J. LAURENS BARNARD

Keys to the Hawaiian Marine Gammaridea, 0-30 Meters

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ABSTRACT

J. Laurens Barnard. Keys to the Hawaiian Marine Gammaridea, 0–30 Meters. *Smithsonian Contributions to Zoology,* 58, 135 pages, 1971.—Methods of collecting Hawaiian Gammaridea, their preservation, sorting by color schemes and head shapes, dissection, terminology and identification are presented. Keys to taxa illustrated with drawings are given for 120 species found in depths from 0 to 30 m. Synonymies, distribution, and notes on crucial characters of each species are given. This paper supplements the formal descriptions of the Hawaiian species contained in *Smithsonian Contributions to Zoology,* number 34.

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Introduction

Gammaridea are the commonest suborder of Amphipoda on the nearshore benthos of Hawaii and one of the most common groups of medium-size and small organisms (1–7 mm body length). Caprellidea, a suborder of skeleton shrimps are also prevalent but less common and not treated here; Hyperiidea, the third major suborder, occur primarily in the oceanic bathypelagic realm.

Hawaiian Gammaridea are very small organisms barely visible to the naked eye and frequently overlooked by the collector. Most Hawaiian species have bodies less than 5 mm in length, many adults are approximately 1 mm in length, but a few species attain lengths of 14 mm. They are abundant in algae and coral heads and on rubble but are rare on sand bottoms. Mud bottoms, though rare in shallow waters of Hawaii, would be expected to have high numbers of amphipods, as they do on continental shores; mud bottoms have not been explored in Hawaii and this treatment of Gammaridea concerns primarily those in epifaunal biotopes.

A potential wealth of ecologic, genetic, and physiological problems occurs in the Amphipoda. Some of these are suggested in Barnard (1969). Food habits, as one measure of the niche, are of primary interest. Adaptation to food ingestion ranges from epiphytic herbivory to ectoparasitic sucking and includes mud ingesting, sand processing, lignivory, detritus feeding, slime lapping, filter feeding, carrion ingestion, and broad spectra of omnivory. Predation by benthic Amphipoda is a very minor consideration but worth investigating. Mechanisms in tube building, swimming, maintenance of nestling positions, saltatory escape, and copulation are of considerable interest and almost unstudied anywhere. Predation and parasitism upon amphipods by other organisms, life histories, and reproductive rates are all known only rudimentarily, even in those few species thus far studied.

This paper presents a system, based on the known species, of identifying Hawaiian Gammaridea dwelling in the range 0–30 m. Before attempting a first identification, however, the observer must have a clear understanding of the topics covered in this introduction. "Methods of Presentation," for example, contains an explanation of the format of the keys and the figures, as well as a brief discussion of the monographs which the student should have at hand for reference; and this is followed by sections outlining the basic method of collection and the techniques of dissection. Problems may arise from oddities in the position of appendages and difficulties in seeing certain characters because of the many setae occluding the chitinous surfaces of the appendages; these problems, which the observer will note immediately after dissection, are treated under the sections "Positions and Terms" and "Setae and Spines." The "Glossary" found on page 6 contains terms especially applicable to the Amphipoda, and a section on "Identification" discusses in general terms use of the keys. The "Key to Hawaiian Families," page 20, is preceded by a headnote warning of problems that may arise during its use. A principal aid to use of the keys is the "Diagnosis of the Basic Gammaridean" presented on page 8, which the student is advised to memorize.

For advanced students wanting assistance and ideas in rapidly sorting complex samples of amphipods ac-

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cording to a limited number of characters, there is presented a special section on "Non-Objective" identification which may be skipped if the reader is interested primarily in identifying one taxon at a time.

The systematic section of this paper is introduced by a formal diagnosis of the suborder Gammaridea, and in this section follow in alphabetical order the keys to families, and under the families, also in alphabetical order, keys to the genera and species thus far found in Hawaiian waters.

Methods of Presentation

To minimize text and to avoid long exclusive diagnoses, the comments appended to keys and taxa are abbreviated to include only major distinctions of the taxa, and may consequently appear indiscriminate or inconsistent. The reader may assume, however, that when a character is mentioned for one taxon but not for another, that it is in a negative state in the other related taxa of that group (family or genus) under discussion.

No words or pictures presented in such a format can absolutely distinguish species, especially in a fauna not completely explored; caution must therefore be exercised in using this work. When questions arise, original descriptions and diagnoses should be consulted, especially in papers by Schellenberg (1938) and J. L. Barnard (1955, 1970). Stebbing (1906) and Sars (1895) remain as invaluable references and should be at hand, particularly for the comprehensive world taxonomic treatment with keys offered by Stebbing, and for the magnificent illustrations of various kinds of amphipods in the Norwegian fauna presented by Sars.

Perusal of Stebbing's work will quickly familiarize the reader with the kinds of characters utilized in gammaridean taxonomy and will remove any overconfidence that the present treatment of Hawaiian Gammaridea is exhaustive. Stebbing's work gives most of the modern names applied to the genera and species in Sars' work, and in it one may observe the general appearance of various genera also occurring in the tropics—for example, *Elasmopus, Ericthonius, Corophium, Gammaropsis* (=*Eurystheus*), *Lembos, Leucothoe, Ampelisca, Byblis, Ampithoe, Aoroides* (like Sars' *Aora*), *Pontogeneia, Maera, Ceradocus, Eriopsia* (tropical members of this genus vary slightly from those shown), and *Laetmatophilus*. Examination of Sars' work is especially helpful in developing familiarity with the gross appearance of such families as the Lysianassidae, Ampithoidae, Gammaridae, Stenothoidae, Amphilochidae, Leucothoidae, Aoridae, Isaeidae (=Photidae), Ischyroceridae, Corophiidae, Dexaminidae, and Liljeborgiidae. But Norwegian talitroids (*Hyale* and beachhoppers of the genera *Orchestia* and *Talitrus*) are not typical of tropical members. The work of Chevreux and Fage (1925) dealing with the Mediterranean (including warm-temperate France) is also useful and slightly more oriented towards genera likely to occur in the tropics than is Sars' Norwegian work.

An index to world species sparsely referenced and keyed to the *Zoological Record* was published by J. L. Barnard (1958), but even in this short time it is out of date because of accelerated study in the group.

In the present work, most of the key characters are illustrated in accompanying figures by outline drawings. Occasionally the drawings are semidiagrammatic and, for clarity of shape, the setae are removed, being indicated by small circles at the points of attachment. To facilitate readability of keys and diagnoses, the figure citations are minimized, but figures can be found to illustrate most characters by searching plates concerned with the appropriate family. Capital letters on the drawings of Figures 5–68 form a code to the species found in each figure legend, whereas lower-case letters indicate the appendage shown. The code to this system is found on page 9. The drawings, unless otherwise marked, represent males but often they actually represent both sexes, since, in many species no significant differences occur between the sexes. The female sign is attached to those appendages in which the female form exhibits a significant taxonomic difference from the male.

The key to families (p. 20) is presented in an abbreviated form in which certain families are keyed out at several points. To most of the families and genera keys have been written to cover both sexes of the various taxa, but a few concern only adult males. The females of these taxa have not yet been adequately differentiated, and this statement may also apply to juveniles, since these usually resemble adult females.

Species of Amphipoda not easily identified by these keys should be presumed to be unrecorded from Hawaii, and for their identification to genus one must resort to Barnard's (1969) handbook. New species and newly recorded species remain to be discovered; for although the species that are abundant and widely

distributed in littoral algae and on ordinary rubble and coral bottoms probably have been captured, exploration has scarcely begun on the specialized habitats, especially those open only to the Scuba diver. Several species not found elsewhere have, for example, been collected in the molluscan assemblage associated with the black-coral *Antipathes;* and another species, *Elasmopus calliactis,* is found only in association with calliactid sea-anemones attached to shells of *Dolium* inhabited by the hermit-crab *Dardanus.* Among the wealth of very specialized habitats such as these must occur many more amphipods which, although of very limited distribution, may be extremely abundant within their niches. More than a dozen Hawaiian species are based on a few specimens; their apparent rarity is in part a measure of the difficulty in sampling their special habitats with gross collecting methods so far utilized.

Collection of Amphipods

Amphipoda are most easily collected by washing substrates in a bucket of seawater mixed with 1–2 ounces of formaldehyde. This poisoned water causes amphipods to swim out of their concealment, die, and fall to the bottom of the bucket amid other debris. The coarse fraction of the debris is removed from the bucket by hand and the remaining contents then strained through a 100 mesh/inch Tyler screen, the solid contents retained by the screen being preserved in a container with a mixture of 5 percent formaldehyde (concentrated formaldehyde diluted 9:1) and seawater. In the laboratory the sample is washed in freshwater; the species are then sorted under a stereoscope and represerved in 70-percent alcohol. Because specimens of a few species remain in their place of concealment, substrate samples should be preserved and examined in the laboratory.

Dissection

Under normal circumstances the student identifying Gammaridea to genera should use the entire procedure of dissection and observation described by Barnard (1969). The fauna of Hawaii is now sufficiently well known, however, that one may initially be able to use the swifter methods described below.

The keys require that the material be in adequate condition, with unbroken uropods and antennae. Broken specimens, except those missing the distal ends of antennae,* should be avoided until experience is gained. The identification requires the initial minimum dissection of the amphipod and observation of other characters not initially removed from the body of the animal; but one must be prepared to continue dissecting off parts of the organism in the event a particular shape has to be observed. Keys, diagrams, and discussion should be perused thoroughly before undertaking the dissection and identification.

Amphipoda vary morphologically from specimen to specimen; if strong sexual dimorphism occurs, there will be considerable difference in male gnathopod 2, which will be generally larger and more strongly ornamented than in females and juveniles; male antennae may be longer; uropod 3 more setose; and eyes larger than in females. A few species have an axial reversal in gnathopodal dominance so that gnathopod 1 is larger and, in males, more complex than gnathopod 2, the latter assuming the character of a first gnathopod. Ovigerous females carry eggs in the ventral brood pouch formed by the lamellae attached to the medial faces of the coxae; on the benthos adult females are generally more common than are males. Large-bodied individuals without brood plates are not always males; these plates may be lost by gerontic females. Males may be determined by microscopic examination of the ventral surface of thoracic segment 7 between the members of pereopod 5. A small pair of penial projections, occasionally minutely spinose, occurs on adult males but they should not be confused with gills occasionally attached to the coxae of that segment. Gills break off easily whereas penial processes do not. So-called intersexual adults may lack any marks of their sex. Juveniles look generally like females.

The specific identity of females occasionally has to be assumed from their repeated association with males in many samples; samples frequently have two or more species of the same genus, with females and juveniles very difficult to distinguish from species to species.

For dissecting and mounting amphipods for microscopic examination, the procedures detailed below have been found useful.

From a sample of Amphipoda preserved in alcohol, or transferred to freshwater, should be isolated a few specimens grossly similar to one another. One is

*Specimens bearing at least one member of pereopods 3–5 (6 legs) and one member of pereopods 1–2 (4 legs) can also be utilized.

chosen as that to be dissected and the others saved for later verification and as source material for opposite sexes and juveniles. The subject amphipod is placed in a Syracuse dish and covered deeply with alcohol.

SLIDE 1.—A small drop of glycerine is placed on a glass slide. The left uropod 3 of the specimen (see Figures 1, 2, and 4) is detached by means of a jewelers forceps plus dissecting needle (insect pin mounted on a wooden stick) and placed in the drop of glycerine. The drop will disperse momentarily in mixing with alcohol but will coalesce quickly if a light breath of air is applied. The uropod on the slide is observed with the stereoscope and arranged so that its dorsal side is up. Observation of the uropod before dissection almost invariably demonstrates sufficient differences in the two rami and shape of peduncle so that the dorsal side can be distinguished after dissection. A glass cover slip is applied gently and manipulated with the forceps so as to prevent the uropod from rolling over while the glycerine spreads.

SLIDE 2.—The carcass of the amphipod with its left side up is placed in a depression slide filled with glycerine and a cover slip is applied. Most Hawaiian amphipods fit snugly into a standard depression slide but a few are so large that supports for the cover slip are required so as to elevate it and prevent crushing of the body. Paper clips, staples, sand grains and broken bits of amphipod appendages are useful as supports of varying thickness.

Glycerine may shrink parts for a few hours but they usually return to normal condition. Many specialists prepare their material by slowly adding glycerine to alcohol so as to adjust the specimens to this medium, and later may dissect the animals in glycerine or warm glycerine jelly. Numerous other media are also satisfactory.

If the urosome (posterior half of abdomen) of the amphipod is strongly flattened and if uropod 3 is not clearly apparent, the full urosome should be removed to slide 1 and mounted dorsal side up. If uropod 3 or its empty socket is still invisible one may have to turn the urosome over in order to find a vestigial uropod 3 appearing as a pair of flaps on the ventral side of the anus and telson.

Uropod 3 on slide 1 is examined with a compound microscope and the observations utilized to commence the basic key (p. 20).

Many of the other observations necessary in later parts of the keys may be made from slide 2 of the body, e.g., coxa 1, antennal length, extent of dorsal depression of the body, gnathopods 1–2 if not strongly twisted, head, urosomite 1, and pereopods. Coxa 1 may be obscured by the thickness of the body interrupting transmitted light, and a slide must be made of it after dissection. If examination of mouthparts, telson, and accessory flagellum (because of its diminutiveness) are required in the keys, further dissection and slide preparation are necessary. The following additional glycerine slides are made by dissecting parts from the carcass of slide 2:

SLIDE 3.—Thoracic legs: all thoracic (pereonal) legs from the right side are removed by using forceps to pull off the legs and their coxae, and are placed on the slide so as to appear to be from the left side; while disengaging these legs one must hold the amphipod in the depression slide (or return it to alcohol in a Syracuse dish) with a forceps or pin in the hand opposite to that grasping the leg; a pin is preferable in holding the amphipod on the segment just above the coxa-leg being removed, so as to prevent breaking the body.

SLIDE 4.—Maxillipeds: the posterior mouthpart, composed of 2 halves basally joined, are easily snapped off with forceps and mounted so that the inner and outer plates (lamellae) face upwards; the curved base may be removed so that the cover-slip fits tightly. Use of the term in the singular (maxilliped) indicates half of the pair.

SLIDE 5.—Maxillae 1–2: these 2 pairs of setose mouthparts lie below the maxillipeds, toward the mandibles, and cover the lower lip; dissection of maxilla 1 requires removal of the inner plates that often are attached more deeply than the remainder of the appendage.

SLIDE 6.—Lower lip: this is often and easily destroyed by tearing while removing maxilla 1, and is difficult to separate because of scleritic connections to mandibles or upper lip; rarely required for purposes of keys herein, it is mounted in glycerine scattered with sand grains to elevate the cover slip.

SLIDE 7.—Mandibles: these are attached by powerful muscles and must be firmly grasped at their muscular bases in order to pull them loose. Knowledge of the palp is essential and observation of palps before dissection will ensure against their

unobserved accidental loss, for the mandible can often be pulled away, leaving its palp. Mandibles often are brittle and easily shattered: they are placed on the slide with the molars, if any, facing upward; otherwise a left mandible should be seated so that the toothed incisor points "north" while the palp points "west"; a right mandible has the palp pointing "east" if the incisor points "north." Sand grains, are usually necessary to support the cover slip.

SLIDE 8.—Right antennae 1 and 2: these are mounted so as to appear left sided, with medial surfaces facing upward. The accessory flagellum of antenna 1, often tiny, occurs on the apicomedial end of peduncular article 3.

SLIDE 9.—Telson: this is the terminal flap on pleonite 6, often bilobed. One must be sure that both lobes are removed, for a single lobe mounted on a slide will appear as an unlobed telson and lead to erroneous identification.

SLIDE 10.—Gnathopods 1 or 2: if these are thick, they should be removed to a separate slide with support for the cover slip.

The carcass is returned to slide 2 and a cover slip replaced; right uropods 1–3, pleopods, upper lip and epistome and all left sided appendages except uropod 3 remain on the animal; if the projection of the epistome must be observed the carcass can be flipped over with its right side up, as the removal of antennae 1–2 on that side permit its view. Pleopods are not utilized in the keys but they can be removed to a storage vial ($\frac{1}{16}$ or $\frac{1}{8}$ dram) so that epimera 1–3 are more clearly visible.

As the right thoracic legs and their coxae are removed from the body they should be observed carefully so as to keep them in numerical sequence; usually the gnathopods are prehensile and gnathopod 2 (coxa 2) is larger than gnathopod 1 (coxa 1); pereopods 1–2 usually are oriented so as to point or function towards the anterior, and coxa 4 (of pereopod 2) is usually larger than coxa 3; pereopods 3–5 (coxae 5–7) usually have coxae smaller than 1–4 (except in some tubicolous species) with coxa 5 largest and bilobed and coxa 7 smallest and simple, coxa 6 being intermediate in size and weakly bilobed; pereopods 3–5 usually increase in size successively but if pereopod 5 is shorter than the others it is usually of distinct morphology. The observer will note that the legs are not numbered in sequence with their coxae, as the first 2 pairs are called gnathopods, even though they are equivalent ontogenetically to pereopods. Gnathopod 2 and pereopods 1–5 or 1–4 have a gill attached to the coxa, and females have a second kind of lamella—the setose brood plate attached one each to coxae 2, 3, 4, and 5. Brood plates may be removed and preserved in the small vial with the pleopods before mounting the legs.

Slides may be labeled with grease pencil and stored flat in boxes to prevent accumulation of dust; storage for more than 2 weeks is inadvisable, as parts become very soft and commence dispersion in glycerine. Slides utilizing permanent mounting media may be made for long-term storage of holotypes or special material, but the time needed makes it inadvisable for a beginning student, who should be involved with dissecting and observation of as many specimens as possible. Many taxonomists preserve their dissected organisms in small vials in alcohol. Parts erroneously mounted upside down are difficult to right in permanent media and it is all too easy to make such mistakes with tiny appendages.

Appendages—Positions and Terms

Gnathopods of amphipods are bent like bird-legs, so that the free ends point forward; other legs or their dactyls also are normally oriented in other than vertical axes. In describing their various parts taxonomists visualize the legs as being straightened out into a vertical axis. Hence the anterodistal corner of article 6 on gnathopod 2 of a vertically oriented appendage appears anterodorsal when the leg is normally positioned by the animal. The true posterior edge of a flexed dactyl on pereopod 5 may appear on the animal to have its face pointing anteriorly or ventrally.

Antennae are described as if they have been fully stretched horizontally to the front.

Uropods are inconsistently described as also occurring in a horizontal plane though they are derivatives of vertically oriented appendages.

The Glossary (p. 6) contains terms used to describe these appendages and positions.

Appendages—Setae and Spines

Gammarideans are especially setose and spinose crustaceans. Setae and spines are a headache to the descriptive taxonomist, who must spend a great deal of time illustrating them; but they often have value in classi-

fication as well as identification, though they occasionally hide other good characters. Except in the taxonomy of freshwater amphipods, the minute structure of setae and spines has rarely been used systematically but it is now being employed more frequently by marine taxonomists. Setae and spines are fundamentally similar, as both have a nerve canal; but spines are shorter, stouter, and stiffer than setae. Some authors correctly use the term setal spines for spines but herein the simpler term spine is used. Many spines (and setae) have apical or subapical branches possibly acting as triggers to the neuron. Some amphipod setae are as complex as those in polychaetes, being composed of two or more articulate parts. Setae and spines are basally articulate but stout spines often become immovably fused to their parent appendage. A good rule of thumb is to call spines those setae that will not bend in the middle without breaking.

In the drawings accompanying this paper most of the plumose setae and many of the triggered spines are drawn as simple lines, because the plumes and triggers are too small or thin to be represented and the added drafting would consume double the time in making all the other figures.

Many gnathopods have a small stiff spine on the palm at the base of the dactyl that in some cases may act to spring open the dactyl or in others to lock it, although the latter is probably rare, as the muscles of the gnathopod appear to be capable only of closing the dactyl. On pereopods the distal end of article 6 often has special spines called "locking spines" and these are often found also defining the proximal end of the palm on the gnathopods. Their purpose is probably to prevent lateral or medial movement of dactyls rather than to lock them into a flexed position; or they may function in ecdysis or prehension. The minute structure of these spines is of special value in recognizing species in the genera *Hyale* and *Ampithoe,* as the spines may be large or small, striate or unstriate, or grossly striate spirally, with the appearance of a screw.

The extent of setation in the gnathopods of *Lembos,* especially in terminal males, is valuable for identification; brushes of setae on antennae of certain species of *Hyale* are also important.

The general and specific setosity of various species has, as yet, scarcely been conveyed by words or statistics, but the taxonomist often relies on gross setal differences as specific characters.

Glossary

[The italic references in parentheses are those used on Figures 5–68 to identify the parts named. A complete list of these is to be found on page 9.]

accessory flagellum (*ac, af*). The secondary ramus of antenna (*a*) 1, often absent or vestigial, and attached medially to peduncular article 3.

aesthetasc, aesthete. Sensory setae of antennae, flattened and nontapering.

article. The segment of an appendage.

calceolus. A small globular or helmet-shaped, articulate sense organ on the antennae; presumably a modified aesthetasc; of rare occurrence in Gammaridea and most often seen in Eusiridae.

carpochelate. Immovable finger of prehensile appendage occurring on carpus (article 5); example: *Leucothoe.*

chela. Immovable finger of prehensile appendage.

chelate. Descriptive of the palm of a gnathopod protruding as an immovable finger on which the dactyl closes. See parachelate, carpochelate, propodochelate, merochelate.

claw, claw-like. Descriptive of a talon or simple, tapering nail. (Not descriptive of chelae as used in decapod terminology.)

compressed. Flattened from side to side.

conjoint. Describing the basal amalgamation of flagellar articles on antennae.

corneal lens. A biconvex cuticular body occurring directly in or on the chitinous cephalic surface in Ampeliscidae; contrasted with subcuticular ommatidia.

coxa (*c*), coxal plate. (Terms used synonymously herein.) Article 1 of a pereonal appendage, expanded into a lateral lamella. (Terms for other articles of the appendages such as basis, ischium, merus carpus, propodus, and dactyl are frequently but not universally used in Gammaridea; instead, the articles are simply numbered.)

dactyl. Talon-like terminal article of pereopods (article 7) or maxillipeds (articles 3 or 4).

depressed. Flattened dorsoventrally.

emarginate. Descriptive of the concave posterior end of an uncleft telson.

entire. Descriptive of an uncleft telson.

epimeron (*ep*). A lateral pleuron of pleonites 1–3; the ventrolateral plate-like extension of the body segment.

epistome. The anterior surface of the head above the labrum; this area is often extended ventrally to ap-

pear as a part of the labrum and may be anteriorly produced as a cusp or lobe.

flagellum. The distal portion of either antenna 1 or 2; on antenna 1 it commences with article 4, on antenna 2 with article 6; because basal peduncular articles of antenna 2 are often difficult to resolve, the juncture may be recognized between the elongated final peduncular article and the shortened first flagellar article which is followed by similar short articles; on antenna 1, however, article 1 of the flagellum is occasionally elongate and apparently composed of nonsegregated (thus conjoint) daughter articles.

galeate. Descriptive of the helmet-shaped heads of various oedicerotids and synopiids.

gnathopod (*g*). One member of the first two pairs of free thoracic appendages; these appendages differ in function and usually in appearance from following pereopods; often called pereopods.

hand. Article 6 of a gnathopod.

incisor (*in*). The apical portion of the mandible, usually formed into a toothed chewing edge or untoothed chopping plate.

joint. The juncture between two articles of an appendage.

labrum. (See upper lip.)

lacinia mobilis (*lm*). Articulated accessory plate proximal to the mandibular incisor, often absent or missing on either left or right mandibles, occasionally indistinguishable from a spine of the spine-row.

locking spine. The distal-most spine(s) on article 6 of pereopods 1–5, near the base of the dactyl.

lower lip (*ll*) (labium). A fleshy complex posterior to the mandibles, always composed of at least one pair of lobes (outer), often with a medioproximal pair of inner lobes; the lateroproximal ends of the outer lobes are often attenuated as alae and are denoted as mandibular lobes.

mandible (*m*). The anterior movable appendage of the buccal group; usually composed of a body bearing a distal incisor, a lacinia mobilis, spine row, molar, and 3-articulate palp.

massive. A term applied to the heads of Synopiidae and Oedicerotidae; head as long as pereonites 1–3 combined and as tall as or taller than long (length not including rostrum). Heads of Ampeliscidae and Phoxocephalidae are elongate but not massive; heads of Acanthonotozomatidae are as tall as long but are not as long as pereonites 1–3 combined.

maxilla (*x*) 1. A pair of cephalic appendages posterior to the lower lip; for taxonomic purposes only three portions of each member are named: the medial lobe (plate) usually bearing marginal setae, the lateral and larger lobe (plate) bearing terminal spines, and, attached to the outer lobe, a palp usually composed of two articles but occasionally absent.

maxilla (*x*) 2. A pair of cephalic appendages posterior to maxilla 1; for taxonomic purposes each member recognized as a pair of lobes (plates) medial and lateral, usually strongly setose.

maxillipeds (*xp*). The posteriormost pair of "cephalic" appendages, representing the primitive first thoracic segment now amalgamated with the head but in amphipod taxonomy not included in the sequential numbering of thoracic appendages; for taxonomic purposes recognized as a pair of basally amalgamated appendages, each member composed of a proximal (inner) plate, a distal (outer) plate, and a palp of four articles, rarely reduced to 3 or 2 articles or absent.

merochelate. Immovable finger of prehensile appendage occurring on merus (article 4); example: gnathopod 1 of *Aoroides*.

metasome. Pleonites 1–3. [Term rarely used.]

molar (*mo*). A process of the mandible, located on the midmedial margin; when completely developed it is a large, massive, subcylindrical body with a surface of ridges and teeth used for grinding (triturative).

ommatidium (singular), ommatidia (plural), ommatidial (adjective). Terms applying to the parts of the subintegumentary compound eye, not to be confused with the corneal lenses of the integument of Ampeliscidae.

palm. A posterior surface or margin of article 6 of a gnathopod or pereopod on which article 7 (dactyl) closes for the purpose of prehension; usually recognizable because of expansion of article 6 or by occurrence of special spines or ornamentation and usually with a proximal defining limit marked by a change in marginal slope or occurrence of special spines.

palp (*pal*). Terminal articles of a buccal appendage, in Amphipoda occurring only on mandibles, first maxillae, and maxillipeds as the stenopodous terminal articles distal to the expanded outer plates or main body.

parachelate. A weakly chelate condition like that shown herein for gnathopods 1–2 of *Biancolina*.

peduncle. The basal articles of a fundamentally biramous appendage; in Amphipoda applied to an-

tennae, pleopods, and uropods; antenna 1 with three peduncular articles, antenna 2 with five peduncular articles (but appendage not biramous); pleopods with one definitive peduncular article but remnants of others occurring proximally; uropods each with one peduncular article.

pereon. The complex of seven free thoracic segments bearing gnathopods and pereopods, not including the maxillipeds.

pereonite. A segment of the pereon.

pereopod (*p*). A walking, grasping, standing, or feeding appendage attached to a pereonite; normally composed of seven articles, including coxa; in Amphipoda the first two pairs are often termed gnathopods and only the last five pairs of thoracic legs are called pereopods.

plate. A flattened lobe on an article of a maxilla or maxilliped.

pleopod (*n*). A biramous swimming appendage on pleonites 1–3, one pair for each pleonite.

pleon (*pl*). The abdomen (of six free segments in Gammaridea, rarely with some segments coalesced). See metasome and urosome.

pleonite. A segment of the pleon.

prehensile. Adapted for seizing or grasping; applicable to but rarely used for gammaridean gnathopods; especially useful in denoting pereopods of several species of *Ampithoe* which either are subchelate or chelate, or have distinct, spinose palms or nonskid surfaces indicating their use in grasping.

propodochelate. Synonymous with chelate.

propodus. The sixth article of a thoracic appendage (especially used to denote the palmar article of a gnathopod).

scale, scale-like. Terms applied to the accessory flagellum (*ac*) when forming a small lamella immovably fused to article 3 of antenna (*a*) 1; and to the inner ramus of uropod (*u*) 3 when strongly reduced and plate-like.

simple. Used in amphipod taxonomy to denote the absence of spines or setae on appendages; or the occurrence of but a single article in the ramus of a uropod; or especially to the absence of a palm on a gnathopod (*g*) or pereopod (*p*). Distinction between subchelate and simple is often weak.

subchelate. Article 6 of a gnathopod or pereopod having a distal palm against which article 7 closes; a prehensile condition in which the palm is not produced to form a finger; intermediate in condition between chelate and simple. Complexly subchelate or complexly chelate are terms referring to the formation of a false chela by protrusion of teeth, cusps, or lobes from articles other than the sixth and upon which article 7 impinges to form a prehensile condition; occurring especially in Aoridae, Corophiidae, and Leucothoidae. See "simple."

telson (*t*). A flap dorsal to the anus attached to pleonite 6, primitively bilobed but usually in Amphipoda with bases coalesced and often with lobes completely coalesced to form a single plate.

terminal. Male or female in final stage of adulthood.

triturative. Descriptive of the rasp-like surface of a mandibular molar, composed of teeth, ridges, and cusps.

upper lip (*ul*) (labrum). A fleshy lobe attached to the anterior cephalic margin in front of the mandibles; occasionally the anterior surface of the labrum protrudes as a lobe or cusp; often the cephalic area to which the labrum is attached is recognizable as an "epistome" and may also be lobed; or both labrum and epistome may be indistinguishable and produced together as a single lobe.

uropod (*u*). One member of the three pairs of terminal pleonal appendages, each formed of a peduncle and two rami (occasionally rami of uropod 3 reduced or absent, rarely rami of uropods 1–2 absent or reduced).

urosome (*ur*). The complex of pleonites 4, 5, 6, carrying uropods (*u*), and telson (*t*). Often numbered as urosomites 1, 2, 3.

urosomite. A segment of the urosome (*ur*).

Diagnosis of the Basic Marine Gammaridean

FIGURES 1, 2

Accessory flagellum well developed, with 4 or more articles. Primary flagellum of antenna 1 not basally conjoint (Figure 2) or elongate.

Mouthpart field quadratiform from lateral view (as contrasted to coniform).

Each mandible with 3-articulate palp, article 3 longer than article 1; molar present, with grinding surface composed of ridges and teeth (= triturative).

Lower lip (labium) with principal (outer) lobes undivided or unnotched and not widely separate, lobes with sharp or blunt lateroproximal extensions ("mandibular extensions"), without inner lobes.

Each maxilla 1 bearing inner lobe, outer spinose lobe and strong, straight palp of 2 articles.

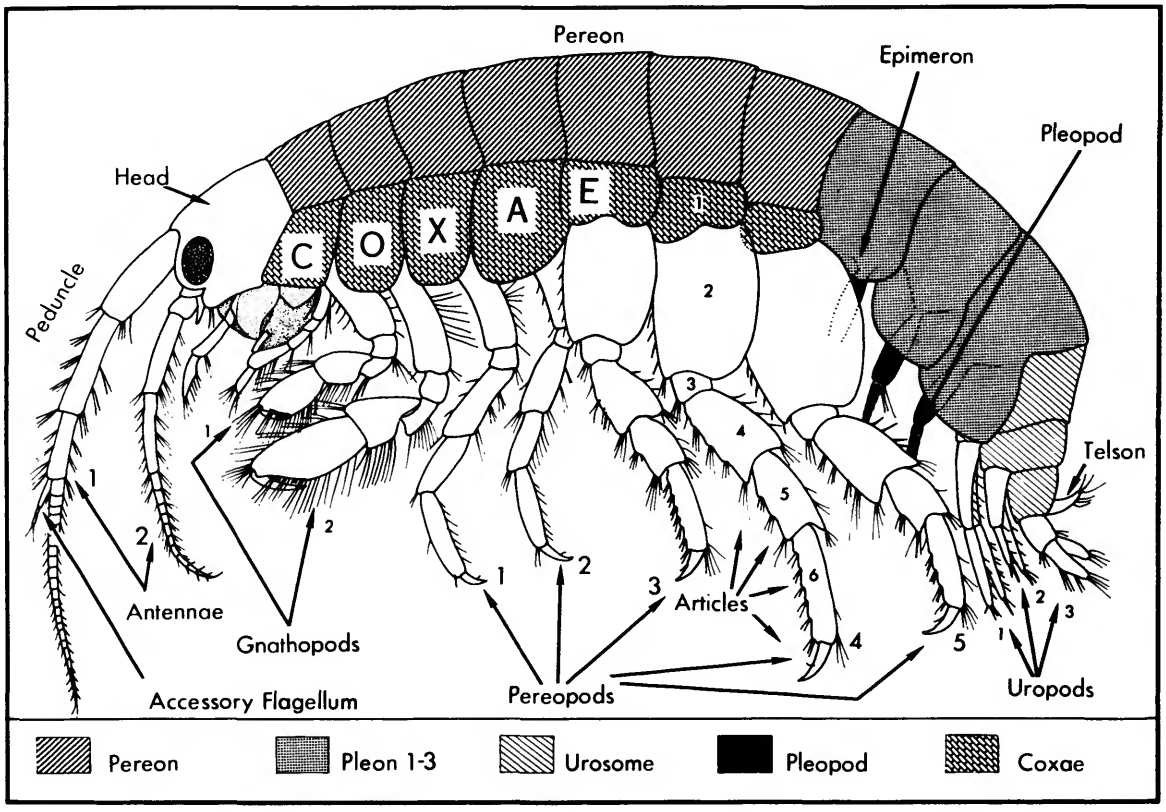


FIGURE 1.—The basic gammaridean.

The following letter symbols are used to identify parts of the amphipods illustrated on Figures 5–68. For additional details of definition, see Glossary (page 6) and also Figure 1.

a	antenna	*l*	lateral	*r*	medial
ac,af	accessory flagellum	*ll*	lower lip	*t*	telson
b	prebuccal mass from lateral view	*lm*	lacinia mobilis	*tl*	telson, lateral
		m	mandible	*u*	uropod
c	coxa	*mo*	mandibular molar	*ul*	upper lip
d	dorsal	*mp*	mandibular palp	*ur*	urosome
ep	epimeron	*mt*	mouthparts	*v*	ventral teeth of pereon
g	gnathopod	*n*	pleopod	*w*	side view
h	head	*op*	outer plate	*x*	maxilla
in	mandibular incisor	*or*	outer ramus	*xp*	maxilliped
ip	inner plate	*p*	pereopod	*z*	gill
ir	inner ramus	*pal*	palp		
j	juvenile	*pl*	pleon		

Each maxilla 2 with 2 well-developed, setose lobes.
Each side of maxillipeds with large inner (proximal) lobe and outer (distal) lobe, and 4-articulate palp, article 4 claw-shaped (unguiform).
Gnathopods well developed and subchelate ("powerful"), non-lysianassid in form. (See lysianassid in Figure 52.)
Gnathopod 2 larger than 1 in male, gnathopod 1 never larger than 2 in female, article 3 of gnathopod 2 short.
Article 4 of pereopods 1–2 not extensively elongate.
Pereopods 3–5 of congruent structure and successively slightly longer.
Three pairs of large and subequal uropods present, all biramous, rami subequal in length, lanceolate (Figure *4E*); peduncle of uropod 3 not elongate.
Telson deeply cleft, of medium length.
Coxae forming elongate, rectangular plates with quadrate or rounded distal edges, coxae 1–4 of uniform shape or slightly increasing in size consecutively, coxa 4 excavate posterodorsally, coxae not splayed.
All body segments free. Metasome (pleonites 1–3) only as long as last 5 pereonites combined; head subcuboidal, not massive, rostrum small. Body laterally compressed.
Eyes if present ommatidial, not corneal and composed of one eye on each side of head.
Figure 2 shows ordinary kinds of dissected parts and illustrates variations in telsons, the fleshy telson, the appearance of quadratiform and conical mouthpart bundles, and a conjoint primary flagellum of antenna 1. Other variations are developed in the figures cited in the Keys.

Identifications—Objective

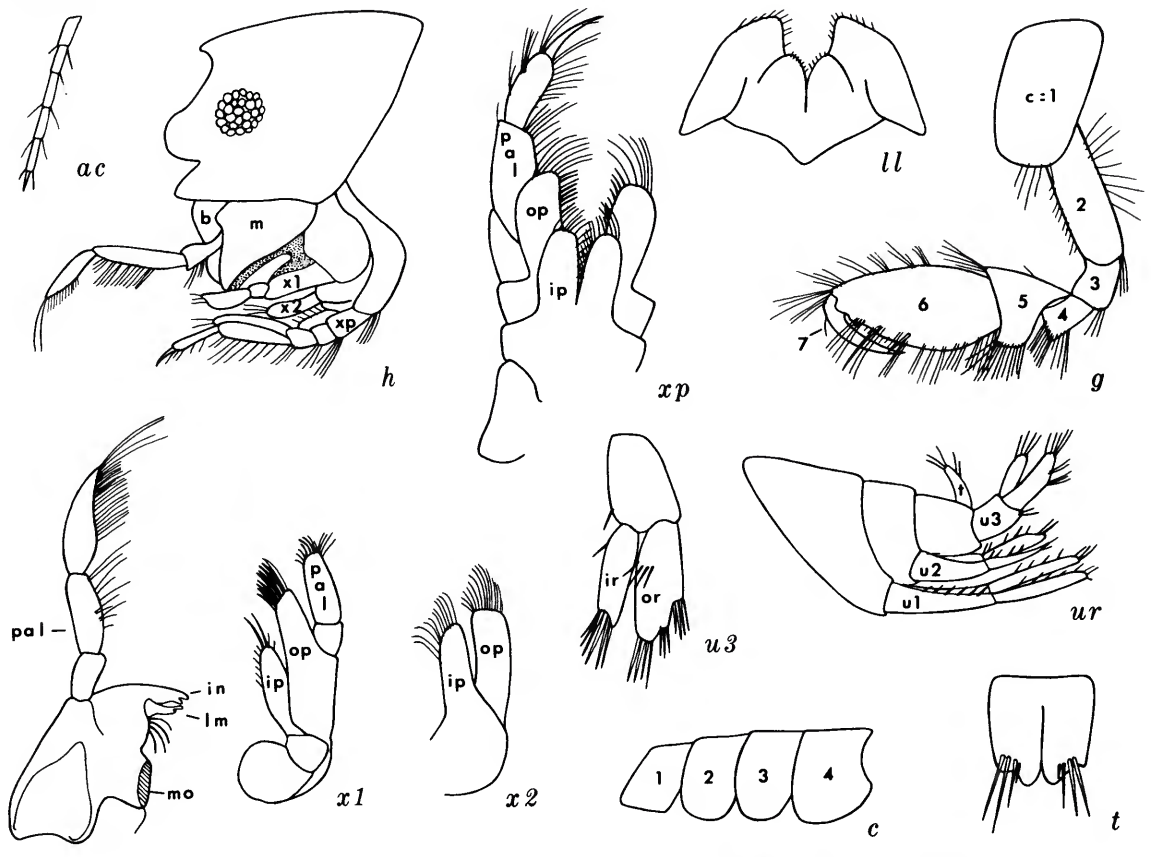
The concept of a basic marine gammaridean is useful to the observer using the key to families (p. 20). The diagnosis of the basic gammaridean on page 8 contains the framework of an ordinary gammaridean as illustrated in Figures 1 and 2 (upper). In a specimen being identified any morphological departure from this plan signals an extraordinary character to be noted. This may hasten the process of operating the various keys, because the observer has at hand a special memory device. For example, the specimen may fit the model of the basic gammaridean in all characters except for the presence of a non-triturative mandibular molar, a condition which should lead one fairly rapidly through the key to the Liljeborgiidae. Or the specimen may fit the basic gammaridean except for having spinose antennae and a short, morphologically distinctive pereopod 5, a condition which should lead to the Phoxocephalidae.

Because of the abbreviated form of the keys their various alternatives should be traced to conclusion, especially where one has difficulty in making a value judgment on a character. For example, in couplet 11 of the first section in the key to families, one may often choose either pathway and trace each to its conclusion. Suppose that the organism truly belongs to the Aoridae of couplet 12 but one is tracing it through Section D (leading from couplet 11): various incongruities will crop up as one terminates the key, perhaps in the Gammaridae, and if the organism is then traced through the key to the Gammaridae (p. 68), it will become clear that no genus or species of Gammaridae has a third uropod precisely like that found in various aorids. One must therefore return to couplet 12. The use of figure 4 in classifying kinds of uropod 3 can be of assistance, as can the classification of heads and eyes in figure 3, although the observations to be made from the head are of a higher order of difficulty than those from uropod 3.

USE OF THE KEYS AND MAJOR PITFALLS.—No Hawaiian gammaridean so far discovered completely lacks a uropod 3 but several taxa (e.g., *Podocerus, Corophium, Palinnotus*) have such small third uropods that superficially these appear to be absent. The podocerid and phliantid uropod 3 is a tiny flap below

FIGURE 2.—Upper half, The basic gammaridean; lower half, variations in pertinent structures of Gammaridea not otherwise shown in subsequent figures:

a1 conjoint main flagellar base (stippled) rarely occurring
ac variations in accessory flagellum
h head of a species with conically arranged mouthparts
ll lower lip of species with outer lobes incised
tl–1 lateral view of normal telson with keel stippled
tl–2 lateral view of fleshy telson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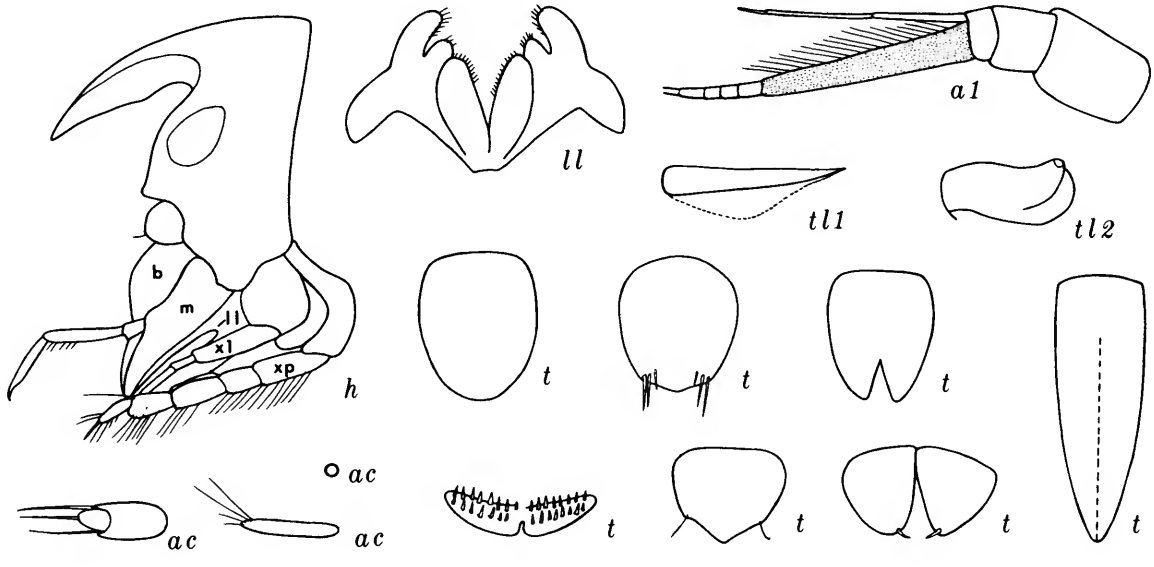
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the telson and has to be observed by mounting the urosome ventral side up on a depression slide and focusing with high power on a compound microscope. Many taxa of Hawaiian amphipods frequently shed uropod 3 on preservation (examples are *Gitanopsis, Melita, Ceradocus, Maera, Leucothoe, Kanaloa;* these genera have exceptionally elongated uropod 3. The socket or invagination on pleonite 6 remain as marks of the presence of the uropod. Until some familiarity is gained with other characters one prefers to avoid specimens lacking uropod 3 but, as a last resort, one may examine brief remarks on each family herein to identify the material by elimination.

The keys cannot be used to elaborate diagnoses of taxa because several are cited twice, in some cases in erroneous positions so as to handle possible observational errors. For example, Oedicerotitdae in couplet 7 of the basic key are misplaced, as they have an elongate peduncle on uropod 3 and belong legitimately where placed in couplet 6 of Key Section B.

Identifications—Non-Objective

FIGURES 3, 4

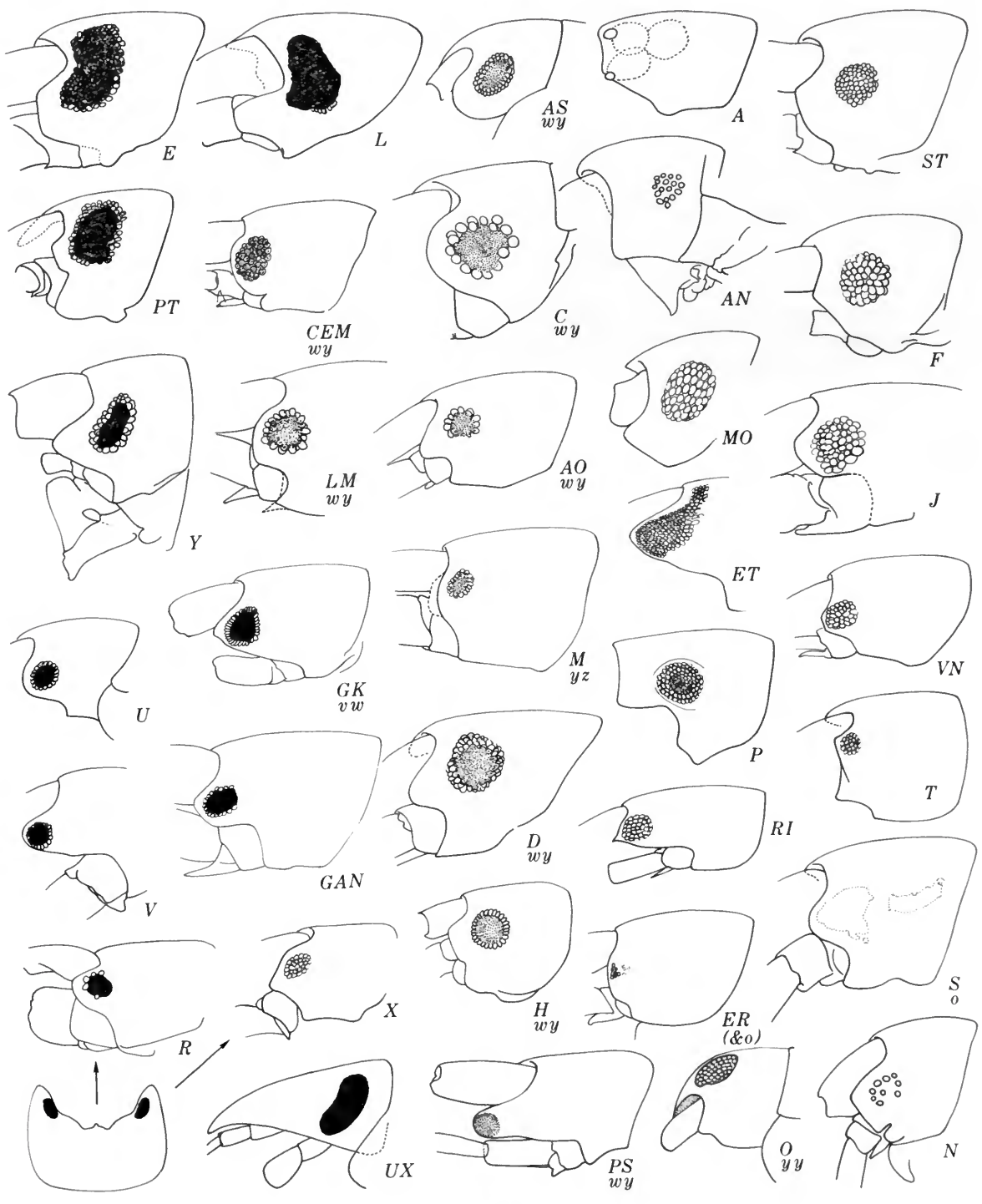
The term non-objective is used here in place of "subjective" because the methods discussed in this section, when fully elucidated, will probably be perfectly objective.

Once a specialist learns the main species of a fauna such as that in Hawaii, he is generally familiar with the overall appearance of those species or, by trial and error, has memorized various clues to their identity. At this point, if he is processing large quantities of material for ecological studies, he does not necessarily pursue a formal identification with each specimen but may separate them into groups by means of non-objective criteria. Shape of body and head, eye color, and structure of uropod 3 are often characters of first recall. They can also be used by the nonspecialist to sort materials into groups before pursuing the formal identifications. Characters of antennae, pereopods and gnathopods can also be useful; but antennae and pereopods often become separated from preserved specimens, and gnathopods often widely differ between the sexes and according to the maturity of the amphipod. Uropod 3 also often falls off specimens, and such specimens should generally be avoided. If uropod 3 is absent one may generally conclude that it was very large or elongate, conditions which are clues to the identity of the amphipod.

The following four sections present several schemes for non-objective identifications based on general body

FIGURE 3.—Heads and eyes of Hawaiian Gammaridea. Heads of *Biancolina, Ochlesis* and *Palinnotus* are omitted, since for them body shape is more important than heads as a recognition character. The left hand side of the figure is mostly composed of black eyes (solid ink), the right red-clear eyes (outlines and clear ommatidia only) whereas in the middle various stippled eyes indicate that either dark or red-clear eyes occur in different species or genera with the head designated. Identifications are as follows:

A	*Ampelisca*	*LM*	*Lembos* and *Maera*	*X*	*Chelura* (eyes amber in alcohol)
AN	*Anamixis*	*M*	Ampithoidae	*Y*	*Lysianassa*
AO	*Aoroides*	*MO*	*Mokuoloe* (Amphilochidae)		
AS	*Amphilochus-Gitanopis-Gitana*	*N*	*Nuuanu*		
C	*Colomastix*	*O*	*Kanaloa* (Oedicerotidae)		
CEM	*Ceradocus-Elasmopus-Maera* (rarely)—*Melita*	*P*	Podoceridae		
		PS	*Photis*		
D	*Parapleustes*	*PT*	*Pontogeneia*		Eyes:
E	*Eusiroides*	*R*	*Corophium*	*o*	absent
ER	*Eriopisa-Eriopisella*	*RI*	*Ericthonius*	*v*	medium brown or caramel
ET	*Gammaropsis atlantica*	*S*	*Seba* (glands shown)	*w*	dark, black, brown, deep purple
F	Leucothoidae	*St*	*Stenothoe*	*y*	red, orange, yellow, clear
GAN	*Gammaropsis-Aloiloi-Neomicrodeutopus*	*T*	*Atylus*	*yy*	permanently yellow
		U	*Wailele*	*z*	medium to pale purple
H	Hyalidae and *Parhyalella*	*UX*	*Paraphoxus*		
J	*Jassa* and *Ischyrocerus*	*V*	*Ventojassa* and *Parajassa*		
L	*Liljeborgia*	*VN*	*Chevalia*		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shape, overall color patterns, the specific pattern of head shape combined with eye shape and color, and the morphology of uropod 3. The last method is least subjective but it is generally useful to classify only to generic level. By more extensive study, however, one may be able to develop it to greater precision. The observation of heads is more precise to specific level than the other methods, but its use requires considerable experience. The overall body shapes are useful only in a few genera. The general color patterns of bodies in various preservatives and in life hold great promise in making rapid identifications, but far more study is required before this method is feasible. These sections are presented mainly as a stimulus to biologists residing in Hawaii, in the hope that they can perfect these methods of identification.

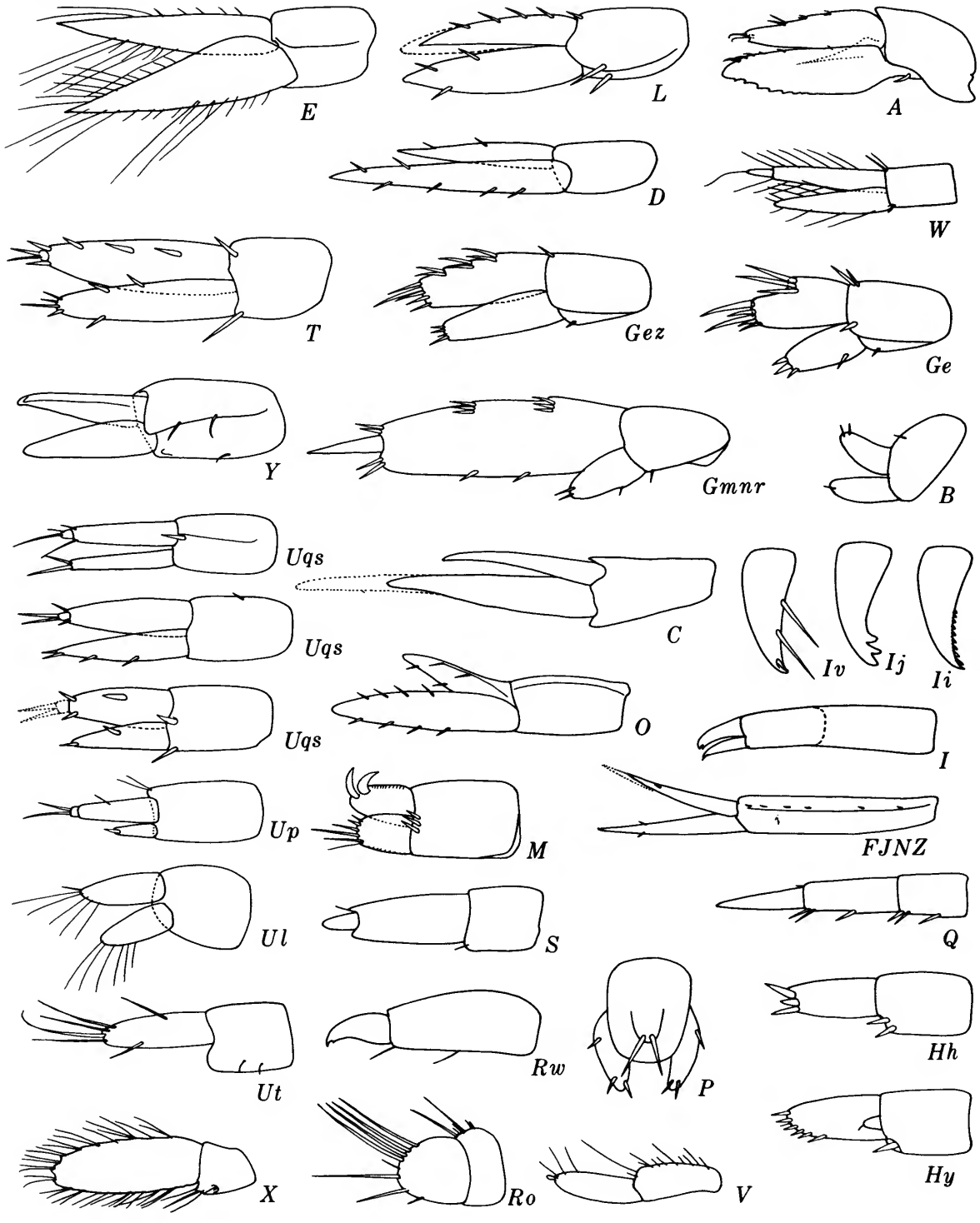
BODY SHAPE.—Because several species of Gammaridea have characteristic body appearances, they will be recognized long before a look at uropod 3 or the head is necessary. For example, the following taxa are best recognized by their general appearance (see figures herein and in Sars, 1895): Ochlesidae, Podoceridae, Colomastigidae, *Corophium,* Cheluridae, and Biancolinidae. The hard, clear white, glossy bodies of Lysianassidae and Sebidae are likewise characteristic.

COLOR IN PRESERVATIVE.—Amphipods preserved in formaldehyde-seawater, though changed in color from life, usually retain a specific color pattern for a few days; and once this color pattern has been matched to certain species, they may be recognized and sorted into groups with rapidity and fair precision. Since they are most easily and inexpensively preserved initially in a formaldehyde-seawater solution and since it is desirable to examine the carcasses in freshwater within 1–2 days after collection, washing the amphipods in freshwater is convenient and it removes the offensive preservative as well; they should, of course, be represerved in alcohol. Species of some genera like *Amphilochus* have several color phenotypes in a 2-day formaldehyde solution, whereas others turn translucent or white but often retain a fairly stable color in the eyes. The frosted appearance of amphipod eyes is lost after death. The colors of orange, red, buff, yellow, green, pink and gray fade after death, and quite rapidly in formaldehyde, but black and brown in the eyes are usually retained both in formaldehyde and in alcohol, though they may be seen under high power magnification to be brownish or purple. Hence the distinction between black (brown, purple) and non-black can be useful in identifying species, and this works well also for specimens preserved in alcohol, since eyes that have become translucent in alcohol generally would have become red or yellow in formaldehyde. This distinction between black and non-black can be used for example, to distinguish juveniles of *Elasmopus calliactis,* which lack the dark ocular pigment, from juveniles of similar species, which have it.

The retention of purplish brown pigments on the body is very useful in distinguishing species of *Lembos* (p. 50) and may become useful in other genera when they can be studied extensively. The patterns are best seen under low-power stereoscopic microscopy. Dark pigments such as black, purple, or brown may actually be covered in life with some other color, like red. Red

FIGURE 4.—Kinds of uropod 3 in Hawaiian Gammarida; all are drawn as left-sided so that the outer ramus of each occurs towards the top of this illustration. Letters in capitals refer to familial groups (sometimes used to identify genus when family is monotypic); letters in lower case refer to infra-familial groups, mainly genera.

A Ampeliscidae
B Biancolinidae
C Colomastigidae
D Pleustidae
E Eusiridae
F Leucothoidae
G Gammaridae
H Hyalidae-Hyalellidae
I Ischyroceridae
J Oedicerotidae
L Liljeborgiidae
M Ampithoidae
N Anamixdae
O Ochlesidae
P Podoceridae
Q Stenothoidae
R Corophiidae
S Sebidae
T Atylidae-Dexaminidae
U Isaeidae-Aoridae
V Phliantidae
W Phoxocephalidae (*Paraphoxus*)
X Cheluridae
Y Lysianassidae (*Lysianassa*)
Z Amphilochidae
e *Elasmopus*
h *Hyale* and *Parhyalella*
i *Ischyrocerus*
j *Jassa*
l *Chevalia*
m *Melita*
n *Nuuanu*
o *Corophium*
p *Photis*
q *Gammaropsis*
r *Eriopsa*
s *aorids*
t *Neomicrodeutopus*
v *Ventojassa*
w *Ericthonius*
y *Parhyale*
z *Maera*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pigment dissolves easily in preservatives under most circumstances, either turning yellow or revealing a yellow pigment mixed with it, and this yellow usually disappears some days later to leave the cuticle or eye translucent. Dissolution of the pigment may occur differentially in various specimens, possibly indicating different phenotypes recognizable in life as red or white-eyed. This is especially noticeable in *Ericthonius brasiliensis;* a sample of this species may contain specimens with red, yellow, and clear eyes, but all of these, after a week of preservation, will bear clear eyes. Eyes deteriorate in any preservative, so that museum specimens often have amber eyes or the eyes undergo chemical reorganization and resemble egg yolks.

A well-developed scheme of identification based on color cannot be presented here, as I was unable to amass sufficient information on all of the Hawaiian species, but the eyes alone have been examined for color in all species. Most of these observations were made within two days of collection on specimens preserved in formaldehyde; this operation became a standard procedure and is so noted in the following sections and in the systematic section of this paper.

HEAD AND EYES (In this section, italic references in parentheses are to parts of Figure 3).—Cephalic outline and attendant eye shape are highly characteristic of Phoxocephalidae and Ampeliscidae, even though their general body appearance is not. Phoxocephalids have visor-shaped rostra (*UX*) and Ampeliscidae have subcuboidal heads with 2 clear jewel-like corneal lenses on each side of the head near the anterior margin. Phoxocephalids have dark eyes, and ampeliscids have red pigmentary masses behind the lenses and in the center of the head; the red masses may bleach in alcohol (some genera like *Byblis* have brown or black pigmentary masses, but such genera have not yet been found in shallow waters of Hawaii).

The galeate head of the oedicerotid *Kanaloa* is also distinctive (*O*). The eyes of this genus are deep yellow in either alcohol or formaldehyde, but other oedicerotids yet uncollected in Hawaii are known to have a wide variety of eye colors, and the tironid *Synopia* may also have yellow eyes like *Kanaloa*.

Heads of Podoceridae (*P*) have a columnar anterior projection; the eyes are reddish, with cores often retaining muddy pink-purple pigment in alcohol; and the species *Laetmatophilus hala* has dorsal cephalic protuberances, a highly distinctive feature.

The remaining kinds of gammaridean heads in Figure 3 are less distinctive than those already discussed and are best classified in groups (left and right in the figure) as to eye color. Genera with eyes drawn in solid black are black-brown-purple (="dark") in formaldehyde after 2 days preservation and they generally remain a dark color after transferral to alcohol. This color retention is of medium extent in a few species of *Elasmopus,* the eyes of which may turn medium purple in alcohol; whereas in two species of Amphilochidae, one of Colomastigidae, and three of Ischyroceridae the eyes may turn muddy magenta or rusty in either formaldehyde or alcohol. Eyes with stipples or bearing the code "*wy*" represent a group in which eyes may be either dark, red, partly pigmented, or clear: for example, the head shape in *LM* is common to *Lembos* and *Maera,* in most species of which the eyes are dark except for a few of *Maera,* which have red or clear eyes. Eyes drawn in outline represent heads (and species) in which eyes are red, yellow, or clear in any preservative.

The distance of observation often makes a difference in the color observed (one species of *Maera* has blood-red eyes that appear black from a distance), and purple eyes often appear more strongly pink upon close observation.

Within a few genera, the species of which have heads of similar shape, and frequently with ordinary specific characters obscured in females or juveniles, the species may often best be distinguished by eye color; examples are the genera *Elasmopus, Maera, Colomastix. Amphilochus.*

Recognition of cephalic outline is difficult as a quick method of identification unless a great study effort is undertaken. Here it should be noted that the illustrations of Figure 3 are designedly fragmentary because they are the views one must become acquainted with. Many pitfalls exist in their use but the cephalic shape can be very useful if a wide variety of materials is available and the student must identify and count numerous specimens for ecological analyses. In addition to the distinctive head shapes discussed above, three main points of focus occur in the head: (1) the shape and size of the rostrum; (2) the protrusions or indentations at the anteroventral corner of the head, partially obscured by coxa 1; and (3) the base of antenna 2, often complex, with obscure sutures and often with a glandcone on article 2 resembling a tooth on the head.

Identification by means of head characters is expedited by the ability to manipulate tools and brushes dexterously, so that the amphipod can be handled with rapid and gentle movements, and by memorizing shapes sufficiently to recognize them from any view. If the amphipod is held with one tool and the pair of first antennae depressed with another tool, the rostrum can usually be seen easily. Then coxa 1 can be turned aside, dirt brushed away, and the head tilted so that reflected light shines on the sutures at the junction between the head and antenna 2. With a little practice, one may determine whether the head is deeply recessed and one may distinguish between a tooth (glandcone) on article 2 of antenna 2 and a tooth or excavation on the head proper. For such examination, fresh specimens with pigmentary stain are superior to bleached museum specimens, unless special stains are applied.

The lists below classify the species of Hawaiian Gammaridea according to eye color, the genera within each list being arranged alphabetically. The conditions noted at the head of each list assume observations of a mounted head, with left coxa 1 removed, under a compound microscope.

Eyes are absent in *Eriopisa laakona* and *Seba ekepuu* (glandular tissue is shown in outline in figure 3).

List 1. Eyes black or brown in formaldehyde (2-day) solution, retaining black-brown, deep purple in alcohol, or eyes with residual black after veneer of garnet dissolved in alcohol (marked with +); species retaining opaque blotches of light purple, muddy brown, and rusty pigment in alcohol are marked with (x); coffee-brown is indicated by (B), caramel orange-brown by (C):

Amphilochus menehune x
Ampithoe kaneohe (tiny black spot in alcohol)
Aoroides nahili
Ceradocus hawaiensis
Chevalia aviculae (tiny black spot in alcohol) +
Colomastix lunalilo x
Corophium acherusicum
Corophium baconi
Corophium insidiosum
Elasmopus diplonyx x
Elasmopus ecuadorensis hawaiensis
Elasmopus hooheno
Elasmopus molokai
Elasmopus piikoi
Elasmopus pocillimanus
Elasmopus rapax
Elasmopus spinidactylus
Eriopisella sechellensis
Eusiroides diplonyx
Gammaropsis afra B–C
Gammaropsis alamoana
Gammaropsis haleiwa
Gammaropsis kaumaka
Gammaropsis pali +
Gammaropsis pokipoki
Gitanopsis pele
Hyale affinis
Hyale ayeli
Hyale grandicornis bishopae
Hyale honoluluensis +
Hyale iole
Hyale laie
Hyale sp.
Ischyrocerus kapu x
Ischyrocerus oahu x
Jassa lilipuna x
Konatopus paao C
Lembos aequimanus
Lembos intermedius
Lembos kamanu x
Lembos leapakahi B
Lembos macromanus B
Lembos pualani
Lembos waipio B
Lembos sp.
Liljeborgia heeia
Liljeborgia laniloa
Lysianassa ewa B
Maera insignis
Maera pacifica
Maera quadrimana
Maera sp. A (a few)
Maera sp. B
Melita pahuwai
Neomicrodeutopus makena
Palinnotus alaniphalias
Parajassa angularis
Paraphoxus centralis
Parapleustes derzhavini
Parhyale hawaiensis
Parhyalella pietschmanni +
Photis kapapa
Pontogeneia pacifica
Ventojassa ventosa
Wailele manene

List 2. Eyes red (R, known red), yellow or clear in formaldehyde, turning yellow or clear in alcohol (CA, known only), except (+) eyes turning black or purple in alcohol after garnet veneer dissolved away; (C) indicates caramel-orange; (x), in alcohol portions of eyes with opaque muddy purple, rusty or pink stain (eyes otherwise in this category are translucent, never opaque in alcohol, except *Kanaloa* with permanently yellow pigment); (P), translucent purple in alcohol, unknown in formaldehyde; (L), head with 4 clear corneal lenses and 5 large red internal pigment masses; (O), orange in alcohol:

Aloiloi nenue +
Ampelisca schellenbergi L
Amphilochus kailua CA
Amphilochus likelike R
Amphilochus menehune x
Ampithoe akuolaka P
Ampithoe kaneohe +, P
Ampithoe orientalis CA
Ampithoe poipu CA
Ampithoe ramondi
Ampithoe waialua P
Ampithoe spp. CA
Anamixis stebbingi R
Aoroides columbiae C, O
Atylus nani R
Biancolina mauihina R
Chevalia aviculae R
Colomastix kapiolani R
Colomastix pusilla R
Colomastix sp. R
Cymadusa filosa CA
Cymadusa hawaiensis CA
Cymadusa oceanica CA
Elasmopus calliactis R
Elasmopus pectenicrus CA
Ericthonius brasiliensis R
Eriopisa hamakua O
Gammaropsis atlantica R
Gammaropsis pali +
Gitana liliuokalaniae R
Hyale honoluluensis +
Hyale waimea R
Ischyrocerus sp. C O
Jassa lilipuna x
Kanaloa manoa Y
Konatopus paao C
Laetmatophilus hala R
Lembos kamanu P
Leucothoe hyhelia R
Leucothoe lihue R
Leucothoe tridens R
Leucothoides pottsi R
Maera kaiulani O
Maera serrata P
Maera sp.A R
Melita appendiculata CA
Mokuoloe ninole R
Nuuanu amikai O
Ochlesis alii O
Paragrubia vorax CA, P
Parapleustes honomu R
Parhyalella pietschmanni +
Photis aina CA
Photis hawaiensis R
Podocerus brasiliensis R
Podocerus hanapepe R
Podocerus talegus R
Stenothoe haleloke R
Stenothoe valida R
Stenothoe sp.A R
Stenothoe sp.B R
Tropichelura insulae (eyes amber in alcohol)

KINDS OF UROPOD 3 (In this section italic references in parentheses are to parts of Figure 4).—The morphology of uropod 3 can be helpful in rapidly identifying a specimen to the familial or generic level. The basic uropod 3 (*E*) has a short peduncle and long lanceolate rami characteristic of Eusiridae (and non-Hawaiian Gammaridae). The Dexaminidae (=Atylidae) (*L* and *T*, dotted lines) have the basic uropod 3 whereas the Ampeliscidae (*A*) and Liljeborgiidae (*L*, solid lines), have the outer ramus slightly shortened. The Pleustidae (*D*) have the outer ramus strongly shortened and the Colomastigidae (*C*) and Ochlesidae (*O*) have the outer shortened and the peduncle slightly elongate. The Phoxocephalidae (*W*) have a 2-articulate outer ramus with the inner ramus slightly shortened but the rami remain thin, whereas in Gammaridae such as *Maera* and *Elasmopus* (*Gez*) the rami are broad and blunt and have multiple spine groups and the outer ramus may or may not have a second article. In *Melita, Eriopisa-Eriopisella,* and *Nuuanu* (*Gmnr*), the inner ramus becomes very short and the outer ramus very elongate. These long uropods (that of *FJNZ,* plus a long version of *Gez*) may often be lost in preserved amphipods.

The isaeid (and aorid) uropod 3 (*U*) is difficult to classify, in that the peduncle is slightly to moderately elongate, but the rami equal or exceed the peduncle in length; they are usually thicker and more cylindrioid or cubiform than in the other taxa discussed above, and the inner ramus in *Photis* is shortened and absent in *Neomicrodeutopus*.

Biancolina has a uropod 3 (*B*) similar to that of the isaeids but it is very small and has short, weak spine-setae.

The Oedicerotidae, Amphilochidae, Leucothoidae and Anamixidae are characterized by a very elongate uropod 3 with both peduncle and rami elongate; the outer ramus occasionally is shortened, especially in the Amphilochidae (*FJNZ*). A shorter and stouter version of this uropod is seen in *Lysianassa* (*Y*).

An elongate peduncle and short rami characterize the Ischyroceridae (*I*), and to some extent the Ampithoidae (*M*) but in *Jassa* the peduncle may not be so conspicuously elongate as in other ischyrocerids (see dotted line in *I*). Ischyroceridae lack the long setae on the inner ramus of uropod 3 found in the Ampithoidae, and the latter have one or two large hooks on the outer ramus, these hooks being larger than in *Jassa*. Ischyrocerids generally have small denticles, cusps, or an apical uncinus on the outer ramus (see variations in *Iv, Ij, Ii*). *Ventojassa* has 1–3 stiff setae on the outer ramus but it is an exceptional ischyrocerid (*Iv*). The outer ramus of ischyrocerids generally has to be viewed with an oil-immersion lens, though uropod 3 of *Jassa* is clear under high power.

The remaining kinds of uropod 3 shown in Figure 4 all lack an inner ramus or have no ramus at all. *Neomicrodeutopus* in the Isaeidae (Aoridae) lacks this ramus and so does *Ericthonius* in the Corophiidae (*Rw*). *Ericthonius* has the long peduncle characteristic of Ischyroceridae and the only ramus present appears also to be ischyrocerid in structure. The other Hawaiian corophiid, *Corophium* (*Ro*), has a small flabellate uropod 3 with a short peduncle and slightly longer ramus; it requires some patience to distinguish the appendage from the nearby telson and uropod 3. *Palinnotus* (*V*) has a thin replica of the corophiid uropod 3 and *Tropichelura* (*X*) has an enormously long replica of uropod 3 seen in *Corophium*.

Podocerus (*P*) has a reduced uropod 3, lacking a ramus and not visible from the side, that lies underneath a large fleshy telson, as shown in the figure.

The talitroids *Hyale* and *Parhyalella* (*Hh*) and *Parhyale* (*Hy*) have an easily visible uropod 3, but the ramus and peduncle are small and subequal in length and have short, stout spines in contrast to *Neomicrodeutopus* and *Palinnotus*. *Parhyale* has a scale-like inner ramus.

The final morph is the 3-piece uropod 3 composed of a peduncle and a 2-articulate ramus found in the Stenothoidae (*Q*) and in *Seba* (*S*). The latter has a broadly flattened uropod 3 with shortened article 2 of the ramus in contrast to that of the Stenothoidae.

Taxonomic Arrangement

Because of the convenience to identification, portions of the old-fashioned system of classification of gammarideans are retained herein. The families Aoridae, Corophiidae and Isaeidae (=Photidae) are maintained distinctly, as Corophiidae have only two easily recognizable genera in Hawaii and because the enlargement of gnathopod 1 in Aoridae is a convenient way to separate the many species of aorids and isaeids in Hawaiian waters.

Referral of corophiids to the isaeid complex is a semantic error, as the term corophiid has priority. The ultimate referral of photids, aorids, isaeids, ischyrocerids, ampithoids, podocerids, chelurids and other groups to a broadly conceived superfamily of corophiids should occur soon and the preferable term corophiidean applied to the complex. Not only is the Corophiidae the oldest rooted name in the group, it has also been most widely used in textbooks and thus is familiar to the general zoologist. The transition from photid to isaeid to corophiidean that has occupied the past two decades is an unfortunate contemporary unheaval necessitated by the correlation of names to familial concepts as they are slowly but carefully studied and amalgamated. If *Corophium,* lending its name to the oldest familial root, were not one of the most atypical of the isaeid-photid-corophiid members, the reestablishment of an inclusive name for the whole group would, undoubtedly, have occurred sooner.

Order AMPHIPODA

Suborder GAMMARIDEA

DIAGNOSIS (restricted to Hawaiian marine species, 0–30m).—Pleon (abdomen) distinctly divided into anterior and posterior sections of 3 segments (or their vestiges) each, first section (metasome) bearing 3 pairs

of flexible pleopods, second section (urosome) bearing 2–3 pairs of stiff uropods; pleopods usually partially hidden by lateral pleurae (epimera), terminal segment of urosome with a flap (telson); carapace absent, thorax (mesosome) composed of 7 freely visible segments, legs attached to segments composed of 2 pairs of prehensile gnathopods (segments 1–2), 2 pairs of forward acting pereopods (segments 3–4) and 3 pairs of lateroposteriorly acting and/or laterally flattened pereopods (segments 5–7); coxae conspicuous; head with 2 pairs of antennae but no movable scales and only antenna 1 occasionally weakly biramous; eyes sessile and enclosed within head or rarely formed of corneal lenses on surface.

REMARKS.—Only tanaids and isopods might be confused with Gammaridea but neither of the first two orders has precisely 3 pairs of pleopods nor more than one pair of uropods. The lateral plate-like coxae (the first articles of the thoracic appendages) are enlarged in Hawaiian marine gammarideans to an extent not seen in other local crustaceans. Unlike various shrimps and mysids, amphipods lack a carapace.

Key to Hawaiian Families of Gammaridea

Figure Numbers Referenced in Italics

Notes:

COUPLET 1.—The inner ramus of *Parhyale* cannot be seen if uropod 3 is mounted upside down; if the uropod appears uniramous the cover slip should be moved so as to roll the uropod for examination on all surfaces; occasionally one ramus will break off but the socket remains.

COUPLET 2.—A failure to clip off all of the appendage can result in an abnormally shortened uropod 3; the appendage should also be checked on slide 2, before dissection.

COUPLET 4.—Coxa 1 is counted as article 1.

COUPLET 5.—Lenses usually are difficult to see except with finely focused compound microscope on slide 2, medium power.

COUPLET 7.—Accessory flagellum is occasionally broken, or antenna 1 is frequently broken between articles 1 and 2; the accessory flagellum is on the mediodistal margin of article 3; antenna 1 on slide 8 should be rotated to see all surfaces with high power.

COUPLET 8.—Extremely rare occurrence; maxillipedal palps universally present in Gammaridea except for this genus and a few deep-sea taxa.

COUPLET 9.—Both sexes may be required.

SECTION A, COUPLET 3.—The palp is often broken off during dissection; slide 2 should be checked before dissecting mouthparts; mandibular palp projects forward between the second antennae and the base of the palp may be seen attached to the mandible just below the anteroventral corner of the head.

SECTION B, COUPLET 4.—Oil immersion objective may be required to see these tiny ornaments.

1. Uropod 3 with one ramus or without rami (4, lower) ..... KEY SECTION A
   Uropod 3 with 2 rami, inner occasionally very small (4, upper) 2
2. Peduncle of uropod 3 of normal dimensions, short (*4E,L,A*) 3
   Peduncle of uropod 3 elongate, either actually, or relative to rami (*4FJNZ,M,I,Y*). KEY SECTION B
3. Inner ramus of third uropod less than half as long as outer ramus (*4Hy,Up,Gmnr*). KEY SECTION C
   Inner ramus of third uropod 75 percent or more as long as outer ramus (occasionally outer ramus shorter than inner) (*4Ge*) 4
4. Article 3 of gnathopod 2 elongate and gnathopod 2 like Figure *52g2* + body arrow. Lysianassidae (p. 105)
   Article 3 of gnathopod 2 not elongate or gnathopod 2 not like Figure *52g2* + body arrow 5
5. Head elongate and bearing small external cuticular lenses 4 in number (*3A,5Ah*) (coxae long and urosomites 2–3 coalesced) ..... Ampeliscidae (p. 22)
   If elongate, head massive or very flat, lacking special lenses, eyes otherwise ommatidial, internal, and multifaceted 6
6. Head massive, galeate, eyes large and essentially coalesced into one mass (seen from dorsal view) (eyes not black in alcohol) (*3O*) 7
   Head not massive, not galeate, eyes if present separate 8

7. Accessory flagellum 3+ articulate, pereopod 5 if elongate much less than 1.5 times as long as pereopod 4, pereopods 3–4 not strongly shortened.....**Synopiidae***
   Accessory flagellum absent or vestigial, pereopod 5 remarkably elongate, at least 1.5 times as long as shortened pereopods 3–4 (*54*, body).....**Oedicerotidae** (p. 105)
8. Maxillipeds lacking palp (*53xp*), mouthparts arranged in conical bundle, body with form and coxae of Figure *53*.....**Ochlesidae** (p. 105)
   Maxilliped with palp (*2xp*), body and coxae not like Figure *53*.....9
9. Body cylindrical or subcylindrical (*22, 24*), mandible lacking palp.....10
   Body compressed laterally or not distinctly subcylindrical, mandible with palp.....11
10. Urosomites 2–3 coalesced, uropod 3 of medium length, at least one ramus elongate, antennae 1–2 stout, short, stiff, projecting anteriorly, head short and thick (*24*).
   Colomastigidae (p. 54)
   Urosomites 2–3 free, uropod 3 short, rami and peduncle equal to each other, peduncle flat, with gap between attached rami, antennae 1–2 thin, elongate, turned posteriorly, head flat like that of insect or spherical and bearing constricted neck (*22*).
   Biancolinidae (p. 52)
11. Telson thick, short, entire, fleshy (*2tl2*).....12
   Telson cleft or entire, short or long, often with ventral keel, but thin and not fleshy (*2tl1*).
   Key Section D
12. Gnathopod 1 showing sexual dimorphism and longer or stouter than gnathopod 2 (*16C,W*).
   Aoridae (p. 40)
   Gnathopod 1 not showing sexual dimorphism and smaller than gnathopod 2, gnathopodal dimorphism, if present, confined to gnathopod 2 (*1*).....**Isaeidae** (=Photidae) (p. 88)

SECTION A

1. Both pairs of gnathopods chelate.....**Sebidae** (p. 117)
   Gnathopods usually subchelate or simple, both pairs never chelate together.....2
2. Gnathopod 2 typical of Figure *52g2* + body arrow.....**Lysianassidae** (p. 105)
   Gnathopod 2 not fitting Figure *52*.....3
3. Coxa 1 small and covered by coxa 2 (and 3) (*62H*).....**Stenothoidae** (p. 120)
   Coxa 1 visible and not less than half surface area of coxa 2 (*1*).....4
4. Body flat dorsoventrally, or cylindrical, often broadened and/or rugose (*23, 55, 58*).....6
   Body compressed laterally (normal gammaridean) (*1*).....5
5. Mandible lacking palp.....**Talitroidea** (p. 122)
   Mandible with palp.....**Isaeidae** (=Photidae) (in part, p. 88)
6. Uropod 3 very large, almost as long as urosome, uropod 2 of abnormal, elephantine structure (*23*).....**Cheluridae** (p. 54)
   Uropod 3 very small or seemingly absent, uropod 2 normally slender.....7
7. Mandible lacking palp, molar vestigial or absent.....8
   Mandible with palp and triturative molar.....9
8. Body cylindrical, coxae very small and not splayed.....**Eophliantidae***
   Body very broad, rugose, armored, depressed, coxae large and splayed (*55*).
   Phliantidae (p. 109)
9. Urosomite 1 elongate (*58L,T*).....**Podoceridae** (p. 113)
   Urosomite 1 not elongate (*1*).....**Corophiidae** (p. 55)

SECTION B

1. Gnathopod 2 typical of Figure *52g2* + body arrow.....**Lysianassidae** (p. 105)
   Gnathopod 2 not fitting Figure *52*.....2
2. Gnathopod 1 either absent or with the form of Figure *14Lg1* and *Ag1*.....3
   Gnathopod 1 present and not like Figure *14*.....4
3. Mandibles and maxillae absent or extremely vestigial and replaced by large, easily visible ventral keel (*15Smt*).....**Anamixidae** (p. 40)
   Mandibles and maxillae present in ordinary condition.....**Leucothoidae** (p. 102)

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*not yet found in Hawaii.

4. Uropod 3 with special form of Figure *4M*, outer ramus with 2 large hooks (rarely one in non-Hawaiian genus) ..... Ampithoidae (p. 29)
   Uropod 3 not like Figure *4M* 5
5. Rami of uropod 3 elongate (*4FJNZ*), outer not uncinate 6
   Rami of uropod 3 shorter than peduncle, outer minutely uncinate and subapically ornamented with tiny denticles (*4Iijv*) ..... Ischyroceridae (p. 97)
6. Coxa 1 small and partially hidden by coxa 2, pereopod 5 not grossly longer than pereopod 4 (*6P*) ..... Amphilochidae (p. 25)
   Coxa 1 large and visible, pereopod 5 much longer than pereopod 4 (*54, body*). Oedicerotidae (p. 105)

SECTION C

1. Inner ramus of uropod 3 scalelike and partially appressed to outer ramus (*4Hy*), mandible lacking palp ..... Talitroidea (in part, p. 122)
   Inner ramus of uropod 3 easily visible and distinct from outer ramus (*4E, Up*), mandible with palp 2
2. Head scarcely rostrate, telson uncleft (fleshy), pereopod 5 resembling 4. Isaeidae (=Photidae) (p. 88)
   Head with visor rostrum (*3UX*), telson cleft, pereopods 4 and 5 grossly different (*5Pp4* and *Pp5*) ..... Phoxocephalidae (p. 109)
   Head poorly rostrate, telson cleft, pereopod 5 resembling 4 (*1*) ..... Gammaridae (p. 66)

SECTION D

1. Urosomites 2–3 or 1–3 coalesced and mandibular palp absent. Dexaminidae (=Atylidae) (p. 61)
   Urosomites 2–3 free and mandibular palp present 2
2. Mandibular molar not triturative (*51Hm*), but often bearing articulate spines 3
   Mandibular molar triturative (bearing ridges and cusps) (2mo) 5
3. Pereopods 3–5 and peduncle of antenna 2 strongly spinose and setose, pereopod 5 shorter of strongly different shape from pereopod 4 (*5*) ..... Phoxocephalidae (p. 109)
   Pereopods 3–5 and peduncle of antenna 2 weakly setose, pereopod 5 like pereopod 4 4
4. Telson cleft, accessory flagellum very long and stout (*51H*) ..... Liljeborgiidae (p. 103)
   Telson entire, accessory flagellum vestigial or absent, not visible grossly (high-power microscope necessary) ..... Pleustidae (p. 109)
5. Inner ramus of uropod 3 much shorter than outer (less than one third). Gammaridae (in part, p. 66)
   Rami of uropod 3 subequal to each other in length or outer slightly shorter than inner 6
6. Accessory flagellum with 2 or more articles ..... Gammaridae (in part, p. 66)
   Accessory flagullum 1-articulate or absent 7
7. Telson cleft ..... Eusiridae (p. 61)
   Telson entire ..... Pleustidae (p. 109)

Family AMPELISCIDAE

Genus *Ampelisca* Krøyer

Ampelisca schellenbergi Shoemaker

FIGURE 5A

Ampelisca schellenbergi. Shoemaker, 1933b:3–5, fig. 2; J. L. Barnard, 1954a:14–16, pls. 7, 8; J. L. Barnard, 1967:8–10, figs. 1 a–m.

Recognized by the elongate, tall head, coalesced urosomites 2–3, the presence of 4 small, shiny, surficial corneal lenses on the head (2 on each anterolateral side), head with bright red pigment in 5 large spots (before placing in alcohol), the characteristic pereopods 4 and 5, 5 being shorter and of different morphology from 4 (*5 Ap4* and *Ap5*). The family differs from phoxocephalids among many characters in the absence of an accessory flagellum, lack of rostrum, relatively short pereopod 4 and coalesced urosomites 2–3.

Ampelisca vaguely resembles *Chevalia* in the Isaeidae but the latter genus has urosomites 1–2 coalesced and 3 is free, while the eyes are ommatidial, internal, and multifaceted.

Ampeliscids build soft domiciliary tubes on mud bottoms but this Pan-American species is also associated with surf grasses on the continent.

Pan-American; off Honolulu, 93–229 m.

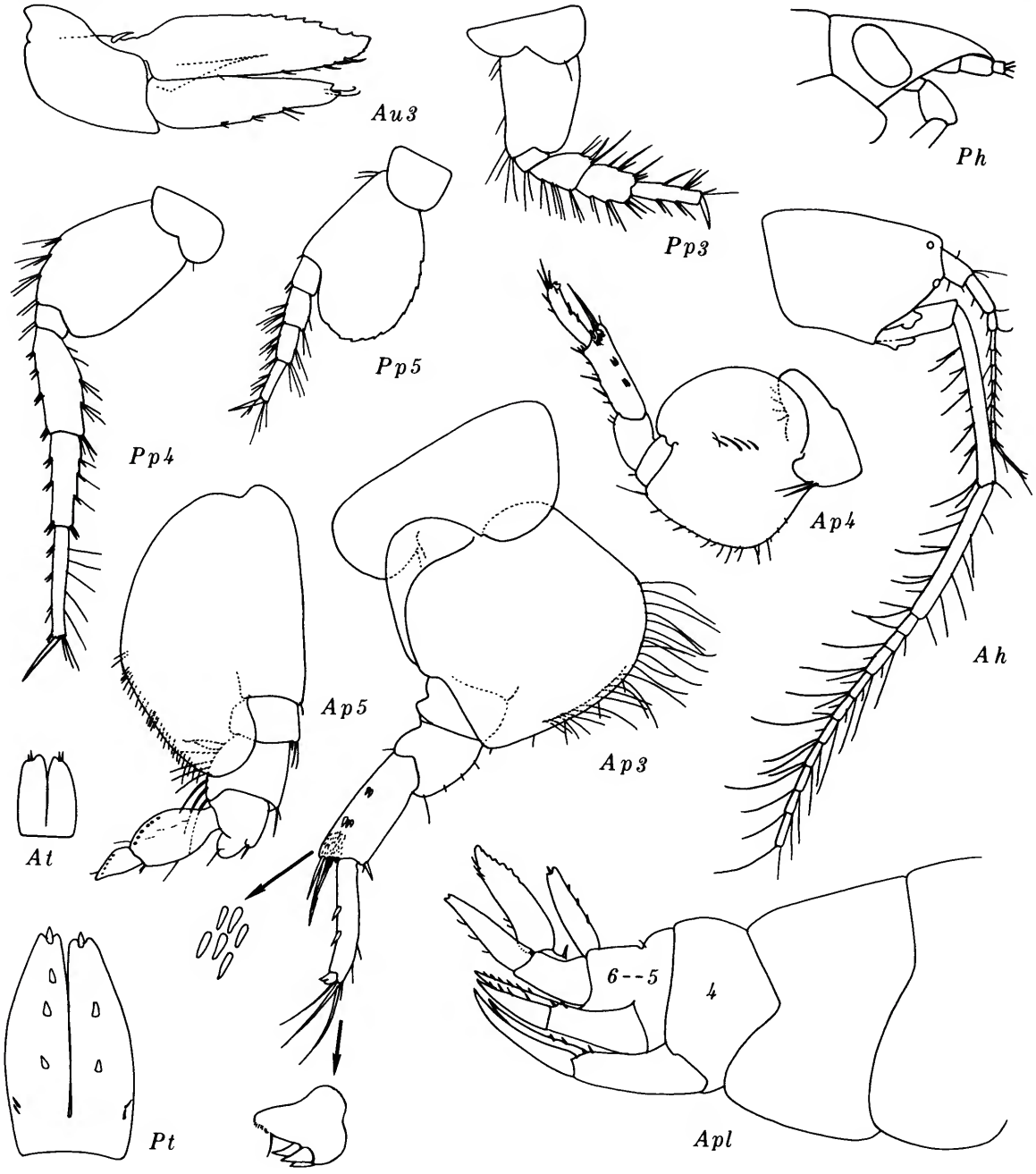
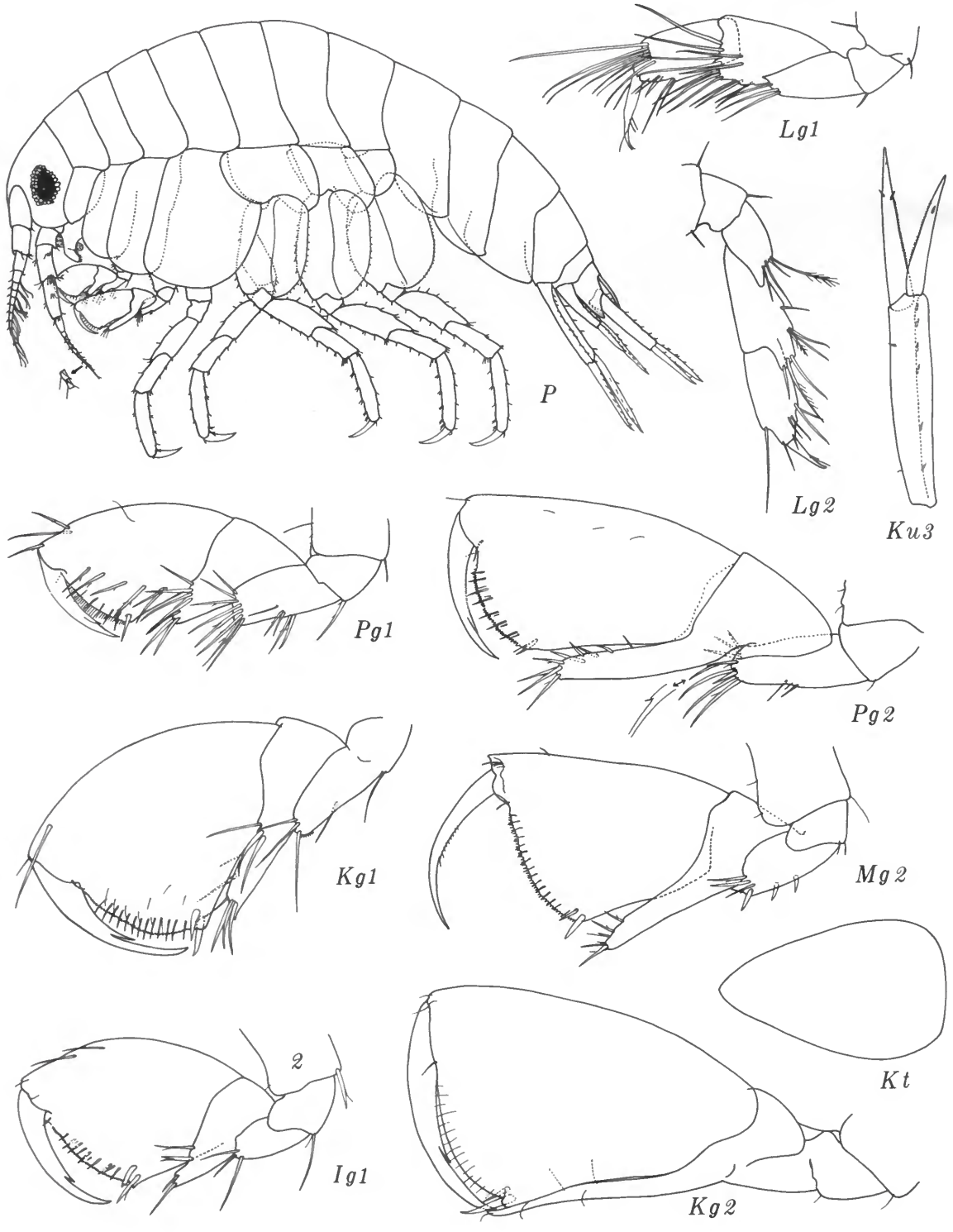


FIGURE 5.—Ampeliscidae and Phoxocephalidae: A, *Ampelisca schellenbergi* Shoemaker; P, *Paraphoxus centralis* (Schellenberg).


Lg1
P
Lg2
Ku3
Pg1
Pg2
Kg1
Mg2
Kt
2
Ig1
Kg2

Family AMPHILOCHIDAE

FIGURES 6–8

This family is characterized by the small coxa 1 (and occasionally small coxa 2), elongate biramous uropod 3 with long peduncle, large coxa 4, conspicuous rostrum, and shortened uropod 2. It differs from the superficially similar Ischyroceridae by the presence of a conspicuous rostrum, the grossly excavate coxa 4, and thin telson. Stenothoidae differ from amphilochids in the uniramous uropod 3. Hawaiian anamixids and those few leucothoids with small coxa 1 differ from amphilochids in the special configuration of gnathopod 1 with its exaggerated carpochelation.

Amphilochids are very small (0.7 to 2.8 mm long) and are difficult to dissect, but presumably we now have in hand the most common Oahuan species and they can be identified by small scale characters, usually without dissection. But it is advisable to confirm initial identifications by dissecting mouthparts and checking them for generic validity until one becomes routinely familiar with the general appearance of amphilochids. A mount of the whole animal on slide 2 is examined with a compound microscope to observe gnathopods 1–2, pereopods and uropods; gnathopods should be extended before mounting and dirt removed by camels-hair brush or syringing with alcohol, and gnathopodal dactyls slightly extended away from the palmar surfaces so as to observe dactylar pectinations—these are difficult to see on dirty specimens with dactyls fully closed. The characters may be checked in the keys but a short diagnosis of each species follows so as to balance all characters.

Hawaiian amphilochuses appear to be strongly associated with scleractinian corals of the genus *Pocillopora*. Many of the amphipods have the same coffee or bronze color of the coral; possibly they feed on the mucus exuded by the coelenterate.

Schellenberg's (1938) identification of *Amphilochus marionis* Stebbing, from Oahu, has not been confirmed in the present study. I am at a loss to recognize that species among hundreds of amphilochids collected recently. The surprising diversity of the family and the presumed high endemicity of the species indicate the improbability of a subantarctic species occurring in Hawaii.

Key to Genera of Amphilochidae

Figure Numbers Referenced in Italics

1. Coxae 3 and 4 contiguous and not overlapping, very large and covering reduced coxae 1 and 2 (*8*, body) (Cyproideinae) ..... ***Mokuoloe*** J. L. Barnard
   Coxa 2 large, visible, coxae 2–4 overlapping each other, coxa 2 covering reduced coxa 1 (*6P*) (Amphilochinae) 2
2. Gnathopods extremely weak, essentially simple (*6Lg1*), palp of maxilla 1 uniarticulate. ***Gitana*** Boeck
   Gnathopods of medium to large size, palms well developed and transverse (*6Kg1*), palp of maxilla 1 biarticulate 3
3. Mandibular molar weakly triturative (*7Mm*) and elongate-conical ..... ***Amphilochus*** Bate
   Mandibular molar heavily triturative and cushion-shaped (*7Pm*) ..... ***Gitanopsis*** Sars

FIGURE 6.—Amphilochidae: I, *Amphilochus likelike* J. L. Barnard; K, *A. kailua* J. L. Barnard L, *Gitana liliuokalaniae* J. L. Barnard; M, *Amphilochus menehune* J. L. Barnard; P, *Gitanopsis pele* J. L. Barnard.

Genus *Gitana* Boeck

Gitana liliuokalaniae J. L. Barnard

Gitana liliuokalaniae J. L. Barnard, 1970:37–39, figs. 7, 8.

This species differs from other Hawaiian amphilochids in the extremely weak and characteristically shaped gnathopods (*6 Lg1* and *Lg2*). Only one specimen has so far been collected. Eyes red in formaldehyde.

Kaneohe Bay, 3–4 m.

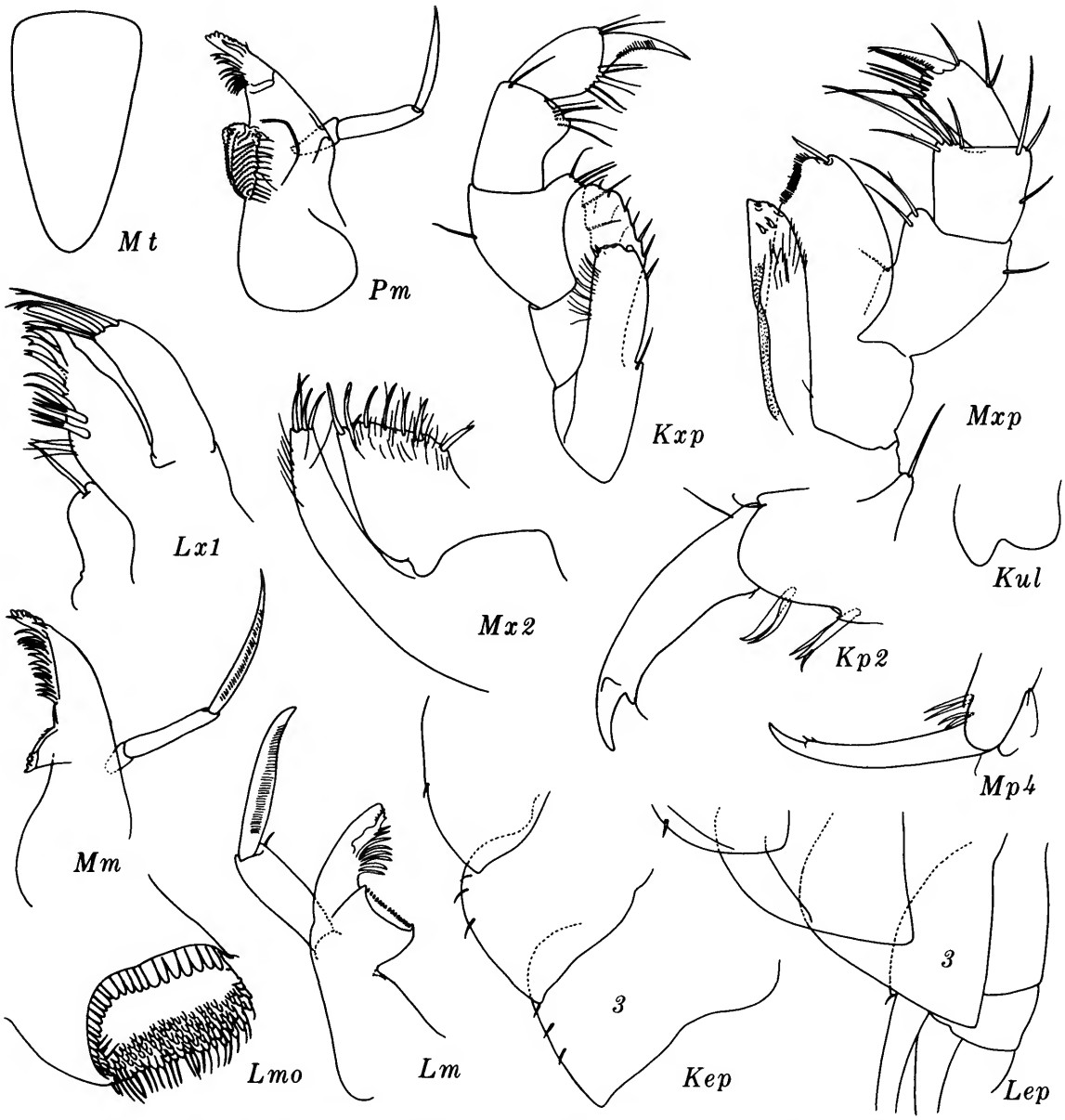


FIGURE 7.—Amphilochidae: K, *Amphilochus kailua* J. L. Barnard; L, *Gitana likiuokalaniae* J. L. Barnard; M, *Amphilochus menehune* J. L. Barnard; P, *Gitanopsis pele* J. L. Barnard.

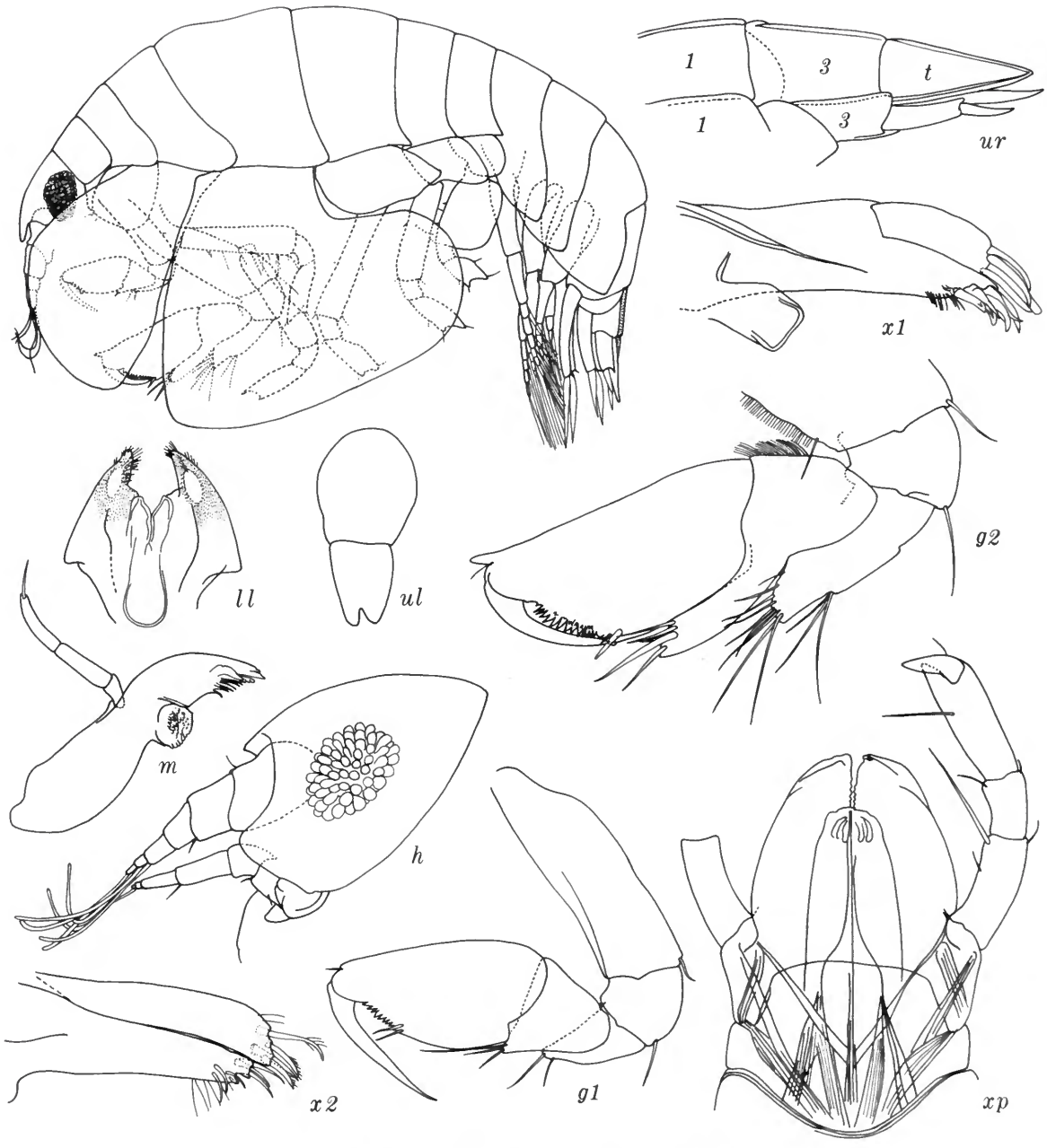


FIGURE 8.—Amphilochidae: *Mokuoloe ninole* J. L. Barnard.

Key to Hawaiian Species of Genera *Amphilochus* Bate and *Gitanopsis* Sars

Figure Numbers Referenced in Italics

1. Gnathopods 1 and 2 small to medium (*6P*), hands smaller than coxa 2, mandibular molar flat, cushion-shaped, extremely triturative (*7Pm*) ..... ***G. pele***
   Gnathopods 1 and 2 large, hands larger than or subequal to coxa 2, mandibular molar long, subconical, weakly triturative (*7Mm*) 2
2. Article 4 of gnathopod 2 with 1–3 stout posterior spines, anterodistal end of hand (article 6) sharp, dactyl of gnathopods 1–2 with minute serrations, scales or pectinae on inner margin besides large tooth (*6Mg2*) ..... ***A. menehune***
   Article 4 of gnathopod 2 without stout spines, anterodistal end of hand softly rounded, dactyls of gnathopods 1–2 lacking serrations, scales or pectinae except for large tooth (*6Kg1*) 3
3. Dactyls of pereopods 1–5 with large mamilliform hump (*7Kp2*), posterodistal end of article 2 on gnathopod 2 lacking stout spines (*6Kg2*) ..... ***A. kailua***
   Dactyls of pereopods 1–5 simple, posterodistal end of article 2 on gnathopod 2 bearing stout spine (*6Ig1*) ..... ***A. likelike***

Amphilochus kailua J. L. Barnard

Amphilochus kailua J. L. Barnard, 1970:30–33, figs. 2, 3.

Gnathopods 1–2 large, hands equal to or larger than coxa 2, article 4 of gnathopod 2 lacking large stout posterior spines (but possibly with setae), anterodistal end of hand of gnathopod 2 softly rounded, dactyls of gnathopods lacking serrations except for main tooth; dactyls of pereopods 1–5 with relatively large mamilliform hump; posterodistal end of article 2 of gnathopod 2 with slender or no seta. Dissection: mandibular molar of medium size, subconical and weakly triturative; outer plate of maxilliped with convex, unpectinate medial margin and several mediomarginal setae.

South shore of Oahu, intertidal algae, to 5 m on sand bottom.

Amphilochus likelike J. L. Barnard

Amphilochus likelike J. L. Barnard, 1970:33, fig. 4.

Gnathopods 1–2 large, hands equal to or larger than coxa 2, article 4 of gnathopod 2 lacking stout posterior spines (but possibly with setae), anterodistal end of hand on gnathopod 2 softly rounded; dactyls of gnathopods lacking serrations except for main tooth; dactyls of pereopods 1–5 simple; posterodistal end of article 2 on gnathopod 1 with a stout spine. Dissection: mandibular molar of medium size, subconical and weakly triturative; outer plate of maxilliped with slightly excavate and pectinate distomedial margin, distolateral end with 1 large sabre-spine.

Oahu, 2–30 m, especially on *Pocillopora*.

Amphilochus menehune J. L. Barnard

Amphilochus menehune J. L. Barnard, 1970:33–37, figs. 5, 6.

Gnathopods 1–2 large, hands equal to or larger than coxa 2, article 4 of gnathopod 2 with 1–3 stout, posterior spines, anterodistal end of hand of gnathopod 2 sharply extended (but minutely); dactyls of gnathopods pectinate or serrate on inner edge apart from main tooth; dactyls of pereopods 1–5 simple; posterodistal end of article 2 on gnathopod 2 with slender or no seta. Dissection: mandibular molar of medium size, subconical and weakly triturative; outer plate of maxilliped with slightly excavate and pectinate distomedial margin, distolateral end with 1 large sabre-spine. Eyes brown.

Oahu, 0–33 m, widespread and abundant in numerous biotopes.

Gitanopsis pele J. L. Barnard

Gitanopsis pele J. L. Barnard, 1970:40, fig. 9.

Gnathopods 1–2 small, hands smaller than coxa 2, article 4 of gnathopod 2 lacking posterior spines (possibly with setae), anterodistal end of hand of gnathopod 2 softly rounded; dactyls of gnathpods pectinate

or serrate on inner edge apart from main tooth; dactyls of pereopods 1–5 simple; posterodistal end of article 2 on gnathopod 2 with slender or no seta. Dissection: mandibular molar very large, flat, cushion-shaped, extremely triturative; outer plate of maxilliped with slightly excavate and pectinate distomedial margin, distolateral end with 1 large sabre-spine. Eyes brown, unlike other red-eyed amphilochids, except *A. menehune.*

Oahu, Kaneohe Bay, 2 m, on *Pocillopora* reef.

Genus *Mokuoloe* J. L. Barnard

Mokuoloe ninole J. L. Barnard

Mokuoloe ninole J. L. Barnard, 1970:40–44, figs. 10, 11.

Mokuoloe is recognized by the grossly enlarged coxa 4, remarkable for amphilochids; coxa 4 is almost shield-like, abuts coxa 3 and the latter covers the reduced coxae 1 and 2. These are characters of Cyproideinae, one subfamily of amphilochids and *Mokuoloe* is the only cyproidein so far found in Hawaii, though others probably will be discovered. A short diagnosis of the genus is given so that other cyproideins may be recognized.

Antenna 2 with only 2 articles in flagellum; rostrum short; mandible with palp and triturative molar; maxilla 1 with 1-articulate palp armed with strap-shaped setae; maxilliped with thin palp, article 3 bearing a thumb that forms a claw with dactyl, outer plate large, not excavate; gnathopods 1–2 subchelate, of medium size, palms oblique and deeply serrate in fan-shaped fashion, sharp dactyl of gnathopod 1 much longer than palm, lobe on article 5 weak, dactyl of gnathopod 2 fitting palm, hand with sharp anterodistal extension, lobe on article 5 long, thick, and guarding article 6; article 2 of pereopods 3–4 thin, of pereopod 5 expanded; outer ramus of uropod 3 shorter than inner ramus; pleonites 4 and 6 weakly keeled dorsally on both sides but pleonite 6 not vaulted over telson; telson long, broad, triangular and weakly keeled dorsally on both margins, thus boat-shaped. Cyproidins resemble Stenothoidae but differ in the biramous uropod 3.

South Oahu, 30 m, on bottom dominated by coralline "footballs."

Family AMPITHOIDAE

FIGURES 9–13

Ampithoids belong with the isaeid group of families bearing fleshy telson and glandular pereopods 1–2; coxa 4 is scarcely or not excavate posteriorly; uropod 3 outer ramus has 2 hooks (one hook only in a non-Hawaiian genus); the rami are much shorter than the peduncle, the latter being subcylindrical and the rami being slightly flattened and subovate (*12Wu3*). Ampithoids may be confused with ischyrocerids but the latter family has thinner, pointed rami on uropod 3 and with one exception their members have only one hook or simply a curved (uncinate) distal end with minute denticles lining the subapical margin of the outer ramus.

Specimens without antenna 1 are difficult, if not impossible to identify generically unless they are members of *Paragrubia.* Juveniles and often females of *Ampithoe* and *Cymadusa* are almost impossible to identify specifically, as their morphological distinctions have not been clarified in Hawaiian species. Considerable ecotypic, seasonal and "founder effect" morphological variation seems to occur in the species of this family. Fully mature males are rare.

Probably the largest species of amphipods in the Hawaiian chain belong to this family. They build tubes of parchment but are often associated with algae presumably to which the tubes are attached, possibly near or among the rhizomes. Members of this family in California have been observed to roll up edges of kelp blades and cement them into tubes; this may also occur in Hawaiian algae and observations should be noted in the literature as this phenomenon has never been adequately described.

Apparently all species in Hawaii have red eyes or no black-brown; *A. kaneohe* however retains a dark spot in the eye after bleaching in alcohol.

The peduncular tooth frequently mentioned on uropods 1–2 lies distalwards and between the rami so that the uropod must be viewed ventrally in order to determine the length of the tooth (*13Ou1*).

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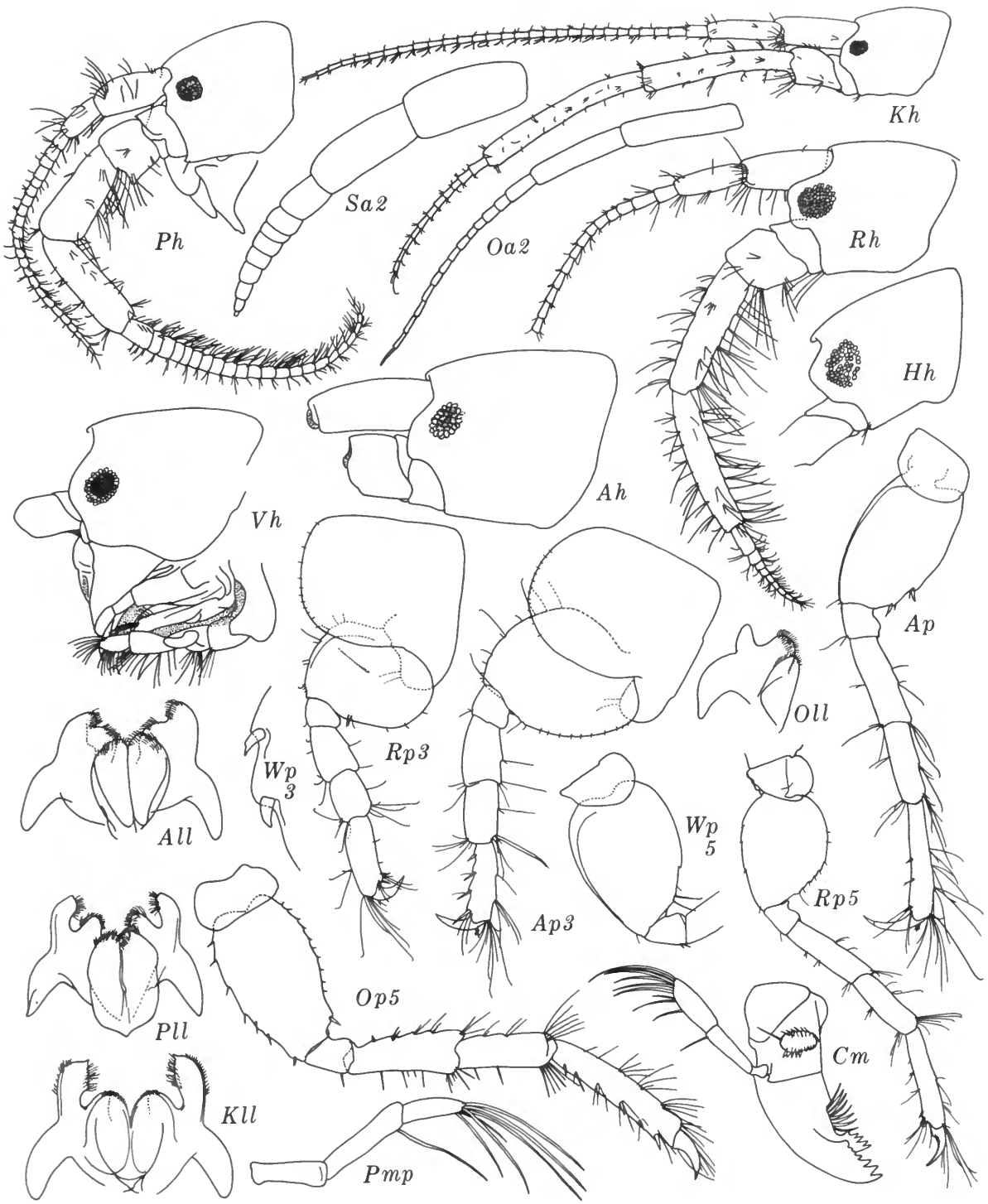


FIGURE 9.—Ampithoidae: A, *Ampithoe akuolaka* J. L. Barnard; C, *Cymadusa oceanica* J. L. Barnard; H, *C. hawaiensis* (Schellenberg); K, *Ampithoe kaneohe* J. L. Barnard; O, *A. orientalis* Dana; P, *A.* (*Pleonexes*) *poipu* J. L. Barnard; R, *A. ramondi* Audouin; S, *Ampithoe* sp.; V, *Paragrubia vorax* Chevreux; W, *A. waialua* J. L. Barnard.

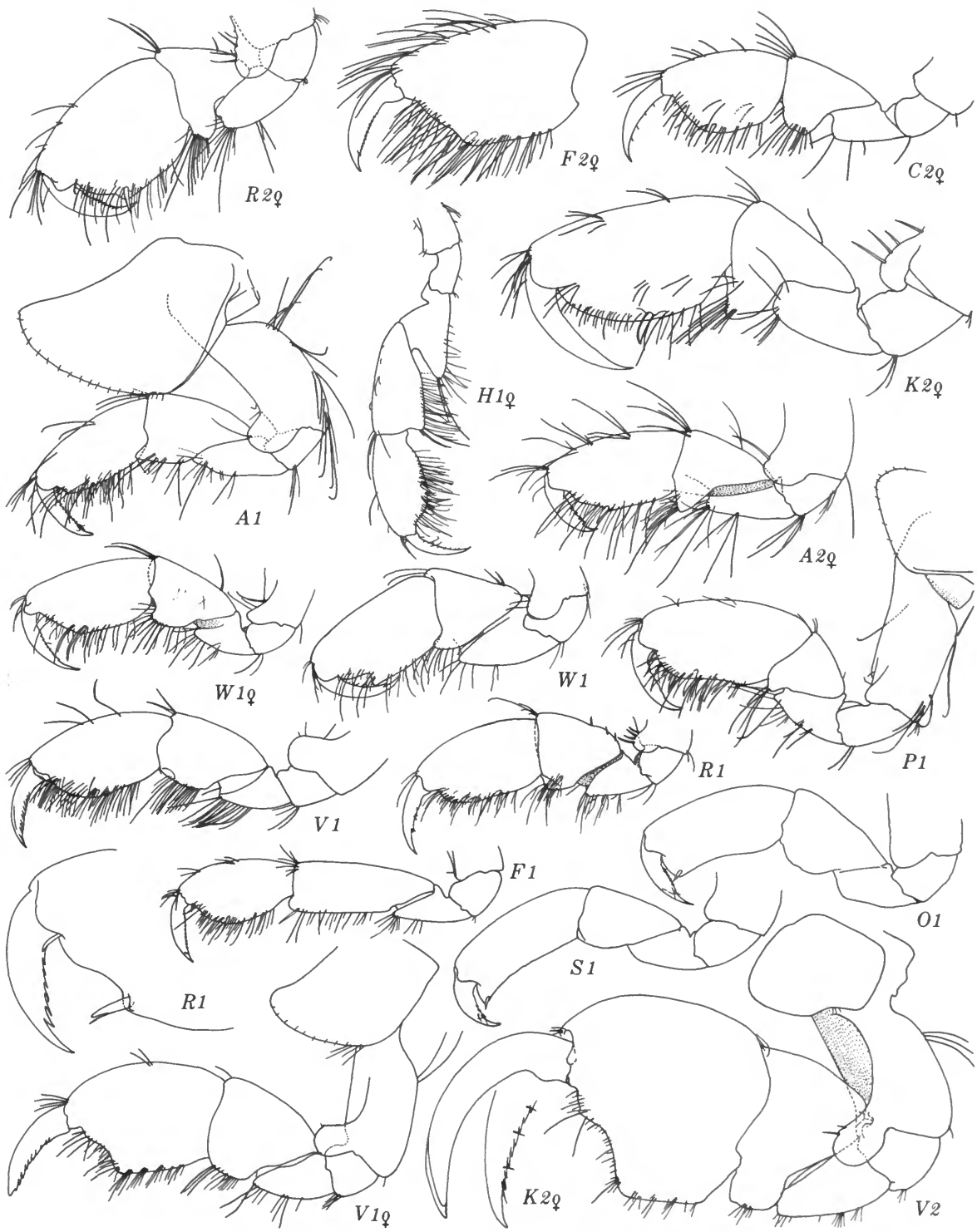


FIGURE 10.—Ampithoidae: A, *Ampithoe akuolaka* J. L. Barnard; C, *Cymadusa oceanica* J. L. Barnard; F, *C. filosa* Savigny; H, *C. hawaiensis* (Schellenberg); K, *A. kaneohe* J. L. Barnard; O, *A. orientalis* Dana; P, *A.* (*Pleonexes*) *poipu* J. L. Barnard; R, *A. ramondi* Audouin; S, *Ampithoe* sp.; V, *Paragrubia vorax* Chevreux; W, *A. waialua* J. L. Barnard.

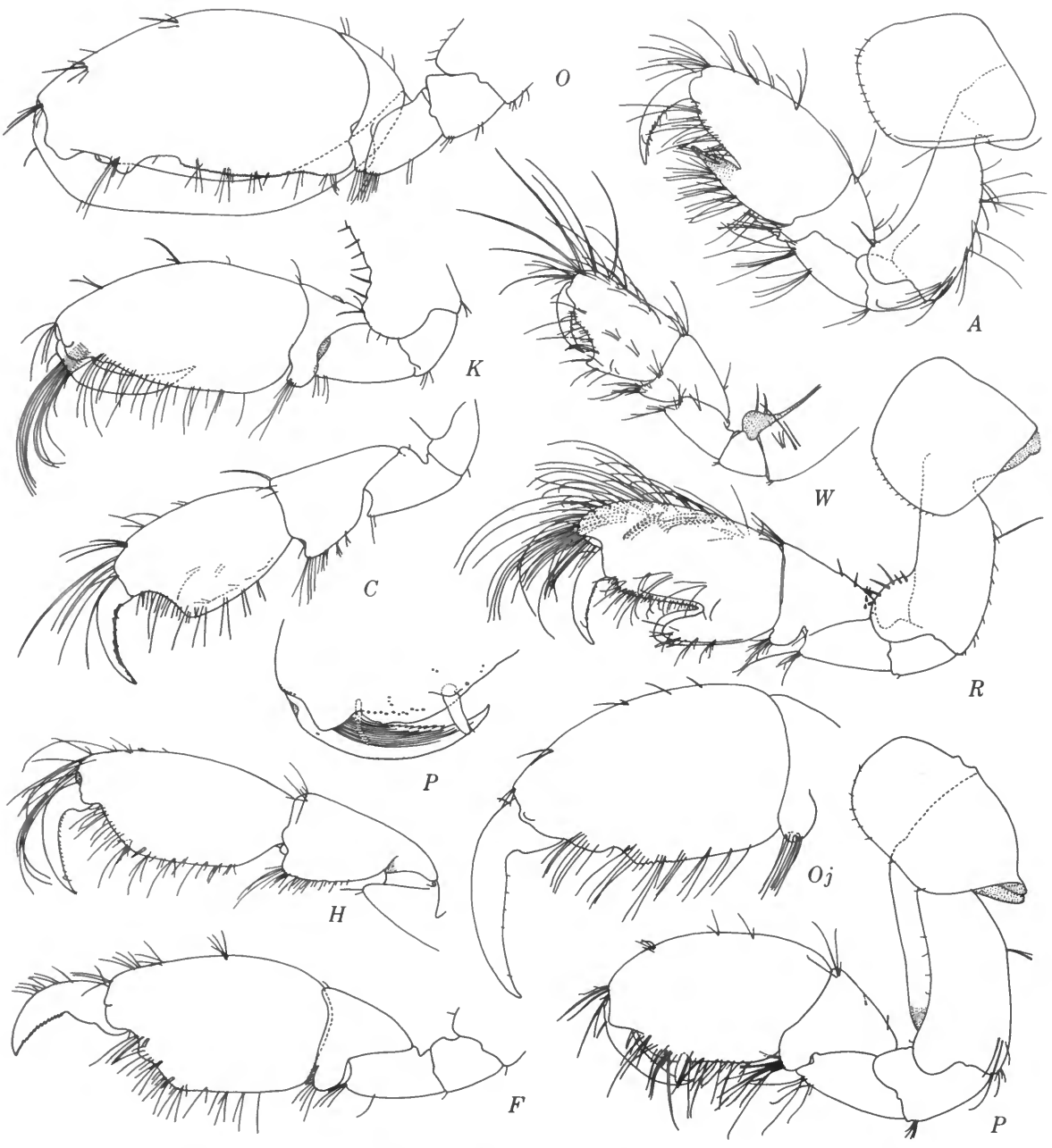
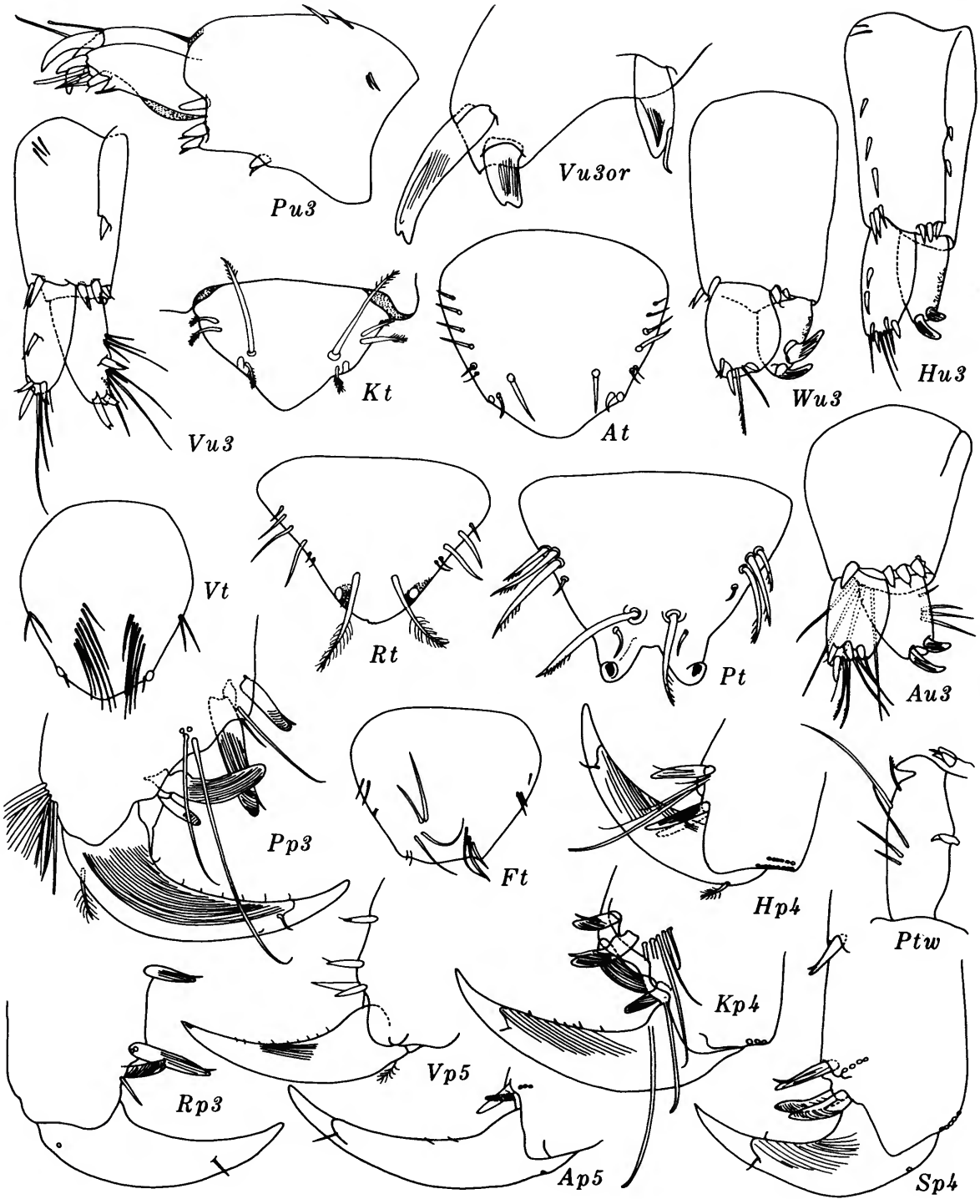


FIGURE 11.—Ampithoidae, male gnathopod 2: A, *Ampithoe akuolaka* J. L. Barnard; C, *Cymadusa oceanica* J. L. Barnard; F, *C. filosa* Savigny; H, *C. hawaiensis* (Schellenberg); K, *A. kaneohe* J. L. Barnard; O, *A. orientalis* Dana; P, *A.* (*Pleonexes*) *poipu* J. L. Barnard; R, *A. ramondi* Audouin; W, *A. waialua* J. L. Barnard.

FIGURE 12.—Ampithoidae: A, *Ampithoe akuolaka* J. L. Barnard; F, *Cymadusa filosa* Savigny; H, *C. hawaiensis* (Schellenberg); K, *Ampithoe kaneohe* J. L. Barnard; P, *A.* (*Pleonexes*) *poipu* J. L. Barnard; R, *A. ramondi* Audouin; S, *Ampithoe* sp.; V, *Paragrubia vorax* Chevreux; W, *Ampithoe waialua* J. L. Barnard.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Vp5
Rp3
Ap5
Sp4

Key to Genera of Ampithoidae

Figure Numbers Referenced in Italics

1. Gnathopod 1 larger than gnathopod 2 in both sexes ..... ***Paragrubia*** Chevreux
   Gnathopod 1 smaller than or equal to gnathopod 2 in both sexes 2
2. Antenna 1 with accessory flagellum ..... ***Cymadusa*** Savigny
   Antenna 1 without accessory flagellum 3
3. Telson with very large dorsoposterior hooks (*12Pt*) ..... ***Ampithoe*** (***Pleonexes***) Bate
   Telson with small dorsoposterior hooks, slits or nobs (*12At*) ..... ***Ampithoe*** Leach

Genus *Ampithoe* Leach

Diagnosis (Hawaii only): Accessory flagellum absent, ventral peduncular tooth of uropod 1 absent, or very short and blunt or long and sharp, gnathopod 2 larger than gnathopod 1 in male, uropod 3 normal, telson with small dorsoposterior hooks or nobs.

Uropod 1 of Hawaiian ampithoes often lacks a peduncular tooth; that character makes the separation of most members of the genus from other Hawaiian ampithoids relatively easy in juveniles and females that may have missing antennae, or gnathopods that are difficult to distinguish from each other in size.

The peduncular tooth is present in *A. orientalis* and *Ampithoe* sp., both otherwise easy to distinguish from other Hawaiian ampithoids in the very thin gnathopod 1 with small transverse or parachelate palms, and in *A. kaneohe* in which the tooth is short and blunt unlike that in *Cymadusa*.

Probably several more Hawaiian ampithoes remain to be discovered and others might have a peduncular tooth on uropod 1. Fortunately most specimens retain at least one member of pereopods 3–5, thus permitting recognition of *A. kaneohe* and *A. poipu* especially but the former species also has significantly small eyes.

Key to Hawaiian Species of Genus *Ampithoe* Leach

Figure Numbers Referenced in Italics

1. Gnathopod 1 of both sexes with narrow, rectangular article 6 bearing distinctly transverse or parachelate palm hidden in dense setal brush (*10S1*) 2
   Gnathopod 1 of both sexes with slightly narrowed to broadened article 6 bearing distinctly oblique, occasionally weak palm not hidden by setal brush (*10P1*) 3
2. Gnathopods 1–2 of female and gnathopod 1 of male parachelate (*10S1*) ..... ***Amphithoe*** sp.
   Gnathopods 1–2 of female and gnathopod 1 of male with perfectly transverse palm (*10 O1*). ***A. orientalis***
3. Pereopods 3–5 strongly subprehensile, sixth articles with special palmar spine sabre-shaped and guarding palm (*12Kp4*) 4
   Pereopods 3–5 weakly or not subprehensile, lacking special sabre-spine guarding a palm (*12Sp4*) 6
4. Telson with 2 strong reverted dorsal hooks easily seen from lateral view (*12Pt*). ***A.*** (***Pleonexes***) ***poipu***
   Telson with weak dorsal nob scarcely shaped as hook (*12Rt*) 5
5. Eyes very small, garnet red in formaldehyde, brown to black to faint purple core in alcohol, pereopods 3–5 with striate sabre spine strongly guarding distinct palm (*12Kp4*). ***A. kaneohe***
   Eyes large, presumably red in life, clear in alcohol in adult or with faint purple core in juvenile, pereopods 3–5 with pair of sub-sabre striate distal locking spines weakly guarding obsolescent palm (*12Rp3*) ..... ***A. ramondi*** (in part)
6. Pleonal epimera with slight notch at posteroventral corner, bearing weak lateral ridges or indented line (*13Aep*), apical lobules of lower lip very short and tumid (*9All*), pereopods 3–5 with pair of straight, unstriate distal locking spines lacking any proximal partners (*12Ap5*) ..... ***A. akuolaka***
   Pleonal epimera smoothly rounded-quadrate posteroventrally (*13Kep*), lacking lateral ridges, apicolateral lobule of lower lip thin and projecting farther than medial lobule (*9Kll*), pereopods 3–5 with pair of sub-sabre striate locking spines with at least one proximal partner (*12Pp3*) 7

7. Pereopods 3–5 with at least 2 spines in tandem proximal to locking pair (*12Rp3*), article 2 of pereopod 3 with weak anterior spines or notches if any, palm of gnathopod 1 weak (*10R1*) ..... ***A. ramondi*** (in part)
Pereopods 3–5 with only 1 spine in tandem proximal to locking pair, article 2 of pereopod 3 with 1–2 large anterior notches bearing very stout spine (*9Wp3*), palm of gnathopod 1 strong (*10W1*) ..... ***A. waialua***

Ampithoe akuolaka J. L. Barnard

Ampithoe akuolaka J. L. Barnard, 1970:44, figs. 12, 13.

Male gnathopod 1 with articles 5 and 6 equal to each other in length, article 6 very thin and slightly tapering distally, palm oblique and weak, defining spine on posterior margin of hand, article 5 with sharp posterodistal extension; female gnathopod 1 with article 5 lobe trapezoidal, unproduced; male gnathopod 2 with strong anterodistal lobe on article 2, hand slightly elongate, not strongly enlarged, palmar region bearing deep slit separating off long posterior tooth, palmar tangent oblique but no distinct palmar margin present, dactyl strongly overlapping palm; female gnathopod 2 with oblique palm distinctly marked by spine, article 5 lobe triangular; pereopods 3–5 simple, bearing pair of straight, unstriate distal locking spines, with no closely adjacent proximal partners, main locking spine on pereopod 3 long, on pereopods 4–5 short; pleonal epimera with rounded posteroventral cusp, notch and setule, lateral faces with ridge; eyes of medium size, pale purple in alcohol; uropod 1 lacking peduncular process between rami; lower lip with especially short and tumid apical lobules.

Oahu, intertidal, on *Sargassum, Ulva,* and rocks.

Ampithoe kaneohe J. L. Barnard

Ampithoe kaneohe J. L. Barnard, 1970:44–47, figs. 14, 15, 16, 24*l*.

Male gnathopod 1 with article 6 longer than 5 and ovatorectangular, well developed oblique palm defined by spine, article 5 with weak, broad, slightly coniform posterior lobe, dactyl fitting palm; female gnathopod 1 with lobe on article 5 truncate; male gnathopod 2 with large anterodistal lobe on article 2, hand very elongate, palm and posterior margin of hand congruent, slightly setose, dactyl about half as long as hand, medioterminal face of hand with long setal brush; female gnathopod 2 like gnathopod 1 but lobe of article 5 sharp; pereopods 4–5 strongly subprehensile, bearing palm guarded by prostrate striate sabre-spine and 3 other erect striate spines; pleonal epimera 1–3 rounded posteroventrally; eyes very small, clear in alcohol or bearing slight dark core near posterior edge; uropod 1 with short truncate peduncular process between rami.

Oahu, intertidal and 30 m.

Ampithoe orientalis Dana

Ampithoe orientalis Dana, 1853:937–939, pl. 64, fig. 2.
Ampithoe orientalis J. L. Barnard, 1955:26–28, fig. 14; 1970: 47, fig. 17 *a-i*.

Male and female gnathopod 1 with articles 5 and 6 subequal to each other in length, both thin, article 5 rectangular, bearing short transverse palm hidden by setae, article 5 unlobate; male gnathopod 2 with weak anterodistal lobe on article 2, hand elongate, palm and posterior margin of hand congruent, distally sinuous, weakly setose, dactyl as long as hand, in young male dactyl much shorter and palm with weak distal excavation; female gnathopod 2 like gnathopod 1 but much stouter, article 5 slightly shorter and lobate and article 6 slightly longer; pereopods 3–5 simple, distal pair of locking spines slightly striate and weakly sabre-shaped, with strong spine in tandem proximally; pleonal epimera rounded posteroventrally and bearing lateral ridges; eyes large, clear in alcohol; ommatidia large; uropod 1 with long sharp peduncular process between rami; lower lip with apicolateral lobules distinctly longer than medial but neither large.

Close to *Ampithoe* sp. but female (and male) antenna 2 thin, with flagellum about as long as articles 4–5 of peduncle and with other characters mentioned under *Ampithoe* sp.

Philippines; Oahu, intertidal, on *Sargassum, Ulva,* and rocks.

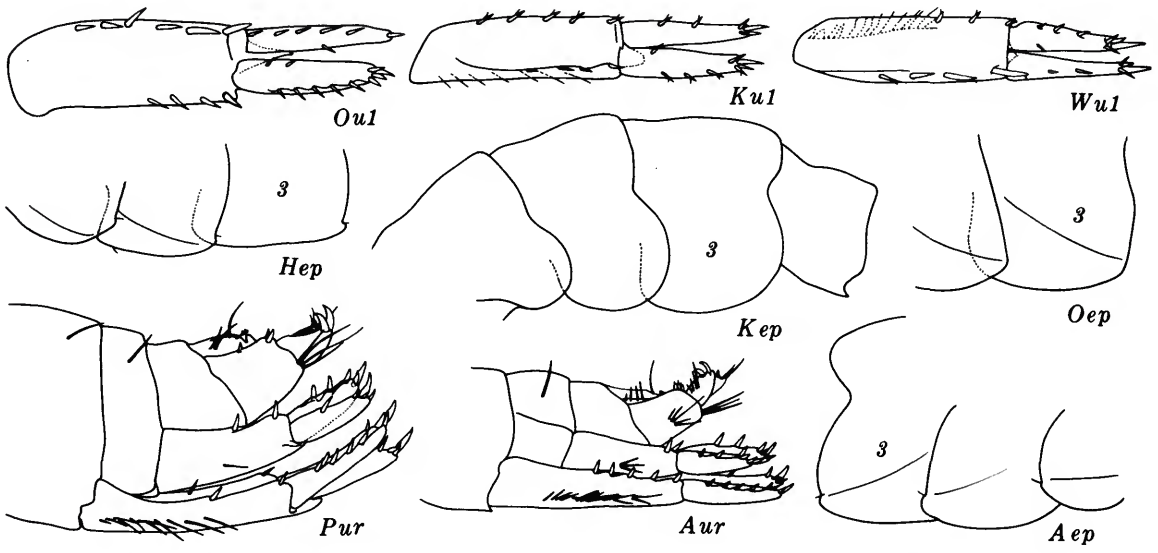


FIGURE 13.—Ampithoidae: A, *Ampithoe akuolaka* J. L. Barnard; H, *Cymadusa hawaiensis* (Schellenberg); K, *Ampithoe kaneohe* J. L. Barnard; O, *A. orientalis* Dana; P, *A. poipu* J. L. Barnard; W, *A. waialua* J. L. Barnard.

Ampithoe (*Pleonexes*) *poipu* J. L. Barnard

Ampithoe (*Pleonexes*) *poipu* J. L. Barnard, 1970:57–61, figs. 22, 23, 24*a–k*.

Male and female gnathopod 1 with article 6 much longer than 5 and rectangular, poorly developed oblique palm defined by large spine actually on posterior margin of hand, article 5 with weak, narrow, slightly twisted posterior lobe, dactyl fitting palm; male gnathopod 2 not strongly enlarged and simply a stouter version of gnathopod 1; female gnathopod 2 like gnathopod 1; pereopods 4–5 strongly subprehensile, bearing palm slightly weaker than in *A. kaneohe*, with similar striate sabre-spine not as strongly guarding palm as in *A. kaneohe* and with 3 other erect striate, straight spines; pleonal epimera 1–3 rounded posteroventrally; eyes of medium size, clear in alcohol; uropod 1 with short truncate peduncular process between rami; telson with 2 dorsal nobs enlarged into strong reverted hooks from lateral view not present in other Hawaiian ampithoids, hooks appearing as large posterior papillae from dorsal view.

The large dorsal hooks of the telson cast this species into the genus *Pleonexes* Bate but I have reduced that genus to subgeneric status under *Ampithoe* and consider that it signals only a grade of evolution and not a clade.

Kauai, Poipu Beach.

Ampithoe ramondi Audouin

Ampithoe ramondi Audouin.—J. L. Barnard, 1955:28–29 (with references); 1970:47, figs. 18, 19.

Male and female gnathopod 1 with article 6 longer than 5, article 6 narrowly ovate and slightly tapering, palm very weak and defining spine on posterior margin of hand, article 5 with broad posterior margin, scarcely lobate; male gnathopod 2 with strong anterodistal lobe on article 2, hand slightly elongate and expanded, in terminal stage anterodistal corner strongly inflated and expanded, setose, palm deeply sigmoid and defined by strong tooth or bearing deep slit guarded by very stout, short thumb; female gnathopod 2 with slightly s-shaped palm and narrow lobe on article 5; pereopods 4–5 slightly subprehensile, with weak palm bearing 2 striate sabre-spines not guarding palm and bearing 2 or more proximal neighboring spines in tandem; pleonal epimera rounded posteroventrally; eyes large, clear in alcohol, red in formaldehyde; uropod 1 lacking peduncular process between rami.

Pereopods 3–5 with different spinal arrangement, in juveniles with only 1 of the distal locking spines appearing distinctly sabre-shaped, the other much smaller and straight.

Circumtropical.

Ampithoe waialua J. L. Barnard

Ampithoe waialua J. L. Barnard, 1970:53–54, figs. 20, 21.

Male gnathopod 1 with article 6 longer than 5 and rectangular, with moderately well developed, oblique and excavate palm, article 5 with small lobe distally sharp and slightly extended, dactyl overlapping palm; female gnathopod 1 with thinner hand, even palm, article 5 lobe smaller; male gnathopod 2 small, article 2 with strong anterodistal lobe, hand small, slightly expanded, palm very oblique and sigmoid, defined by strong cusp, dactyl not fitting palm; female gnathopod 2 with hand stouter than on gnathopod 1, palm slightly s-shaped, lobe on article 5 subtriangular; pereopods 3–5 simple, distal pair of locking spines straight, striate, erect, bearing adjacent proximal spine; pleonal epimera rounded posteroventrally; eyes large, clear in alcohol; uropod 1 with obsolescent, leaf-like peduncular tooth between rami.

Females of this species and *A. ramondi* are grossly indistinguishable.

Oahu, intertidal to 30 m.

Ampithoe sp., J. L. Barnard

Ampithoe sp., J. L. Barnard, 1970:54–57, fig. 17 *j–p*.

Only female known: gnathopods 1 and 2 with article 6 longer than 5, more so in gnathopod 2 than in gnathopod 1, article 5 unlobate, article 6 very slender, palms parachelate and partially hidden by setae; pereopods 3–5 simple, distal pair of locking spines slightly striate, slightly sabre-shaped, adjacent to large proximal spine in tandem; pleonal epimera rounded posteroventrally and bearing lateral ridges; eyes of medium size, ommatidia small, with pale purple core in alcohol; uropod 1 with long sharp peduncular process between rami; lower lip with weak apical lobules extending almost equally.

Differs from *A. orientalis* not only in gnathopods but female antenna 2 very stout and short, flagellum scarcely longer than article 5; articles 2 and 4 of pereopods 1–2 especially tumid, though article 2 of *A. orientalis* very stout and distally subquadrate; differs also from other Hawaiian ampithoes in especially enlarged uropod 3.

Oahu, intertidal on *Sargassum, Ulva,* and rocks.

Genus *Cymadusa* Savigny

Diagnosis: Accessory flagellum present, ventral peduncular tooth of uropod 1 long and sharp, gnathopod 2 larger than gnathopod 1, uropod 3 normal; telson without large hooks.

The two species of this genus endemic to Hawaii are not yet well defined in all stages as they have been rarely collected and materials are sparse. By coincidence, they and *Paragrubia vorax* plus the cosmopolitan *Cymadusa filosa* have a long peduncular cusp between the rami of uropod 1 and thus are distinguished from all but one known species of *Ampithoe* in Hawaii. But in other regions *Ampithoe* often has the same tooth. Members of *Cymadusa* have a small 1–4 articulate accessory flagellum on antenna 1 and under preservation many cymadusas retain that antenna, so that they are easy to distinguish from *Ampithoe,* which lacks an accessory flagellum. No member of Hawaiian *Cymadusa* has the large rounded anterodistal lobe on article 2 of the gnathopods seen in *Paragrubia.* All cymadusas have an elongate article 5 on male gnathopod 1 rarely occurring in Hawaiian ampithoes and the posterior margin of that article is very flat and often slightly produced or slightly angular at the posterodistal end. Article 4 on gnathopod 1 is triangular and most of the triangular lobate portion is separated from, but matches contiguously, the oblique proximal margin of article 5.

Key to Hawaiian Males of Genus *Cymadusa* Savigny

Figure Numbers Referenced in Italics

1. Pleonal epimera 1–3 with very small tooth and notch on posteroventral corners (observe from slide 2 on medium-power compound microscope) (*13Hep*) ..... ***C. hawaiensis***
   Pleonal epimera 1–3 rounded-quadrate posteroventrally, occasionally with extremely weak indication of cusp (*13Oep*) 2

2. Palm of gnathopod 2 semilunar (*11C*) posterior lobe on article 5 as broad as length of article 4 ..... ***C. oceanica***
Palm of gnathopod 2 not excavate, often with small hump in middle (*11F*), posterior lobe on article 5 narrow, much less than half as broad as length of article 4 ..... ***C. filosa***

Cymadusa filosa Savigny

Cymadusa filosa Savigny.—J. L. Barnard, 1955: 29, fig. 15 (with synonymy); 1970: 61.

Article 5 of male gnathopod 1 longer than article 6, with weakly produced posterodistal corner, article 6 subovate and strongly palmate; article 5 of gnathopod 2 short, posterior lobe thin and tumid, article 6 of medium enlargement, palm short, often with small hump in middle, dactyl very stout and fitting palm.

This species has gone under various names throughout the world and apparently is highly variable; the Hawaiian population is especially noted for the weak setation on the gnathopods.

Cosmopolitan in the tropics; in Hawaii generally on seaweeds in intertidal zone.

Cymadusa hawaiensis (Schellenberg)

Grubia hawaiensis Schellenberg, 1938:88–90, fig. 45.
Cymadusa hawaiensis.—J. L. Barnard, 1970:61, figs. 25, 26.

Articles 5 and 6 of male gnathopod 1 equal to each other in length, article 6 broadly subrectangular, palm of medium distinctness; article 5 of gnathopod 2 with truncate posterior lobe of medium breadth, as broad as length of article 4, article 6 longer than 5, subrectangular and similar to that of gnathopod 1 but palm slightly longer, oblique, straight, dactyl fitting palm. Gnathopods 1–2 are very elongate in comparison to those of other species but juveniles have not been described adequately.

Oahu, intertidal, on seaweeds.

Cymadusa oceanica J. L. Barnard

Cymadusa oceanica J. L. Barnard, 1955:31, fig. 16.

Articles 5–6 of male gnathopod 1 subequal to each other in length, with strongly angular posterodistal corner on article 5, article 6 thin and poorly palmate, article 5 of gnathopod 2 with truncate posterior lobe of medium breadth but as broad as length of article 4, article 6 slightly longer than 5, generally small, palm short and excavate, dactyl overlapping palm.

Waimanalo, Oahu, depth unknown but presumably intertidal among algae.

Genus *Paragrubia* Chevreux

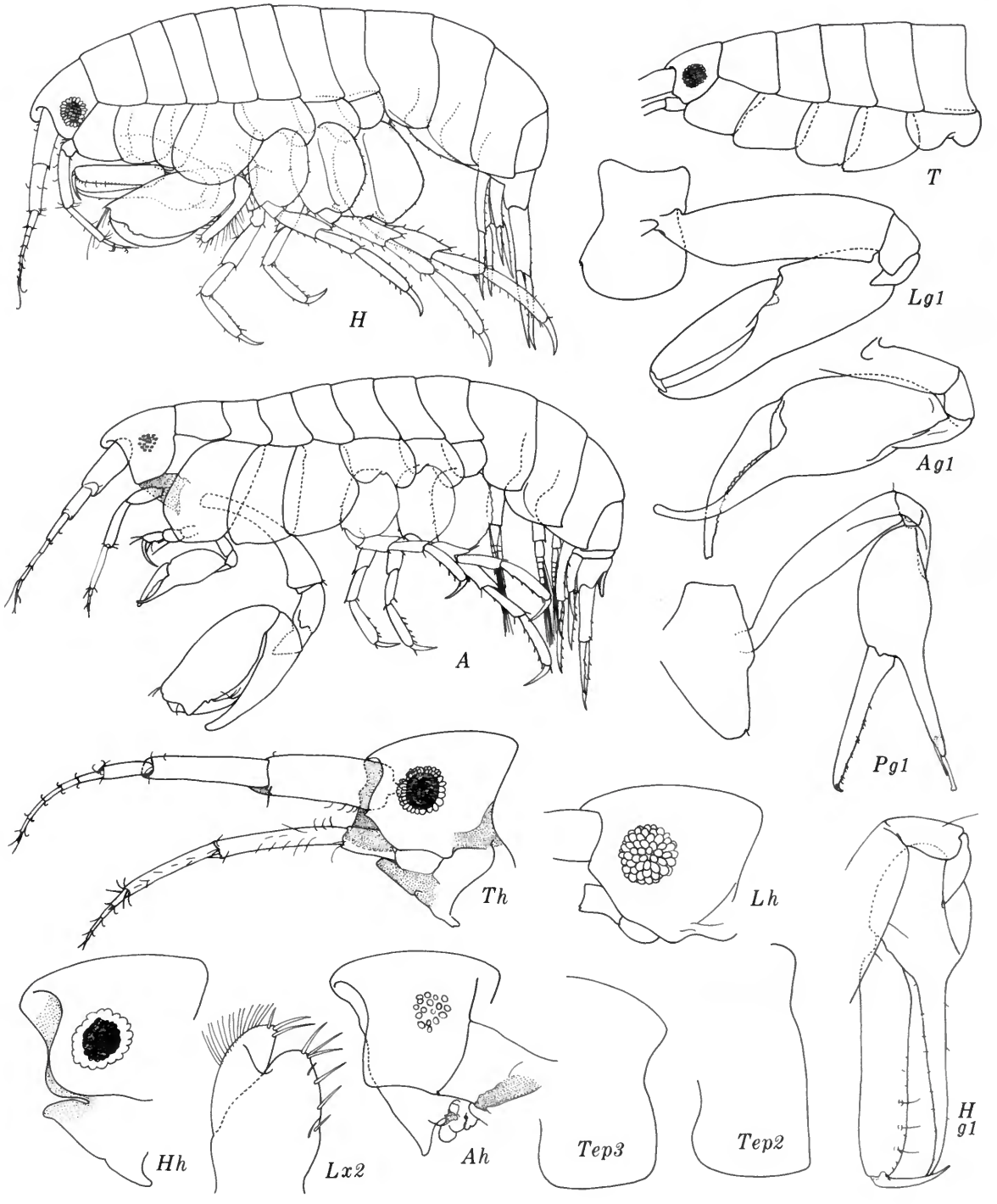
DIAGNOSIS.—Accessory flagellum absent, ventral peduncular tooth of uropod 1 present, gnathopod 1 larger than gnathopod 2 (but very little in female or juvenile), uropod 3 with special form slightly distinct from other ampithoids in combination of characters; rami narrow and elongate, hook spines of outer ramus differ strongly from each other in size and proximal hook not distinctly reverted toward head of animal, inner ramus with stout distal spines; telson without large hooks.

Paragrubia vorax Chevreux

Paragrubia vorax Chevreux, 1901:427–431, figs. 50–55.—Schellenberg, 1938: 90.—J. L. Barnard, 1955:31–34, fig. 17; 1970:61, fig. 32 *h-m*.

Apparently *Paragrubia* is monotypic and distributed throughout the Indo-Pacific tropics. Gnathopod 1 is larger than gnathopod 2 in both sexes though scarcely discernible in the female. Uropod 3 in combination with gnathopod 1 would provide immediate recognition of this as an ampithoid and not an aorid if uropod 3 were precisely typical of ampithoids but it is not. The 2 hooks on the outer ramus are not as strongly reverted as in other ampithoids and one of those spines is larger than the other. The rami appear thinner than in other ampithoids. The resemblance to Isaeidae (= Photidae) and Aoridae is confusing in undissected individuals but once uropod 3 is dissected and observed from flattened dorsal view the characteristic apical

FIGURE 14.—Anamixidae and Leucothoidae: A, *Anamixis stebbingi* Walker; H, *Leucothoe hyhelia* J. L. Barnard; L, *L. lihue* J. L. Barnard; P, *Leucothoides pottsi* Shoemaker; T, *Leucothoe tridens* Stebbing.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g1

spines are revealed from among various setae and the cylindrical or planocylindrical character of the peduncle and rami is also more readily seen.

Male gnathopod 1 in terminal stages is very bulky, articles 5 and 6 very broad, the dactyl almost semilunar and overlapping a scarcely oblique, slightly concave palm (*10V2*). The smaller male gnathopod 2 palm is also concave.

Eyes clear or pale purple in alcohol.

Presumably throughout Hawaii among shallow-water algae.

Family ANAMIXIDAE

Genus *Anamixis* Stebbing

Anamixis stebbingi Walker

FIGURES 14A, 15S (Except *Sg1*)

Anamixis stebbingi Walker, 1904:259–261, pl. 3, fig. 18.—J. L. Barnard, 1965:488–489, fig. 4; 1970:61–63, fig. 27.

Anamixids have the leucothoid morphology with a carpochelate gnathopod 1 (*14Ag1*), and large gnathopod 2 also seeming to be carpochelate but with an inflated article 6 (hand). Anamixids have a small coxa 1 like some leucothoids but differ in the loss or extreme reduction of mandibles and maxillae, a ventral cephalic keel prominently replacing these mouthparts. The keel may be seen by focusing ventromedially on the head (slide 2). Some anamixids (*Paranamixis*) lose gnathopod 1 completely. Gnathopod 2 of Hawaii's anamixid is very characteristic (*15Sg2*) and distinguishes it from any leucothoid. See the latter family (page 102) for color notes.

Presumably anamixids pierce and suck tissues of sessile invertebrates, possibly sponges, coelenterates, or ascidians.

Ceylon to Hawaii. Oahu, intertidal to 30 m, presumably piercing tissues of sessile invertebrates.

Family AORIDAE

FIGURES 16–21

Aorids belong with the greater isaeid (=photid) complex in having a fleshy telson and glandular pereopods 1–2. Aoridae are probably broadly polyphyletic descendents of various isaeids in which a reversal in dominance of gnathopods has occurred, gnathopod 1 becoming large and complex in males and simply enlarged in females.

Like other isaeids, aorids build tubes attached to algae and hard substrates or they apparently line existing holes with their parchment-like material spun from glands in pereopods 1–2.

Species of this family often shed antennae and pereopods 3–5 on preservation. They may be distinguished from the commonly occuring ampithoid *Paragrubia* in the absence of distinct hooks on the stout outer ramus of uropod 3. The uropod should be mounted and observed from dorsal view to make this distinction.

Key to Genera of Aoridae

Figure Numbers Referenced in Italics

1. Antenna 1 lacking accessory flagellum, male gnathopod 1 with article 4 produced strongly into long free acute tooth (merochelate) (*18Cg1*) ..... ***Aoroides*** Walker
   Antenna 1 bearing accessory flagellum, male gnathopod 1 lacking long free tooth on article 4 ..2
2. Article 6 of male gnathopod 1 narrower and/or shorter than article 5, latter with strong or rudimentary posterodistal tooth (*18Kg1, Mg1*) 3
   Article 6 of male gnathopod 1 as broad as or broader than article 5, article 6 longer than article 5 and strongly palmate, latter without teeth (*18Ag1, Pg1*) 4
3. Uropod 3 biramous, head deeply recessed ventrally for attachment of antenna 2 (*17Kh*). ***Konatopus*** J. L. Barnard
   Uropod 3 uniramous, head weakly recessed ventrally for attachment of antenna 2 (*17Nh*). ***Neomicrodeutopus***(?) Schellenberg
4. Antennae short and extending equally, article 3 of antenna 1 as long as article 1, inner plate of maxilla 1 with numerous medial setae, peduncle of uropod 2 with vestigial but sharp tooth between rami (*20Qu2*) ..... ***Aloiloi*** J. L. Barnard
   Antenna 1 much longer than antenna 2, article 3 much shorter than article 1, inner plate of maxilla 1 bearing only 1 long terminal seta, peduncle of uropod 2 with long sharp tooth between rami (*21Bur*) ..... ***Lembos*** Bate

Females of Aoridae

1. Uropod 3 uniramous ..... *Neomicrodeutopus* (?) Schellenberg
   Uropod 3 biramous 2
2. Inner plate of maxilla 1 with many medial setae 3
   Inner plate of maxilla 1 with only terminal seta(e) 4
3. Head deeply recessed for attachment of antenna 2, eyes caramel-brown or reddish brown in alcohol (*17Kh*) ..... *Konatopus* J. L. Barnard
   Head weakly recessed for attachment of antenna 2, eyes black or purplish brown in alcohol (*17Ah*) ..... *Aloiloi* J. L. Barnard
4. Accessory flagellum absent ..... *Aoroides* Walker
   Accessory flagellum present ..... *Lembos* Bate

Genus *Aloiloi* J. L. Barnard

Aloiloi nenue J. L. Barnard

Aloiloi nenue J. L. Barnard, 1970:63–68, figs. 28–30.

This monotypic Hawaiian genus has a gross resemblance to various members of *Lembos*. Gnathopod 1 appears very similar to that of *Lembos* but closer examination demonstrates many characters in common with *Gammaropsis pali* in the Isaeidae. Gnathopod 2 is larger than normal for Hawaiian members of *Lembos* and resembles that of various members of *Gammaropsis*. Antenna 1 is short like antenna 2 and has an elongate article 3 like that of *Gammaropsis* and unlike that of *Lembos*. The inner plate of maxilla 1 is unlike other Hawaiian aorids in the presence of medial setae on the inner plate, and it thus resembles several species of *Gammaropsis*. Uropod 2 has only a vestigial tooth between the rami, unlike various members of *Lembos* in Hawaii, and it thus resembles most species of *Gammaropsis*.

The weakly excavate palm of gnathopod 1 bearing a minutely ridged defining corner and the giant palmar spine of gnathopod 2 are uncharacteristic of *Lembos*. Uropod 3 has rami equal to each other in length, not longer than the peduncle, the outer with barrel-shaped article 2. Pleonal epimera 1 and 3 bulge posteriorly and have a small or medium posteroventral cusp and notch, epimeron 2 with these characters weak.

Article 2 of pereopods 3–5 is narrowly rectangular like those of *Gammaropsis pali*. The head is of moderate recessment for the attachment of antenna 2 and the eyes are irregularly ovate, garnet red in formaldehyde, pale purple in alcohol. Article 3 of antenna 1 and the distal ends of the flagella of both antennae are bright pink in formaldehyde. The stout mandibular palp strongly dominates the remainder of the mandible.

Oahu, Kaneohe Bay, 3–4 m. Rare.

Key to Hawaiian Species of Genus *Aoroides* Walker

Eyes black or deep brownish purple in formaldehyde and alcohol, uropod 1 with, but uropod 2 lacking long ventral cusp between rami ..... ***A. nahili***
Eyes orange or clear in formaldehyde and alcohol, uropod 2 with long acute cusp between rami on both uropods 1–2 ..... ***A. columbiae***

Aoroides columbiae Walker

Aoroides columbiae Walker, 1898:285, pl. 16, figs. 7–10.—Thorsteinson, 1941:83–84, pl. 6, figs. 65–66.—J. L. Barnard, 1954b:24–26, pl. 22; 1970:68–70, figs. 31, 32 *a–g*.
Aoroides californica Alderman, 1936: 63–66, figs. 33–38.

Male gnathopod 1 has an elongate sharp cusp on article 4 like that of the genus *Aora* (*18Cg1*), but antenna 1 lacks all but a vestige of an accessory flagellum. Article 6 is elongate and rectangular and bears a large dactyl. Females have gnathopods of median stoutness for amphipods and both sexes differ from species of *Lembos* and *Aoroides nahili* by the orange or pale, not black, eyes. The orange-eyed *Konatopus* has a deep ventral recessment on the head for the attachment of antenna 2.

Pacific America, warm and cold temperate, to Hawaii. Oahu, 3–30 m, rarely and questionably intertidal.

Aoroides nahili J. L. Barnard

Aoroides nahili J. L. Barnard, 1970:70, fig. 33.

Gnathopods 1–2 of the female and gnathopod 2 of the male are conspicuously thinner in this species than in

FIGURE 15.—Anamixidae and Leucothoidae: H, *Leucothoe hyhelia* J. L. Barnard; L, *L. lihue* J. L. Barnard; P (and *Sg1*), *Leucothoides pottsi* Shoemaker; S (except *Sg1*), *Anamixis stebbingi* Walker; T, *Leucothoe tridens* Stebbing.

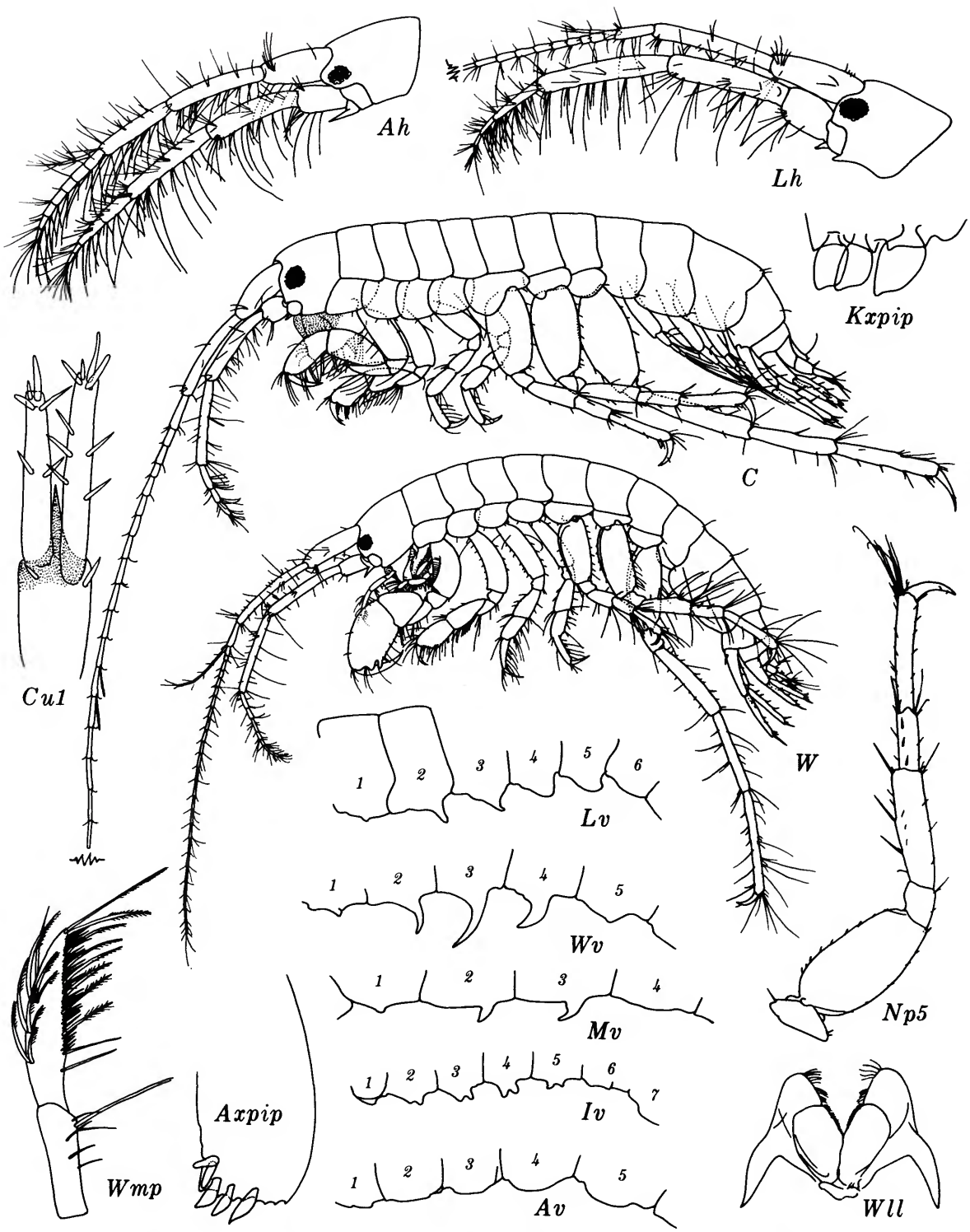

FIGURE 16.—Aoridae (Isaeidae): A, *Aloiloi nenue* J. L. Barnard; C, *Aoroides columbiae* Walker; I, *Lembos intermedius* Schellenberg; K, *L. kamanu* J. L. Barnard; L, *L. leapakahi* J. L. Barnard; M, *L. macromanus* (Shoemaker); N, *Neomicrodeutopus (?) makena* J. L. Barnard, W, *Lembos waipio* J. L. Barnard.

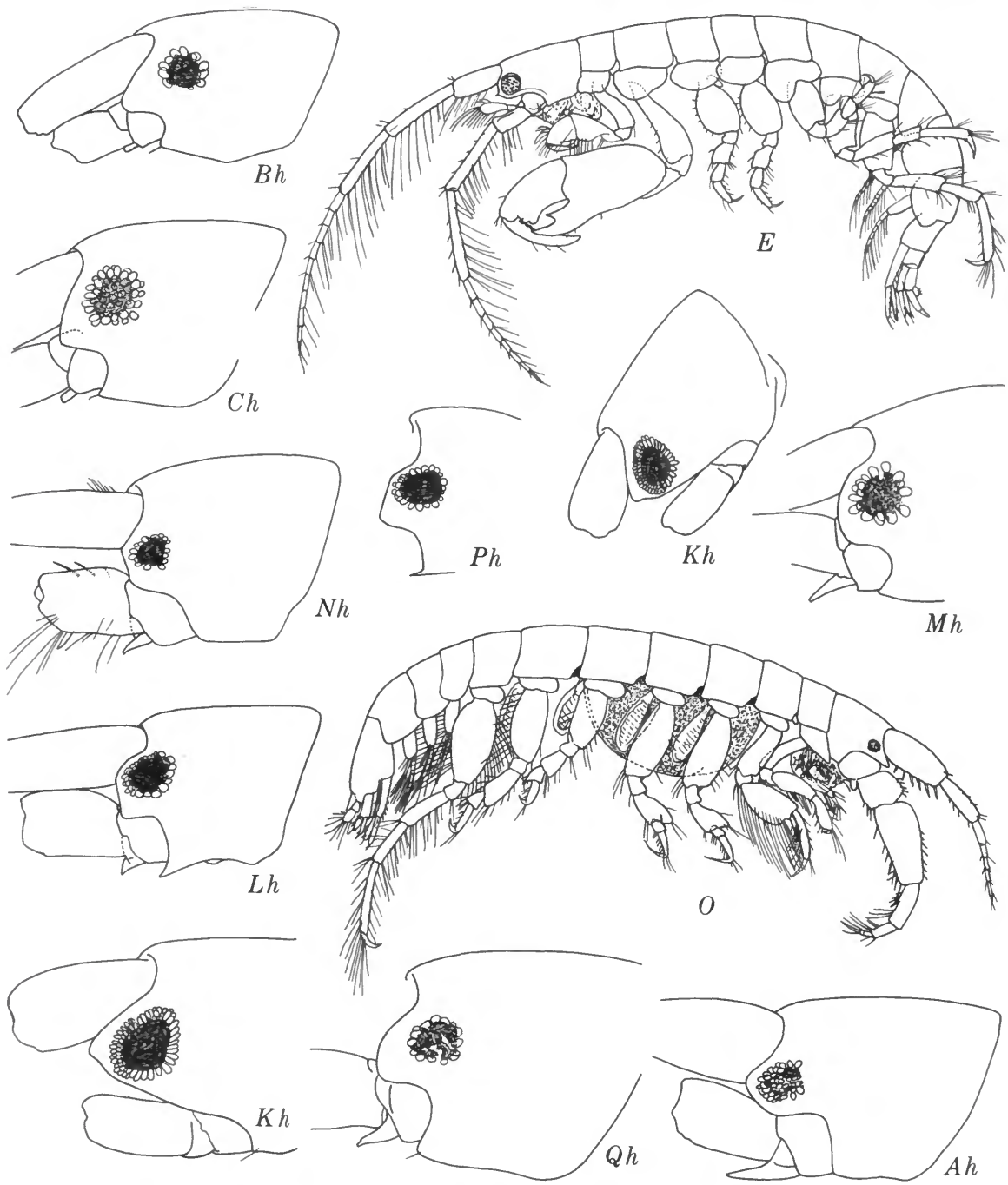

FIGURE 17.—Aoridae (Isaeidae and Corophiidae): A, *Aloiloi nenue* J. L. Barnard; B, *Aoroides nahili* J. L. Barnard; C, *Aoroides columbiae* Walker; E, *Ericthonius brasiliensis* Dana; K, *Konatopus paao* J. L. Barnard; L, *Lembos leapakahi* J. L. Barnard; M, *Lembos kamanu* J. L. Barnard; N, *Neomicrodeutopus* (?) *makena* J.L. Barnard; O, *Corophium acherusicum* Costa (See also Figure 26); P, *Lembos pualani* J. L. Barnard; Q, *L. aequimanus* Schellenberg.

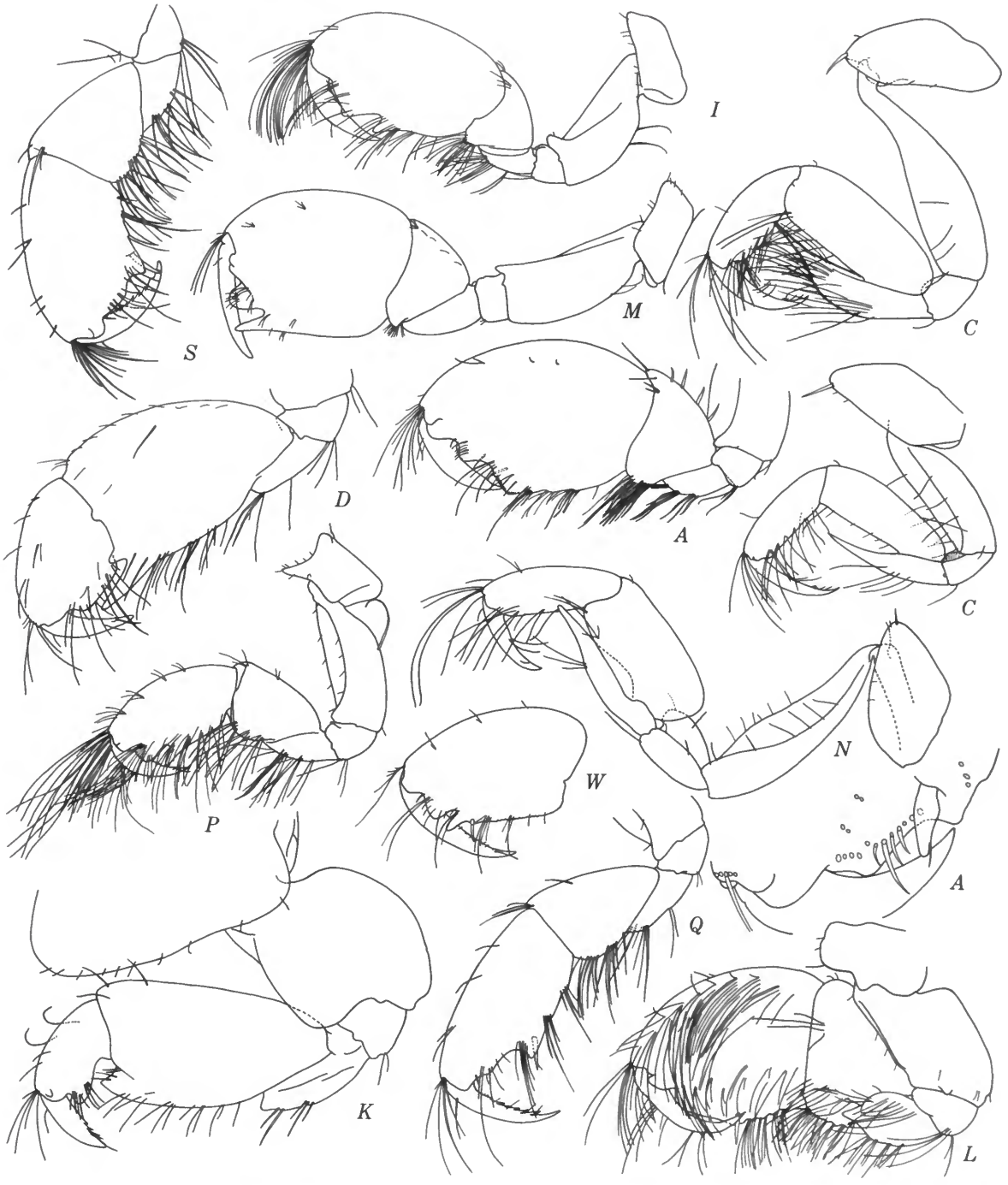

FIGURE 18.—Aoridae (Isaeidae), gnathopod 1: A, *Aloiloi nenue* J. L. Barnard; C, *Aoroides columbiae* Walker; D, *Neomicrodeutopus makena* J. L. Barnard; I, *Lembos intermedius* Schellenberg; K, *Konotopus paao* J. L. Barnard; L, *Lembos leapakahi* J. L. Barnard; M, *L. macromanus* (Shoemaker); N, *Aoroides nahili* J. L. Barnard; P, *L. pualani* J. L. Barnard; Q, *L. aequimanus* Schellenberg; S, *Lembos* sp.; W, *L. waipio* J. L. Barnard.

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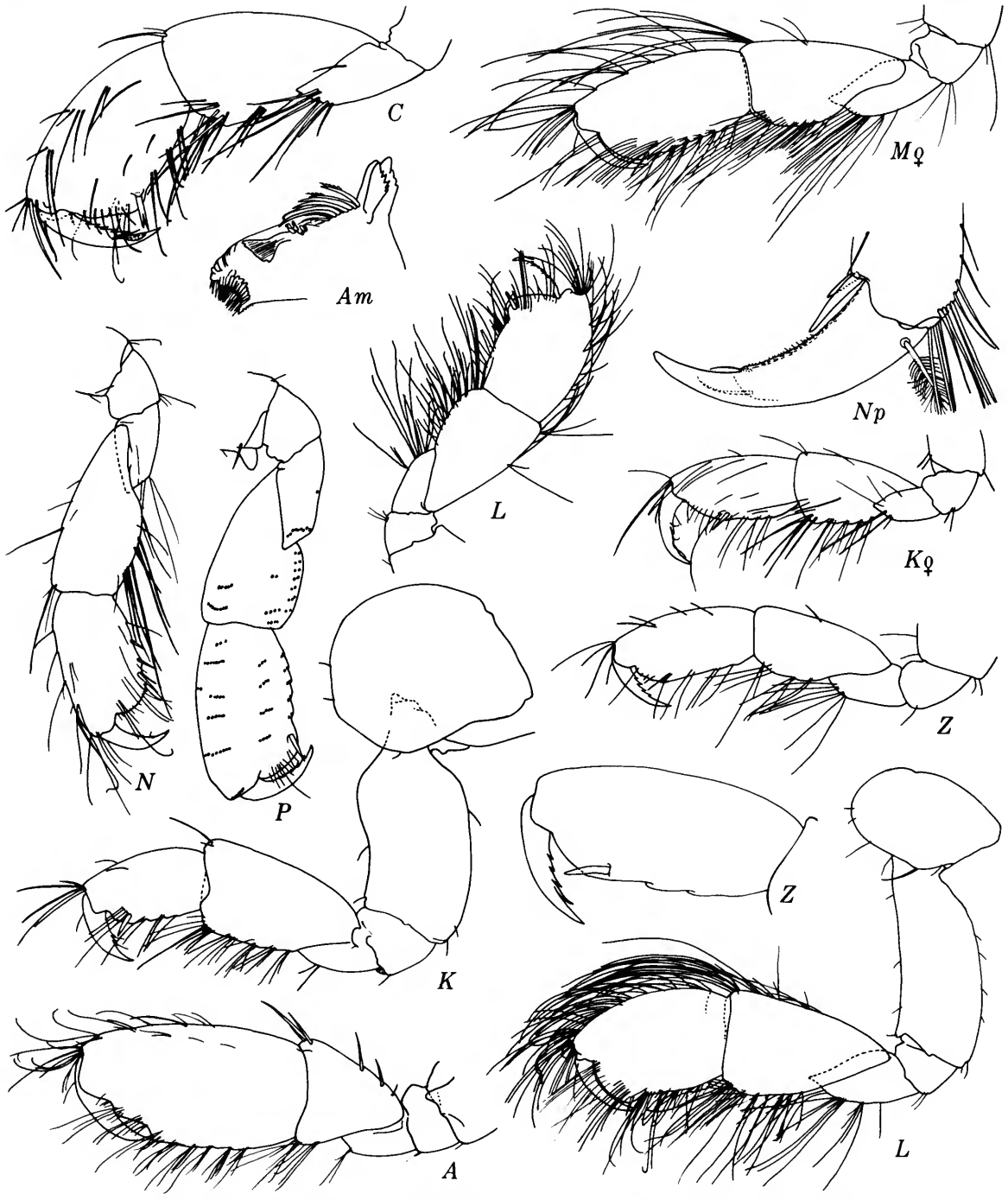


FIGURE 19.—Aoridae (Isaeidae) gnathopod 2: A, *Aloiloi nenue* J. L. Barnard (also mandible); C, *Aoroides columbiae* Walker; K, *Konatopus paao* J. L. Barnard; L, *Lembos leapakahi* J. L. Barnard; M, *L. macromanus* (Shoemaker); N, *Neomicrodeutopus* (?) *makena* J. L. Barnard (also mandible); P, *Lembos pualani* J. L. Barnard; Z, *Aoroides nahili* J. L. Barnard.

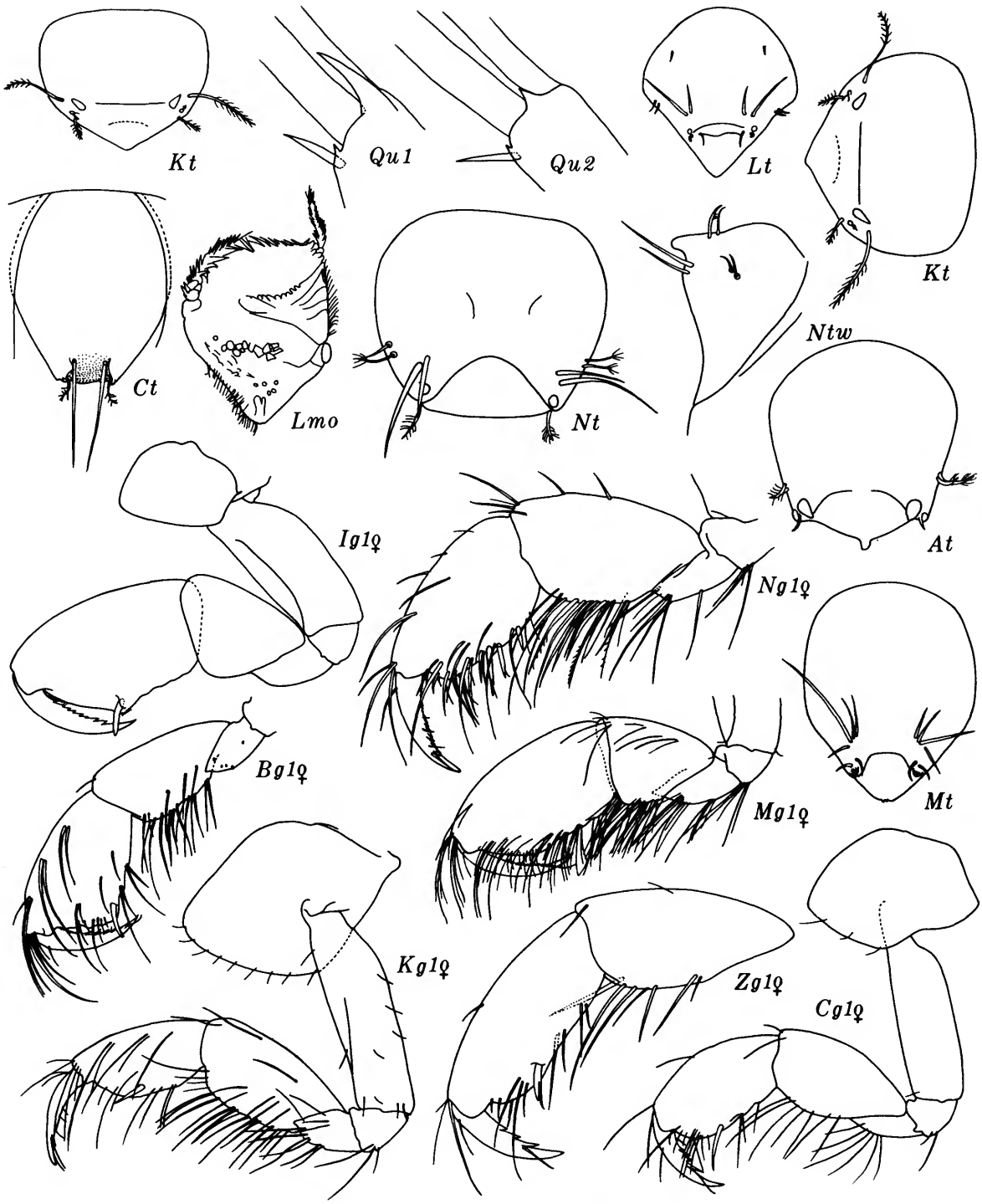


FIGURE 20.—Aoridae (Isaeidae): A, *Aloiloi nenue* J. L. Barnard; B, *Lembos kamanu* J. L. Barnard; C, *Aoroides columbiae* Walker; I, *Lemos intermedius* Schellenberg; K, *Konatopus paao* J. L. Barnard; L, *Lembos leapakahi* J. L. Barnard; M, *L. macromanus* (Shoemaker); N, *Neomicrodeutopus* (?) *makena* J. L. Barnard; Q, *Lembos aequimanus* Schellenberg; Z, *Aoroides nahili* J. L. Barnard.

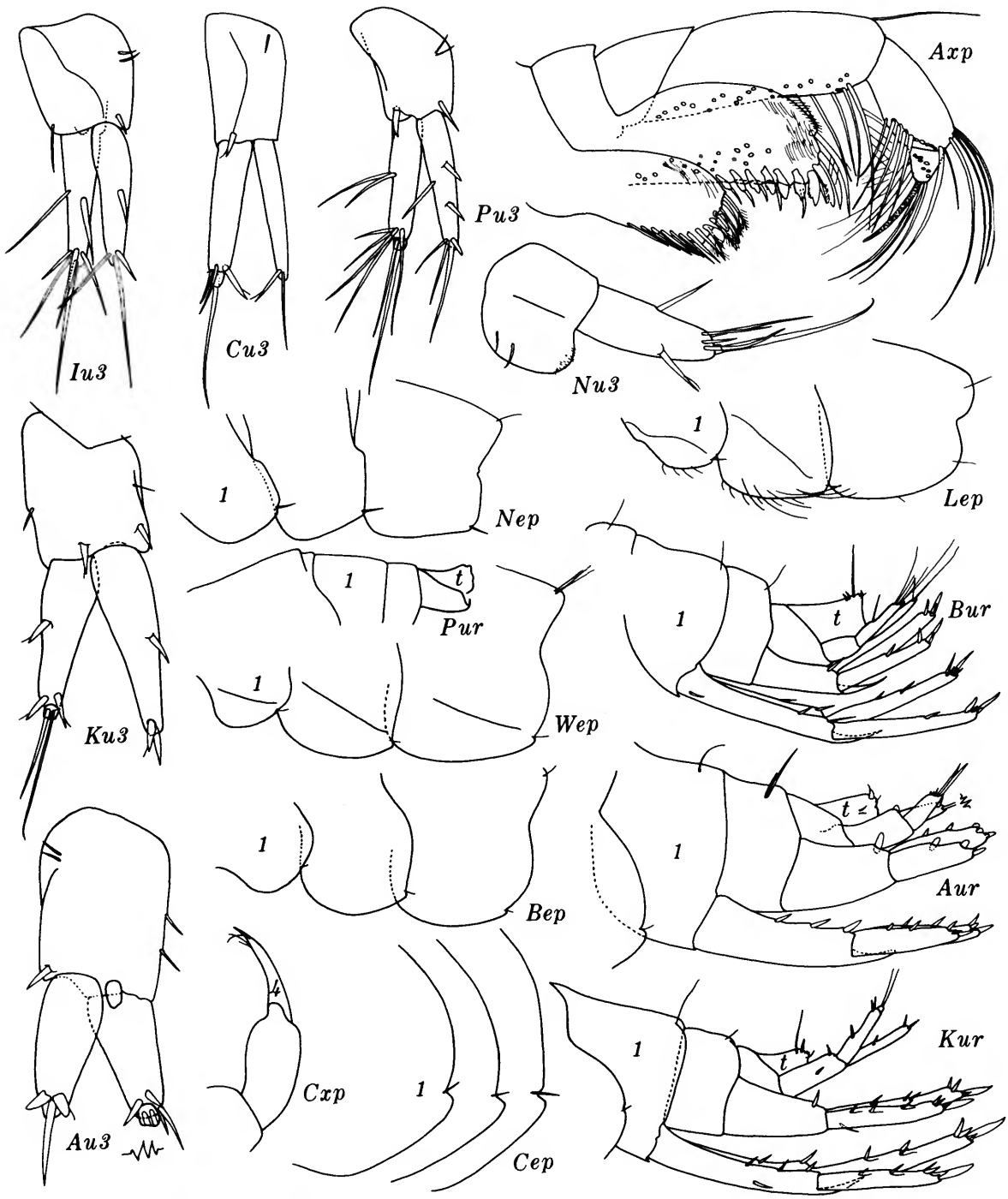


FIGURE 21.—Aoridae (Isaeidae): A, *Aloiloi nenue* J. L. Barnard; B, *Lembos kamanu* J. L. Barnard; C, *Aoroides columbiae* Walker; I, *Lembos intermedius* Schellenberg; K, *Konatopus paao* J. L. Barnard; L, *Lembos leapakahi* J. L. Barnard; N, *Neomicrodeutopus* (?) *makena* J. L. Barnard; P, *Lembos pualani* J. L. Barnard; W, *L. waipio* J. L. Barnard.

A. columbiae but both species have to be observed together to note the differences until experience is gained; otherwise the small gnathopods have to be dissected, mounted flat, and compared with Figures *19Cg2* and *Zg2*. Male gnathopod 1 differs slightly from that on *A. columbiae* in the turgid proximoanterior margin of article 5. The black eyes are combined with brownish purple pigment occurring in most specimens on thoracic segment 5.

Oahu, 0–4 m, generally phycophilous.

Genus *Konatopus* J. L. Barnard

Konatopus paao J. L. Barnard

Konatopus paao J. L. Barnard, 1970:70–72, figs. 34, 35.

Male gnathopod 1 is like that of *Microdeutopus* Costa (see Sars, 1895, plate 192) but the distal tooth of article 5 is rudimentary and article 6, though shorter and more slender than article 5, has a minute palm. The head has a deep recessment for the attachment of antenna 2 and the lateral cephalic lobes are much longer than in other Hawaiian aorids. Article 3 of antenna 1 peduncle is as long as article 1 and the inner plate of maxilla 1 has medial setae; it thus resembles *Aloiloi* alone among other Hawaiian aorids in these characters. The rami of uropod 3 are only slightly longer than the peduncle and the outer has a barrel-shaped article 2; uropod 2 lacks a peduncular process between the rami. Pleonal epimera 1–3 have the bulging posterior margins and small posteroventral tooth and notch. Article 2 of pereopods 3–5 is slender. Female gnathopods 1–2 are scarcely different in size and females thus might be classified as Isaeidae.

The ochraceous, caramel or reddish brown eyes are unique in the Aoridae except for the weak orange eyes of *Aoroides columbiae*. Other aorids have black or purple-brown in the eyes, even in alcohol. Eyes should be examined under medium-power compound microscopy as they may appear black from a distance under low-power stereoscopy.

Male pereonite 1 and coxa 1 become extremely elongate anteroposteriorly in terminal stages.

Oahu, intertidal to 30 m.

Genus *Lembos* Bate

Members of *Lembos* are numerous in Hawaii and often difficult to distinguish from each other in female and juvenile stages. A sample with 3 or 4 species may seem impossible to partition into taxa but if one commences looking for *L. leapakahi*, the most easy to distinguish by its pure white color in alcohol and large smooth gnathopods, next *L. intermedius* by the color pattern of head, pereonite 1 and pereonite 6, followed by *L. waipio* with distinct pale brown color on the dorsal sides of pereonites 2–6, one is then faced only with the problem of distinguishing *L. macromanus* from *L. pualani* by observing the stairstepping of the urosomal segments dorsally and the dorsally short urosomite 2 in *L. macromanus*. *L. pualani* has dull eyes with distinct ommatidia separated from each other by clear space. *L. kamanu* and other taxa are distinguished from *L. pualani* by small differences and are known only in the female condition as yet.

Males are very easy to distinguish in their terminal stages according to teeth on the belly of the thorax. Sternal teeth must be observed from direct lateral view after coxae 1–5 have been dissected off both sides of the carcass (see Figure *16Lv*, etc.). Article 2 on the outer ramus of uropod 3 is missing in one species only, but occasionally an aberrant specimen of other species may lack this article on a regenerating ramus. Collections older than 2 months and preserved in alcohol are not reliable for color differentiation.

All terminal males except those of *L. leapakahi* have a deep notch on the palm of gnathopod 1. *Lembos macromanus* males have especially dense setae projecting anteriorly from article 5 of gnathopod 2 and *L. pualani* has a very dense brush of setae projecting distomedially from article 6 of gnathopod 1. Coxa 1 is highly modified in *L. pualani*.

Female gnathopod 1 is larger than 2 but relatively plain, with a simple palm defined by a spine; in *L. leapakahi* it resembles that of the male and is thus easy to distinguish but only in *L. macromanus* of the other Hawaiian species is there a slightly increased tumidity of articles 5–6. Female gnathopod 2 does not always match that of the male precisely in setation or lobation on article 2.

Numerous other characters occur on members of *Lembos* but they have not been studied adequately in relation to various instars of the species. For example, the following offer promise as characters of qualitative value to distinguish all stages of each species instead of the present necessity to rely on the artifact of color preservation in alcohol: (1) The extent of distal setation on the outer ramus of uropod 3; (2) the number

of setae and condition of ornaments on the telson; (3) mixture of spines and setae on article 2 of pereopods 3–5; (4) relative length to antenna 1 and stoutness of antenna 2 peduncle; (5) ocular structure; (6) precise structure of shark-tooth flake on left mandibular molar.

Eyes of this genus are brown, from bright coffee to dull deep brown, except for *L. kamanu*.

Key to Hawaiian Species of Genus *Lembos* Bate

Figure Numbers Referenced in Italics

1. Gnathopod 1 of both sexes with large subcircular article 6, palm convexly transverse, lacking deep notch, article 6 not significantly longer than broad article 5 (*18Lg1*), pleonal epimera 2–3 rounded posteroventrally, gnathopod 2 especially stout in both sexes, body usually pure white and lacking any pigmentary spots in alcohol ..... ***L. leapakahi***

   Gnathopod 1 of male larger and more complex than that of female, article 6 subrectangular (*18Ig1*), palm transverse or oblique but in male bearing deep notch with defining tooth, article 6 significantly longer than article 5, all pleonal epimera with small posteroventral notch and tooth, gnathopod 2 not especially stout, body with small to large amount of pigment in alcohol 2

2. Uropod 3 lacking article 2 on outer ramus, thoracic sternal teeth on male bifid (*16Iv*), body pigment in alcohol forming broad dark stain on posterior half of head, anterior half of pereonite 1 and posterior half of pereonite 6 ..... ***L. intermedius***

   Uropod 3 with small barrel-shaped article 2 on outer ramus, thoracic sternal teeth of male simple if present (*16Mv*), body pigment composed either of spots or blotches more widely scattered than just on head, pereonite 1 and pereonite 6 3

3. Dorsal margin of urosomite 2 not especially short, male gnathopod 1 relatively narrow, article 5 long, article 6 strongly setose medially (*18Pg1*), male thoracic sternites lacking teeth, each ocular ommatidium distinctly visible ..... ***L. pualani***
   (Proceed also to subkey, below)

   Dorsal margin of urosomite 2 especially short and full dorsal margin of urosome conspicuously stairstepped, male gnathopod 1 stout, article 5 short, article 6 poorly setose medially (*18Mg1*), male thoracic sternites 2, 3 or 4 with teeth, ommatidia not clearly distinct 4

4. Body background buff in alcohol, covered with dark spots, eyes bright coffee color, male sternal teeth on thoracic segments 2–3 only (*16Mv*) ..... ***L. macromanus***

   Body background pure white in alcohol, with pale brown dorsal stripes or blotches on pereonites 2–6 or 3–6, eyes medium-dull brown, male sternal teeth on thoracic segments 2–4 (*16Wv*) ..... ***L. waipio***

Some Females of *Lembos* from Couplet 3

1. Gnathopod 1 normal for female of *Lembos*, palm evenly convex ..... ***L. pualani***

   Gnathopod 1 with slightly scalloped palm (uniquely also with shark-tooth on left mandibular molar, and strongly depressed urosomite 3 (*20Bg1*) ..... ***L. kamanu***

   Gnathopod 1 with sinuous or excavate palm 2

2. Lateral lobe of head narrow, rami of uropod 3 elongate, peduncular tooth of uropod 2 short. ***L. aequimanus***

   Lateral lobe of head normally broad, rami of uropod 3 short, peduncular tooth of uropod 2 long. ***Lembos*** sp.

Lembos ?aequimanus Schellenberg

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

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

Lembos ?aequimanus.—J. L. Barnard, 1970:72–76, fig. 36 *a–e*.

Only the female stage of this species is known; it resembles the female of *L. pualani* in many ways but has a narrow gnathopod 1 with excavate palm bearing a weak distal protrusion; the urosome is normal. Rami of uropod 3 are elongate. Lateral cephalic lobe narrow and mammilliform, anteroventral corner of head quadrate.

Peduncular tooth of uropod 1 shorter than in other species of *Lembos* and tooth of uropod 2 uniquely obsolescent.

Body ground color slightly brownish, with scattered darker spots.

Gilbert; Fiji; Oahu, intertidal, *Sargassum*.

Lembos intermedius Schellenberg

Lembos intermedius Schellenberg, 1938:77–78, fig. 40.—J. L. Barnard, 1955:34; 1970:76–77, fig. 37.

Male coxa 1 with quadrate anteroventral corner; article 2 of gnathopod 2 with strong, thin mammilliform anterodistal lobe, article 5 less than half as long as article 6, latter expanded, anteriorly bulging, moderately setose medially, palm oblique, defining process thus short, dactyl scarcely overlapping palm; article 2 of gnathopod 2 with large lobe similar to that on gnathopod 1, palm nearly transverse, setation dense medically; thoracic sternites 2–5 each with low broad bifid tooth, sternite 1 with obtuse simple tooth, 6 with tiny cusp; uropod 3 lacking article 2 on outer ramus; female gnathopod 1 normal, article 6 longer than 5, article 2 of gnathopod 2 with anterodistal corner sharply quadrate.

Posterior portion of head, anterior half of pereonite 1, and posterior half of pereonite 6 with dark brownish-purple stain.

Oahu, 0–4 m.

Lembos kamanu J. L. Barnard

Lembos kamanu J. L. Barnard, 1970:77–79, fig. 38.

Only the female stage of this species is known; it resembles the female of *L. pualani* but has a weakly scalloped palm on gnathopod 1, has a strongly depressed urosomite 3 that drops strongly from the dorsal line of urosomite 2; but the latter is elongate like that of *L. pualani*. Uropod 3 has a short peduncle with very long rami in comparison to those of several species of *Lembos* but not extraordinarily different from that of *L. pualani;* the anteroventral cephalic tooth is thick. The main spines on the inner plate of the maxilliped are extremely broad and flabellate; they are difficult to see because of their transparency and concealment by various other setae.

Body very white in alcohol, bearing scattered pigment spots, eyes pale purple in alcohol, central cores surrounded by one layer of large ommatidia.

Oahu, intertidal.

Lembos leapakahi J. L. Barnard

Lembos leapakahi J. L. Barnard, 1970:79–81, figs. 39, 40.

This beautiful amphipod has a large smooth gnathopod 1 in both sexes and juveniles; article 6 appears almost circular, and article 5 is nearly as long as 6. Gnathopod 2 is slightly larger than in any other Hawaiian member of *Lembos*. Males have simple teeth on pereonal sternites 2–5.

Body pure white in alcohol, eyes ochraceous brown and bright.

Oahu, 0–30 m.

Lembos macromanus (Shoemaker)

Bemlos macromanus Shoemaker, 1925:36–41, figs. 10–13.
Lembos macromanus.—Schellenberg, 1938:79.—J. L. Barnard, 1962:9, fig. 3; 1970:82, figs. 41, 42 *a–m, o*.

Male coxa 1 quadrate, with subrounded anteroventral corner; article 2 of gnathopod 1 with sharp downward pointing submammilliform lobe, article 5 about half or much less as long as article 6, latter very broad in terminal male, rectangular, weakly setose medially, palm transverse, main process slightly rounded apically and marked basally with suture in terminal stage, dactyl strongly overlapping palm; article 2 of gnathopod 2 with quadrate or weakly produced anterodistal corner, palm nearly transverse, setation dense medially and on anterior margin of article 5; thoracic sternites with weak tooth on segments 2–3; female gnathopod 1 stouter than normal, article 5 shorter than 6, gnathopod 2 lacking anterodistal lobe on article 2 and article 5 poorly setose in contrast to male. Pereopods 4–5 with especially dense plumose setae on the posterior margin of article 2.

Body buff in alcohol, with numerous dark spots and blotches, eye brightly coffee brown throughout, ommatidia indistinct.

Pacific America; Philippines; Oahu, 0–30 m.

Lembos pualani J. L. Barnard

Lembos (Bemlos) aequimanus.—J. L. Barnard, 1955:34 (not Schellenberg).
Lembos pualani J. L. Barnard, 1970:82–85, figs. 42 *n*, 43.

Male coxa 1 quadrate, anterior and ventral margins deeply concave, anteroventral corner sharply attenuate; article 2 of gnathopod 1 with medium-size mammilliform anterodistal lobe, article 5 about 70 percent as long as article 6, latter rectangular, strongly setose

medially, dactyl strongly overlapping palm; article 2 of gnathopod 2 with long, thin, mammilliform lobe, articles 5 and 6 equal to each other in length, palm nearly transverse, setation dense medially; thoracic sternites lacking teeth; female gnathopod 1 normal, article 6 longer than 5, gnathopod 2 lacking anterodistal lobe on article 2.

Body very white in alcohol, bearing scattered pigment spots, eyes dull purplish brown and each ommatidium distinct from another.

Oahu, 0–4 m.

Lembos waipio J. L. Barnard

Lembos waipio J. L. Barnard, 1970:85–87, figs. 44, 45.

Male coxa 1 with rounded anteroventral corner; article 2 of gnathopod 1 with anterodistal process scarcely evident, article 5 half as long as 6, latter slightly expanded, subrectangular, tapering distally, poorly setose, defining process with stout posterior spine, dactyl strongly overlapping palm; article 2 of gnathopod 2 with weak anterodistal cusp, article 5 longer than 6, palm oblique, setation on gnathopod 2 of moderate extent; thoracic sternites 2–4 with one spine tooth each; female gnathopod 1 normal, article 5 subequal to 6 in length, gnathopod 2 lacking anterodistal lobe on article 2.

Body very white in alcohol, with gross pale purple-brown dorsal stripes or blotches on pereonites 2–6 or 3–6; eyes intermediate between dull and bright, ommatidia indistinct.

Oahu, 0–30 m.

Lembos sp., J. L. Barnard

Lembos sp., J. L. Barnard, 1970:87–90, fig. 36*f-i*.

Only the female stage of this species is known; it resembles the female of *L. pualani* in many ways but the normal-sized gnathopod 1 has a slightly sinuous palm with a posterior excavation marking a weak defining cusp; the urosome and lateral cephalic lobe are normal. Peduncular teeth of uropods 1–2 normally long.

Body ground color white with scattered darker spots.

Oahu, intertidal.

Genus *Neomicrodeutopus* (?) Schellenberg

Neomicrodeutopus (?) *makena* J. L. Barnard

Neomicrodeutopus (?) *makena* J. L. Barnard, 1970:90–92, figs. 19*f*, 46, 47.

The uniramous uropod 3 is diagnostic and male gnathopod 1 has the appearance of that on various boreal species of *Microdeutopus*, a stout but long article 5 bearing one long and one short posterodistal tooth guarding the stout, almost simple article 6 with medium sized dactyl; gnathopod 2 is small, slender, palm nearly transverse; pleonal epimera 1–3 are fairly unusual in their posteriorly truncate appearance, each with small posteroventral bevel-notch bearing a stout seta; ventral margins of those epimera naked.

Female gnathopod 1 generally like that of female *Lembos* but distinguishable from Hawaiian species of that genus in the combination of uropod 3, pleonal epimera and non-extended anteroventral corner of head.

Eyes maintaining dark pigment core in irregularly circular ommatidial group.

Oahu, Makapuu Point, on *Zoanthus*.

Family BIANCOLINIDAE

Genus *Biancolina* Della Valle

Biancolina mauihina J. L. Barnard

FIGURE 22

Biancolina mauihina J. L. Barnard, 1970:103, figs. 57, 58.

Body subcylindrical, urosome depressed, coxae short but family differing from Corophiidae in the fully biramous, though small uropod 3 and from the Colomastigidae in the presence of long flexible antennae curling backwards from a flattened head resembling that of some isopods and insects, uropod 3 short, rami stubby and bearing one or 2 apical spines and ventrolateral margins of uropods 1–2 bearing long plumose setae like those of *Parajassa angularis;* differing from latter in shorter uropod 3 with short peduncle, flexible antennae, small almost parachelate gnathopods and prehensile pereopods 3–5. The telson of *Biancolina* is very short and in this species minutely notched. Uropods 1 and 2 are diverse: in some specimens the outer rami are simple, stubby, nearly half as long as inner rami; whereas in other specimens the outer ramus of uropod 2 has a long stout spine reaching to the apex of the inner ramus, and on uropod 1 the outer ramus is a grotesquely armed piece nearly as long as the inner ramus. These differences have not been resolved as to

FIGURE 22.—Biancolinidae: *Biancolina mauihina* J. L. Barnard.

whether they denote different species or different sexes of the same species. Eyes red in formaldehyde.

Probably bores into stems of algae. Oahu, Kawela Bay, intertidal.

Family CHELURIDAE

Genus *Tropichelura* J. L. Barnard

Tropichelura insulae (Calman)

FIGURE 23

Chelura insulae Calman, 1910:182, pl. 5, figs. 1–6.—J. L. Barnard, 1955:39.

Tropichelura insulae.—J. L. Barnard, 1959: 6, figs. 2, 4C, D, E.

Uropod 2 with its broadly lamellar, setose peduncle and minute rami is an unmistakable character of this species. Uropod 3 is very elongate and the inner ramus is absent. The urosome is elongate and the segments coalesced together to form a shallow box. Gnathopod 1 is enormously enlarged, like gnathopod 2 of a *Maera*, whereas gnathopod 2 is very small.

Eyes dull ochraceous to amber in alcohol.

Bores or rasps wood, occurring mainly in tunnels already created by limnoriid isopods; Honolulu Harbor, pilings and floating docks.

Circumtropical.

Family COLOMASTIGIDAE

Genus *Colomastix* Grube

FIGURES 24, 25

Colomastigids resemble some corophiids in the cylindrical body plan and very short coxae; but urosomites 2–3 are distinctly coalesced, whereas, in corophiids they are either free or coalesced with urosomite 1; and colomastigids have a distinctly biramous uropod 3 and large telson. The mandible lacks palp and incisor and bears large terminal spines curved medially (*24 Lm*). The maxillipeds are thin like those of stenothoids and leucothoids and have either free or coalesced inner lobes, broad but short outer lobes and a thin palp; the basal articles may form a large shell-like hood (seen

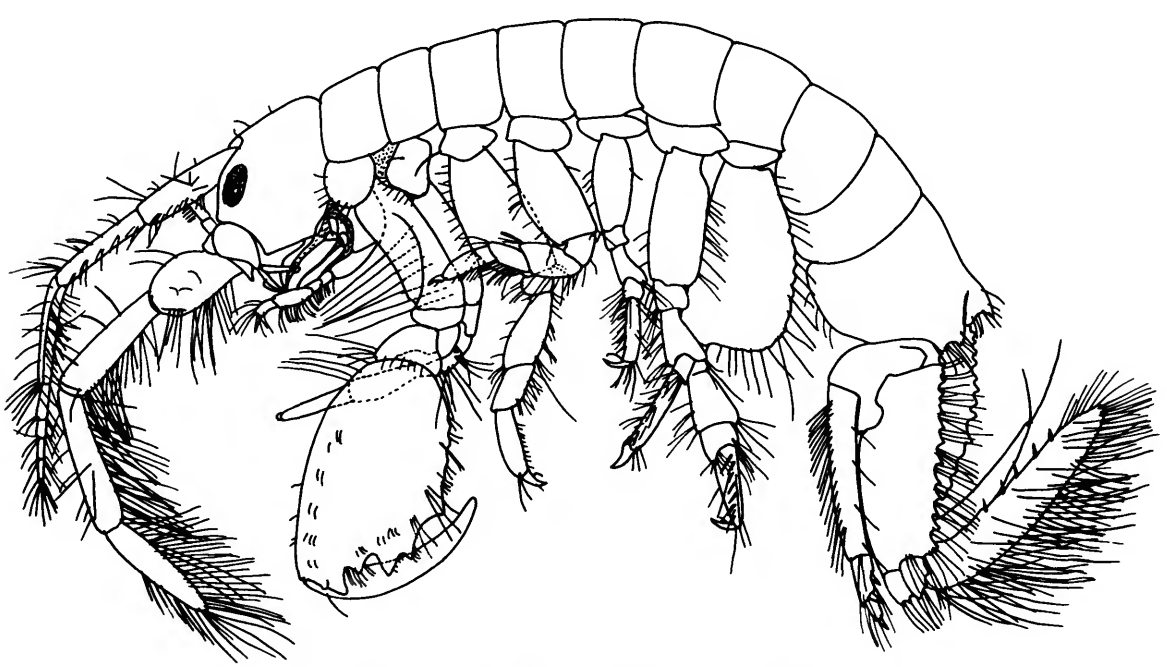


FIGURE 23.—Cheluridae: *Tropichelura insulae* (Calman).

from lateral view before dissection). Gnathopod 1 is very thin and usually bears a distal brush of setae with dactyl concealed or unidentifiable, but the male of *C. pusilla* has a shortened gnathopod 1 with stout, short dactyl. Male gnathopod 2 becomes enlarged and distinctly subchelate, often grotesquely. The antennal flagella are short.

Colomastigids in Hawaii are very small and the obscure mouthparts are very difficult to extirpate. They can be checked in situ by rolling the head ventral side up so that the spiny mandibles, protruding epistome, and midcephalic keel can be seen, along with vague outlines of the maxillae; the maxillipeds should be removed first.

Key to Hawaiian Species of Genus *Colomastix* Grube

Figure Numbers Referenced in Italics

1. Outer ramus of third uropod half or less as long as inner ramus (*25Ltu3*) ..... ***C. lunalilo***
   Outer ramus of third uropod 75–100 percent as long as inner ramus 2
2. Uropod 1 extending the same distance as uropod 2 (coxae 1–4 broadly rounded anteriorly, outer rami of uropods 1–3 varying from 66 to 75 percent as long as inner rami, inner plates of maxillipeds freely split) ..... ***C. kapiolani***
   Uropod 1 short, extending only as far as middle of rami of uropod 2 3
3. Each pair of rami on uropods 1–3 equal in length (coxae 1–4 narrowed and attenuate but not pointed anteriorly, inner plates of maxilliped coalesced) ..... ***C. pusilla***
   Outer ramus of uropod 3 slightly shorter than inner ramus (other characters unknown). ***Colomastix*** sp.

Colomastix kapiolani J. L. Barnard

Colomastix kapiolani J. L. Barnard, 1970:96, fig. 50.

Terminal male gnathopod 2 has a characteristic shape (*25Kg2*).

Oahu, 2–30 m, especially on *Pocillopora* bottoms.

Colomastix lunalilo J. L. Barnard

Colomastix lunalilo J. L. Barnard, 1970:96–100, figs. 51, 52.

The eyes are brown in formaldehyde and remain dark in alcohol; all other species of the genus so far collected in Hawaii have red eyes in formaldehyde that become rusty-pink or clear in alcohol. The anterior coxae are not attenuate anteriorly but have small nipple-like points; the inner plates of the maxilliped are coalesced like those of *C. pusilla*.

Oahu, Kaneohe Bay, 3–4 m, on bottom of corals, algae, and rubble.

Colomastix pusilla Grube

Colomastix pusilla Grube.—J. L. Barnard, 1955:39–42, fig. 20 (with references).

Male gnathopod 1 is shortened and has a short stout dactyl unlike females of *C. pusilla* and both sexes of the other species of the genus that all have a distal setal brush on gnathopod 1.

Possibly cosmopolitan in tropical and temperate seas. Oahu, Kaneohe Bay, depth and biotopes unknown.

Colomastix sp., J. L. Barnard

Colomastix sp., J. L. Barnard, 1970:100.

A single juvenile of this species has been collected; it may represent a stage of *C. pusilla* but gnathopod 1 has only a single long hooked seta (?dactyl) and is possibly a stage in the transformation between the juvenile-female state to that of the male; however, the outer ramus of uropod 3 is slightly shortened, unlike *C. pusilla*. Coxae and maxillipeds have not been studied.

S. Oahu, 30 m, bottom dominated by coralline "footballs."

Family COROPHIIDAE

FIGURES 17E, O, 26

Corophiids belong to the isaeid-complex, with fleshy telson and grandular pereopods 1–2 but corophiids have a strongly flattened urosome; they differ from podocerids in the relatively short urosomite 1; uropod 3 is uniramous in Hawaiian corophiids. Keys to Isaeidae (page 88), Ischyroceridae (page 97), and Aoridae (page 40) should also be examined for species superficially similar to Corophiidae.

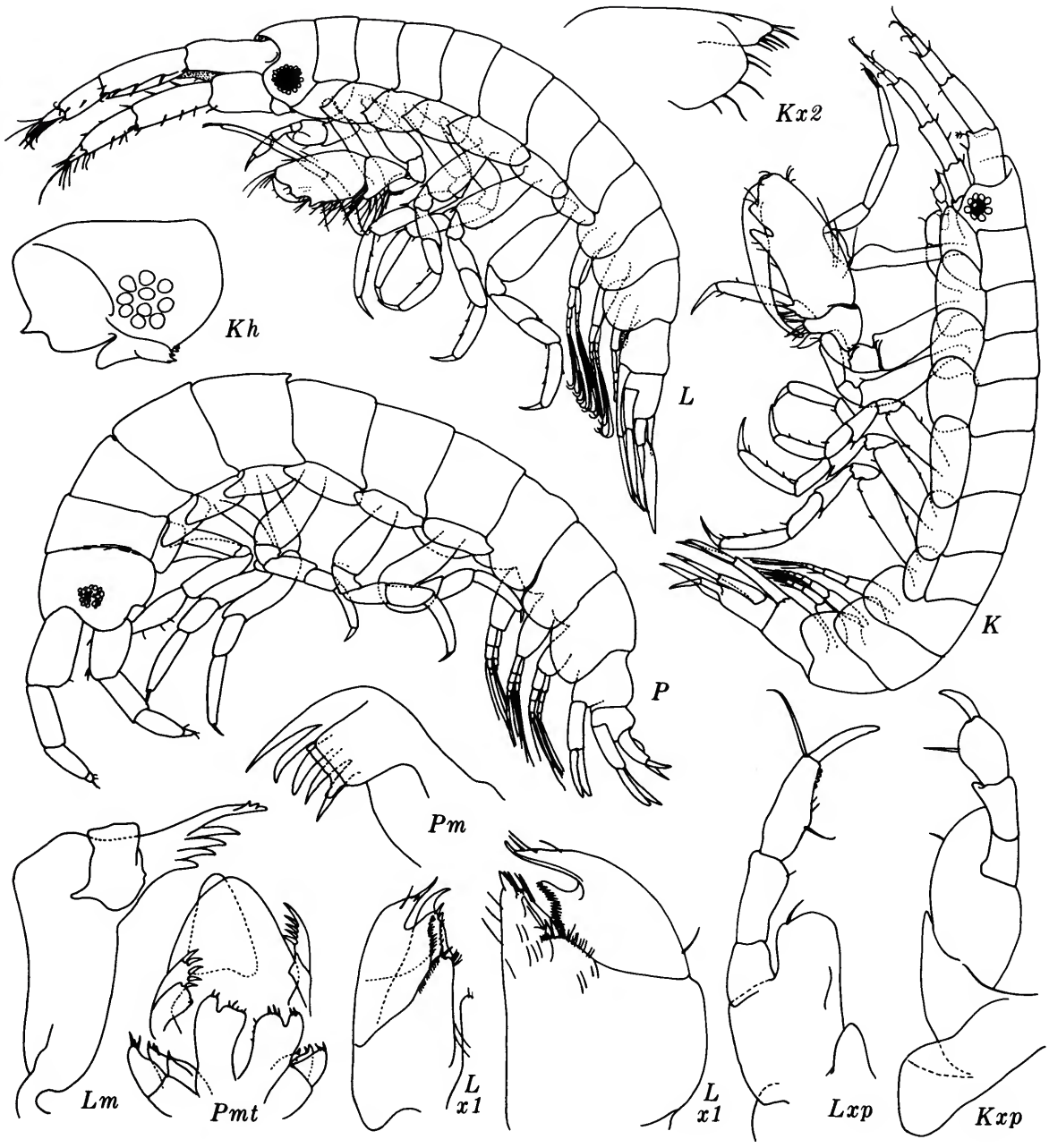
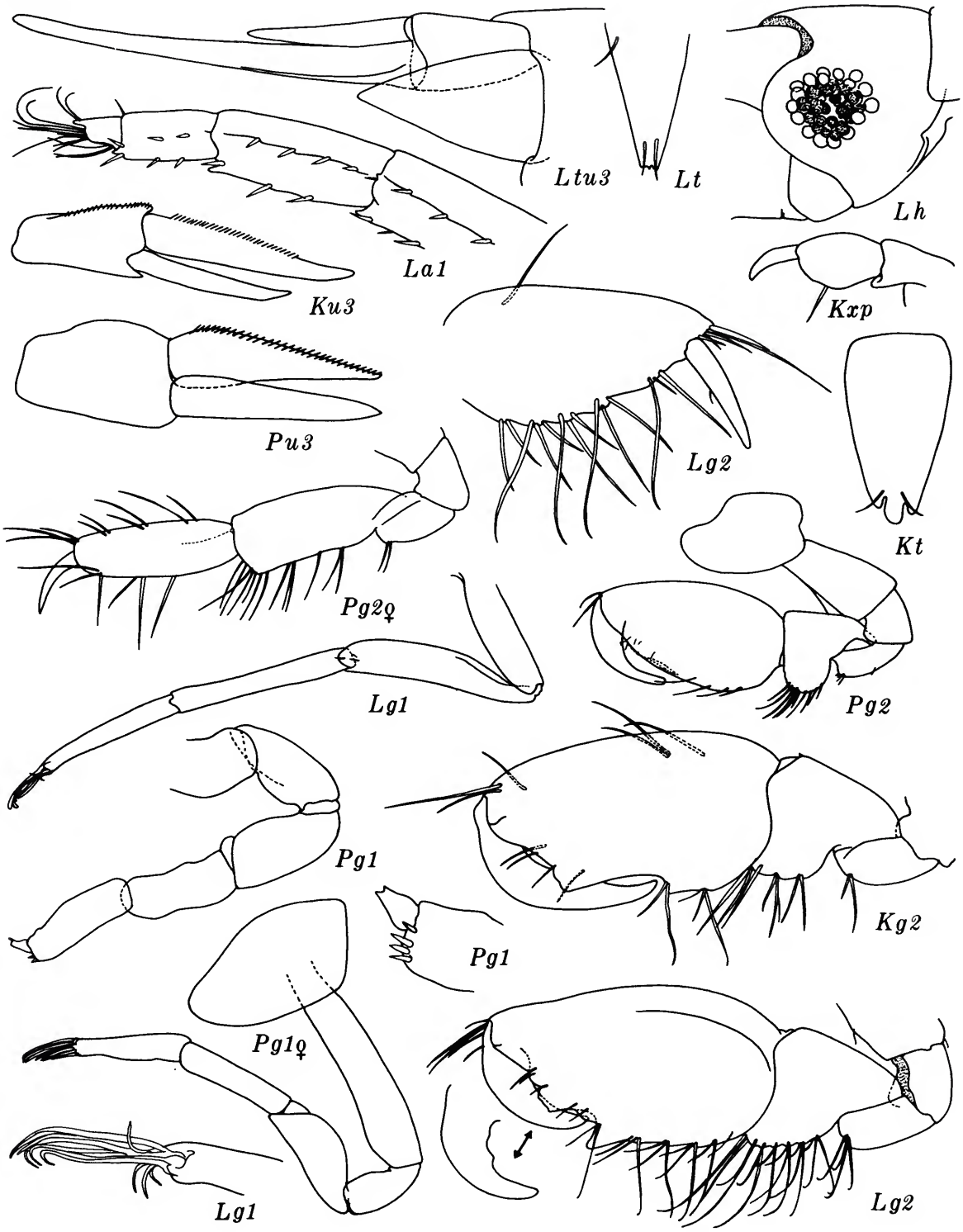


FIGURE 24.—Colomastigidae: K, *Colomastix kapiolani* J. L. Barnard; L, *C. lunalilo* J. L. Barnard; P, *C. pusilla* Grube.

FIGURE 25.—Colomastigidae: K, *Colomastix kapiolani* J. L. Barnard; L, *C. lunalilo* J. L. Barnard; P, *C. pusilla* Grube.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Pu3
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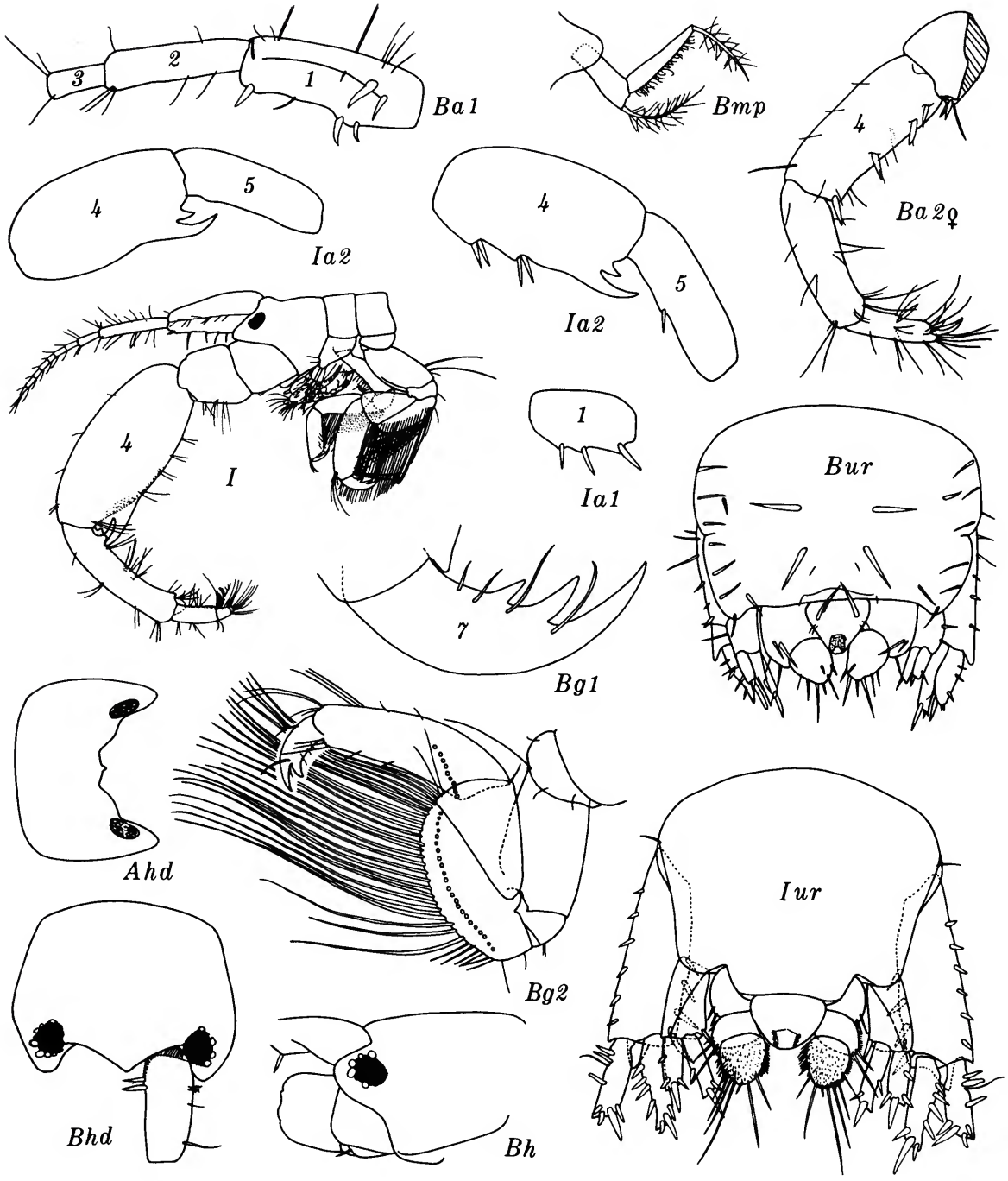

FIGURE 26.—Corophiidae: A, *Corophium acherusicum* Costa (see also Figure 17); B, *C. ?baconi* Shoemaker; I, *C. insidiosum* Crawford.

Key to Genera of Corophiidae

Figure Numbers Referenced in Italics

Article 3 of antenna 1 shorter than article 1, antenna 2 very stout in male (*26I*) and article 4 with tooth in male or strong spines in female; mandibular palp 2-articulate (*26Bmp*), gnathopods small but gnathopod 2 grossly setose; uropod 3 flat (*26Bur*), eyes dark.
Corophium Latreille

Article 3 of antenna 1 longer than article 1, antenna 2 slender in male (*17E*), article 4 lacking tooth or strong spines (but setose); mandibular palp 3-articulate; gnathopod 1 small, gnathopod 2 in male very large, carpochelate (*17E*); uropod 3 subcylindrical and with special form of Figure *4Rw*, eyes red or clear.....***Ericthonius*** Milne-Edwards

Key to Hawaiian Species of Genus *Corophium* Latreille

Figure Numbers Referenced in Italics

1. Urosome boat- or saucer-shaped, segments all coalesced, forming a lateral upturned rim with a slight notch on each side, uropods 1 and 2 attached ventrally (*26Bur*)..... ***C. ?baconi***
   Urosomites separate (or if coalesced not forming a saucer), marked with lateral stairsteps or notches for insertion of uropods 1–2 (*26Iur*).....2
2. Antenna 2 with large distal tooth on article 4 (*26Ia2*, left) . . . males.....3
   Antenna 2 lacking tooth, article 4 bearing large spines ventrally (*26Ba2*) . . . females.....4
   Antenna 2 with both a tooth and spines on article 4 (*26Ia2*, right).
   aberrant kinds of ***C. insidiosum***
3. Rostrum large from dorsal view (*26Bhd*).....***C. insidiosum***
   Rostrum obsolete, head deeply invaginated from dorsal view (*26Ahd*).....***C. acherusicum***
4. Spines of article 4 on antenna 2 occurring in 2 pairs and a single terminal.....***C. insidiosum***
   Spines of article 2 on antenna 2 occurring in 3 pairs and a single terminal.....***C. acherusicum***

Corophium acherusicum Costa

Corophium acherusicum Costa.—Crawford, 1937:617–620, fig. 2.—Shoemaker, 1947:53, figs. 2, 3; 1949:76.—J. L. Barnard, 1955:37.

Microscopic examination of the large tooth on male antenna 2 demonstrates that it is really two teeth, the second very small; the same is true of *C. insidiosum* males. The dactyl of gnathopod 2 has two accessory teeth. The female head is normally rostrate like males of *C. baconi*. Eyes black-brown like other species of *Corophium* herein.

This species, like *C. insidiosum*, is cosmopolitan in harbors; it builds tubes on pilings, boats and docks.

Oahu, Waikiki, on bottom of small boat.

Corophium ?baconi Shoemaker

?Corophium baconi Shoemaker, 1934:356–359, fig. 1; ?Shoemaker, 1949:82, figs. 5, g, h.—J. L. Barnard, 1970:100–101, fig. 53.

Male and female rostra are normal. Male antenna 2 is generally like that of *C. acherusicum* and normal *C. insidiosum*. The female lacks spines on article 5 of antenna 2 unlike females of *C. acherusicum* and *C. insidiosum*. The urosome (26 Bur) is characteristic; this is the only species from the Pacific Ocean as yet known to have this kind of urosome. The dactyl of gnathopod 2 has only 1 accessory tooth.

Eastern and Central Pacific in the quadrangle from Bering Sea to Hawaii to California to Peru. Generally a species of the open seas, in contrast to its Hawaiian congeners. Oahu, Kaneohe Bay, Hawaii Marine Laboratory dock area.

Corophium insidiosum Crawford

Corophium insidiosum Crawford, 1937: 615, fig. 2 a-g.—Shoemaker, 1947: 53, figs. 6, 7.—J. L. Barnard, 1970: 101–102, fig. 54.

See notes on *C. acherusicum*. Dactyl of gnathopod 2 with 2–3 accessory teeth. The population at Hilo, only record so far of the species from Hawaii, is highly aberrant. Only a few individuals are normal; most males and females display one or more characters of the opposite sex. Males may have a few stout spines on the ventral margins of antenna 2 and females may have a distal tooth on article 4 like males. This may represent the loss of phenotypic stability as the result

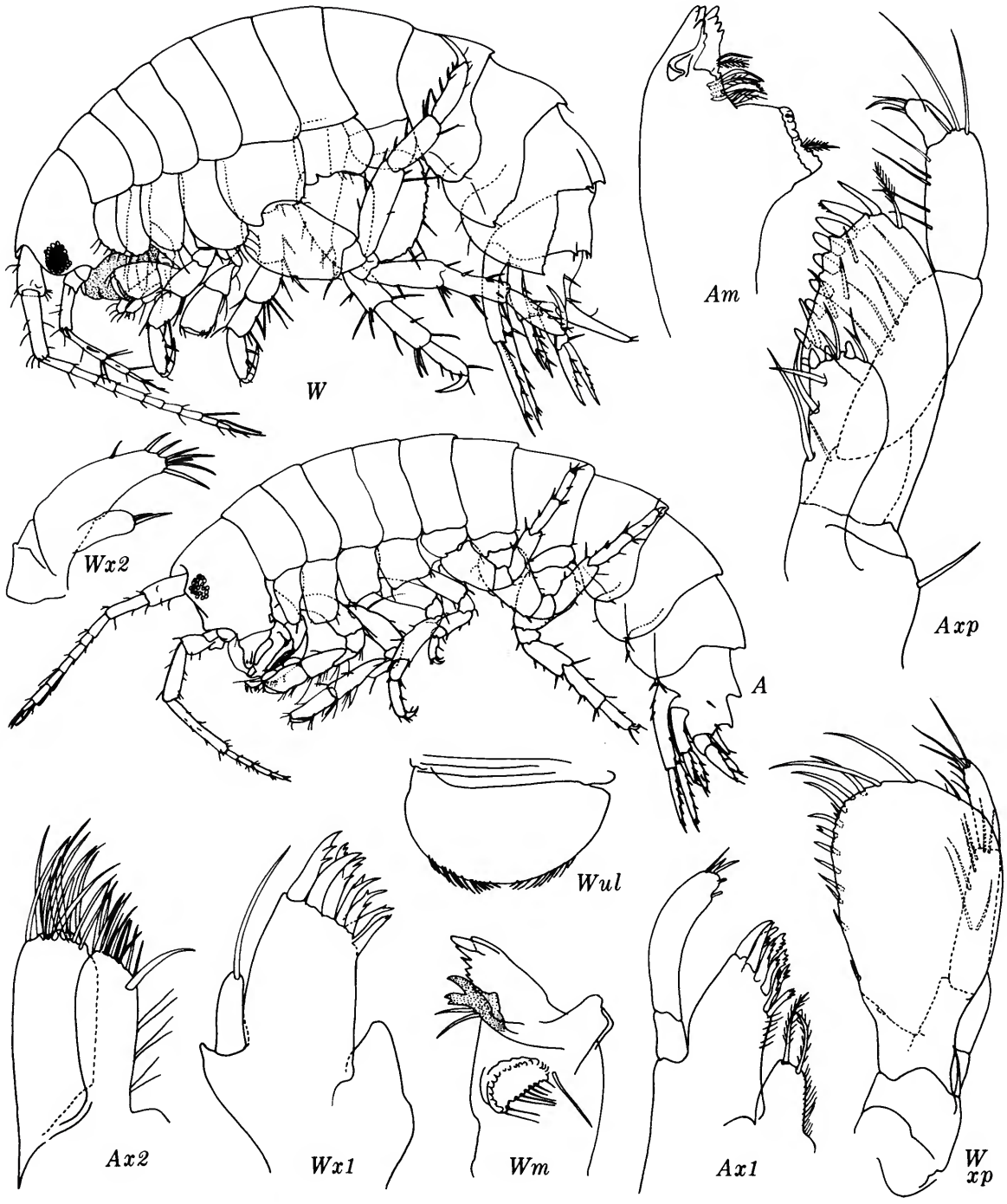

FIGURE 27.—Dexaminidae (=Atylidae): A, *Atylus* (*Kamehatylus*) *nani* J. L. Barnard; W, *Paradexamine* (*Wailele*) *maunaloa* J. L. Barnard.

of a "founder effect." The species is presumed to have been introduced, like *C. acherusicum*, by shipping in the last 2 centuries.

Hawaii, Hilo.

Genus *Ericthonius* Milne-Edwards

Ericthonius brasiliensis (Dana)

Ericthonius brasiliensis.—Stebbing, 1906:671–672.—Schellenberg, 1938:90.—J.L. Barnard, 1955:37–38.
Erichthonius abditus.—Sars, 1895:602–603, pl. 215.

The ocular (cephalic) lobes are long, the eyes red in life, turning yellow or clear in spirit; the telson is very short and broad and covered with tiny hooks; uropod 3 is unmistakable.

Cosmopolitan in tropical and temperate seas, forming great masses of silty tubes attached to piles and docks in harbors of Oahu but also occurring sparsely in the open sea to depths of at least 30 m.

Family DEXAMINIDAE (= Atylidae)

FIGURES 27, 28

The Atylidae were recently synonymized with the Dexaminidae (J. L. Barnard, 1970, p. 26, n. 10). The family is recognized by the coalesced urosomites 2–3, the cleft telson, long antennae with vestigial or obsolete accessory flagellum, and small but subchelate gnathopods. Dexaminids are distinguished from Ampeliscidae in their compound ommatidial eyes; from Sebidae in the biramous uropod 3; and from Colomastigidae by the lateral body compression, the presence of a subchelate gnathopod 1, and the occurrence of mandibular incisors and elongate coxae.

The only atylin of Hawaii is *Atylus* (*Kamehatylus*) *nani*. It lacks a mandibular palp and thus differs from the majority of *Atylus*, but it is so clearly derived from a line of atylins especially represented by a Japanese species that it must remain within the genus *Atylus*.

Key to Genera of Dexaminidae

All urososmites coalesced, palp of maxilliped extending well beyond outer plate, inner plate of maxilliped well developed, palp of maxilla 1 reaching end of outer plate and 2-articulate, lower lip lacking inner lobes, pleonites with only 1, or less than 1, dorsal tooth each. ***Atylus* (*Kamehatylus*)**

Only urosomites 2–3 coalesced, palp of maxilliped not extending beyond outer plate, inner plates absent, palp of maxilla 1 very short and 1-articulate, lower lip with inner lobes, pleonites 3 and 4 with dorsolateral tooth besides dorsal tooth..... ***Paradexamine* (*Wailele*)**

Genus *Atylus* Leach

Atylus (*Kamehatylus*) *nani* J. L. Barnard

Atylus (*Kamehatylus*) *nani* J. L. Barnard, 1970: 93–96, figs. 48, 49.

This species differs from all other atyluses in the coalescence of all urosomites and from most atyluses in the absence of a mandibular palp and the presence of 2 articulate spines on each side of the urosome, like various other genera of dexaminids.

Body with overall ochraceous-orange color of *Sargassum* sp., but composed of mottled orange, ochre, rust, yellow, and buff; eyes red in formaldehyde, bleaching clear in alcohol. Probably free-living in *Sargassum* sp.

Oahu, Kawela, intertidal.

Genus *Paradexamine* Stebbing

Paradexamine (*Wailele*) *maunaloa* J. L. Barnard

Paradexamine (*Wailele*) *maunaloa* J. L. Barnard, 1970:102–103, figs. 55, 56.

Body white, eyes black in formaldehyde and alcohol. Possibly inhabits ascidians.

Oahu, near Kualoa Point, intertidal, on rock covered with ascidians.

Family EUSIRIDAE (= Calliopiidae)

FIGURES 29, 30

These are basic gammarideans like the family Gammaridae and differ only in degree from various gammarids. The accessory flagellum is either absent or is composed only of 1 article in Hawaiian eusirids. Both

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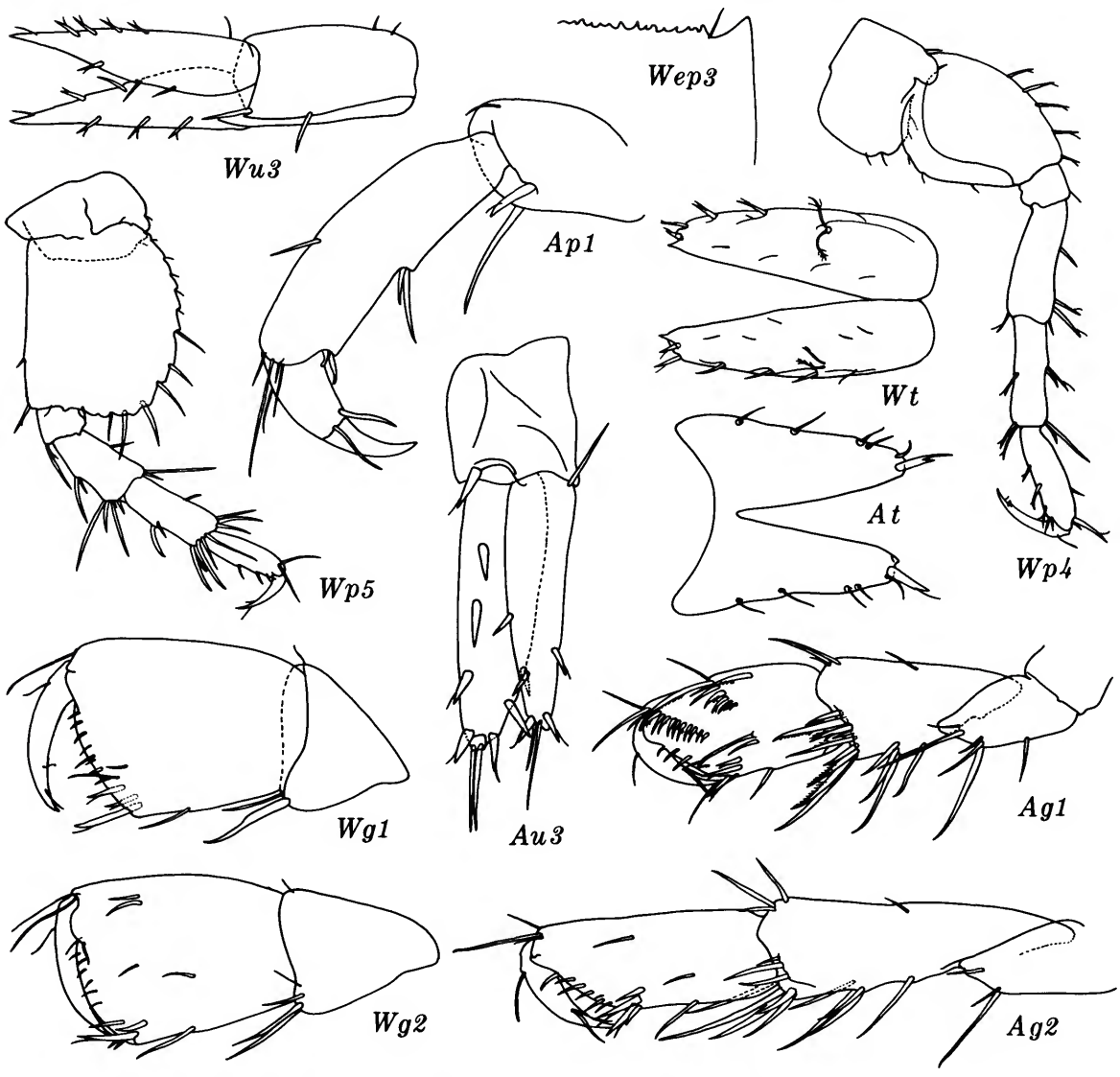


FIGURE 28.—Dexaminidae (=Atylidae): *Paradexamine* (*Wailele*) *maunaloa* J. L. Barnard and *Atylus* (*Kamehatylus*) *nani* J. L. Barnard.

species from the Hawiian Islands have large dark eyes, long thin antennae with short peduncles, article 2 of the peduncle on antenna 1 is slightly shorter than article 1 and article 3 is very short, uropod 3 has long triangular, sharply pointed rami bearing long plumose setae and short spines, and the outer rami of uropods 1–2 are shorter than the inner.

Eusirids differ from liljeborgiids in the vestigial accessory flagella, the weakly toothed or smooth dactyls of the gnathopods, and for both Hawaiian genera of eusirids, strongly triturative mandibular molars. Eusirids resemble pleustids but differ in the cleft telson and normal lower lip.

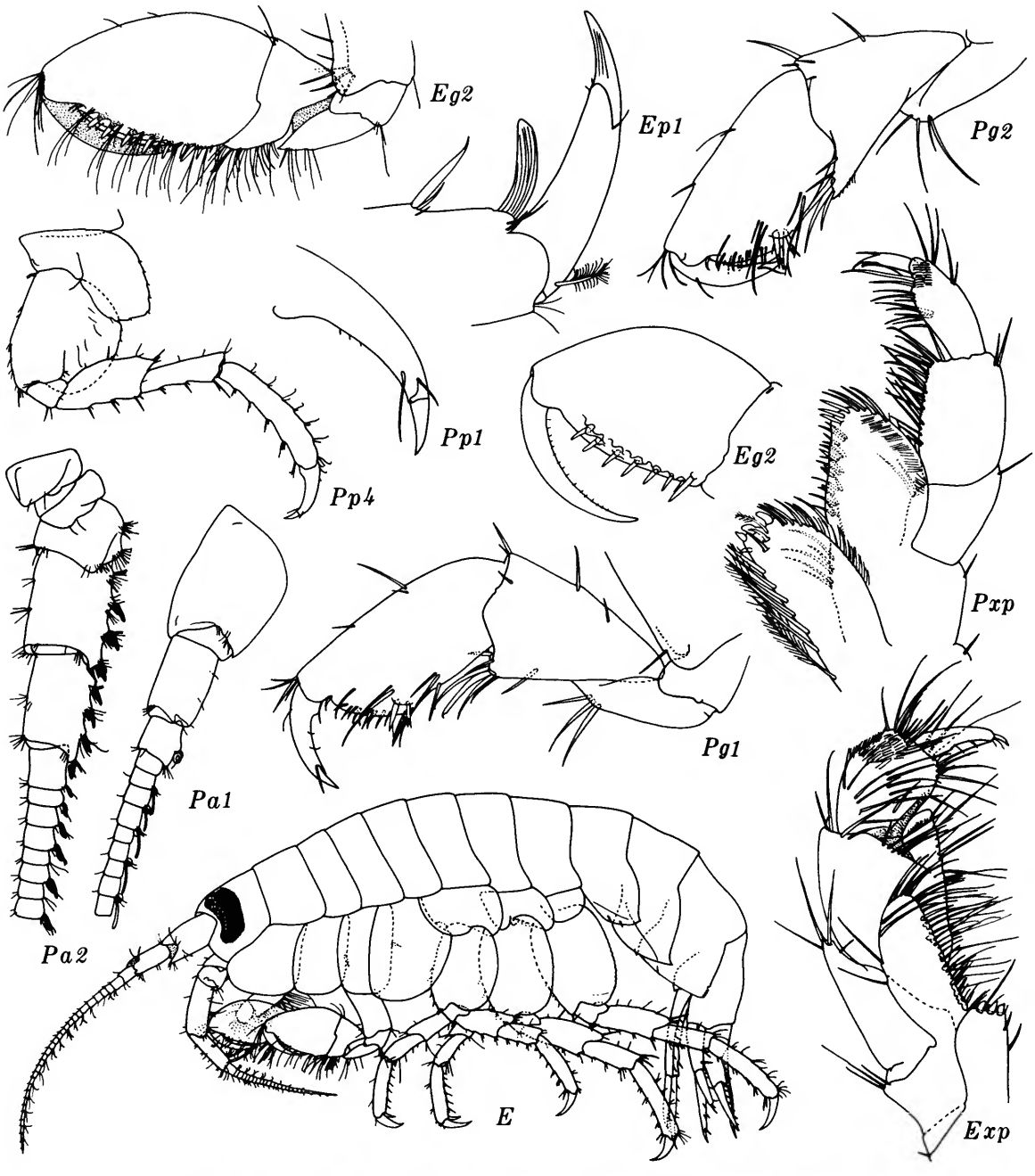


FIGURE 29.—Eusiridae: E, *Eusiroides monoculoides* (Haswell); P, *Pontogeneia pacifica* Schellenberg.

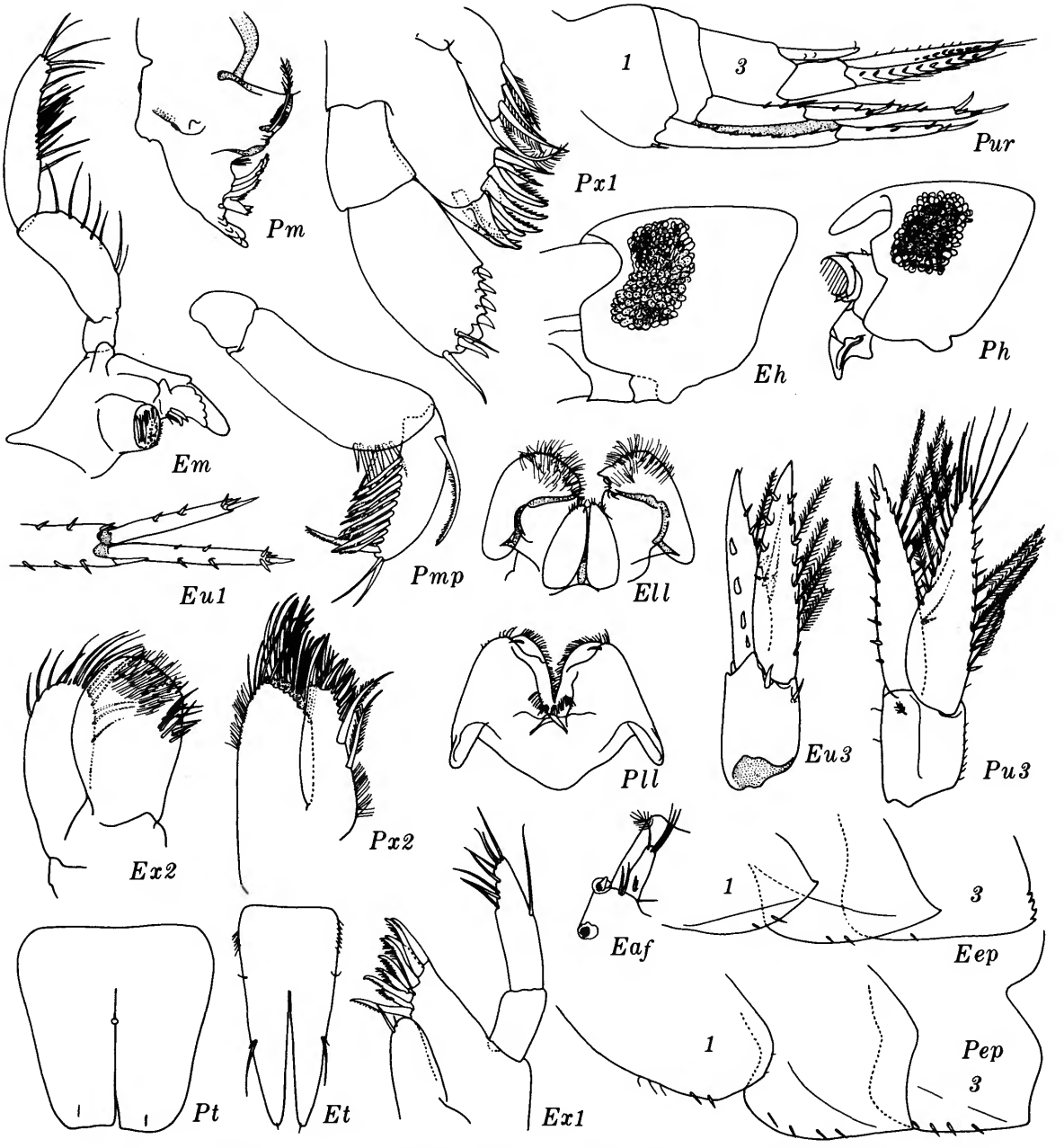
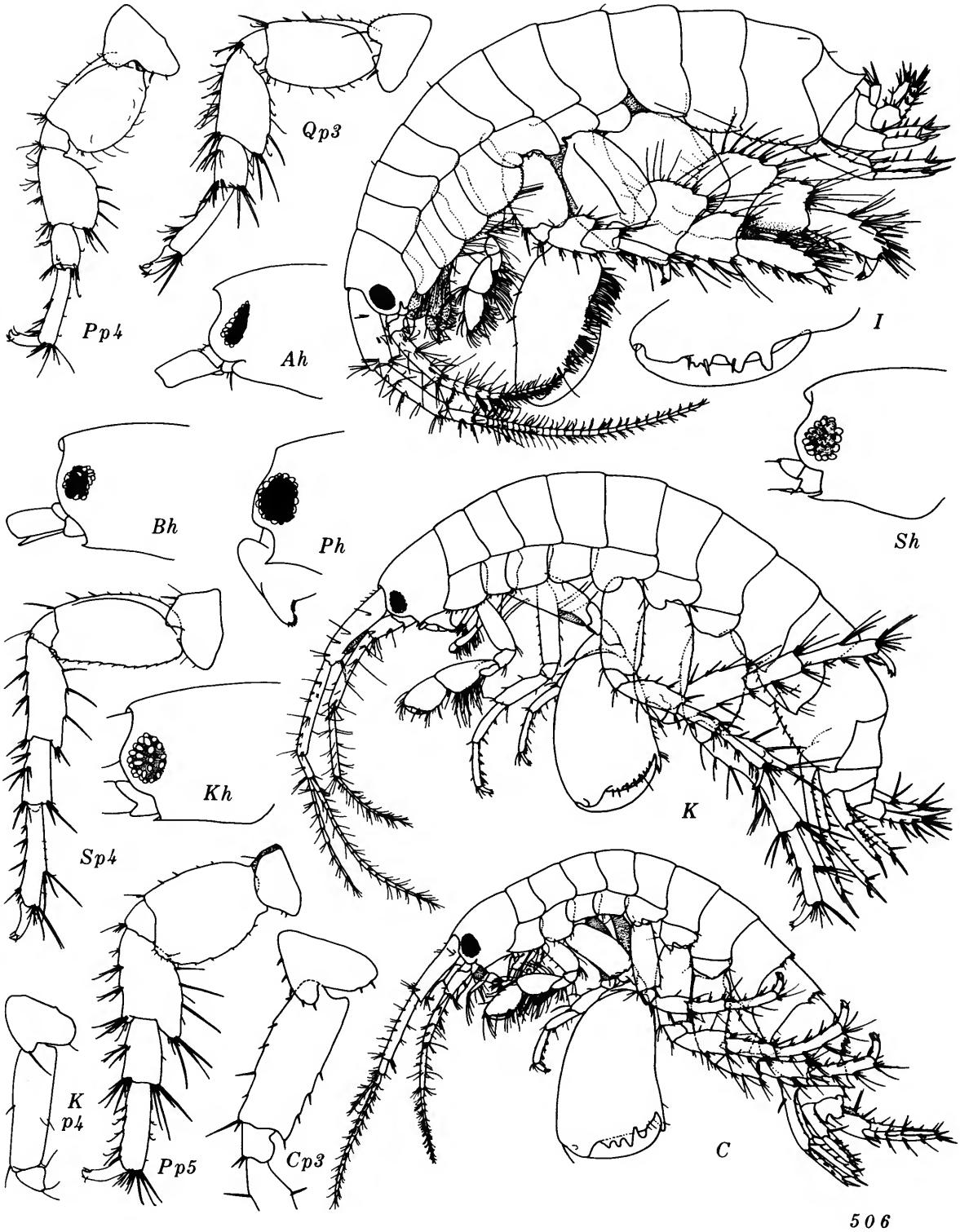


FIGURE 30.—Eusiridae: E, *Eusiroides monoculoides* (Haswell); P, *Pontogeneia pacifica* Schellenberg.

FIGURE 31.—Gammaridae: A, *Maera* sp. A; B, *Maera* sp. B; C, *Ceradocus hawaiensis* J. L. Barnard; I, *Maera insignis* (Chevreux); K, *M. kaiulani* J. L. Barnard; P, *M. pacifica* Schellenberg; Q, *M. quadrimana* (Dana); S, *M. serrata* Schellenberg.


Qp3
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Pp5
Cp3
C

Key to Hawaiian Species of Family Eusiridae

Figure Numbers Referenced in Italics

Accessory flagellum absent, inner plate of maxilla 1 with 4 large plumose setae (possibly 3–5) in adult, gnathopods small, palms weakly setose (*29Pg2*), uropod 2 much shorter than uropod 1, inner plate of maxilla 2 narrower than outer, strongly and regularly setose (*30Px2*).
Pontogeneia pacifica

Accessory flagellum present, small, (*30Eaf*), inner plate of maxilla 1 with 2 terminal setae, gnathopods large, palms bearing line of very stout spines (*29Egl,2*), uropod 2 reaching end of uropod 1, inner plate of maxilla 2 large, flabellate, irregularly setulose (*30Ex2*).
Eusiroides diplonyx

Genus *Eusiroides* Stebbing

Eusiroides diplonyx Walker

Eusiroides diplonyx Walker, 1909:333–334, pl. 43, fig. 4.—Pirlot, 1936:302–303, figs. 126–128.—Schellenberg, 1938: 35.—J. L. Barnard, 1970:109–110, figs. 59–61.

With large black eyes and large gnathopods 1–2 this species resembles *Liljeborgia*, but the accessory flagellum is minute and 1-articulate and the palms of the gnathopods bear a line of extremely stout spines in contrast to the cycles of thin spines in *Liljeborgia*. Maxilla 2 of *Eusiroides* has an extremely enlarged, flabellate inner plate with short setae organized into a facially dispersed group rather than in normal rows or simply marginal.

Pleonal epimeron 3 with 3–5, occasionally 1–2, rarely obsolescent, strong or weak, small upturned teeth at posteroventral corner. Male and female similar.

Pereopods 1–2 have a very large, sabre-shaped posterodistal locking spine on article 6.

Oahu, intertidal to 30 m.

Genus *Pontogeneia* Boeck

Pontogeneia pacifica Schellenberg

Pontogeneia pacifica Schellenberg, 1938:35–37, fig. 17.—J. L. Barnard, 1955:5; 1970:110–111, figs. 62–64.

The eyes of this species also are large and dark in formaldehyde but fade to pale purple in alcohol. The head has a long, thin but blunt rostrum projecting between the antennae; its shape is variable, often projecting straight, or curved downwards. The accessory flagellum is absent; but article 3 of the peduncle, especially in the male, has a minute quadrate extension on the medial side. Peduncles of the male antennae are strongly notched and bear on peduncles and flagella numerous anthurium-shaped, transparent calceoli. Gnathopods of both sexes are similar to each other, small, article 6 rectangular, palm oblique but shorter than posterior margin of hand, defined by 2 pairs of medial and lateral spines, dactyl fitting weakly setose palm, dactyls weakly toothed (in contrast to strongly toothed in *Liljeborgia*), article 5 of gnathopod 1 with weak triangular lobe, of gnathopod 2 with strongly triangular lobe extended distally. Maxilla 2 normally slender and with large setae on medial margin of inner plate.

Pleonal epimeron 1 with small posteroventral notch, 2 and 3 with bulging posterior margin, slightly sinuous posteroventral margin and sharply quadrate posteroventral corners, lacking serrations.

Hawaiian Islands, shallow water.

Family GAMMARIDAE

FIGURES 31–41

Hawaiian taxa of this family conform to the basic gammaridean plan, with normal mouthparts and cleft telson, 2+-articulate accessory flagellum (one species has 1-articulate condition in juveniles), uropod 3 with short peduncle and other parts generally normal, but often with various modifications of uropod 3 such as elongation of the outer ramus, the frequent occurrence of a long article 2 on that ramus and occasionally with the inner ramus reduced to a leaf-like scale.

Coxa 4 is posteriorly excavate in many Gammaridae but often it is very weakly excavate or totally unexcavate.

Many Hawaiian Gammaridae have a strong slit or notch on the head below the lateral ocular lobe but the alternates are numerous.

Gammaridae have medium-length to short cleft telsons with one or more spines on each lobe, often

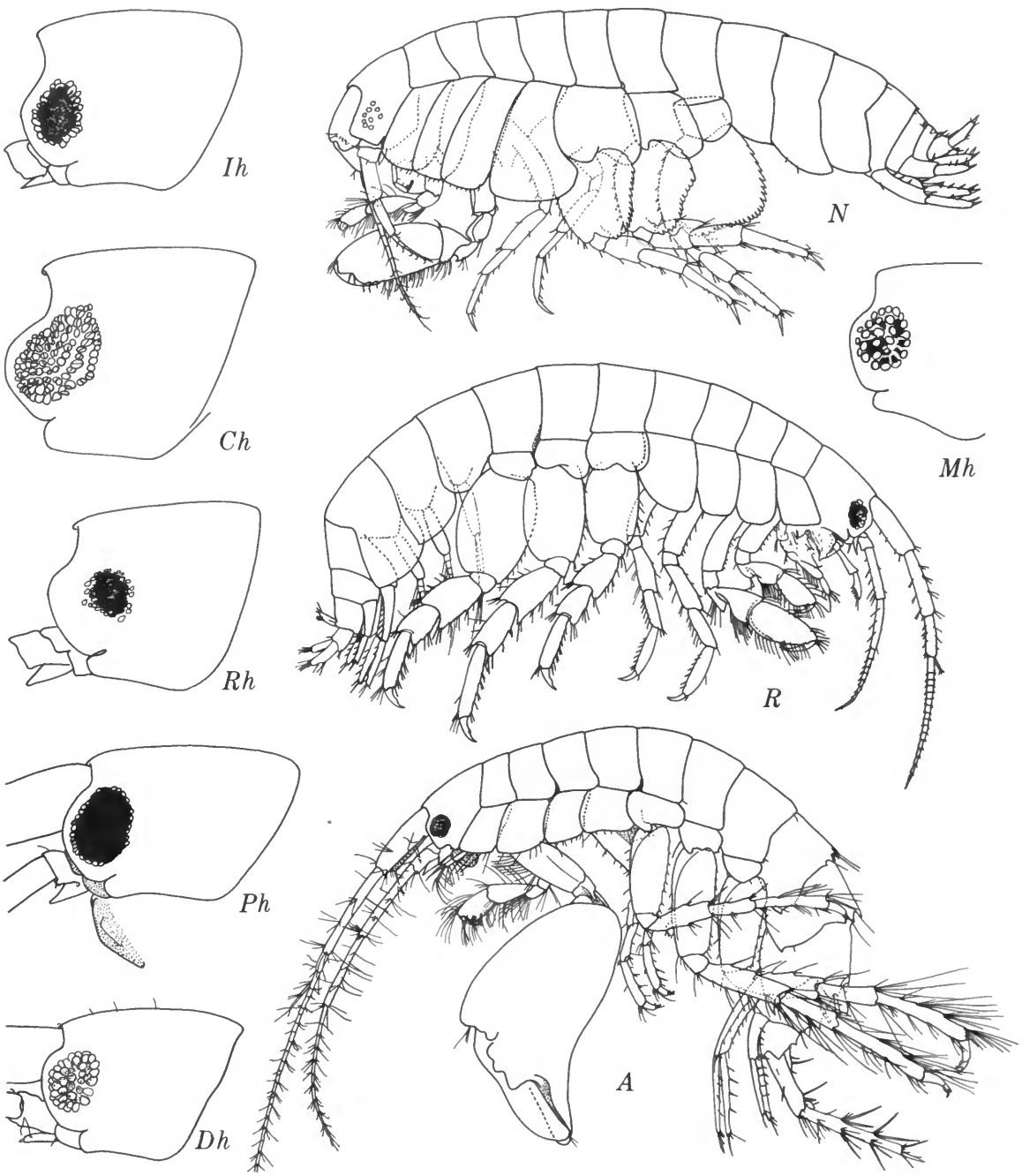


FIGURE 32.—Gammaridae: A, *Melita appendiculata* (Say); C, *Elasmopus calliactis* Edmondson; D, *E. ?diplonyx* Schellenberg; I, *E. piikoi* J. L. Barnard; M, *E. molokai* J. L. Barnard; N, *Nuuanu amikai* J. L. Barnard; P, *E. pocillimanus* (Bate); R, *E. rapax* Costa.

multispinose. Antenna 1 is usually much longer than antenna 2 but both are stiff and well constructed, with elongate peduncle on antenna 1, and they are rarely lost during preservation. The accessory flagellum is occasionally difficult to see because it is only 2-articulate and article 2 is very minute. Gnathopod 2 is usually large in males but it is weak in the eriopisa-eriopisella group.

The most common Hawaiian gammarids belong to the genus *Elasmopus,* characterized by short uropod 3 with broad, truncate, spinose rami, and a large mandibular palp projecting forward with article 3 subfalcate and strongly setose.

Uropod 3 is frequently lost during preservation in *Melita, Eriopisa, Eriopisella, Nuuanu, Ceradocus* and in those species of *Maera* with elongate rami. Only in *Elasmopus* and those species of *Maera* and *Ceradocus* with short rami is uropod 3 consistently present. In Hawaiian waters *Eriopisa, Eriopisella* and most members of *Maera* may be recognized by the absence of an anteroventral cephalic slit, and the two former genera are differentiated from each other by the fully setose inner plates of *Eriopisa.* The genera with cephalic slit are *Ceradocus* and *Nuuanu,* with medially setose inner plates of maxillae 1–2, and *Melita,* and (rarely) *Maera* with only terminal setae on those plates. *Nuuanu* has characteristic pereopods and weak eyes in comparison with *Ceradocus.* Females of *Melita* have a hooked coxa 6 and females of *Maera* do not. Males of the two genera all have individualistic gnathopods, but juveniles of the two genera may be difficult to separate until various minute characters of adults are traced down through juvenile stages.

The comb row of spines on the mediodistal end of uropod 2 in *Eriopisa* and *Eriopisella* can be seen only by dissection or strong twisting of the attached appendage; the comb rows distinguish those genera from species of *Maera* with long uropod 3, often lost.

Keys to Genera of Gammaridae

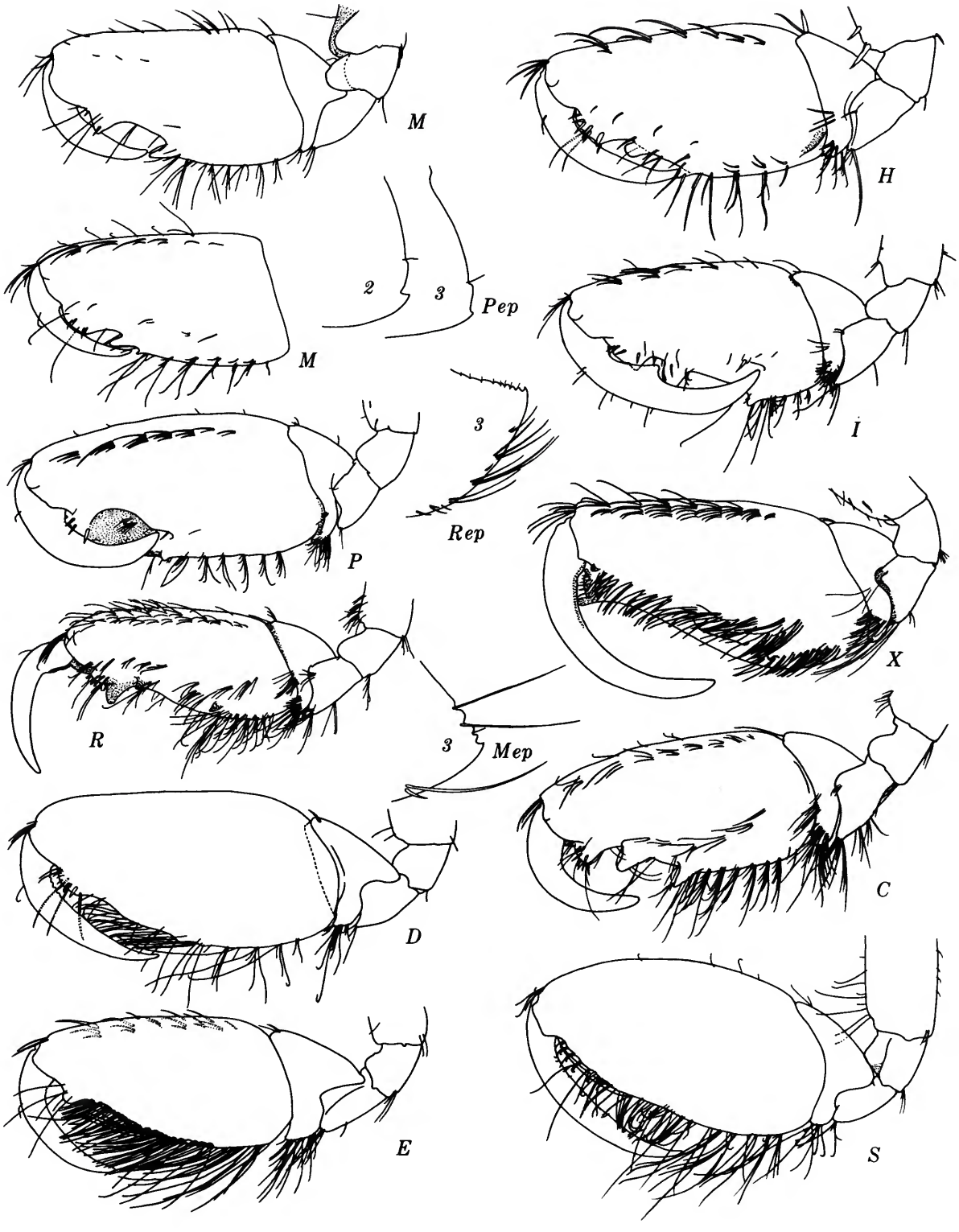
Figure Numbers Referenced in Italics

1. Inner ramus of uropod 3 short and scale-like (*37Mu3*), outer ramus elongate 2
   Rami of uropod 3 subequal to each other in length, rarely in juvenile inner ramus half as long as outer 5
2. Inner plates of maxillae 1–2 with medial edges lacking setae 3
   Inner plates of maxillae 1–2 with medial edges strongly setose their full lengths 4
3. Head rounded anteroventrally and lacking notch or slit, uropod 2 with comb-row of spines on mediodistal end of peduncle (*36Hu2*), female coxa 6 normal ..... ***Eriopisella*** Chevreux
   Head with deep anteroventral notch (*31Ah*), uropod 2 lacking comb-row, female coxa 6 with large anterior hooked process (*39Mc6*) ..... ***Melita*** Leach
4. Uropod 3 greatly exceeding uropods 1–2, head lacking anteroventral notch .. ***Eriopisa*** Stebbing
   Uropod 3 scarcely exceeding uropods 1–2, head with deep anteroventral notch. ***Nuuanu*** J. L. Barnard
5. Palp article 3 of mandible falcate and strongly setose on one linear margin (*35Dmp*). ***Elasmopus*** Costa
   Palp article 3 rectolinear and with setae mostly terminal 6
6. Inner plates of maxillae 1–2 strongly setose their full length on medial edges .. ***Ceradocus*** Costa
   Inner plates of maxillae 1–2 with only terminal setae ..... ***Maera*** Leach

Alternative Key if Uropod 3 Missing

1. Mandibular palp article 3 weakly to strongly falcate and densely setose along concave margin (*35Cmp*) 2
   Mandibular palp article 3 rectolinear, setae mostly terminal 4
2. Inner plates of maxillae 1–2 with setae mainly terminal ..... ***Elasmopus*** Costa
   Inner plates of maxillae 1–2 with medial edges setose their full length 3

FIGURE 33.—Gammaridae, *Elasmopus;* male gnathopod 2 and epimera: C, *E. calliactis* Edmondson; D, *E. diplonyx* Schellenberg; E, *E. ecuadorensis hawaiensis* Schellenberg; H, *E. hooheno* J. L. Barnard; I, *E. piikoi* J. L. Barnard; M, *E. molokai* J. L. Barnard; P, *E. pocillimanus* (Bate); R, *E. rapax* Costa; S, *E. spinidactylus* Chevreux; X, *E. pectenicrus* (Bate).


M
H
2
3
Pep
M
I
3
Rep
P
X
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3. Head with broad, triangular lateral lobes and deep anteroventral notch (*3N*), uropod 3 not strongly exceeding uropods 1–2 ..... ***Nuuanu*** J. L. Barnard
   Head with truncate anterolateral margin and weak anteroventral excavation, no notch (*37Lh*), uropod 3 strongly exceeding uropods 1–2 ..... ***Eriopisa*** Stebbing
4. Inner plates of maxillae 1–2 densely setose along full medial edges ..... ***Ceradocus*** Costa
   Setae on inner plates of maxillae 1–2 mostly terminal 5
5. Rami of uropod 3 equal to each other in length, either short or elongate ..... ***Maera*** Leach
   Inner ramus of uropod 3 very short and scale-like, outer ramus elongate (*37Lu3*) 6
6. Head broadly truncate or weakly convex on anterolateral margin, uropod 2 with comb-row of spines on mediodistal end of peduncle (*36Hu2*) ..... ***Eriopisella*** Stebbing
   Head with deep anteroventral notch or slit below prominent lateral lobe (*37Mh*), uropod 2 lacking peduncular comb-row ..... ***Melita*** Leach

Genus *Ceradocus* Costa

Ceradocus hawaiensis J. L. Barnard

Ceradocus hawaiensis J. L. Barnard, 1955:5–8, figs. 2, 3; 1970:115, fig. 65.

Maera insignis, Melita appendiculata, and *Ceradocus hawaiensis* all have a pair of triangular dorsal teeth on urosomite 1 and thus are distinguishable at first glance from all other Hawaiian gammarideans. *Maera insignis* has no other dorsal serrations on the pleon and *C. hawaiensis* and *Melita appendiculata* have other serrations on the pleon while *C. hawaiensis* may further be distinguished from *M. appendiculata* in the presence of serrations on pleonal epimeron 3, the presence of an anteroventral cephalic notch and a single anteroventral cephalic tooth in contrast to the absence of a notch and a pair of teeth on *M. appendiculata.* The pereopodal dactyls of *C. hawaiensis* have 2–4 tiny accessory cusps, whereas dactyls of *M. appendiculata* have 1 large accessory tooth. Both males and females of *C. hawaiensis* have one large gnathopod 2 and one small (mixed between right and left), similar between the sexes, with a transverse deeply toothed palm; whereas male *M. appendiculata* has one enlarged gnathopod 2 (always the left) with extremely attenuate palmar tooth on which the dactyl closes, resembling a shrimp claw. Females of *M. appendiculata* have very small gnathopod 2 on both sides, and both males and females of *C. hawaiensis* have one of their second gnathopods small, like those of right side of male and both sides of female *M. appendiculata.* The rami of uropod 3 are of medium and equal extent in *C. hawaiensis,* whereas they are highly unequal and the outer is very long in *M. appendiculata;* but in both species they are frequently lost in preservative. Coxa 1 of *C. hawaiensis* is sharply attenuate anterodistally.

The inner plate of maxilla 1 on *Ceradocus hawaiensis* is lined its full medial margin with stout setae but the inner plate on *M. appendiculata* has 2 stout terminal setae and several very thin medial setules.

Eyes black.

Oahu, 0–30 m.

Genus *Elasmopus* Costa

Elasmopus is the most diverse genus of Gammaridea in the Hawaiian Islands; it is represented by 8 or 9 species occurring in a variety of habitats from intertidal zones to depths as great as 30 m; the species are mainly associated with algae. The short uropod 3 with subequal, flat rami, falcate article 3 of the mandibular palp, and terminally (but not medially) setose inner plates of the maxillae, distinguish elasmopuses from other members of Gammaridae. All have a deep lateral cephalic notch, but other familial taxa also bear that character.

Comments on each species are abbreviated as positive statements, the combination of characters being unique for each species. Eyes are therefore mentioned only for *E. calliactis* and *E. pectenicrus,* since they are the only species lacking black pigment (brown-purple when faded); but locking spines of pereopods 1–2 are mentioned for each species owing to their diagnostic variability. Sharply serrate epimeron 3 combined with black eyes characterize *E. rapax,* but *E. pectenicrus* females also have those sharp serrations; the clear eyes (red in life) combined with castello-serrations on one or more article 2 of pereopods 3–5 are better diagnostic features for recognition of *E. pectenicrus* than would be a partially negative statement on epimeron 3.

Keys to Hawaiian Species of Genus *Elasmopus*

Figure Numbers Referenced in Italics

Terminal Males

1. Palm of gnathopod 2 with marginal cusp or tooth easily visible and defining proximal end of palm (*33Cg2, Rg2*) 2
   Palm of gnathopod 2 lacking marginal defining tooth, occasionally with locking tooth on medial face of hand (*33Dg2, Xg2*) 5
2. Palm of gnathopod 2 with only 1 distal protuberance besides defining tooth, palm otherwise flat (*33Mg2*) ..... ***E. molokai*** (eyes dark)
   Palm of gnathopod 2 with protrusion or tooth in middle besides distal protrusion and proximal defining tooth (*33Hg2*) 3
3. Eyes with dark pigment 4
   Eyes red in life, clear in alcohol 9
4. Telson squamiform (*35Et*), main locking spine of pereopods 1–2 a striate sabre (*34Hp1*). ***E. hooheno***
   Telson normally long (*35It*), main locking spine of pereopods 1–2 straight, unstriate, apically chisel-shaped (*34Ip2*) ..... ***E. piikoi***
5. Hand of gnathopod 2 with large cuplike medial hollow (*33Pg2*), article 6 of pereopods 1–2 with 2 sabre-shaped striate locking spines (*34Pp4*) ..... ***E. pocillimanus***
   Hand of gnathopod 2 lacking medial hollow, article 6 of pereopods 1–2 with either simple locking spines or with only one member sabre-shaped and striate (*34Ep2*) 6
6. Dactyls of pereopods 1–5 with 2–5 large castelloserrations or villi proximal to main constriction (*34Sp1*) ..... ***E. spinidactylus***
   Dactyls of pereopods 1–5 proximally smooth 7
7. Dactyls of pereopods 1–2 with elephantine spine at constriction (plus setules) (*34Dp2*). ***E. diplonyx***
   Dactyls of pereopods 1–2 with normal seta-spine at constriction (plus setules) (*34Ip2*) 8
8. Palm of gnathopod 2 with 3 distal processes, one long lateral, one small slightly proximomedial and truncate, one distomedial shallow and spinose, plus mediofacial locking tooth for end of dactyl, palm poorly setose (*33Rg2*) ..... ***E. rapax***
   Palm of gnathopod 2 with only a small or absent distal process, palm heavily setose, with or without weak mediofacial locking cusp (*33Eg2*) ..... ***E. ecuadorensis hawaiensis***
9. Pereopod 4 with posteroventral excavation on article 2 lined with deep crenuloserrations or castellae (fluted) (*35Xp4*) ..... ***E. pectenicrus***
   Pereopod 4 normally ovatorectangular, unexcavate and with small normal serrations (like *35Hp5*) ..... ***E. calliactis***

Females and Juveniles

(Applicable Also to Most Males)

1. Article 6 of pereopods 1–2 with 2 sabre-shaped, striate locking spines on posterodistal end at base of dactyl (*34Pp4*) ..... ***E. pocillimanus***
   Pair of locking spines composed of 1 sabre-shaped and 1 simple spine (*34Sp1*) 2
   Pair of locking spines composed of either 2 simple spines or with one member of the pair slightly chisel-shaped apically (*34Ep5*) 4
2. Dactyls of pereopods 1–5 with long castellae or villi proximal to normal constriction (*34Sp1*). ***E. spinidactylus***
   Dactyls lacking accessory villi 3
3. Smaller locking spine of pereopods 1–2 of corkscrew kind (*34Hp1*), larger locking spine of pereopods 3–5 striate and sabre-shaped ..... ***E. hooheno***
   Smaller locking spine of pereopods 1–2 simple (*34Ep2*), larger locking spine of pereopods 3–5 straight and simple ..... ***E. ecuadorensis hawaiensis***
4. Ornament of constriction on dactyls of pereopods 1–5 composed of an elephantine spine in addition to setules (*34Dp2*) ..... ***E. diplonyx***
   Ornament of constriction on dactyls of pereopods 1–5 composed of a stout to slender seta in addition to setules (*34Hp1*) 5

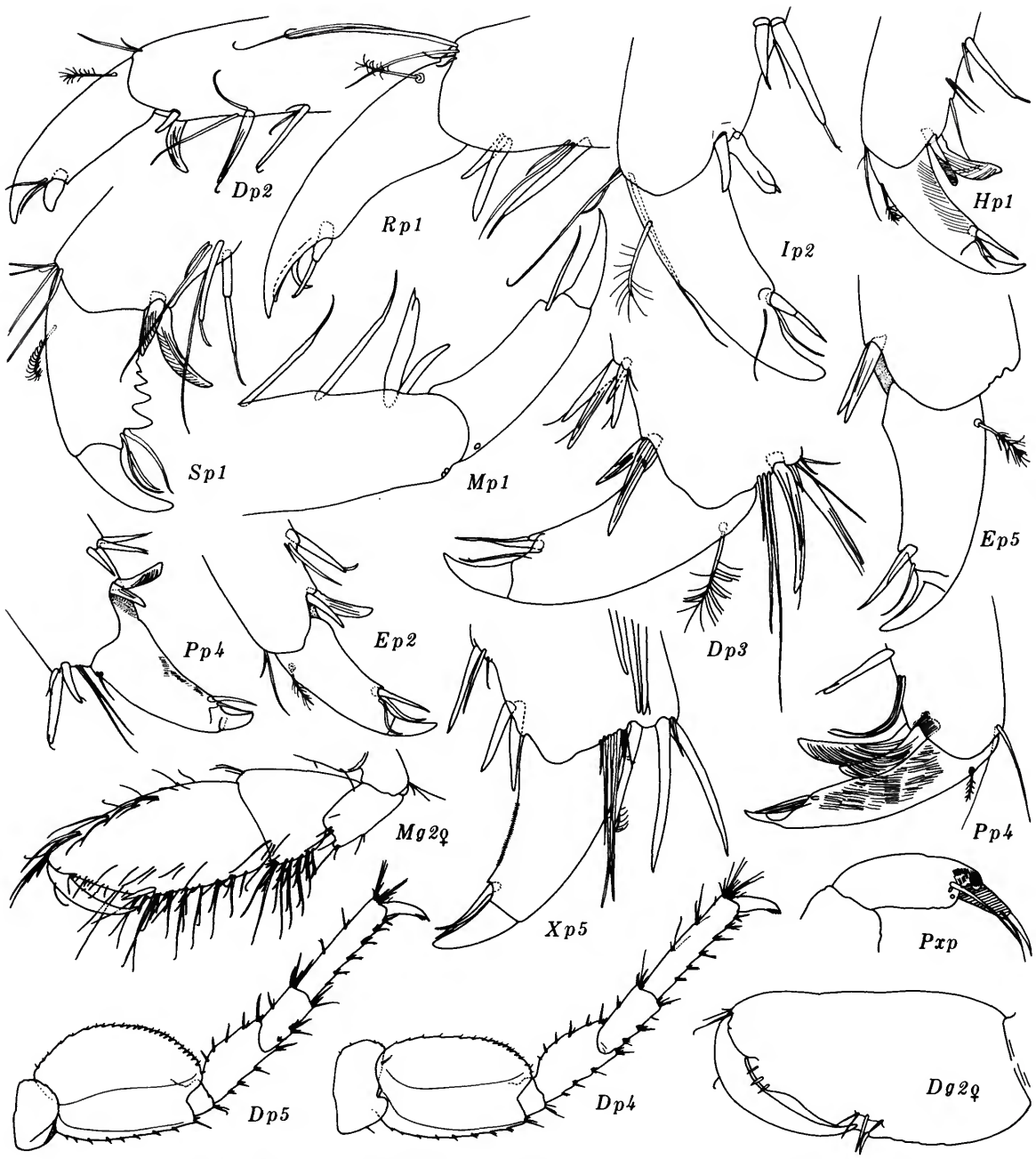
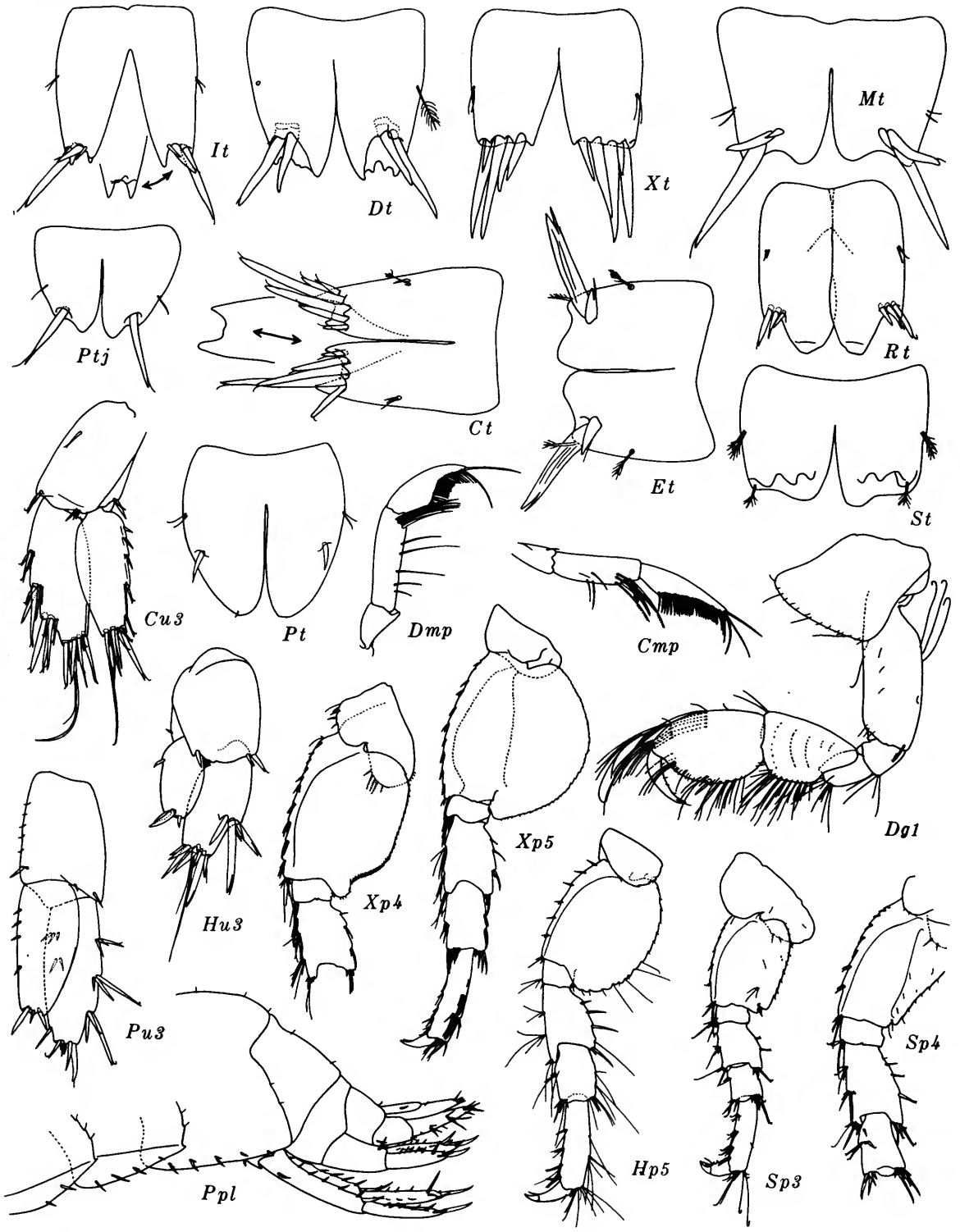


FIGURE 34.—Gammaridae, *Elasmopus:* D, *E. diplonyx* Schellenberg; E, *E. ecuadorensis hawaiensis* Schellenberg; H, *E. hooheno* J. L. Barnard; I, *E. pükoi* J. L. Barnard; M, *E. molokai* J. L. Barnard; P, *E. pocillimanus* (Bate); R, *E. rapax* Costa; S, *E. spinidactylus* Chevreux; X, *E. pectenicrus* (Bate).

FIGURE 35.—Gammaridae, *Elasmopus:* C, *E. calliactis* Edmondson; D, *E. diplonyx* Schellenberg; E, *E. ecuadorensis hawaiensis* Schellenberg; H, *E. hooheno* J. L. Barnard; I, *E. piikoi* J. L. Barnard; M, *E. molokai* J. L. Barnard; P, *E. pocillimanus* (Bate); R, *E. rapax* Costa; S, *E. spinidactylus* Chevreux; X, *E. pectenicrus* (Bate).


It
Dt
Xt
Mt
Ptj
Ct
Et
Rt
St
Cu3
Pt
Dmp
Cmp
Dg1
Xp5
Xp4
Hu3
Pu3
Hp5
Sp3
Sp4
Ppl

5. Eyes clear in alcohol or red in life and formaldehyde 6
   Eyes retaining brown-black-purplish pigment in alcohol 7
6. Article 6 of gnathopod 1 subovate, palm very oblique, outer ramus of uropod 3 with small article 2 seen in ventral view, pereopods 4–5 with normally small posterior serrations on article 2, dactyl of gnathopod 2 with few setules only, not wavy or castellate .... ***E. calliactis***
   Article 6 of gnathopod 1 rectangular, palm nearly transverse, outer ramus of uropod 3 without article 2, pereopod 4 in female, pereopods 4–5 in juvenile with deep castellations on article 2, dactyl of gnathopod 2 castelloserrate or wavy on inner margin ..... ***E. pectenicrus***
7. Telson short, scarcely as long as broad (*35Mt*) ..... ***E. molokai***
   Telson long, longer than broad (*35Rt*) 8
8. Pleonal epimeron 3 with 2+ sharp serrations including posteroventral corner (*33Pep*), telson with subapical lateral spines only, with smoothly projecting apical margins (*35Rt*). ***E. rapax***
   Pleonal epimeron 3 with only one sharp tooth at posteroventral corner, apices of telson truncate and spinose (*35It*) ..... ***E. piikoi***

Elasmopus calliactis Edmondson

Elasmopus calliactis Edmondson, 1951:189–191, fig. 3.—J. L. Barnard, 1970:115, fig. 66.
Elasmopus rapax J. L. Barnard, 1955:11 (only those specimens from Honolulu Aquarium, not Costa).

This species and *E. pectenicrus* are the only members of the genus in Hawaii lacking black-brown-purple pigment in the eyes. In life the eyes are red and the body banded in red but the pigment bleaches in alcohol. Telson long, each lobe with apical excavation hidden by rank of 5–6 subterminal spines.

Terminal male palm of gnathoped 2 defined by large cusp and bearing middle tooth and adze-shaped distal process, dactyl simple.

Elasmopus pectenicrus differs in having deep castello-serrations on article 2 of either or both pereopods 4–5 in both sexes or juveniles.

Oahu, in Honolulu Aquarium and in depths presumably to 30 m, in association with *Dardanus* hermit crab bearing *Calliactis* sea-anemones on its *Dolium* shell.

Elasmopus ?diplonyx Schellenberg

?Elasmopus diplonyx Schellenberg, 1938:54, fig. 26.
Elasmopus ?diplonyx J. L. Barnard, 1970:115–119, figs. 67, 68.

Characterized in all stages by the very stout, sharp (juvenile) or blunt (adult) spine occupying the constriction of the dactyls on pereopods 1–2. Telson medium in length, apices excavate and sinuous or raggedly serrate, each subapex with 2 spines.

Terminal male palm of gnathopod 2 scarcely defined by acclivity and spines, medial face with locking ridge and 2 spines, dactyl slightly overriding palmar margin, palm with small distal protuberance, strongly setose and lacking middle tooth.

Posterior margin of article 2 on pereopods 4–5 deeply crenuloserrate but distinguished from *E. pectenicrus* in the dark eyes and dactylar tooth-spine.

Micronesia to Hawaii. Oahu, off Moku Manu Island, 33 m, on base of black coral in mollusk association.

Elasmopus ecuadorensis hawaiensis Schellenberg

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

Article 6 of pereopods 1–2 with one striate sabre-spine and one simple spine in the locking pair, dactyl normal. Telson very short, apices slightly excavate, with 2 apicolateral spines on each lobe.

Terminal male gnathopod 2 with undefined s-shaped heavily setose palm with small distal process, small ridge on medial palmar face, and small medial locking spine on ridge at apex of dactyl, latter simple, curved.

Differs from *E. hooheno* in that the secondary locking spine of pereopod 1 is simple, not ornamented as a corkscrew and both spines of the locking pair on pereopods 3–5 are simple. Male gnathopod 2 looks like that of *E. pectenicrus* but article 2 of pereopod 4 is unmodified and the locking spines of pereopods 1–2 are different.

Oahu, Kaneohe Bay; Hawaii, Hilo; Molokai.

Elasmopus hooheno J. L. Barnard

Elasmopus hooheno J. L. Barnard, 1970:121, fig. 70.

Article 6 of pereopods 1–2 with 1 striate sabre-spine and 1 uncurved corkscrew spine in the locking pair,

dactyl normal. Telson very short, apices slightly excavate, with 2 apicolateral spines on each lobe.

Terminal male gnathopod 2 palm defined by large cusp, bearing truncate tooth in middle and slightly scalloped, spinose distal protrusion, dactyl simple.

Close to *E. molokai* but main locking spine of pereopods 1–2 sabre-shaped and male gnathopod 2 with middle palmar tooth.

Oahu, Kawela Bay, intertidal.

Elasmopus molokai J. L. Barnard

Elasmopus molokai J. L. Barnard, 1970:121–125, figs. 71, 72.

Article 6 of pereopods 1–2 with 1 normal short spine and one long apically chisel-shaped spine in the locking pair, dactyl normal. Telson very short, apices sinuous, with 2–4 apical-subapical spines each.

Terminal male gnathopod 2 palm defined by large cusp, lacking midprocess, bearing subfalcate distal protrusion, dactyl simple.

Close to *E. piikoi*, the latter with long telson and close to *E. ecuadorensis hawaiensis*, the latter with male gnathopod 2 of similar, heavily setose, uncuspidate morphology as *E. pectenicrus*. The telson of *E. rapax* (*35 Rt*) is distinctive of that species.

Oahu, widely distributed from intertidal zones to depths of 30 m.

Elasmopus pectenicrus (Bate)

Moera pectenicrus Bate, 1862:192, pl. 34, fig. 8.

Elasmopus serrula Walker, 1904:277–278, pl. 8, fig. 37.

Elasmopus pectenicrus.—J. L. Barnard, 1955:8–10, fig. 4 (with references); 1970:125, figs. 73, 74.

Without black pigment in the eyes, thus like *E. calliactis*. Locking spines of pereopods almost straight and otherwise normal. Inner ramus of uropod 3 only two-thirds as long as outer ramus, latter without article 2. Telson of medium length, apices truncate, with 4–6 spines each.

Terminal male gnathopod 2 with undefined, s-shaped, heavily setose palm with small process on transverse distal end, small ridge on medial palmar face, and small medial locking cusp near apical extent of overriding dactyl, latter simple, curved.

Male with article 2 of pereopod 4 excavate posteroventrally and deeply castelloserrate, female with serrations slightly weaker but not excavate, juvenile without excavation but with serrations on both pereopods 4 and 5, unlike adult.

Tropicopolitan. Oahu, Pearl Harbor, on buoys and docks. Possibly introduced by shipping.

Elasmopus piikoi J. L. Barnard

Elasmopus piikoi J. L. Barnard, 1970:127–128, figs. 75–76.

Article 6 of pereopods 1–2 with 1 normal and 1 apically chisel-shaped spine in the locking pair, dactyl normal. Telson of normal length, lobes apically excavate, with 3 terminal spines each.

Terminal male gnathopod 2 palm defined by small cusp, middle of palm with large truncato-coniform process, distal end with truncate or slightly bilobate process; inner margin of dactyl bisinuate, with large process.

Elasmopus molokai has a short telson and all stages of *E. rapax* have 2+ sharp posteroventral serrations on pleonal epimeron 3, whereas *E. piikoi* either has 1 serration forming the corner in juveniles and females or lacks serrations in males. The telson of *E. rapax* has spines only on the subapical lateral notch and has long smooth medial lobes, whereas *E. piikoi* has spines terminally.

Oahu, intertidal to 18 m.

Elasmopus pocillimanus (Bate)

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

Elasmopus pocillimanus.—Stebbing, 1906:443–444.—Chevreux and Fage, 1925:246, fig. 257.—Schellenberg, 1938:56, fig. 28.—J. L. Barnard, 1970:128–131, figs. 77, 78.

Distinguished in all stages by the presence of 2 large, striate sabre-shaped locking spines on article 6 of pereopods 1–2.

Telson long, lobes apically extended and smooth, each lobe with 1 midlateral spine. Eyes densely pigmented with black-brown-purple, more so than in other species in Hawaii.

Terminal male palm of gnathopod 2 defined by weak cusp, with slight distal protrusion but medial surface of hand bearing deep hollow defined proximally by weak spine, dactyl simple, stout, overlapping palmar face to close within recess.

Cosmopolitan in warm seas. Oahu, (0)–30 m, coral and coralline bottoms.

Elasmopus rapax Costa

Elasmopus rapax Costa.—J. L. Barnard, 1955:10–12, fig. 5 (in part, not figs. 5b, g), (with references); 1970:131–134, figs. 79, 80.

Article 6 of pereopods 1–5 with grossly simple pair of locking spines, longest spine minutely gnarled, twisted and pointed apically (seen under oil-immersion lens only). Telson of normal length, with broad smooth apices and 2–3 spines on subapical lateral notch, apices pointed in juveniles and females. Pleonal epimeron 3 with 2–6 sharp serrations including that of posteroventral corner. Uropod 3 lacking article 2 on outer ramus.

Terminal male palm of gnathopod 2 defined by strong tooth on medial face (not seen from lateral view), middle of palm with tooth slightly medioproximal to long lateral tooth, distal end with shallow spinose process; palm and medial face thus with 4 teeth in all.

Cosmopolitan in warm and cool seas. Oahu, shallow water, primarily harbors, possibly introduced by shipping.

Elasmopus spinidactylus Chevreux

Elasmopus spinidactylus Chevreux, 1908:486–489, figs. 9–10.—Walker, 1909:336–37.—Schellenberg, 1938:55.—Shoemaker, 1942:13.—J. L. Barnard, 1965:504; 1970:136–138, figs. 81, 82.

Dactyls of pereopods 1–5 with several villiform or castelliform teeth on margin proximal to main constriction, condition unique in Hawaii to this species. Article 6 of pereopods 1–2 with 1 striate sabre and 1 small normal locking spine. Telson short, apices broadly truncate, each armed with 3 spines.

Terminal male palm of gnathopod 2 unknown in Hawaii but in southern Polynesia it has a large and broad fully dominating, falconiform protrusion. Middle-size males and females have the palm and posterior margin of article 6 on gnathopod 2 confluent, heavily setose, distally with a low, broad, spinose protrusion. Pereopods 3–5 have rectangular article 2 with deep posteroventral notch.

Almost circumtropical. Oahu and Molokai, intertidal.

Key to Hawaiian Species of Genus *Eriopisa* Stebbing

Figure Numbers Referenced in Italics

Pleonal epimeron 3 with large sharp posteroventral tooth and slightly bulging posterior margin (*36Lur*) ..... ***E. laakona***

Pleonal epimeron 3 grossly extended posteriorly as wide obtuse rounded lobe bearing small sharp cusp on posterodorsal corner (*36Hep*) ..... ***E. hamakua***

Eriopisa (?)*hamakua* J. L. Barnard

Eriopisa (?)*hamakua* J. L. Barnard, 1970:138–140, figs. 83, 84.

Uropod 3 of this species is not known but is presumed to fit the eriopisa model. The unnotched head lobes and medially setose inner plates of the maxillae suggest the generic classification. Gnathopod 2 of the male is relatively large for the genus, article 5 is short, almost subcircular, article 6 is very slender and elongate, densely setose on the posterior margin, the palm defined by a small bulge with 2 spines and the distal end of the palm with 3 medial spines among the many setae, palm with weak medial excavation. Gnathopod 1 much more slender, setose and elongate than in *E. laakona*.

Eyes very weak and orange in formaldehyde.

S. Oahu, 3–4 m, sandbottom and encrustations.

Eriopisa laakona J. L. Barnard

Eriopisa laakona J. L. Barnard, 1970:140–143, figs. 85, 86.

Both articles 5 and 6 of male gnathopod 2 are elongate, the palm very oblique, weakly setose and defined by 2 spines, the dactyl slightly overlapping the palm. Eyes absent.

Oahu, intertidal to 4 m.

Genus *Eriopisella* Chevreux

Eriopisella sechellensis upolu J. L. Barnard

Eriopisella sechellensis upolu J. L. Barnard, 1970:143–147, figs. 87, 88.

With its brownish-purple eyes in alcohol and melita-like uropod 3 this species of *Eriopisella*, unlike mem-

bers of clear-eyed or blind *Nuuanu* and *Eriopisa,* resembles *Melita pahuwai* closely but differs from various melitas either in the absence of an anteroventral cephalic notch or in the presence of a comb-row of closely set spines on the mediodistal end of the peduncle on uropod 2. This appendage must be viewed from dorsal aspect in order to see the row of spines.

The sexes are similar to each other; they have a small gnathopod 2 scarcely larger than gnathopod 1 and similarly shaped, except that article 6 of gnathopod 2 is somewhat protuberant along the posterior margin of the subrectangular article 6.

Oahu, Kaneohe Bay, 3–4 m, bottom of mixed corals, corallines and algae.

Genus *Maera* Leach

Two groups of *Maera* occur in Hawaii: those species with transverse palms of gnathopod 2 in both sexes plus bifid pereopodal dactyls, and those species with oblique palms on gnathopod 2 and non-bifid pereopodal dactyls. *Maera insignis,* a dominant Hawaiian intertidal gammaridean, is easily recognized by the pair of sharp dorsal carinae on pleonite 4. Only 2 species of Hawaiian *Maera* have a lateral cephalic notch like various species of *Elasmopus,* and all species of the latter genus have a conspicuously falcate article 3 of the mandibular palp, easily seen without dissection. Uropod 3 of *Elasmopus* is consistently short but is variable in *Maera.* Specimens of *Elasmopus* retain uropod 3 on preservation but specimens of *Maera* with long rami may lose that appendage as do specimens of *Ceradocus, Melita, Eriopisella* and *Eriopisa. Ceradocus* is distinguished from *Maera* in the densely setose medial edges of the inner plates of maxillae 1–2; members of *Eriopisella* have a comb row of spines on the mediodistal end of the peduncle on uropod 2; one species of *Melita,* in contrast to all but two members of *Maera,* has a cephalic notch and the other species is grossly toothed dorsally on the pleon; and members of *Eriopisa* have weakly subfalcate and strongly setose article 3 on the mandibular palp.

Key to Hawaiian Species of *Maera* Leach

Figure Numbers Referenced in Italics

1. Pleonite 4 with large triangular dorsal carinae (*311*) ..... ***M. insignis***
   Pleonite 4 dorsally smooth 2
2. Palm of gnathopod 2 oblique 3
   Palm of gnathopod 2 transverse 4
3. Coxa 1 sharply hooked forward, head with anteroventral notch. ***Maera* sp. A (cf. *M. hamigera*)**
   Coxa 1 evenly trapezoidal, head lacking anteroventral notch but armed with anteroventral cusp ..... ***Maera* sp. B**
4. Pleonite 3 with 1 or many posterior serrations besides posteroventral tooth ..... ***M. serrata***
   Pleonite 3 bearing only posteroventral tooth 5
5. Article 2 of pereopods 3–4 thin and subrectangular (*31Qp3*), palm of male gnathopod 2 with 3 truncate processes and 2 sinuses (besides sinus adjacent to defining tooth) (*38Qg2*). ***M. quadrimana***
   Article 2 of pereopods 3–4 moderately broad and subovate (*31Pp4*), male gnathopod 2 with 2 truncate processes and 1 sinus (*38Pg2*) 6
6. Eyes dark, purple-brown in alcohol, telsonic lobes weakly excavate-bifid, primarily with medial cusp on either lobe (*40Pt*) ..... ***M. pacifica***
   Eyes orange or clear in alcohol, telsonic lobes deeply bifid (*40Kt*) ..... ***M. kaiulani***

Maera insignis (Chevreux)

Elasmopus insignis Chevreux, 1901:406–412, figs. 24–31.
Maera insignis.—Schellenberg, 1938:50–52, fig. 24.—J. L. Barnard, 1955:12–13; 1970:147 fig. 89.

See remarks under *Ceradocus hawaiensis* (page 70).

This species differs from all other Hawaiian members of *Maera* in the pair of sharply triangular dorsal processes on pleonite 4. The lateral cephalic slit gapes and the telsonic lobes are stiffly fixed in a slightly spiral form so as to appear from dorsal view as sharp triangles with oblique apical margins lined with long spines.

Male pereopods 4–5 are especially broadened and the male gnathopod 2 palm essentially occupies the full posterior margin of the hand although the dactyl

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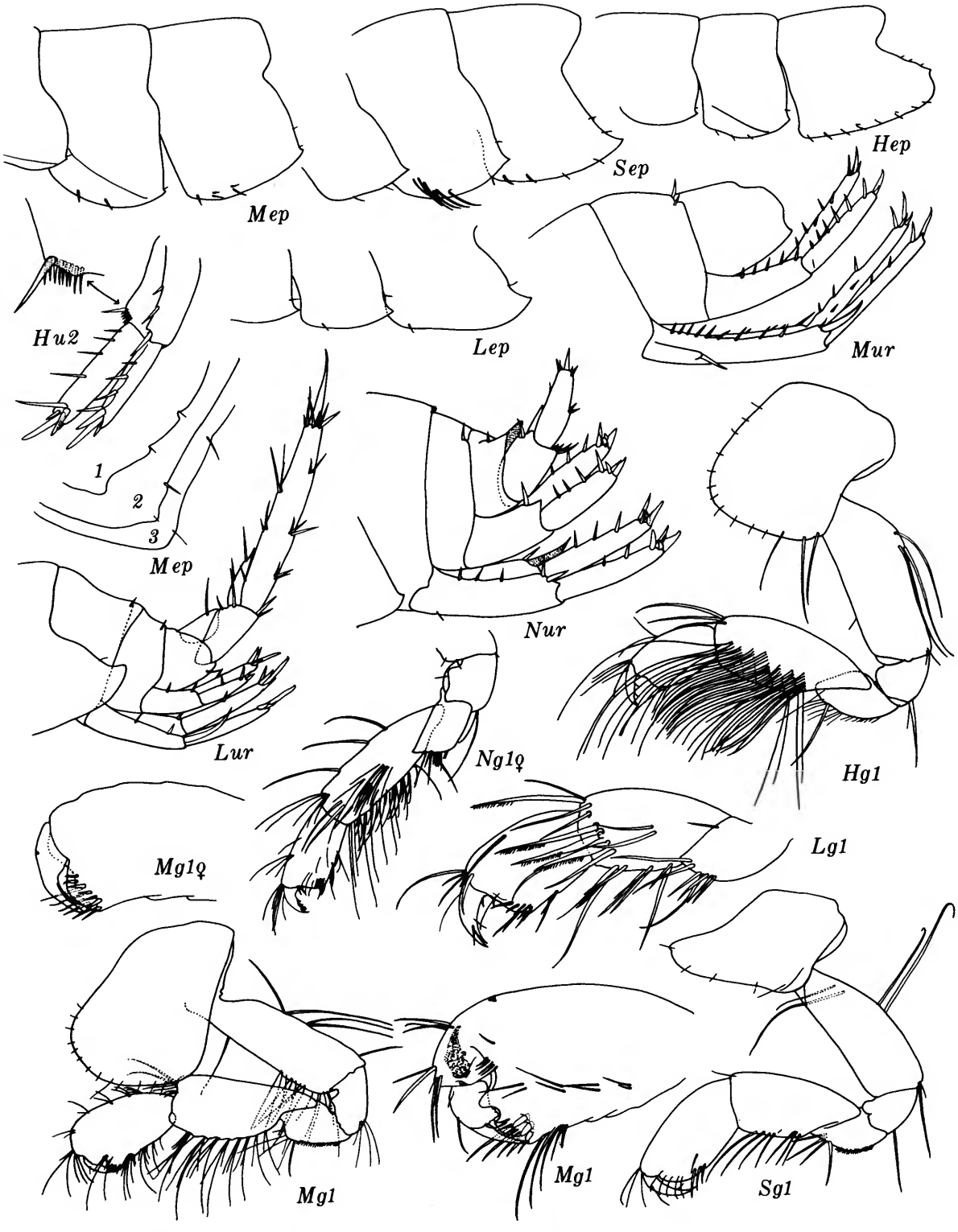


FIGURE 36.—Gammaridae: H, *Eriopisa (?)hamakua* J. L. Barnard: L, *E. laakona* J. L. Barnard; M, *Melita pahuwai* J. L. Barnard; N, *Nuuanu amikai* J. L. Barnard; S, *Eriopisella sechellensis upolu* J. L. Barnard.

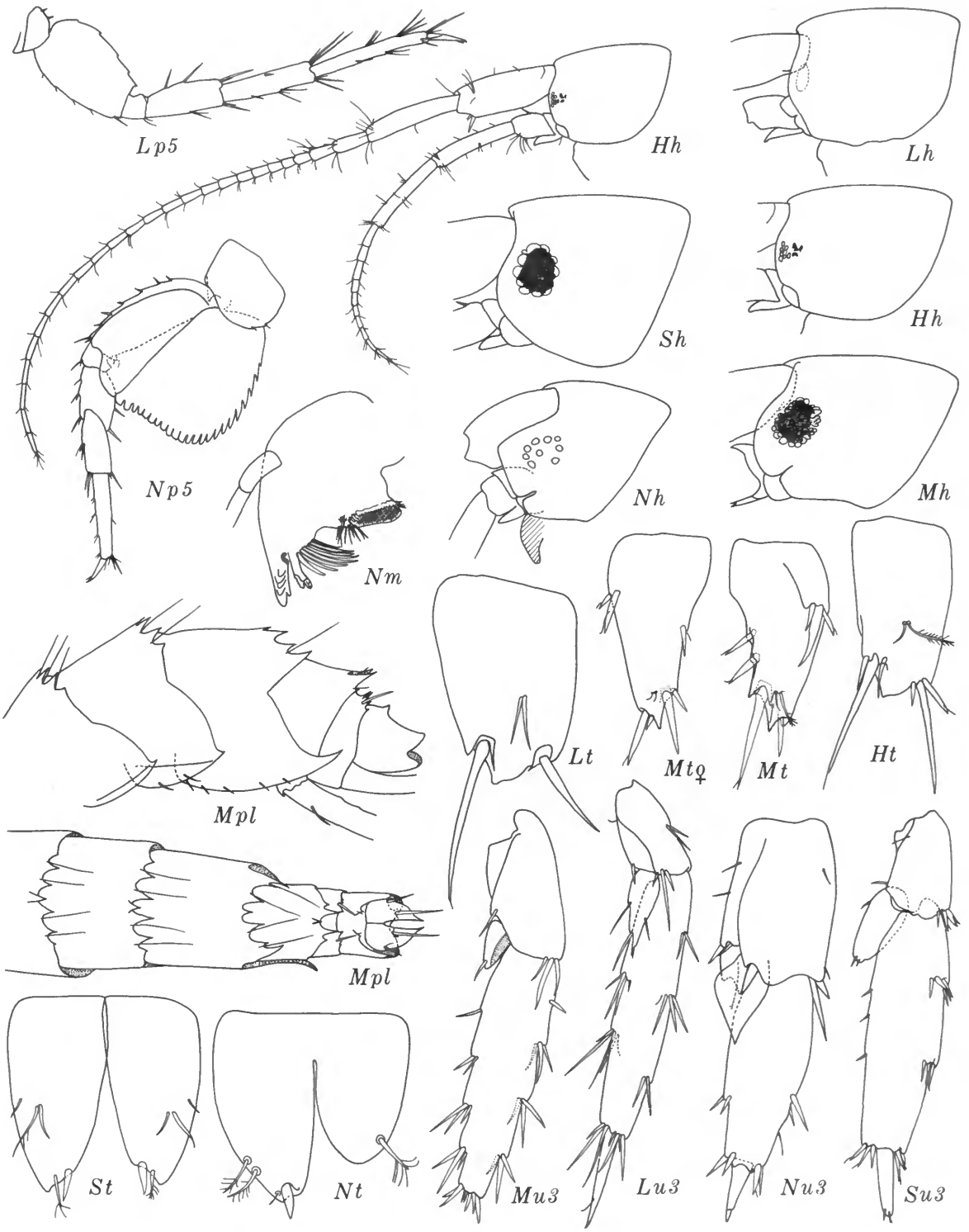


FIGURE 37.—Gammaridae: A, *Melita appendiculata* (Say); H, *Eriopisa hamakua;* L, *E. laakona;* M, *Melita pahuwai* J. L. Barnard; N, *Nuuanu amikai* J. L. Barnard; S, *Eriopisella sechellensis upolu* J. L. Barnard.

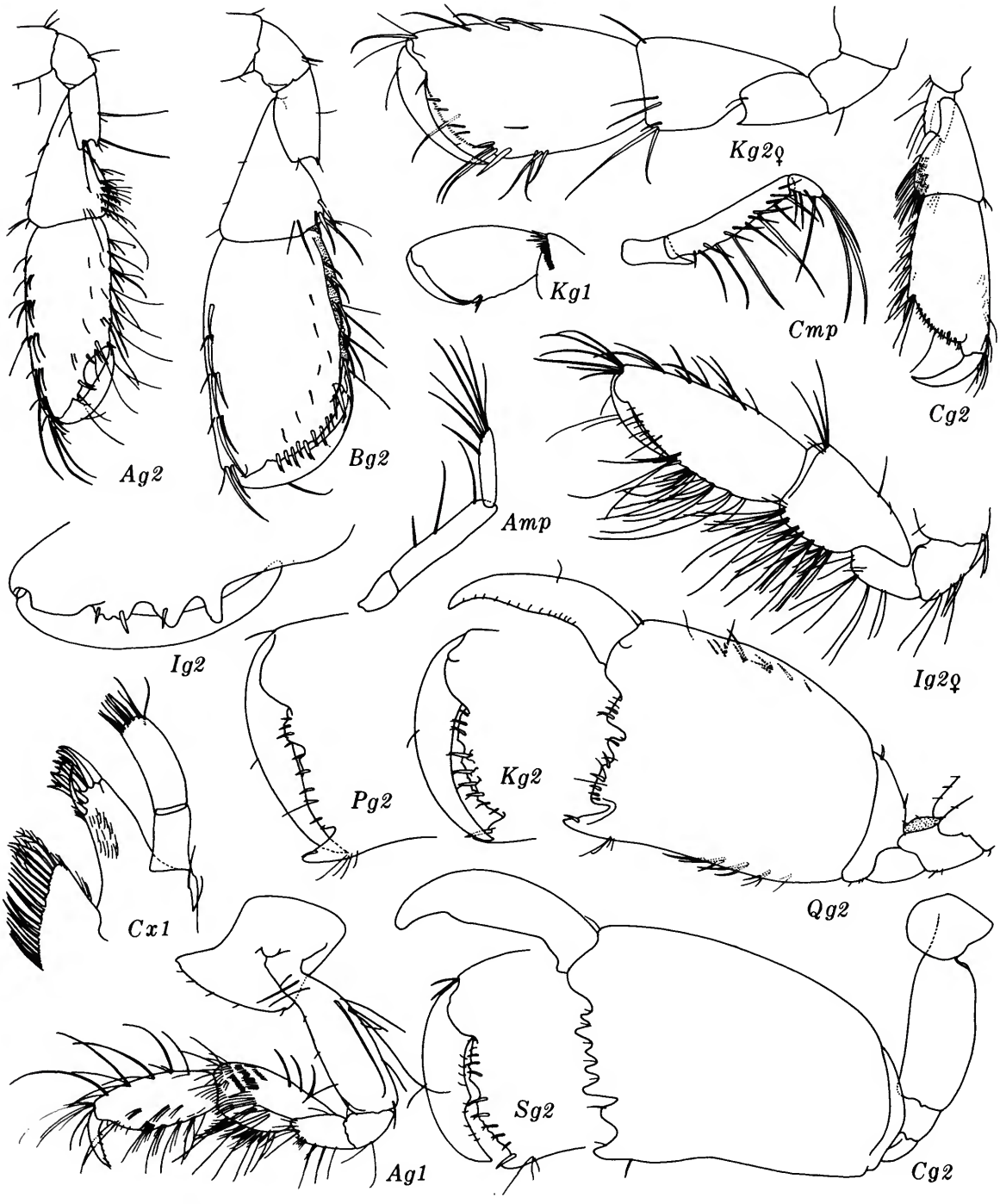


FIGURE 38.—Gammaridae: A, *Maera* sp. *A;* B, *Maera* sp. B; C, *Ceradocus hawaiensis* J. L. Barnard; I, *Maera insignis* (Chevreux); K, *M. kaiulani* J. L. Barnard; P, *M pacifica* Schellenberg; Q, *M. quadrimana* (Dana); S, *M. serrata* Schellenberg.

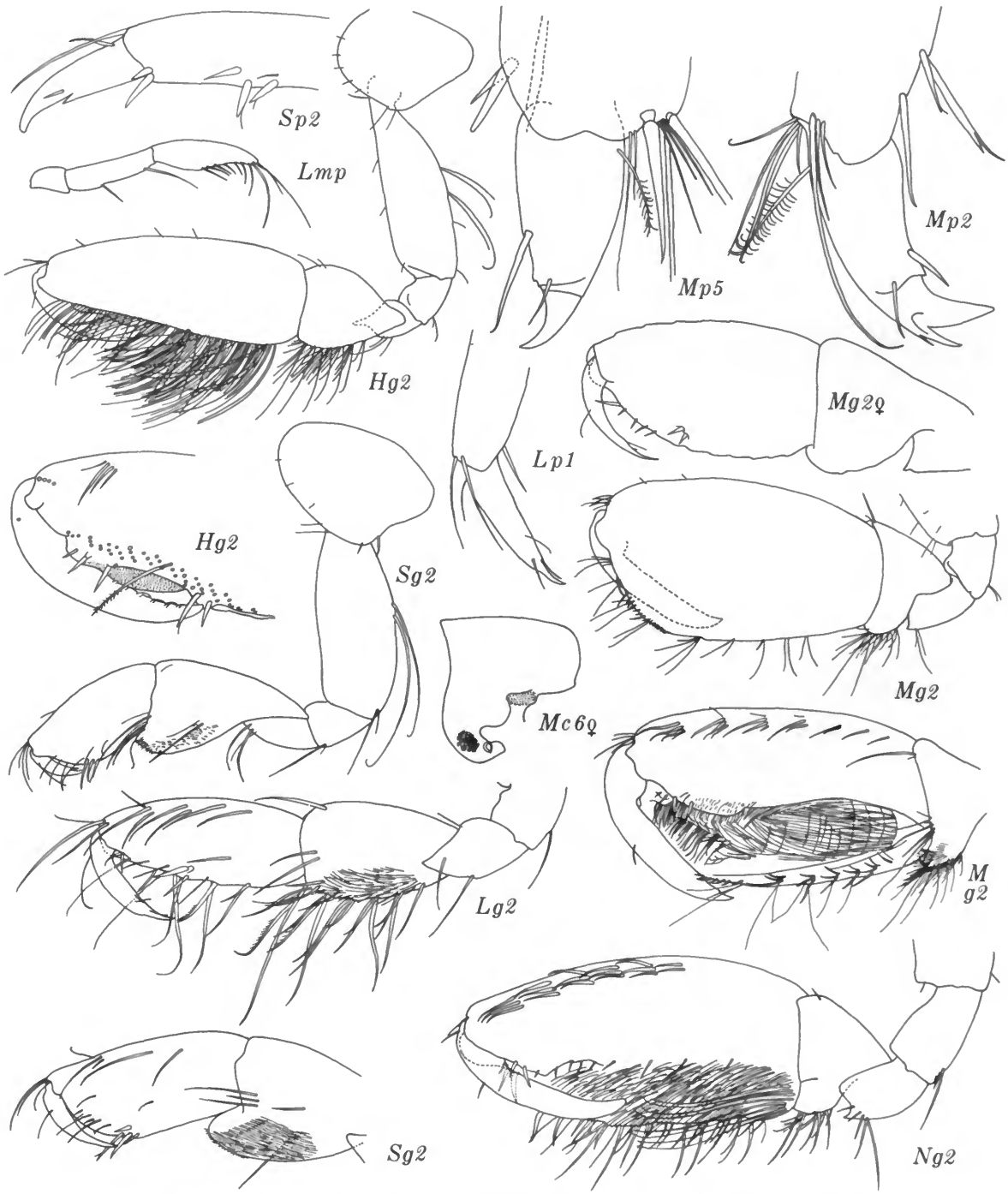


FIGURE 39.—Gammaridae: A, *Melita appendiculata* (Say); H, *Eriopisa hamakua* J. L. Barnard; L, *E. laakona* J. L. Barnard; M, *Melita pahuwai* J. L. Barnard; N, *Nuuanu amikai* J. L. Barnard; S, *Eriopisella sechellensis upolu* J. L. Barnard.

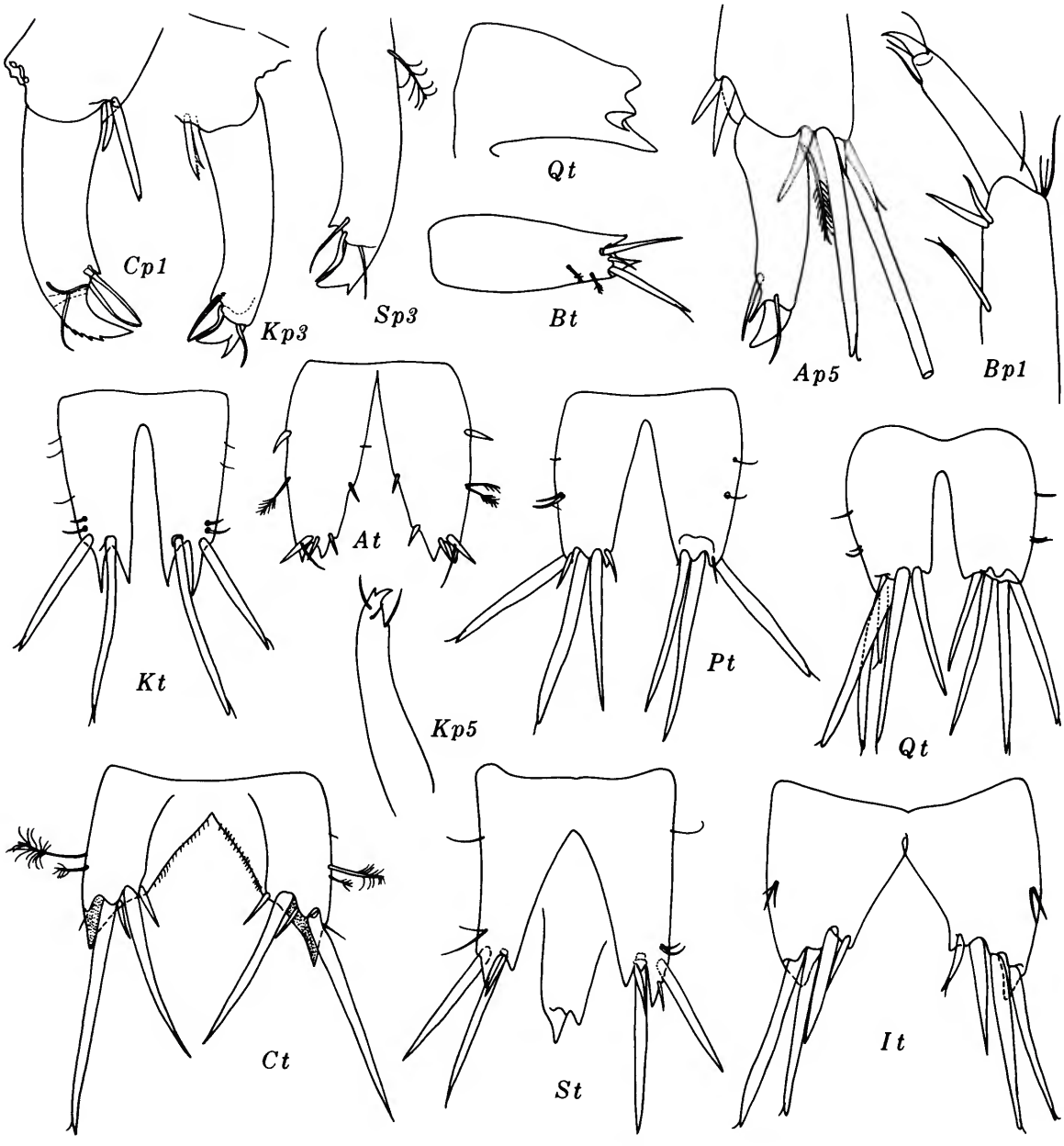


FIGURE 40.—Gammaridae: A, *Maera* sp. A. (cf. *M. hamigera*); B, *Maera* sp. B; C, *Ceradocus hawaiensis* J. L. Barnard; I, *Maera insignis* (Chevreux); K, *M. kaiulani* J. L. Barnard; P, *M. pacifica* Schellenberg; Q, *M. quadrimana* (Dana); S, *M. serrata* Schellenberg.

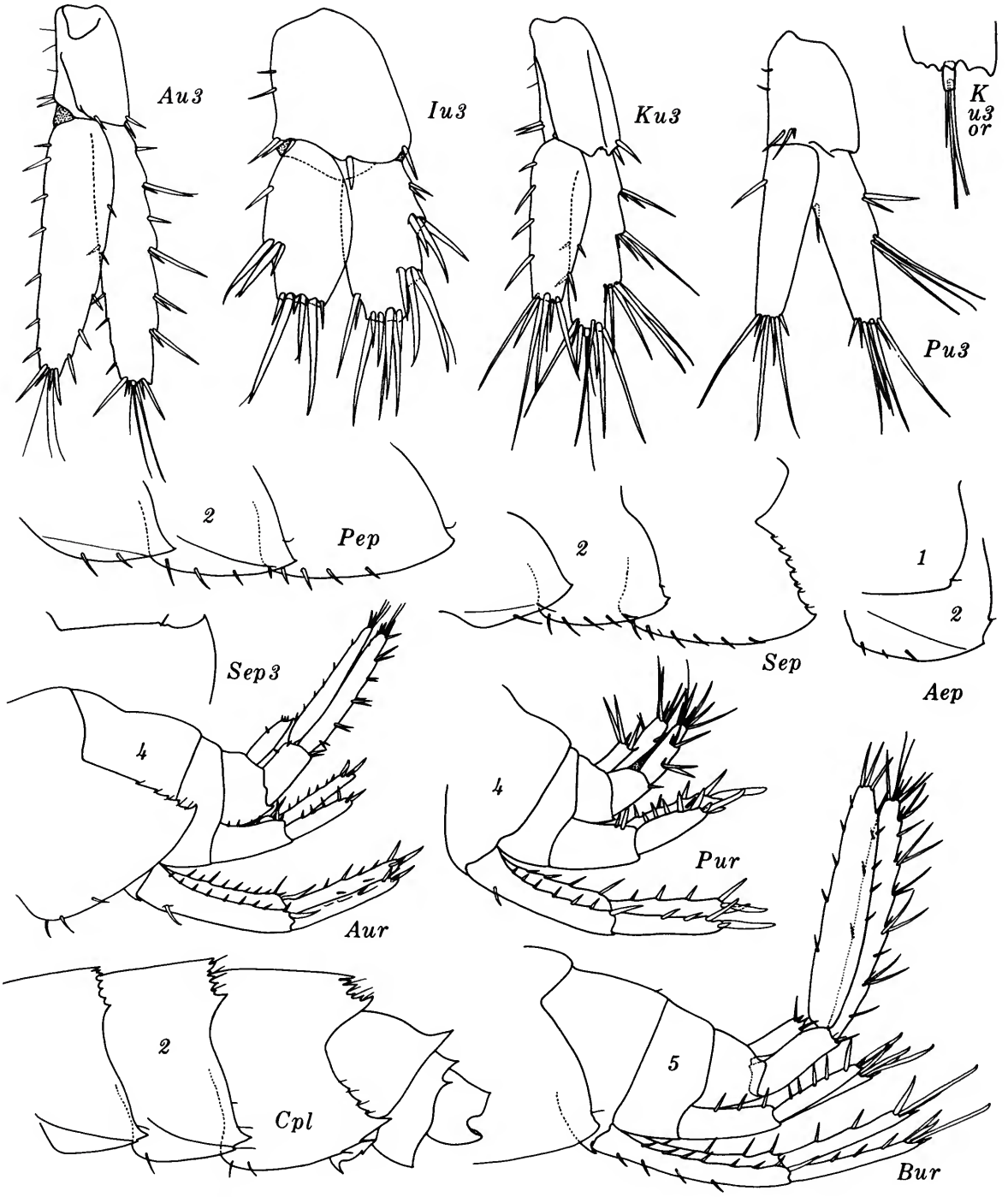


FIGURE 41.—Gammaridae: A, *Maera* sp. A; B, *Maera* sp. B; C, *Ceradocus hawaiensis* J. L. Barnard; I, *Maera insignis* (Chevreux); K, *M. kaiulani* J. L. Barnard; P, *M. pacifica* Schellenberg; S, *M. serrata* Schellenberg.

reaches only about three-fourths of its distance; the palm is heavily setose but bears 2 large sharp teeth in the middle and a smaller bi- or trifid distal protrusion. The rami of uropod 3 are short and subequal and the eyes are black.

Indo-Pacific. Oahu, intertidal, common.

Maera kaiulani J. L. Barnard

Maera kaiulani J. L. Barnard, 1970:147–150, figs. 90, 91.

See diagnosis of *M. pacifica,* below, with following differences: eyes orange or clear in alcohol; article 4 of gnathopod 2 with strong or weak cusp, palm scalloped distinctly, occasionally in terminal male with one excavation in middle; article 2 of pereopods 3–5 thinly rectangular only in juveniles; inner ramus of uropod 3 only half that of outer ramus in juvenile, rami elongate, and extending strongly beyond uropods 1–2, becoming normally short in adults; telson with deeply incised lobes with very sharp cusps, 2 large spines.

Oahu, 4–5 m.

Maera pacifica Schellenberg

Maera pacifica Schellenberg, 1938:42–45, figs. 19–20.—J. L. Barnard, 1965:511; 1970:150–151, figs. 92, 93.

Eyes bright or brownish purple in alcohol, anteroventral cephalic corner with sharp tooth (rotate head to see); male and female gnathopod 2 large and similar to each other but occasionally right and left members different in size, article 4 without tooth, transverse palm with strong defining process and very weakly scalloped palm, male with large excavation in middle, dactyl often with inner acclivity fitting palmar excavation; dactyls of pereopods 1–5 complexly bifid; article 2 of pereopods 3–5 ovate, posteroventral lobes broad; uropod 3 with medium to short rami, thin or of medium breadth, scarcely exceeding uropods 1–2, rami subequal to each other; telson with truncate apices or small medial cusp and 3 large spines on each lobe, not bifid; pleonal epimera 1–3 each with bulging posterior margin and small to medium-sized sharp posteroventral cusp.

Southern Polynesia; Micronesia; Oahu, 0–30 m.

Maera quadrimana (Dana)

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

Maera quadrimana.—Schellenberg, 1938:46–48, figs. 21, 22.—J. L. Barnard, 1955:13; 1965, 511–512, fig. 17; 1970:152–155, figs. 94, 95.

See diagnosis of *M. pacifica,* above, with following differences: article 4 of gnathopod 2 slightly extended distally; male gnathopod 2 with 2 sinuses and 3 truncate processes in middle of palm; dactyl lacking acclivity; article 2 of pereopods 3–4 subrectangular, of 5 subovate, posteroventral lobes narrow and quadrate; in terminal stages medial cusps on telsonic lobes obsolescent.

In Hawaii this species and *M. pacifica* are often difficult to distinguish in female and juvenile stages because pereopods 3–5 often are missing or, if regenerating, article 2 is thin in both species. Study is required to clarify their distinctions, since variations in rami of uropod 3 and male gnathopod 2 shape also occur. Medium-size males of *M. quadrimana* occasionally have one stunted palmar process.

Southern Polynesia; Micronesia; Hawaiian Islands, 0–30 m.

Maera serrata Schellenberg

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

Maera serrata.—J. L. Barnard, 1970:155–156, figs. 96, 97.

See diagnosis of *M. pacifica,* above, with following differences: eyes red in formaldehyde, pale purple in alcohol; article 4 of gnathopod 2 with sharp posteroventral extension; male palm of gnathopod 2 with small excavation in middle, dactyl with small inner hump fitting excavation; bifidation of dactyls on pereopods weaker than in *M. pacifica, M. quadrimana,* or *M. kaiulani;* article 2 of pereopods 3–5 narrowly subrectangular, with narrow and serrate posteroventral lobes; rami of uropod 3 equal to each other in length, thin; narrow telsonic lobes apically bifid, each with 2 pairs of long spines.

Pleonal epimeron 3 deeply serrate posteriorly unlike other species of Hawaiian *Maera.* Juveniles have at least one weak serration and setule besides posteroventral tooth.

Southern Polynesia; Micronesia; Oahu, 0–3 m.

Maera sp. A (cf. *M. hamigera*), J. L. Barnard

Maera species A J. L. Barnard, 1970:156–159, figs. 98, 99.

A single female is known. Rami of uropod 3 extremely elongate and palm of gnathopod 2 oblique. Dis-

tinguished from *Maera* sp. B in the presence of a lateral cephalic notch and from juveniles of *M. kaiulani* in the dark eyes (blood red to black), cephalic notch, and oblique palm of gnathopod 2. Dactyls of pereopods not bifid.

Southern Oahu, 30 m.

Maera sp. B, J. L. Barnard

Maera species B J. L. Barnard, 1970:159–161, fig. 100.

A single female is known. Rami of uropod 3 extremely elongate and palm of gnathopod 2 oblique. Head without lateral cephalic notch. Eyes black. Dactyls of pereopods not bifid as in species like *M. pacifica.*

Oahu, Kawela Bay, intertidal.

Key to Hawaiian Species of Genus *Melita* Leach

Figure Numbers Referenced in Italics

Pleon with numerous dorsal serrations and cusps (*37Mpl*), head with bifid corner below lateral lobe ..... ***M. appendiculata*** (=fresneli)

Pleon bearing only small, almost microscopic dorsolateral cusp on pleonite 4, head with deep slit below lateral lobe (*37Mh*) ..... ***M. pahuwai***

Melita appendiculata (Say) (= *fresneli* (Audouin))

Melita appendiculata (Say).—J. L. Barnard, 1970:161, figs. 101, 102.

Melita fresneli (Audouin).—J. L. Barnard, 1955:13–14 (with references).

See remarks under *Ceradocus hawaiensis* (page 70).

Melita appendiculata is one of the most striking amphipods in any ocean because of the large decapodous claw of the left male gnathopod 2. In resemblance to fiddler crabs the right gnathopod 2 is small; both gnathopods are small in the female.

The conspicuous dorsal serrations and cusps on the pleon distinguish the species from *M. pahuwai* but so many fundamental differences occur between the two species that they scarely seem to be in the same genus. Gnathopod 1 of *M. appendiculata* is of the normally gammarid kind, that of *M. pahuwai* is complexly ornamented and has transversely bulging palms and complex dactyls. *Melita pahuwai* has the normal cephalic notch whereas *M. appendiculata* has only a bifid anteroventral cephalic corner.

Eyes dark orange in alcohol.

Cosmopolitan in warm seas.

Melita pahuwai J. L. Barnard

Melita pahuwai J. L. Barnard, 1970:161–166, figs. 103, 104.

Male gnathopod 2 has a flabellate hand with distally quadratiform definition, minutely spinose, medial surface with axial channel filled with setae, dactyl overriding palm onto medial surface; male gnathopod 1 with hand distally swollen, palm complexly sinuous and spinose, dactyl grotesquely bulging basally but apically unguiform. Outer ramus of uropod 3 with only 1 article in contrast to *M. appendiculata.* Both gnathopods of the male are enlarged.

Pereopodal dactyls with double distal constriction but no accessory tooth as in *M. appendiculata.*

Eyes brownish purple in alcohol.

Oahu, Kawela Bay, intertidal.

Genus *Nuuanu* J. L. Barnard

Nuuanu amikai J. L. Barnard

Nuuanu amikai J. L. Barnard, 1970:166, figs. 105, 106.

Nuuanu is a genus endemic to Hawaii and resembling *Melita* but having uropod 3 very short and the outer ramus composed of 2 articles. In this character *Nuuanu* also resembles *Eriopisa* and *Eriopisella* but differs from them in the elongate coxae, the tall head with very widely triangular cheeks (cephalic lobes) bearing a few scattered clear ommatidia, a weak dorsal tooth on each of pleonites 1 and 2 and a small dorsolateral spine on each side of urosomites 2 and 3. Article 2 of pereopods 3–5 is deeply castello-serrate, like pereopod 4 of *Elasmopus pectenicrus* and pereopods 4–5 of *E. diplonyx,* but the shapes of article 2 (*37Np5*) are distinctive and the serrations occur on all 3 members of pereopods 3–5.

Southern Oahu, 18 m, on *Pocillopora* reef.

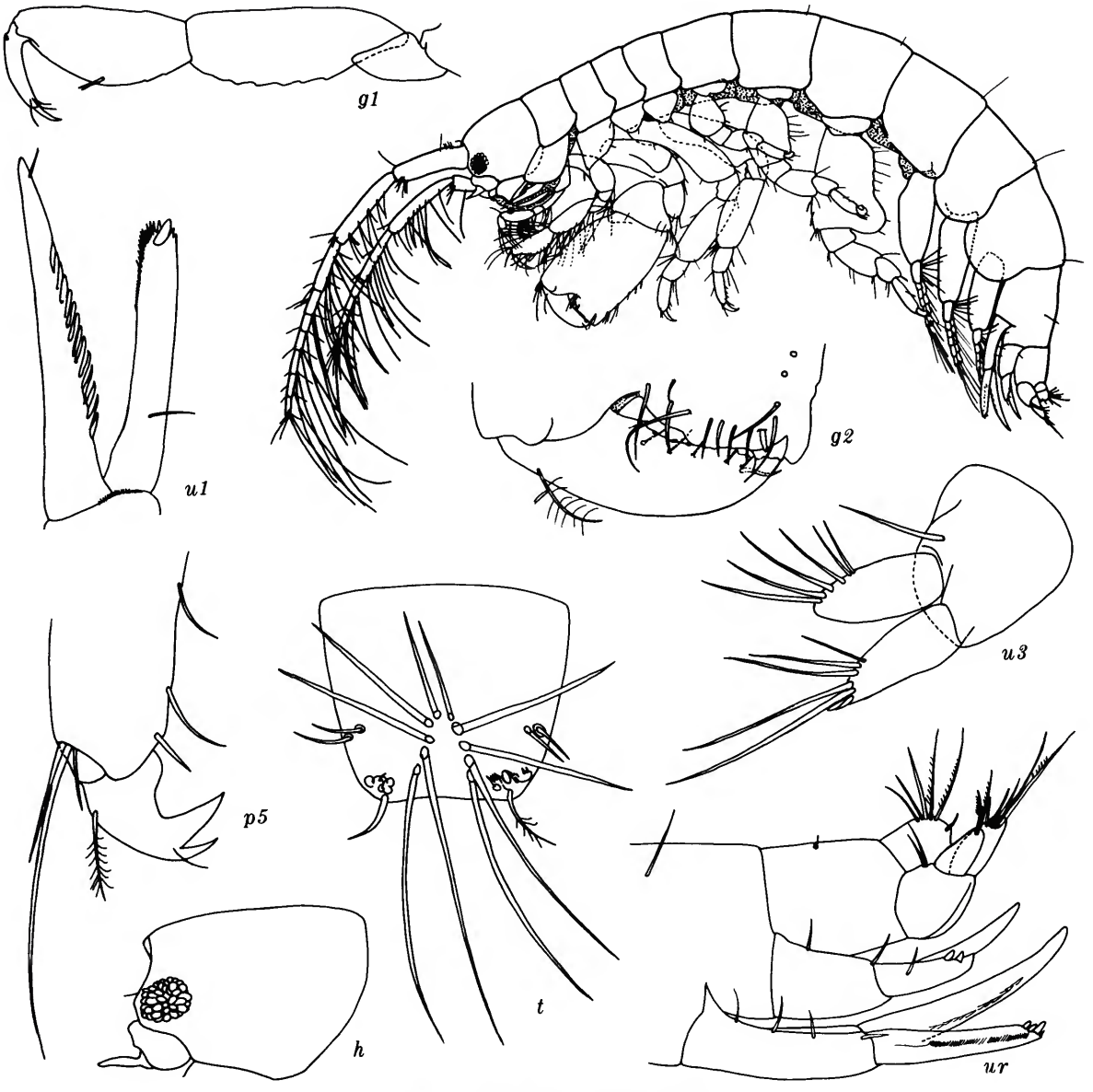
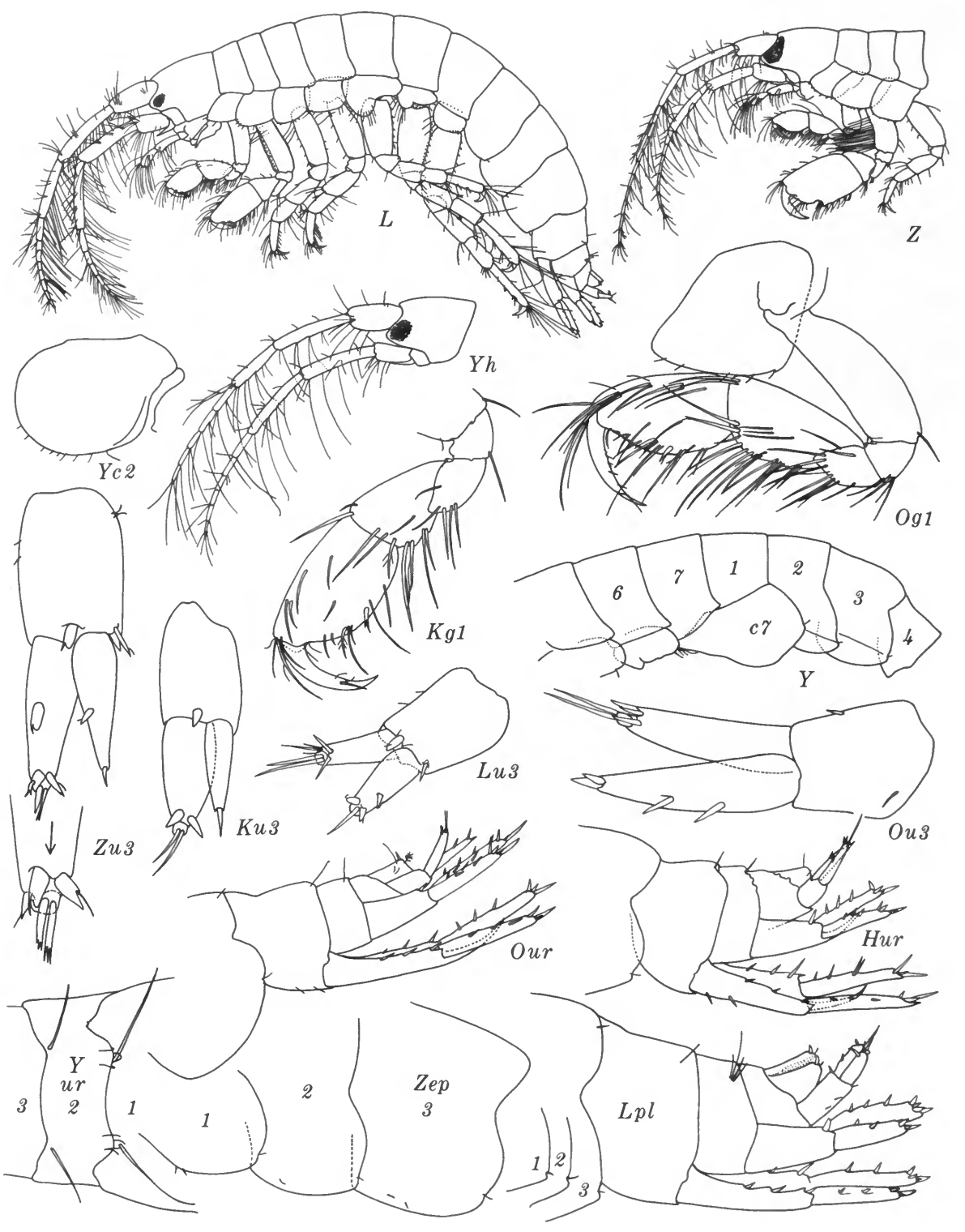


FIGURE 42.—Isaeidae: *Chevalia aviculae* Walker.

FIGURE 43.—Isaeidae, *Gammaropsis* (=*Eurystheus* Bate): H, *Gammaropsis haleiwa* J. L. Barnard; K, *G. kaumaka* J. L. Barnard; L, *G. pali* J. L. Barnard; O, *G. pokipoki* J. L. Barnard; Y, *G. alamoana* J. L. Barnard; Z, *G. atlantica* Stebbing.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Family ISAEIDAE (= Photidae)

FIGURES 42–47

The basic member of the isaeid complex, including the families Ampithoidae, Aoridae, Ischyroceridae, Corophiidae, and, for purposes of this paper, the Podoceridae, has a fleshly telson, very thick, broad, short, and uncleft, though often dorsally excavate. From a lateral view the telson projects from behind the lateral wings of urosomite 3 as a small tent, often armed with at least 1 thick spine, often with an additional seta, and occasionally with a conspicuous cornified bead or hook; in the Corophiidae the telson and urosome may become so flattened that these remarks are no longer true. Isaeid-complex members, except apparently for podocerids, have glands in articles 2 and 4, and occasionally 3 and 5, of pereopods 1–2. The glands may have a variety of colors, even purple and orange, but usually in preserved specimens the glands have been changed to yellow, ochre, amber, or brown; occasionally they are colorless. They conceal the muscles normally seen as axially oriented fibrous bundles. Often a duct may be traced through the appendage to the subapex or the dactyl where secretions are emitted and spun into tubes.

Isaeids generally have the appearance of the basic gammaridean except for the telson, the glandular pereopods and the absence of a posterior excavation on coxa 4. The unexcavate coxa is also characteristic of some Gammaridae and it is therefore an unreliable familial character by itself.

Mouthparts of most isaeid members are grossly monotonous, fulfilling the basic gammaridean concept. Isaeidae have the fewest modifications of their group, the outer ramus of uropod 3 lacking spine hooks seen in Ampithoidae, or the tiny denticles and hooked appearance of Ischyroceridae; and Isaeidae have gnathopod 2 larger than 1 in the male.

Rami of uropod 3 are never flattened or perfectly lanceolate as they are in many other gammarideans; generally the rami are thin cylinders or elongate boxes, and the peduncle is never elongate as it is ischyroceridae, nor are the rami broadened as in Ampithoidae.

Key to Genera of Isaeidae

Figure Numbers Referenced in Italics

1. Pleonites 4–5 coalesced (*42*, body), but pleonite 6 free ..... ***Chevalia*** Walker
   All pleonites free 2
2. Inner ramus of uropod 3 half or less as long as outer ramus (*46Ku3*) ..... ***Photis*** Krøyer
   Inner ramus of uropod 3 as long as or longer than outer.
   Gammaropsis Liljeborg (= Eurystheus)

Cheiriphotis, a genus not yet found in Hawaii but expected to occur there resembles *Photis* in having the inner ramus of uropod 3 very short, often absent in terminal adults; the peduncle of uropod 3 is platelike and very small, and article 3 of antenna 1 is much shorter than article 1, whereas in *Photis* article 3 is as long article 1.

Genus *Chevalia* Walker

Chevalia aviculae Walker

FIGURE 42

Chevalia aviculae Walker, 1904:288–290, pl. 7, fig. 50, pl. 8, fig. 50.—J. L. Barnard, 1962:17–20, fig. 5; 1970: 166–170, fig. 107.

The coalesence of urosomites 1 and 2 is unique to this species of Hawaiian amphipod; urosomite 3 is freely articulate. The urosome is tall, so that the coalesence of the 2 segments is clearly apparent from lateral view. Coxae 5–7 are very small and discontiguous and coxae 1–4 also are small and barely touch. Antenna 1 is much longer than 2 and the antennae usually remain with the animal upon preservation. *Chevalia* is frequently very abundant in sublittoral samples; but the organisms are small (3 mm) and may be spotted by their white bodies with red or clear eyes, large gnathopod 2 with transverse palm, and long setose antennae plus pereopods 3–5 (especially 3–4) and thick peduncles on the pleopods. The outer rami of uropods 1–2 are shorter than the inner, the outer bearing conspicuous terminal spines, but both pairs of rami lack dorsal spines. The rami of uropod 1 have minute setules and spines on their lateral margins. The outer ramus of uropod 3 appears shorter than the inner only from

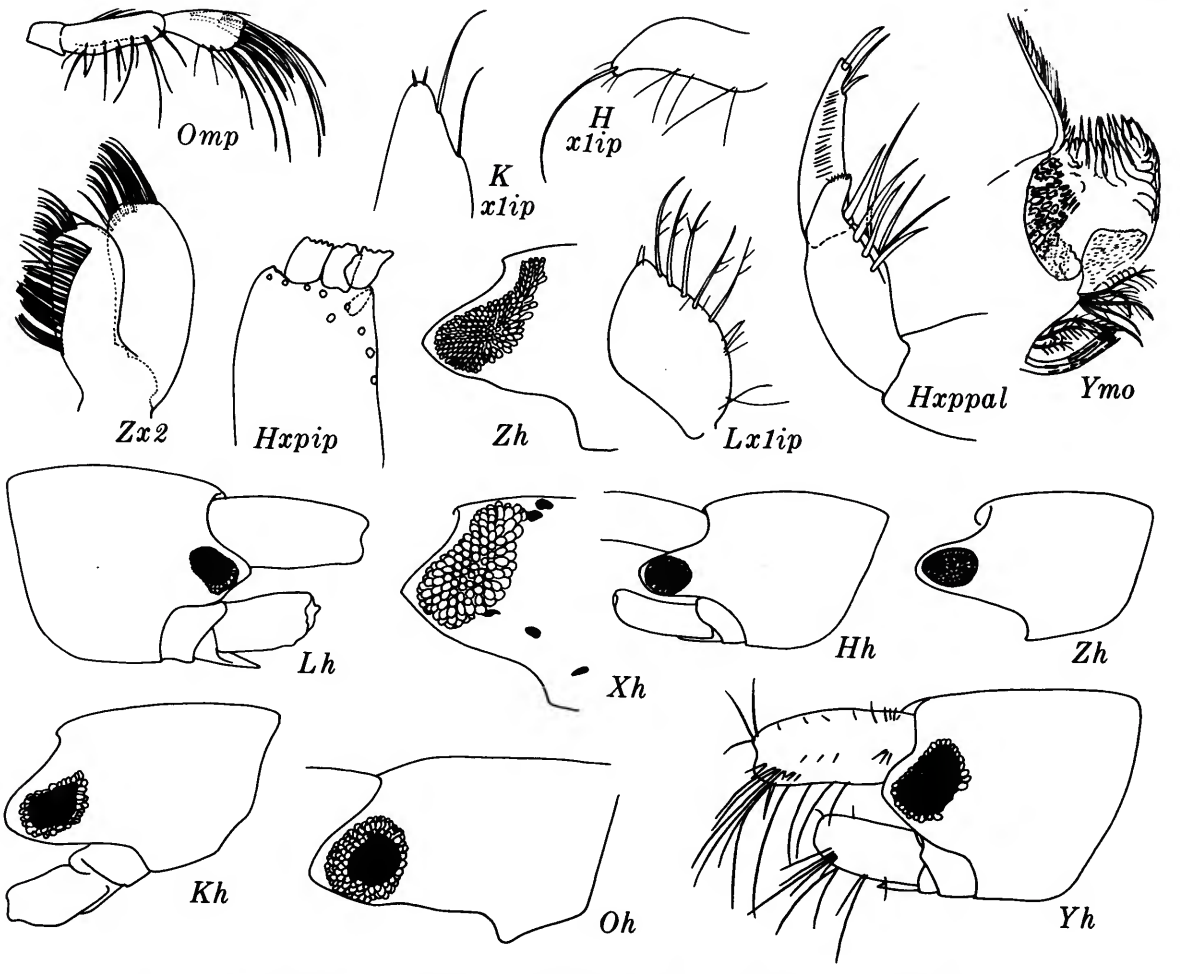


FIGURE 44.—Isaeidae, *Gammaropsis:* H, *G. haleiwa* J. L. Barnard; K, *G. kaumaka* J. L. Barnard; L, *G. pali* J. L. Barnard; O, *G. pokipoki* J. L. Barnard; X, *G. afra* Stebbing; Y, *G. alamoana* J. L. Barnard; Z, *G. atlantica* Stebbing.

lateral view. The telson is fleshy, subquadrate, shaped like a pillow, and strongly setose dorsally. Antenna 1 has a 2-articulate accessory flangellum.

Oahu, 0–30 m, common. Circumtropical and warm-temperate.

Genus *Gammaropsis* Liljeborg (= *Eurystheus* Bate)

FIGURES 43–45

A diverse assemblage of species assigned to this genus occurs in Hawaii. The several groups may not be congeneric but the differences among them are minute and have not been studied carefully in the world fauna to see their significance. The main group of species is composed of the *atlantica-afra-pali-pokipoki-kaumaka* complex in which uropod 3 has a small article 2 and the inner plate of maxilla 1 has at least 3, often 5+ setae lining the medial margin. *Gammaropsis pali* differs from its four other group members in the presence of a fan-shaped transparent flake on the smooth base of the right mandibular molar, but *G. pokipoki* has a rugose surface in the same area. *Gammaropsis haleiwa* forms a class by itself: it has 2 articles in the outer ramus of uropod 3; maxilla 1 has only 1 long

terminal seta (plus a short one); the right mandibular molar has a flake; and the maxillipedal palp article 3 bears a distal adze-shaped process, and article 4, unlike other members of Hawaiian *Gammaropsis,* is long, almost unguiform, and with a short terminal nail. Other members have article 4 shorter, stouter, barrel-shaped, and bearing terminal setal spines as long as the article itself. *Gammaropsis haleiwa* and *G. kaumaka* are marked by a long ventral peduncular cusp on uropod 2 similar to that seen on uropod 1 of all members of *Gammaropsis*. The remaining species, *G. alamoana* lacks article 2 on the outer ramus of uropod 3 and lacks setae on the inner plate of maxilla 1; *G. alamoana* has a right molar flake and seta and *G. alamoana* is distinguished in its conically acute epistome projecting forward.

Key to Hawaiian Species of Genus *Gammaropsis* Liljeborg

Figure Numbers Referenced in Italics

1. Apex of outer ramus on uropod 3 lacking a minute article 2 and bearing 2–5 setae or spines. (Palm of gnathopod 1 lacking stout defining spines in both sexes, eyes retaining black pigment in alcohol, urosomite 1 with small dorsal pair of protuberances, uropod 2 lacking ventral peduncular tooth between rami, epistome with long, coniform anterior projection.) ***G. alamoana***

   Apex of outer ramus on uropod 3 with minute cuboid article 2 bearing 2 setae (*43Ku3*) and often surrounded or partially hidden by other setae 2
2. Uropod 2 with long sharp peduncular tooth between rami (*43Hur, 45Ku2*) 3

   Uropod 2 lacking long peduncular tooth 4
3. Telson with 2 stout dorsal spines, urosomites smooth, inner plate of maxilla 1 with medial setae, maxillipedal palp article 3 lacking process, 4 short, with long apical setae .. ***G. kaumaka***

   Telson lacking dorsal spines, urosomal margins with weak castellae, inner plate of maxilla 1 with only terminal setae, maxillipedal palp article 3 with strong distal lobe (*44Hxppal*) article 4 long, unguiform, with apical nail ..... ***G. haleiwa***
4. Article 5 of gnathopods 1–2 with 2–3 stout anterior spines (*43L*), article 6 of gnathopod 1 rectangular, palm shorter than posterior margin of article 6, article 2 of pereopods 3–5 slender and rectangular ..... ***G. pali***

   Article 5 of gnathopods 1–2 lacking stout anterior spines, article 6 of gnathopod 1 ovate, palm and posterior margin of article 6 equal to each other in length*, article 2 of pereopods 3–5 ovate or pyriform, especially broad on pereopod 3 (*45Yp3*) 5
5. Rami of uropod 3 about 150 percent as long as peduncle (*43Ou3*), inner slightly longer than outer, inner with 2 stout apical spines, urosomites 1–2 simple, each with 1 dorsolateral seta, lateral margins straight, dactyl of male gnathopod 2 overlapping palm (*45Og2*), palmar excavation dominating palmar area, gnathopod 2 small, eyes retaining black pigment in alcohol, black in life ..... ***G. pokipoki***

   Rami of uropod 3 subequal to peduncle in length (*43Zu3*), outer slightly longer than inner, inner with 1 small apical spine, urosomites 1–2 with 1 dorsolateral seta marking dorsal boundary of bulging lateral urosomital margin, dactyl of male gnathopod 2 not overlapping palm, palmar excavation not dominating palmar area, gnathopod 2 large, eyes becoming clear or rust colored in alcohol, red or brown in life 6
6. Eyes horizontally ovate (*44Zh*) ..... ***G. atlantica,*** form B

   Eyes vertically ovate, lageniform, reniform or trapezoidal 7
7. Eyes lageniform (*43Z*) ..... adults of ***G. atlantica,*** form A

   Eyes otherwise 8
8. Eyes vertically ovate (like *44Oh*) ..... juveniles of ***G. atlantica*** forms A & B?

   Eyes vertically reniform or trapezoidal (*44Xh*) 9
9. Adults 2.2 mm or less in body length, eyes brown in 2-day formaldehyde, retaining dark brown or rust stain in alcohol, body white ..... ***G. afra***

   Adults about 3.0 mm or longer, specimens smaller always immature, eyes red in 2-day formaldehyde, becoming clear in alcohol but body (and especially head) retaining pink-purple stain ..... ***G. afra-atlantica*** hybrids

*Separated from each other by a stout spine.

Gammaropsis afra Stebbing

Gammaropsis afra and *G. afer,* Stebbing, 1888:1097, pl. 113; J. L. Barnard, 1970:170, fig. 108.
Eurystheus afra.—Stebbing, 1906:612.—?K. H. Barnard, 1916:249–250, pl. 28, fig. 11; 1937:165–166, fig. 12.—Pillai, 1957:55–56, fig. 13.—J. L. Barnard, 1961:113–114, fig. 79.

Outer ramus of uropod 3 with 2 articles, inner plate of maxilla 1 with 3+ medial setae, right mandibular molar with seta, no flake, epistome unproduced, article 5 of gnathopods 1–2 lacking stout anterior spines, article 6 of gnathopod 1 ovate and with stout defining spine, article 2 of pereopods 3–5 ovate or pyriform, uropod 2 lacking ventral peduncular tooth, rami of uropod 3 not significantly longer than peduncle, urosomites 1–2 with bulging posterolateral margins marked dorsally by a seta, gnathopod 2 of both sexes large, dactyl fitting palm, palm oblique, excavate at proximal end only, with giant articulate spine.

Eyes brown, body clear in 2-day formaldehyde, eyes trapezoidal or reniform on short ocular lobes. Adults not exceeding 2.2 mm in length.

Hybrid form, with *G. atlantica:* reaching 4 mm in length, eye slightly more reniform than in *G. afra,* palm of gnathopod 2 much less oblique, concavity narrowest, palmar bulge quadrate instead of lobed as in *atlantica* and *afra,* proximal inner margin of dactyl with low quadrate process; color as in *G. atlantica,* with red eyes and body-head pigment.

Almost circumtropical. Oahu, 30–33 m, on deep *Pocillopora* reef and black coral base.

Gammaropsis alamoana J. L. Barnard

Gammaropsis alamoana J. L. Barnard, 1970:170–174, figs. 109, 110.

Outer ramus of uropod 3 lacking article 2, inner plate of maxilla 1 lacking setae (bearing setular wisps only), right mandibular molar with large seta and molar flake, epistome with long, conical anterior cusp, article 5 of gnathopods 1–2 lacking stout anterior spines, article 6 of gnathopod 1 ovate and lacking stout defining spine, article 2 of pereopods 3–5 ovate or pyriform, uropod 2 lacking ventral peduncular tooth, rami of uropod 3 not significantly longer than peduncle, urosomite 1 with shallow pair of dorsal protuberances, gnathopod 2 of both sexes large, dactyl fitting or shorter than palm, palm oblique, with strong defining tooth, and broad palmar tooth, excavation flat, bearing large spine becoming lost in terminal males, latter having coxa 7 enlarged enormously.

Eyes black, ovoreniform, ocular lobes of medium extent.

Oahu, widely distributed from intertidal zone to depths of 30 m.

Gammaropsis atlantica Stebbing

Gammaropsis atlantica Stebbing, 1888:1101, pl. 114.—J. L. Barnard, 1970:174–178, figs. 111–113.
Gammaropsis zeylanicus Walker, 1904:282–283, pl. 6, fig. 41.
Gammaropsis Gardineri Walker, 1905:929–930, pl. 88, figs. 11–14, 16, 17.
Eurystheus atlanticus Stebbing, 1906:611.—Pillai, 1957:56–57, fig. 14.—J. L. Barnard, 1965:534–535, fig. 29.

Outer ramus of uropod 3 with 2 articles, inner plate of maxilla 1 with 3 plus medial setae, right mandibular molar with seta, no flake, epistome unproduced, article 5 of gnathopods 1–2 lacking stout anterior spines, article 6 of gnathopod 1 ovate and with stout defining spine, article 2 of pereopods 3–5 ovate or pyriform, uropod 2 lacking ventral peduncular tooth, rami of uropod 3 not significantly longer than peduncle, urosomites 1–2 with bulging posterolateral margins marked dorsally by a seta, gnathopod 2 of both sexes large, dactyl fitting palm, palm oblique, excavate at proximal end only, with giant articulate spine.

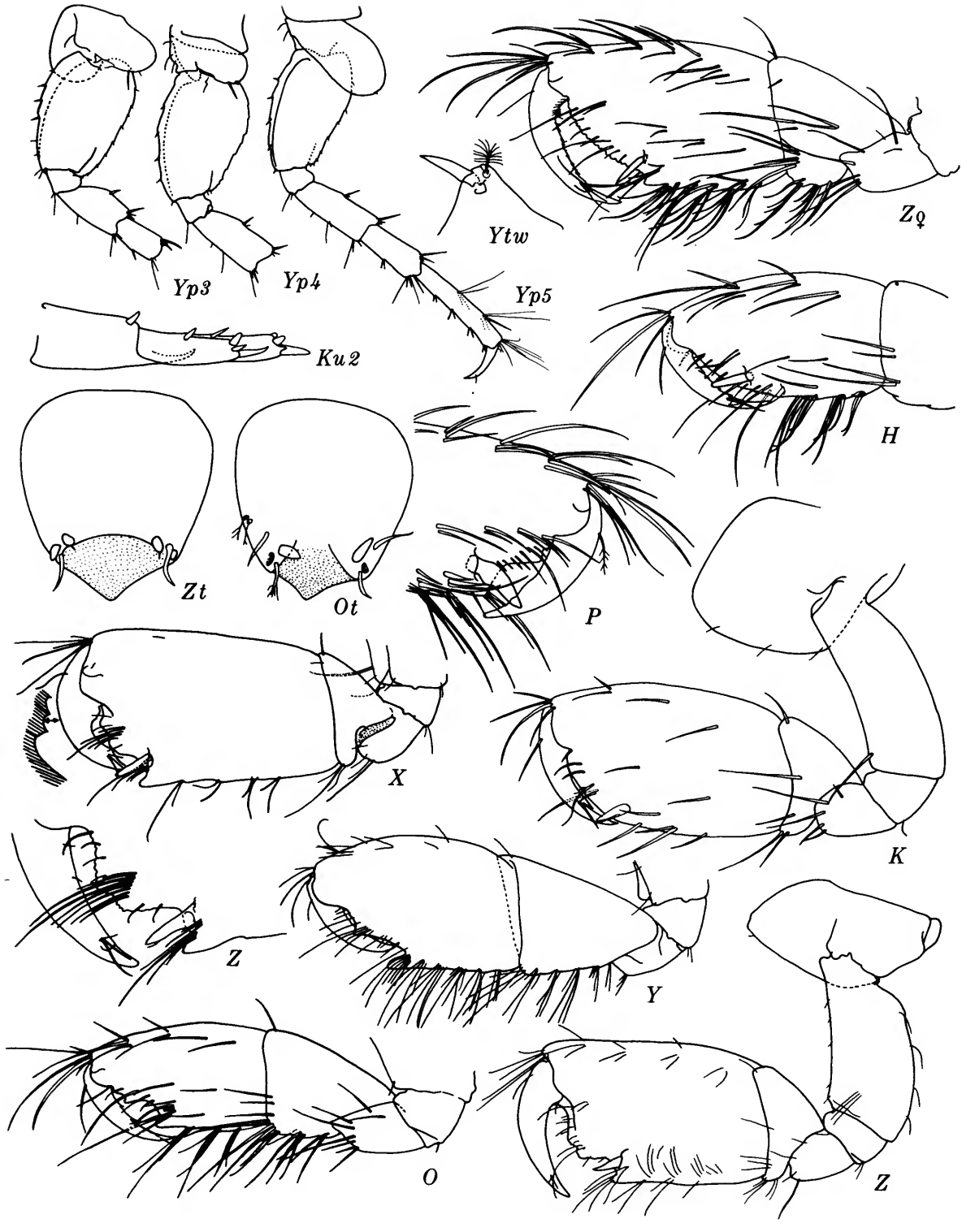
Eyes red, body and head clear or purplish pink in a 2-day formaldehyde, eyes lageniform on medium to long ocular lobes or ovate on long ocular lobes. Ovate eyes either horizontal or vertical. This species occurs in several ocular forms with intermediate stages, the eyes of adults showing ommatidial proliferation to form a lageniform condition. See *G. afra* for remarks on hybrids.

Almost circumtropical; Oahu, widely distributed from intertidal depths to 30 m, mainly in depths exceeding 5 m.

Gammaropsis haleiwa J. L. Barnard

Gammaropsis haleiwa J. L. Barnard, 1970:178–181, fig. 115.

Outer ramus of uropod 3 with 2 articles, inner plate of maxilla 1 with 1–2 terminal setae, right mandibular


Yp3
Yp4
Yp5
Ytw
Zφ
Ku2
H
Zt
Ot
P
X
K
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Y
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Z

molar with seta and flake, epistome unproduced, article 5 of gnathopods 1–2 lacking stout anterior spines (rarely with an anterior seta), article 6 of gnathopod 1 ovate and with stout defining spine, article 2 of pereopods 3–5 ovate or pyriform, uropod 2 with long peduncular tooth between rami, rami of uropod 3 significantly longer than peduncle, urosomites 1–2 with slight modifications like *afra-atlantica,* gnathopod 2 of male small, dactyl fitting palm, palm oblique, scarcely excavate, bearing 2 stout but not greatly enlarged spines; urosomites 2 and 3 with posterodorsal marginal nobs; maxillipedal palp article 3 extended in strong adze-shaped process, article 4 elongate, tipped with nail. Female unknown.

Eyes small and subcircular, with black central core surrounded by a few clear ommatidia on elongate narrow ocular lobes.

Oahu, Kaneohe Bay, 2 m.

Gammaropsis kaumaka J. L. Barnard

Gammaropsis kaumaka J. L. Barnard, 1970:181, fig. 116.

Outer ramus of uropod 3 with 2 articles, inner plate of maxilla 1 with 2 medial and 2 terminal setae, right mandibular molar poorly known, probably without flake but with basal rugosity, epistome unproduced, article 5 of gnathopods 1–2 lacking stout anterior spines, article 6 of gnathopod 1 subrectangular and with stout defining spine, article 2 of pereopods 3–5 pyriform, uropod 2 with long peduncular tooth between rami, rami of uropod 3 not exceeding length of peduncle, urosomites 1–2 with smooth margins, gnathopod 2 of presumed male of medium size, dactyl fitting palm, palm oblique, smoothly rounded, unexcavate, defined by large spine; maxillipedal palp article 3 unproduced or lobate, article 4 short and bearing long apical setae. Female unknown.

Eyes of medium size, irregularly ovate and slightly tilted from horizontal axis, with black-brownish purple central core surrounded by a few clear ommatidia on ocular lobes of medium extension.

Oahu, Kawela Bay, intertidal.

Gammaropsis pali J. L. Barnard

Gammaropsis pali J. L. Barnard, 1970:183–184, figs. 117, 118.

Outer ramus of uropod 3 with 2 articles, inner plate of maxilla 1 with 3+ medial setae, right mandibular molar with seta and flake, epistome unproduced, article 5 of gnathopods 1–2 with 2–3 stout anterior spines, article 6 of gnathopod 1 rectangular and with stout defining spine, article 2 of pereopods 3–5 slender, rectangular, uropod 2 lacking ventral peduncular tooth, rami of uropod 3 not significantly longer than peduncle, urosomites 1–2 simple, gnathopod 2 of both sexes of medium size, dactyl overriding palm, palm oblique, widely and deeply excavate but scarcely defined, with giant articulate spine.

Eyes bright garnet-ruby red in 2-day formaldehyde, head with similar red spots, red lost in alcohol revealing black core, antennae dark splotchy garnet, a few body segments with brown vertical stripes, ocular lobes of medium extent.

Oahu, Kaneohe Bay, 2 m.

Gammaropsis pokipoki J. L. Barnard

Gammaropsis pokipoki J. L. Barnard, 1970:185, figs. 119, 120.

Outer ramus of uropod 3 with 2 articles, inner plate of maxilla 1 with 3+ medial setae, right mandibular molar with seta, no flake but with basal rugosity, epistome unproduced, article 5 of gnathopods 1–2 lacking stout anterior spines, article 6 of gnathopod 1 ovatorectangular, bearing stout defining spine, article 2 of pereopods 3–5 ovate or pyriform, uropod 2 lacking ventral peduncular tooth, rami of uropod 3 nearly 150 percent as long as peduncle and outer slightly shorter than inner, urosomites 1–2 simple, gnathopod 2 of both sexes small, sexually dimorphic, dactyl overlapping palm in male, palm oblique, broadly and deeply excavate, with giant articulate spine, female palm very weakly and scarcely defined.

Eyes large, subcircular, with black central core in alcohol surrounded by thick ring of small, numerous clear ommatidia on long ocular lobe.

Oahu, 2–30 m.

FIGURE 45.—Isaeidae. *Gammaropsis;* all unlettered figures are gnathopod 2: H, *G. haleiwa* J. L. Barnard; K, *G. kaumaka* J. L. Barnard; O, *G. pokipoki* J. L. Barnard; P, *G. pali* J. L. Barnard; X, *G. afra* Stebbing; Y, *G. alamoana* J. L. Barnard; Z, *G. atlantica* Stebbing.

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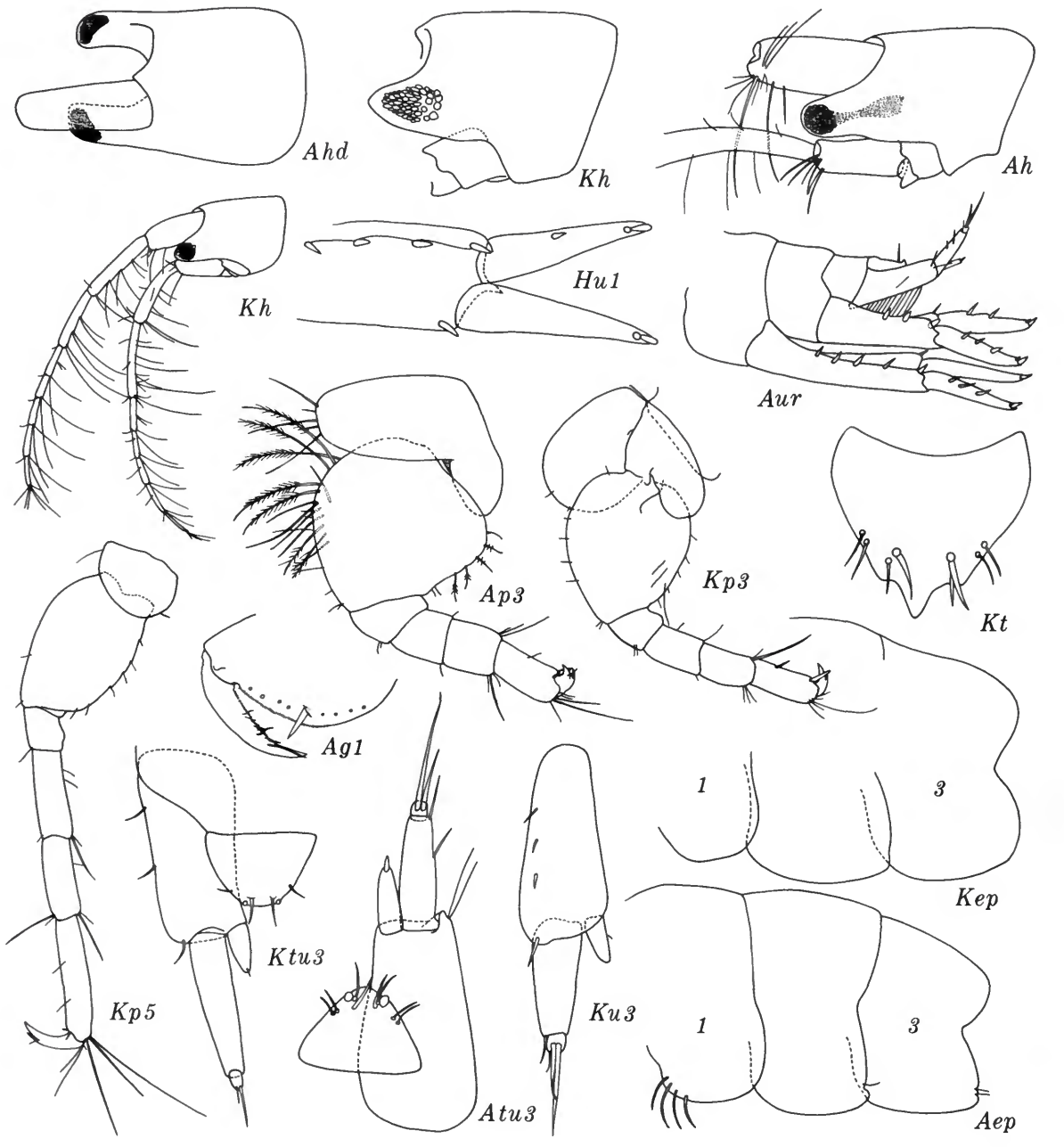
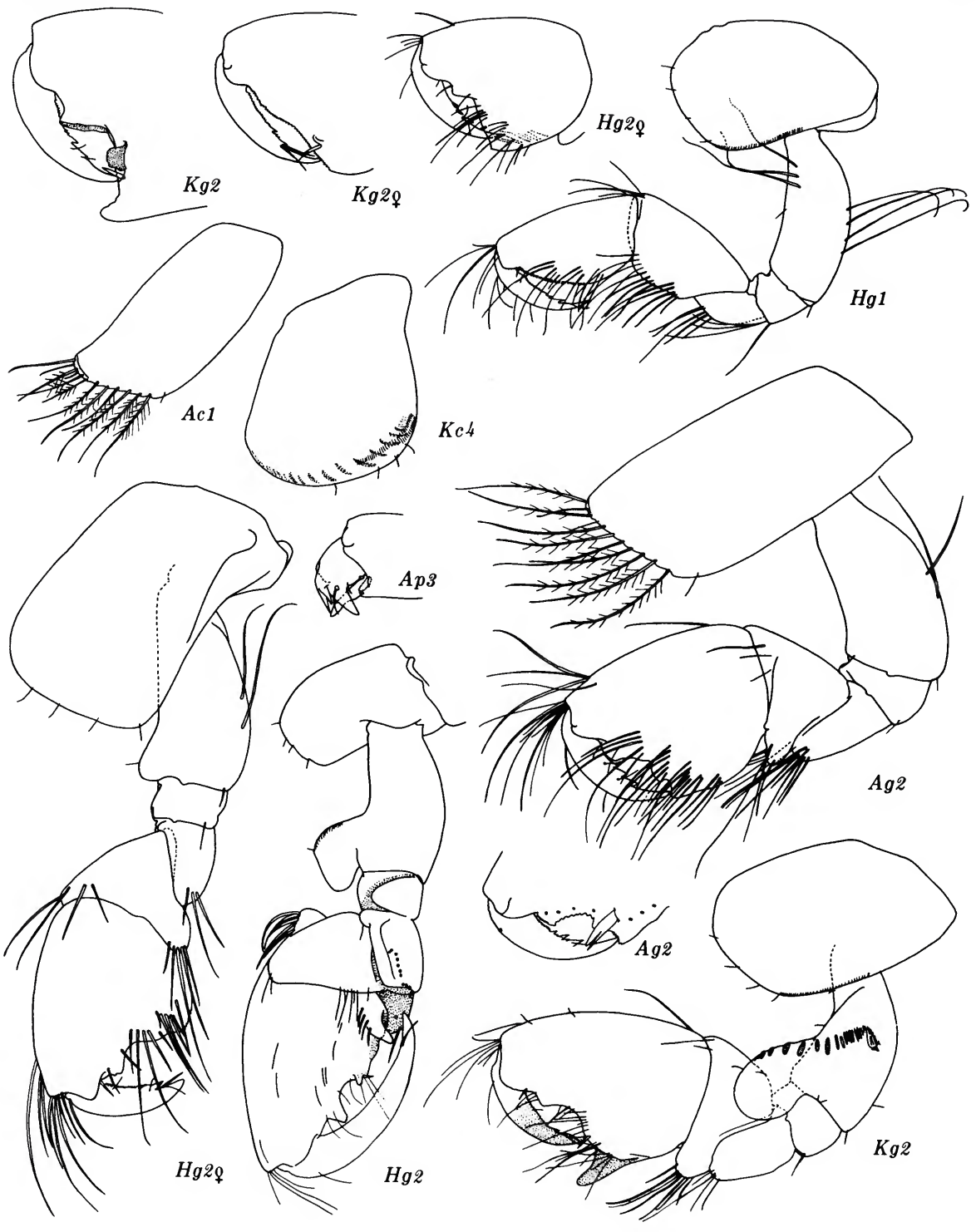


FIGURE 46.—Isaeidae, *Photis:* A, *Photis aina* J. L. Barnard; H, *P. hawaiensis* J. L. Barnard; K, *P. kapapa* J. L. Barnard.

FIGURE 47.—Isaeidae, *Photis:* A, *Photis aina* J. L. Barnard; H, *P. hawaiensis* J. L. Barnard; K, *P. kapapa* J. L. Barnard.


Kg2
Kg2♀
Hg2♀
Hg1
Ac1
Kc4
Ap3
Ag2
Ag2
Hg2♀
Hg2
Kg2

Key to Hawaiian Species of Genus *Photis* Krøyer

Figure Numbers Referenced in Italics

1. Eyes composed of relatively large ommatidia, many of them noncontiguous and few of them perfectly spherical, eyes horizontally ovate and filling ocular lobe and protruding into head proper, ocular lobe of medium length, eyes microscopically eosin in alcohol; uropods 1–2 with minute but distinct sharp deltoid tooth on peduncle between rami; telson sharply and evenly triangular in adult male (like *49Ptu3*), but softly triangular in other stages, in male with 2 sharp lateral cusps in place of normal nobs ..... ***P. hawaiensis***

   Eyes composed of tiny spherical ommatidia tightly packed into small horizontally ovate or circular eyes occupying only apex of long ocular lobes (*46Ah*), eyes black or clear in alcohol; uropods 1–2 lacking peduncular tooth between rami; telson softly triangular or irregular (with separate apex) and with nobs, unlike males of first half of couplet 2

2. Eyes black or brown in alcohol and formaldehyde, anterior coxae distally rounded weakly, essentially without setae except a few on coxa 1, inner ramus of uropod 3 about one-fourth as long as outer (*46Ktu3*) ..... ***P. kapapa***

   Eyes red or clear in alcohol and formaldehyde, anterior coxae long rectangles with numerous long ventral setae, inner ramus of uropod 3 about half as long as outer (*46Atu3*) .. ***P. aina***

Photis aina J. L. Barnard

Photis aina J. L. Barnard, 1970:185–191, figs. 121, 122.

Male gnathopod 2 small, article 2 lacking distal lobe, hand broad, palm slightly oblique, bisinuate, defined by quadrate corner, bearing weak hump near defining corner and one near base of dactyl, medioproximal face of palm with large spine, dactyl fitting palm in young male, much shorter in terminal male; female gnathopod 2 slightly smaller than in male, defining corner rounded, palm with 1 weak smooth sinus, otherwise crenulate.

Pereopod 3 very stout. Eyes clear in formaldehyde.

Oahu, 2–30 m, primarily in deeper end of depth range.

Photis hawaiensis J. L. Barnard

Photis hawaiensis J. L. Barnard, 1955:35–37, figs. 18, 19; 1970:191–192, fig. 123.

Male gnathopod 2 grotesque: article 2 bearing immense anterolateral mammilliform lobe armed with stridulation ridges, article 3 with lobe projecting medially, article 4 strongly setose medially, article 5 with large, heavily setose anterior keel-lobe, posteriorly with large lobe partially hiding base of hand, latter tapering distally, occupied by palm posteriorly, palm defined by proximomedial tooth and small medial excavation, dactyl equalling palm; female gnathopod 2 with oblique palm, tooth and slight excavation, defined by quadrate corner, hand expanded.

Pereopod 3 about normal for genus, slightly stoutened, bearing only 1 accessory cusp on dactyl.

Male coxae 3–4 with ventral stridulation ridges, coxae 1–2 lacking ridges, all coxae scarcely setose.

Inner ramus of uropod 3 very short, less than one-fourth as long as outer ramus. Eyes pale eosin or clear in formaldehyde.

Oahu, Kaneohe Bay, shallow water.

Photis kapapa J. L. Barnard

Photis kapapa J. L. Barnard, 1970:192–195, figs. 124, 125.

Male gnathopod 2 small, article 2 with anterodistal mammilliform lobe bearing stridulation ridges, article 4 not produced posterodistally, article 5 of medium breadth, cup-shaped, with tumid posterior lobe, hand expanded, palm slightly oblique, defined by large blunt tooth, palm weakly bisinuate, with small obtuse cusp near dactylar base, medial spine on low hump and medial quadrate process anterior to spine, young male with weaker defining cusp, dactyl fitting palm in juvenile, becoming progressively shorter in terminal male; female gnathopod 2 palm variable, slightly oblique, s-shaped and fully crenulate or with semicircular smooth excavation in middle, dactyl fitting palm or much shorter, palm defined by softly rounded quadrate corner.

Pereopod 3 normal for genus.

Male coxae 1–2 with weak posterior stridulation ridges, 4 with complex of medial and lateral ventral ridges, 3 with weak ventral stridulation ridges. Eyes black in formaldehyde.

Oahu, 2–30 m.

Family ISCHYROCERIDAE

FIGURES 48–50

See Isaeidae (page 88) for an introduction to this family. Ischyroceridae are part of the isaeid tubicolous complex and are difficult to distinguish from Isaeidae without clear microscopic resolution of the apical hook or apicolateral denticles on the outer ramus of uropod 3. *Jassa* and *Ischyrocerus* are relatively easy to recognize because the peduncle of uropod 3 is elongate and the rami short; isaeids usually have the peduncle short and the rami elongate. Occasionally ischyrocerids lose uropod 3 after death. *Parajassa* and *Ventojassa* have the peduncle of uropod 3 less elongate than the other genera and one must observe the very minute apical uncinus on the outer ramus of uropod 3. Often the oil immersion adaptation of the microscope must be used. But *Parajassa angularis,* the only Hawaiian member of the genus, has long plumose setae on the lateral margins of the peduncles of uropods 1–2, a character unique to that species and the biancolinid *Biancolina mauhina.* One must not confuse misdirected setae of the pleopods for uropodal setae. Adults of *Ventojassa ventosa,* the only Hawaiian member of the genus, have characteristic outer rami on uropod 3, seen even with low power microscopy. The outer ramus forms a digit with 1–3 short, stout, wirelike marginal setae (*49 Vu3or*). All isaeids have either stout lateral spines or thin terminal setae on the outer ramus of uropod 3.

Ventojassa and *Parajassa* form a pair of "mimics" often co-occurring with relatively similar color patterns (fading in alcohol) but *Ventojassa* has pink antennae and *Parajassa* has clear antennae reflecting the brownish purple of the body. A species of *Lembos* also has pink antennae but can be distinguished by the enlarged gnathopod 1. Shapes of ocular lobes differ between *Parajassa* and *Ventojassa;* and *Parapassa* has short antennal flagella, very stout article 2 on pereopods 1–2 and numerous plumose setae on the anterior margin of article 2 on pereopod 3. Sexes in both species are similar to each other. Even gnathopod 2 is relatively similar between the sexes of both species.

The almost ubiquitous *Jassa falcata* (Montagu) has not yet been found in the Hawaiian Islands. It differs from *J. lilipuna* and other Hawaiian ischyrocerids in the presence of an articulate but partially immersed apical hook on the outer ramus of uropod 3 besides the 2 or 3 apicolateral, reverted, large, asymmetrical sharp cusps, all of these features being visible under medium power compound microscopy. Males and females of *J. falcata* have a variety of shapes in gnathopod 2 as the species is of extreme multiform character (Sexton and Reid, 1951).

Jassa lilipuna, Ischyrocerus kapu, and *I. oahu* are small bodied species (1–3 mm), with superficial similarities, the heads with sharp but not acute cephalic lobes and circular to subcircular eyes with clear peripheral ommatidia and brown cores; the antennal pairs are subequal in length, moderately short and stout, the accessory flagellum being grossly visible, a thick 2-articulate piece usually standing erect from antenna 1 on article 3.

Key to Hawaiian Species of Ischyroceridae

Figure Numbers Referenced in Italics

1. Accessory flagellum a small tubercle on article 3 of antenna 1, not usually visible macroscopically, uropods 1–2 with long peduncular setae (*49Pur*) ..... ***Parajassa***
   Accessory flagellum 2–3 articulate and elongate, often thick (*50Jaf*), uropods 1–2 without peduncular setae (*49Jur*) 2
2. Outer ramus of uropod 3 armed with 1–2 (or 3) stiff lateromarginal setae besides distal nail or hook (*49Vu3or*) ..... ***Ventojassa***
   Outer ramus of uropod 3 lacking gross spines or setae, with slightly hooked apex and bearing (including apical hook) 1–12 large or small apicolateral denticles, cusps or villi (*49Pu3or, Ju3, Ou3*) 3
3. Eyes lacking black-brown pigment in alcohol, bleaching to rusty-orange .... ***Ischyrocerus*** sp. C
   Eyes retaining black-brown pigment cores in alcohol 4
4. Gnathopod 2 of male (female unknown) with long spike-like article 4 (*50Kg2*). ***Ischyrocerus kapu***
   Gnathopod 2 with unproduced article 4 5

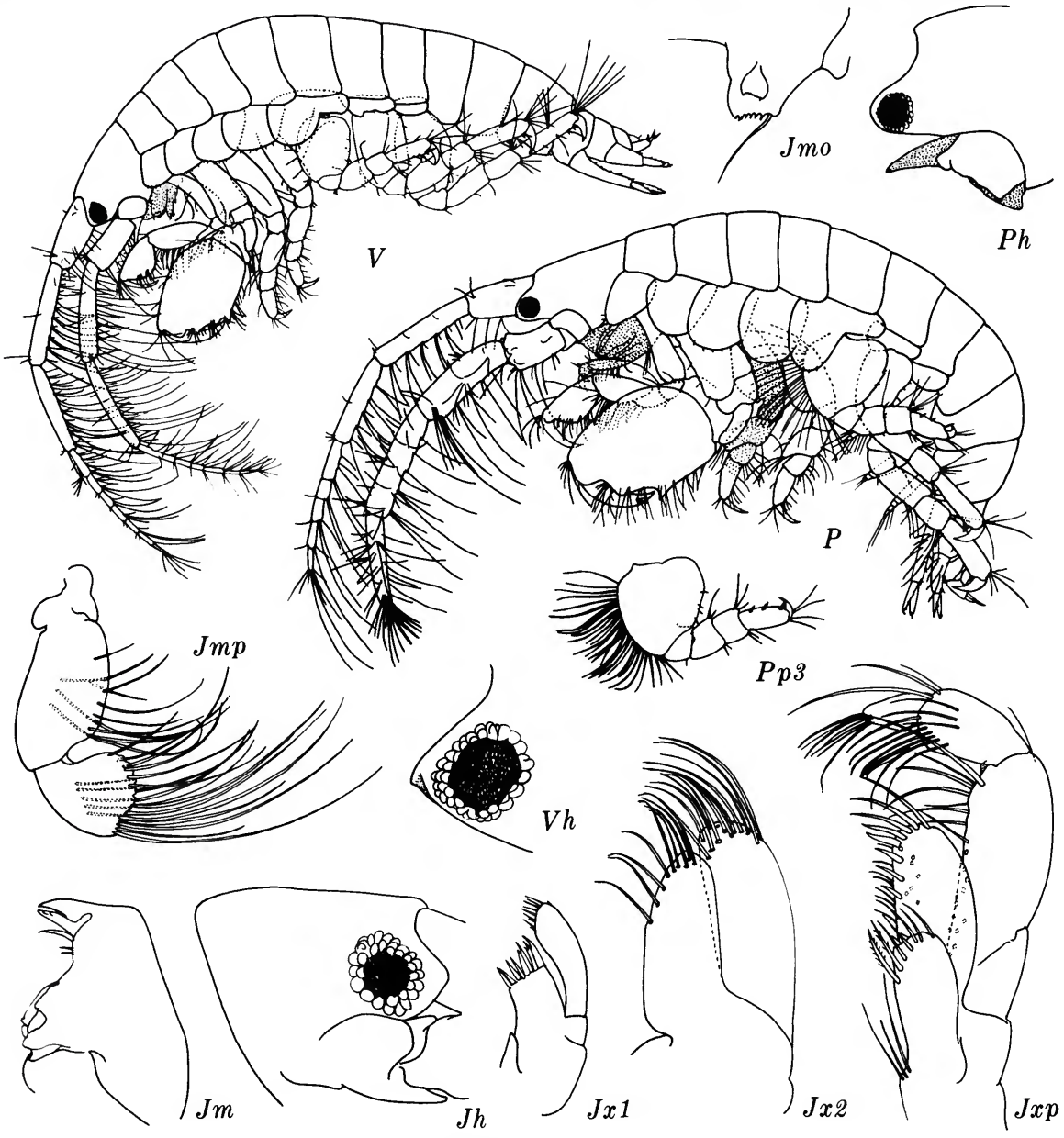


FIGURE 48.—Ischyroceridae: J, *Jassa lilipuna* J. L. Barnard; P, *Parajassa angularis* Shoemaker; V, *Ventojassa ventosa* (J. L. Barnard).

5. Article 6 of pereopods 1–2 short and stout, male gnathopod 2 article 5 shielded from posterior margin by articles 4 and 6 (*50Jg2*), outer ramus of uropod 3 with 2–4 large cusps (*49Ju3*), coxae 3–4 longer than broad, article 2 of pereopods 3–5 broad, posteroventrally lobate on pereopods 3–4 ..... ***Jassa liliputa***

Article 6 of pereopods 1–2 long and moderately slender (*50 Op1*), male gnathopod 2 article 5 not shielded from posterior margin and bearing blunt lobe (*50 Og2*), outer ramus of uropod 3 with 4–7 small cusps (seen only under oil-immersion lens) (*49 Ou3*), 3–4 as broad as or broader than long, article 2 of pereopods 3–5 narrow and not lobate posteroventrally. ***Ischyrocerus oahu***

Ischyrocerus (*?*) *kapu* J. L. Barnard

Ischyrocerus (?) *kapu* J. L. Barnard, 1970:195, fig. 126.

Only the male is known so far and it is unique in the world family for the large spikelike projection on article 4 that seems to serve in place of a proximal palmar tooth on gnathopod 2. The palm of gnathopod 2 has 2 distal processes, and extends the full length of article 6; the dactyl is long. The coxae are very short. The outer ramus of uropod 3 is shorter than the inner and bears a row of about a dozen tiny apicolateral denticles appearing as villi. Eyes rusty purple in alcohol.

Oahu, 2–30 m, rare.

Ischyrocerus oahu J. L. Barnard

Ischyrocerus oahu J. L. Barnard, 1970:195–198, fig. 127.

The terminal male gnathopod 2 is very large, article 6 elongate and slender, the posterior margin slightly concave and moderately setose marginally and submarginally, distally the palm bearing a weak bilobation, dactyl as long as article 6 and inner basal margin bisinuate to fit palmar process, article 5 with posterior margin reaching free space and bearing blunt lobe (in contrast to *I. kapu* and *Jassa liliputa*), young male with shorter dactyl and stouter article 6; pereopods 1–2 with long article 6 (in contrast to *J. liliputa*) and bearing locking spines (in contrast to *I. kapu*); outer ramus of uropod 3 slightly shorter than inner ramus and often projecting laterally so as to appear even more shortened, bearing 4–7 long, apicolateral denticles. Eyes rusty purple in alcohol.

Oahu, 0–2 m.

Ischyrocerus sp. C

General appearance, uropod 3 and coxae like *I. oahu* but eyes lacking any dark pigment in alcohol, rusty-orange.

S. Oahu, 30 m.

Jassa (*?*) *liliputa* J. L. Barnard

Jassa (?) *liliputa* J. L. Barnard, 1970:198–202, figs. 128–130.

Male gnathopod 2 is large and undergoes numerous changes during maturation. Coxa 1 is slightly shorter than coxa 2 but this is difficult to see without dissection and mounting of parts. Uropod 3 is diagnostic; the outer ramus is slightly curved distally and bears 2–3 medium-sized cusps. The species of *Ischyrocerus* have extremely minute denticles.

Article 6 of pereopods 1–2 is short in *J. liliputa* whereas it is long in the other 2 species. Eyes clear in alcohol or retaining rusty pink core under high magnification.

Oahu, Waikiki, intertidal, on *Sargassum, Ulva,* and *Padina.*

Parajassa angularis Shoemaker

Parajassa angularis Shoemaker, 1942:41–44, figs. 14, 15.—J. L. Barnard, 1962:58, figs. 26, 27; 1970:202–204, figs. 131, 132.

The outer ramus of uropod 3 of Hawaiian individuals has 2 non-articulate hooks and 2 minute apical setules (use oil immersion lens). The peduncular setae on uropods 1–2 are diagnostic. Eyes black.

A warm-temperate Californian species. S. Oahu, 2–30 m.

Ventojassa ventosa J. L. Barnard

Eurystheus ventosa J. L. Barnard, 1962:20–22, figs. 6, 7.
Ventojassa ventosa J. L. Barnard, 1970:204–205, figs. 133, 134.

The outer ramus on uropod 3 of Hawaiian individuals has a slightly hooked apex with 2-3 partially immersed setules and 1–3 stiff, wirelike lateromarginal setae visible under low-medium power on slide 2. They are diagnostic. Eyes brown-black in formaldehyde.

A warm-temperate Californian species. Oahu, 4–33 m.

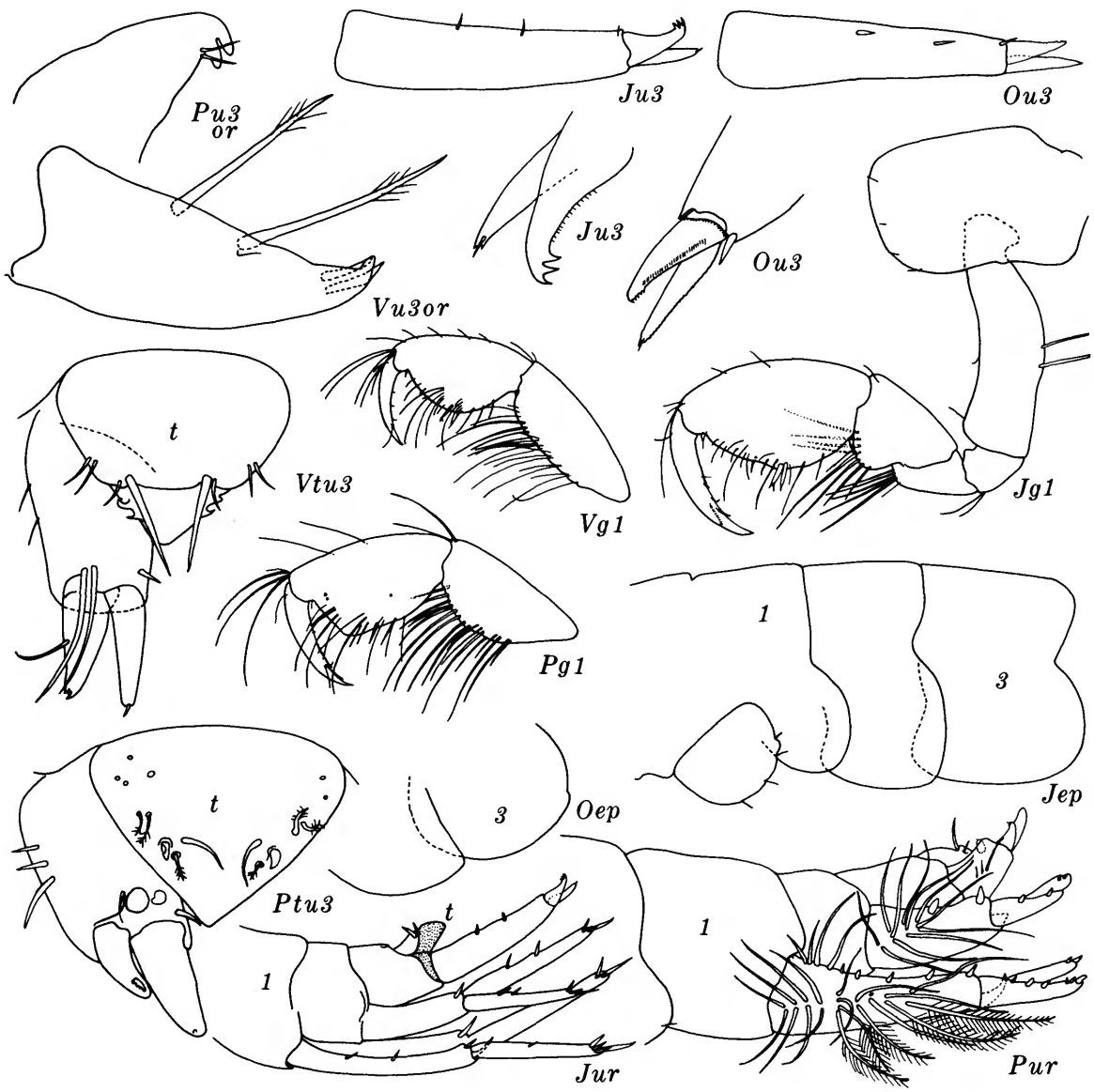
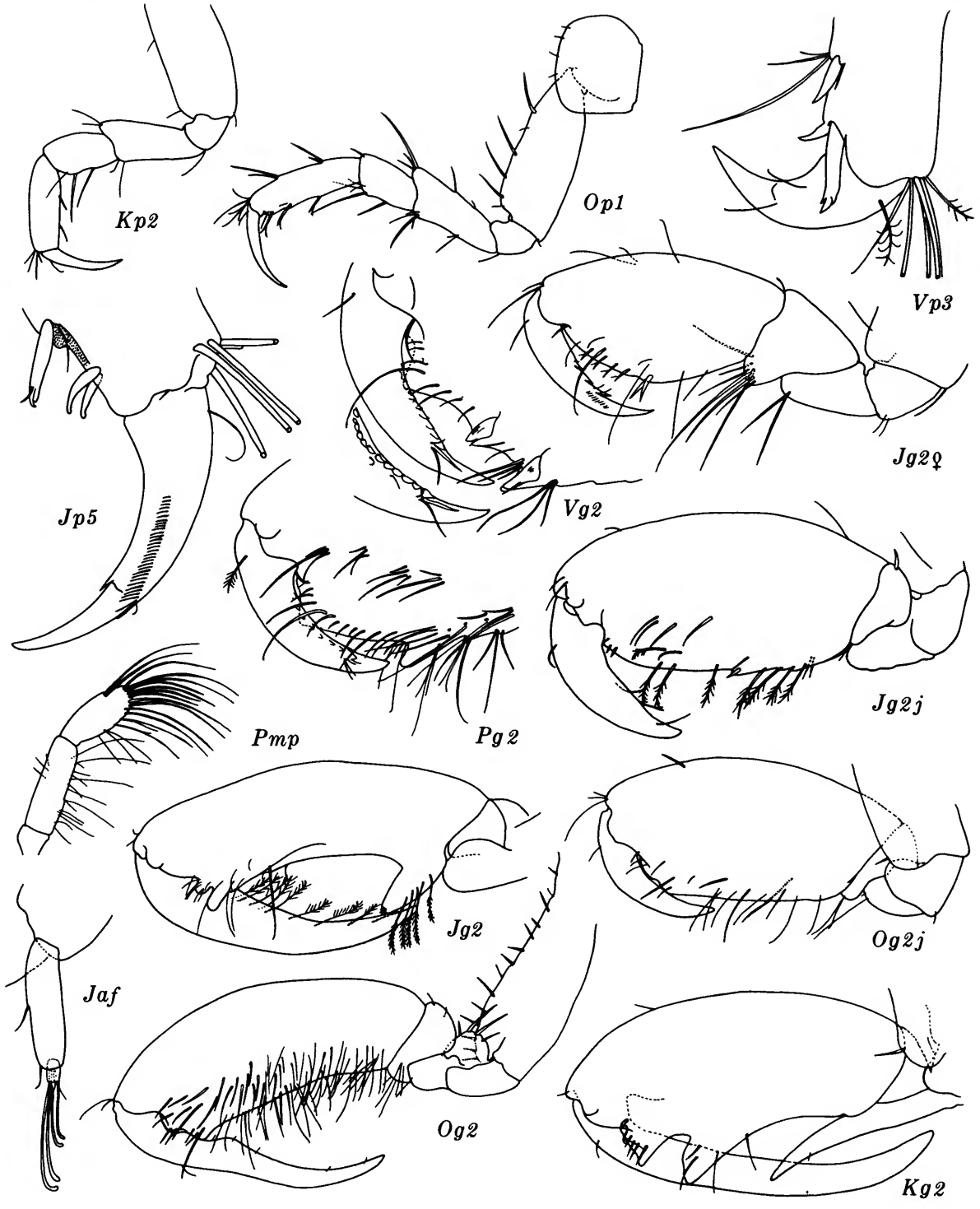


FIGURE 49.—Ischyroceridae: J, *Jassa (?)lilipuna* J. L. Barnard; O, *Ischyrocerus oahu* J. L. Barnard; P, *Parajassa angularis* Shoemaker; V, *Ventojassa ventosa* (J. L. Barnard).

FIGURE 50.—Ischyroceridae: J, *Jassa lilipuna* J. L. Barnard; K, *Ischyrocerus kapu* J. L. Barnard; O, *Ischyrocerus oahu* J. L. Barnard; P, *Parajassa angularis* Shoemaker; V, *Ventojassa ventosa* (J. L. Barnard).


Kp2
Op1
Vp3
Jp5
Vg2
Jg2♀
Pmp
Pg2
Jg2j
Jg2
Og2j
Jaf
Og2
Kg2

Family LEUCOTHOIDAE (cf. Anamixidae)

FIGURES 14 (part), 15 (part)

Leucothoids have a characteristic and unmistakeable gnathopod 1 like the Anamixidae (*14Lg1*), with strong carpochelation and narrow article 6. They have ordinary mandibles and maxillae, whereas anamixids have these replaced by a ventral keel. Leucothoid mandibles are flabellate, lack molars, and have weak palps. The Hawaiian anamixid has a characteristic gnathopod 2, whereas leucothoids have 2 kinds of gnathopod 2 (*15Lg2* and *Pg2*). These animals are small (1–3 mm), shiny, usually pure white or with red vertical bands at body segment junctions and with red eyes; but some phenotypes of *Anamixis* have red vertical bands in the middle parts of the segments.

Uropod 3 is elongate, with the peduncle equalling the two rami, but the appendage often falls off during preservation. Uropod 2 is shortened. *Leucothoe* has large and visible coxa 1 but *Leucothoides* has a small coxa 1 like the Amphilochidae and may be distinguished from the latter by the characteristic gnathopod 1.

Leucothoids appear to be associated as inquilines with sessile invertebrates; some non-Hawaiian species are known to live in the branchial cavities of ascidians.

Key to Genera of Leucothoidae

Figure Numbers Referenced in Italics

1. Coxa 1 small and partially covered by enlarged coxa 2; gnathopod 2 characteristic (*15Pg2*), palm distinct, scarcely oblique, slightly concave, palp of mandible 1-articulate.
Leucothoides Shoemaker

   Coxa 1 as large as coxa 2 and visible, gnathopod 2 characteristic (*15Hg2*), very large, article 6 ovate, palm and posterior margin of article 6 confluent, mandibular palp 3-articulate.....2
2. Coxa 1 beveled and/or smooth anteroventrally, coxae 2 and 4 rounded anteroventrally.
Leucothoe Leach

   Coxa 1 sharply serrate and pointed anteroventrally, coxae 2 and 4 pointed anteroventrally.
Leucothoella* Schellenberg

Key to Hawaiian Species of *Leucothoe* Leach

Figure Numbers Referenced in Italics

1. Gnathopod 1 short and stout, dactyl very short (*14Lg1*), article 6 only 130 percent as long as anterior margin of article 5.....***L. lihue***

   Gnathopod 1 long, slender, dactyl long (*14Hg1*), article 6 about 190 percent as long as anterior margin of article 5.....2
2. Lateral cephalic lobe with sharp anterior cusp (*14Th*), coxa 4 short and not excavate posteriorly, article 2 of pereopods 3–5 evenly ovate (*15Tp5*), pleonal epimeron 2 rounded-quadrate posteroventrally or scarcely protuberant, uropod 2 extending only three fourths along peduncle of uropod 3, anterior cephalic keel between antennae sharply pointed (not to be confused with epistome).....***L. tridens***

   Lateral cephalic lobe evenly and broadly rounded (*14Hh*), coxa 4 long and deeply excavate posterodorsally, article 2 of pereopods 3–5 broadened and especially broadly beveled on pereopod 5 (*15Lp5*), pleonal epimeron 2 with large posteroventral tooth, uropod 2 extending to end of peduncle of uropod 3, anterior cephalic keel between antennae rounded.
L. hyhelia

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* *Leucothoella* is a widely distributed Indo-Pacific genus that may be discovered in Hawaii.

Leucothoe hyhelia J. L. Barnard

Leucothoe hyhelia J. L. Barnard, 1965:489–490, fig. 5; 1970:205–209, fig. 135.

Two phenotypes appear to occur in Hawaii; the typical member has a rounded quadrate posteroventral corner on epimeron 2 and the atypical member has that corner slightly protuberant. Gnathopods 1–2 of this species and *L. tridens* are identical. The telson is scarcely trilobate apically.

Micronesia to Hawaii, Oahu, widely distributed from intertidal zones to depths of 30 m.

Leucothoe lihue J. L. Barnard

Leucothoe lihue J. L. Barnard, 1970:209–211, fig. 136.

This species superficially resemble *L. hyhelia* in terms of coxae, antenna 1, epimera, and pereopods 3–5 (see description of *L. hyhelia* in couplet 2); but article 2 of pereopod 5 is weakly concave on the obliquely beveled posteroventral margin. The head weakly resembles that of *L. tridens* but the cephalic lobe is obtusely angular, not sharp. Gnathopod 2 is characteristically broadened in the middle of article 6 (in males) and article 5 has a villus-like apical protrusion on the long lobe. The telson resembles that of *L. tridens*.

Oahu, off Moku Manu Island, 33 m, on base of black coral in mollusk association.

Leucothoe tridens Stebbing

Leucothoe tridens Stebbing, 1888:777–779, pl. 47.—Schellenberg, 1938:21–23, fig. 11.—J. L. Barnard, 1970:211, fig. 137.

The telson has a weak trilobation apically. See key and discussions with other species of the genus.

Tropical Pacific Ocean. Oahu, 2–30 m.

Genus *Leucothoides* Shoemaker

Leucothoides ?pottsi Shoemaker

?Leucothoides pottsi Shoemaker, 1933a:249–250, fig. 3.—Schellenberg, 1938:26–28, fig. 13; J. L. Barnard, 1970: 211–213, fig. 138.

This genus is easily recognizable by the small coxa 1 and the relatively small gnathopod 2, with short article 6 and subtransverse, concave palm with conical ornaments.

Pan-American. Oahu, 0–30 m.

Family LILJEBORGIIDAE

FIGURE 51

The two Hawaiian species of this family may be distinguished from other gammarideans by a combination of characters: the thick antenna 1 (*51H*) with a very stout and well developed primary and secondary flagella; the presence of a tiny dorsal point on pleonites 1–2 (microscopically composed of 3 points each); thin or stout but characteristically shaped uropod 3 (*51Hu3*), large black eyes; and large gnathopods 1–2 (*51H* and *Hg2*), these being similar to each other and bearing long carpal processes like those of gnathopod 2 in leucothoids. But the palms of *Liljeborgia* have a complex 2 or 3 cycles of densely crowded, short, medium and long spines or setae, one cycle of spines often being composed of hooks. See *Eusiroides* in the Eusiridae (page 66), and *Parapleustes* in the Pleustidae (page 112).

Key to Hawaiian Species of Genus *Liljeborgia* Bate

Figure Numbers Referenced in Italics

Pereopods 1–2 with minute palms on article 6 and several stout distal spines (*51H*), dactyls of gnathopods not flagellate, uropod 3 of medium stoutness, pleonal epimeron 3 with a simple posteroventral tooth (*51H*), mandibular spine row with numerous long articulate spines, palp article 3 of mandible shorter than article 1 ..... ***L. hesia***

Pereopods 1–2 simple and article 6 with numerous short posterodistal setae (*51Lp1*), dactyls of gnathopods flagellate (*51Lg1*), uropod 3 slender, pleonal epimeron 3 with small sinus above posteroventral tooth (*51Lep3*), mandibular spine row with only 3 tiny sharp inarticulate serrations (*51Lm*), mandibular palp article 3 slightly longer than article 1 ..... ***L. laniloa***

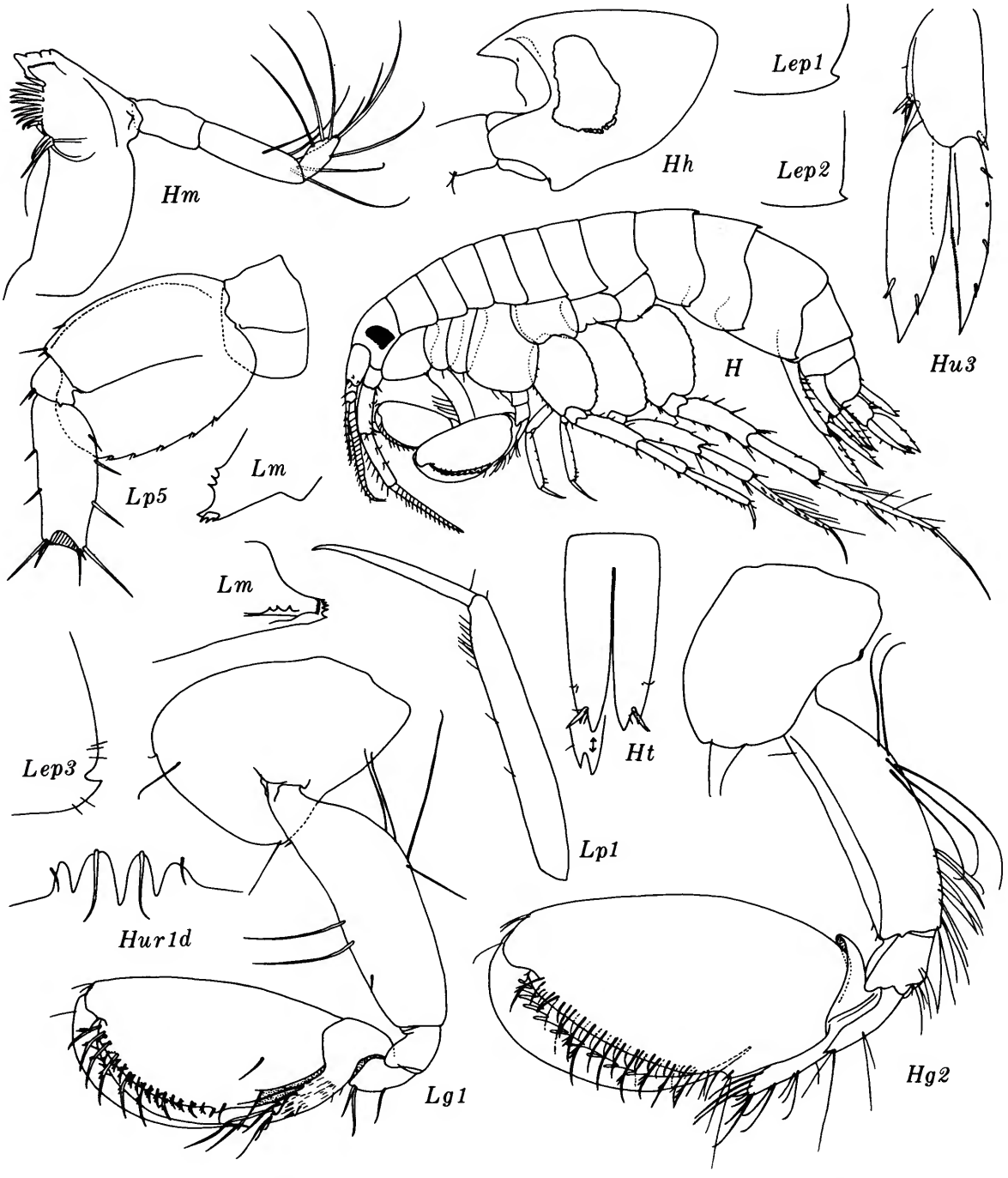

FIGURE 51.—Liljeborgiidae: H, *Liljeborgia heeia* J. L. Barnard; L, *L. laniloa* J. L. Barnard.

Liljeborgia heeia J. L. Barnard

Liljeborgia heeia J. L. Barnard, 1970: 213–216, figs. 139, 140.

This species may be recognized without dissection by observing on slide 2 the minute palms of pereopods 1–2.

Oahu, 2–30 m.

Liljeborgia laniloa J. L. Barnard

Liljeborgia laniloa J. L. Barnard, 1970: 216, fig. 141.

The pereopods of this species are normal and like most species of *Liljeborgia* in other seas; hence to guarantee a solid identification, in the event other undiscovered liljeborgias occur in Hawaii, one must confirm the identification by observing the other characters mentioned in the key.

Intertidal, northeast Oahu, living on coral block covered with ascidians.

Family LYSIANASSIDAE

This family has been inadequately collected in Hawaii and should yield several more than the one species now known. The mitten-shaped article 6 of gnathopod 2, the presence of dense brushes of short stiff setae on articles 5–6, the frequent occurrence of a "pineapple texture" (term invented by the Russian Gurjanova) on article 5, and the elongate article 3 of gnathopod 2 are unmistakeable characters of this family. Antenna 1 is short and stout and usually has a large accessory flagellum; articles 2–3 of the peduncle are very short and partially telescoped. The body is plain, heavy, hard and shiny. Mouthparts and uropod 3 are highly diverse as numerous species are ectoparasites.

Genus *Lysianassa* Milne Edwards

Lysianassa ewa J. L. Barnard

FIGURE 52

Lysianassa ewa J. L. Barnard, 1970: 216–220, figs. 142, 143.

A short diagnosis will serve to distinguish at least this this genus from others expected: accessory flagellum 2–3 articulate; upper lip produced as vertical, rounded lamella (seen from lateral view); mandibular palp attached proximal to weak spiny or setulose molar; maxillae and maxillipeds normally gammaridean but inner plate of maxilla 1 non-setose on medial edge; coxa 1 as large as coxa 2; gnathopod 1 simple but slightly stoutened; inner ramus of uropod 2 with deep notch; uropod 3 biramous and inner ramus usually well developed, but peduncle of *L. ewa* expanded into a laterally flat plate, rami short and uniarticulate; telson entire or weakly excavate; pereopods simple. Eyes are brown in formaldehyde and spirit.

Oahu, 4–18 m.

Family OCHLESIDAE

Genus *Ochlesis* Stebbing

Ochlesis alii J. L. Barnard

FIGURE 53

Ochlesis alii J. L. Barnard, 1970: 220–223, figs. 144, 145.

Unmistakeably recognized by its general body plan and coxae (see figure), this monogeneric family has affinities with Acanthonotozomatidae, in which some of the coxae are distinctly pointed. Possibly members of the latter family occur in Hawaii but have not been found; they may occur as ectoparasites on sessile invertebrates or motile crustaceans. *Ochlesis* also is probably such an ectoparasite but its host has not been determined. Its mouthparts are of the piercing and sucking kind and the maxillipedal palps are absent, the only known shallow-water genus of its kind in the suborder. Eyes orange in formaldehyde.

Southern Oahu, 18 m, on *Pocillopora* reef. Rare.

Family OEDICEROTIDAE

Genus *Kanaloa* J. L. Barnard

Kanaloa manoa J. L. Barnard

FIGURE 54

Kanaloa manoa J. L. Barnard, 1970: 224–226, figs. 146, 147.

Like all oedicerotids, *Kanaloa,* an endemic Hawaiian genus, differs from other Hawaiian gammarideans in the following combination of characters: (1) Uropod 3 peduncle elongate as in Leucothoidae, Amphilochidae; (2) Pereopod 5 much longer than pereopods 3–4;

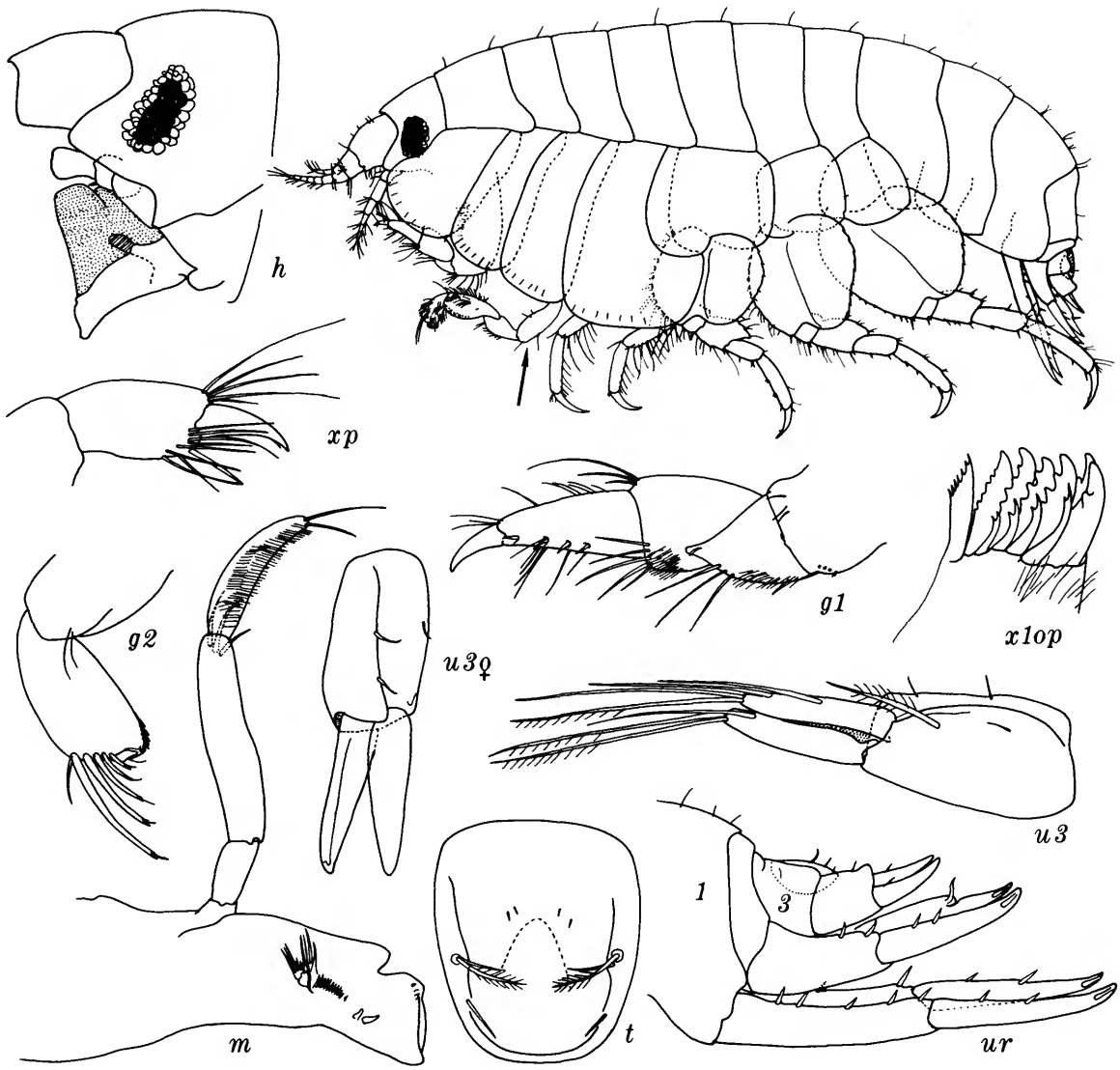

FIGURE 52.—Lysianassidae: *Lysianassa ewa* J. L. Barnard.

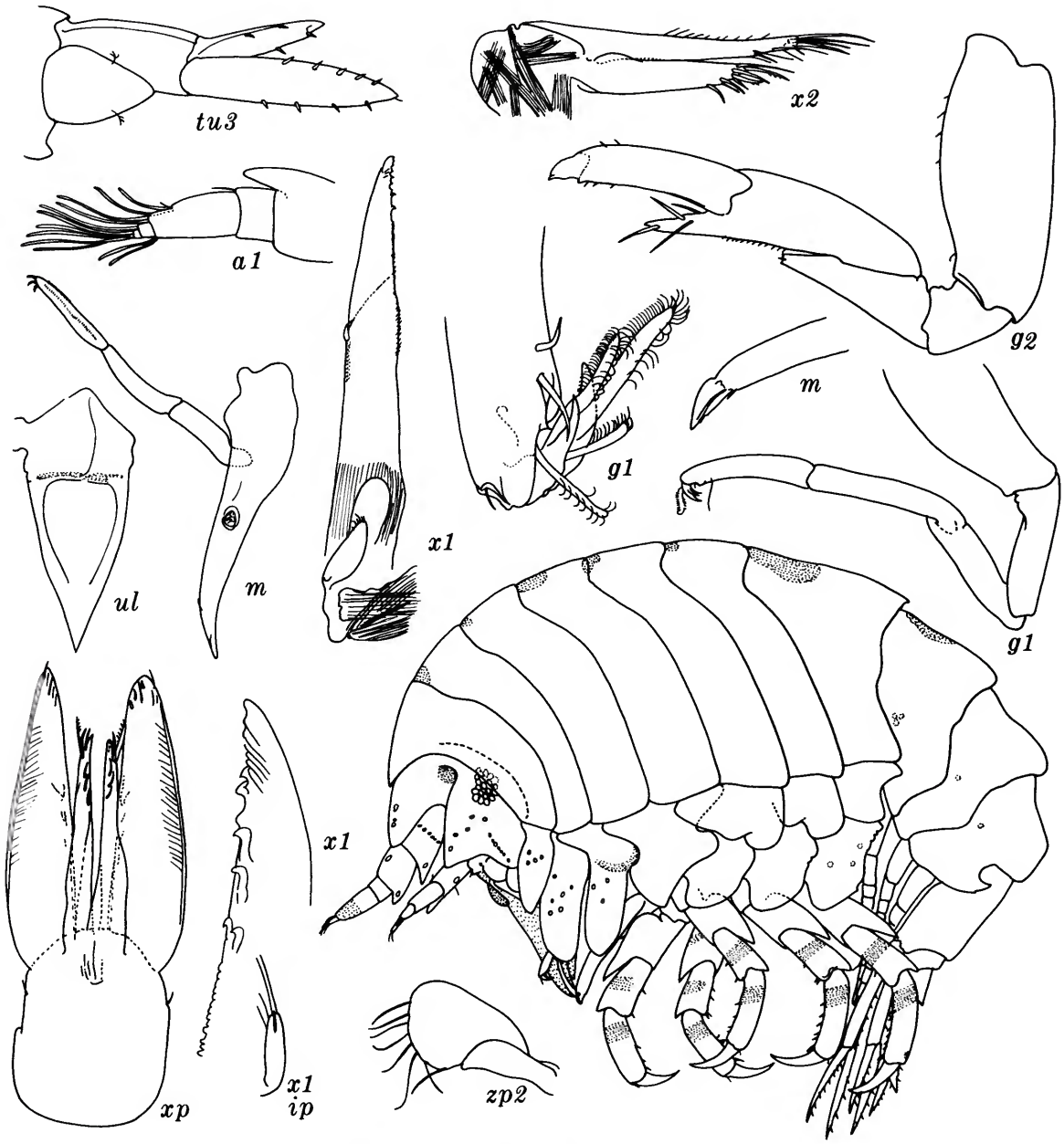

FIGURE 53.—Ochlesidae: *Ochlesis alii* J. L. Barnard.

FIGURE 54.—Oedicerotidae: *Kanaloa manoa* J. L. Barnard.

(3) Head massive, nearly as long as pereonites 1–3 together, and often galeate (*54*, body); (4) Accessory flagellum absent (or extremely minute vestige present); (5) Eyes coalesced together or contiguously so close together as to appear coalesced from dorsal view.

Kanaloa has large yellow-orange eyes in formaldehyde, fading in spirit; an enlarged pereonite 7; and a characteristically spiny gnathopod 2 (*54g2*), both pairs of gnathopods being feeble. If the synopiid genus *Synopia* also occurs in Hawaii it could be confused with *Kanaloa*, but *Synopia* has a short peduncle of uropod 3 and bears a macroscopic accessory flagellum.

Oahu, (?2)–30 m. Affinitives are with antiboreal-antarctic genera.

Family PHLIANTIDAE

Genus *Palinnotus* Stebbing

Palinnotus alaniphlias J. L. Barnard

FIGURE 55

Palinnotus alaniphlias J. L. Barnard, 1970:226–227, figs. 148–150.

Adult phliantids are immediately recognized by the broad, rugose, dome-shaped or boat-shaped bodies resembling an abbreviated stegosaurid. The thorax is dominant and the small abdomen flexed beneath the thorax. The Hawaiian genus has only 2 urosomal segments visible dorsally; uropod 2 has only 1 ramus and the third uropods are a small pair of flaps adhering to the ventral surface of the telson, as if they were anal flaps. The rostrum is obsolescent, mandibles lack palps, maxilla 1 has a small palp and the maxilliped has only 3 palp articles. Gnathopods 1 and 2 are simple and resemble pereopods; the medial surface of gnathopod 1 has numerous prickles and asparagoid spines.

Juveniles may resemble eophliantids in the large head and semicylindrical bodies but the urosome remains diagnostic for *Palinnotus*.

Gut often filled with a black streak of presumed lignin material; phliantids probably feed on tough, almost woody stipes of algae. Body ochraceous-orange in formaldehyde, eyes black.

Oahu, intertidal, among algae.

Family PHOXOCEPHALIDAE

Presumably soft bottoms of Hawaii, when explored adequately, will yield more than the one species now known. Phoxocephalids have a visor-like rostrum, elongate pereopod 4, and short pereopod 5 with broad article 2; pereopod 3 and the antennae are strongly setose or spinose; eyes when present are ommatidial (rather than corneal as in Ampeliscidae) and are black. The near-related *Platyischnopus* of Haustoriidae has a rostrum like an ordinary shark nose and very elongate pereopods 4–5; this genus is also expected to occur in Hawaii. Both families are comprised of species forming burrows in soft sediment.

Genus *Paraphoxus* Sars

Paraphoxus centralis (Schellenberg)

FIGURE 5P

Pontharpinia centralis Schellenberg, 1938:15–17, fig. 8.

"Fern Island"; "Whale Island."

Family PLEUSTIDAE

Pleustidae, close to Liljeborgiidae and Eusiridae (= Calliopiidae), are non-tropical. Apparently these are the first tropical pleustids to be described. One is highly aberrant and easy to distinguish from *Liljeborgia* in the clear or red eyes lacking black pigment, the uncleft telson, the large rostrum, very small gnathopods with slender articles and obsolescent palms, and the absence of a large accessory flagellum. The other species is grossly distinguished only in the uncleft telson, the absence of strong teeth on the gnathopodal dactyls, the vestigial accessory flagellum, and the absence of the faint dorsal teeth on pleonites 1–2 seen in *Liljeborgia*.

The two Hawaiian pleustids resemble *Liljeborgia* also in the non-triturative molars. The lower lip of pleustids is formed of tilted oval outer lobes astride partially coalesced apically truncate inner lobes forming a broad gap between the outer lobes. This character differentiates pleustids from calliopiids but not distinctly from *Liljeborgia*, which has a weakly similar lower lip. The outer rami of pleustid uropods are shorter than the inner, either slightly or strongly, and they are usually strongly spinose like those of podocerids. The mandibular palp is large, with heavily developed spine-setae on a subclavate or subfalcate article 3.

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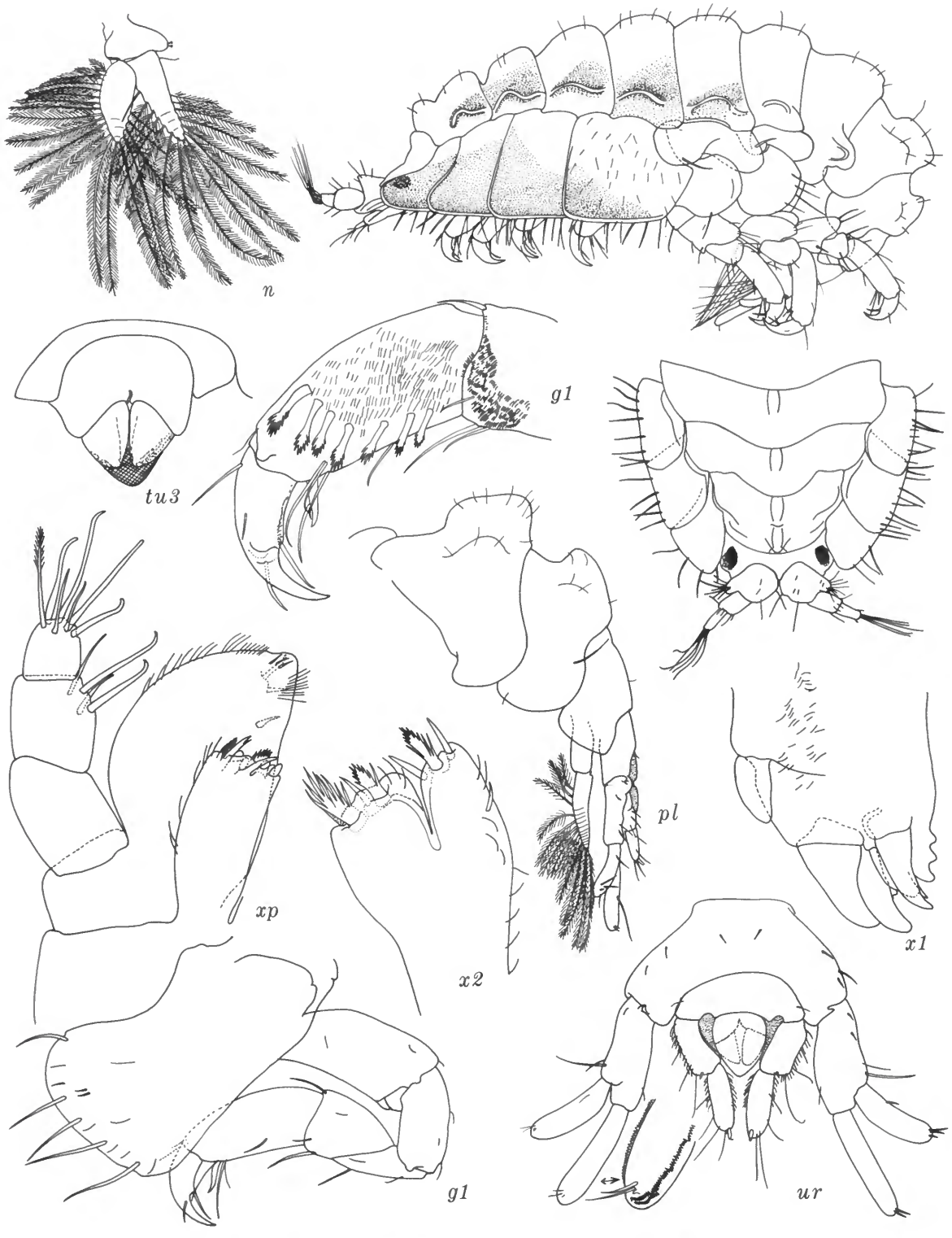


FIGURE 55.—Phliantidae: *Palinnotus alaniphlias* J. L. Barnard.

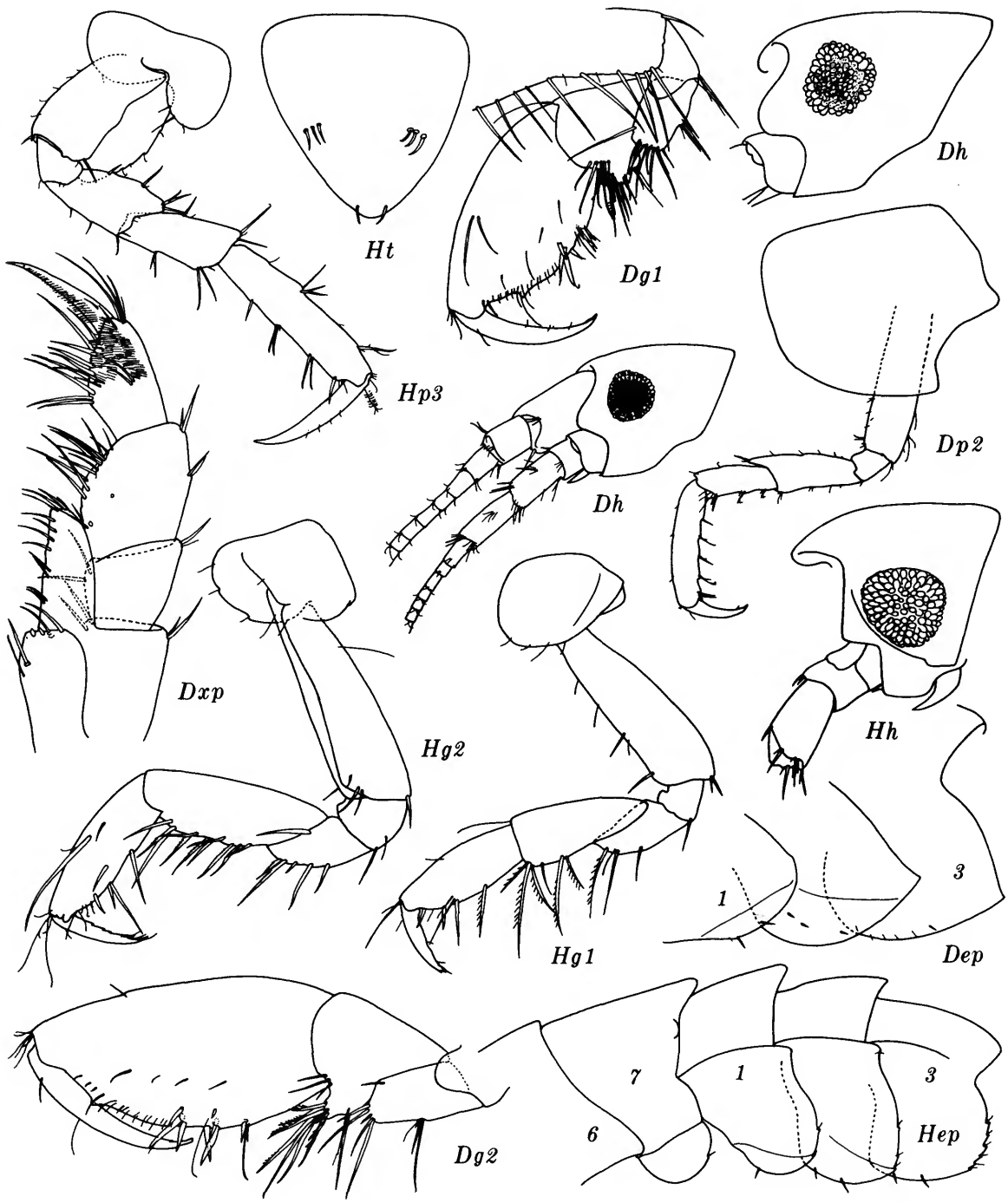


FIGURE 56.—Pleustidae: D, *Parapleustes derzhavini makiki* J. L. Barnard; H, *P. honomu* J. L. Barnard.

Genus *Parapleustes* Buchholz

FIGURES 56, 57

Parapleustes derzhavini makiki J. L. Barnard

Parapleustes derzhavini makiki J. L. Barnard, 1970:227–230, figs. 151, 152.

The maxillipedal palp is normally 4-articulate, article 4 being long and unguiform; pereonites and pleonites lack dorsal carinae or teeth; pleonal epimera 1–3 with convex posterior margins, 1–2 with lateral ridge, 1 and 3 with small posteroventral cusp, 2 with longer sharply extended tooth, ventral margins of 1 and 3 spinose and ventrolateral face of 2 spinose; pereopods 1–5 of normal stoutness, gnathopods 1–2 of medium size and similar to each other, article 2 of gnathopod 1 strongly setose anteriorly (setae very large but few in number), article 4 of gnathopod 2 with sharp posterodistal process (seen only under high power), fifth articles shorter than sixth, posteriorly lobate, sixth articles expanded but not as strongly as in *Liljeborgia*, palms defined by group of spines and bearing another palmar spine set and a small cusp in the middle, but dactyls not deeply serrate; eyes formed of dark brownish purple cores surrounded by clear ommatidia.

Oahu, 3–4 m.

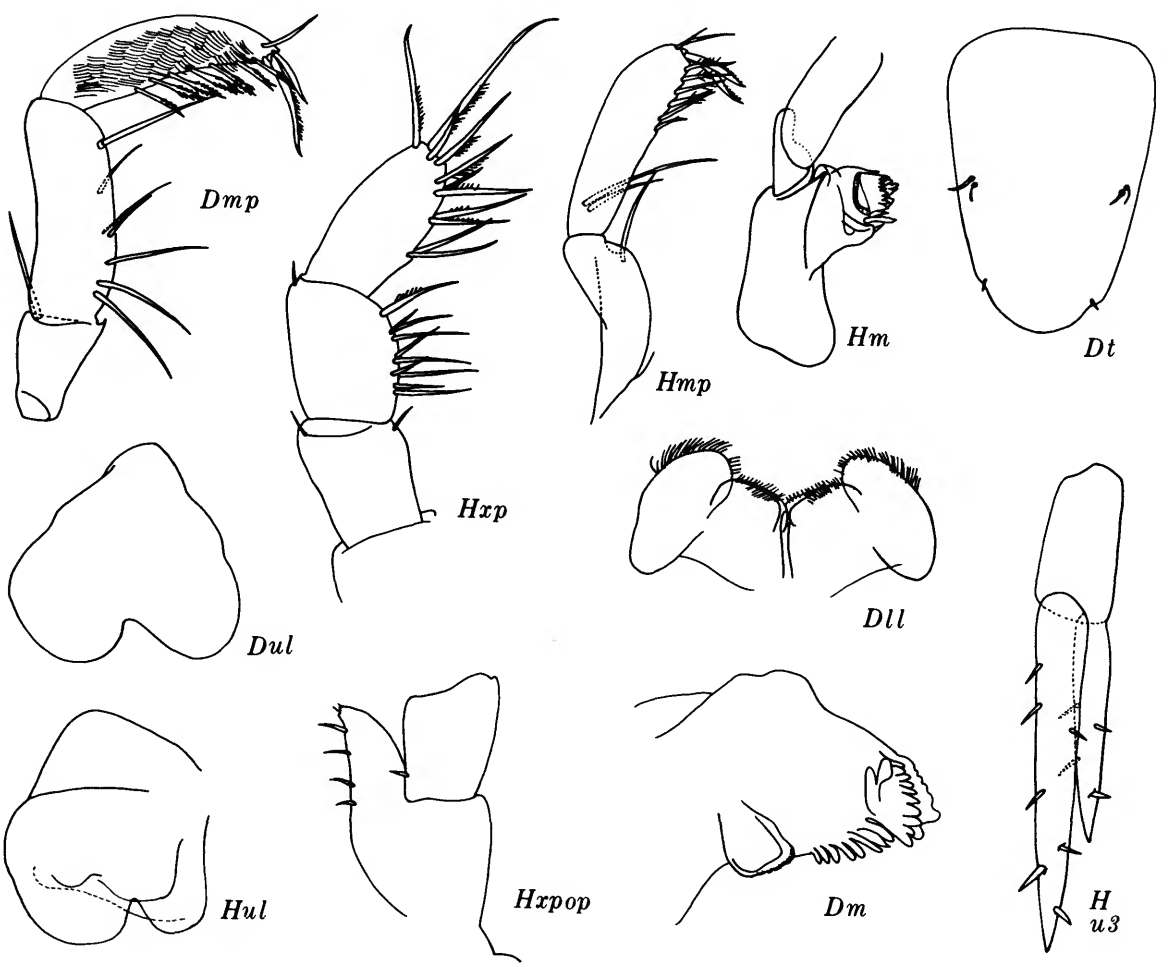


FIGURE 57.—Pleustidae: D, *Parapleustes derzhavini makiki* J. L. Barnard; H, *Parapleustes* (*?*) *honomu* J. L. Barnard.

Parapleustes (?) *honomu* J. L. Barnard

Parapleustes (?) *honomu* J. L. Barnard, 1970:233, figs. 153, 154.

The maxillipedal palp lacks a fourth article, heretofore not characteristic of pleustids; pleonites 1–2 have strong dorsolateral carinae in addition to the dorsal humps that are found also on pereonites 6–7, pleonite 3 with weak partial lateral carina and no dorsal hump, epimeron 3 serrate posteriorly; pereopods 1–5 very robust; antennae unknown but presumably typical of other pleustids: eyes clear in spirit.

Oahu, off Moku Manu Island, 33 m, on base of black coral in mollusk association.

Family PODOCERIDAE

FIGURES 58–60

Podocerids have the normal mouthparts of the basic isaeid plus the fleshy telson, but the pereopods are not glandular and the body of Hawaiian members is broad and flattened, the coxae are small, the pleon flexes strongly under the thorax, and urosomite 1 is very elongate. Uropod 3 is formed of a pair of small plates without rami below the telson. They are easily overlooked. Podocerids in preservative often lose all pereopods and antennae, but Hawaiian species may be clearly distinguished by other characters even though the most distinctive characters often occur in missing parts.

Key to Genera of Podoceridae

Figure Numbers Referenced in Italics

Urosome (*58L*) with only 1 pair of long uropods (=uropod 1), other uropods composed only of small pair of flaps below telson, pereonite 1 elongate and grossly marked off from pereonite 2 by posterior sleeve-like constriction..... ***Laetmatophilus*** Bruzelius

Urosome (*58T*) with 2 pairs of long uropods (=uropods 1–2) and bearing also pair of uropodal flaps below telson, pereonite 1 neither elongate nor strongly marked off from pereonite 2. ***Podocerus*** Leach

Genus *Laetmatophilus* Bruzelius

Laetmatophilus hala J. L. Barnard

Laetmatophilus hala J. L. Barnard, 1970:233–237, fig. 155.

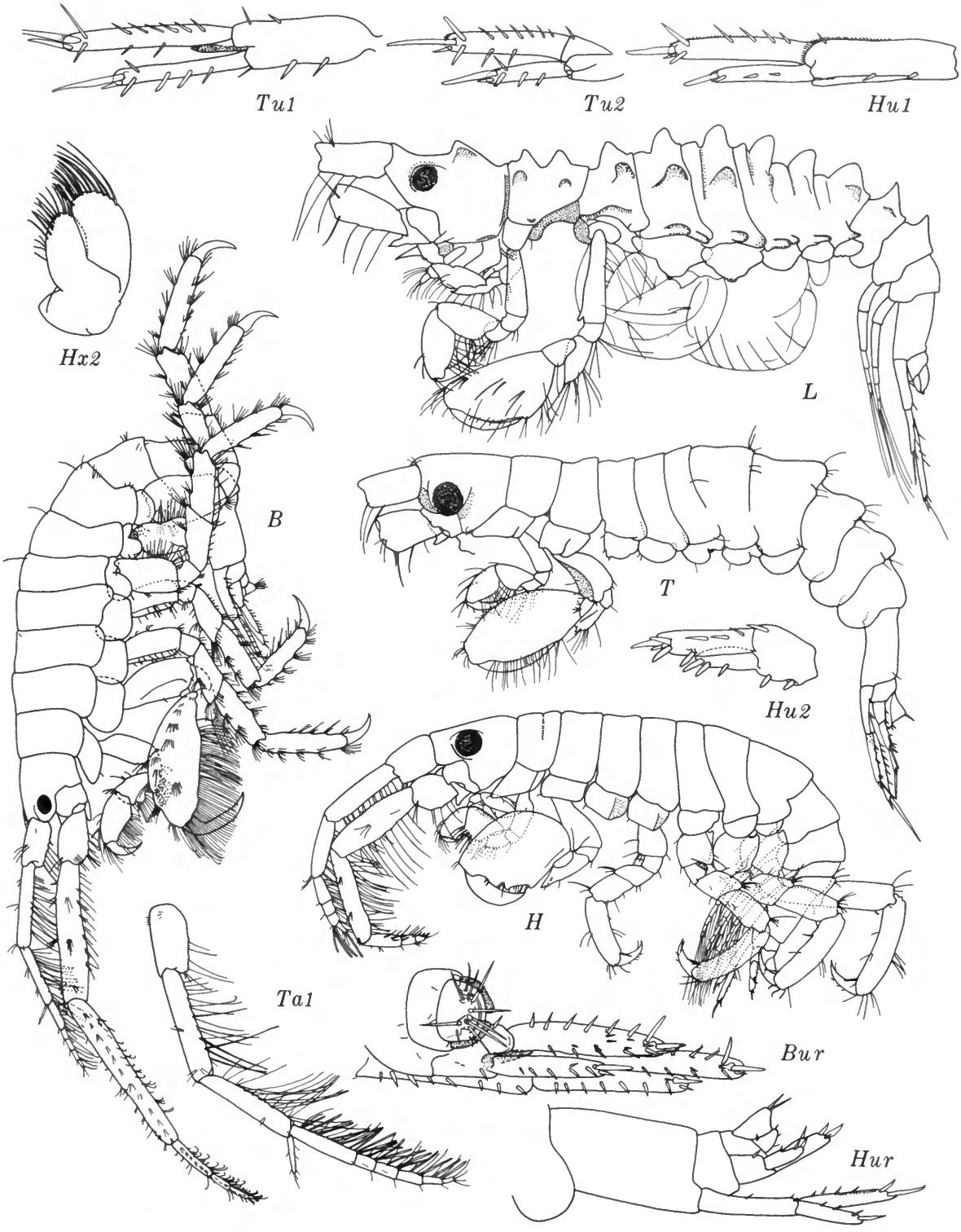
Body and head covered sparsely with blunt dorsal teeth, or weak humps in juvenile, head with 3 teeth, pereonite 1 with 2 dorsal teeth in tandem and 2 dorsolateral teeth in tandem on each side, pereonites 2–5 each with 1 dorsal and one lateral tooth on each side, in each case primary hump middorsal; in addition, pereonites 1–7 with humps just above coxae; head strongly extended forward and upward, ocular lobes much posterior of anteroventral cephalic corner; coxae 3–4 broadly triangular and with obtuse ventral points; gnathopod 1 with ovate articles 5–6, palm occupying posterior margin of hand, dactyl nearly as long as hand; article 2 of female gnathopod 2 (male unknown) with sharp anterodistal cusp, article 4 with medium sized posterodistal process, article 5 unlobate, article 6 narrow basally and broadly expanding distally, palm long and oblique, defined by slight acclivity, dactyl fitting palm.

Eyes red in formaldehyde, clear in alcohol.

Oahu, 18–30 m.

Genus *Podocerus* Leach

Uropods 1–2 are very long, with outer rami shorter than inner but strongly spined, telson strongly elevated dorsally, appearing from dorsal view to have a tumid nob, bearing a pair of spines in two species and many spines in a third species; pleonal epimera broadly rounded below; pereonites 6–7 very large, elongate and heavily muscularized in *P. talegus lawai,* slightly shorter in *P. hanapepe* and scarcely different from anterior segments in *P. brasiliensis.* Epistome produced conically only in *P. brasiliensis* and this species also bears in the male an enormous medial flange projecting from the coxa above the insertion of article 2; the flange bears ridges as if it were used for stridulation and can be seen only by dissecting off gnathopod 2 with its coxal plate and viewing it medially.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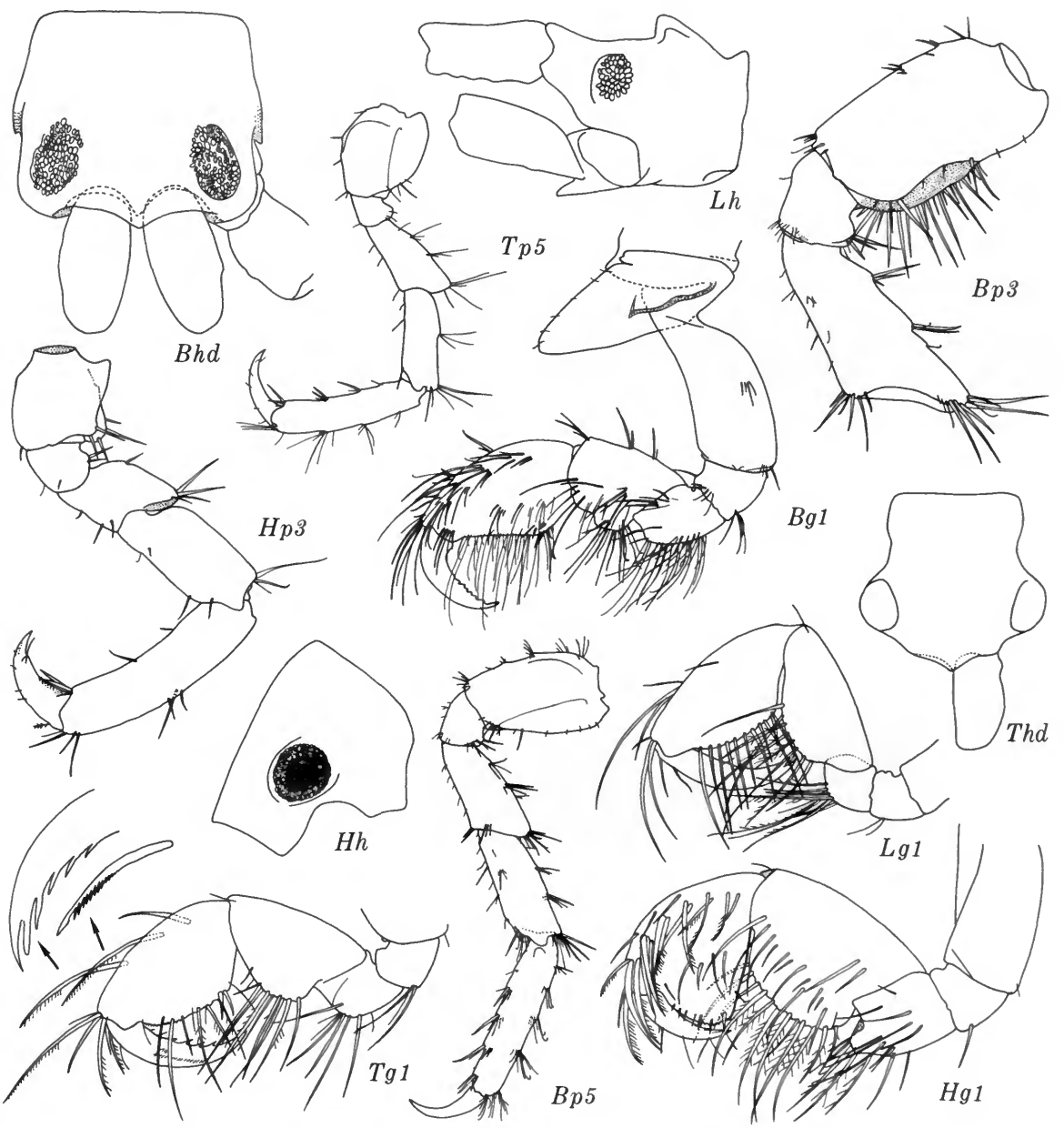


FIGURE 59.—Podoceridae: B, *Podocerus brasiliensis* (Dana); H, *P. hanapepe* J. L. Barnard; L, *Laetmatophilus hala* J. L. Barnard; T, *Podocerus talegus lawai* J. L. Barnard.

FIGURE 58.—Podoceridae: B, *Podocerus brasiliensis* (Dana); H, *Podocerus hanapepe* J. L. Barnard; L, *Laetmatophilus hala* J. L. Barnard; T, *Podocerus talegus lawai* J. L. Barnard.

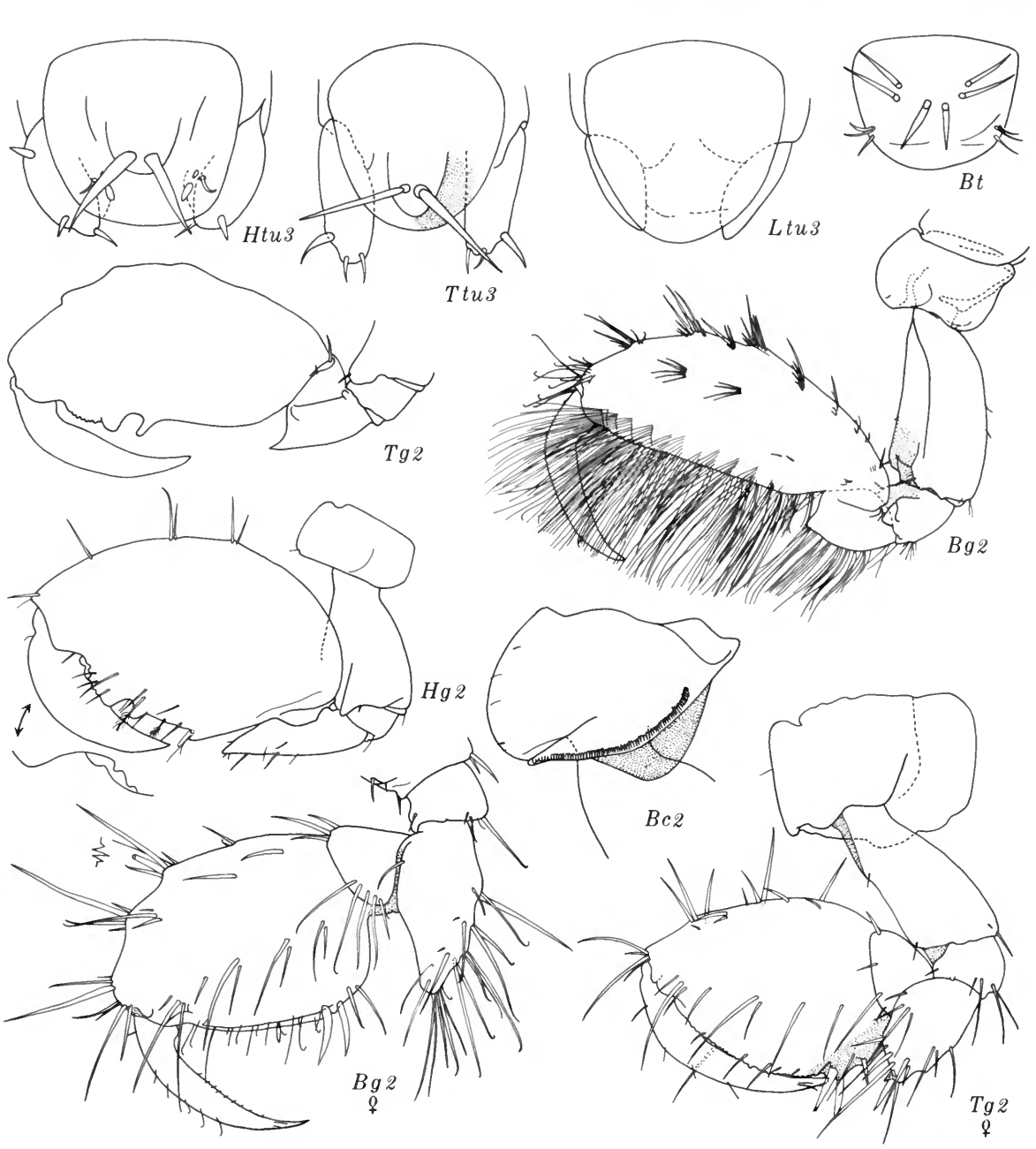


FIGURE 60.—Podoceridae: B, *Podocerus brasiliensis* (Dana); H, *P. hanapepe* J. L. Barnard; L, *Laetmatophilus hala* J. L. Barnard; T, *Podocerus talegus lawai* J. L. Barnard.

Key to Hawaiian Species of Genus *Podocerus*

Figure Numbers Referenced in Italics

1. Eyes occupying bulge forming anteroventral corners of head (*58B*), telson with 4–8 long dorsal setal-spines (*60Bt*) ..... ***P. brasiliensis***
   Eyes occupying bulges behind anteroventral corners of head (*58H, T*), those corners quadrate or rounded, telson with 2 very large dorsal setal-spines (*60Tt*) 2
2. Palm of gnathopod 1 transverse, hand thus triangular and distally expanded (*59Hg1*). ***P. hanapepe***
   Palm of gnathopod 1 oblique, hand thus ovate (*59Tg1*) ..... ***P. talegus lawai***

Podocerus brasiliensis (Dana)

Platophium brasiliense Dana, 1853:838–839, pl. 55, fig. 9.
Platophium synaptochir Walker, 1904:296–297, pl. 8, fig. 52.
Podocerus brasiliensis.—Schellenberg, 1938:94.—J. L. Barnard 1953:87 (with references); 1955:39; 1970:237–240, figs. 156, 157.

Hand of male gnathopod 2 extremely elongate and large, palm occupying full posterior margin of hand and densely setose, bearing small distal process hidden by setae, undefined, dactyl about half as long as palm; palm of gnathopod 1 tumidly ovate (like that of *P. talegus lawai*), palm long, heavily setose and bearing a few short spines at defining corner; article 2 of pereopods 1–2 long, strongly spinose, that of pereopods 3–5 stout, densely spinose on pereopods 3–4, that of pereopod 3 weakly bilobate; accessory flagellum long and thin but 1-articulate; body lacking dorsal processes.

Eyes clear or ochraceous in alcohol.

Female gnathopod 2 with very large triangular posterior extension on article 4, article 5 very small and broadly cup-shaped, hand subcircular, palm long and defined by 2 large spines, dactyl fitting palm; gnathopod 1 with long palmar setae but no short defining spines.

Tropicopolitan. Oahu, mainly as fouling organism in harbors. Possibly introduced by shipping.

Podocerus hanapepe J. L. Barnard

Podocerus hanapepe J. L. Barnard, 1970:240, figs, 158, 159.

Hand of male gnathopod 2 ovate, stout, bearing distinct palm defined by cusp and bearing 2 distal processes; article 2 of pereopods 1–2 very stout and short, article 2 of pereopod 3 complexly lobate, anteroventral corner of head quadrate and head strongly extended forward, antennae short and accessory flagellum very short but 1-articulate; body lacking dorsal ornaments. Female unknown.

Eyes red in formaldehyde, ochraceous in alcohol. Oahu, Waikiki Beach, intertidal, on *Ulva*, rare.

Podocerus talegus lawai J. L. Barnard

Podocerus talegus lawai J. L. Barnard, 1970:241–243, figs. 160, 161.

Hand of male gnathopod 2 very elongate, palm occupying full posterior margin of hand, dactyl about half as long as palm, palm undefined but bearing 3 distal processes, one low and minutely castellate, one rounded and one truncatoconiform; processes often difficult to see from marginal views and hand must be rotated and viewed from dorsomedial position, processes rudimentary in young male; article 2 of pereopods 1–2 of medium stoutness, article 2 of pereopod 3 simply lobate, anteroventral corner of head slightly rounded, head moderately extended forward, antennae long, accessory flagellum long and thick (but 1-articulate).

Eyes red in formaldehyde and ochraceous in alcohol.

Female gnathopod 2 with small article 4 bearing weak cusp, hand stout, short, broadly ovate, palm long, strongly defined by 2 spines and weak cusp, palm minutely castellate.

Oahu, intertidal to 30 m.

Family SEBIDAE

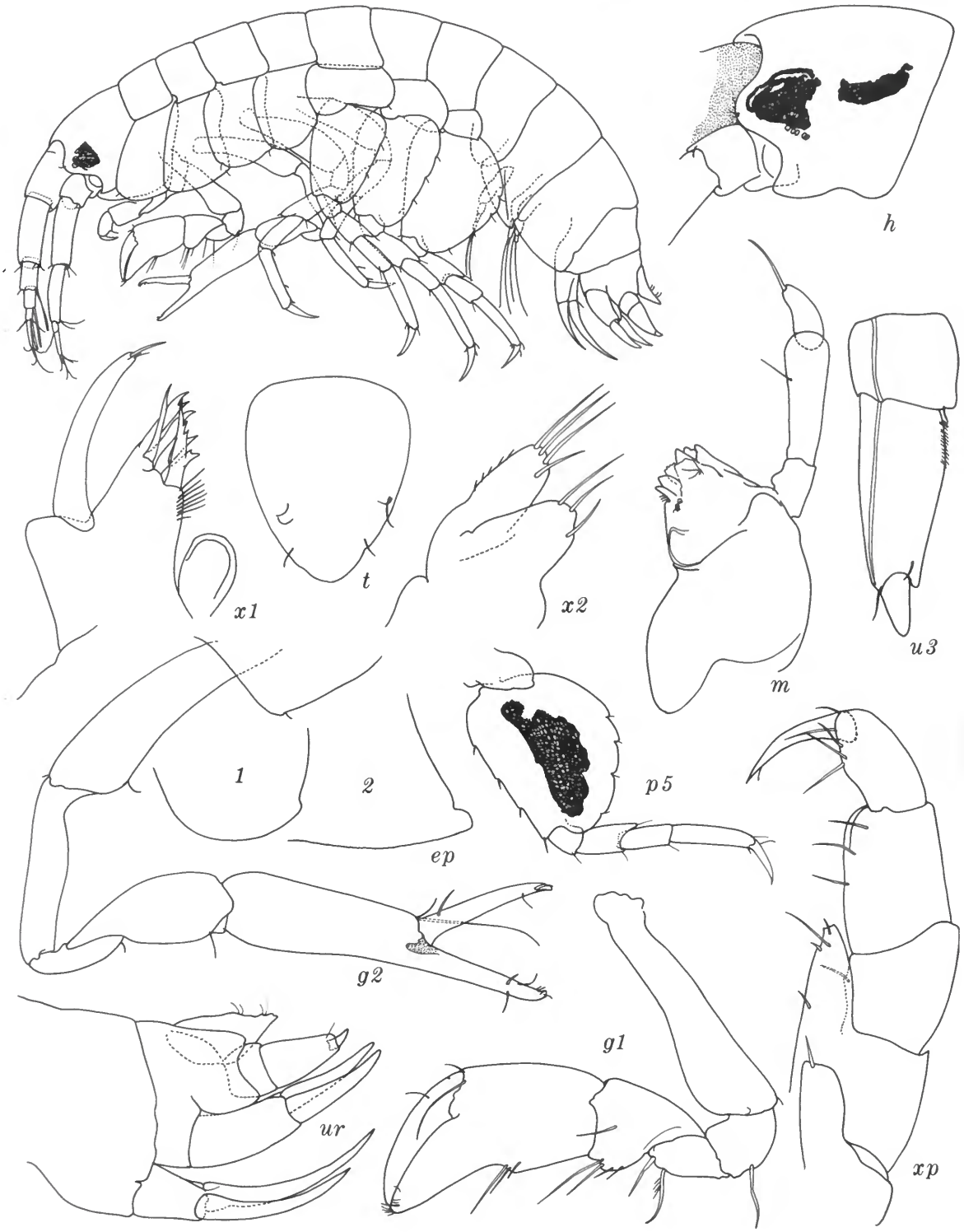
Genus *Seba* Bate

FIGURE 61

Seba ekepuu J. L. Barnard

Seba ekepuu J. L. Barnard, 1970:247, figs. 162, 163.

The body is thin and the antennae short and stiff, and thus sebids resemble the Colomastigidae but differ from them in the larger coxae, the uniramous uropod 3 and the remarkably chelate gnathopods 1 and 2 (*61g1* and *g2*). Well developed mandibles and maxillae occur in sebids whereas colomastigids have a palpless mandi-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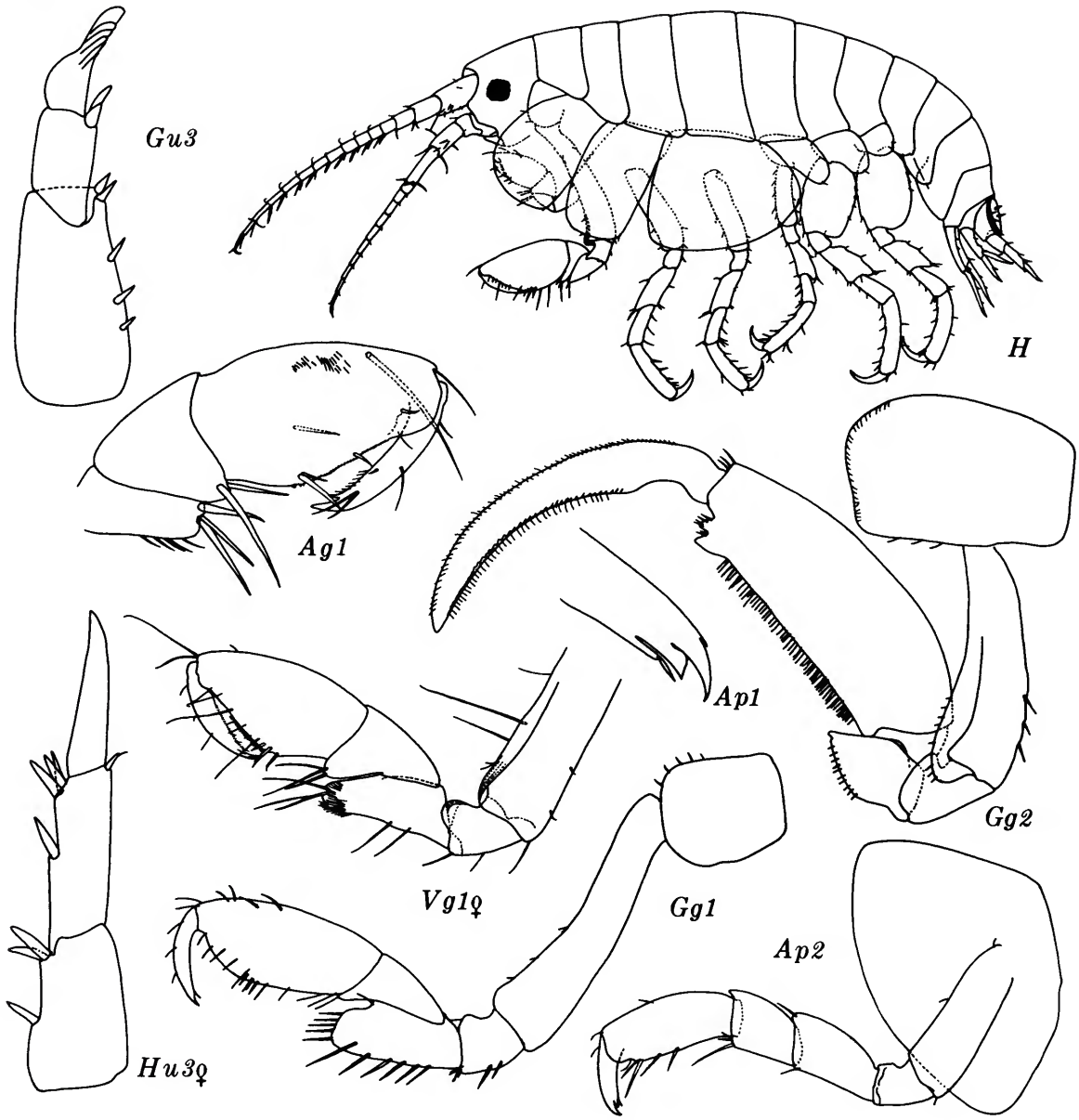


FIGURE 62.—Stenothoidae: A, *Stenothoe* sp. A; G, *Stenothoe gallensis* Walker; H, *S. haleloke* J. L. Barnard; V, *S. valida* Dana.

FIGURE 61.—Sebidae: *Seba ekepuu* J. L. Barnard.

ble and spines replacing the incisor. The elongate article 3 of gnathopod 2 in sebids recalls the Lysianassidae but gnathopod 2 of the latter is otherwise distinct in its mitten shape, strong, stiff fuzz and pineapple texture on article 5; article 2 of antenna 1 on Lysianassidae is very short but is elongate in Sebidae. The uniramous uropod 3 of sebids resembles that of Stenothoidae but the short, even coxae distinguish sebids from stenothoids. Eyes apparently are absent although a dense granular tissue occupies this ocular region in these tiny amphipods (1.0–1.5 mm long).

Oahu, Kawela Bay, intertidal, in algae.

Family STENOTHOIDAE

FIGURES 62, 63

This family is characterized by a uniramous uropod 3 composed of three segments: a peduncle and articles 1–2 of the ramus; coxa 1 is strongly reduced in size and covered by a large coxa 2 while coxa 4 is even more enlarged, shieldlike and lacks a posterior excavation. Uropod 3 distinguishes stenothoids from amphilochids but, in addition, the known stenothoids of Hawaii, all in the genus *Stenothoe,* lack a mandibular palp and the body of the mandible is characteristic (see *63Gm*). In numerous other stenothoid genera of higher latitudes, the mandibular palp is very fragile and easily broken off during dissection, so that great care must be taken in this operation when checking Hawaiian stenothoids for the possible occurrence of those genera.

Only five species of *Stenothoe* are known from Hawaii but more members of the family are expected to be found. They are often associated with coelenterates, especially hydroids, and numerous possible niches have not been explored. *Stenothoe* is the strongest genus of the family in the tropics and no other may occur in Hawaii but as a safeguard all stenothoids should be checked against the following diagnosis of *Stenothoe:*

Mandibular palp either absent or composed of 1 article; palp of first maxilla 2-articulate (often very difficult to ascertain); pereopod 3 with slender, linear article 2, while pereopods 4–5 with expanded, subovate article 2.

Eyes apparently red, fading rapidly in all Hawaiian species.

Key to Hawaiian Species of Genus *Stenothoe* Dana

Figure Numbers Referenced in Italics

1. Dactyls of pereopods 1–5 with accessory claw (*62Ap1*) ..... ***Stenothoe* sp. A**
   Dactyls of pereopods 1–5 simple 2
2. Peduncle (basal article) of uropod 3 shorter than next article (article 1 of ramus) (*62Hu3*). ***S. haleloke***
   Peduncle of uropod 3 as long as or longer than next article 3
3. Pereopods 1–5 without spines on articles 4–6 ..... ***Stenothoe* sp. B**
   Pereopods 1–5 with spines on articles 4–6 4
4. Distal bifid process on palm of male gnathopod 2 with its branches extending equally (*62Gg2*), fully adult (Hawaii only) individuals with coxa 2 unexcavate posteroventrally, coxa 3 with anterior and posterior margins parallel, female gnathopod 2 palm unarmed .... ***S. gallensis***
   Distal bifid process on palm of male gnathopod 2 with its branches extending unequally (*63Vg2*), fully adult individuals with coxa 2 excavate posteroventrally, coxa 3 with anterior and posterior margins divergent, especially in male, female gnathopod 2 palm with small distal tooth (*63Vg2* ♀) ..... ***S. valida***

Stenothoe gallensis Walker

Stenothoe gallensis Walker, 1904:261–262, pl. 3, fig. 19.—J. L. Barnard, 1955:3–5 (with references).
Stenothoe crenulata Chevreux, 1908:471–475, figs. 1–3.

The taxonomy of this species and *S. valida,* though often treated, is not yet clarified. So-called *S. gallensis* and *S. valida* have been reported from around the world but each local population seems to differ from another and the two species, where they occur in close proximity seem to shift to and fro morphologically in many characters of presumed phenotypic content. In Hawaii, those specimens that have been identified as *S. gallensis* because of the structure of male gnathopod 2 (see key) differ from populations in the western Indo-Pacific in the absence of a posteroventral excavation on coxa 2 in either sex and they therefore differ

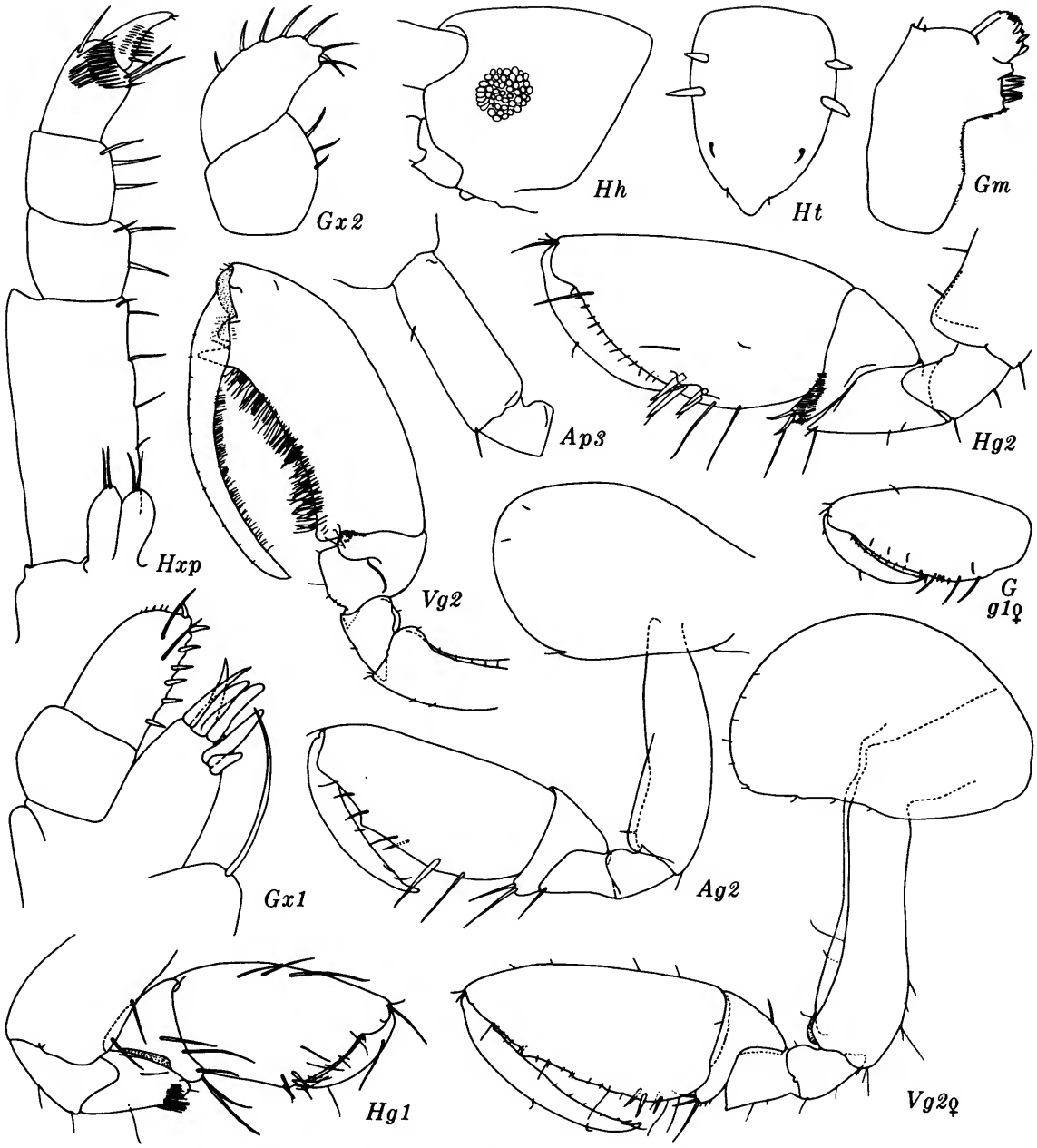


FIGURE 63.—Stenothoidae: A, *Stenothoe* sp. A; G, *S. gallensis* Walker; H, *S. haleloke* J. L. Barnard; V, *S. valida* Dana.

from so-called adult Hawaiian *S. valida* in this character. But Hawaiian juvenile *S. valida* appears also to have unexcavate coxa 2, so that juveniles of the two species are inseparable. Until this difficulty and several others not worth wordage in this brief report are better understood, the surest way to identify the two species is by terminal males, through their gnathopods (see key) plus the subgeniculate and ridged terminal article of uropod 3 in *S. gallensis*. That article in presumed terminal males of *S. valida* is smooth, simple, and straight. One has to presume that associated females and juveniles are specifically identical with males in the collections, but there may be potential error even in this attitude. We may be dealing with a single species occurring in 2 phases, a *gallensis* phase with special uropod 3 that represents phenotypes of a particular season or econiche plus a normal *valida* phase.

At any rate, males of the two species are easily distinguished from other Hawaiian stenothoids in the grossly elongate article 6 of gnathopod 2, with a densely setose palm extending the full length, plus a long dactyl also setose on its inner edge.

The Hawaiian *S. gallensis* is one of the finest tropical members of the family, in that it is relatively large (3–5 mm) and compact, heavily chitinized, and preserves exceptionally well for a stenothoid.

Oahu and Hawaii, primarily as fouling organism in harbors probably associated with hydroids, possibly introduced by shipping, and probably circumtropical.

Stenothoe haleloke J. L. Barnard

Stenothoe haleloke J. L. Barnard, 1970:247–249, fig. 164.

A small red-eyed species with flecks of bluish purple on the body in 2-day formaldehyde. Gnathopod 2 of the male resembles that of female *S. gallensis* and *S. valida,* but uropod 3 is diagnostic (see key). Perhaps terminal males have not been accounted for.

Oahu, Waikiki Beach, intertidal, on *Ulva.*

Stenothoe valida Dana

Stenothoe validus Dana, 1853:924–925, pl. 63, figs. 1a-o.
Stenothoe valida.—J. L. Barnard, 1953:83–87 (with synonymy); ?1970:250–251, fig. 165.

Uropod 3 of both sexes is of the simple, straight, unornamented kind seen in females, but not males, of *S. gallensis* (see the latter species, above, for remarks). The Hawaiian population of this species has an unusually narrow article 4 on pereopods 3–5, a character of possible subspecific value.

Oahu, off Moku Manu Island, 33 m, on base of black coral in mollusk association.

Stenothoe sp. A, J. L. Barnard

Stenothoe sp. A, J. L. Barnard, 1970:251, fig. 166 *a-i.*

An undescribed species known only in juvenile form but distinct from all other Hawaiian stenothoids in the presence of accessory claws on the pereopodal dactyls and the thickened and distally expanding sixth articles of pereopods 1–5.

Southern Oahu, 18 m.

Stenothoe sp. B, J. L. Barnard

Stenothoe sp. B, J. L. Barnard, 1970:251, fig. 166 *j.*

An undescribed species known only in juvenile form but distinguished from all other Hawaiian stenothoids in the absence of any spines on articles 4–6 of pereopods 1–5. There may be several undescribed Hawaiian stenothoids in this condition as juveniles, so the category is probably of value only as a catch-all.

Oahu, Kaneohe Bay, 2 m.

Superfamily TALITROIDEA

Families HYALIDAE, HYALELLIDAE

FIGURES 64–68

This is the only portion of the Gammaridea so far ordered into a superfamily, and the Talitroidea are herein treated as equivalent to other families.

The essentially or fully uniramous uropod 3, combined with a strongly triturative mandibular molar, lacking a palp, and the absence of an accessory flagellum characterize Hawaiian talitroids. The regularly quadrate anterior coxae and strong molar distinguish talitroids from stenothoids; the latter also have a strongly 2-articulate ramus on uropod 3 and weak lobes on the maxillipeds.

Sebidae have a mandibular palp, nontriturative molar, coalesced urosomites 2–3 (but *Parhyalella* of Talitroidea might be confused in this regard), an accessory flagellum, and grossly chelate gnathopods.

Female brood lamellae of aquatic talitroids have curl-tipped setae with apices appearing tangled.

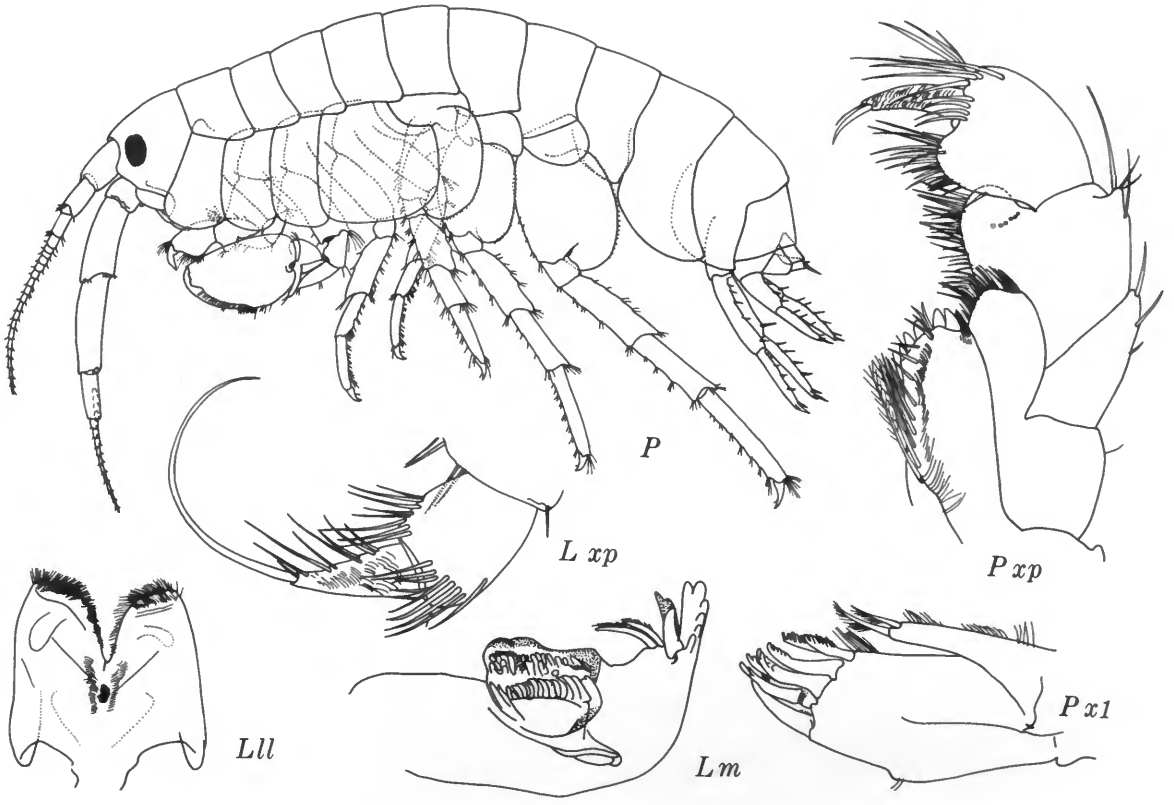


FIGURE 64.—Talitroidea—Hyalidae and Hyalellidae: L, *Hyale waimea* J. L. Barnard; P, *Parhyalella pietschmanni* Schellenberg.

Key to Aquatic Talitroidea

Figure Numbers Referenced in Italics

1. Uropod 3 with small scalelike inner ramus (*68Hu3*) ..... ***Parhyale*** Stebbing
   Uropod 3 lacking inner ramus 2
2. Telson cleft (*68Ht* and *Lt*), article 5 of male gnathopod 2 masked between articles 4 and 6, unlobed (*67Gg2*) ..... ***Hyale*** Rathke
   Telson entire (*68Pt*), article 5 of male gnathopod 2 bearing long lobe separating articles 4 and 6 (*67Yg2*) 3
3. Pleonites 1–2 with large dorsal tooth each, maxilla 1 with small palp. ***Hyalella azteca*** (freshwater swamp)
   Pleonites 1–2 smooth dorsally, maxilla 1 lacking palp ..... ***Parhyalella*** Kunkel

Genus *Hyale* Rathke

One of the most commonly occurring genera in the tropics and subtropics, *Hyale* is a genus of nestlers most often found in the tropics with *Sargassum*. Hawaii has at least 7 species and more probably will be found when better collections are made. The several species do not seem to be as numerically abundant as they are on continents, as no collections made by J. L. Barnard (1970) showed them dominating certain kinds of samples as they do in Panama and California.

Like most preserved amphipods the eyes slowly change after initial preservation, so that collections of

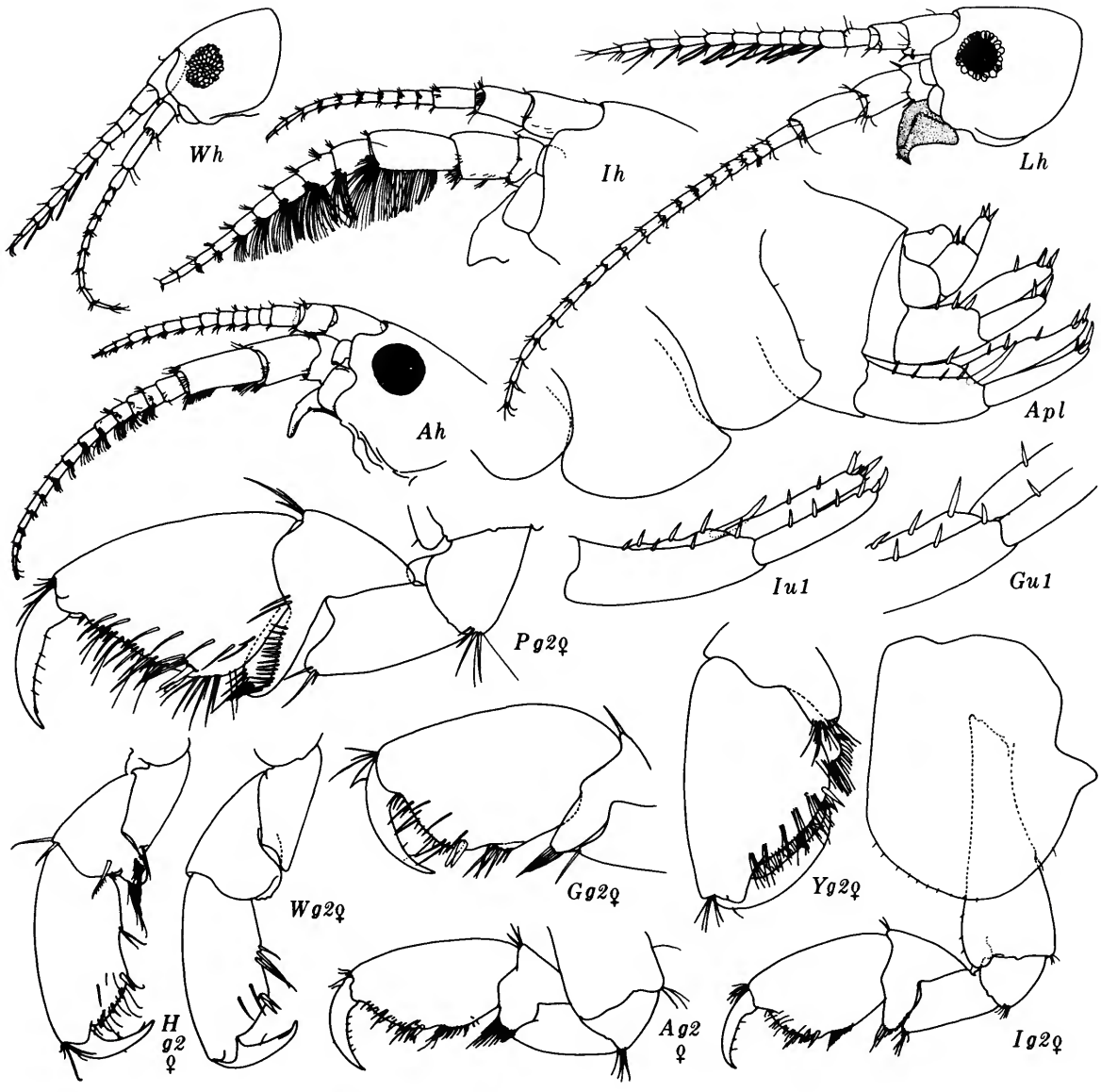


FIGURE 65.—Talitroidea—Hyalidae and Hyalellidae: A, *Hyale ayeli* J. L. Barnard; G, *H. grandicornis bishopae* J. L. Barnard; H, *H. honoluluensis* Schellenberg; I, *H. iole* J. L. Barnard; L, *H. laie* J. L. Barnard; P, *Parhyalella pietschmanni* Schellenberg; W, *H.* (*Lelehua*) *waimea* J. L. Barnard; Y, *Parhyale hawaiensis* (Dana).

several years age may have the eyes resembling egg yolks. All but one Hawaiian species has black to purple eyes in alcohol (1 to 2 months). Pereopodal dactyls and locking spines are very useful in identifying all stages of most of the species, but females of 2 Hawaiian species are grossly indistinguishable (see below). The location of the major distal spine on the peduncle of uropod 1 and the number of posterior setae on the hands of male gnathopod 1 and female gnathopods 1–2 are very useful. One contrasts a pair (or 3) posterior setae against a spread of numerous setae (more than 6). Other characters not mentioned but also of diagnostic value are the shape of uropod 3 (thick or thin) and the shape of telson from lateral view and from flattened dorsal view.

Key to Hawaiian Species of Genus *Hyale*

Figure Numbers Referenced in Italics

1. Eyes red in formaldehyde, clear in alcohol, palp article 4 of male maxilliped with long whip-like terminal seta (*64Lxp*) ..... ***H. waimea***
   Eyes with purple or brown pigment in alcohol, palp article 4 of maxilliped normally setose (*64Pxp*) 2
2. Article 6 of pereopods 1–5 with small or medium undifferentiated distal locking spine (*68Ip5*), and medium sized mid-setule on dactyl, major peduncular spine of uropod 1 on mediodistal margin, gnathopod 1 with numerous posterior setae on article 6 3
   Article 6 of pereopods 1–5 with large striate distal locking spine (of corkscrew kind) (*68Ep5*) weak or no distal setule on dactyl, major peduncular spine of uropod 1 on laterodistal margin, gnathopod 1 with only 2 or 3 posterior setae on article 6 4
   Article 6 of pereopods 1–2 with small or no poorly striate distal locking spine next to larger striate spine (*68Rp5*) weak distal setule on dactyl, major peduncular spine of uropod 1 on laterodistal margin, gnathopod 1 with numerous posterior setae 6
3. Antenna 2 in adult with dense brushes of setules (*65Ih*), article 5 of gnathopod 1 with broad posterior lobe (*66Igl*), coxa 4 with weak posterior acclivity, ramus of uropod 3 with only terminal spines (*68Iu3*) ..... ***H. iole***
   Antenna 2 in adult lacking dense brushes of setules, article 5 of gnathopod 1 with narrow posterior lobe (*66Ggl*), coxa 4 with sharp, attenuate posterior cusp, ramus of uropod 3 with one spine on side margin besides terminal spines (*68Gu3*) .... ***H. grandicornis bishopae***
4. Palm of male gnathopod 1 defined by large cusp, palm of male gnathopod 2 with strong distal process ..... ***H. laie***
   Palm of male gnathopod 1 bearing weak defining hump or none, palm of male gnathopod 2 simple 5
5. Palm of male gnathopod 2 distinct from posterior margin of hand (*67F*), posterior coxal acclivities (coxae 1–3) close to ventral margins ..... ***H. affinis***
   Palm of male gnathopod 2 confluent with posterior margin of hand and dactyl extending its full length (*67H*), posterior coxal acclivities near middle of posterior margins. ***H. honoluluensis***
6. Outer rami of uropods 1–2 lacking spines on dorsal margin, antenna 2 with small but distinct brushes of posterior setules, coxae 1–3 with sharply quadrate, slightly attenuate posterior acclivities (*66Igl*) ..... ***H. ayeli***
   Outer rami of uropods 1–2 with spines on dorsal margins, antenna 2 lacking posterior setular brushes, coxae 1–3 with posterior acclivities obsolescent and softly rounded (*66Ygl*). ***Hyale*** sp.

Hyale affinis Chevreux

Hyale affinis Chevreux, 1908:503–506, figs. 21–22.—Schellenberg, 1938:67–68.—J. L. Barnard, 1955:14 (in part, not fig. 6); 1970:251–255, fig. 167 *e-h*.

Antenna 2 simple.

Coxae 1–4 with quadrate posterior acclivities especially close to ventral margins. Coxa 4 with strongly sinuous excavation.

Male gnathopod 1 with expanded hand, anterodistally tumid, palm oblique and bearing large spine, defining corner softly rounded, setose, dactyl reaching main spine, posterior margin of hand with 2–3 setae in 1 clump; spiny palm of male gnathopod 2 deeply recessed from short posterior margin of hand, latter bearing 1 spinule, palm defined by 2 spines.

Female gnathopods 1–2 with article 6 slender, rec-

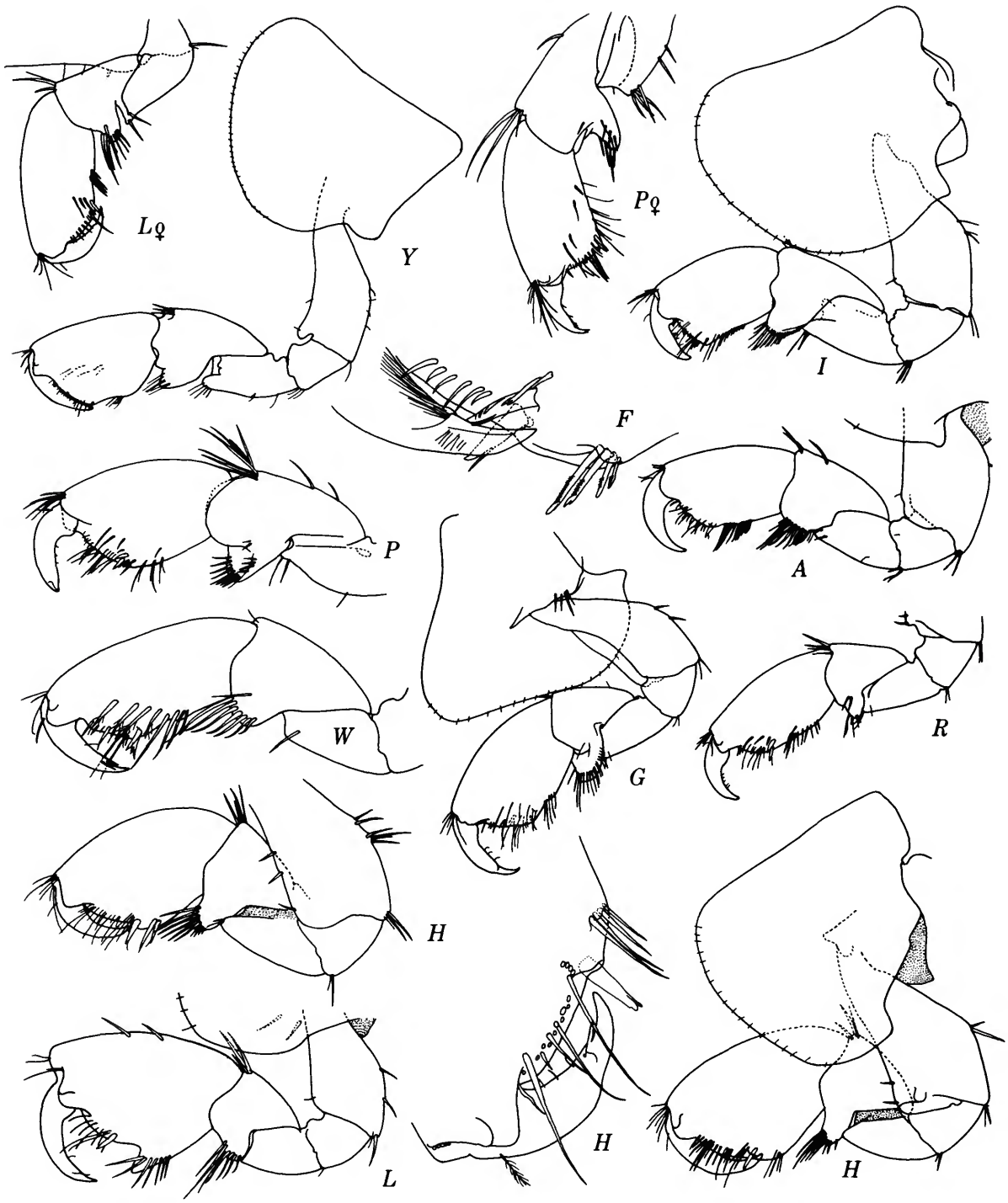


FIGURE 66.—Talitroidea—Hyalidae and Hyalellidae; gnathopod 1: A, *Hyale ayeli* J. L. Barnard; F, *H. affinis* Chevreux; G, *H. grandicornis bishopae* J. L. Barnard; H, *H. honoluluensis* Schellenberg; I, *H. iole* J. L. Barnard; L, *H. laie* J. L. Barnard; P, *Parhyalella pietschmanni* Schellenberg; R, *H. rubra* (Thomson); W, *H.* (*Lelehua*) *waimea* J. L. Barnard; Y, *Parhyale hawaiensis* (Dana).

tangular, palm oblique, simple, posterior margin of hand with pair of setae.

Pereopodal locking spines formed of 1 large and 1 small spirally striate members in tandem, dactyl with small distal setule and microcastellations.

Uropod 1 with major peduncular spine distolateral.

Ramus on uropod 3 with only terminal spines. Eyes purple in alcohol.

Southern Polynesia; Laysan; Kauai; Oahu, intertidal.

Hyale ayeli J. L. Barnard

Hyale ayeli J. L. Barnard, 1955:14–15, fig. 7; 1970:255, figs. 168, 169.

Male and female antenna 2 with weak to strong posterior setal brushes on peduncle and base of flagellum.

Coxae 1–3 with sharply quadrate, slightly attenuate posterior acclivities; coxa 4 with simple excavation.

Male gnathopod 1 with narrow rectangular hand, palm oblique and defined by spines at rounded defining corner, dactyl fitting palm, posterior margin of hand with wide spread of numerous setae; spiny palm of male gnathopod 2 oblique, equal to posterior margin of hand, weakly defined by softly rounded defining corner, dactyl fitting palm, in terminal male palm with weak distal quadrate protrusion, absent in young male.

Female gnathopods 1–2 with article 6 slender, rectangular (like male gnathopod 1), posterior margins of hand with wide spread of numerous setae.

Pereopodal locking spines differing on pereopods 1–2 and 3–5; on pereopods 1–2 with large distal spirally striate (weakly) single spine, in pereopods 3–5 with largest spine strongly striate spirally and bearing a more distal small, axially-spirally striate spine; dactyl with small distal seta.

Uropod 1 with major peduncular spine distolateral.

Uropods 1–2 with outer rami lacking dorsal spines.

Ramus of uropod 3 with only terminal spines. Eyes brown-black.

Oahu, intertidal.

Hyale grandicornis bishopae J. L. Barnard

Hyale bishopae J. L. Barnard, 1955:16–17, fig. 8.
Hyale grandicornis bishopae J. L. Barnard, 1970:257, fig. 170.

Antenna 2 stout but simple.

Coxae 1–3 with well developed, slightly to strongly attenuate posterior acclivities. Coxa 4 with simple excavation.

Male gnathopod 1 with stout rectangular hand, palm oblique and short, defined by 2 spines at defining corner, posterior margin of hand with spread of several setae; spiny palm of male gnathopod 2 oblique and equal to posterior margin of hand, weakly defined by 2 spines.

Female gnathopods 1–2 with article 6 stout, rectangular (like male gnathopod 1), posterior margin of hand with spread of several setae.

Pereopodal locking spines small and simple, dactyl with large middle seta.

Uropod 1 with major peduncular spine mediodistal but scarcely enlarged.

Ramus of uropod 3 with at least one subterminal dorsal spine disjunct from terminal set. Eyes brown-black.

Oahu, intertidal.

Hyale honoluluensis Schellenberg

Hyale honoluluensis Schellenberg, 1938:69–71, figs. 35b, c.—J. L. Barnard, 1955:18; 1965:520, figs. 22, 23; 1970: 257–259, figs. 167*a–d*, 171.

Antenna 2 simple.

Coxae 1–3 with a strong quadrate posterior acclivity. Coxa 4 with sinuous excavation.

Male gnathopod 1 with expanded hand, anterodistal margin tumid, palm oblique, bearing striate spine, softly rounded defining corner with 2 spines, dactyl not reaching main spine; spiny palm of terminal male gnathopod 2 occupying full posterior margin of hand, dactyl very long and overlapping free margin of hand, younger male with shorter palm defined by 2 spines but palm not recessed and lacking posterior spinule seen in *H. affinis*.

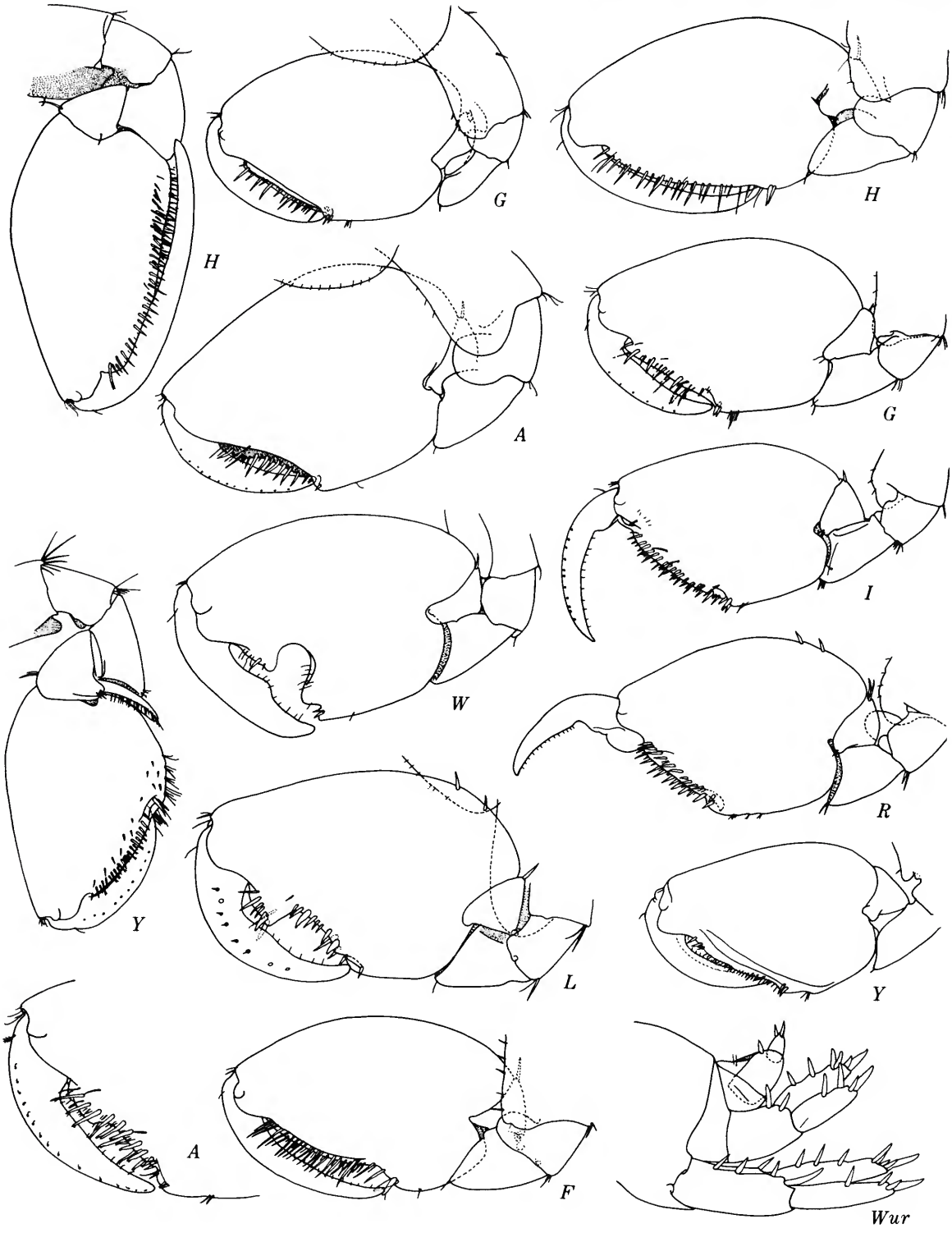
Female gnathopods 1–2 with article 6 slender, rectangular, palm oblique, simple, posterior margin of hand with pair of setae.

Pereopodal locking spines composed of 1 large and 1 small spirally striate members in tandem, dactyl with small distal seta and microcastellations.

Uropod 1 with major peduncular spine distolateral.

Ramus of uropod 3 with only terminal spines.

Females of this species and *H. laie* are grossly indistinguishable.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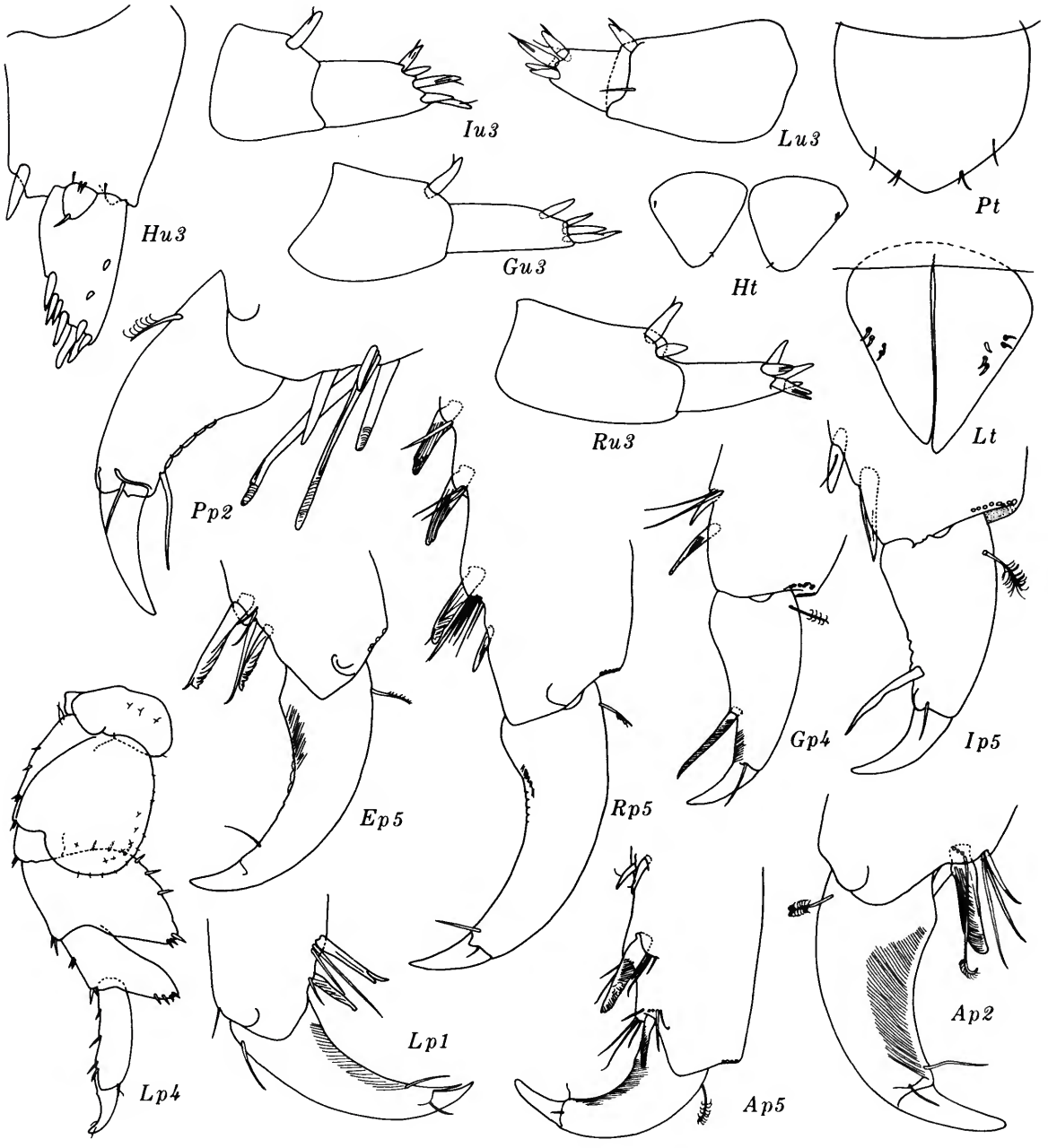

FIGURE 68.—Talitroidea—Hyalidae and Hyalellidae: A, *Hyale ayeli* J. L. Barnard; E, *H. laie* J. L. Barnard; G, *H. grandicornis bishopae* J. L. Barnard; H, *Parhyale hawaiensis* (Dana); I, *Hyale iole* J. L. Barnard; L, *H. waimea* J. L. Barnard; P, *Parhyalella pietschmanni* Schellenberg; R, *Hyale rubra* (Thomson).

FIGURE 67.—Talitroidea—Hyalidae and Hyalellidae; gnathopod 2: A, *Hyale ayeli* J. L. Barnard; F, *H. affinis* Chevreux; G, *H. grandicornis bishopae* J. L. Barnard; H, *H. honoluluensis* Schellenberg; I, *H. iole* J. L. Barnard; L, *H. laie* J. L. Barnard; R, *H. rubra* (Thomson); W, *H.* (*Lelehua*) *waimea* J. L. Barnard (also urosome); Y, *Parhyale hawaiensis* (Dana).

Eyes garnet-ruby in formaldehyde, dark purple in alcohol.

Indo-Pacific; Hawaiian Islands, shallow water.

Hyale iole J. L. Barnard

Hyale iole J. L. Barnard, 1970:260, fig. 172.

Male and female antenna 2 with extremely thick posterior setal brushes on peduncle and base of flagellum.

Coxae 1–3 with sharp and attenuate posterior acclivities. Coxa 4 with simple excavation.

Male gnathopod 1 with rectangular hand, palm oblique, short, defined by large spine at rounded defining corner, posterior margin of hand with long spread of numerous setae; spiny palm of male gnathopod 2 oblique, equal in length to posterior margin of hand, weakly defined by softly rounded corner.

Female gnathopods 1–2 with article 6 slender, rectangular (like male gnathopod 1), posterior margin with medium spread of posterior setae.

Pereopodal locking spines formed of 1 medium and 1 small axially striate spines in tandem, dactyl with large seta in middle.

Uropod 1 with major peduncular spine mediodistal and very large.

Ramus of uropod 3 with only terminal spines. Eyes brown-black.

Maui, Kahalui Harbor.

Hyale laie J. L. Barnard

Hyale laie J. L. Barnard, 1970:260–264, figs. 173, 174.

Antenna 2 simple.

Coxae 1–3 with strongly quadrate posterior acclivity. Coxa 4 with sinuous excavation.

Male gnathopod 1 with expanded hand, anterodistally tumid, palm oblique and defined by large triangular cusp, dactyl fitting palm, spiny palm of male gnathopod 2 oblique, defined from short posterior margin of hand by hump and pair of spines, bearing large blunt distal process, dactyl fitting palm, hand with 2 anterior spines.

Female gnathopods 1–2 with article 6 slender, rectangular, palm oblique, simple, posterior margin of hand with pair of setae.

Pereopodal locking spines composed of 1 large and 1 small spirally striate members in tandem, dactyl with small distal seta and microcastellations.

Uropod 1 with major peduncular spine distolateral.

Ramus of uropod 3 with only terminal spines. Eyes brown-black.

Oahu and Kauai, intertidal.

Hyale sp. (cf. *rubra* Thomson)

Hyale sp. (cf. *rubra* Thomson) J. L. Barnard, 1970:268–269, fig. 178.

Antenna 2 simple.

Coxae 1–3 with posterior acclivity obsolescent and softly rounded. Coxa 4 with slightly sinuous excavation.

Male gnathopod 1 with thin, tapering rectangular hand, palm very oblique and short, defined by 2 spines, dactyl short and fitting palm, posterior margin of hand with wide spread of numerous setae; spiny palm of male gnathopod 2 oblique and equal to posterior margin of hand, weakly defined by spines, dactyl fitting palm.

Female unknown.

Pereopodal locking spines composed of 1 small, weakly striate distal and 1 large spirally striate member in tandem, dactyl with small distal seta.

Uropod 1 with major peduncular spine distolateral.

Ramus of uropod 3 with only terminal spines. Eyes damaged and color unclear.

Maui, Kahalui Harbor.

Hyale (*Lelehua*) *waimea* J. L. Barnard

Hyale (*Lelehua*) *waimea* J. L. Barnard, 1970:264–268, figs. 175–177.

This species is the only member of Hawaiian *Hyale* with colorless eyes in alcohol; the others retaining some purple or brown color in that medium. The subgenus is distinguished in the male by the presence of a very long terminal seta on palp article 4 of the maxilliped. Coxa 4 has only a small dorsal point in the posterodorsal excavation and otherwise coxae 1–3 have essentially no posterior acclivities or cusps. Gnathopod 1 has many posterior setae on the narrow, rectangular article 6; male gnathopod 2 has a deep hemispherical incision on the palm and a hump on the inner edge of the dactyl. Pereopodal dactyls have a medium distal setule on the inner edge, a facial setule, and a thin sharp spine-tooth appressed to the dactylar terminus; the distal locking spine is weakly striate and small and is adjacent to a larger smoother spine. Pereopod 3 has a widely inflated nasiform article 4 with posterior spines,

and articles 4–5 of male pereopod 4 are like the normal pereopod 5 of the male. The main peduncular spine of uropod 1 occurs laterally, the ramus of uropod 3 is unusually short and bears only terminal spines, and the telson is uniquely narrow. Female gnathopod 2 is similar to gnathopod 1 but much less setose.

Southern Oahu, 30 m.

Genus *Parhyale* Stebbing

Parhyale hawaiensis (Dana)

Parhyale inyacka (K. H. Barnard).—J. L. Barnard, 1955:23, fig. 12 (with references).

Parhyale hawaiensis (Dana).—Shoemaker, 1956:351–356, figs. 3–4 (with references).—J. L. Barnard, 1965:521–523, fig. 24.

Among the aquatic talitroids this species differs from all others in the presence of a small scale representing the inner ramus of uropod 3. The uropod is dissected and mounted dorsal side up so it can be viewed with a compound microscope. Eyes black, turning deep purple in alcohol.

Circumtropical in shallow waters.

Genus *Parhyalella* Kunkel

Parhyalella pietschmanni Schellenberg

Parhyalella pietschmanni Schellenberg, 1938:71–74, figs. 36, 37.—J. L. Barnard, 1970:269, figs. 179, 180.

A large species, up to 11 mm in length, *P. pietschmanni* is also one of the most beautiful Hawaiian amphipods, and like the Hawaiian beach-hopper *Orchestia platensis* Krøyer, would form excellent introductory laboratory material in a study of amphipods. The animal preserves well and is easy to dissect.

The adult male has very stout peduncles on antenna 2 but those of the female are thin. The eyes in alcohol are dark purple throughout but garnet in formaldehyde. Urosomite 2 is dorsally telescoped into urosomite 1 and does not freely reach the dorsal body margin. Urosomite 3 is shaped like the prow of a ship, and uropod 3 projects from it like a bowsprit.

Oahu, beach wrack.

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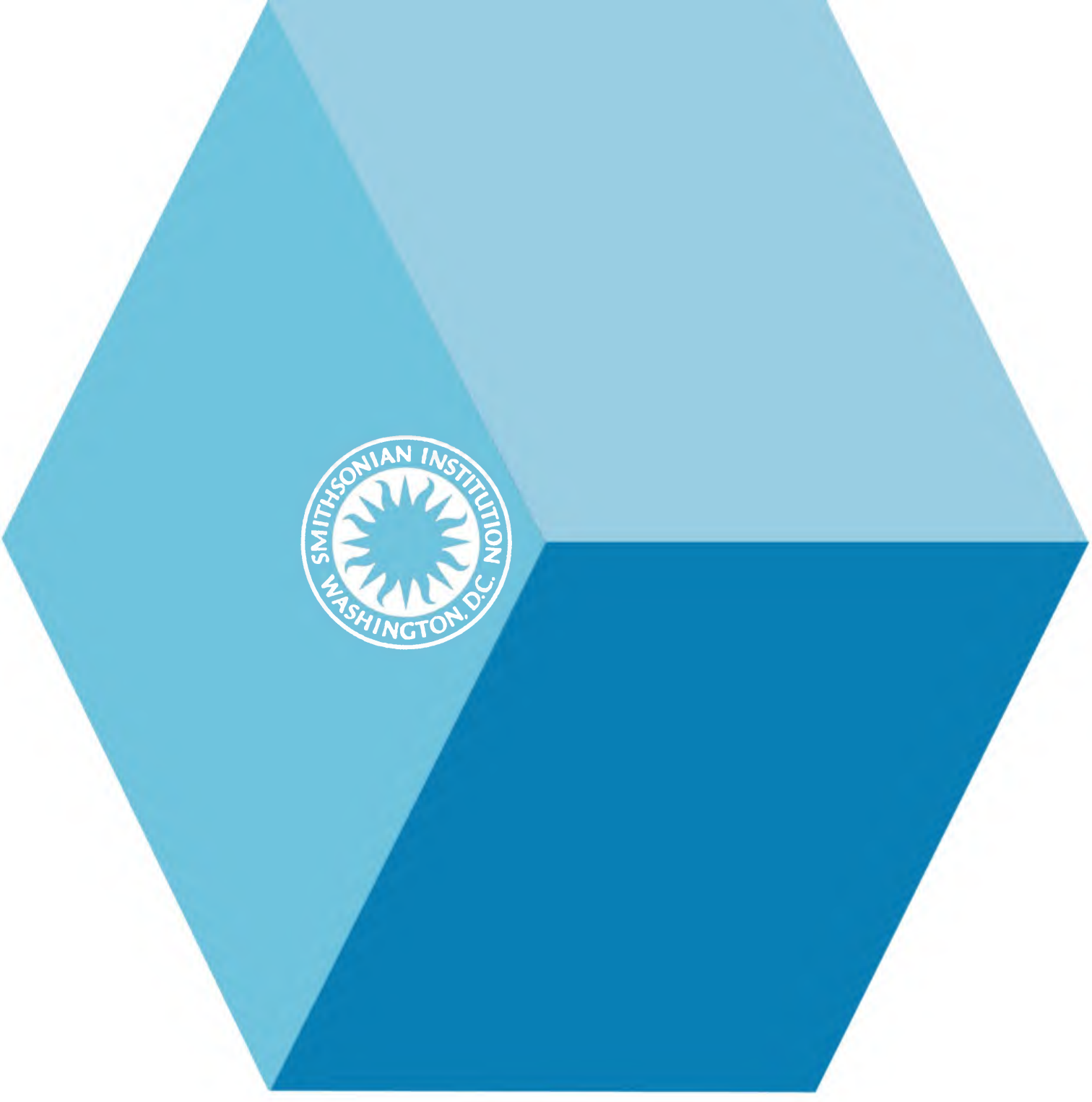
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