TALITROIDEA

Hyale affinis Chevreux

FIGURE 167*e-h*

Hyale affinis Chevreux, 1908, pp. 503–506, figs. 21–22.—Schellenberg, 1938, pp. 67–68.—J. L. Barnard, 1955a, p. 14 (in part, not fig. 6).

DESCRIPTION.—Following characters and parts as illustrated for *H. laie,* new species: female gnathopods 1 and 2, male and female head, eye shape, pereopods 1, 2, 3, 4, uropods 1, 2, 3, urosome, telson.

Characters differing from *H. laie* slightly: eyes paler purple, aesthetascs on antenna 1 shorter, flagellum of antenna 2 slightly longer, coxae 1–4 with posterior acclivity sharper and nearer ventral margin; articles 4–6 of pereopod 5 slightly stouter; pleonal epimera 2–3 slightly sharper.

DIFFERENTIAL CHARACTERS (male).—Hand and palm of gnathopod 1 slightly expanded, dactyl not reaching full length of palm but reaching spine near softly rounded defining corner armed with several short setae, not bulging or cuspidate, palm otherwise setose; gnathopod 2 with palm more than twice as long as free posterior margin of hand, oblique and slightly convex, defined by 2 spines, overall palm recessed deeply from posterior defining bulge, densely spinose.

MATERIAL.—JLB Hawaii 17 (5). Poipu Beach, Kauai, 17 September 1959, collector H. Caspers (50+).

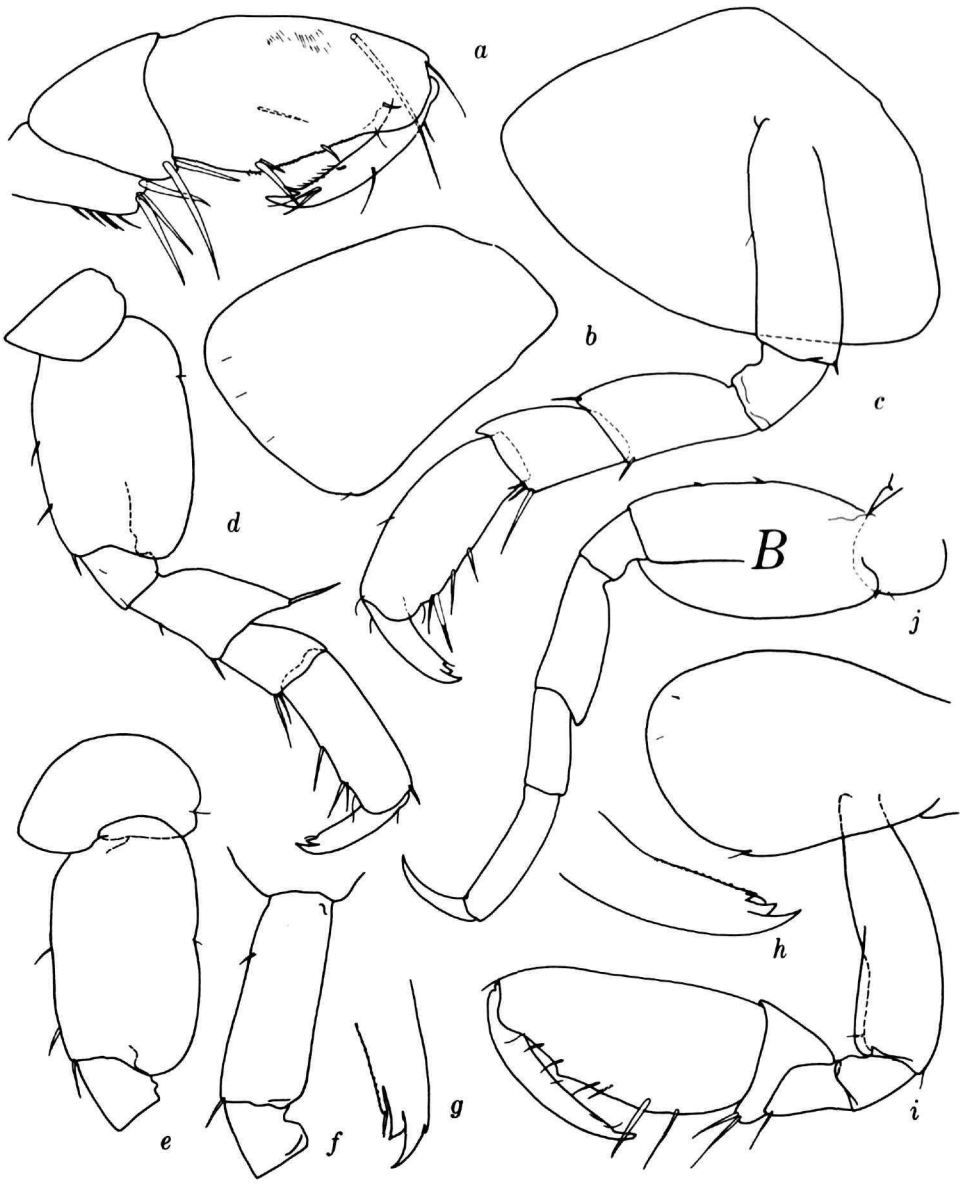

FIGURE 166.—*Stenothoe* species A and B. Figures *a–i*, *Stenothoe* species A, juvenile, 1.0 mm, JLB Hawaii 3: *a*, apex of gnathopod 1; b, coxa 3; *c*, *d*, *e*, *f*, pereopods 2, 5, 4, 3; *g*, *h*, apices of dactyls on pereopods 2, 1; *i*, gnathopod 2. *Stenothoe* species B, female, 1.4 mm, JLB Hawaii 10: *j*, pereopod 5.

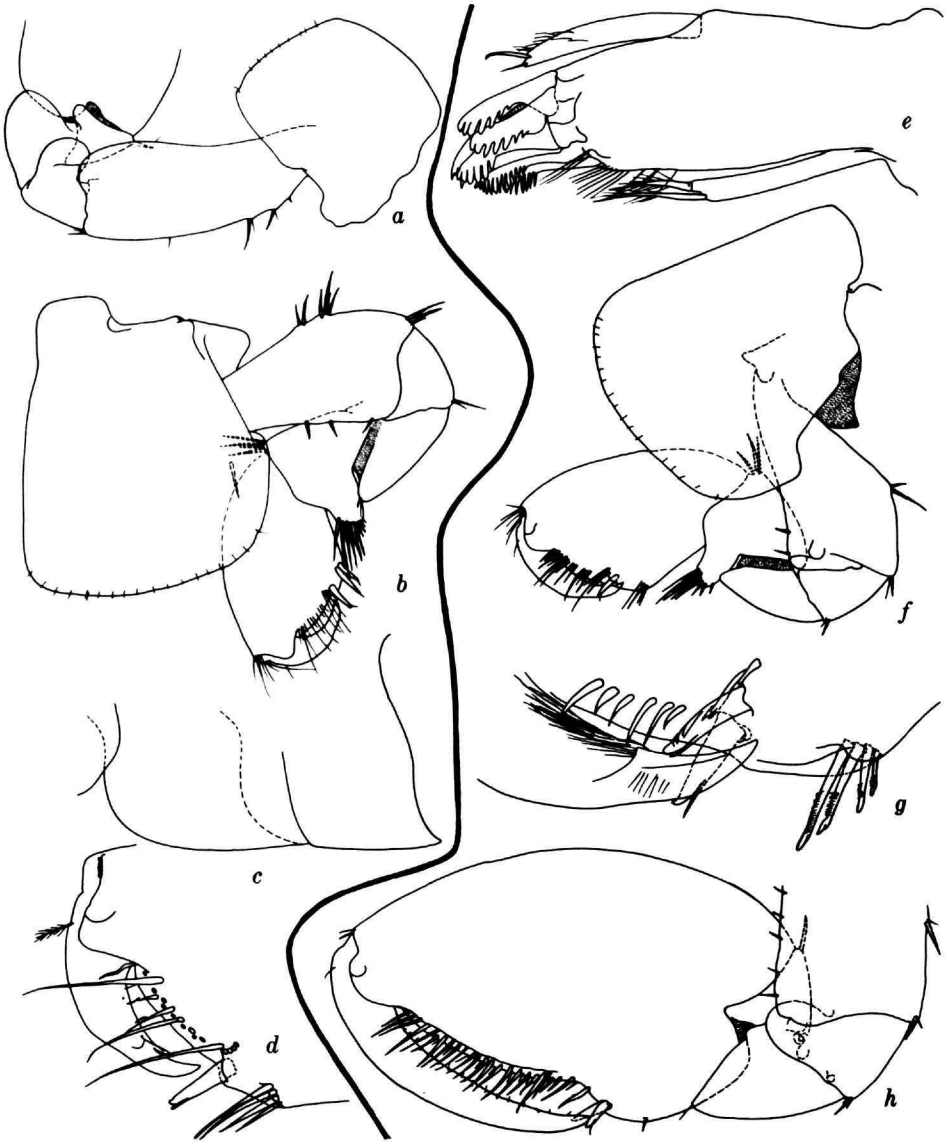

FIGURE 167.—*Hyale honoluluensis* Schellenberg and *Hyale affinis* Chevreux. *H.h.*, male, 6.4 mm, Fee 1: *a*, articles 1–4 of lateral gnathopod 2; *b*, gnathopod 1; *c*, pleonal epimera 1–3; *d*, palm of gnathopod 1. *H. a.*, female, 4.9 mm, Jarvis Island: *e*, maxilla 1. Male, 6.6 mm, JLB Hawaii 17: *f*, *g*, gnathopod 1; *h*, lateral gnathopod 2.

REMARKS.—The Oahuan population of this species resembles that described by Schellenberg from Laysan Island, but the rami of uropod 1 extend equally, the ramus of uropod 3 is equal to the peduncle, and the palm of male gnathopod 1 is without a defining bulge.

The Hawaiian population (of the high islands) thus differs from that of the Gambier Archipelago in the softly rounded, unbulging defining corner of male gnathopod 1 palm, the strongly defined acclivities on the anterior coxae, the presence of a pair of posterior setae on the hands of the female gnathopods, and the longer palm of male gnathopod 2.

Male *H. affinis* in Hawaii differs from young males of *H. honoluluensis* Schellenberg in the dactyl of gnathopod 1 overlapping the palmar spine and the presence of a small spine on the posterior margin of the hand of gnathopod 2, proximal to the palm. Females differ in gross characters only in the coxal acclivities of *H. affinis* being nearer the ventral margins than in *H. honolulensis*.

Figure 6 of Barnard (1955a) is erroneous, representing actually female gnathopods of *H. bishopae* J. L. Barnard.

DISTRIBUTION.—Tropical Pacific.

Hyale ayeli J. L. Barnard

FIGURES 168, 169

DIAGNOSIS OF MALE.—Lateral cephalic lobes broadly truncate, anteroventral cephalic excavation shallow but asymmetrically indented, anteroventral corner of head rounded; eyes large, subcircular, black cores in alcohol; antennae of medium length, antenna 1 reaching more than halfway along antenna 2, flagellum with numerous aesthetascs, peduncle of antenna 2 of medium length, thick, and bearing a few medioposterior setular brushes, flagellum of medium thickness and bearing weak brushes; coxa 1 of normal breadth, scarcely extended forward, coxae 1–4 with slightly attenuate but strong, rounded acclivities, coxa 4 with simple excavation; article 2 of gnathopod 1 unproduced anterodistally, article 4 with medium distal extension, lobe on article 5 broad, article 6 evenly rectangular but not thin, palm oblique, defined by pair of spines and about one-half of posterior margin of hand armed with short setae, dactyl fitting palm; article 2 of gnathopod 2 with broad anterodistal lobe, article 3 with broad anterior lobe, article 4 weakly extended, article 5 immersed posteriorly, hand very large, palm oblique, spinose, and simple in young males but progressively marked with strong, distal, quadrate protrusion, palm about as long as posterior margin of hand, defined by weak hump and pair of small spines, dactyl fitting palm; pereopods 1–2 with one large striate distal locking spine partially hidden by a few setae, one of which strongly hooked, next proximal armament composed of 2 slender setae and 1 slightly thickened spine-seta scarcely one-fourth as wide as main spine; pereopods 3–5 with distal locking spine small and slightly striate spirally, next spine in tandem much larger and more heavily striate, almost forming screw, next proximal spines forming pair of small unstriate members; dactyls of pereopods 1–5 slightly striate, bearing weak distal setule and facial setule; article 6 of pereopods 3–5 lacking posterior spines or setae; pleonal epimeron 1 rounded posteroventrally, epimera 2–3 slightly sinuous posteriorly and with strong blunt posteroventral protrusion; uropod 1 with large distolateral spine on peduncle, outer rami of uropods 1–2 without dorsal spines, uropod 3 with peduncle and ramus of medium breadth and spinose apex.

FEMALE.—Gnathopod 1 like that of male, but gnathopod 2 with narrower lobe on article 5 and slightly bulging posterior margin of hand.

JUVENILE.—Gnathopods 1–2 like adults of *H. laie*, thus with only 2–3 posterior setae on hands.

MATERIAL.—The original material, especially the lot from Hanauma Bay, Oahu (36).

REMARKS.—Ruffo (1956) considered *Hyale ayeli* to be a synonym of *H. media* (Dana) in view of Hurley (1957) and Stephensen (1949) reporting specimens with setular brushes on antenna 2, but the following characters of the Hawaiian specimens differ from those described by Hurley from New Zealand: (1) the palm of gnathopod 2 has a strong protrusion in adult and subadult males; (2) the posteroventral corner of article 2 on pereopod 5 is rounded; (3) uropod 1 has a strong distolateral spine on the peduncle (not present in *H. media*); (4) uropods 1–2 lack dorsal spines on the outer rami; (5) the posterior setae on gnathopod 1 of both sexes and gnathopod 2 of the female are more broadly spread than in *H. media*.

Hyale grandicornis (Krøyer)

Hyale grandicornis Krøyer.—Hurley, 1957, pp. 904–907, figs. 1–23 [with references] [not forma *thomsoni*].

Hyale novaezealandiae Thomson.—Iwasa, 1939, pp. 276–278, fig. 16, pl. 16.

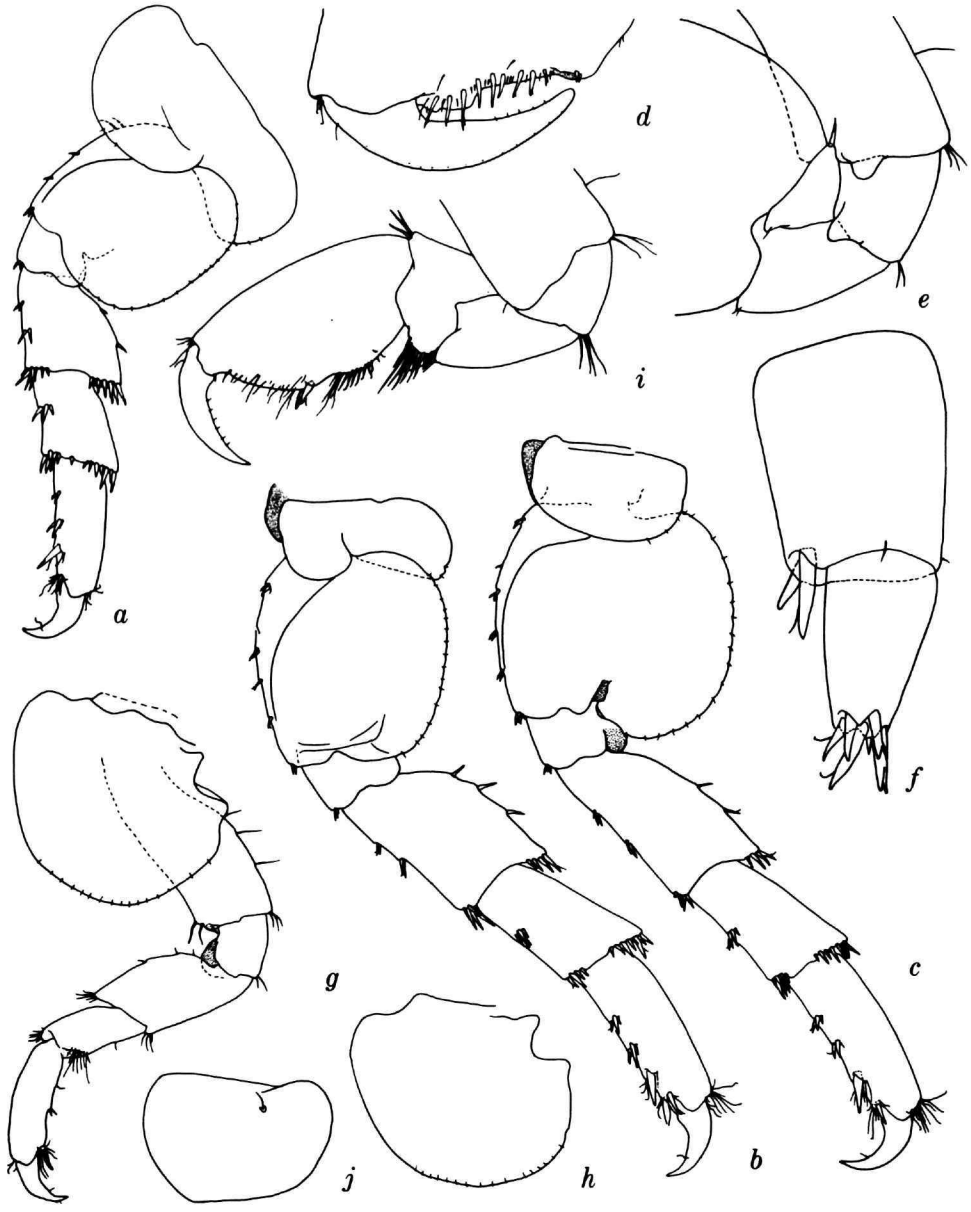

FIGURE 168.—*Hyale ayeli* J. L. Barnard, male, 8.0 mm, Hanauma Bay, 24 November 1951: *a, b, c,* pereopods 3, 4, 5; *d, e,* medial gnathopod 2; *f,* uropod 3; *g,* pereopod 2; *h,* coxa 3. Female, 7.0 mm: *i,* lateral gnathopod 1; *j,* left side of telson from lateral view.

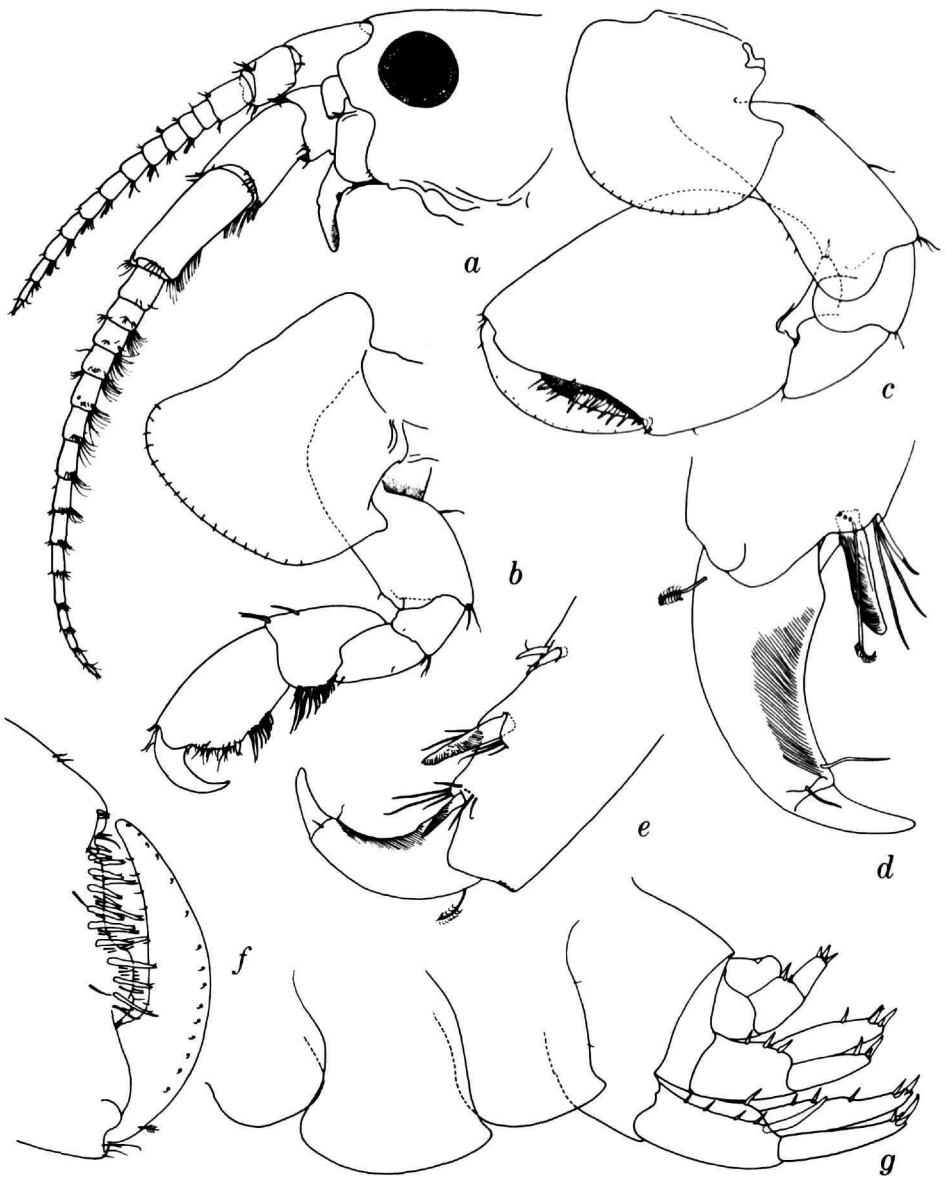

FIGURE 169.—*Hyale ayeli* J. L. Barnard, male, 8.0 mm, Hanauma Bay, 24 November 1951: *a*, head; *b*, *c*, gnathopods 1, 2; *d*, *e*, dactyls of pereopods 2, 5; *f*, palm of medial gnathopod 2; *g*, pleon.

Hyale grandicornis bishopae J. L. Barnard, new combination

FIGURE 170

Hyale bishopae J. L. Barnard, 1955a, pp. 16–17, fig. 8.

DIAGNOSIS OF MALE.—Lateral cephalic lobes broadly truncate, anteroventral cephalic excavation shallow and flat, anteroventral corner of head rounded-quadrate; eyes large, subovate, with black-brown-purple cores; antennae short, antenna 1 reaching about halfway along antenna 2, flagellum with numerous aesthetascs, peduncle of antenna 2 of medium length, flagellum thick and bearing few setules; coxa 1 extraordinarily broad, slightly extended forward, coxae 1–4 with strong cuspidiform posterior acclivities, coxa 4 with simple excavation; article 2 of gnathopod 1 unproduced anterodistally, article 4 with weak posterodistal process, lobe of article 5 of medium breadth, article 6 evenly rectangular, palm oblique, defined by pair of spines and about one-fourth of posterior margin of hand armed with short setae, dactyl fitting palm; article 2 of gnathopod 2 with weak anterodistal lobe, article 3 with distinct but small tumid lobe, article 4 weakly extended, article 5 immersed posteriorly, hand very large, palm oblique and simple, spinose, slightly longer than free posterior margin of hand, defined by two enlarged spines, posterior margin with several distal setules, dactyl weakly curved, fitting palm; pereopods 1–2 with pair of small, distal, straight, unstriate spines in tandem; pereopods 3–5 with straight distal locking spine enlarged and slightly striate axially, in tandem with smaller spine; dactyls of pereopods 1–5 slightly striate distalward, bearing large, stiff, spirally striate setule in middle, dactyl with one facial setule; article 6 of pereopods 3–5 lacking posterior setae or spines; pleonal epimeron 1 rounded-quadrate posteroventrally, bearing 2 weak notches, epimeron 2 concave posteriorly and bearing rounded posteroventral protrusion, epimeron 3 convex posteriorly and bearing smaller protrusion than epimeron 2; uropod 1 with medium-sized mediodistal spine on peduncle, rami of uropods 1–2 spinose, uropod 3 with broad peduncle not especially short, ramus slender, with narrow oblique spinose apex and one dorsal, subterminal, discontiguous spine seen from lateral view; telson with quadrate lobes.

FEMALE.—Gnathopod 1 like that of male, but gnathopod 2 like that of female *H. iole,* new species.

MATERIAL.—The type material: Hanauma Bay, Oahu, 24 November 1951, algae, collector Donald Bates (6 specimens, holotype not seen again).

REMARKS.—This species differs from *H. iole,* new species, in the broader, shorter coxa 1, the shorter article 5 of gnathopod 1, and larger hand with fewer posterior setae, in the distinct tumid lobe of article 3 on male gnathopod 2, in the smallness of the distal locking spine on pereopods 1–2 and the presence of a second spine in tandem, in the spiral striations of the dactylar seta, in the smallness of the mediodistal spine on the peduncle of uropod 1, in the disjunct ramal spine on uropod 3 (seen from lateral view), in the more strongly rounded epimeron 1 with small notches bearing setules, and in the absence of heavy brushes of setules on antenna 2.

Hyale bishopae seems to fall into the *H. grandicornis* complex represented by populations from New Zealand, South Africa, and Japan. The characters uniting these widespread populations are especially: (1) a large dactylar seta on pereopods 1–5; (2) a disjunct subterminal spine on the ramus of uropod 3; (3) a small or medium-sized straight distal locking spine on pereopods 1–5 with another spine proximal to it; (4) the dominant spine on the peduncle of uropod 1 is mediodistal and scarcely enlarged; (5) coxae 1–4 have a strongly attenuate posterior acclivity; (6) hands of male and female gnathopod 1 and female gnathopod 2 have a narrowly spread clump of several setae on the posterior margin.

Tiny pectinations seen on the dactyl of pereopods 1–5 in New Zealand and Japanese individuals are not present in Hawaiian specimens; uropod 3 is thin like that on New Zealand but not on Japanese specimens. The latter population has a pyriform article 6 on male gnathopod 2. The dactylar seta on pereopods 1–5 of *H. g. bishopae* has spiral striations not mentioned for the other members of the complex.

DISTRIBUTION.—Hawaiian Islands.

Hyale honoluluensis Schellenberg

FIGURES 167*a-d,* 171

Hyale honoluluensis Schellenberg, 1938, pp. 69–71, figs. 35b, c.—J. L. Barnard, 1955a, p. 18; 1965a, p. 520, figs. 22, 23.

DESCRIPTION.—Following characters and parts as illustrated for *H. laie,* new species: Female gnathopods

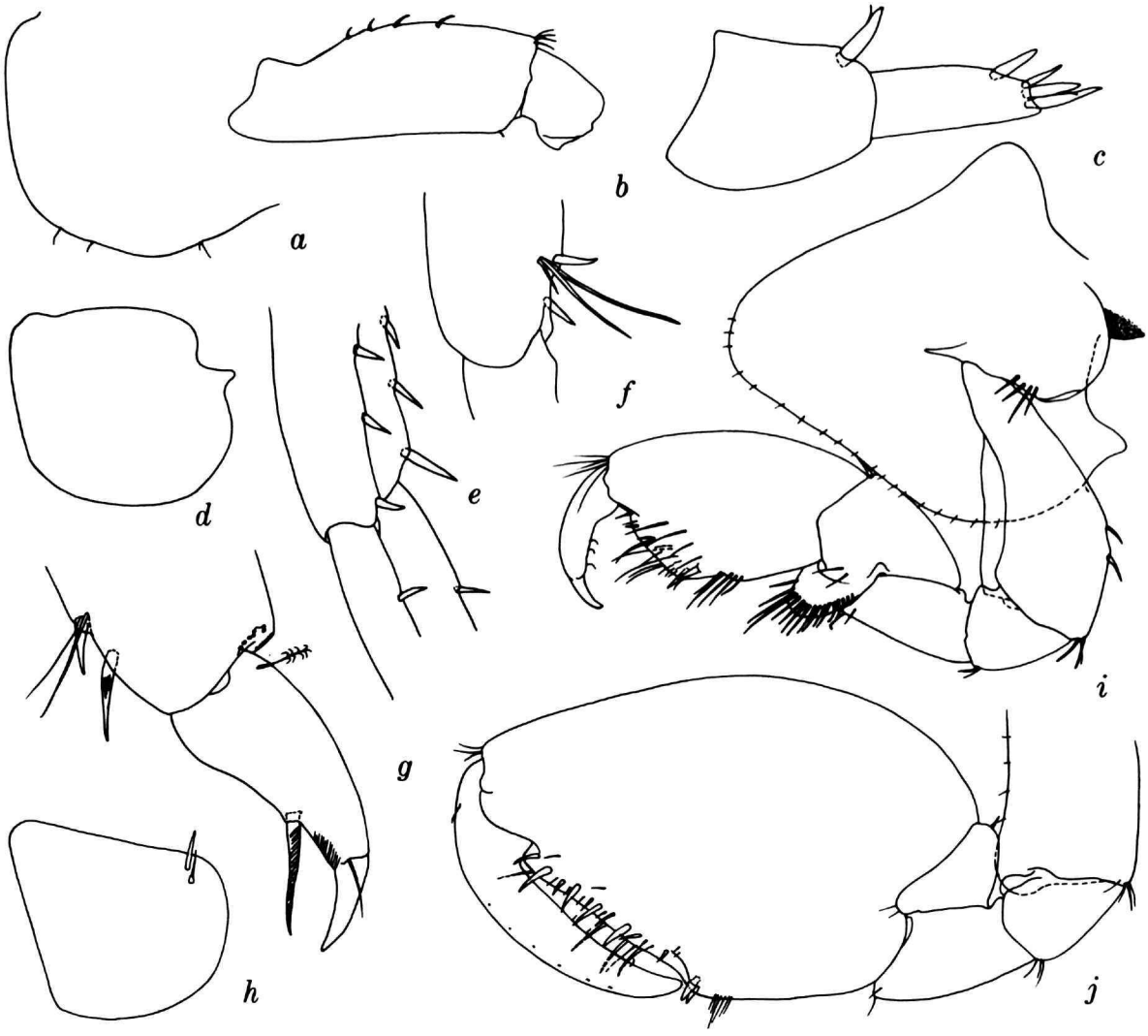

FIGURE 170.—*Hyale grandicornis bishopae* J. L. Barnard, male, 6.9 mm, Hanauma Bay, 1951: *a*, pleonal epimeron 1 (tilted); *b*, articles 2–3 of pereopod 1; *c*, uropod 3; *d*, coxa 4; *e*, uropod 1; *f*, locking spines of pereopod 2; *g*, dactyl of pereopod 4; *h*, left lateral side of telson; *i*, *j*, medial gnathopods 1, 2.

1 and 2, eye shape, pereopods 1–5, uropods 1, 2, 3, urosome, telson, coxae 1–4, but coxa 1 not as strongly extended forward.

Characters differing from *H. laie* slightly: articles 2–3 of antenna 1 equal in length to each other, female coxa 2 slightly longer.

DIFFERENTIAL CHARACTERS.—Hand and palm of gnathopod 1 slightly expanded, dactyl not reaching full length of palm and not reaching spine near softly rounded corner bearing 2 stout spines, margin near spine slightly bulging, palm otherwise setose; gnathopod 2 of terminal male with palm occupying entire posterior margin of hand, dactyl overlapping free palmar margin, younger male with shorter palm defined by two spines but not deeply recessed and lacking posterior spinule seen in *H. affinis;* presumed juvenile male with short oblique palm defined by 2 spines, palm shorter than posterior margin of hand, latter with 1

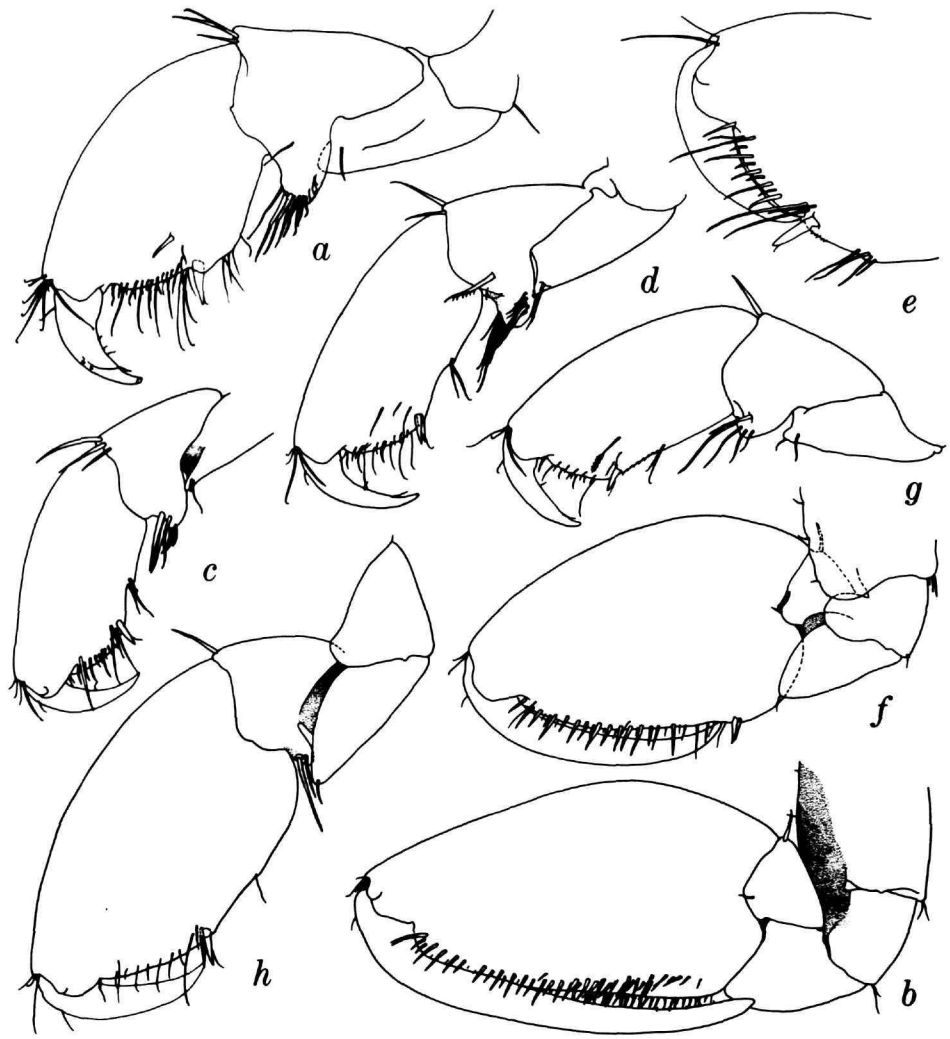

FIGURE 171.—*Hyale honoluluensis* Schellenberg, male, 6.4 mm, Fee 1: *a, b,* medial gnathopods 1, 2. Female, 4.8 mm: *c, d,* medial gnathopods 1, 2. Juvenile, 5.2 mm: *e,* palm of gnathopod 1; *f,* lateral gnathopod 2. Juvenile, 3.5 mm: *g,* medial gnathopod 1; *h,* lateral gnathopod 2.

setule (thus juvenile male possibly that of *H. affinis* and not *H. honoluluensis*).

Eyes ruby or garnet in formaldehyde but rapidly turning dark purple in formaldehyde or alcohol.

MATERIAL.—JLB Hawaii 12 (2). Fee 1 (51). Canton Island, February 1958, collector Drs. Degener (100+). French Frigate Shoals, Tern Island, 13 August 1959, collector H. Caspers (25).

REMARKS.—Probably *H. honoluluensis* should be reduced to a subspecies of *H. chevreuxi* K. H. Barnard (see J. L. Barnard, 1965a, for references). Specimens from Canton Island, a member of the Phoenix Islands and thus close to the Gilberts from which Schellenberg reported *H. chevreuxi,* have the palm of male gnathopod 2 as in *H. honoluluensis,* and suggest possibly that a cline exists between the original material of *H. chevreuxi* from the Seychelles and the eastern populations. Barnard (1965a) also identified *H. honoluluensis* from the Marshall Islands.

DISTRIBUTION.—Hawaiian, Phoenix, and Marshall Islands.

Hyale iole, new species

FIGURE 172

DIAGNOSIS OF MALE.—Lateral cephalic lobes broadly truncate, anteroventral cephalic excavation shallow and flat, anteroventral corner of head rounded-quadrate; eyes large, subcircular, with black-brown-purple cores; antennae of medium length, antenna 1 reaching halfway along antenna 2, flagellum with few aesthetascs, peduncle of antenna 2 of medium length, both peduncle and flagellum base with dense brushes of setules; coxa 1 broad, slightly extended forward, coxae 1–4 with strong posterior acclivity projecting as tooth, coxa 4 with simple excavation; article 2 of gnathopod 1 with slight, subterminal, quadrate extension on anterodistal margin, article 4 with strong posterodistal process, lobe of article 5 of medium breadth, article 6 evenly rectangular, palm slightly oblique, defined by pair of spines and about half of posterior margin of hand armed with short setae, dactyl fitting palm; article 2 of gnathopod 2 with slightly bilobate, strong anterodistal protuberance, article 3 unlobate, article 4 weakly extended, article 5 immersed posteriorly, hand very large, palm oblique and simple, spinose, slightly longer than free posterior margin of hand, defined by two slightly enlarged spines, posterior margin with 2 distal setules, dactyl curved, fitting palm; pereopods 1–2 with 1 small, nearly straight distal locking spine, slightly striate axially; pereopods 3–5 with distal locking spine similar and slightly larger than next proximal spine; dactyls of pereopods 1–5 slightly castellate in middle and bearing very large stiff seta in middle, seta slightly striate axially, dactyl with one facial setule; article 6 of pereopods 3–5 lacking posterior setae or spines; pleonal epimeron 1 rounded-quadrate posteroventrally, epimeron 2 concave posteriorly and bearing rounded posteroventral protrusion, epimeron 3 convex posteriorly and bearing smaller protrusion than epimeron 2; uropod 1 with large mediodistal spine on peduncle, rami of uropods 1–2 spinose, uropod 3 with especially short broad peduncle, ramus with oblique, spinose distal margin, no discontiguous spine from lateral view; telson normal.

FEMALE.—Article 2 of gnathopods 1–2 with rounded or subquadrate anterodistal lobe, gnathopod 1 otherwise like that of male; gnathopod 2 stouter than gnathopod 1, article 4 like that on gnathopod 2 of male, article 4 with narrow lobe, article 6 stouter than in gnathopod 1, palm more oblique, and short posterior setae extending only about one-third of hand length.

HOLOTYPE.—Bishop Museum collections, catalog number 7303, male, 11.3 mm.

TYPE-LOCALITY.—Kahalui Harbor, Maui, 28 May 1953.

MATERIAL.—Thirty-three specimens from the type-locality.

REMARKS.—This species has a superficial resemblance to *H. ayeli*, but differs in numerous characters, including: (1) narrower lobes on article 5 of gnathopod 1 in both sexes and gnathopod 2 in the female; (2) the shorter, broader peduncle of uropod 3; (3) the presence of spines on both rami of uropods 1–2; (4) the shift of the major peduncular spine on uropod 1 from lateral to medial side; (5) the broader hand and thinner dactyl of male gnathopod 2, plus the presence of distinct, though small defining spines on the palm; (6) the presence of a large, dominant dactylar seta on the pereopods; (7) the slightly stronger coxal cusps.

Hyale iole has affinities with *H. grandicornis bishopae* from Hawaii, but the former differs from the latter in the larger mediodistal spine on the peduncle of uropod 1, the absence of a disjunct spine on the ramus of uropod 3, the slightly castellate dactyls of pereopods 1–5, the stout uropod 3, the antennal brushes and the longer row of posterior setae on the hands of gnathopods 1 and 2.

The strong brushes of setules on antenna 2 resemble those on *Hyale plumulosus* (Stimpson) from cool-water North America. Presumed specimens of that poorly known species from Point Richmond, Contra Costa County, California, differ from *H. iole* in the presence of a distinct point and notch on pleonal epimeron 1, in a slightly more extended posteroventral corner on epimeron 2, the absence of black pigment in the eyes, more attenuate and sharper coxal acclivities, and the blunt, unextended article 4 on male gnathopod 1. Fully adult male gnathopod 2 of *H. plumulosus* has not been observed in this comparison.

DISTRIBUTION.—Hawaiian Islands.

Hyale laie, new species

FIGURES 173, 174

DIAGNOSIS OF MALE.—Lateral cephalic lobes broadly truncate, anteroventral cephalic excavation shallow and flat, anteroventral corner rounded-quadrate; eyes

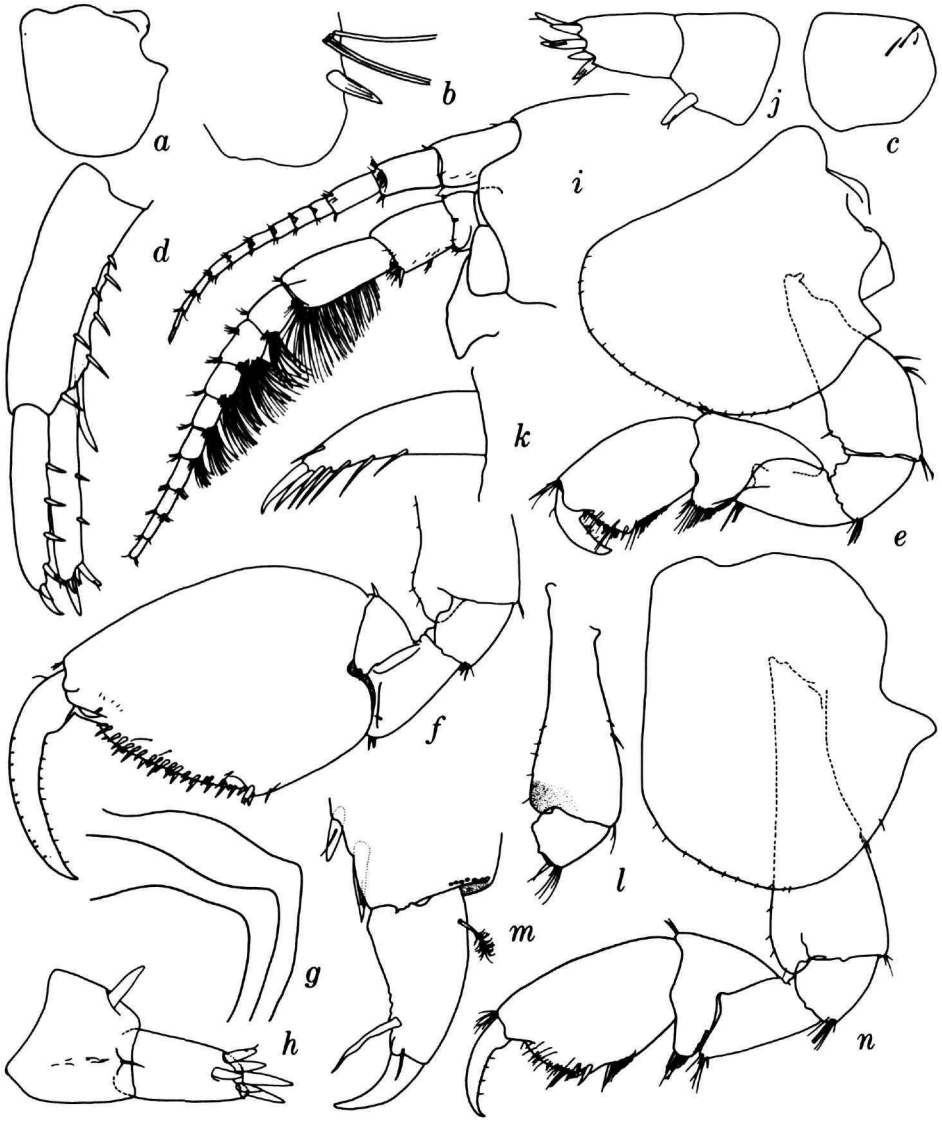

FIGURE 172.—*Hyale iole*, new species, holotype, male, 11.3 mm, Kahului Harbor, Maui: *a*, coxa 4; *b*, locking spine of pereopod 1; *c*, half of telson, right side, lateral; *d*, uropod 1; *e*, *f*, gnathopods 1, 2; *g*, pleonal epimera 1–3; *h*, uropod 3. Female, 10.4 mm: *i*, head and antennae; *j*, uropod 3; *k*, palp article 4 of maxilliped; *l*, articles 2–3 of gnathopod 1; *m*, dactyl of pereopod 5; *n*, gnathopod 2.

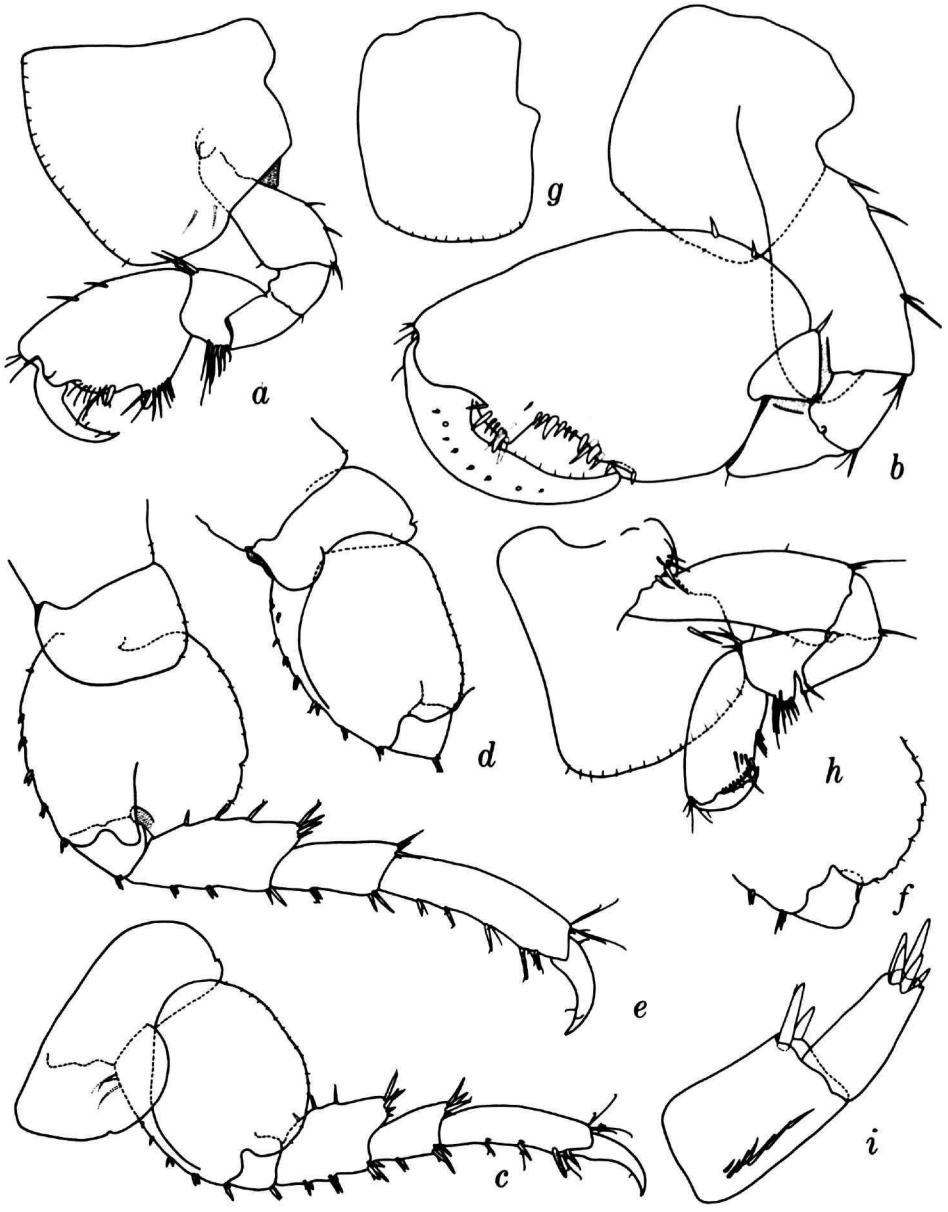

FIGURE 173.—*Hyale laie*, new species, holotype, male, 4.2 mm, JLB Hawaii 14: *a*, *b*, gnathopods 1, 2; *c*, *d*, *e*, pereopods 3, 4, 5; *f*, part of pereopod 5, medial view. Female, 5.6 mm: *g*, coxa 3; *h*, gnathopod 1; *i*, uropod 3.

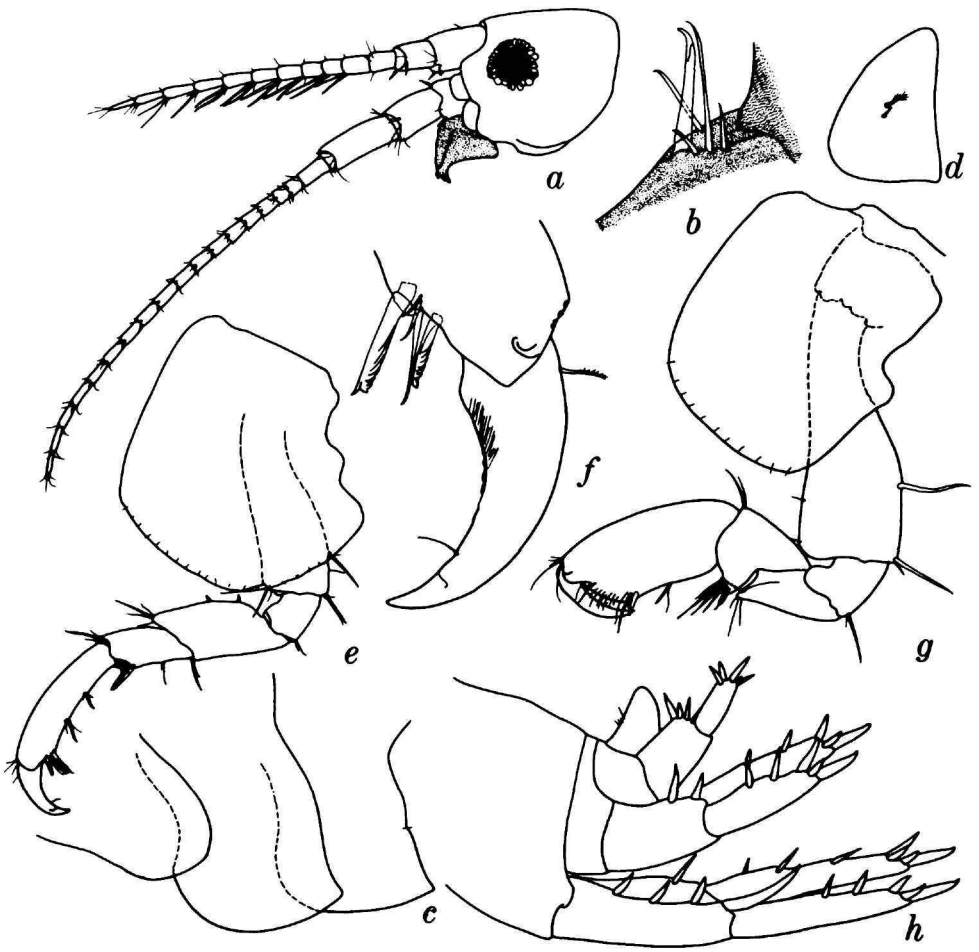

FIGURE 174.—*Hyale laie*, new species, holotype, male, 4.2 mm, JLB Hawaii 14: *a*, head; *b*, posterodistal end of article 5 on pereopod 2 (upside down); *c*, pleonal epimera 1–3. Female, 5.6 mm: *d*, right half of telson, arrow pointing posteriorly; *e*, pereopod 2; *f*, dactyl of pereopod 5; *g*, gnathopod 2; *h*, urosome.

large, subcircular, with black-brown-purple cores; antennae of medium length, antenna 1 reaching halfway along flagellum of antenna 2, flagellum with numerous aesthetascs, peduncle of antenna 2 short, flagellum setose only; palp of maxilla 1 uniarticulate and reaching to apex of outer plate; coxa 1 very broad, slightly extended forward, coxae 1–3 with strong, quadrate posterior acclivity, coxa 4 with bisinuate posterodorsal excavation; article 2 of gnathopod 1 unproduced anterodistally, article 4 weakly extended posterodistally, lobe of article 5 narrow, article 6 broadly expanded, anterodistal corner tumid, palm oblique, defined by large, blunt cusp, palm convex and bearing large spine in middle, dactyl fitting palm; article 2 of gnathopod 2 broadly lobate anterodistally, article 3 with broad hemicircular lobe, article 4 weakly extended, article 5 immersed posteriorly but bearing slight lobe, hand very large, bearing 2 anteroproximal spines, palm oblique, much longer than free posterior margin of hand, bearing distal truncate process, remainder of palm excavate and bearing slight hump near rounded defining corner, palm spinose throughout, dactyl fitting palm and slightly S-shaped on inner margin; pereopods 1–5 with main locking spine and smaller spine heavily striate in corkscrew pattern distally, dactyls bearing small distal setule and very weak castellations and

striations on inner edge; article 2 of pereopods 3–5 broad, subcircular or slightly flattened posteriorly on pereopod 4, weakly serrate, articles 4–6 moderately slender and without special features, article 6 lacking posterior setae; pleonal epimera rounded-quadrate posteriorly, epimeron 2 slightly sinuous and scarcely extended, epimeron 3 slightly smaller, less sinuous, with slight posteroventral extension, subacute corner; uropod 1 with large distolateral spine on peduncle, rami of uropods 1–2 dorsally spinose, uropod 3 with row of peduncular setae, thin ramus slightly shorter than peduncle, bearing only terminal spines; telson normal.

FEMALE.—Article 2 of gnathopod 1 slightly tumid anterodistally, article 4 with small subacute spinose protrusion posterodistally, article 5 longer than in male, article 6 slender, subrectangular, with 2 posterior setae, palm oblique, simple, slightly convex, defined by spine, dactyl fitting palm; gnathopod 2 similar to gnathopod 1 but larger, lobe of article 5 more slender.

HOLOTYPE.—Bishop Museum collections, catalog number 7304, male, 4.2 mm.

TYPE-LOCALITY.—JLB Hawaii 14, 1 mile N of Kualoa Point, Oahu, intertidal, algae, dead coral heads, 23 May 1967.

MATERIAL.—JLB Hawaii 14 (17), 15 (14), 17 (7), 18 (3). Kauai, Poipu, 17 September 1959, *Chir. haw.*, H. Caspers (1).

This species has strong affinities with *H. affinis* Chevreux (1908), but male gnathopod 2 palm of *H. affinis* is simple, the palm of gnathopod 1 lacks a midspine, and the defining hump is very weak.

Hyale pusilla Chevreux (1908) has the ornamented palm seen in *H. laie,* but it has 2 distal humps instead of 1 and otherwise lacks spines except on those humps. Male gnathopod 1 of *H. pusilla* is slightly expanded distally but the palm is simple and not defined by a cusp.

Gnathopod 1 of *H. laie* resembles the male of *H. galateae* Stebbing (1899a), but the dactyl of Stebbing's species is bifid.

Hyale laie probably has its closest affinities with that species identified by Iwasa (1939) from Japan as *H. dollfusi* Chevreux, a species originally described from the Mediterranean Sea. Perhaps the Japanese form should become a subspecies of *H. laie* and not be identified with *H. dollfusi.* Iwasa's material differs from the Mediterranean species in the distinct palmar protrusion of male gnathopod 2, though it is weaker than in *H. laie.* The Japanese material also has relatively longer antenna 2 than that from Hawaii.

DISTRIBUTION.—Hawaiian Islands.

Hyale Rathke

Lelehua, new subgenus

DIAGNOSIS.—*Hyale* with article 4 of male maxillipedal palp bearing long whiplike terminal seta.

TYPE-SPECIES.—*Hyale* (*Lelehua*) *waimea,* new species.

Hyale (Lelehua) waimea, new species

FIGURES 175, 176, 177

DESCRIPTION.—Lateral cephalic lobes scarcely truncate, slightly convex, anteroventral cephalic excavation weak; eyes large, subovate, red or yellow in formaldehyde, clear in alcohol; antennae short, 1 slightly shorter than 2, flagellum of 1 with aesthetascs; palp of maxilla 1 uniarticulate and reaching to apex of outer plate; palp article 4 of female maxilliped with several long stiff setae lining medial margin (when flattened); coxa 1 very broad, slightly extended forward, coxae 1–3 with obsolescent posterior acclivity, 4 with small sharp acclivity in posterodorsal excavation; article 2 of gnathopod 1 unproduced anterodistally, article 4 unextended posterodistally, lobe of article 5 of medium breadth, article 6 narrow and rectangular, palm oblique, defined by pair of spines, posterior margin setose, medial face of hand with row of stout setae, dactyl fitting palm; article 2 of gnathopod 2 with broad but not deeply extended anterodistal lobe, article 3 with small mammilliform hump, article 4 distally triangular, article 5 hidden between articles 4 and 6 and bearing short lobe extending over article 6, latter normally broad, palm slightly oblique, bearing deep narrow rounded excavation in middle, with medial flanges narrowing the excavation on medial side, palm defined by weak tooth adjacent to small sinus, bearing 2 medial spines, dactyl thick, fitting palm, bearing inner hump; pereopods 1–5 with small, striate locking spine adjacent to larger simpler spine, dactyl slightly striate, bearing distal sharp flake, marginal setule and facial setule; pereopods 3–5 with broadly expanded article 2, article 4 on pereopods 3–4 very broad and nasiform, posteriorly spinose, article 5 also broad on pereopod 4, article 6 lacking posterior setae; pleonal

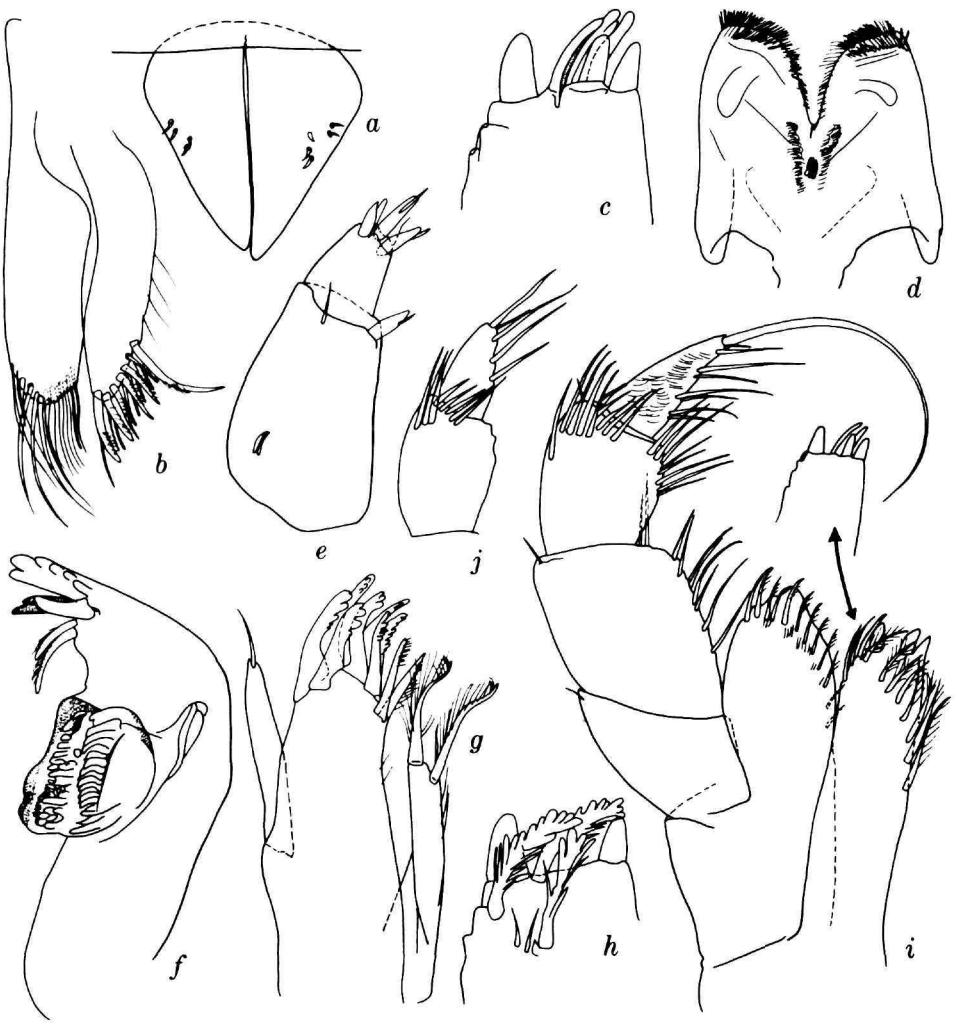

FIGURE 175.—*Hyale (Lelehua) waimea,* new subgenus, new species, holotype, male, 3.8 mm, JLB Hawaii 5: *a,* telson; *b,* maxilla 2; *c,* inner plate of maxilliped, setae removed; *d,* lower lip; *e,* uropod 3; *f,* mandible; *g,* maxilla 1; *h,* inner plate of maxilliped, with setae; *i,* maxilliped. Female, 3.3 mm: *j,* palp articles 3–4 of maxilliped.

epimeron 1 rounded posteroventrally, epimera 2–3 with slightly sinuous posterior margin and rounded posteroventral protuberance; uropod 1 with large distolateral spine on peduncle, rami of uropods 1–2 spinose, uropod 3 with 2 basal peduncular setae, broad short ramus much shorter than peduncle, bearing only terminal spines; telson sharply triangular.

FEMALE.—Gnathopod 1 like that of male, gnathopod 2 similar in size and shape to gnathopod 1, but article 4 with strong posterodistal extension, article 6 poorly setose posteriorly and medially compared with gnathopod 1; articles 4–5 of pereopod 4 like those of pereopod 5 of male and not like pereopod 4 of male.

JUVENILE MALE.—Palm of gnathopod 2 with weak excavation, dactyl without inner hump.

HOLOTYPE.—Bishop Museum collections, catalog number 7305, male, 3.8 mm.

TYPE-LOCALITY.—JLB Hawaii 5, off Ewa Beach, Oahu, 30 m, *Pocillopora,* 29 January 1967.

MATERIAL.—Ten specimens from the type-locality.

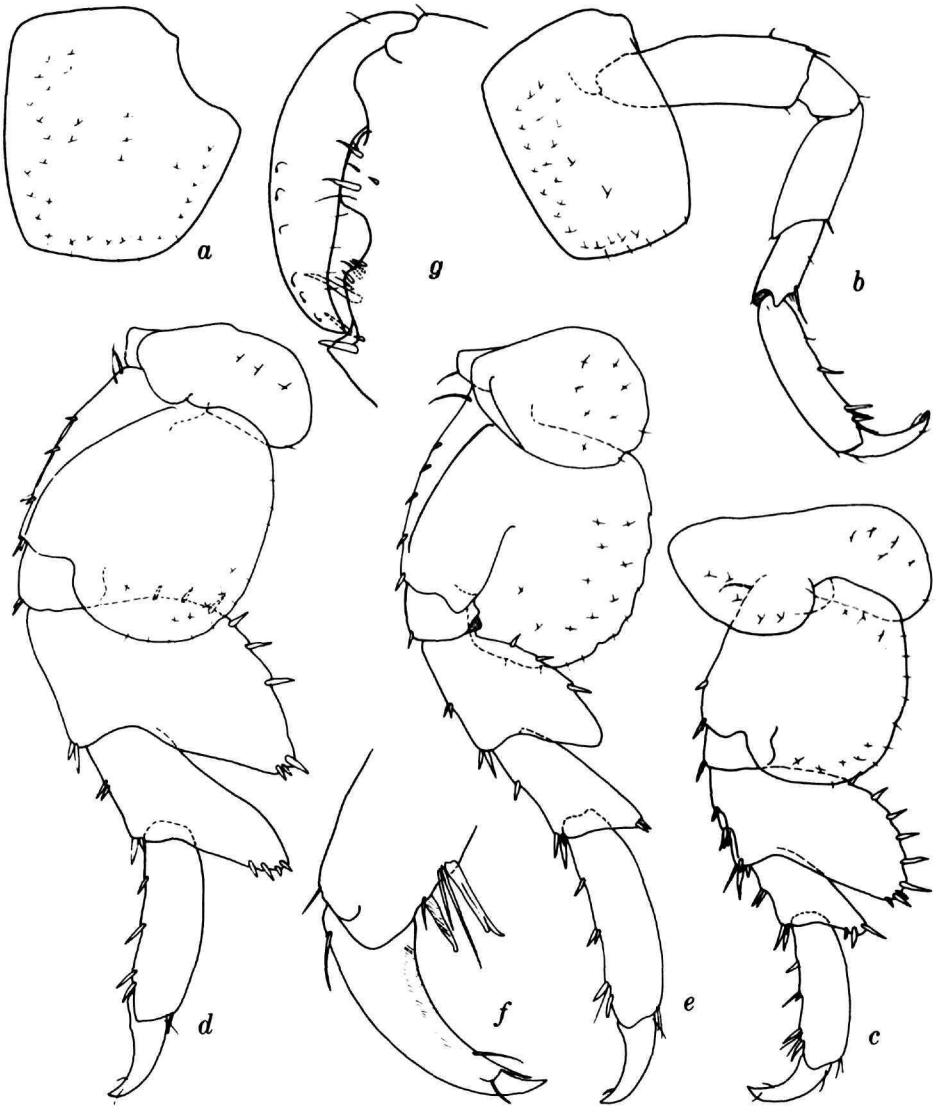

FIGURE 176.—*Hyale (Lelehua) waimea,* new subgenus, new species, holotype, male, 3.8 mm, JLB Hawaii 5: *a,* coxa 4; *b, c, d, e,* pereopods 1, 3, 4, 5; *f,* dactyl of pereopod 1. Juvenile male, 2.6 mm: *g,* palm of medial gnathopod 2.

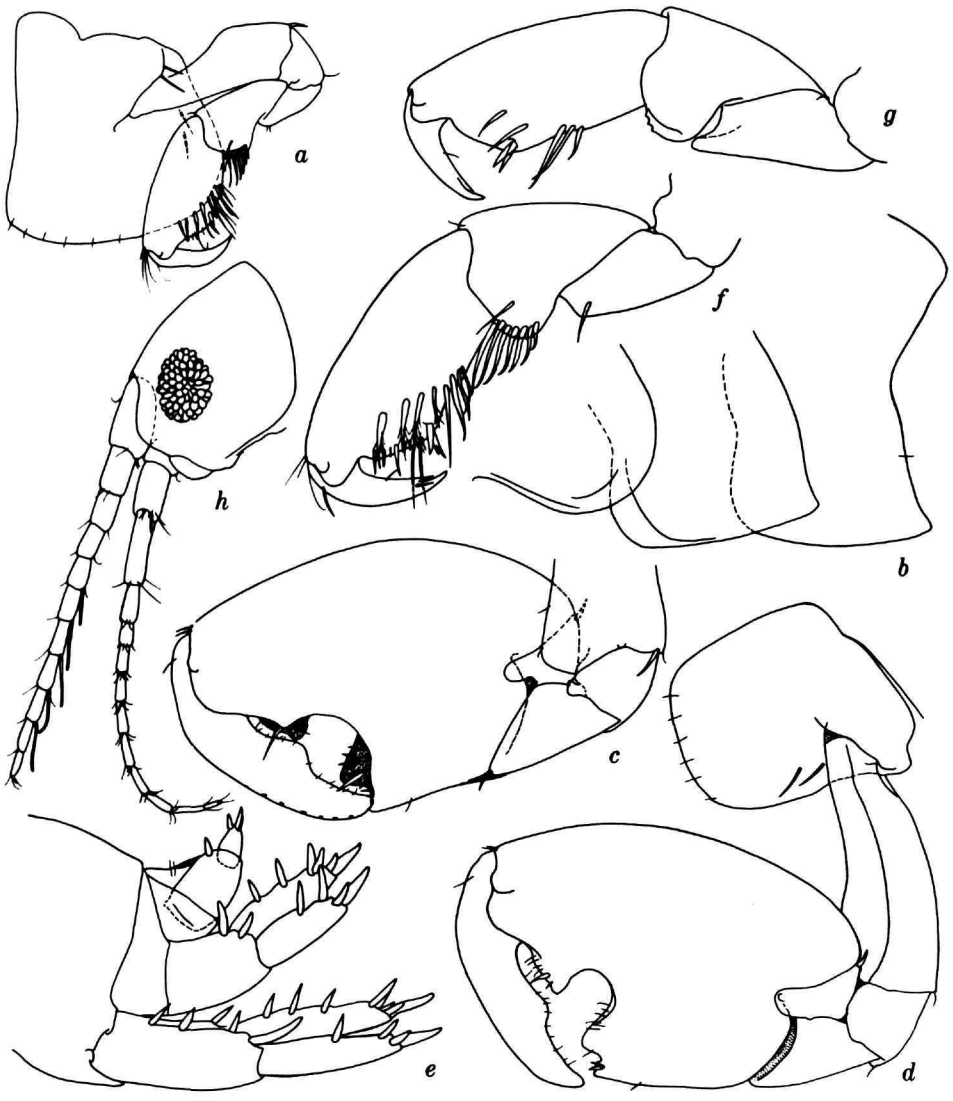

FIGURE 177.—*Hyale* (*Lelehua*) *waimea*, new subgenus, new species, male, 3.8 mm, JLB Hawaii 5: *a*, gnathopod 1; *b*, pleonal epimera 1–3; *c*, *d*, lateral and medial gnathopod 2; *e*, urosome. Female, 3.3 mm: *f*, *g*, gnathopods 1, 2, setae removed from latter; *h*, head.

REMARKS.—The long flagellate seta of the male maxillipedal palp should be used as a subgeneric character to separate this species from the many other members of *Hyale* lacking it. Maxillipedal palps of few of the 45 known species have been specifically mentioned and others may have this character. *Hyale carinata* (Bate) of the Mediterranean Sea (Chevreux and Fage, 1925) also has this seta but it is shorter. That species probably also should be assigned to *Lelehua*.

DISTRIBUTION.—Hawaiian Islands.

Hyale species (*cf. rubra* [Thomson])

FIGURE 178

DIAGNOSIS OF MALE.—Lateral cephalic lobes broadly truncate, anteroventral cephalic excavation shallow and flat, anteroventral corner of head rounded-quadrate; eyes dark in alcohol (shape destroyed by preservative); antennae of medium length, antenna 1 reaching about halfway along antenna 2, flagellum with a few aesthetascs, peduncle of antenna 2 of medium length, flagellum normal and bearing a few setules; coxa 1 of regular expansion, scarcely extended forward, coxa 1 weakly lobate posteriorly but with no sharp acclivity, coxae 2–3 with strong, quadrate, softly rounded acclivity; coxa 4 with slightly sinuous excavation; article 2 of gnathopod 1 with spinose, quadrate anterodistal extension proximal to corner, article 4 almost unproduced distally, lobe on article 5 thin, article 6 narrowly rectangular and tapering distally, palm very oblique and short, defined by 2 spines, dactyl short, fitting palm, half of posterior margin of hand

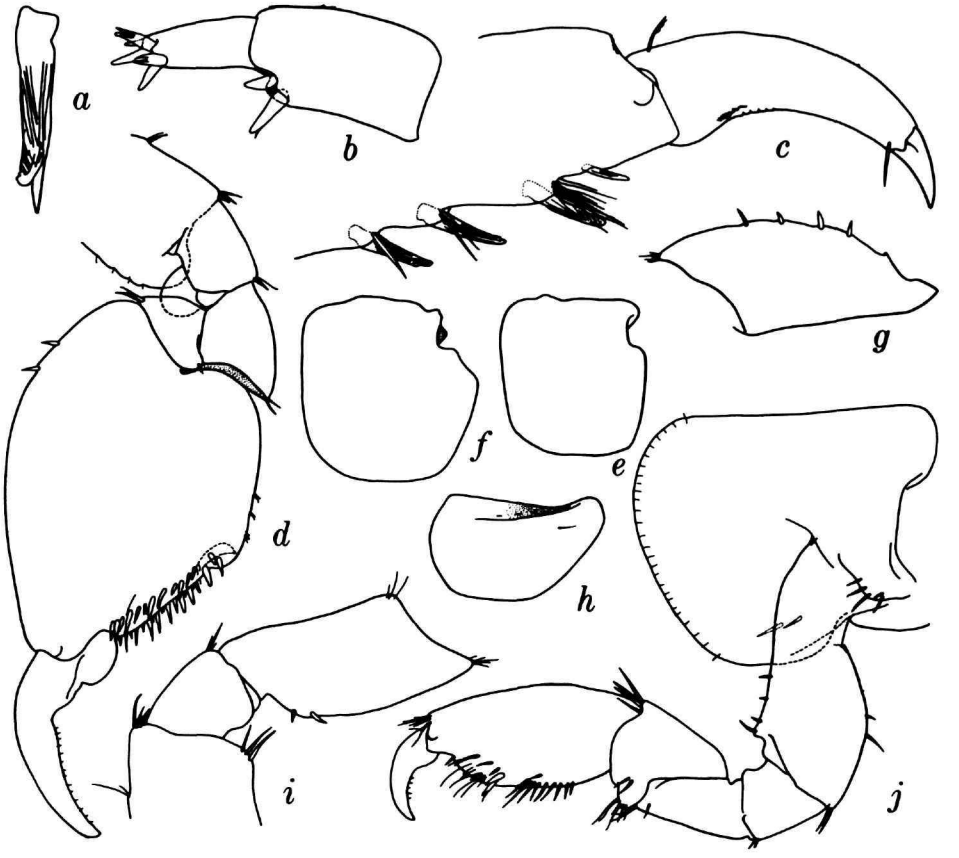

FIGURE 178.—*Hyale* species (cf. *H. rubra*), male, 10.5 mm, Kahului Harbor, Maui: *a*, largest spine on article 6 of pereopod 2; *b*, uropod 3; *c*, apex of pereopod 5; *d*, medial gnathopod 2; *e*, *f*, coxae 3, 4 (in different magnifications); *g*, article 4 of pereopod 1; *h*, left side of telson, lateral view; *i*, articles 2–4 of pereopod 2; *j*, gnathopod 1.

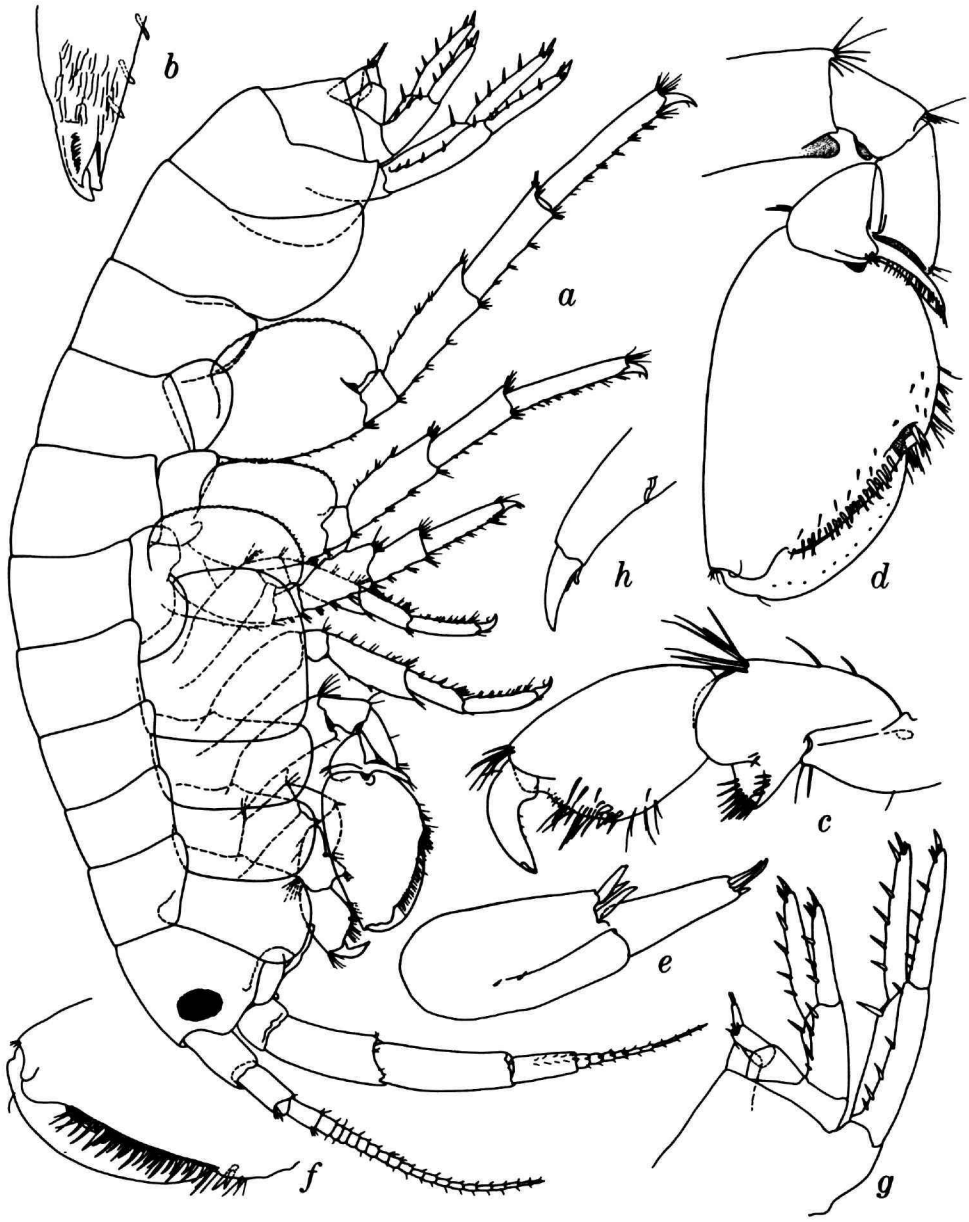

FIGURE 179.—*Parhyalella pietschmanni* Schellenberg, male, 10.3 mm, Lanikai: *a*, body; *b*, apex of dactyl on gnathopod 1; *c*, *d*, medial gnathopods 1, 2; *e*, uropod 3; *f*, lateral palm of gnathopod 2; *g*, urosome. Female, 9.2 mm: *h*, apex of dactyl on gnathopod 2.

FIGURE 180.—*Parhyalella pietschmanni* Schellenberg, male, 10.3 mm, Lanikai: *a*, dactyl of pereopod 2; *b*, maxilla 1; *c*, mandible; *d*, head; *e*, lower lip; *f*, maxilliped; *g*, apex of uropod 3; *h*, pleonal epimera 1–3. Female, 9.2 mm: *i*, telson; *j*, head; *k*, *l*, medial gnathopods 1, 2.

lined with short setae; article 2 of gnathopod 2 with medium anterodistal lobe, article 3 with large tumid lobe, article 4 weakly extended, article 5 immersed posteriorly, hand very large, with 2 anteroproximal spines, palm oblique and simple, spinose, about equal to free posterior margin of hand, spines at defining corner not enlarged, posterior margin of hand with 3 groups of tiny setules, dactyl curved, fitting palm; pereopods 1–5 with small, weakly striate distal spine, next proximal spine large and striate like other marginal spines, dactyl with small distal seta and facial setule, with weak proximal castellations; pleonal epimera and uropods 1–2 as figured for *H. laie,* new species, thus largest peduncular spine of uropod 1 on lateral side, outer ramus of uropod 2 much thinner and shorter than outer ramus, rami of uropods 1–2 marginally spinose; uropod 3 slender, all spines of ramus apical; telson with triangular lobes.

Female unknown.

MATERIAL.—Kahalui Harbor, Maui, 28 May 1953 (3 males).

REMARKS.—This species belongs with *H. laie-honoluluensis-affinis* complex in its uropod 1, but differs from those species and *H. g. bishopae* and *H. ayeli* in the thin hand of gnathopod 1, from the *laie* complex by the numerous posterior setae on that hand, and from *H. g. bishopae* and *H. ayeli* in the obsolescent posterior acclivities on coxae 1–3 and the smallness and distal placement of the main dactylar seta on pereopods 1–5.

This population of 3 males appears to be related to *H. rubra* (Thomson) (Hurley, 1957), but gnathopod 1 tapers distally proximal to the palm, and the lobe on article 5 is thin; article 2 of pereopods 1–2 has relatively long setae on the anterodistal corner. The specimens appear similar to those identified by Iwasa (1939) from Japan as *Hyale schmidti.*

Parhyalella pietschmanni Schellenberg

FIGURES 179, 180

Parhyalella pietschmanni Schellenberg, 1938, pp. 71–74, figs. 36, 37.

The long description and several figures published by Schellenberg, plus the additional figures presented herein, should adequately define this species for the present. The eyes in formaldehyde are a mixture of garnet below frosty pink ommatidial outlines, turning to dark brownish purple in alcohol, the eyes completely pigmented to their periphery, unlike most Hawaiian marine amphipods with dark ocular pigment.

Parhyalella pietschmanni differs from *P. whelpleyi* (Shoemaker, 1933b) in the broader coxa 4, the larger pleonal epimeron 2, the slightly broader sixth article of gnathopods 1–2, and the much longer ramus of uropod 3.

MATERIAL.—Lanikai, Oahu, 20 May 1967, collection D. H. Devaney, beach wash associated with algae (10).

DISTRIBUTON.—Hawaiian Islands.

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Appendix 1

(Groups of Gammaridea not expected from the Hawaiian Islands sublittoral)

Cold-Water Groups, Either Cold-Temperate or Deep-Sea

Astyridae, most Calliopiidae, Cressidae, Dogielinotidae, most Eusiridae, Haustoriidae, Hyperiopsidae, Ischyroceridae (but 5 species occur in Hawaii), Lafystiidae, Laphystiopsidae, Lepechinellidae, Melphidippidae, most Oedicerotidae, Pagetinidae, Paramphithoidae, Pardaliscidae, Pleustidae (2 species in Hawaii), Sebidae (1 species in Hawaii), Stegocephalidae, most Stenothoidae except *Stenothoe,* Stilipedidae, most Synopiidae except *Synopia* and *Tiron,* Thaumatelsonidae, Vitjazianidae.

Absence of Kelps for Lignivores

Eophliantidae, Phliantidae (1 species of each family in Hawaii).

Endemic Elsewhere

Bateidae (America).

Brackish Water

Grandidierella.

Poorly Known or Rare Groups

Kuriidae, Ochlesidae (1 species in Hawaii), Prophliantidae.

Appendix 2

List of samples and species. Samples represent aliquots reduced to low denominators.

JLB Hawaii 2, open sea off W end of Pearl Harbor, 4–5 m, sand bottom, wash of giant encrustation mass from hard sand reef, 29 January 1967, King Yacht *Pele. Amphilochus kailua* 2, *Amphilochus menehune* 3, *Ampithoe ramondi* 1, *Chevalia aviculae* 5, *Cymadusa filosa* 3, *Elasmopus piikoi* 32, *Eriopisa hamakua* 1, *Gammaropsis alamoana* 6, *Gammaropsis atlantica* 14, *Konatopus paao* 13, *Lembos macromanus* 2, *Leucothoe hyhelia* 1, *Leucothoides ?pottsi* 4, *Liljeborgia heeia* 7, *Lysianassa ewa* 1, *Maera kaiulani* 12, *Parajassa angularis* 16, *Photis aina* 34, *Photis kapapa* 13, *?Podocerus talegus lawai* 2, *Ventojassa ventosa* 69.

JLB Hawaii 3, off Ewa beach, 18 m, wash of *Pocillopora,* other corals, bryozoans and encrustations, 29 January 1967, King Yacht *Pele. Amphilochus menehune* 2, *Ampithoe* species 1, *Aoroides columbiae* 31, *Chevalia aviculae* 17, *Elasmopus molokai* 15, *Elasmopus piikoi* 1, *Ericthonius brasiliensis* 6, *Gammaropsis alamoana* 1, *Gammaropsis atlantica* 23, *Ischyrocerus kapu* 1, *Konatopus paao* 5, *Laetmatophilus hala* 2, *Lembos waipio* 10, *Leucothoides ?pottsi* 3, *Liljeborgia heeia* 10, *Lysianassa ewa* 7, *Melita appendiculata* 1, *Nuuanu amikai* 1, *Ochlesis alii* 1, *Parajassa angularis* 1, *Photis aina* 88, *Photis kapapa* 38, *Stenothoe* species A 1, *Ventojassa ventosa* 7.

JLB Hawaii 5, off Ewa Beach, Oahu, 30 m, wash of *Pocillopora* heads from long coral reef, 29 January 1967, King Yacht *Pele. Amphilochus likelike* 2, *Amphilochus menehune* 8, *Ampithoe waialua* 36, *Aoroides columbiae* 5, *Chevalia aviculae* 8, *Colomastix kapiolani* 1, *Elasmopus molokai* 25, *Elasmopus pocillimanus* 2, *Eusiroides diplonyx* 2, *Gammaropsis afra* 15, *Gammaropsis alamoana* 3, *Gammaropsis altantica* 6, *Gammaropsis pokipoki* 4, hybrid forms of above 10, *Ischyrocerus* species C 1, *Laetmatophilus hala* 1, *Lelehua waimea* 10, *Lembos leapakahi* 1, *Lembos waipio* 1, *Leucothoe hyhelia* 2, *Liljeborgia heeia* 6, *Maera quadrimana* 3, *Maera* species A (cf. *hamigera*) 1, *Melita appendiculata* 1, *Parajassa angularis* 1, *Photis aina* 11, *Photis kapapa* 4, *Podocerus talegus lawai* 1, *Ventojassa ventosa* 3.

JLB Hawaii 6, off Barbers Point, Oahu, about 30 m, wash of numerous coralline footballs, 29 January 1967, King Yacht *Pele. Amphilochus menehune* 8, *Ampithoe waialua* 8, *Anamixis stebbingi* 1, *Aoroides columbiae* 2, *Ceradocus hawaiensis* 9, *Chevalia aviculae* 10, *Colomastix kapiolani* 1, *Colomastix* species 1, *Elasmopus molokai* 22, *Elasmopus pocillimanus* 1, *Ericthonius brasiliensis* 3, *Eriopisella sechellensis upolu* 1, *Eusiroides diplonyx* 2, *Gammaropsis atlantica* 10, *Gammaropsis pokipoki* 3, *Ischyrocerus kapu* 1, *Kanaloa manoa* 15, *Konatopus paao* 11, *Laetmatophilus hala* 1, *Lembos waipio* 8, *Leucothoe tridens* 9, *Leucothoides ?pottsi* 1, *Liljeborgia heeia* 9, *Maera ?pacifica* 2, *Melita appendiculata* 3, *Mokuoloe ninole* 1, *Paragrubia vorax* 1, *Photis aina* 40, *Photis kapapa* 6.

JLB Hawaii 8, off W end of Pearl Harbor, 25–30 m, several giant *Pocillopora* heads and large masses of short-tufted red algae, calcareous encrustations, 29 January 1967, King Yacht *Pele. Amphilochus menehune* 2, *Ampithoe waialua* 3, *Chevalia aviculae* 150+, *Elasmopus molokai* 6, *Gammaropsis alamoana* 26, *Gammaropsis atlantica* 1, *Konatopus paao* 1, *Lembos macromanus* 1, *Leucothoe hyhelia* 2, *Leucothoides ?pottsi* 1, *Liljeborgia heeia* 2, *Maera insignis* 1, *Paragrubia vorax* 8, *Parajassa angularis* 7, *Photis aina* 180+, *Photis kapapa* 7, *Ventojassa ventosa* 14.

JLB Hawaii 10, Kaneohe Bay, Oahu, 2 m, heads of *Pocillopora meandrina,* recovered by divers Kruschwitz and Bowers, Sampan Pass, 23 February 1967. *Amphilochus menehune* 3, *Ampithoe ramondi* 2, *Anamixis stebbingi* 2, *Colomastix kapiolani* 2, *Elasmopus molokai* 6, *Gammaropsis alamoana* 13, *Gammaropsis atlantica* 20, *Gammaropsis haleiwa* 1, *Gammaropsis pali* 11, *Gammaropsis pokipoki* 6, *Gitanopsis pele* 50, *Ischyrocerus kapu* 1, *Ischyrocerus oahu* 4, *Kanaloa manoa* 1, *Konatopus paao* 4, *Leucothoe hyhelia* 2, *Leucothoe tridens* 1, *Leucothoides ?pottsi* 6, *Lembos intermedius* 5, *Lembos leapakahi* 3, *Liljeborgia heeia* 1, *Photis kapapa* 9, *Stenothoe* species B 3.

JLB Hawaii 11, Kaneohe Bay, Coconut Island Inlet, alga *Dictyospora* and coral head, 2 m, 23 February 1967, recovered by diver Bowers. *Amphilochus likelike* 4, *Corophium ?baconi* 4, *Elasmopus molokai* 1.

Ericthonius brasiliensis 18, *Lembos leapakahi* 7, *Lembos macromanus* 28, *Liljeborgia heeia* 4, *Leucothoe hyhelia* 1.

JLB Hawaii 12, Kaneohe Bay, Oahu, inside reef, 3–4 m, dredge of small corals, fleshy algae, corallines, aboard U. Hawaii R/V *Salpa*, Jack M. Levitz, 4 March 1967. *Ampithoe kaneohe* 2, *Ampithoe ramondi* 10, *Ampithoe waialua* 2, *Anamixis stebbingi* 1, *Aoroides nahili* 2, *Cymadusa filosa* 1, *Elasmopus molokai* 2, *Elasmopus pūkoi* 12, *Ericthonius brasiliensis* 5, *Eriopisa laakona* 1, *Eriopisella sechellensis upolu* 7, *Gammaropsis alamoana* 1, *Gammaropsis atlantica* 4, *?Gammaropsis pokipoki* 1, *Hyale honoluluensis* 2, *Jassa lilipuna* 1, *Konatopus paao* 2, *Lembos intermedius* 4, *Lembos macromanus* 1, *Lembos pualani* 17, *Leucothoe tridens* 1, *Lysianassa ewa* 2 *Maera serrata* 5, *Maera insignis* 23, *Paragrubia vorax* 3, *Photis kapapa* 4, *Podocerus talegus lawai* 3, leucothoid, possible new genus, gnathopod 2 like gnathopod 1 of *Seba* (1).

JLB Hawaii 13, same as JLB Hawaii 12, 8 April 1967. *Aloiloi nenue* 1, *Amphilochus menehune* 7, *Aoroides nahili* 7, *Ampithoe kaneohe* 6, *Anamixis stebbingi* 2, *Colomastix lunalilo* 3, *Cymadusa filosa* 8, *Elasmopus molokai* 3, *Elasmopus pūkoi* 14, *Ericthonius brasiliensis* 26, *Eusiroides diplonyx* 2, *Gammaropsis alamoana* 10, *Gammaropsis atlantica* 18, *Gitana liliuokalaniae* 1, *Jassa lilipuna* 6, *Konatopus paao* 43, *Lembos intermedius* 13, *Lembos macromanus* 6, *Lembos pualani* 24, *Leucothoe hyhelia* 20, *Leucothoe tridens* 3, *Leucothoides ?pottsi* 6, *Liljeborgia heeia* 1, *Lysianassa ewa* 9 (all in sample), *Maera insignis* 7, *Maera serrata* 3, *Maera pacifica* 3, *Melita appendiculata* 42, *Paragrubia vorax* 3, *Parapleustes derzhavini makiki* 9, *Photis kapapa* 3 (1 aber. female), *Podocerus talegus lawai* 3.

JLB Hawaii 14, 1 mi N of Kualoa Point, Windward Oahu, near old sugar mill, intertidal, general wash of algae and dead coral heads, 23 May 1967. Sample not evenly sorted. *Amphilochus menehune* 13, *Ampithoe waialua* 13, *Aoroides nahili* 2, *Cymadusa filosa* 4, *Elasmopus molokai* 1, *Elasmopus pūkoi* 25, *Eusiroides diplonyx* 6, *Gammaropsis alamoana* 5, *Gammaropsis pali* 1, *Hyale laie* 17, *Konatopus paao* 1, *Lembos pualani* 6, *Lembos waipio* 2, *Leucothoe hyhelia* 1, *Leucothiodes ?pottsi* 1, *Maera insignis* 9++, *Maera pacifica* 6, *Maera quadrimana* 1, *Maera serrata* 3, *Paragrubia vorax* 3, *Pontogeneia pacifica* 2.

JLB Hawaii 15, same locality as JLB Hawaii 14, wash of coral block with globular ascidians. Not evenly sorted. *Amphilochus menehune* 1, *Ampithoe kaneohe* 2. *Ampithoe ramondi* 4, *Ampithoe waialua* 7, *Anamixis stebbingi* 1, *Chevalia aviculae* 3, *Cymadusa filosa* 5, *Hyale laie* 14, *Ischyrocerus oahu* 1, *Konatopus paao* 1, *Lembos intermedius* 9, *Lembos leapakahi* 7, *Lembos macromanus* 7, *Lembos pualani* 17, *Lembos kamanu* 1, *Leucothoe hyhelia* 1, *Liljeborgia laniloa* 2, *Maera insignis* 18+, *Maera serrata* 2, *Paradexamine* (*Wailele*) *maunaloa* 5, *Pontogeneia pacifica* 17.

JLB Hawaii 17, Kawela Bay, Oahu, intertidal wash of *Sargassum*, other algae, rocks and corals, 24 May 1967. Sample dominated by *Maera insignis, Hyale* species, *Pontogeneia* and *Lembos*, examined primarily for faunal additions. *Amphilochus kailua* 4, *Amphilochus menehune* 3, *Ampithoe akuolaka* 2, *Ampithoe orientalis* 1, *Ampithoe ramondi* 1, *Ampithoe* species 1, *Aoroides nahili* 16, *Atylus* (*Kamehatylus*) *nani* 1, *Biancolina mauihina* 1, *Chevalia aviculae* 3, *Elasmopus pocillimanus* 1, *Elasmopus hooheno* 5, *Elasmopus piikoi* 2, *Ericthonius brasiliensis* 1, *Eriopisa laakona* 3, *Eusiroides diplonyx* 1, *Gammaropsis atlantica*, hybrid 5, *Gammaropsis kaumaka* 1, *Hyale laie* 7, *Hyale affinis* 5, *Ischyrocerus oahu* 9, *Jassa lilipuna* 9, *Lembos leapakahi* 8, *Lembos pualani* 7, *Lysianassa ewa* 1, *Maera insignis* 5++, *Maera pacifica* 4, *Maera* species B 1, *Melita pahuwai* 3, *Palinnotus alaniphlias* 1, *Podocerus talegus lawai* 1, *Pontogeneia pacifica* 2, *Seba ekepuu* 2.

JLB Hawaii 18, Kawela Bay, Oahu, intertidal, wash of rocks and *Ulva lactuca*, 24 May 1967. Report only of unusual species. *Ampithoe akuolaka* 2, *Ampithoe* species 1, *Hyale laie* 3, *Melita pahuwai* 2, *Neomicrodeutopus* (?) *makena* 2.

Devaney 1. Seaward of Moku Manu, windward Oahu, 33 m, stem of black coral, *Antipathes irregularis* Verrill, including bivalve community attached to coral, 13 May 1967, collector D. Devaney. *Amphilochus menehune* 1, *Elasmopus diplonyx* 8, *Gammaropsis afra* 19, *Leucothoe hyhelia* 2, *Leucothoe lihue* 5, *Parapleustes* (?) *honomu* 1, *Stenothoe valida*, var. 84, *Ventojassa ventosa* 1.

Fee 1. Waikiki Beach, Oahu, intertidal, wash of *Ulva lactuca* and substrate, 25 April 1967, collector James Fee. *Amphilochus kailua* 38, *Ampithoe kaneohe* 24, *Ampithoe orientalis* 6, *Ampithoe ?ramondi* 6, *Biancolina mauihina* 1, *Cymadusa filosa* 3, *Cymadusa hawaiensis* 1, *Elasmopus ?molokai* 1, *Ericthonius brasiliensis* 3, *Hyale honoluluensis* 51, *Jassa lilipuna* 11, *Maera insignis* 27, *Maera pacifica* 2, *Palinnotus alaniphlias* 1, *Paragrubia vorax* 1, *Podocerus talegus lawai* 5, *Pontogeneia pacifica* 32, *Stenothoe haleloke* 1.

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Principal Hawaiian species and genera and their main page references are entered in boldface. Subjects in tables, figures, and appendices are omitted.

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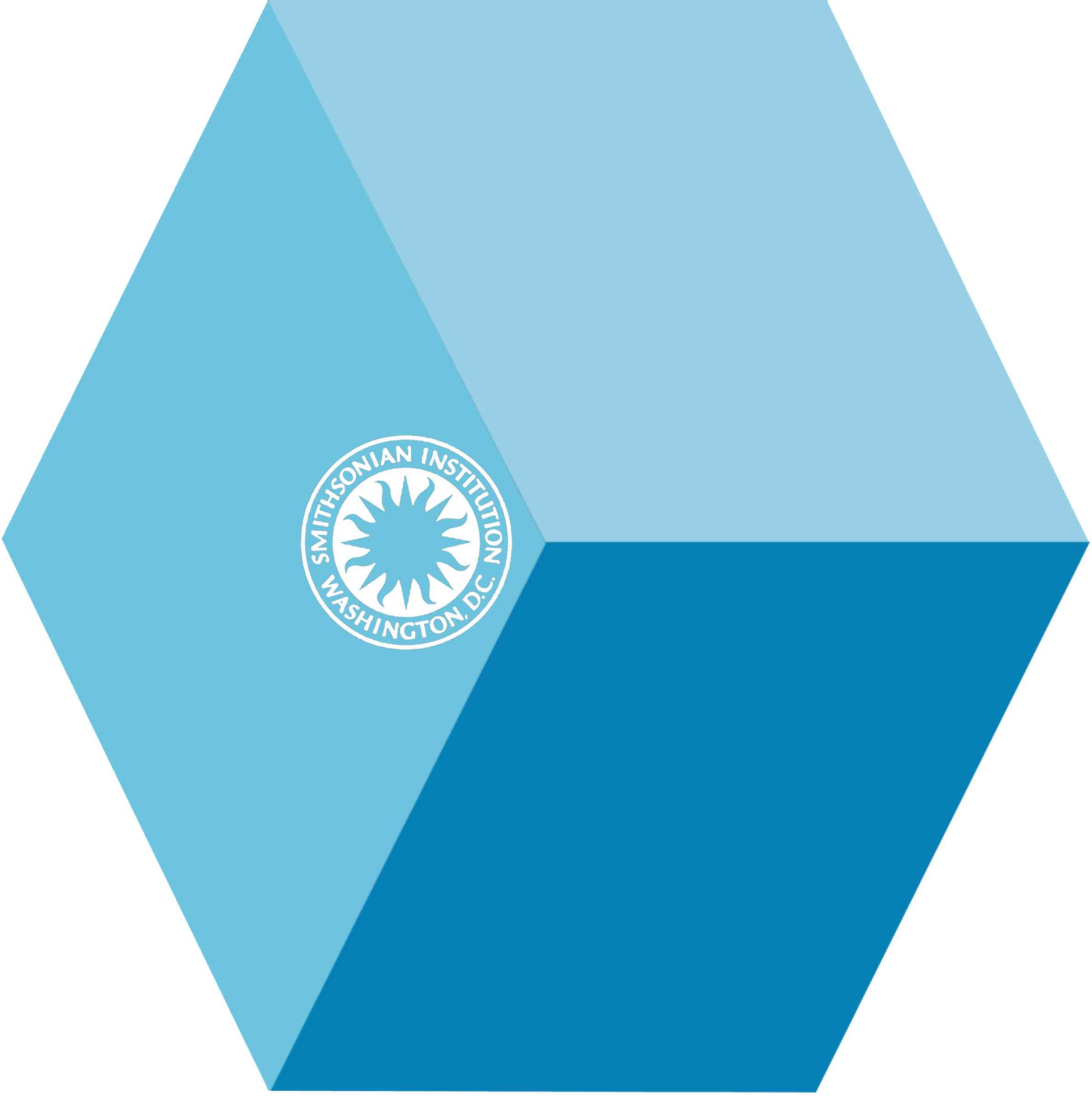
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