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Gammaridean Amphipoda of the Rocky Intertidal of California: Monterey Bay to La Jolla

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Abstract

A survey of intertidal gammaridean Amphipoda of the southern half of California is based on 360+ quantitative and non-quantitative samples taken primarily in the *Phyllospadix*-pelvetiid zone below mean low water. The samples were collected at 7 rocky intertidal sites from Monterey Bay to La Jolla. The coastal region embraces portions of both warm- and cold-temperate environments and as a result the distributional limits of many northern and southern species were expected to occur in the region. The logic of this supposition is shown by the analysis of 139 species, 39 of which occur primarily north and 30 primarily south of Pt. Conception. Of the remainder, 31 occur on both sides of the point in equal density and the distributions of 39 are poorly known. About 20 additional species occur in the intertidal zone only as strays from deeper water.

A checklist of 155+ species from the Californian intertidal is presented. Nineteen species and 4 genera are described for the first time.

About 20 species of Amphipoda are numerically dominant in the intertidal zone, 2–4 of each occurring dominantly in each of several habitats, such as the *Phyllospadix*-pelvetiid zone, kelp holdfasts, articulated corallines, sponges and tunicates, and phragmatopomid masses. Localities impoverished of flora owing to heavy surf or sand scouring are dominated by different species of Amphipoda than those localities having dense floral stands. *Lysianassa macromerus* is believed to be an indicator of sedimentary inundation while *Oligochinus lighti* and *Parallorchestes ochotensis* are believed to be indicators of heavy surf conditions. Most of the dominant Amphipoda belong to diverse, rather than to monotypic genera.

Domiciliary Amphipoda comprise more than a third of the species of the Californian fauna but their tubes apparently are so fragile that they never form the bulk of intertidal fouling organisms. In contrast, amphipodan tubes often dominate pilings in protected harbors.

The *Phyllospadix*-pelvetiid zone is shown to support 72 species throughout the coastal region but a maximum of 47 occurs at any one locality (Cayucos). Intermixture of northern and southern species is very strong at Cayucos, adjacent to Pt. Conception.

Kelp stipes of the intertidal zone are poorly populated with Amphipoda, except those of *Egregia* having numerous individuals of

Hyale rubra frequens and *Amphilochus litoralis*. Holdfasts of kelps in intertidal zones are small but heavily populated with Amphipoda, most of which are identical with those of the *Phyllospadix*-pelvetiid zone. Kelp holdfasts from subintertidal depths have a different amphipodan fauna from those of intertidal zones. More than 35 species of Amphipoda have been found in one holdfast of *Macrocystis pyrifera* in 3 m. of water. The largest Amphipoda of Californian coastal shallows, *Cymadusa uncinata*, inhabit the largest kelps. Articulated coralline algae are densely populated with a poorly diversified amphipodan fauna and few Amphipoda are restricted to that substrate. In contrast, more than a dozen species of Amphipoda inhabit sponges and tunicates obligatorily. Interstitial rock nestlers and intertidal sedimentary burrowers occurring under rocks also are very scarce.

Those taxonomic problems of particular interest concern the identifications and nomenclature of various species of *Hyale*, *Lysianassa*, *Elasmopus*, and *Ischyrocerus*.

Contents

Gammaridean Amphipoda of the Rocky Intertidal of California: Monterey Bay to La Jolla

Introduction

The Californian rocky intertidal, with its rich flora and its exposure to seas of normal salinity, supports a diverse and numerically abundant amphipodan fauna. Gammaridean Amphipoda are the most abundant of the macroscopic Crustacea in this zone; their density exceeds that of the larger Decapoda and those companion orders of similar body size such as Isopoda, Cumacea, and perhaps Tanaidacea. However, the latter organisms are very small in size and may be lost in sample processing methods using meshes of 0.5 mm. openings. The smaller Copepoda and Ostracoda, of course, are far more abundant than Amphipoda.

Despite their known frequency, intertidal Amphipoda of California have not been studied intensively, although Shoemaker in his broad attack on world amphipod problems has touched on them frequently and has made important contributions in modernizing the nomenclature. The present paper describes the amphipods collected in a survey of the southern half of California from Monterey Bay to La Jolla, a distance of nearly 5 degrees of latitude or roughly 600 kilometers. The survey is based on more than 360 samples, many of which are crudely quantitative, taken at 7 major collecting sites.

Literature

Short systematic reviews of Californian Amphipoda appeared in "Between Pacific Tides" by Ricketts and Calvin (late editions edited by Joel W. Hedgpeth) and in the second edition of Light's "Intertidal Invertebrates of the Central Californian Coast" (edited by Ralph I. Smith and others). Nomenclaturally, those presentations are modernized herein (Appendix II) but revised keys await continued exploration in northern California.

The literature of Californian Amphipoda must include that of Washington (Puget Sound, Friday Harbor), Oregon, and Baja California. Many of the Californian taxa were first described from those areas. Some subintertidal Amphipoda stray into intertidal zones so that some of the offshore benthic literature must be considered also. The literature is small in comparison to that of the British Isles, for instance, and the resulting paucity of distributional records results in a scanty zoogeographic knowledge.

The first eastern Pacific aquatic Amphipoda later to be found living in California were described by Dana (1853) from Puget Sound, the collections resulting from the U.S. Exploring Expedition of 1838–42. Those species are now cited as *Parapleustes pugettensis* (Dana) and *Anisogammarus pugettensis* (Dana). Following that, in 1854, Dana described one more aquatic species, *Allorchestes angustus*, from Californian collections made by Dr. John L. LeConte. Stimpson (1856, 1857, 1864) established several species from the eastern Pacific Ocean, some having been collected in or near San Francisco Bay. Those species now recognized in California are *Ampelisca pugetica*, *Ampithoe humeralis*, *Anisogammarus confervicolus*, *Corophium spinicorne*, and *Hyale plumulosa*. *Gammarus subtener* has since been determined to be a synonym of *Melita appendiculata*, but four other species have not been identified subsequently: *Allorchestes seminuda*, *Amphithonotus occidentalis*, *A. septemdentatus*, and *Phoxus grandis*.

Bate (1858) described *Ampithoe lacertosa* from "Arctic Seas." Subsequently, this giant species (20+ mm. long) has been found on both sides of the north Pacific Ocean as far south as Japan and Baja California. Boeck (1871), in a paper remarkably detailed for its time, described and figured 5 (4 new) species, of which *Cerapus rapax* Stimpson (1857) has been removed to *Ericthonius brasiliensis* (Dana), *Podocerus californicus* has been fused with *Jassa falcata* (Montagu), *Metopa esmarki* has been transferred to *Mesometopa*, *Paramphithoë Bairdi* has been synonymized with *Parapleustes pugettensis* (Dana), and *Amphithoë Stimpsoni* has been considered to be a synonym of *Ampithoe lacertosa* Bate. Harford (1877) described *Dexamine scitulus* from Bahía Magdalena, Baja California, and his taxon is now believed to be a synonym of *Ampithoe lacertosa*.

The early works of Dana, Stimpson, Bate, Boeck, and Harford were confined to a period of about 25 years, following which more than 20 years elapsed before further treatments of eastern Pacific Amphipoda were to be published. Although several of Stimpson's species have not been recognized subsequently, all of those described by early workers were characterized by their large body size and/or their abundance. Even Stimpson's unrecognized species, believed to be a *Hyale*, a *Pleustes*, a *Melita*, and a large *Paraphoxus*, must be relatively large for amphipods in the area concerned. The recording of *Ampithoe* *lacertosa* thrice is evidence of the concern with primarily large bodied amphipods in early explorations.

In 1898 both Calman and Walker published papers on some Amphipoda of Puget Sound. Calman described *Polycheria osborni*, *Maera dubia* (later found to be a synonym of *M. danae*) and *Ampithoe humeralis* Stimpson, while Walker erected *Maeroides thompsoni* (later transferred to *Eurystheus*) and *Aoroides columbiae*. These were the last important amphipodan papers written by members of the old school of carcinologists treating several groups of Crustacea simultaneously. In 1908, Holmes' treatment of subintertidal Amphipoda collected by the "Albatross," principally from Monterey Bay and the Californian Channel Islands, marked the beginning of the modern period of study in the eastern Pacific region. His work reflected the high standards reached by Stebbing's (1906) world monograph of the Gammaridea. Only two of his species have been found subsequently to occur frequently in intertidal zones: *Ampelisca lobata* and *Ceradocus spinicauda*.

Stout (1912, 1913) described 18 new species from Laguna Beach, California, fortunately in detail sufficient that Shoemaker (1941) could rectify the nomenclatural assignments after patient examination of collections accumulated in the U.S. National Museum. Apparently, Stout's types, in the defunct Laguna Marine Laboratory of Pomona College, have been lost. The one unrecognized species, *Ampithoe corallina*, is presumed by the writer to be a senior synonym of *A. simulans* Alderman, but the solution to the problem must await life history studies of ampithoids in the region. The 17 other aquatic species, after recognition of synonyms, have been reduced to the following entities bearing Stout's authorship: *Amphilochus litoralis*, *Cymadusa uncinata*, *Lysianassa dissimilis*, *Melita sulca*, *Maera simile*, *Elasmopus antennatus*, *Hyale rubra frequens*, *Lembos concavus*, *Photis californica*, and *Ischyrocerus parvus*(?).

Commencing in 1916, Shoemaker at the U.S. National Museum, published at least 17 papers concerning Californian or eastern Pacific Amphipoda. Although he died in 1958, his works were still being published as late as 1964. Some of these papers give Californian records without attention so being noted in the titles of the works. At least 20 Californian species bear Shoemaker's authorship and others from Baja California are expected to be found occurring in the islands off southern California. Shoemaker, besides contributing new standards of description and illustration, untangled old problems such as those involving the synonyms of *Eurystheus tenuicornis* (Walker), the Stout nomenclature, and the *Parhyale* question. His work is embodied in the faunal compilation of Santa Cruz Island (Hewatt, 1946) and that of Elkhorn Slough (MacGinitie, 1935).

Skogsberg and Vansell (1928) made a notable Californian contribution in their study of the biology of *Polycheria osborni*, a taxon later to be submerged, perhaps erroneously, in the *Polycheria antarctica*-complex. Alderman (1936) at Moss Beach (not Moss Landing!) and Thorsteinson (1941) in Puget Sound continued to find new species and unravel old problems. Schellenberg (1936) described two species, one from British Columbia and one from the Galapagos Islands.

The British Columbian fauna just north of Puget Sound has been the subject of papers by Bousfield (see Literature Cited) and Mills (1961, 1962), the latter treating atylids and oedicerotids. Bousfield has made important contributions to the systematics of Californian beachhoppers, those Amphipoda of the genera *Orchestia* and *Orchestoidea* (not treated in the present report). Beachhoppers are the Amphipoda most familiar to university students and often are the subject of unpublished theses and reports.

The work of Barnard, like that of Holmes (1908) and some of that of Shoemaker, has been concerned primarily with subintertidal Californian Amphipoda. The valuable synopsis of Californian Lysianassidae published by Hurley (1963) also treats primarily of subintertidal faunas.

Since 1853 numerous species of Amphipoda described from extrinsic seas have been found in Californian waters, some of these species being ubiquitous and others of pan-boreal or tropicopolitan distribution. They do not form an integral part of the history of names of Californian Amphipoda.

Materials and Methods

Seven accessible rocky intertidal localities were surveyed as follows: Carmel Point, Cayucos (5 km. north of the town), Hazard Canyon reef, Goleta (Coal-Oil Point precisely), Pt. Dume, Corona del Mar (2 km. south of breakwater), and La Jolla (between 3 and 5 km. south of town). At each locality one or more gridworks were established by the placement of crossed strings 3 m. apart in the lower intertidal during ebb tides of minus 1.1 ft. or greater (table 1). Samples of a surface area of $\frac{1}{44}$th or $\frac{1}{50}$th square m. were taken from each gridwork intersection and preserved in a mixture of formaldehyde and seawater. At least one gridwork at each locality was placed in the densest stands of flora in the *Phyllospadix*-pelvetiid zone as shown in figure 114 of Hedgpeth's revision of "Between Pacific Tides" (1963). Generally these floras occur in the zone below mean low water. The seaward extent of the sampling sites in the major grids lay in the relatively pure stands of surf grass, *Phyllospadix* sp., and the landward extent in mixed pelvetiid algal floras.

A square brass or wooden frame with an inside area of either 1/44th or 1/50th square m. was dropped near each gridwork intersection and all epiflora enclosed by the frame and as much substrate as feasible was removed from the rock surfaces and preserved. Samples of 1/50th square m. were taken only at Carmel, La Jolla, and Corona del Mar. Long leaves of surf grass and stipes of algae were stranded through the frame and included in the samples. Various metal tools were used to chisel rock surfaces and to remove algal rhizomes.

At several localities (table 1), either simultaneously with the rock-surface collections or subsequently at other periods of ebb tide, gridworks were reestablished. The unconsolidated cobbles and boulders nearest each intersection were overturned and quantitative samples of either the underrock substrate or the encrusting faunas on the undersides of the rocks were taken. Quantitative samples also were collected in areas other than the *Phyllospadix*-pelvetiid zone. Occasionally these samples were grouped in grid-patterns but more often they were one sample sites of irregular or unusual substrate, such as: beds of sea anemones, sandy reef-like masses of the polychaete *Phragmatopoma* sp., tidepools containing articulated coralline algae, sponges, tunicates, algal turf, masses of soft polychaete tubes, hydroids, and mytilid beds. Many samples, not reported upon herein because they lacked amphipodan specimens, were taken of bare rocks, sparse algal mats, and underrock substrates.

A few samples collected by scuba divers in depths of 3 to 8 m. are described as examples of the contrast to amphipodan faunas of the intertidal zone. Subintertidal amphipodan faunas from 1 to 10 m. of depth are virtually unstudied in California and many more samples of this type should be collected.

During the period of 1946 to 1960 the writer collected samples occasionally at La Jolla, Corona del Mar, Pt. Fermin, and Monterey Bay. These samples were primarily of those substrates and floras that presumably would provide the best nestling sites for amphipods. Only a few of those collections are reported upon herein because the survey made between 1961 and 1963 has provided a broader representation of materials, owing in large part to the use of the gridwork sampling pattern. The latter method makes mandatory the collection of a sample at an intersection whether the site appears to be a habitat favorable for amphipods or not. In a larger sense, the selection of localities from a map also makes mandatory the sampling of areas seemingly unfavorable for collecting large quantities of amphipods. These methods have resulted in the discovery of many previously unrecorded or unknown species that were not found in the earlier samples noted above. Notwithstanding, a large number of gross, non-quantitative samples again was collected at each locality in the years 1961–63, primarily for the purpose of detecting extremely rare species. These samples are called "formalin washes" and consist of the washing of large quantities of substrate, flora, or sessile animals in a bucket of weak formaldehyde and seawater. The weak preservative disturbs motile organisms which emerge from their nestling sites, swim briefly in the water, die, and fall to the bottom of the bucket. The residues in the bucket are screened and preserved. Analyses of a few of these washes are included in Appendix I, especially those in which records of rare species are noted. Presumably a few species of Amphipoda are insufficiently mobile to be collected in formalin washes, although aliquots of washed substrates were examined in the laboratory for species which might not have emerged. Only *Polycheria antarctica*, an inhabitant of tunicates, was found still embedded in the tests of the hosts.

In the laboratory the samples were washed in a Tyler Screen of 0.5 mm. mesh, the Amphipoda counted and identified and in some cases separated by species into lots. However, after processing, most of the samples were represerved in alcohol in bulk lots and deposited in the collections of the Allan Hancock Foundation, University of Southern California, Los Angeles. Aliquots of the larger mass-samples were taken by weighing on a microgram balance.

Several species of rare occurrence and juveniles of others have not been described or identified. These are reserved until the survey can be extended to the north and south and into subintertidal depths where presumably larger suites of adults may be collected.

Ecological records of Amphipoda cited in the systematic section to follow are frequently appended with the terms rare, scarce, moderately abundant, and abundant. These approximations refer to the frequency of the species only in relation to other species of the stated sample.

The Collecting Localities

Northern area.—A single collecting locality on the Monterey Peninsula at Carmel Point represents the northern limit of this survey. It lies on the coast of middle California in the Montereyan subprovince of the Oregonian zoogeographic province. Its fauna is believed to be a southern representative of the cold-temperate region. The writer, after analysis of the samples, concluded that the selected site does not represent the richest possible habitat for Amphipoda in the area. Further exploration of the Monterey Peninsula has not been possible because of the termination of the writer's tenure in California. Floristically, the locality probably was impoverished and poorly protected from surf because the amphipodan fauna of rock-surface samples in the low tide zone was sparse, poorly diverse, and monotonous, in resemblance to samples from Goleta and Pt. Dume.

Middle area.—The coast between Cayucos and Goleta includes, according to geographers, portions of both middle and southern California. Pt. Conception, the well known biogeographic boundary between cold- and warm-temperate waters, is located in the middle of this coastal segment. Much of the shore between Cayucos and Goleta is inaccessible to humans because of military restrictions and the barring of access roads by gates of privately owned cattle ranches. Where public roads do reach the sea, the intertidal is usually composed of sand or cobble beaches often heavily pounded by surf and largely devoid of flora. Much of the apparently rocky coast (according to maps) between Point Conception and Goleta is drowned in sand, so that no rich collecting site typical of Cayucos or Corona del Mar has been sampled there. The Goleta substrate supports surf grass but the site has no barrier rocks, islets, lagoons, tidepools, or other structures associated with dense floras. Hence, the very interesting possibility of studying the kilometer-by-kilometer change in fauna on either side of an important environmental boundary has not been feasible because of the lack of similar substrates. Perhaps an impoverished locality north of Pt. Conception and similar to that of Goleta could be found and faunal comparisons could be made but numerous indicator species presumably would not occur in such impoverished sites.

Southern area.—Three localities from north to south, Pt. Dume, Corona del Mar, and La Jolla, represent the southern Californian coast. Pt. Fermin, a locality between Pt. Dume and Corona del Mar, might have been sampled but for the knowledge that since 1947 its fauna and flora have been altered by an outfall sewer and the extensive collecting by "holiday naturalists."

The locality known provincially as "Little Corona del Mar" is rather well known to local naturalists as a rich intertidal area with sufficient seaward protection to provide a few tidepools, several overhanging ledges, surge channels, and a diverse biota with unusually conspicuous sponge masses. In the writer's opinion, as based on observations between 1947 and 1962, the site at Corona del Mar has not been affected by human inroads as seriously as that at Pt. Fermin, although both are frequented by numerous collectors and biology classes. Corona del Mar appears to be a richer area than any at Laguna Beach, a few kilometers to the south where Vinnie Ream Stout (1912, 1913) made her collections and established the type localities of several Pacific species.

The poorly protected Pt. Dume locality is on a massive headland pounded by heavy surf; it lacks seaward reefs and is composed largely

280-102 O-69—2

of a few small rock platforms and unconsolidated cobbles. Its impoverished and monotonous amphipodan fauna reflects this situation.

The La Jolla locality is situated on a long, virtually straight coast extending between the town and Pacific Beach a dozen or more kilometers to the south. It has a few small reentrants and a few massive rocks affording partial protection to floras, but it is primarily a sloping platform of unconsolidated and fixed lithodes of cobble to boulder size. The algal flora appeared to be in good condition during the years 1947 to 1960 but during the collecting period reported herein the flora was wilted, desiccated, and bleached. Probably this situation was the result of a series of low tides coinciding with warm to hot, very dry climatic conditions. The presence of numerous amateurs (perhaps in the thousands per week) turning over rocks but failing to reset them in their original positions also may have contributed to the floral damage. In comparison to collections made in earlier years, the body sizes of the Amphipoda were notably smaller in the 1963 survey.

Locality summary.—The following paragraphs, tables, and appendices may demonstrate that, of those sites analyzed herein, only the amphipodan fauna of Corona del Mar is presently suitable as a descriptive base for interprovincial comparisons. The descriptive base is a list of species from the area. The Corona del Mar fauna may be representative of the northeastern Pacific warm-temperate region because it may contain a large percentage of those species endemic to the province. Additional names from La Jolla might be added to the list but that locality as a whole appears to be less diverse in units of substrate and flora than that at Corona del Mar. The locality at Pt. Fermin is affected adversely by an outfall. The sites at Pt. Dume and Goleta are impoverished and support several obviously cold-temperate taxa. None of the herein-studied localities north of Pt. Conception is suitable as a descriptive base for the cold-temperate region or even for the Montereyan subprovince. Hazard Canyon reef is a somewhat impoverished area, that fauna at Carmel Point is poorly diverse, and the extremely rich Cayucan site is not only close to Pt. Conception but supports an extraordinary mixture of clearly southern and clearly northern species. Indeed, several southern species occurring at Cayucos have not been collected from Corona del Mar. Whether the occurrence of southern species in high frequencies at Cayucos is the result of thermal changes during the years 1957–60 or whether the species inhabit a steady-state fauna thermally maintained by an eddy of the north flowing inshore Davidson current are factors to be investigated. No suitable collections of fauna from Cayucos and no inshore thermal records in years prior to the sea warming of the late 1950's are in existence as far as is known to the writer. According to offshore thermal records of the California Cooperative Fishery Investigation (CalCOFI) and unpublished records deposited in the Allan Hancock Foundation (from California Water Pollutional Survey studies) offshore sea temperatures returned to relatively normal ranges after 1960. The possible fluctuations in faunal composition and densities of species at Cayucos in relation to inshore thermal values would be information of use in determining whether a few type areas could be established for monitoring small changes in thermal environment by periodic faunal diagnoses. Perhaps organisms are better sensors of slight environmental changes than are human instruments.

The absence of some southern species at Corona del Mar, in contrast to their presence at the more northerly Cayucos site, may be the result of human interference with the environment and should be investigated.

If the warm-temperate northeastern Pacific region is definable as that coast between Bahía Magdalena, Baja California, and Pt. Conception, California (Garth, 1955), then the use of Corona del Mar as a descriptive base may be disadvantageous because of its northerly situation in the region. On the other hand, it is one of the few rocky intertidal areas of the 1100 km. coast that is not presumed to be under the influence of upwelling. Most of the Californian rocky intertidal occurs on projecting headlands; cold-temperate organisms are known to be distributed discontinuously southward on these headlands. Most of the headlands presumably would be unsuitable for the description of a warm-temperate provincial faunal type. The only other locality, known to the writer through personal observation, which might be suitable as a descriptive base is a 30 km. length of coast east of Punta Eugenia (east of Cedros Island, Baja California). However the fauna there is known to have two conspicuously different species not recorded from the mainland of California (J. L. Barnard, 1952b, 1952c). Those species have strong tropical affinities and may be representatives of an isolated tropical fauna.

The Amphipodan Fauna

This analysis is based on those quantitative and non-quantitative samples summarized in tables 3–25 and all samples described in full detail in Appendix I. Various samples not otherwise discussed are also included in Appendix I; they have unique combinations of species or new records.

As much of the data as possible have been collected with crude quantitative methods to provide information on frequencies of species (table 2). Those frequency data are to be used primarily as relative information within specific localities. Accurate total populations of the coastal intertidal cannot be calculated from those data because the sampling of substrates in the *Phyllospadix*-pelvetiid zone has been emphasized.

More than 155 species of Amphipoda, including those 118 species reported herein are now known to occur in the Californian intertidal (Appendix II). Nineteen of the species, requiring the erection of 4 genera, are new. Although more than a sixth of a million specimens has been processed in this survey, a surprisingly large number of species is rare (those having been collected as fewer than 10 specimens). Undoubtedly, numerous special habitats and niches remain unsurveyed. The unexpected divergence of amphipodan faunas at localities such as Pt. Dume and Goleta is evidence of the need for more detailed examination of additional localities. Study of specific habitats and ectocommensal relationships, utilization of screening devices with even smaller meshes, and the careful identification of juvenile stages are other desiderata for future studies.

GRIDWORKS IN THE *Phyllospadix*-pelvetiid ZONES.—Gross field observations have shown that these zones vary greatly from locality to locality. The dissimilarity in densities and kinds of flora, differences in degree of slope and therefore the width of the zone, the degree of exposure to surf, and the variable occurrence of sands all are reflected in the amphipodan faunas. In one grid at Carmel Point (48–A–E, table 3) the fauna is dominated numerically by *Oligochinus lighti*, with *Hyale grandicornis* and *Allorchestes anceps* next in rank, followed by low frequencies of *Hyale rubra frequens*. In a neighboring gridwork (table 4) *Hyale rubra frequens* is the most abundant species but it is nearly equalled by *Elasmopus rapax mutatus* and is followed in rank by *Photis* (cf. *bifurcata*) and *Aoroides columbiae; Oligochinus lighti* is a poor fifth in frequency and *Hyale grandicornis* and *Allorchestes anceps* are absent. In comparison with the *Phyllospadix*-pelvetiid zone at Cayucos, reported below, the sites at Carmel are impoverished; one of the sample grids at Carmel (table 3) yielded only 9 species of Amphipoda and the other (table 4) only 17 species. Other samples of *Phyllospadix* and algae are described in tables 5 and 6 in order to demonstrate a greater diversity to the fauna at Carmel than shown just by the gridworks of tables 3 and 4.

The *Phyllospadix*-pelvetiid zone at Cayucos seems as well developed and diversified as any observed between Monterey and La Jolla. Nevertheless, it is similar to most other sample grids of the zone at other localities because of the high frequencies of *Hyale rubra frequens*, *Aoroides columbiae*, *Photis brevipes* and *Calliopiella pratti* (table 7). A total of 47 species of Amphipoda has been collected in the sample grid (Appendix I). A contributing factor to this diversity is the strong intermixture of northern and southern species: northern *Calliopiella* *pratti, Oligochinus lighti,* and *Atylus levidensus;* and southern *Cheriphotis megacheles, Chevalia aviculae,* and *Ampelisca schellenbergi.* Other species of weaker northern or southern affinities occur in this sample grid: northern *Parallorchestes ochotensis, Parapleustes nautilus, Ocosingo borlus,* and southern *Eurystheus spinosus* and *Megamphopus effrenus.*

The *Phyllospadix* zone at Hazard Canyon reef occurs as a narrow strip adjacent to the steeply sloping, wave splashed edge of the main reef platform; the zone was not sampled effectively because many of the underwater, hand scraped samples undoubtedly suffered washing losses. For instance, only 10 species and 68 individuals of Amphipoda were found in sample 42-T-9 (Appendix I), whereas an average of about 17 species and 400 individuals per sample occurred in the gridwork at Cayucos. Only 20 species of Amphipoda were found in a sample grid of the reef platform (table 8 and Appendix I). The amphipodan fauna of Hazard Canyon, like that of one of the grids at Carmel, is dominated numerically by *Oligochinus lighti.* Perhaps, this is a reflection of the poor protection from surf and the reduction in density of plants. Some of the numerically predominant species found at Carmel also occur with *Oligochinus* at Hazard Canyon: *Elasmopus rapax mutatus, Parapleustes nautilus,* and *Parallorchestes nautilus.* The latter two species apparently occur most frequently under conditions of heavy surf whereas those predominant species at Cayucos, *Photis brevipes* and *Calliopiella pratti,* do not. *Aoroides columbiae* also appears to be depleted in situations of heavy surf. *Hyale grandicornis* and *Allorchestes anceps,* although not of high rank numerically, are conspicuous members of the fauna at Hazard Canyon.

The *Phyllospadix*-pelvetiid zone at Goleta (Coal-Oil Point) is very small, impoverished, and quite unprotected from surf action, although the shore faces south to the Santa Barbara Channel and is far more protected from northwestern Pacific swells than the region between Hazard Canyon and Monterey. *Hyale rubra frequens* is extremely abundant at Goleta (table 10) but its high ranking codominants are *Lysianassa macromerus, Jassa falcata, Ischyrocerus* sp. A, and *Pontogeneia rostrata,* an unusual combination of species. *Jassa falcata* is an ubiquitous harbor dweller often found in situations impoverished of other species and thus it is a logical inhabitant of Goleta. But the occurrence of a lysianassid amphipod, *Lysianassa macromerus,* is striking. Although Lysianassidae are the most diverse family of marine Amphipoda, their individuals are rarely abundant in any situation (except in Polar seas). Presumably *Lysianassa macromerus* is a deposit feeder and its frequency may be related to the partial inundation by sediments of the habitat at Goleta. The lysianassid may feed on sediments trapped in pockets among leaves and clumps of *Phyllos-*

padix, the sediments being protected from a severe cycle of erosion and deposition by the surf grass. Another dense population of amphipods presumably protected by algae in a sand inundated situation at the high tide line of La Jolla is described in table 24.

At Pt. Dume the *Phyllospadix* component of the lower intertidal zone is scarce. The densest zone of pelvetiids supports a mixture of typical Cayucan species plus those Amphipoda indicating some sedimentary encroachment and extreme wave-dash (table 11). Typically, *Hyale* and *Aoroides* are mixed with sand-encroachment indicators, *Pontogeneia rostrata* and *Lysianassa macromerus* plus the wave-dash indicator, *Parallorchestes ochotensis*. The prominence of *Paraphoxus spinosus*, member of a burrowing family, suggests the presence of unconsolidated sediments. Even the scrapings of coralline algae (table 12) have roughly the same faunistic composition as that of the pelvetiid zone. In an area slightly removed from that depicted in table 11, the phaeophytic samples of table 13 show a high ranking of paraphoxids, *Jassa* and *Parallorchestes*. This combination suggests impoverishment as a result of sand inundation and heavy surf. Indeed, 5 samples of corallines have only 11 species of amphipods. *Parallorchestes ochotensis* completely dominates those amphipods in a group of samples from a stand of brown algae on a vertical, wave dashed outcrop (table 14).

The *Phyllospadix*-pelvetiid zones at Corona del Mar and La Jolla are strongly intermingled with various species of articulated coralline algae. Despite differences in specific appellations, the amphipodan fauna is similar to that of Cayucos in the dominance of *Hyale rubra frequens*, followed in rank by several species of *Elasmopus* and *Photis*, and with *Aoroides columbiae* occurring in moderate abundance (table 19). However, *Microjassa litotes*, ranking sixth at Cayucos, comes to second place at La Jolla, and *Calliopiella pratti* has disappeared completely from intertidal zones south of Goleta. The several species of *Elasmopus* are much more prominent in the warm intertidal region of southern California than in the cooler region to the north. Strangely enough, they differ as to infraspecific designation between Corona del Mar and La Jolla, despite seasonal similarity in collecting. The niches filled by *Photis bifurcata* and *P. brevipes* at Cayucos apparently are filled by *P. elephantis* and *P. conchicola* at Corona del Mar. However, *Photis brevipes* is abundant at La Jolla and *P. elephantis* is sparse (tables 21, 23, 25), thus indicating possible stress between the two species. The subtropical apseudid-like *Cerapus tubularis* is a striking occupant of Corona del Mar. Bodies of the individuals are dark purple in alcohol and in life they inhabit circumferentially-striped, ochre-yellow-brown, cylindrical tubes.

The occurrence of a coralline flora in the *Phyllospadix*-pelvetiid zone of southern California not only seems to be associated with a replacement of species of those subdominant amphipodan genera occurring in middle California, but also with the occurrence of several southern species and genera (at least in terms of frequency rankings).

The dominant Amphipoda inhabiting the *Phyllospadix*-pelvetiid zone are summarized in table 26. Twenty species are considered to be numerically dominant in this zone but only a few are dominant at any one locality. Fifteen of the species occur throughout the region and 5 occur either north or south of Pt. Conception only. All of the dominant species, except the last two, are also the most abundant species of the zone (considered as a whole). Eight other species appended to the list are also very abundant in the zone but never dominate at any locality. The remaining species of the total of 72 occurring in the *Phyllospadix*-pelvetiid zone are of medium or low frequency.

WASHES OF SESSILE INVERTEBRATES.—Sessile organisms with numerous cavities often harbor large numbers of small nestling and commensal organisms. Pearse (1932), at the Dry Tortugas, collected one loggerhead sponge containing more than 17,000 individuals of invertebrates, largely crustaceans. Nothing of that order of magnitude has been collected in this survey, although the writer estimates that some sponges collected in this survey have yielded approximately the same density of crustaceans (100 per liter of sponge). Sponges and tunicates have proved to be excellent nestling sites for amphipods, second only to algae and surf grass. Most of the sponges collected, except for some loggerheads (*Spheciospongia* sp.), have been poor in vacuities; probably most of the Amphipoda have been nestling externally or occupying domiciliary tubes attached to the surfaces. Generally this situation is true also of tunicates. *Amaroucium* spp. (table 16) are hosts for *Polycheria osborni* (see Skogsberg and Vansell, 1928) but sample 38–F–1 of *Amaroucium* sp. was rich in non-polycheria Amphipoda which presumably inhabited its partially sand-encrusted epifauna. Thin layers of encrusting sponges and tunicates have very few amphipodan inhabitants.

Because sponges and tunicates often were collected together in mass samples, more discriminating work is required to discover the precise host for the following Amphipoda apparently restricted to those substates: *Anamixis linsleyi, Leucothoides pacifica, Fresnillo fimbriatus, Ocosingo borlus, Lysianassa pariter, L. dissimilis, Netamelita cortada*, both species of *Leucothoe*, and the very small and thus rare (because of screen sizes) *Colomastix pusilla*.

Of those Amphipoda associated obligatorily with sponges or tunicates, *Polycheria osborni* is best known because of its occurrence in small burrows in the tests of *Amaroucium* spp. Presumably the tunicates provide only refuge and not food for the amphipod, because the burrows apparently are formed by displacement and not consumption of the host tissues. The amphipod lies on its back in the burrow, circulates water with its pleopods, and apparently ingests filtered materials such as diatoms. On the other hand, *Anamixis linsleyi* bears extensively modified piercing-and-sucking mouthparts and presumably feeds on the tissues of its host, whatever that may be, tunicate or sponge. *Leucothoides pacifica, Leucothoe alata,* and *L. spinicarpa* generally are found with sponges. They may be inquilines, although their mouthparts are not as strongly modified for piercing and sucking as are those of *Anamixis*. The tiny lysianassids, *Ocosingo borlus* and *Fresnillo fimbriatus*, have piercing-and-sucking mouthparts and strongly reduced or modified urosomal appendages. These modifications indicate that they are sedentary inquilines. *Lysianassa pariter* and *L. dissimilis* are obligate associates of sponges and tunicates; this is unusual because some of their congeners are known to be deposit feeders and grazers (e.g. stomachs of *L. macromerus* have been found to be filled with fusiform diatoms; alimentary tracts of *L. oculata* and *L. holmesi* have been found to be filled with silt). Both of these spongicolous lysianassids have normal biting and chewing mouthparts. Presumably they have survived niche exclusion (by *L. macromerus* for instance) by living and feeding within sessile hosts. Stomachs of the few available specimens of *L. pariter* and *L. dissimilis* have been empty.

The supposition regarding niche exclusion may be true of *Elasmopus holgurus*, a gammarid rarely found outside of its association with sponges and tunicates. Its more "successful" relative, *E. rapax*, occupies a nestling niche in the *Phyllospadix*-pelvetiid zone. *Netamelita cortada* is also in this category—a chewer-biter associated with sessile organisms.

Often a rich source of small crustaceans, almost exclusively amphipods, are the sandy, reef-like masses of the polychaete, *Phragmatopoma* sp. Calcareous masses of *Dodecacaria* sp. are rather poorly inhabited by nestling Crustacea. Some quantification was possible in samples of the phragmatopomid mass at Pt. Dume (table 15) where 8 species representing 1380 individuals per square m. were collected. The amphipodan composition of these masses is not consistent because another sample taken at Corona del Mar (station 6) was dominated by *Ericthonius brasiliensis, Eurystheus thompsoni,* and *Elasmopus holgurus*, whereas the mass at Pt. Dume contained no specimens of *Ericthonius* and was dominated numerically by *Ampithoe pollex* and *Elasmopus* sp.

Special attention has been given in this survey to beds of sea anemones, *Anthopleura elegantissima* (Brandt), and the semi-solitary *Anthopleura xanthogrammica* (Brandt), in a vain search for the peculiar amphipod, *Allogaussia recondita* Stasek (1958). Anemone beds have been sampled by scrapings, mass accessions, and by sucking with large syringes. The type specimens of *A. recondita* were collected from beds of *A. elegantissima* at Moss Beach (San Mateo County, north of Monterey Bay). The southern intertidal limit of the amphipod may be near Moss Beach. If and when captured the species is easy to recognize because of its excellent description and large size. J. L. Barnard (1964b) considers *Allogaussia* to be a synonym of *Orchomene* but the problem remains whether the minute telsonic differences of various allogausiids (primarily Antarctic) are indicative of some overlooked morphological difference of greater magnitude. Some, but not all, Antarctic allogausiids have distorted pereopods but so also do some orchomeniids. Orchomeniids presumably are either benthic deposit feeders or nektonic. Stasek's discovery of *A. recondita* in an inquilinous habitat indicates an ecotype which may be distinguishable by, as yet undetected, morphological or anatomical characters. On the other hand, *Lysianassa pariter* not only occupies a habitat remote from that of its relatives but it is not grossly distinct morphologically from other species of *Lysianassa*.

The diversity of Acanthonotozomatidae apparently is very poor in Californian waters. That manifold family of primarily Antarctic occurrence is characterized by piercing-and-sucking mouthparts. Most of the 52 species may inhabit sessile hosts. Only two acanthonotozomatids, *Panoploea rickettsi* and a new panoploeid described herein, have been found in California. Probably a closer inspection of epifaunas by scuba divers would reveal more. The newly described panoploeid was collected at Goleta on a holdfast of *Macrocystis pyrifera* having a few intertangled sponges and tunicates.

Washes of kelp holdfasts.—Tangled masses of the rhizomes of the larger brown algae (the genera *Macrocystis*, *Laminaria*, *Egregia*, and *Postelsia*) afford numerous nestling positions, protected substrate for the attachment of domiciliary tubes and traps for sediments in which burrowers may occur (tables 9, 18). These woody kelps also provide niches for eophliantid plant burrowers, two of which have been discovered for the first time in the northeastern Pacific Ocean.

Holdfasts of *Macrocystis* are not of large dimensions in the Californian intertidal but are comparable to those of *Egregia* and *Laminaria*. Of the stipes of the larger kelps only those of *Egregia* provide a substrate for a poorly diversified amphipodan fauna (table 18);

generally 4 to 10 species of Amphipoda occur, with domination by *Hyale rubra frequens*, often with numerous individuals of *Amphilochus litoralis* and occasional unique locality occurrences of ampithoids such as *Ampithoe ?tea* and *A. ?mea.*

In the kelp-holdfast microcosm numerous secondary ecological mechanisms must be operating besides the basic protection afforded by the rhizomal interstices. The primary nestling and tube-dwelling niches are rather consistently occupied by *Hyale rubra frequens* and *Aoroides columbiae*, but various species occupying secondary positions as dominants are less consistently present. Presumably, the exposure of the plants to surf, the accumulation of sediments, and the presence of epiphytes are a few of the inter-rhizomal factors associated with the occurrence of amphipods. In 10 sets of samples of intertidal holdfasts of *Macrocystis*, *Egregia*, and *Laminaria* collected throughout the coastal area, *Hyale rubra frequens* numerically dominated 6 times and *Aoroides columbiae* was an abundant secondary dominant in 7 of the sample sets. Twenty-one other species were abundant secondary dominants in the 10 sets of samples but only *Parapleustes pugettensis* and *Eurystheus thompsoni* occurred in 4 sets, only *Ericthonius brasiliensis*, *Elasmopus rapax mutatus*, and *Photis conchicola* occurred in 3 sets, only *Elasmopus holgurus*, *Oligochinus lighti*, and *Najna ?consiliorum* occurred in 2 sets. The remaining 13 species occurred only in one set apiece; among these species were such important inhabitants of the *Phyllospadix*-pelvetiid zone as *Elasmopus rapax serricatus*, *Photis brevipes*, *P. elephantis*, *Megamphopus martesia*, and *Microjassa litotes*.

Holdfasts of *Macrocystis* in depths below intertidal surf action are very large (often with volumes of more than 100 liters). These infrequently sampled habitats harbor a very diversified host of amphipods, many of which are rare or absent in the intertidal zone (sample 41 of Goleta, Appendix I). The dominant Amphipoda in sample 41 are *Photis bifurcata*, *P. brevipes*, *Microdeutopus schmitti*, *Maera simile*, *Eurystheus thompsoni*, and *Heterophlias seclusus escabrosa*. More than 35 species have been found in one small aliquot of the 40-liter sample and undoubtedly analyses of additional materials would reveal numerous other species. In another *Macrocystis* holdfast collected at Campbell station 6 near Goleta, the dominant Amphipoda are *Ceradocus spinicauda*, *Cymadusa uncinata*, *Maera simile*, *Microdeutopus schmitti*, and *Eurystheus mamolus*. Few of those species occur in the intertidal zone. Apparently *Heterophlias* of the Phliantidae is a woody plant borer or scavenger, because, with one exception noted below, its individuals have been collected in association with kelps and they bear lignin-like material in their alimentary tracts. *Cymadusa uncinata*, reaching 40 mm. in length, is the largest species of Amphipoda in Californian coastal shallows; the largest individuals have been found only in association with the largest marine plant. Possibly this is the amphipod, reported by scuba divers, which rolls up the blade margins of *Macrocystis* and "stitches" (?cements) them into dwelling cylinders; however, all the specimens at hand of *C. uncinata* have been collected in rhizomes. The striking *Ceradocus spinicauda*, of northern affinity and occurring intertidally at Coos Bay, Oregon, apparently is obligatorily associated with marine plants but in southern California it occurs only subintertidally.

A surprisingly large number of species appears to be restricted to kelp holdfasts or to occur most frequently in those habitats. Amphipoda believed to be restricted to holdfasts are: *Amphilochus picadurus*, *Ceradocus spinicauda*, *Cymadusa uncinata*, *Eurystheus mamolus*, *Lembos ?concavus*, *Lignophliantis pyrifera* (the borer), *Liljeborgia geminata*, *Maera lupana*, *Melita appendiculata*, and *Najna ?consiliorum*. Those species occurring more frequently in holdfasts than in other habitats are: *Ampithoe humeralis* (a northern species rare in southern California), *Ampithoe lindbergi* (abundant in *Egregia*-stipes), *Chevalia aviculae*, *Corophium uenoi* (also in red-algal fields, on diopatrid-bottoms and in lagoons), *Heterophlias seclusus escabrosa*, and *Maera simile*. A third list to follow includes those species apparently occurring as strays in holdfasts; these Amphipoda are otherwise far more frequent on soft bottoms: *Ampelisca pugetica*, *Batea transversa* (abundant in subintertidal clumps of small fleshy algae in the Channel Islands), *Lepidepecreum gurjanovae*, *Metaphoxus fultoni*, *Orchomene pacifica*, and *Synchelidium* sp. M (sand bottoms and semi-neritic).

Corallinaeceous algal-dwellers.—Jointed coralline algae were sampled at Carmel (station 48–H–2), Hazard Canyon (42–B–4–X, 42–T–11), Pt. Dume (table 11), and La Jolla (45–O–1, O–2, T–1, W–3 and W–4). At La Jolla and Corona del Mar, corallines were so inextricably mixed with the *Phyllospadix*-pelvetiid flora that the zone has been denoted herein by the term "*Phyllospadix*-corallinaceous."

In the larger group samples of relatively pure stands of corallines the overwhelmingly dominant amphipod is *Hyale rubra frequens*, which is 7 to 10 times more numerous than the second most abundant species. The algal stand at La Jolla is probably more typical of southern California than that stand at sand scoured Pt. Dume. Thus, 5 samples from La Jolla reveal 27 species of Amphipoda and 5 from Pt. Dume only 16 species. *Pontogeneia rostrata* is a conspicuous subdominant at Pt. Dume, but it is rare at La Jolla and is not replaced by another abundant pontogeneiid. Probably the southern limits of *Pontogeneia rostrata* occur in this region of southern California. At La Jolla conspicuous subdominants are *Elasmopus rapax* *serricatus*, *Ampithoe pollex*, *A. plumulosa*, *Microjassa litotes*, *Aoroides columbiae*, *Microdeutopus schmitti*, and *Photis brevipes*. At Pt. Dume only *Aoroides columbiae* and *Ampithoe pollex* are as frequent as they are at La Jolla, and at Pt. Dume they occur with *Lysianassa macromerus*, an apparent indicator of sand inundation, and *Parallorchestes ochotensis*, a species presumably near its southern limits in the area.

Corallines are scarce at Carmel and Hazard Canyon but those familiar amphipods, *Hyale* and *Aoroides*, dominate in conjunction with *Oligochinus lighti* (a northern species) and *Elasmopus rapax mutatus*. *Parapleustes nautilus* appears to have a strong positive association with corallines in middle California.

Dense, almost pure stands of various species of corallines occur in many places in southern California but few Amphipoda are confined to them obligatorily. Indeed, the amphipodan fauna of coralline substrates is poorly diverse in contrast to the faunas of *Phyllospadix*-stands, kelp holdfasts and some of the larger masses of sponge and arenaceous polychaetes. Only 5 species of Amphipoda appear to have a strong association with corallines: *Amphilochus litoralis* (also on stipes of *Egregia*), *A. neapolitanus*, *Ampithoe plumulosa*, *Pontogeneia quinsana*, and *Stenothoe estacola*. Only the latter species is obligatorily restricted to corallines; the others are found in other situations, *A. plumulosa* especially having been collected frequently on floating docks in harbors.

Interstitial rock nestlers, foulers, and sedimentary burrowers.—The most conspicuous rock nestlers discovered in this survey are the pale pink *Maera vigota*, n.sp., individuals of which were lying partially desiccated between rocks in the intertidal of Cayucos. Their clusters gave the appearance of colonies of pink encrusting organisms.

Sedimentary substrates under rocks are poorly inhabited by Amphipoda. Samples from Cayucos (43–B–2, 43–C–1, 43–H–1), Corona del Mar (table 20), and La Jolla (table 22 and Appendix I) are representative. At La Jolla the underrock substrate is dominated by *Elasmopus rapax serricatus*, *Photis brevipes*, and *Microjassa litotes*. Six of the first 11 species of table 22 are tube dwellers, 4 are nestlers, and one, *Heterophlias seclusus*, is an unusual member of this habitat in view of the previously stated supposition that it is a woody-algal burrower or scavenger. The only prominent sediment burrowers in the intertidal are the several species of *Paraphoxus*, *P. obtusidens*, *P. spinosus*, and *P. stenodes*. They are found primarily under rocks on sands and fine sands. Tubes of domiciliary Amphipoda rarely dominate a wave dashed rock to the extent they dominate pilings in protected harbors (table 17). Presumably wave dash is too severe for tube dwellers to colonize rocks unless protection has been established by encrusting organisms. Even in surf protected situations rocks are poorly fouled with amphipod tubes. Nevertheless, the number of tube dwellers in the Californian intertidal is large, 58 of the 155+ species reported upon herein (Appendix II) being of that habit (Isaeidae, Ischyroceridae, Corophiidae, Aoridae, Ampeliscidae, and Ampithoidae). Only 8 species of sediment burrowers have been found in the Californian intertidal and most of those are more abundant on subintertidal soft bottoms than on intertidal epibioses.

The important species of Amphipoda.—Several species of high frequency, unusual habitat, or particular usefulness as indicators of various ecological or zoogeographic conditions are discussed in sequel. Problems of identification of some taxa also are emphasized. Most of the minute details of occurrences, frequencies, and combinations of species in various samples is left for the reader to examine in the tables and appendices.

The most abundant amphipod in the Californian intertidal (from at least middle California southward) is *Hyale rubra frequens* (tables 3–24). This fact has long been known to naturalists gathering intertidal plant materials and observing swarms of *Hyale* emerging when disturbed by preservatives. Individuals of *Hyale* are especially prevalent on surf grass and on stipes of *Egregia*, in the holdfasts of kelps, and in tidepools partially filled with coralline algae. Although the ubiquity of *Hyale* is monotonous, the individuals exhibit a degree of phenotypy which should be studied ecogenetically. The typical subspecies was described from New Zealand. The Californian subspecies, *H. r. frequens*, as so considered herein, differs only in minor characters not warranting full specific recognition in light of the present state of knowledge and practice in amphipodan systematics. The extreme density of this subspecies in the intertidal is good evidence of the success of an epigenotype which may have ties across vast distances of the sea, especially in view of its orientation to plant materials which can be rafted. Study in progress on Galapagan Amphipoda indicates a close connection between California and the Galapagos Islands through rafting of plant materials. Vegetable debris collected by the "Galathea" expedition at sea far from continental shores contains dense, apparently viable populations of amphipods, not however *H. rubra* (material examined in 1961). Possibly the poorly known *Hyale nigra* of Australia and the Red Sea is another representative of the *Hyale rubra*-complex.

The systematics of the genus should be studied with a view that a Rassenkreis of hyalid taxa might exist throughout the Pacific Ocean. The amphipodan fauna of California appears to have several connections with that of Japan. For instance, Iwasa (1939) reported *H. schmidti*, a species which is closest to the *H. rubra* of California. As further discussed in the systematic section to follow, that identification of European *H. schmidti* from Japan may be erroneous and Iwasa's specimens may need a new or different name. The Japanese specimens are as closely related to *H. rubra* of New Zealand as they are to the rather confused depiction of European *H. schmidti.* In this respect one might suggest an origin of New Zealand *H. rubra* from Californian *H.r. frequens,* followed by fully specific differentiation in the Japanese *H. "schmidti."* On the other hand, *H. rubra rubra* is reported herein as occurring in "subtropical" waters of Santa Catalina Island and Cedros Island, thus giving the species a pan-Pacific distribution. Hence, *H.r. frequens* may simply be a northern race of a widely distributed tropical species and it may have no direct connection with New Zealand or Japanese populations.

The European *Hyale camptonyx* is a puzzle because it has been reported several times in rather distinct morphs and because no reliable character is known which distinguishes it from *H. rubra.* But *Hyale rubra frequens* is distinguished from *H. camptonyx, H. schmidti* of Japan and *H. rubra* of New Zealand by the shortness of the terminal setae of the maxillipedal dactyls. This character may prove to be of specific value.

Oligochinus lighti, a taxon recognized in the first edition of "Light's Manual," occupies a prominent position in the fauna of the heavily wave dashed platforms of Hazard Canyon reef and Carmel Point where stands of algae and surf grass are short-tufted. In those places its frequency exceeds that of *Hyale rubra* by nearly an order of magnitude. In the more rocky and protected zone at Cayucos, *Oligochinus* is considerably less abundant relative to other species than it is at Hazard Canyon and Carmel. Apparently *Oligochinus* is a nestler, like *Hyale. Calliopiella pratti,* another conspicuously northern species, like *Oligochinus,* is a calliopiid and presumably a nestler.

Aoroides columbiae is extremely numerous at Cayucos. Apparently it attaches its tubes to the leaf bases of the surf grass. It is less frequent on the exposed Hazard Canyon platform and it is strongly diminished in numbers in southern California. However, it is abundant on the benthos of the coastal shelf to depths of about 80 m. and apparently it submerges in southern waters as an ecothermic response.

The extreme abundance at Goleta and Pt. Dume of the previously discussed *Lysianassa macromerus* is of considerable interest because of the infrequent occurrence of Lysianassidae in mid-latitudinal intertidal zones. Presumably this abundance of *L. macromerus* is related to floral impoverishment, poor protection from surf, and partial inundation by sediments of the mentioned sites.

The genus *Photis* is well diversified in California and like other multispecific genera of the area, females and juveniles are difficult to identify specifically because most of the conspicuous taxonomic characters are found on male second gnathopods. Terminal adult males of *Photis* spp. are, perhaps, rarer than those of any other sexually dimorphic group collected in this survey. Ovigerous females and young males obviously are sufficiently common to sustain intertidal populations but subterminal males are remarkably similar among the several species. If the autecologist were to require identification of young individuals, a morphometric analysis of various character proportions would be needed. The large background-count of juvenile photises in these samples has complicated the recognition of allied genera having small-bodied adults. The distinctive third uropod of photises can be observed readily by placing the specimens on a depression slide and utilizing medium powers of compound microscopes. After considerable trial and error the indescribably subtle differences in body shapes of juvenile photids can be recognized and the individual mounting dispensed with. Juvenile photises especially may be confused with adults of *Microjassa litotes*. Specimens of the latter species are distinguished by their shiny bodies and pale pink eyes (in alcohol). Juvenile photises have dull bodies and darkly pigmented eyes; however, photids preserved for more than a year may lose all pigmentation. Uropod 3 of *M. litotes* is fully biramous in contrast to those of photises but this condition is difficult to resolve by use of low power dissecting microscopes.

Photis elephantis, with its elephantine pereopods on terminal males, is a most unusual appearing species. The pereopods autotomize readily in preservative. Expanded pereopods apparently do not occur on all terminal males possibly because intersexual development occurs. That the species is not a localized race at Corona del Mar or a diseased population of some other species, are facts suggested by its occurrence in a slightly different morph at the Galapagos Islands (material in hand).

Although the genus *Maera* is well diversified in California (5 species) the frequency of individuals is very low in the intertidal. On the other hand, the closest generic relative, *Elasmopus*, is represented in California by 4 or 5 species, the individuals of which are extremely abundant. Both genera are primarily tropical in occurrence. Another genus of Gammaridae, the cold-temperate *Melita* (3 species in California) is poorly represented in the southern half of California. Individuals of the two northern species are scarce. One of the few tropical melitids, *M. appendiculata*, is also rare in the Californian intertidal. The latter species is remarkable because of its disymmetrical, *Uca*-like male second gnathopods (see Chevreux and Fage, 1925).

The importance of the genus *Elasmopus* in the Californian intertidal should be emphasized. Like so many other amphipods the adult males of *Elasmopus* are more easily identified than females or juveniles. Small lots of *Elasmopus* spp., with a single male and numerous other individuals, have been identified only by the male, although the other individuals have been examined cursorily for gross distinctions. Variation in the *Elasmopus rapax*-complex is of such an order as to confound the taxonomy of the group. Two major open sea morphs are present in California, *E.r. serricatus* and *E.r. mutatus*. Apparently their niches are spatially isolated because they do not occur together in samples of 1/44th square m. size in the *Phyllospadix*-pelvetiid zone. The typical subspecies, *E.r. rapax*, occurs in California only in harbors. Perhaps *E. holgurus* is a member of the *E. rapax* complex; again it has a detectable ecological isolation because of its obligatory association with sponges or tunicates. *Elasmopus antennatus* is but one character removed from the complex: it lacks palmar ornamentation on male gnathopod 2. A population of *E. antennatus* from Carmel Point resembles *E. rapax serricatus* because of its serricate fifth pereopod. Serrication of pereopods, being represented otherwise only on *E. pectenicrus* (pereopod 4), is rare in the genus *Elasmopus* (35+ species). That two species, heretofore considered distinct, should be shown to have morphs of this kind in a confined area (of perhaps a few square meters), confounds their taxonomic separation. Seasonal phenotypy in amphipodan species has scarcely been studied but it might be used as a point of departure in the elucidation of this problem.

Intertidal ampeliscids of southern California are primarily of southern affinity. The pan-American *Ampelisca schellenbergi* reaches its northern limit in southern California and the giant *A. venetiensis*, of tropical eastern Pacific distribution, is so rare that it has not been collected in this survey even though it was described originally from Venice, California. *Ampelisca lobata* is a pan-American species of wider distribution than *A. schellenbergi;* the former occurs as far north as Puget Sound and is, by far, the most frequently occurring intertidal ampeliscid. Both *A. lobata* and *A. schellenbergi* presumably have an obligatory association with plant materials whereas most of their congeners build their domiciliary tubes on soft bottoms. *Ampelisca* is the most diverse gammaridean genus (95+ species).

At least 10 ampithoids, including a pleonexes and a cymadusa, occur in the Californian intertidal and more may be discovered in northern California. They especially inhabit kelps and may be found to be more diversified subintertidally than heretofore shown. The intertidal collections of the family are difficult to identify specifically because of the rarity of adult males. J. L. Barnard (1965a) gives a few aids in identifying females and juveniles but all problems have not been solved. The complex of "northern" species, those with slender, poorly palmate first gnathopods, is especially difficult to resolve and one must consider the possibility that *A. lindbergi*, *A. plea*, *A. "mea,"* and *A. tea* are all morphs of a single epigenotype. In southern California *Ampithoe pollex* and *A. simulans* (=*A. dalli*) are extremely difficult to differentiate because *A. pollex* appears to have at least 2 phenotypes (as evidenced by color in alcohol, hence artificial). Possible hydridization has been detected but not thoroughly investigated in several specimens.

The nomenclatural history of *Eurystheus thompsoni* has been the most confused of that of any Californian amphipod, owing in part to the radical morphological changes which occur at sexual maturity. The most remarkable of those changes is the enormous increase in size of the male seventh coxae, a change unique to this gammaridean and its phylon from the Gulf of California (Barnard, 1968). Other species of *Eurystheus*, *Megamphopus* and even *Aoroides* resemble *E. thompsoni* (=*E. tenuicornis*, =*Podoceropsis concava*) but the minute dorsal ornamentation of the fourth pleonite is distinctive for *E. thompsoni*.

Stenothoids are poorly represented in the Californian intertidal; they are small, 1 to 3 mm. in adult length and many of them may have been lost in the screening of the samples. They are extraordinarily difficult to identify generically because of taxonomic dependence on palps of mouthparts. However, those so far discovered have diverse combinations of gnathopod 1, shapes of pereopods 3–5, coxa 4, antennal lengths, eyes and minute ornamentation of pereopodal dactyls. Excision of mouthparts for identification of each specimen is therefore not necessary.

Juveniles of ischyrocerids, photids, ampithoids, and small-bodied species of *Eurystheus* and *Megamphopus* form a high "background" count in Californian intertidal samples. The ischyrocerids may be recognized by the elongation of the third uropodal peduncle, the rami being short and styliform. In contrast, ampithoids have stout, stubby, even shorter rami than those of ischyrocerids. *Jassa falcata*, the ubiquitous ischyrocerid, is recognized by the outer ramus of uropod 3 bearing a distally hooked, basally immersed spine, with 2 (occasionally 1 or 3) sharp, flat, asymmetrically triangular, slightly reverted scales proximally adjacent to the distal spine. Other ischyrocerids may bear the spine but those so having also bear scales (denticles, teeth, cusps) which are less flattened, not reverted, much smaller, blunter, and more numerous than those of *J. falcata*. Although *Jassa falcata* is well known to amphipodan taxonomists because of its extreme antennal and gnathopodal polymorphism (see Sexton and Reid, 1951), a new kind with unusually slender

280-102 O-69—3

body and second gnathopods is recognized herein. Because of its remarkable appearance and its abundance it should be marked as a distinct member of the Californian fauna, even though it is not distinguished nomenclaturally.

Geographic Relationships of Californian Amphipoda

Eastern Pacific relationships.—More than 25 percent of the Californian amphipodan fauna is of unknown geographic affinities (table 30), but taxa of northern (table 28) and of southern character (table 29) have been detected. The latter elements are of approximately equal diversity but each is less manifold than that "ubiquitous" element (table 27) found throughout the area. Amphipodan faunas to the north of California have been studied more thoroughly than those to the south and this results in a stronger northern aspect to the southern Californian fauna than is perhaps realistic. Probably most of the species of unknown affinity (table 30) are either southern in affinity or are endemic to warm-temperate waters.

In those diverse faunas of Corona del Mar and Cayucos the most frequently occurring taxa are ubiquitous in California, for example: *Hyale rubra frequens*, *Aoroides columbiae*, *Jassa falcata*, *Ericthonius brasiliensis*, *Microjassa litotes*, *Eurystheus thompsoni*, *Photis brevipes*, *Parapleustes pugettensis*, and *Elasmopus rapax mutatus*. North of Pt. Conception, however, other species of northern affinity also occur in abundance: *Oligochinus lighti*, *Parapleustes nautilus*, and *Pontogeneia rostrata*. South of Pt. Conception several southern species are abundant: *Photis elephantis*, *Cheiriphotis megacheles*, *Megamphopus effrenus*, *M. martesia*, and *Microdeutopus schmitti*. At impoverished sites such as Pt. Dume the individuals of the northern *Parallorchestes ochotensis* are quite abundant and at Hazard Canyon and Carmel the presumedly Californian *Lysianassa macromerus* and the northern *Oligochinus lighti* are frequent in occurrence.

About one third of the southern species is known to be tropicopolitan and many but not all of the remainder may be tropical pan-American in distribution.

Coincidentally, about one third of the northern species has been identified in boreal seas on both sides of the Pacific Ocean, although some of the identifications are questionable.

About one quarter of the ubiquitous Californian species is also extrinsic, some taxa being cosmopolitan, others of northwestern Pacific affinity and one, *Heterophlias*, of tropical American affinity. Many of the so-called ubiquitous Californian species undoubtedly occur southward only to Magdalena Bay on the Baja Californian coast where subtropical and warm-temperate faunas are replaced by tropical faunas of the Gulf of Californian and Panamic provinces. Probably all of the following species are confined northward of the tropical boundary: *Aoroides columbiae, Ampithoe humeralis, A. lacertosa, A. lindbergi, Cymadusa uncinata, Eurystheus thompsoni,* and *Parapleustes pugettensis.* Other species that may be in this category are those occurring as far north as Puget Sound, for example: *Maera simile, Melita sulca, Photis brevipes,* and *P. bifurcata.* Most of the remaining ubiquitous Californian species are known to or are presumed to occur well into tropical latitudes although some inhabit only subintertidal depths.

The nearly equal distribution of the fauna among ubiquitous, northern, southern, and presumed endemic species is not surprising in view of the transition from cold- to warm-temperate environments in the region. Those facts supporting the view that Pt. Conception represents a boundary between provinces (table 28) are as follows: the absence, rarity, submergence, or occurrence in special environments (lagoons with extreme thermal ranges) of numerous northern species south of Pt. Conception; the same factors applying in reverse to southern species north of Pt. Conception.

Relationships to faunas of other seas.—Few surveys of intertidal Amphipoda comparable to that being reported upon have been made in other parts of the world. Indeed, Amphipoda of the subintertidal benthos appear to have been studied more thoroughly than those of the intertidal zone. For instance, Sars' (1895) Amphipoda of Norway was based primarily on dredged samples; perhaps this reflected the problem of reaching intertidal localities on a rugged coastline by land transport. Even the early work of Bate and Westwood (1863) was based primarily on dredgings made in Plymouth Sound. Many of the records of European Amphipoda published in the 19th and early 20th centuries were imprecise as to habitat. The writer, to assemble the data presented in tables 31–33, has selected information for the British Isles from the "Plymouth Marine Fauna, 1957" and from the faunal list of the Isle of Man prepared by Bruce, Colman, and Jones (1963). Some species included in those compilations have been omitted from present consideration owing to imprecision as to habitat. The faunal extract of French Mediterranean and Atlantic shores is based on Chevreux and Fage (1925) and a conservative approach again has been necessary because of imprecision as to the intertidal occurrences of several species. Details of the Magellanic fauna have been taken from the compilation published by Schellenberg (1931) with the understanding that his term "littoral" includes primarily sublittoral species. The writer has amalgamated Gurjanova's (1951) records of Amphipoda from the Okhotsk Sea and Japan Sea but has omitted insular Japanese records in order to compress the area covered and make it comparable to that covered in California.

The numbers of known amphipodan species in various regions of the world are compared in table 31. The tropical data are not equivalent to the other data. No tropical continental shore has been explored adequately, although several insular faunas have been rather well studied. All known Indo-Pacific intertidal species have been tallied with the presumption that numerous insular endemics are included. There is no evidence in the literature that Amphipoda are more diversified in the tropics than they are in higher latitudes. For instance, the sums of all known littoral-sublittoral Amphipoda from either Norway, southern California, or of the tropical Indo-Pacific are approximately equal: $300 \pm 5\%$. Tropical islands are known to have a poorly diverse intertidal amphipodan fauna (Schellenberg, 1938 and J. L. Barnard, 1965). The only other evidence in the matter is the writer's examination of the Caribbean Panamic intertidal reef fauna (in preparation). There, the diversity of Amphipoda is poor, although several species occur in very high frequencies of individuals. A coral reef may afford numerous nestling sites for organisms such as Amphipoda, but the paucity of fleshy algae, debris, and detritus may be a restrictive factor. The real test of the latitudinal diversity hypothesis will come when a continental shelf fauna in the tropics can be studied. To be comparable to those areas already studied in higher latitudes the tropical shelf must be composed of relatively fine-grained sediments, generally in the range of 30 to 125 microns of median diameter with an average between 60 and 80 microns. Thus, the survey of the Gold Coast continental shelf by Buchanan (1957) revealed few Amphipoda, but the sediments were extremely coarse. J. L. Barnard (1963) gave evidence showing the impoverishment of amphipodan faunas on coarse sediments.

Differences among tallies of Amphipoda in those regions listed in table 31 are not sufficiently extreme to be significant, except in the case of Mediterranean France. Atlantic France and the southern half of California have approximately equal numbers of species, even though the median latitude of France is nearly 15° farther north than the median latitude of that portion of California. According to Ekman (1953) the warm-temperate region of the northeastern Atlantic extends northward approximately to the western end of the English Channel; thus, warm-temperate waters occur about 15° farther north in the eastern Atlantic than they do in the eastern Pacific. Indeed, Ekman did not recognize a warm-temperate northeastern Pacific region but this erroneous conclusion was rectified by Garth (1955). The faunas of the southern half of California and Atlantic France are comparable in their equal division between warm and cold-temperate waters, Pt. Conception and the capes of Brittany representing the dividing lines in either case. Mediterranean France has a similar atmospheric climate to that of California south of Pt. Conception and winter marine thermal regimes also are similar. In summer, the temperature of inshore Mediterranean waters is about 5° higher than that of southern California. Despite these similarities the amphipodan fauna of Mediterranean France is considerably less diverse than that of California or Atlantic France. Species of the three amphipodan faunas are compared in table 32.

Many similarities occur between the faunas of Atlantic France and California. Several subcosmopolitan species occur in both places (e.g. *Leucothoe spinicarpa, Amphilochus neapolitanus*) and a tropical species, *Ampithoe ramondi,* occurs in the southern half of each area. Both faunas have: a species of *Panoploea;* several species of *Ampelisca,* two of which are probably obligatory inhabitants of epifloras in each area; subequal representation of amphilochids, aorids, atylids, corophiids, eophliantids, gammarids (Gammaridae, not *Gammarus*), hyalids, isaeids (=photids), stenothoids, and ischyrocerids. On the other hand there is poor representation of ampithoids and eusirids and a complete absence of anamixids, bateids and pleustids in France. In California the following groups are absent or poorly represented: calliopiids (especially *Apherusa*), dexaminids, haustoriids (mostly inhabitants of sediments) and especially lysianassids. Possibly some of these groups are interreplaceable ecologically but, with the exception of Enequist's (1950) work, little is known of the ecology of the various families. For instance, eusirids and calliopiids may occupy similar niches (indeed the two families eventually may be amalgamated) and bateids may have requirements similar to those of the above groups; thus, 2 bateids, 2 calliopiids, and 7 eusirids of California may be the ecological equivalents of the 5 calliopiids and 1 eusirid of France. The large number of presumed intertidal French lysianassids may be figmentary because they may have been collected primarily in subintertidal depths. Pleustids are numerous in the Californian intertidal and, although they are not reported from the French intertidal, they are frequent in subintertidal collections. Perhaps the most striking impoverishment of the French fauna is the poor representation of the genus *Ampithoe;* only 2 species occur in France whereas at least 11 occur in California. The genus is poorly represented everywhere in the north Atlantic Ocean.

Endemic genera are more numerous in California than in France. Almost all of the French genera are found in other regions of the world. In contrast, California has the following genera which have not been found in other seas, as yet: *Neomegamphopus, Netamelita, Fresnillo, Ocosingo,* and *Pleusirus.* France has 69 genera and California 70, but

6 genera of Lysianassidae, Haustoriidae, and Oedicerotidae probably should not be included as "normal" inhabitants of the French rocky intertidal.

No information on individual frequency of the French species is available, but it may be true, as it is in California, that the most diverse genera often have those species which are most abundant in individuals. Thus, the Californian intertidal is dominated by species of diverse genera such as *Hyale, Photis, Ampithoe, Elasmopus, Ericthonius, Eurystheus,* and *Ischyrocerus;* only 2 poorly diverse genera, *Aoroides* and *Oligochinus*, are also dominant in individuals. Several diverse genera with poor numerical representation in the intertidal are dismissed as being those primarily adapted to other habitats: *Paraphoxus, Ampelisca* and *Corophium. Maera* and *Melita* are diverse genera with low frequency in the Californian intertidal but the first is primarily a tropical genus, the second a cold-temperate genus. In California the exceptional diverse genus with infrequently occurring individuals is *Pontogeneia* (4 species in the region).

In order to avoid publishing long lists of species, a simple comparative index has been devised to interrelate any two faunas. The index base is composed of the lesser number of species occurring in the same genus in two areas. The sums of all genera are tallied. The sum is 48 species for the pair of geographic areas: Atlantic France and California. The smallest total number of species in the two faunas is the 123 of France. The index (39%) is the percent of species in the same genera of the less diverse of the two faunas.

The Californian fauna may be compared with that of other regions by the above index, as follows: Magellan 37%, Japan-Okhotsk Seas 51%, Plymouth-Isle of Man 46%, Indo-Pacific tropics 60% (New Zealand 62%, Australia 47%, the latter two sets of data being scanty and overlapping several zoogeographic provinces). The resulting percentages are surprisingly high; they reflect the common occurrence of diverse genera in all intertidal faunas of the world (table 33). Diverse genera and families are listed in table 35 with the numbers of their species in each fauna. The strong relationship between Californian and tropical faunas is a result of the common occurrence of the genera *Ampithoe, Cymadusa, Elasmopus, Eurystheus, Hyale, Ischyrocerus, Lembos, Maera, Photis,* and *Podocerus.* Generic similarity to the Magellan area is reflected primarily in the large numbers of species of *Eurystheus* and *Pontogeneia.* Strong relationship to the Japan-Okhotsk region occurs in the genera *Ampithoe* and *Pontogeneia.* The genera *Hyale, Lysianassa,* and *Melita* are common to the faunas of the British Isles and California.

Although the intertidal amphipodan fauna of California is strongly influenced by the occurrence of tropical genera (above list plus

Chevalia and *Cheiriphotis*), most of the species which are shared with any other well-studied region are those occurring in the Japan-Okhotsk region (with particular emphasis on the genus *Ampithoe*). Even though the greatest regional dissimilarity may occur between the faunas of California and France and the presently known greatest similarities occur between California and the northwestern Pacific, the fauna of the western Atlantic (including the Caribbean Sea) may prove to be that most congruent with California. The warm-temperate and tropical Amphipoda of the western Atlantic Ocean are poorly known. Only 71 species have been reported from littoral-sublittoral depths of the Caribbean Sea and Gulf of Mexico, but 34 of these also occur in the eastern Pacific Ocean. Some of these pan-American taxa occur as far north as California: *Ampithoe pollex*, *A. longimana*, *A. valida*, *Paraphoxus spinosus*, *Ampelicsa schellenbergi*, *A. lobata*, *A. venetiensis*. Several pan-boreal or pan-tropical species occur on both shores of the Americas: *Leucothoe spinicarpa*, *Calliopius laeviusculus*, *Pontogeneia inermis*, *Jassa falcata*, *Ischyrocerus anguipes*, *Cerapus tubularis*, *Ericthonius brasiliensis*, *E. hunteri*, *Elasmopus rapax*, both known species of *Parhyale*, and *Melita appendiculata*. Common sub-intertidal pan-American species are *Ampelisca cristata*, *A. compressa*, *A. romigi*, *A. pacifica*, *Paraphoxus floridanus*, *P. epistomus*, and *Monoculodes nyei*. Various closely related counterparts occur as geminate pairs of species or subspecies: *Heterophlias seclusus* ssp., *Leucothoides pacifica*, and *L. pottsi*, several bateids and carinobateids, *Pontogeneia longleyi* and *P. ?minuta*. At least 9 of these pairs have been detected.

Some of the evidence that the exchange of species has occurred primarily from west to east has been discussed by J. L. Barnard (1958). This evidence is composed in the main of the greater diversity of various genera on the Pacific side than on the Atlantic side of America (for instance, 19 Pacific as against 4 Atlantic species of *Paraphoxus*). Thus, it is appropriate to suggest that the Californian fauna may have its strongest affinities with the Caribbean region but inappropriate to suggest that the Californian fauna *originated* from Caribbean emigrants.

The intergeographic relationships and heterogeneity of the Californian Amphipoda may be described in terms of the worldwide distribution of intertidal genera, as well as by those methods already discussed. Intertidal genera of the northern three fourths of the earth are listed in table 34 with their numbers of species, their occurrence in California and their endemicity to the Californian region. The generic relationships of Californian Amphipoda to those of Antarctic seas are so obviously remote that Antarctic genera are excluded from the discussion; in any case few intertidal records of them are extant.

Statements defining the distribution of non-Californian genera are included in table 34; this compilation thus represents a data sheet in which subsequent tables and the following statements are to be verified and seen in perspective.

A total of 174 genera of rocky intertidal habitus, representing 1118 species, is known from the northern three fourths of the earth. Of these, 63 genera have species occurring in California and these genera have 747 species in all seas. Eleven of the genera are endemic to the Californian region but none has more than 2 species.

The 102 genera not found in California are arranged into the following geographic groups:

North Atlantic Ocean and South Africa	36
Australia, New Zealand and satellites	19
Tropical	12
Cold-temperate and arctic	10
Subintertidal in California	8
Northwestern Pacific Ocean	5
Red Sea	3
Antisubtropical	3
Indian Ocean	3
Baja California subtropical (*Eriopisa, Ensayora*)	2
"Coldwater"	1
	102

These assignments omit the genera *Apherusa, Biancolina, Eriopisella, Halirages, Laetmatophilus, Microprotopus, Palinnotus, Parametopa, Prothaumatelson,* and *Seba;* their species are widely distributed throughout the several oceans but presumably they do not occur in the Californian intertidal.

The first item of the above table reflects the enormous physical barrier between California and the eastern Atlantic Ocean. The pantropical genera not occurring in California are surprisingly few; exploration of the Indonesian and Australian tropic shores has been so scanty as to suggest that many more endemic genera will be found in the Indo-Pacific tropics. The large number of Californian genera shared with the northwestern Pacific Ocean is indicative of considerable faunal exchange between the regions. The few Caribbean genera not shared with California are included in the tropical item.

Comparisons of intertidal faunas between California and arctic-subarctic regions are complicated by the poor representation of intertidal faunas in high latitudes owing to ice-scouring; the intertidal fauna of several tropical shores is also weakly developed because of poor tidal amplitudes.

In summary, the data of table 34 suggest that one third of the world's intertidal genera occur in California, that one third of the genera are excluded from California because of extensive physical barriers such as continents and oceanic basins, and that about one sixth of the genera may be excluded by thermal barriers. At least 8 genera of the remaining one sixth occur in subintertidal depths of California and the species of about a dozen diverse genera either have not penetrated into the area or have not been collected there. One may conclude that the amphipodan fauna of California is not impoverished. The transition from cold- to warm-temperate character may be appreciated in table 35 by noting the confrontation or overlap of northern and southern elements. The weak representation in California of several diverse boreal and tropical circumferential genera apparently is characteristic of the midlatitudinal position of California. For instance, *Eurystheus*, *Lembos*, *Hyale*, and *Stenothoe* are diverse *tropical* genera which are poorly represented in California, and *Liljeborgia*, *Melita*, *Paramoera*, and *Atylus* are diverse *boreal* genera which are poorly represented in California. Families and subfamilies which are poorly represented in California for unknown reasons are the Dexaminidae, Phliantidae, Stenothoidae, Podoceridae, and the cyproidin Amphilochidae.

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Tables

Table 1.—Spatial distribution of quantitative samples in grids at Carmel Point, Cayucos, Hazard Canyon, Corona del Mar and La Jolla, California. Samples are spaced at 3 meter intervals on lines.

Station 48

Carmel Point, California, December 30–31, 1963, 1/50th sq. m. samples on surfaces of cobbles and boulders lying on sandy substrate, primarily in pelvetiid zone with short-tufted red algae, especially *Botryoglossum* sp.

	Toward land		Toward sea		
Line	A	B	C	D	E
	1	1	1	1	1
	2	2	2	2	2
	3	3	3	3	3
	4	4	4	4	4
	5	5	5	5	5

A grid of 1/50th sq. m. samples to seaward of above grid, just above low-water in pelvetiid-*Phyllospadix* zone.

Line F, toward land	1	2	3	4	5
Line G, toward sea	1	2	3	4	5

Station 38

Cayucos, California, July 1, 1961, 1/44th square meter samples on rock surfaces in *Phyllospadix*-pelvetiid zone.

		Toward sea in *Phyllospadix*			Toward land in pelvetiids		
Line	A	1	2	3	4	–	–
	B	1	2	3	4	5	6
	C	1	2	3	4	5	6
	D	1	2	3	4	5	6
	E	1	2	3	4	5	6

Station 43

Cayucos, California, January 5–6, 1962, 1/44th sq. m. samples, miscellaneous placements: A-1, C-2, E-1, E-2, E-3, E-4, S-1, S-2.

Station 42

Hazard Canyon reef, California, December 8–9, 1961, 1/44th sq. m. samples.

Anthopleura elegantissima—pelvetiid zone

Line	A	1	2	bare	4	5
	B	1	2	3	4	5

Algal turf on flat platform 0.67 m. above surge channel

Line	C	1	2	3	6 m. from channel
	D	1	2	3	
	E	1	2	3	edge of channel

Algal turf on flat platform 0.16 m. above surge channel

Line	F	1	2	3	6 m. from channel
	G	1	2	3	
	H	1	2	3	edge of channel

Station 39

Goleta (Coal-Oil Point), California, July 2, 1961, 1/44th sq. m. samples on rock surfaces in *Phyllospadix*-pelvetiid zone.

		Toward sea in *Phyllospadix*			Toward land in pelvetiid zone		
Line	H	1	2	3	4	5	6
	J	1	2	3	4	5	6
	K	1	2	3	4	5	6

Table 1.—Spatial distribution of quantitative samples in grids at Carmel Point, Cayucos, Hazard Canyon, Corona del Mar and La Jolla, California. Samples are spaced at 3 meter intervals on lines—Continued

Station 46

Corona del Mar, California, December 9–11, 1962, 1/60th sq. m. samples on a flat reef of shale, no loose rocks, in zone of *Phyllospadix*, coralline algae, *Egregia* sp., pelvetiid, tufted red algae.

	Toward sea		Toward land		
Line	A	B	C	D	E
	1	1	1	1	1
	2	2	2	2	2
	3	3	3	3	3
	4	–	4	–	4
	5	5	5	5	5

1/60th sq. m. samples in a zone southeast of first grid, with turnable rocks, samples taken of substrate under rocks, largely sand.

	Toward sea					Toward land			
Line H	1	2	3	4	5	6	7	8	9
I	1	2	3	4	5	6	7	8	9

Station 45

La Jolla, California, November 11–13, 1962, 1/60th sq. m. samples.

Coralline-gracilarioid-*Phyllospadix* mixed with loose cobbles and sand pockets, samples scraped from tops of rock.

	Toward land		Toward sea		
Line A	1	2	3	4	5
B	1	2	3	4	5
C	1	2	3	4	5
D	1	2	3	4	5
E	1	2	3	4	5

Three meters southwest of above grid, scrapings of substrate under rocks.

Line F	1	2	3	4	5	6	7	8	9	10	11	12
G	1	2	3	4	5	6	7	8	–	10	11	—

Table 2.—Relative densities of Amphipoda, as individuals per square meter, in various groups of grid samples.

Phyllospadix-pelvetiid zones	
Carmel, epifaunal cobble-boulders, poor epiflora	804
fixed substrate, medium epiflora	1,725
Cayucos, rich epiflora	21,839
Goleta, intermediate epiflora	13,476
Pt. Dume, poor epiflora	2,250
Corona del Mar, *Phyllospadix*-coralline, rich epiflora	15,904
La Jolla, *Phyllospadix*-coralline, rich epiflora	14,716
Algal turf on platforms	
Hazard Canyon	4,222
Pt. Dume	9,421
La Jolla	18,393
Coralline algae, Pt. Dume	17,570
Phragmatomid masses, Pt. Dume	1,382
Underrock substrates	
Corona del Mar	42
La Jolla	1,194

Table 3.—Carmel Point, California, December 30–31, 1963, grid of 25 samples of station 48 A–E, on surfaces of cobbles and boulders in pelvetiid zone, list of all species, with individuals per square meter.

Oligochinus lighti, 644; *Hyale grandicornis californica*, 54; *Allorchestes anceps* 50; *Hyale rubra frequens*, 20; *Parapleustes nautilus*, 18; *Ampithoe pollex*, 8; eophliautid, 4; *Jassa falcata*, 2; *Ampithoe simulans*, 2.

TABLE 4.—Carmel Point, California, December 30–31, 1963, grid of 10 samples of station 48 F–G, on substrate surface in pelvetiid-*Phyllospadix* zone, list of all species, with individuals per square meter.

Hyale rubra frequens, 365; *Elasmopus rapax mutatus*, 350; *Photis* sp., juvs., 255; *Aoroides columbiae*, 165; *Oligochinus lighti*, 135; *Parapleustes nautilus*, 105; *Parallorchestes ochotensis*, 85; *Photis bifurcata*, 85; *Microjassa litotes*, 70; *Jassa falcata*, 35; *Ericthonius brasiliensis*, 25; *Ampithoe* sp., juvs. southern sp., 15; *Paraphoxus spinosus*, 10; *Cerapus tubularis*, 5; *Fresnillo ?fimbriatus*, 5; *Gitanopsis vilordes*, 5; *Maera* cf. *simile*, 5; *Polycheria antarctica*, 5.

TABLE 5.—Carmel Point, California, December 30–31, 1963, combination of 4 samples having similar amphipodan faunas, samples 48 H–3, H–4, H–5, H–8, of algae and their holdfasts, *Botryoglossum* sp., *Cystoseira* sp., zanardinulid-prionitid types, *Pelvetia* sp., list of all species, with total number of individuals.

Hyale rubra frequens, 250; *Photis* sp., juvs., 197; *Jassa falcata* thick, 94; *Elasmopus* sp., juvs., 56; *Aoroides columbiae*, 40; *Ericthonius brasiliensis*, 32; *Microjassa litotes*, 24; *Ischyrocerus anguipes*, 13; *Najna consiliorum*, 13; *Megamphopus martesia*, 12; *Photis conchicola*, 9; *Oligochinus lighti*, 9; *Ampithoe lindbergi*, 7; *Eurystheus thompsoni*, 5; *Pontogeneia intermedia*, 5; *Maera vigota*, 3; *Pontogeneia rostrata*, 3; *Leucothoides pacifica*, 2; *Melita* sp., juvs., 2; *Amphilochus litoralis*, 1; *Ampithoe simulans*, 1; *Anamixis linsleyi*, 1; *Ocosingo borlus*, 1; *Parapleustes nautilus*, 1; *Polycheria antarctica*, 1.

TABLE 6.—Carmel point, California, December 30–31, 1963, wash of plant materials from below low water, 1.5 liters each of: 48–H–6, *Phyllospadix* and roots; 48–H–7, 48–I–2, *Egregia* stipes and holdfasts; 48–I–6, *Macrocystis* holdfast; list of all species.

Species	Total specimens *Phyllospadix*	*Egregia*	*Macrocystis*
Photis sp., juvs. (prob. incl. *P. conchicola*)	123	1	33
Elasmopus antennatus (serricate var.)	92		
Hyale rubra frequens	29	271	
Aoroides columbiae	11	15	53
Ischyrocerus anguipes	10		
Jassa falcata, thin	9		
Ericthonius brasiliensis	5		
Photis bifurcata	5		
Megamphopus martesia	4	3	52
Jassa falcata, thick	4	4	1
Ampithoe sp., juvs.	4	1	
Cerapus tubularis	2		
Parapleustes nautilus	2		
Atylus levidensus	1		
Eurystheus thompsoni	1	1	67
pontogeneiid	1		
Parajassa angularis	1		
Leucothoe alata	1		
Maera simile	1		3
Paraphoxus spinosus	1		
Ocosingo borlus	1		
Polycheria antarctica	1		
Podocerus brasiliensis	1		
Elasmopus rapax serricatus		24	
Najna consiliorum		18	
Ampithoe lindbergi		5	
Microjassa litotes		1	4
Cymadusa uncinata, juvs.			19
Elasmopus antennatus			7
Melita sulca			5
Heterophlias seclusus escabrosa			3
Lepidepecreum gurjanovae			1

Table 7.—Cayucos, California, July 1, 1961, grid of 28 surface samples in *Phyllospadix*-pelvetiid zone, station 38 A–E, the most abundant species listed in rank, with individuals per square meter.

Hyale rubra frequens, 7,507; *Aoroides columbiae*, 2,622; *Photis brevipes*, 1,671; *Photis bifurcata*, 1,362; *Calliopiella pratti*, 1,304; *Microjassa litotes*, 956; *Photis conchicola*, 814; *Parallorchestes ochotensis*, 727; *Elasmopus antennatus*, 695; *Jassa falcata*, 633; *Oligochinus lighti*, 568.

Table 8.—Hazard Canyon reef, California, December 8–9, 1961, grid of 18 samples on surface of flat platform above surge channel in algal turf, station 42 C–H, the most abundant species listed in rank, with individuals per square meter.

Oligochinus lighti, 2,677; *Hyale rubra frequens*, 419; *Ampithoe pollex*, 330; *Parapleustes nautilus*, 200; *Parallorchestes ochotensis*, 105; *Elasmopus rapax mutatus*, 97; *Aoroides columbiae*, 89.

Table 9.—Hazard Canyon reef, California, December 8–9, 1961, the most abundant amphipods in holdfasts of intertidal kelps, *Macrocystis* sp., *Egregia* sp., and *Laminaria* sp., listed in rank from samples 42–C–7, 42–T–5, 42–T–7, 43–B–3, with average number of individuals per sample.

Hyale rubra frequens, 41; *Photis conchicola*, 32; *Elasmopus holgurus*, 24; *Elasmopus rapax mutatus*, 21; *Parapleustes pugettensis*, 19; *Oligochinus lighti*, 19; *Aoroides columbiae*, 18; *Eurystheus thompsoni*, 16; *Ericthonius brasiliensis*, 12.

Table 10.—Goleta (Coal-Oil Point), California, July 2, 1961, grid of 18 surface samples in *Phyllospadix*-pelvetiid zone, station 39 H–K, the most abundant amphipods listed in rank, with individuals per square meter.

Hyale rubra frequens, 10,300; *Lysianassa macromerus*, 1,588; *Ischyrocerus* sp. A, 705; *Jassa falcata*, thick, 236; *Pontogeneia rostrata*, 234; *Jassa falcata*, thin, (31).

Table 11.—Point Dume, California, February 5–7, 1963, 4 samples of short brown algae near surf and at edge of tidepool, 47–C–1, C–3, D–1, D–2, list of all species, with individuals per square meter.

Hyale rubra frequens, 4,355; *Pontogeneia rostrata*, 1,585; *Aoroides columbiae*, 1,450; *Lysianassa macromerus*, 1,020; *Parallorchestes ochotensis*, 340; *Stenothoe estacola*, 176; *Paraphoxus spinosus*, 154; *Ampithoe pollex*, 154, *Ampithoe* sp., northern sp., 44; *Parapleustes pugettensis*, 44; *Amphilochus neapolitanus*, 33; *Gitanopsis vilordes*; 33; *Ericthonius brasiliensis*, 11; *Jassa falcata*, 11; *Melita dentata*, 11.

Table 12.—Point Dume, California, February 5–7, 1963, grid of 5 samples of coralline algae in a surge channel, 47–B–1, B–2, B–3, B–4, B–5, list of all species, with individuals per square meter.

Hyale rubra frequens, 10,400; *Pontogeneia rostrata*, 1,480; *Aoroides columbiae*, 1,390; *Ampithoe pollex*, 1,373; *Lysianassa macromerus*, 1,285; *Parallorchestes ochotensis*, 555; *Stenothoe estacola*, 330; *Elasmopus* sp., juvs., 255; *Amphilochus neapolitanus*, 255; *Parapleustes pugettensis*, 158; *Photis* sp., juvs., 35; *Paraphoxus spinosus*, 18; *Ericthonius brasiliensis*, 18; *Podocerus brasiliensis*, 9; *Melita sulca*, 9; *Microjassa litotes*, 9.

Table 13.—Point Dume, California, February 5–7, 1963, 5 quantitative samples of pelvetiid zone, each sample with 1–2 clumps of the dominant brown alga and associates, 47–G–1, G–2, G–3, G–4, G–5, list of all species, with individuals per square meter.

Hyale rubra frequens, 1,360; *Paraphoxus spinosus*, 343; *Jassa falcata*, thin, 229; *Parallorchestes ochotensis*, 167; *Paraphoxus heterocuspidatus*, 44; *Ampithoe ?tea*, 35; *Elasmopus* sp., juvs., 18; *Lysiannassa macromerus*, 18; *Paraphoxus obtusidens*, 18; *Ischyrocerus* sp. B, 9; *Photis sp.*, juvs., 9.

Table 14.—Point Dume, California, February 5–7, 1963, 5 samples of short-tufted greenish-brown algae from a vertical face on seaward side of ridge 0.3 meter above low water, 47–H–1, H–2, H–3, H–4, H–5, list of all species, with individuals per square meter.

Parallorchestes ochotensis, 1,200; *Hyale rubra frequens*, 202; *Elasmopus rapax mutatus*, 197; *Lysianassa macromerus*, 176; *Aoroides columbiae*, 70; *Paraphoxus spinosus*, 35; *Elasmopus rapax serricatus*, 14; ?*Cheiriphotis megacheles*, 9; *Parapleustes pugettensis*, 9; *Stenothoe estacola*, 9.

Table 15.—Point Dume, California, February 5–7, 1963, 3 samples of reef-forming tube masses of polychaete, *Phragmatopoma* sp., 47–C–2, E–4, E–5, list of all species, with individuals per square meter.

Ampithoe pollex, 675; *Elasmopus* sp., juvs., 220; *Allorchestes anceps*, 147; *Hyale rubra frequens*, 147; *Aoroides columbiae*, 88; *Lysianassa macromerus*, 73; *Parapleustes pugettensis*, 15; *Parallorchestes ochotensis*, 15.

Table 16.—Point Dume, California, February 5–7, 1963, 5 quantitative samples of *Amaroucium* sp., 47–E–6, E–7, E–8, E–9, F–2, list of all species, with total number of individuals.

Aoroides columbiae, 9; *Elasmopus holgurus*, 12; *Hyale rubra frequens*, 1; *Lysianassa dissimilis*, 2; *Paraphoxus spinosus*, 1; *Photis* sp., juv., 1.

Table 17.—Point Dume, California, February 5–7, 1963, washes of loose rocks densely covered with algae, samples being unique for adult condition of most specimens and presence of numerous ostracods, 47–L–1, L–2, L–3, list of all species, with total number of specimens in an aliquot.

Lysianassa macromerus, 302; *Hyale rubra frequens*, 165; *Pontogeneia rostrata*, 54; *Aoroides columbiae*, 33; *Ampithoe pollex*, 20; stenothoids, 15; *Amphilochus neapolitanus*, 7; *Ampithoe* sp., northern sp., juvs., 6; *Melita sulca*, 6; *Eurystheus thompsoni*, 3; *Paraphoxus spinosus*, 2; *Parallorchestes ochotensis*, 1; *Elasmopus* sp., juv., 1; *Lysianassa dissimilis*, 1; *Paraphorus heterocuspidatus*, 1; *Batea lobata*, 1; *Jassa falcata*, juv., 1; *Parapleustes pugettensis*, 1; *Photis* sp., juv., 1.

Table 18.—Point Dume, California, February 5–7, 1963, washes of *Egregia* sp., stipes and holdfasts, total specimens listed to show ratios of species frequencies.

Species	47–K–1 47–K–2 47–K–3 Holdfasts	47–J–2 Stipes	47–F–3 Total plant
Hyale rubra frequens	346	153	158
Lysianassa macromerus	26		
Parapleustes pugettensis	24		1
Parallorchestes ochotensis	17		
Elasmopus sp., juvs.	8		1
Leucothoe alata	8		
Ampithoe pollex	6		
Aoroides columbiae	6		2
Ampithoe sp., cf. *mea*	3	13	10
Paraphoxus spinosus	3		
Jassa falcata	2 thin	1 thick	
Photis sp., juvs.	2		1
Ischyrocerus sp. A	1		2
Paraphoxus heterocuspidatus	1		
Ampithoe sp.		7	
Pontogeneia rostrata			9
Amphilochus neapolitanus			3
Amphilochus litoralis			2
Stenothoe estacola			2

TABLE 19.—Corona del Mar, California, December 9–11, 1962, grid of 23 surface samples of *Phyllospadix*-coralline zone, station 46–A–E, the most abundant species, with individuals per square meter.

Hyale rubra frequens, 9,100; *Elasmopus rapax mutatus*, 3,228; *Photis elephantis*, 688; *Photis conchicola*, 607; *Ampithoe pollex*, 476; *Aoroides columbiae*, 438; *Ericthonius brasiliensis*, 210; *Jassa falcata*, 188; *Microjassa litotes*, 152, *Cerapus tubularis*, 106.

TABLE 20.—Corona del Mar, California, December 9–11, 1962, grid of 18 samples of underrock substrate, station 46 H–I, list of all species, with individuals per square meter.

Ampithoe pollex, 14; *Melita sulca*, 14; eusirid, 4; *Dulzura sal*, 3; *Gitanopsis vilordes*, 2; *Paraphoxus spinosus*, 2; *Photis* sp., juvs., 2; *Ericthonius brasiliensis*, 1.

TABLE 21.—La Jolla, California, November 11–13, 1962, grid of 25 surface samples of *Phyllospadix*-coralline-cobble platform, station 45 A–E, list of most abundant species, with individuals per square meter.

Hyale rubra frequens, 4,890; *Microjassa litotes*, 2,177; *Elasmopus rapax serricatus*, 1,714; *Photis brevipes*, 935; *Photis conchicola*, 745; *Elasmopus antennatus*, 736; *Microdeutopus schmitti*, 503; *Cerapus tubularis*, 498; *Aoroides columbiae*, 408; *Paraphoxus spinosus*, 303; *Ericthonius brasiliensis*, 250; *Amphilochus litoralis*, 149; *Megamphopus effrenus*, 142; *Jassa falcata*, 142; *Megamphopus martesia*, 130.

TABLE 22.—La Jolla, California, November 11–13, 1962, grid of 22 samples of substrate scrapings beneath turnable rocks, station 45 F–G, list of the most abundant species, with individuals per square meter.

Elasmopus rapax serricatus, 293; *Photis brevipes*, 178; *Microjassa litotes*, 98; *Cheiriphotis megacheles*, 92; *Maera simile*, 88; *Aoroides columbiae*, 60; *Ampithoe pollex*, 58; *Hyale rubra frequens*, 54; *Heterophlias seclusus escabrosa*, 38; *Melita sulca*, 38; *Microdeutopus schmitti*, 38.

TABLE 23.—La Jolla, California, November 11–13, 1962, 6 samples on pitted substrate of ridge covered with short-tufted red algae, near Bird Rock, 3rd landward ridge, station 45 H–1, H–2, H–3, M–1, M–2, M–3, list of all species; a non-quantitative wash of the same materials, 45–L–1, aliquotted and compared to right.

Species	Individuals per square meter	Total specimens Mass wash, 45–L–1
Ampelisca lobata	7	*Amphilochus litoralis*, 2
Ampithoe plumulosa	175	*Amphilochus neapolitanus*, 1
Ampithoe pollex	672	37
Aoroides columbiae	73	
Cerapus tubularis	66	4
Elasmopus rapax serricatus	988	
Elasmopus rapax mutatus	1,060	167
Elasmopus sp., juvs.	965	
Ericthonius brasiliensis	36	
Hyale rubra frequens	13,350	685
Microjassa litotes	117	2
Jassa falcata	22	
Megamphopus martesia	44	*Lysianassa macromerus*, 1
Microdeutopus schmitti	95	13
Paraphoxus spinosus	29	1
Parapleustes pugettensis	58	*Pleustes platypa*, 2
Photis brevipes	22	*Tiron biocellata*, 1
Photis sp., juvs. (prob. *brevipes*)	614	18

TABLE 24.—La Jolla, California, November 11–13, 1962, 3 samples of sand-inundated algae at high tide line, 45–R–1, R–2, R–3, list of all species, with individuals per square meter.

Hyale rubra frequens, 16,100; *Ampithoe pollex*, 7,920; *Aoroides columbiae*, 1,910; *Jassa falcata*, 1,012; *Lysianassa macromerus*, 367; *Orchestia* sp., 88; *Microdeutopus schmitti*, 73; *Paraphoxus spinosus*, 59; *Photis* sp., juvs., 29; *Corophium baconi*, 29.

TABLE 25.—La Jolla, California, November 11–13, 1962, 5 non-quantitative wash-samples of the short-tufted algal platform, 45–O–1, O–2, T–1, W–3, W–4, the most abundant species, with total number of individuals.

Hyale rubra frequens, 1,005; *Elasmopus rapax serricatus*, 202; *Photis* sp., juvs., 138; *Microjassa litotes*, 115; *Ampithoe pollex*, 112; *Microdeutopus schmitti*, 91; *Aoroides columbiae*, 87; *Elasmopus antennatus*, 82; *Amphilochus litoralis*, 43.

TABLE 26.—Locality comparison of the dominant Amphipoda in seven grids of the *Phyllospadix*-pelvetiid zone of California. Numbers represent individuals per square meter. Those species marked with asterisks have unidentified juveniles included in proportion to adult representation in the samples. Italicized numbers denote species dominating the particular grid. The gridwork at Hazard Canyon is located on a platform of algal turf and not in the *Phyllospadix*-pelvetiid zone. The species are arranged in rank according to the totals of the frequencies in the seven grids. Eight other species of high frequency are listed terminally and are numbered by rank in sequence with the dominant species. None of the eight terminal species is a major dominant in any of the seven grids but the cumulative frequencies of several exceed the frequencies of a few of the dominant species.

Name of species	Carmel	Cayucos	Hazard	Goleta	Pt. Dume	Corona del Mar	La Jolla
1. *Hyale rubra frequens*	*365*	*7,507*	*419*	*10,300*	*1,360*	*9,100*	*4,890*
2. **Elasmopus rapax mutatus*	*350*	135	*97*	0	0	*3,628*	74
3. *Aoroides columbiae*	*165*	*2,622*	*89*	24	0	*438*	408
4. *Oligochinus lighti*	*135*	*568*	*2,677*	0	0	0	0
5. *Microjassa litotes*	70	*956*	0	2	0	152	*2,177*
6. **Photis brevipes*	0	*1,671*	0	0	0	40	*935*
7. **Photis conchicola*	0	*814*	28	0	0	*607*	*745*
8. **Elasmopus rapax serricatus*	0	0	0	0	0	42	*1,714*
9. **Photis bifurcata*	*340*	*1,362*	0	0	0	0	0
10. *Lysianassa macromerus*	0	6	0	*1,588*	18	28	11
11. *Jassa falcata*	35	*633*	*110*	*236*	*229*	188	142
12. **Elasmopus antennatus*	0	*695*	0	0	0	0	*736*
13. *Calliopiella pratti*	0	*1,304*	0	5	0	0	0
14. *Ampithoe pollex*	0	251	*330*	0	0	*476*	107
15. *Paraphoxus spinosus*	0	332	6	88	*343*	4	303
16. *Parallorchestes ochotensis*	85	*727*	*105*	0	*167*	0	0
17. *Ischyrocerus* sp. A	0	172	61	*705*	0	0	63
18. *Photis elephantis*	0	0	0	0	0	*688*	0
22. *Pontogeneia rostrata*	0	142	22	*234*	0	0	44
24. *Parapleustes nautilus*	*105*	16	*200*	0	0	0	0
19. *Cerapus tubularis*	5	11	0	0	0	106	498
20. *Microdeutopus schmitti*	0	0	0	0	0	22	503
21. *Ericthonius brasiliensis*	25	128	0	5	0	210	250
23. *Cheiriphotis megacheles*	0	239	0	0	0	0	90
25. *Megamphopus effrenus*	0	92	0	0	0	8	142
26. *Eurystheus spinosus*	0	209	0	0	0	0	0
27. *Amphilochus litoralis*	0	27	0	0	0	18	149
28. *Eurystheus thompsoni*	0	168	3	0	0	12	0

TABLE 27.—List of intertidal Amphipoda which are ubiquitous in the Monterey-La Jolla portion of California. They are arranged subjectively in rank from the most abundant to the least abundant in occurrence. Cosmopolitan species are marked with two asterisks, and those species common to the northwestern Pacific Ocean are marked with one asterisk.

Hyale rubra frequens	*Photis bifurcata*	***Polycheria osborni*
Aoroides columbiae	**Ampithoe lacertosa*	*Ampelisca lobata* (presumed)
***Jassa falcata*	*Paraphoxus spinosus*	*Podocerus brasiliensis*
***Ericthonius brasiliensis*	*Elasmopus antennatus*	*Paraphoxus obtusidens* (presumed)
Microjassa litotes	**Ampithoe lindbergi*	*Cymadusa uncinata* (submerges southward)
Eurystheus thompsoni	***Cerapus tubularis*	*Melita sulca*
Elasmopus rapax mutatus	*Ampithoe humeralis*	*Heterophlias seclusus escabrosa*
Photis brevipes	*Leucothoe alata*	*Amphilochus litoralis*
Parapleustes pugettensis (presumed)	*Leucothoides pacifica*	*Ampithoe plumulosa* (presumed)
Ampithoe pollex	*Maera simile*	*Corophium baconi* (presumed)
	Anamixis linsleyi	

TABLE 28.—List of intertidal Amphipoda with northern affinities. They show evidence of disappearance from the intertidal at the southern end of the Monterey-La Jolla coastal region. They are arranged subjectively in rank from the most abundant to the least abundant in occurrence. Species which possibly are amphi-Pacific-boreal in distribution are marked with asterisks. Southernmost intertidal records are enclosed in parentheses. Two sections are included: those species found in the present survey and those taken from the literature.

PRESENT SURVEY

Oligochinus lighti (Goleta)	*Allorchestes anceps* (Pt. Dume)	*Orchomene pacifica* (submerged)
Calliopiella pratti (Goleta)	*Ampithoe simulans* (rare, La Jolla)	*Ocosingo borlus* (submerged)
Parapleustes nautilus (Hazard Canyon)	*Ceradocus spinicauda* (submerged)	*Atylus levidensus* (Hazard Canyon)
Photis conchicola (Pt. Dume)	*Liljeborgia geminata* (submerged)	*Hyale plumulosus* (lagoon of Playa del Rey)
**Hyale grandicornis californica* (Corona del Mar, rare)	**Ericthonius hunteri* (?Cayucos)	*Lepidepecreum gurjanovae* (presumed)
Najna ?consiliorum (Hazard Canyon)	**Ischyrocerus anguipes* (?Cayucos)	*Synchelidium shoemakeri* (submerged)
**Pontogeneia rostrata* (Pt. Dume)	**Pontogeneia intermedia* (?Corona del Mar)	*Paramoera mohri* (Hazard Canyon)
**Parallorchestes ochotensis* (Pt. Dume)	**Melita ?dentata* (Pt. Dume)	
	Synchelidium rectipalmum (submerged)	
	Gitanopsis vilordes (submerged)	

Northeastern Pacific species in the literature but not found in present survey; listed in alphabetical order

Allogaussia recondita	*Calliopius* sp.	*Maera danae* (submerged)
Allorchestes angustus	*Corophium uenoi* (presumed)	*Melita oregonensis*
Ampelisca pugetica (submerged)	*Heterophoxus oculatus* (submerged)	*Paraphoxus milleri*
Ampithoe valida (estuarine)	*Leucothoe spinicarpa*	*Paraphoxus tridentatus pallidus*
Atylus tridens (submerged)		*Pontogeneia inermis*

280-102 O-69—4

TABLE 29.—List of intertidal Amphipoda with southern affinities. They show evidence of disappearance from the intertidal at the northern end of the Monterey-La Jolla coastal region. They are arranged subjectively in rank from the most abundant to the least abundant in occurrence. Known or presumed tropicopolitan species are marked with asterisks. Northernmost intertidal records are enclosed in parentheses. Two sections are included: those species found in the present survey and those taken from the literature.

PRESENT SURVEY

Photis elephantis (Corona del Mar)
**Cheralia aviculae* (Cayucos)
Megamphopus effrenus (Cayucos)
Megamphopus martesia (Corona del Mar)
Microdeutopus schmitti (Corona del Mar)
**Cheiriphotis megacheles* (Cayucos)
Lembos macromanus (Goleta)
Lembos concavus (unclear)
**Podocerus cristatus* (Cayucos)
Eurystheus spinosus (rare Carmel)
**Eusiroides monoculoides* (Corona del Mar)
Ampelisca schellenbergi (Cayucos)
Parajassa angularis (rare Carmel)
**Amphilochus neapolitanus* (Cayucos)
Paraphoxus heterocuspidatus (Goleta)
Gitanopsis ?pusilloides (Corona del Mar)
Pontogeneia quinsana (La Jolla)
Orchomene magdalenensis (La Jolla)
**Colomastix pusilla* (Cayucos, presumed)
Megaluropus spp. (Goleta)

Southern species of eastern Pacific in the literature but not found in the present survey; listed in alphabetical order

Ampelisca venetiensis (Venice, California)
Ampithoe longimana (lagoons, Newport Bay)
Batea lobata (Morro Bay)
Batea transversa (Channel Islands)
Ceradocus paucidentatus (middle Baja California)
Eriopisa garthi (middle Baja California)
**Melita appendiculata* (Laguna Beach)
Metaceradocus occidentalis (Newport Bay)
Pontogeneia "minuta" (Newport Bay)
Synchelidium sp. M (subintertidal)

TABLE 30.—List of Californian intertidal Amphipoda with unknown geographic affinities.

PRESENT SURVEY

Accedomoera vagor
Ampithoe "mea"
Ampithoe plea
Ampithoe tea
Dulzura sal
Elasmopus holgurus
Elasmopus rapax ssp.
Fresnillo fimbriatus
Ischyrocerus spp. A,B
Lignophliantis pyrifera
Lysianassa dissimilis
Lysianassa macromerus
Lysianassa pariter
Maera "inaequipes"
Maera lupana
Maera vigota
Megaluropus longimerus
Metaphoxus frequens
Metaphoxus fultoni
Metopa cistella
Netamelita cortada
Paraphoxus stenodes
Parapleustes den
Photis californica
Pleonexes aptos
Pleusirus secorrus
Pleustes depressa, P. platypa
Stenothoe estacola
Stenothoides burbanki
Stenula incola

Species from the literature

Eurystheus mamolus
Eurystheus ventosus
Ischyrocerus parvus
Liljeborgia geminata
Melita californica
Mesometopa esmarki
Podocerus fulanus (lagoons)
Podocerus spongicolus
Sympleustes "glaber"

TABLE 31.—Number of intertidal species of Gammaridea in several regions of the world.

Area	Species	Reference
Magellan continental	74	Schellenberg (1931)
Falkland Islands	62	Schellenberg (1931)
South Georgia	62	Schellenberg (1931)
Japan Sea, Okhotsk Sea	80	Gurjanova (1951)
Plymouth, England	92	Plymouth Marine Fauna (1957)
Isle of Man	66	Bruce *et alia* (1963)
Atlantic France	109	Chevreux and Fage (1925)
Mediterranean France	72	Chevreux and Fage (1925)
Indo-Pacific tropics [1]	204	J. L. Barnard (1965b)
California, Monterey-La Jolla [2]	128	herein
Monterey-Pt. Conception [3]	84	herein
Pt. Conception-La Jolla [4]	107	herein

[1] Not including 22 additional species in the Red Sea.
[2] Rocky intertidal only, not including *Ampelisca cristata*, *A. macrocephala*, *A. pugetica*, *Ampithoe plea*, all species of *Anisogammarus*, *Chelura terebrans*, *Corophium acherusicum*, *C. brevis*, *C. californianum*, *C. insidiosum*, *C. spinicornis*, *C. stimpsoni*, *Elasmopus rapax rapax*, *Hyale perieri*, *Lepidepecreum gurjanovae*, *Lignophliantis pyrifera*, *Maera danae*, *M. lupana*, *Melita californica*, *Mesometopa esmarki*, *Metopa cistella*, *Parapleustes commensalis*, *Podocerus spongicolus*, *Sympleustes glaber*.
[3] Not including 12 southern species at Cayucos.
[4] Not including 3 northern species at Goleta.

TABLE 32.—The intertidal Amphipods of Atlantic France, Mediterranean France and the southern half of California (Monterey Bay to La Jolla). They are listed according to the alphabetical order of their families. Those species preceded by asterisks occur mostly on intertidal sand-mud flats and not in the rocky intertidal.

Atlantic France	Mediterranean France	California, southern half
Panoploea minuta	*Panoploea minuta*	*Panoploea hedgpethi*
**Ampelisca brevicornis*	*Ampelisca rubella*	**Ampelisca cristata*
Ampelisca gibba	*Ampelisca serraticaudata*	*Ampelisca lobata*
Ampelisca spinipes		**Ampelisca macrocephala*
**Ampelisca tenuicornis*		**Ampelisca pugetica*
**Ampelisca typica*		*Ampelisca schellenbergi*
		Ampelisca venetiensis
Amphilochus neapolitanus	*Amphilochus neapolitanus*	*Amphilochus neapolitnaus*
Amphilochus spencebatei		*Amphilochus litoralis*
		Amphilochus picadurus
Gitana sarsi	*Gitana sarsi*	*Gitanopsis vilordes*
Ampithoe ramondi	*Ampithoe ramondi*	*Ampithoe ramondi*
Ampithoe rubricata		*Ampithoe humeralis*
		Ampithoe lacertosa
		Ampithoe lindbergi
		Ampithoe longimana
		Ampithoe plumulosa
		Ampithoe pollex
		Ampithoe simulans
	Cymadusa crassicornis	*Ampithoe tea*
	Cymadusa filosa	*Ampithoe valida*
		Ampithoe sp. ("*mea*")
Sunamphitoe pelagica	*Pleonexes ferox*	*Cymadusa uncinata*
Pleonexes gammaroides	*Pleonexes gammaroides*	*Pleonexes aptos*

TABLE 32.—The intertidal Amphipods of Atlantic France, Mediterranean France and the southern half of California (Monterey Bay to La Jolla). They are listed according to the alphabetical order of their families. Those species preceded by asterisks occur mostly on intertidal sand-mud flats and not in the rocky intertidal—Continued

Atlantic France	Mediterranean France	California, southern half
		Anamixis linsleyi
Aora typica	*Aora typica*	*Aoroides columbiae*
Lembos websteri	*Lembos websteri*	*Lembos concavus*
Microdeutopus chelifer	*Microdeutopus chelifer*	*Lembos macromanus*
Microdeutopus anomalus	*Microdeutopus anomalus*	*Microdeutopus schmitti*
Microdeutopus damnoniensis	*Microdeutopus damnoniensis*	
Microdeutopus gryllotalpa	*Microdeutopus gryllotalpa*	*Neomegamphopus roosevelti*
Microdeutopus stationis	*Microdeutopus stationis*	
Atylus falcatus		*Atylus levidensus*
Atylus guttatus	*Atylus guttatus*	*Atylus tridens*
Atylus swammerdami	*Atylus swammerdami*	
		Batea lobata (rare)
		Batea transversa (rare)
Apherusa bispinosa	*Apherusa bispinosa*	*Calliopiella pratti*
Apherusa cirrus		*Oligochinus lighti*
Apherusa jurinei		
Apherusa ovalipes		
Calliopius crenulatus		
Chelura terebrans	*Chelura terebrans*	*Chelura terebrans* (wood borer)
Colomastix pusilla	*Colomastix pusilla*	*Colomastix pusilla*
		Cerapus tubularis
Corophium acutum	*Corophium acutum*	*Corophium acherusicum*
Corophium bonelli	*Corophium acherusicum*	*Corophium baconi*
Corophium volutator	*Corophium volutator*	*Corophium insidiosum*
	Corophium runcicorne	*Corophium spinicorne*
		Corophium stimpsoni
		Corophium uenoi
Ericthonius brasiliensis	*Ericthonius brasiliensis*	*Ericthonius brasiliensis*
Ericthonius difformis		*Ericthonius difformis*
Unciola crenatipalma		
Dexamine spiniventris	*Dexamine spiniventris*	*Polycheria osborni*
Dexamine spinosa	*Dexamine spinosa*	
Dexamine thea		
Guernea coalita		
Tritaeta gibbosa	*Tritaeta gibbosa*	

TABLE 32.—The intertidal Amphipods of Atlantic France, Mediterranean France and the southern half of California (Monterey Bay to La Jolla). They are listed according to the alphabetical order of their families. Those species preceded by asterisks occur mostly on intertidal sand-mud flats and not in the rocky intertidal—Continued

Atlantic France	Mediterranean France	California, southern half
Amphitholina cuninculus	_Amphitholina cuninculus_	_Lignophliantis pyrifera_
Eusiroides dellavallei	_Eusiroides dellavallei_	_Eusiroides monoculoides_
(?=_E. monoculoides_)		_Accedomoera vagor_
		Paramoera mohri
		Pontogeneia intermedia
		Pontogeneia ?minuta
		Pontogeneia quinsana
		Pontogeneia rostrata
Cheirocratus sundevalli		_Anisogammarus confervicolus_
Eriopisella pusilla		_Ceradocus spinicauda_
Gammarellus angulosus	_Gammarellus angulosus_	_Dulzura sal_
Gammarellus homari	_Gammarus olivii_	_Elasmopus antennatus_
Gammarus locusta	_Gammarus locusta_	_Elasmopus holgurus_
Elasmopus rapax	_Elasmopus rapax_	_Elasmopus rapax_ ssp.
	Elasmopus pocillimanus	_Maera danae_
Gammarus marinus	_Maera inaequipes_	_Maera inaequipes_
Maera grossimana	_Maera grossimana_	_Maera lupana_
Maera othonis	_Maera othonis_	_Maera simile_
	Maera hirondellei	_Maera vigota_
Megaluropus agilis		_Megaluropus longimerus_
Melita gladiosa	_Melita coroninii_	_Melita appendiculata_
Melita obtusata		_Melita californica_
Melita palmata	_Melita palmata_	_Melita dentata_
Melita pellucida		_Melita sulca_
		Metaceradocus occidentalis
Pherusana fucicola	_Pherusana fucicola_	_Netamelita cortada_
*_Bathyporeia guilliamsoniana_		(Possibly _Eohaustorius_ spp.)
*_Bathyporeia pelagica_		
*_Bathyporeia robertsoni_		
*_Urothoe elegans_		
*_Urothoe grimaldii_		
*_Urothoe marina_		
Urothoe pulchella		
Hyale dollfusi	_Hyale grimaldii_	_Allorchestes anceps_
Hyale nilssoni	_Hyale nilssoni_	_Allorchestes angusta_
Hyale perieri	_Hyale perieri_	_Hyale grandicornis_ ssp.
Hyale pontica	_Hyale pontica_	_Hyale rubra_ ssp.
Hyale schmidti	_Hyale schmidti_	_Hyale plumulosa_
	Hyale camptonyx	_Parallorchestes ochotensis_
	Allorchestes aquilinus	
	Allorchestes plumicornis	

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Atlantic France	Mediterranean France	California, southern half
		Cheiriphotis megacheles
		Chevalia aviculae
Eurystheus maculatus	*Eurystheus maculatus*	*Eurystheus spinosus*
Leptocheirus hirsutimanus		*Eurystheus thompsoni*
Leptocheirus pectinatus		*Eurystheus ventosa*
Leptocheirus pilosus	*Leptocheirus pilosus*	*Megamphopus effrenus*
Megamphopus cornutus		*Megamphopus martesia*
Microprotopus longimanus		*Photis bifurcata*
Microprotopus maculatus		*Photis brevipes*
Photis longicaudata		*Photis californica*
Podoceropsis nitida		*Photis conchicola*
		Photis elephantis
		Ischyrocerus anguipes
		Ischyrocerus parvus (sp. A?)
		Ischyrocerus sp. B
		Microjassa litotes
		Microjassa claustris
Jassa falcata	*Jassa falcata*	*Jassa falcata*
Jassa ocia		*Parajassa angularis*
Parajassa pelagica		
Leucothoe spinicarpa	*Leucothoe spinicarpa*	*Leucothoe spinicarpa*
Leucothoe incisa	*Leucothoe pachycera*	*Leucothoe alata*
Leucothoe lilljeborgi		*Leucothoides pacifica*
?*Idunella picta*		*Liljeborgia geminata*
Idunella longirostris		
**Acidostoma laticorne*		*Fresnillo fimbriatus*
Hippomedon denticulatus		
Lepidepecreum longicornis		
Lysianassa ceratina	*Lysianassa ceratina*	*Lysianassa dissimilis*
Lysianassa plumosa		*Lysianassa macromerus*
**Menigrates obtusifrons*		*Lysianassa pariter*
Nannonyx goesi		
Nannonyx spinimanus	*Nannonyx propinquus*	
Normanion quadrimanus		*Ocosingo borlus*
Orchomene commensalis		*Orchomene magdalenensis*
Orchomene humilus		
Orchomene nana		
Orchomene similis		
Perrierella audouiniana		
Socarnes erythrophthalmus		
Tmetonyx cicada		
Tmetonyx similis		
Tryphosa grandimana		

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Atlantic France	Mediterranean France	California, southern half
Monoculodes carinatus		
**Perioculodes longimanus*		
**Pontocrates norvegicus*		
**Pontocrates arenarius*		**Synchelidium rectipalmum*
**Synchelidium haplocheles*	**Synchelidium haplocheles*	**Synchelidium shoemakeri*
**Synchelidium maculatum*		**Synchelidium* sp. M.
Pereionotus testudo	*Pereionotus testudo*	*Heterophlias seclusus escabrosa*
**Harpinia crenulata*		**Mandibulophoxus uncirostratus*
**Metaphoxus fultoni*		**Metaphoxus fultoni*
**Metaphoxus pectinatus*		**Metaphoxus frequens*
		**Paraphoxus jonesi*
		Paraphoxus obtusidens
		Paraphoxus spinosus
		**Paraphoxus stenodes*
		Parapleustes den
		Parapleustes nautilus
		Parapleustes pugettensis
		Pleusirus secorrus
		Pleustes platypa and *depressa*
		Sympleustes ?glaber
Podocerus variegatus	*Podocerus variegatus*	*Podocerus brasiliensis*
		Podocerus cristatus
		Podocerus fulanus
Metopa borealis		*Metopa cistella*
Stenothoe gallensis		*Stenothoe estacola*
Stenothoe cavimana	*Stenothoe dollfusi*	
Stenothoe monoculoides	*Stenothoe monoculoides*	
Stenothoe spinimana	*Stenothoe spinimana*	
Stenothoe valida	*Stenothoe valida*	*Stenothoe valida*
Stenula latipes		*Stenothoides burbanki*
		Stenula incola
		**Tiron biocellata*

TABLE 33.—Numbers of species in diversified genera and families in the intertidal faunas of several regions of the world.

Names of genus or group	California	Magellan	Japan-Okhotsk	Tropics	Plymouth-Man	Atlantic France
acanthonotozomatids	1	4	1	3	0	1
amphilochids	5	1	0	6	1 (?3)	3
Ampithoe	9	1	10	6	2	2
Apherusa	0	0	0	0	4+	4
Atylus	1	2	2	2	?3	3
calliopiids	3	0	3	1	5	5
Corophium	3+	1	0	2	7	3
Cymadusa	1	0	0	4	0	0
Dexamine	0	(1)	0	2	2	3
Ela smopus	4	0	0	19	1	1
Gammarus and *Marinogammarus*	0	0	0	0	5+3	2
Eurystheus	4	3	1	7	1	1
Hyale	3	1	1	11	3	5
Ischyrocerus	3	0	0	2	1	0
Lembos	2	1	0	9	1	1
Lysianassa and *Parawaldeckia*	3	1+1	0	3	1	2
Maera	4	0	0	12	1	2
Melita	2	1	2	3	5	3
Megamphopus-Eurystheus	6	3	1	7	1	2
Microdeutopus	1	0	0	1	4	5
Paramoera	1	2	2	0	0	0
Photis and (*Haplocheira*)	5	(2)	1	7	1	1
Pleonexes	1	0	0	1	1	1
Podorerus	3	0	0	8	1	1
Pontogeneia	4	5	4	1	0	0
stenothoids	4	1	13	5	6+	7

TABLE 34.—List of world intertidal gammaridean genera in the region of 90° N to 40° S. The following families are not included because their members occur primarily on soft-bottoms, in pelagic waters, or as epibionts: Acanthonotozomatidae, Ampeliscidae, Haustoriidae, most genera of Lysianassidae, Oedicerotidae, Pardaliscidae, Paramphithoidae, Phoxocephalidae, Stegocephalidae, Stilipedidae, Synopiidae (=Tironidae), Talitridae (beachhoppers). Endemic Californian genera are marked with asterisks.

Name of genus	Total shallow-water species	Californian shallow-water species	Distribution of non-Californian genera
Accedomoera	4	1	
**Acuminodeutopus*	2	1	
Allorchestes	12	2	
**Amphideutopus*	1	1	
Amphilochoides	4	0	Atlantic
Amphilochus	10	3	
Amphithoides	2	0	Red Sea
Ampithoe	37	11	
Anamixis	3	1	
Anatylus	1	0	Northwestern Pacific
Anelasmopus	1	0	Brazil
Anisogammarus (brackish)	14	2	
Anonyx	19	0	Cold-temperate
Aora	2	0	Atlantic
Aoroides	2	1	
Apherusa	16	0	Subcosmopolitan
Atylus	21	2	
Batea	4	2	
Biancolina	2	0	Atlantic, Australia
Bircenna	5	0	Australia

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Name of genus	Total shallow-water species	Californian shallow-water species	Distribution of non-Californian genera
Calliopiella	2	1	
Calliopius	2	1	
Carinobatea	2	0	Tropical pan-American
Casco	1	0	Western Atlantic
Ceina	1	0	Antiboreal
Ceinina	1	0	Japan
Ceradocus	15	1	
Cerapopsis	1	0	Mediterranean (?=*Gaviota*)
Cerapus	5	1	
Cheiriphotis	2	1	
Cheirocratus	4	0	Northeastern Atlantic
Chevalia	1	1	
Colomastix	8	1	
Concholestes	1	0	Indian Ocean
Coremapus	1	0	Northeastern Atlantic
Corophium (mostly brackish)	cf. 38	9	
(*Cressa*)	(6)	0	
Cyclotelson	1	0	Caribbean
Cymadusa	9	1	
Cyproidea	2	0	Australian tropics
Cyrtophium	2	0	Australasia
Dexamine	5	0	Atlantic
Dexaminella	1	0	Red Sea
Dexaminoides	1	0	Red Sea, tropics
Dogielinotus	2	1	
**Dulzura*	1	1	
Elasmopoides	1	0	South Africa
Elasmopus	34	5 forms	
Endevoura	1	0	Australia
**Ensayora*	1	0	Baja California
Eophliantis	1	0	Australia
Ericthonius	7	2	
Eriopisa	6	0	Subcosmopolitan
Eriopisella	2	0	Mediterranean-Indian
Eurystheus	53	4	
Exampithoe	1	0	South Africa
**Fresnillo*	1	1	
Gammaracanthus	1	0	Arctic
Gammarellus	2	0	Arctic-Atlantic
Gammarus, s.l.	numerous	0	Atlantic
Gitana	4	0	one deep-sea California
Gitanogeiton	1	0	Australia
Gitanopsis	11	2	
Goesia	1	0	Arctic, cold-temperate
Grandidierella	15	0	Tropical, brackish
Guernea	2	0	Atlantic
Halirages	10	0	Amphi-cold-temperate
Haustoriopsis	1	0	Tropical Pacific
Heterophlias	1	1	
Hoplopheonoides	1	0	Caribbean
Hornellia	1	0	Indian Ocean
Hyale	48	4	
Icilius	4	0	Australia

Table 34.—List of world intertidal gammaridean genera in the region of 90° N to 40° S. The following families are not included because their members occur primarily on soft-bottoms, in pelagic waters, or as epibionts: Acanthonotozomatidae, Ampeliscidae, Haustoriidae, most genera of Lysianassidae, Oedicerotidae, Pardaliscidae, Paramphithoidae, Phoxocephalidae, Stegocephalidae, Stilipedidae, Synopiidae (=Tironidae), Talitridae (beachhoppers). Endemic Californian genera are marked with asterisks—Continued

Name of genus	Total shallow-water species	Californian shallow-water species	Distribution of non-Californian genera
Insula	1	0	Bermuda
Iphinotus	1	0	New Zealand
Iphiplateia	1	0	Australia
Isaeopsis	1	0	South Africa
Ischyrocerus	18	4	
Jassa	?7	2 forms	
Kamaka	3	0	Northwestern Pacific
Kuria	1	0	Indian Ocean
Laetmatophilus	4	0	Atlantic-Indian
Leipsuropus	1	0	Australia
Lemboides	4	0	Antiboreal
Lembopsis	1	0	Caribbean
Lembos	25	2	
Leptocheirus	10	0	Atlantic
Leucothoe	17	2	
Leucothoella	1	0	Indo-Pacific
Leucothoides	2	1	
**Lignophliantis*	1	1	
Liljebrogia	16	1	
Lysianassa	23	3	
Macropisthopus	1	0	South Africa
Maera	26	5	
Maeracunha	1	0	Tristan da Cunha
Maerella	1	0	Eastern Atlantic
Megaluropus	3	1+	
Megamphopus	13	2	
Melita	37	4	
Melitoides	1	0	Subarctic
Mesometopa	3	1	
Metaceradocus	2	1	
Metopa	34	1	
Metopella	8	0	Amphiboreal
Metopelloides	9	0	Cold-temperate
Microdeutopus	10	1	
Microjassa	4	2	
Microphotis	1	0	Cambodia
Microprotopus	2	0	Atlantic
Najna	1	1	
Neocyproidea	3	0	Australasia
**Neomegamphopus*	1	1	
Neomicrodeutopus	2	0	West Africa
Neopleustes	5	0	Cold-temperate
**Netamelita*	1	1	
Ochlesis	3	0	Antitropical-boreal
**Ocosingo*	1	1	
**Oligochinus*	1	1	
Onisimus	11	0	Subarctic
Palinnotus	3	0	Subcosmopolitan
Paracyproidea	1	0	Australia
Paradexamine	1	0	Australia
Paragrubia	1	0	Tropical
Parajassa	4	1	
Paraleucothoe	1	0	Australasia

TABLE 34.—List of world intertidal gammaridean genera in the region of 90° N to 40° S. The following families are not included because their members occur primarily on soft-bottoms, in pelagic waters, or as epibionts: Acanthonotozomatidae, Ampeliscidae, Haustoriidae, most genera of Lysianassidae, Oedicerotidae, Pardaliscidae, Paramphithoidae, Phoxocephalidae, Stegocephalidae, Stilipedidae, Synopiidae (=Tironidae), Talitridae (beachhoppers). Endemic Californian genera are marked with asterisks—Continued

Name of genus	Total shallow-water species	Californian shallow-water species	Distribution of non-Californian genera
Parallorchestes	2	1	
Parametopa	3	0	Atlantic, Alaska
Parametopella	3	0	Cold-temperate Pacific
Paramoera	28	1	
Paranamixis	1	0	Tropical Pacific
Paraoroides	1	0	Australia
Parapherusa	1	0	Australia
Parapleustes	15	4	
Parelasmopus	2	0	Tropical
Parhyale	2	0	Tropical
Pariphinotus	1	0	Bermuda
Parunciola	1	0	Mediterranean
Pectenogammarus	1	0	Northeastern Atlantic
Peltocoxa	2	0	Mediterranean
Pereionotus	1	0	Mediterranean
Pherusana	1	0	Eastern Atlantic
Phlias	1	0	Australia
Photis	37	6	
Phoxostoma	1	0	South Africa
Pleonexes	4	1	
Pleustes	7	2	
Plioplateia	1	0	South Africa
Podoceropsis	4	0	Amphiboreal
Podocerus	18	4	
Polycheria	4	1	
Pontogeneia	26	5	
Proboloides	17	0	Amphiboreal
Prophlias	1	0	Australia
Prostenothoe	1	0	Northwestern Pacific
Prothaumatelson	2	0	Bipolar
Protomedeia	14	0	Cold-temperate
Pseudalibrotus	7	0	Arctic
Quadrivisio	2	0	Tropical
Quasimodia	3	0	Australia
**Rudilemboides*	1	1	
Seba	5	0	Subcosmopolitan
Siphonoecetes	7	0	Arctic-boreal
Sphaerophthalmus	1	0	Red Sea
Stenopleustes	4	0	Cold-temperate
Stenothoe	24	2	
Stenothoides	7	1	
Stenula	10	1	
Syndexamine	1	0	New Zealand
Sympleustes	15	0	Cold-temperate
Temnophlias	2	0	South Africa
Tritaeta	2	0	Atlantic
Weyprechtia	2	0	Arctic
Xenocheira	2	0	Tropical

TABLE 35.—The presence and absence of northern and southern elements in the amphipodan fauna of California. Genera marked with asterisks have their northern or southern limits in the region between Monterey Bay and La Jolla. Good representation indicates either a diversity of species or a high frequency of individuals of a monotypic genus.

Northern elements	Southern elements
Well represented	Well represented
Aoroides	*Anamixis*
Parallorchestes	*Elasmopus*
Parapleustes	*Eurystheus*
	Hyale
Poorly represented	Poorly represented
Allorchestes (*?)	**Batea*
Anisogammarus (brackish)	*Ceradocus*
**Atylus*	**Cheiriphotis*
Liljeborgia	**Chevalia*
Melita	*Lembos*
**Najna*	*Maera*
**Paramoera*	*Stenothoe*
**Pleonexes*	
Pleustes	
Pontogeneia	
**Protomedeia* (subintertidal)	
**Sympleustes*	
Absent	Absent
Anonyx	*Carinobatea*
Calliopius	*Grandidierella* (brackish)
Dexamine	*Paragrubia*
Neopleustes	*Parelasmopus*
Pseudalibrotus	*Parhyale* (?Channel Islands)
Siphonoecetes	
Stenopleustes	

Appendix I

Appendix to Tables

List of all species in samples summarized in tables 3–25 and additional selected samples forming the bulk of material reported upon in the ecological summaries of each species in the systematic section.

STATION 48, Carmel Point, California, December 30–31, 1963.

48–H–2, 1/50th sq. m. of coralline algae and very small red algae on south side of boulder above low water: *Aoroides columbiae* 11, *Elasmopus rapax mutatus* 51, *Hyale rubra frequens* 46, *Oligochinus lighti* 4, *Parajassa angularis* 2, *Parapleustes nautilus* 4, *Photis* juvs. 9, *Polycheria osborni* 1.

48–H–9, non-quantitative wash of *Postelsia* stipe: *Ampithoe* sp. juv. 1, *Hyale rubra frequens*, 35, *Najna consiliorum* 1.

48–H–12, non-quantitative wash of 2 liters of *Macrocystis* stipe: *Ampithoe humeralis* 1, *Hyale* juvs. 9, *Ischyrocerus anguipes* 1, *Jassa falcata* thin 1, *Najna consiliorum* 1.

48–I–1, non-quantitative wash of 1 liter of *Ulva* sp. at extreme high tide line: *Hyale grandicornis californica* 1, *Hyale rubra frequens* 2.

48–H–1, 48–H–10, non-quantitative samples of algae below low water: *Amphilochus litoralis* 17, *Cerapus tubularis* 1, *Elasmopus* sp. juvs. 6, *Hyale rubra frequens* 401, *Ischyrocerus anguipes* 6, *Microjassa litotes* 3, *Jassa falcata* 22, *Oligochinus lighti* 1, *Parajassa ?angularis* 1, *Photis* juv. 5, *Pleonexes aptos* 12, *Pleustes depressa* 1, *Pleustes* sp. 6, *Pontogeneia ?intermedia* 1, *Pontogeneia rostrata* 3, pontogeneiid 8.

48–H–11, 2 liters of tunicates and sponges: *Ampithoe simulans* 5, *Ampithoe* juvs. 3, *Aoroides columbiae* 13, *Elasmopus antennatus* 43, *Ericthonius* juvs. 17, *Eurystheus thompsoni* 1, *Hyale rubra frequens* 24, *Ischyrocerus anguipes*, 7, *Jassa falcata* thick 16, *Leucothoe alata* 3, *Leucothoides pacifica* 1, *Maera simile* 1, *Megamphopus martesia* 1, *Microjassa litotes* 15, *Ocosingo borlus* 1, *Parapleustes nautilus* 2, *P. pugettensis* 2, *Photis conchicola* 1, *Photis* juvs. 34, *Podocerus ?brasiliensis* juv. 1, *Polycheria osborni* 36, *Stenothoides burbanki* 1.

Station 38, Cayucos, California, July 1, 1961.

Individuals per square meter of *Phyllospadix*-pelvetiid grid of 28 samples, A–E, see table 6 for synopsis.

Allorchestes anceps 1, *Ampelisca lobata* 34, *A. schellenbergi* 56, *Amphilochus litoralis* 27, *A. neapolitanus* 17, *Ampithoe lacertosa* 6, *A. pollex* 251, *A. simulans* 51, *Ampithoe* spp., juvs. 312, *Aoroides columbiae* 2622, *Atylus levidensus* 16, *Calliopiella pratti* 1304, *Cerapus tubularis* 11, *Cheiriphotis megacheles* 239, *Chevalia aviculae* 62, *Corophium baconi* 6, *Elasmopus antennatus* 624, *E. rapax mutatus* 123, *Elasmopus* sp. juvs. 83, *Eurystheus spinosus* 209, *E. thompsoni* 168, *Ericthonius brasiliensis* 128, *E. hunteri* 9, *Fresnillo fimbriatus* 3, *Gitanopsis* sp. 3, *Hyale rubra frequens* 7507, *Ischyrocerus* sp. A 172, ischyrocerid juveniles of sp. A and *Jassa falcata* 418, *Jassa falcata* 353, *Lysianassa macromerus* 6, *Megamphopus effrenus* 92, *Melita* sp. juvs. 3, *Microjassa litotes* 956, *Ocosingo borlus* 3, *Oligochinus lighti* 568, *Parallorchestes ochostensis* 727, *Paraphoxus spinosus* 332, *Parapleustes nautilus* 16, *P. pugettensis* 56, *Photis bifurcata* 200, *P. brevipes* 243, *P. californica* 2, *P. conchicola* 117, *Photis* spp. juvs. 3321, photid of 38–A–1 23, *Pleustes depressa* 9, *Pleustes* sp. juvs. 8, *Podocerus cristatus* 12, *Podocerus* sp. juvs. 5, *Polycheria osborni* 23, *Pontogeneia rostrata* 142, pontogeneiid short rostrum of 38–B–5 56.

38–F–1, wash of tunicate *Amaroucium* sp. from underside of cavern facing shoreward, lower-water wash area: *Aoroides columbiae* 56, *Calliopiella pratti* 79, *Corophium baconi* 2, *Elasmopus holgurus* 68, *Ericthonius brasiliensis* 5, *Eurystheus spinosus* 4, *Fresnillo fimbriatus* 8, *Hyale rubra frequens* 36, *Ischyrocerus* sp. B 53, juvs. of *Ischyrocerus* sp. B and *Jassa falcata* 64, *Jassa falcata* thin 15, *Maera inaequipes* 1, *Microjassa litotes* 20, *Ocosingo borlus* 41, *Parapleustes pugettensis* 10, *Photis bifurcata* 34, *Podocerus* sp. juv. 1, *Polycheria osborni* 18.

38–F–2, wash of sponge in mussel-bed association, 0.66 m. above low water (−1.7 ft.) in tide-pool crack parallel to shore: *Aoroides columbiae* 13, *Elasmopus holgurus* 52, *Fresnillo fimbriatus* 1, *Leucothoe alata* 18, *Microjassa litotes* 1, *Oligochinus lighti* 1, *Photis* sp. juvs. 4, *Podocerus cristatus* 2, *Polycheria osborni* 1.

Station 43, Cayucos, California, January 5–6, 1962, list of species and specimens in underrock and miscellaneous samples.

43–A–1, ¼th sq. m. of encrusting sponge under rock: *Aoroides columbiae* 3, *Photis conchicola* 1.

43–A–2, scrapings of small red anemone: *Aoroides columbiae* 1, *Calliopiella pratti* 1, *Photis conchicola* 1.

43–B–1, straining of disturbed water in pool of *Phyllospadix*, small aliquot of total 5000 specimens: *Aoroides columbiae* 2, *Calliopiella pratti* 250, *Hyale rubra frequens* 21, *Jassa falcata* thin 2.

43–B–2, 4 large cobbles buried under small boulders, encrusting materials scraped: *Ampelisca lobata* 6, *Amphilochus neapolitanus* 2, *Ampithoe simulans* 9, *Aoroides columbiae* 63, *Calliopiella pratti* 13, *Elasmopus* sp. juv. 1, *Ericthonius brasiliensis* 12, *Eurystheus thompsoni* 16, *Fresnillo fimbriatus* 1, *Gitanopsis vilordes* 10, *Hyale rubra frequens* 8, *Ischyrocerus* sp. B 3, *Jassa falcata* 1, *Lembos* sp. 6, *Leucothoe alata* 1, *Leucothoides pacifica* 6, *Maera simile* 4, *Maera vigota* 73, *Melita sulca* 1, *Microjassa litotes* 13, *Paraphoxus spinosus* 2, *Parapleustes pugettensis* 2, *Photis bifurcata* 1, *P. brevipes* 2, *P. conchicola* 2, *Photis* spp. juvs. 176, *Pleusirus secorrus* 1, *Podocerus brasiliensis* 2, *Pontogeneia rostrata* 2.

43–B–3, wash of small *Macrocystis* holdfast, 5% aliquot analyzed, weight of aliquot 0.42 gm.: *Ampelisca lobata* 1, *Amphilochus neapolitanus* 1, *Ampithoe humeralis* 2, *A. lindbergi* 2, *A. simulans* 18, *Aoroides columbiae* 55, *Calliopiella pratti* 2, *Chevalia aviculae* 19, *Corophium baconi* 2, *Elasmopus antennatus* 1, *E. holgurus* 4, *Elasmopus* spp. juvs. 37, *Ericthonius brasiliensis* 14, *Eurystheus thompsoni* 31, *Hyale rubra frequens* 2, *Hyale* sp. juvs. 5, *Lembos* sp. 6, *Leucothoides pacifica* 1, *Maera simile* 24, *Microjassa litotes* 18, *Ocosingo borlus* 1, *Parapleustes pugettensis* 5, *Photis conchicola* 1, *Photis* sp. juvs. 128, *Pleustes depressa* 1, *Podocerus brasiliensis* 1, *Pontogeneia rostrata* 2.

43–C–1, wash of sand under small boulder: *Aoroides columbiae* 1, *Chevalia aviculae* 1, *Paraphoxus spinosus* 62, *Photis* sp. juvs. 3.

43–C–2, 1/44th sq. m. of soft polychaete tubes on seaward face of small protected rock: *Amphilochus litoralis* 1, *Aoroides columbiae* 3, *Calliopiella pratti* 3, *Elasmopus* sp. juv. 2, *Eurystheus spinosus* 1, *Fresnillo fimbriatus* 1, *Hyale rubra frequens* 1, *Lysianassa pariter* 1, *Megamphopus effrenus* 3, *Microjassa litotes* 1, *Parapleustes pugettensis* 1, *Photis bifurcata* 21, *Polycheria osborni* 9.

43–D–1, scrapings of small red anemone, no amphipods.

43–D–2, scrapings of walls of surf channel, largely polychaete tubes mixed with sponge: *Aoroides columbiae* 33, *Elasmopus* sp. juv. 15, *Fresnillo fimbriatus* 1, *Jassa falcata* 9, *Leucothoe alata* 1, *Microjassa litotes* 1, *Ocosingo borlus* 1, *Oligochinus lighti* 1, *Photis conchicola* 1, *Photis* sp. juvs. 6, *Podocerus* sp. juv. 1, *Polycheria osborni* 67.

43–E–1, 1/44th sq. m. of sponge and tunicate under rock, with pink *Maera vigota* partially desiccated lying at wet interface between rock and substrate: *Aoroides columbiae* 1, *Calliopiella pratti* 4, *Ericthonius* *brasiliensis* 16, *Leucothoe alata* 7, *Maera vigota* 8, *Ocosingo borlus* 3, *Photis* sp. juv. 31, *Polycheria osborni* 19.

43–E–2, 1/44th sq. m. of encrusting white sponge under rock: *Aoroides columbiae* 2, *Ericthonius brasiliensis* 2, *Leucothoe alata* 7, *Polycheria osborni* 8.

43–E–3, 1/44th sq. m. of dendritic sponge under rock: *Aoroides columbiae* 7, *Elasmopus* sp. juv. 9, *Ericthonius brasiliensis* 3, *Eurystheus thompsoni* 2, *Fresnillo fimbriatus* 1, *Lysianassa pariter* 6, *Microjassa litotes* 2, *Ocosingo borlus* 7, *Parapleustes pugettensis* 6, *Photis ?bifurcata* largely juvs. 59, *Polycheria osborni* 30.

43–E–4, 1/44th sq. m. of *Amaroucium*-like tunicate on side of rock: *Calliopiella pratti* 1, *Elasmopus* sp. juvs. 4, *Hyale* sp. juv. 1, *Polycheria osborni* 1.

43–E–5, 1 liter of large sponge buried in dark hole in rock: *Ampithoe pollex* 10, *Aoroides columbiae* 4, *Colomastix pusilla* 1, *Elasmopus* sp. 1, *Jassa falcata* 1, *Leucothoe alata* 35, *Leucothoides pacifica* 1, *Maera* sp. juv. 1, *Parapleustes pugettensis* 1, *Photis conchicola* 50.

43–E–6, clumps of medium-sized, nodose, pink tunicate under rocks below water level: *Ericthonius brasiliensis* 6, *Ischyrocerus* sp. A 1, *Ischyrocerus* sp. B 4, *Lysianassa pariter* 6, lysianassid 2, *Polycheria osborni* 19.

43–E–7, sponge under same rock as 43–E–6: *Amphilochus neapolitanus* 4, *Aoroides columbiae* 25, *Chevalia aviculae* 24, *Elasmopus* sp. juvs. 9, *Ericthonius brasiliensis* 74, *Eurystheus spinosus* 22, *E. thompsoni* 6, *Hyale rubra frequens* 4, *Ischyrocerus litotes* 16, *Ischyrocerus* sp. B 5, *Leucothoe alata* 5, *Leucothoides pacifica* 1, *Lysianassa pariter* 1, *Maera simile* 1, *Microjassa litotes* 16, *Ocosingo borlus* 6, *Parapleustes pugettensis* 4, *Photis bifurcata* 1, *Photis* sp. and juvs. some probably *P. brevipes* 50, *Podocerus brasiliensis* 3, *P. cristatus* 4, *Polycheria osborni* 22.

43–F–1, syringe suckings of *Anthopleura xanthogrammica* in upper tidal zones (not *A. elegantissima*): *Hyale* sp. 1, pontogeneiid juv. 1.

43–H–1, wash of shell fragments in tidepool: *Calliopiella pratti* 8, *Hyale rubra frequens* 3, *Photis conchicola* 3, *Pontogeneia rostrata* 1.

43–H–2, wash of shell fragments mixed with brown algae: *Amphilochus litoralis* 1, *Aoroides columbiae* 1, *Calliopiella pratti* 117, *Elasmopus* sp. juv. 1, *Hyale rubra frequens* 11, *Jassa falcata* 1, *Parallorchestes ochotensis* 1, *Pleustes depressa* 1, *Pontogeneia rostrata* 14.

43–J–1, wash of *Laminaria* sp. and coralline algae on large rock: *Amphilochus litoralis* 20, *A. neapolitanus* 4, *Ampithoe simulans* 21, *Aoroides columbiae* 1, *Calliopiella pratti* 5, *Cerapus tubularis* 1, *Cheiriphotis megacheles* 1, *Chevalia aviculae* 3, *Elasmopus* sp. juvs. 2, *Ericthonius brasiliensis* 2, *Hyale rubra frequens* 51, *Ischyrocerus* sp. 1, *Jassa falcata* 2, *Maera* sp. juv. 1, *Parajassa angularis* 1, *Photis conchicola* 19.

43–J–2, wash of *Phyllospadix* roots: *Ampithoe simulans* 1, *Ampithoe* sp. juvs. 8, *Amphilochus litoralis* 3, *A. neapolitanus* 2, *Aoroides columbiae* 1, *Atylus levidensus* 3, *Calliopiella pratti* 27, *Chevalia aviculae* 5, *Corophium baconi* 1, *Elasmopus antennatus* 1, *Elasmopus* sp. juvs. 37, *Eurystheus spinosus* 1, *E. thompsoni* 1, *Hyale rubra frequens* 88, *Ischyrocerus* sp. A 31, *Jassa falcata* thin 22, *Leucothoe alata* 2, *Maera simile* 1, ?*Microdeutopus schmitti* 1, *Microjassa litotes* 3, *Parallorchestes ochotensis* 2, *Photis conchicola* 1, *Photis* sp. juvs. 9, *Pontogeneia rostrata* 12.

43–S–1, 1/44th sq. m. of short-cropped brown algae on top of rock: *Oligochinus lighti* 49, *Parallorchestes ochotensis* 10.

43–S–2, 1/44th sq. m. of new growth of brown algae: *Ampithoe* sp. juvs. 2, *Aoroides columbiae* 10, *Elasmopus antennatus* 48, *Hyale rubra frequens* 20, *Parallorchestes ochotensis* 17, *Paraphoxus spinosus* 38, *Photis conchicola* 6.

STATION 42, Hazard Canyon reef, California, December 8–9, 1961, three grids of samples on platform of algal turf, amphipods listed as individuals per square meter.

Lines A, B: *Hyale grandicornis californica* 30, *H. rubra frequens* 130, *Oligochinus lighti* 30.

Lines C, D, E: *Allorchestes anceps* 30, *Ampithoe pollex* 467, *Aoroides columbiae* 50, *Elasmopus rapax mutatus* 61, *Hyale rubra frequens* 139, *Jassa falcata* 33, *Lysianassa macromerus* 6, *Metopa cistella* 11, *Oligochinus lighti* 4600, ?*Parallorchestes ochotensis* 6, *Parapleustes nautilus* 11, *Photis* sp. juvs. 11.

Lines F, G, H: *Allorchestes anceps* 61, *Ampithoe pollex* 194, *Aoroides columbiae* 128, *Elasmopus* sp. juvs. 133, *Eurystheus thompsoni* 6, *Hyale plumulosa* 11, *H. rubra frequens* 700, *Ischyrocerus* sp. A 122, ischyrocerid juvs. of sp. A and *Jassa falcata* 50, *Jassa falcata* thin 61, *Oligochinus lighti* 755, *Parallorchestes ochotensis* 205, *Paraphoxus obtusidens* 22, *P. spinosus* 11, *Parapleustes nautilus* 389, *P. pugettensis* 55, *Photis conchicola* 22, *Photis* sp. juvs. 22, *Pontogeneia rostrata* 44, *Stenothoides burbanki* 44, *Stenula incola* 6.

42–B–4–x, wash of clumps of coralline algae immersed in tidepool: *Ampithoe pollex* 1, *Ericthonius brasiliensis* 1, *Hyale* sp. 1, *Oligochinus lighti* 11, *Parallorchestes ochotensis* 1, *Parapleustes nautilus* 2.

280-102 O-69—5

42–C–4, sparse algae scraped from edge of ledge on surge channel: *Ampithoe* sp. 1, *Elasmopus rapax mutatus* 10, *Hyale* sp. 2, *Jassa falcata* 6, *Oligochinus lighti* 56, *Parapleustes nautilus* 15.

42–C–5, wash of sponge and tunicates encrusting side of surge channel: *Ampithoe pollex* 5, *Elasmopus rapax mutatus* 3, *Ericthonius brasiliensis* 1, *Oligochinus lighti* 3, *Parapleustes nautilus* 2, *Polycheria osborni* 7.

42–C–6, wash of large tunicate in surge channel: *Hyale rubra frequens* 1, *Jassa falcata* 5.

42–C–7, wash of rhizomes of *Egregia* sp. and *Laminaria* sp.: *Ampithoe humeralis* 1, *A. lindbergi* 2, *A. simulans* 9, *Ampithoe* sp. juvs. 12, *Aoroides columbiae* 84, *Elasmopus holgurus* 62, *Ericthonius brasiliensis* 33, *Eurystheus thompsoni* 32, *Hyale rubra frequens* 101, *Ischyrocerus* sp. A 10, juvs. of sp. A and *Jassa falcata* 6, *Jassa falcata* 4, *Maera simile* 1, *Microjassa litotes* 1, *Parallorchestes ochotensis* 11, *Paraphoxus spinosus* 1, *Parapleustes nautilus* 5, *P. pugettensis* 47, *Photis* sp. juvs. 5, *Podocerus brasiliensis* 8, *Stenothoides burbanki* 5, *Stenula incola* 2.

42–T–1, wash of hydroid *Aglaophenia* sp. and mixed algae at sea edge: *Ampithoe* sp. juvs. 3, *Elasmopus* sp. juvs. 3, *Ericthonius brasiliensis* 1, *Eurystheus thompsoni* 1, *Hyale rubra frequens* 196, *Ischyrocerus* sp. B 62, *Leucothoe alata* 3, *Parallorchestes ochotensis* 6, *Parapleustes nautilus* 8, *P. pugettensis* 106, *Photis* sp. juv. 5, *Podocerus brasiliensis* 1, stenothoid juv. 1.

42–T–2, wash of sponges from seaward-most surge channels: *Ampithoe pollex* 1, *Aoroides columbiae* 5, *Elasmopus holgurus* 16, *Eurystheus thompsoni* 9, *Ericthonius brasiliensis* 5, *Hyale* cf. *plumulosa* 24, *Ischyrocerus* sp. B 13, *Ischyrocerus-Jassa* juvs. 14, *Jassa falcata* 2, *Leucothoe alata* 44, *Parapleustes nautilus* 16, *P. pugettensis* 27, *Photis* sp. juv. 1, *Podocerus brasiliensis* 6, *Polycheria osborni* 2, stenothoid juvs. 2.

42–T–3, wash of clumps of alga *Cladophora tricotonia* in high splash pool with *Mytilus* sp.: *Hyale* sp. juvs. 26, *Oligochinus lighti* 30.

42–T–4, 1/44th sq. m. of clump of brown alga on sandy base slightly below water: *Ampithoe pollex* 8, *Aoroides columbiae* 12, *Hyale rubra frequens* 148, *Leucothoe alata* 1, *Oligochinus lighti* 80.

42–T–5, wash of *Egregia* holdfasts: *Allorchestes anceps* 1, *Ampithoe ?lindbergi* 1, *A. pollex* 6, *A. simulans* 2, *Ampithoe* sp. juv. 1, *Aoroides columbiae* 2, *Elasmopus rapax mutatus* 83, *Ericthonius* sp. 1, *Hyale rubra frequens* 26, *Jassa falcata* 16, *Oligochinus lighti* 58, *Paraphoxus spinosus* 1, *Parapleustes nautilus* 5, *Photis* sp. juvs. 2.

42–T–6, wash of *Egregia* stipes: *Ampithoe lindbergi* 2, *Calliopiella pratti* 3, *Hyale rubra frequens* 483, *Najna consiliorum* 1.

42–T–7, wash of *Egregia* holdfasts on seaward-most flat: *Ampithoe lindbergi* 1, *A. pollex* 9, *Aoroides columbiae* 14, *Elasmopus* sp. juv. 3, *Eurystheus thompsoni* 1, *Hyale rubra frequens* 28, *Ischyrocerus* sp. juv. 2, *Jassa falcata* 16, *Melita sulca* 1, *Metopa cistella* 1, *Paraphoxus spinosus* 1, *Parapleustes nautilus* 2, *P. pugettensis* 24, *Pontogeneia rostrata* 4, *Stenothoides burbanki* 10, *Stenula incola* 1.

42–T–8, $\frac{1}{44}$th sq. m. of dense short brown algae, largely *Rhodomela laryx: Hyale rubra frequens* 49, *Ischyrocerus* sp. A 2, *Jassa falcata* 1, *Parallorchestes ochotensis* 1, *Parapleustes nautilus* 7, *Pontogeneia intermedia* 1, stenothoid juv. 1.

42–T–9, $\frac{1}{44}$th sq. m. of *Phyllospadix* on sand slightly out of water: *Aoroides columbiae* 2, *Atylus levidensus* 1, *Cerapus tubularis* 1, *Hyale rubra frequens* 21, *Ischyrocerus* sp. 1, *Jassa falcata* thin 7, *Parallorchestes ochotensis* 10, *Paraphoxus spinosus* 7, *Parapleustes pugettensis* 16, *Pontogeneia ?intermedia* 2, *Stenothoides burbanki* 5.

42–T–10, $\frac{1}{44}$th sq. m. of dense short brown algae on flat rock next to surge channel, largely *Rhodomela laryx: Hyale rubra frequens* 16, *Jassa falcata* 8, *Parallorchestes ochotensis* 69, *Parapleustes nautilus* 5, *Photis* sp. juv. 5.

42–T–11, wash of short coralline algae on sandy holes: *Ampithoe* sp. juvs. 2, *Ericthonius brasiliensis* 1, *Hyale rubra frequens* 17, *Ischyrocerus anguipes* 1, *Jassa falcata* 1, *Oligochinus lighti* 1, *Parallorchestes ochotensis* 3, *Paraphoxus spinosus* 1, *Parapleustes nautilus* 4, *P. pugettensis* 1, *Pontogeneia* sp. 1, *Stenothoides burbanki* 2.

42–T–12, wash of vertical face of ledge having sponges, sand, short *Phyllospadix*, short algae: *Ampithoe pollex* 1, *Aoroides columbiae* 9, *Eurystheus thompsoni* 4, *Hyale rubra frequens* 3, *Ischyrocerus* sp. B 2, *Jassa falcata* thin 6, *Leucothoe alata* 7, *Parapleustes pugettensis* 12, *Photis* sp. juv. 1, *Podocerus brasiliensis* 4, *Polycheria osborni* 1.

42–T–13, wash of sponge: *Ampithoe ?pollex* 1, *Ischyrocerus* sp. 2, *Leucothoe alata* 8, *Maera* sp. 1, *Paraphoxus spinosus* 6, *Photis conchicola* 5.

42–T–14, *Aglaophenia* and sponges collected by scuba diver in surge channel: *Ampithoe* sp. 2, *Elasmopus* sp. juv. 1, *Ericthonius brasiliensis* 1, *Eurystheus thompsoni* 2, *Ischyrocerus* sp. B 35, *Jassa falcata* 1, *Leucothoe alata* 7, *Parapleustes nautilus* 1, *P. pugettensis* 57, *Photis* sp. juv. 1, *Podocerus* sp. juv. 1, *Polycheria osborni* 6, stenothoid 3.

Physical description of quantitative samples from station 42 as example of areas covered in stations 38, 39, 42.

42–A–1, pocket in rock with *Anthopleura* surrounded by bare surface.

42–A–2, small ridge 0.2 m. high with dense pelvetiid making 1.5 liter volume, many terebrid snails at base of algae, some sand present.

42–A–3, bare rock, no sample.

42–A–4, a small rough mound with sharp crevices, sand, a few anemones.

42–A–5, barren smooth flat rock with thin sand covering.

42–B–1, sandstone 1/10th covered with barnacles.

42–B–2, slight ridge 1/5 covered with *Anthopleura.*

42–B–3, bare platform 1/8 covered with *Anthopleura* and a few barnacles.

42–B–4, a few *Anthopleura* in a small pool, otherwise barren.

42–B–5, moderately rough sandstone, sand, a few *Anthopleura.*

42–C–1, level rock platform covered with *Phragmatopoma* sp.

42–C–2, small amount of *Phragmatopoma* sp., some red algae and anemones.

42–C–3, eroded rock with anemones and a piece of pelvetiid.

42–D–1, knoll on top of sandy substrate with many pelvetiids.

42–D–2, hard rock near pool with pelvetiids.

42–D–3, small channel under an overhang with corallines and pelvetiids.

42–E–1, same as 42–D–1.

42–E–2, highest nearby pinnacle, rather bare, scattered barnacles and small pelvetiids.

42–E–3, top of tiny mesa, barnacles, *Ulva.*

42–F–1, rugged top adjacent to subsidiary channel, some broad-bladed brown algae.

42–F–2, 0.67 m. lower elevation than previous sample, sandy substrate with short-tufted algae.

42–F–3, 0.3 m. higher elevation than previous sample, short-tufted brown and red algae, some corallines.

42–G–1, same as F–1 with coralline also.

42–G–2, *Phyllospadix* bed on sand.

42–G–3, vertical side of pinnacle, corallines and medium-sized brown algae.

42–H–1, edge of rock splash, barren, small amount of algae, coralline and sand.

42–H–2, algae on sandy holes.

42–H–3, near an overhang on a slope, sand with sparse, short brown algae.

STATION 39, Goleta (Coal-Oil Point), California, July 2, 1961, grid of 18 samples in *Phyllospadix*-pelvetiid zone, H–K, amphipods listed as individuals per square meter, see table 9 for synopsis.

Amphilochus neapolitanus 2, *Ampithoe humeralis* 5, *A.* "*mea*" 63, *A. simulans* 17, *Ampithoe* spp. juvs. 51, *Aoroides columbiae* 24, *Batea lobata* 5, *Calliopiella pratti* 5, *Elasmopus* sp. juvs. 2, *Ericthonius brasiliensis* 5, *Hyale rubra frequens* 10,300, *Ischyrocerus* sp. A 405, *Ischyrocerus* sp. B 100, *Ischyrocerus-Jassa* juvs. 376, *Jassa falcata* 149, *Lysianassa macromerus* 1588, *Megaluropus longimerus* 2, *Melita* sp. juv. 2, *Microjassa litotes* 2, *Paraphoxus heterocuspidatus* 15, *P. obtusidens* 12, *P. spinosus* 88, *P. stenodes* 10, *Pontogeneia rostrata* 234, *Stenothoe estacola* 10, *Synchelidium shoemakeri* 2.

STATION 41, Goleta, California, July 6, 1961, wash of 40 liters of densely-packed rhizomes of kelp *Macrocystis pyrifera* from depth of 3 meters, specimens of amphipods based on aliquots and rounded to nearest 10 specimens, thus providing density ratio:

Ampelisca lobata 150, *Amphilochus picadurus* 10, ?*Aoroides columbiae* 10, *Ceradocus spinicauda* 110, *Chevalia aviculae* 170, *Corophium uenoi* 20, *Cymadusa uncinata* 170, *Ericthonius brasiliensis* 70, *Eurystheus thompsoni* 290, *Heterophlias seclusus escabrosa* 260, *Lembos* ?*concavus* 100, *Lignophliantis pyrifera* 150, *Liljeborgia geminata* 30, *Maera lupana* 110, *M. simile* 360, *Melita appendiculata* 10, *Metaphoxus fultoni* 20, *Microdeutopus schmitti* 420, *Microjassa litotes* 20, *Paraphoxus spinosus* 20, *Parapleustes nautilus* 10, *Photis bifurcata* 90, *Photis brevipes* 180, *Photis* spp. juvs. 2660, *Pontogeneia rostrata* 110, *Podocerus* sp. juvs. 20, *Photis* n. sp. (unifurcate) 10.

Additional species of station 41, occurring rarely in non-aliquot portion of sample: *Ampelisca pugetica* 2, *Amphilochus litoralis* 2, *Batea transversa* 1, *Elasmopus* sp. 1, *Lepidepecreum* ?*gurjanovae* 2, *Lysianassa dissimilis* 2, *Maera inaequipes* 1, *Orchomene pacifica* 4, *Panoploea* (?) *hedgpethi* 1, *Podocerus brasiliensis* 1.

STATION 40, Goleta (Coal-Oil Point), California, July 2, 1961.

40–A, wash of pelvetiids: *Ampithoe simulans* 14, *Hyale rubra frequens* 357, *Parapleustes pugettensis* 1, *Photis* sp. juvs. 5, *Pontogeneia rostrata* 12.

40–B, 1/44th sq. m. of *Anthopleura elegantissima* bed: *Hyale rubra frequens* 2, *Megaluropus longimerus* 1.

40–G–7, wash of transitional epiflora between *Phyllospadix* and pelvetiid zones: *Aoroides columbiae* 1, *Elasmopus* sp. juv. 1, *Ericthonius brasiliensis* 1, *Hyale rubra frequens* 160, *Jassa falcata* 6, *Metaphoxus* *frequens* 1, *Paraphoxus obtusidens* 1, *P. spinosus* 1, *Parapleustes pugettensis* 2, *Photis* sp. juvs. 2, *Pontogeneia rostrata* 3.

40–G–8, wash of *Phyllospadix* on sand: *Aoroides columbiae* 1, *Amphilochus neapolitanus* 1, *Hyale rubra frequens* 143, *Ischyrocerus* sp. B 1, *Jassa falcata* 9, *Lysianassa macromerus* 4, *Oligochinus lighti* 2, *Paraphoxus obtusidens* 2, *P. spinosus* 1, *Pontogeneia rostrata* 5.

40–G–9, wash of *Phyllospadix* on bare sand mixed with sea anemones, short-tufted algal mat and *Ulva: Hyale rubra frequens* 17, *Lysianassa macromerus* 6, *Paraphoxus heterocuspidatus* 2, *P. obtusidens* 6, *Pontogeneia rostrata* 3, *Stenothoe estacola* 1.

40–G–10, wash of *Anthopleura elegantissima* bed on sand: *Hyale rubra frequens* 12, *Paraphoxus ?heterocuspidatus* 1.

Campbell Station 1, Hope Ranch Beach, Goleta, California, January 8, 1962, samples collected by scuba diving.

1–A, bottle of sand dipped from shore: *Mandibulophoxus uncirostratus* 1, *Paraphoxus jonesi* 1, *P. obtusidens* 1.

1–B, scrapings from rock outcrop at 8 m. depth, about 2 m. above sand bottom: *Ampelisca lobata* 1, *Amphilochus picadurus* 16, *Elasmopus antennatus* 5, *Eurystheus thompsoni* 1, *Ischyrocerus* sp. 1, *Microdeutopus schmitti* 1, photid 21, *Microjassa litotes* 8, *Photis bifurcata* 3, *P. conchicola* 2, *Photis* sp. juvs. 18, *Podocerus brasiliensis* 10.

1–F, end sawed off submerged log at 8 m. depth: *Ampelisca lobata* 16, *Amphilochus picadurus* 1, *Chevalia aviculae* 1, *Corophium californianum* 50, *Ericthonius brasiliensis* 1, *Eurystheus mamolus* 3, *E. thompsoni* 6, *Gitanopsis ?pusilloides* 1, *Lembos* sp. juv. 2, *Leucothoe alata* 2, *Leucothoides pacifica* 1, *Liljeborgia geminata* 1, *Maera simile* 4, *Microdeutopus schmitti* 3, *Microjassa litotes* 4, photid 4, *Photis brevipes 15*, *Podocerus brasiliensis* 3.

Campbell Station 5, Hope Ranch Beach, Goleta, California, March 2, 1962, wash of holdfast of *Macrocystis pyrifera: Ampelisca lobata* 6, *Ampithoe lindbergi* 1, *Ampithoe* sp. juvs. 13, *Ceradocus spinicauda* 49, *Chevalia aviculae* 2, *Cymadusa uncinata* 29, *Ericthonius brasiliensis* 2, *Eurystheus mamolus* 23, *Jassa falcata* 2, *Lembos* sp. 12, *Maera simile* 26, *Maera-Ceradocus* juvs. 14, *Metaphoxus frequens* 1, *Microdeutopus schmitti* 34, *Microjassa litotes* 2, *Paraphoxus spinosus* 4, *Photis* sp. juvs. 5, *Pleusirus secorrus* 1, *Podocerus cristatus* 1, *Pontogeneia rostrata* 3, *Synchelidium* sp. M 1.

Campbell Station 6–A, Hope Ranch Beach, Goleta, California, February 27, 1962, wash of *Egregia laevigata:* eophliantid, n. sp. (not *Lignophliantis pyrifera*), 2, *Hyale rubra frequens* 50, *Synchelidium* sp. M 2.

Station 47, Point Dume, California, February 5-7, 1963.

47-A-1, A-2, A-3, each $\frac{1}{44}$th sq. m. of *Anthopleura elegantissima; Aoroides columbiae* 1, *Lysianassa macromerus* 32, *Pontogeneia rostrata* 1.

47-E-1, E-2, each $\frac{1}{44}$th sq. m. of pendant, sand-encrusted, social tunicates: *Ampithoe* cf. *pollex*, juv. 1, *Aoroides columbiae* 30, *Eurystheus thompsoni* 1, *Hyale rubra frequens* 4, *Jassa falcata* 1, *Parapleustes pugettensis* 8, stenothoid juv. 1.

47-E-3, $\frac{1}{44}$th sq. m. of sandy sponge from landward face of vertical rock, 0.67 m. above low water: *Ampithoe pollex* 4, *Aoroides columbiae* 21, *Elasmopus rapax mutatus* 182, *Hyale rubra frequens* 6.

47-F-1, $\frac{1}{44}$th sq. m. of old algal holdfast encrusted with sand tubes: *Ampithoe pollex* 13, *Aoroides columbiae* 12, *Elasmopus rapax mutatus* 111, *Hyale rubra frequens* 3, *Photis* sp. juvs. 3.

47-F-4, non-quantitative wash of pendant, sand-encrusted, social tunicates on underside of ledge: *Aoroides columbiae* 12, *Elasmopus holgurus* 1, *Ericthonius brasiliensis* 1, *Hyale* sp. juvs. 4, *Leucothoe alata* 7, *Lembos* sp. juv. 1, *Parapleustes pugettensis* 25.

STATION 46, Corona del Mar, California, December 9-11, 1962.

46-A-E, grid of 23 samples in *Phyllospadix*-coralline zone, see table 18 for synopsis, amphipods listed as individuals per square meter: *Amphilochus litoralis* 18, *A. neapolitanus* 16, *Ampithoe lindbergi* 4, *A. pollex* 476, *Ampithoe* sp. juvs. 2, *Aoroides columbiae* 438, *Cerapus tubularis* 106, *Dulzura sal* 4, *Elasmopus rapax mutatus* 3228, *E. rapax serricatus* 38, *Elasmopus* spp. juvs. 404, *Ericthonius brasiliensis* 210, *Eurystheus thompsoni* 12, *Gitanopsis ?pusilloides* 2, *G. vilordes* 2, *Hyale grandicornis californica* 12, *Hyale rubra frequens* 9100, *Jassa falcata* thick 10, *J. falcata* thin 178, *Lembos* sp. juv. 2, *Lysianassa macromerus* 28, *Megamphopus effrenus* 8, *M. martesia* 2, *Megamphopus* spp. juvs. 4, *Melita sulca* 46, *Microdeutopus schmitti* 22, *Microjassa litotes* 152, *Paraphoxus spinosus* 4, *Parapleustes pugettensis* 22, *Photis brevipes* 2, *P. conchicola* 30, *P. elephantis* 34, *Photis* spp. juvs. 1282, *Podocerus brasiliensis* 2, *Stenothoe estacola* 4.

46-G-8, G-13, G-15, J-1, washings of loose rocks: *Amphilochus litoralis* 3, *A. neapolitanus* 48, *Ampithoe pollex* 2, *Ampithoe* sp. juvs. 8, *Aoroides columbiae* 166, *Cerapus tubularis* 3, *Cheiriphotis megacheles* 1, *Dulzura sal* 1, *Elasmopus rapax serricatus* 32, *Elasmopus* sp. juvs. 31, *Ericthonius brasiliensis* 48, *Eurystheus thompsoni* 1, *Eusiroides monoculoides* 16, *Gitanopsis vilordes* 37, *Hyale rubra frequens* 833, *Ischyrocerus* sp. A 1, *Jassa falcata* thick 22, *Lysianassa macromerus* 37, *Maera ?simile* 57, *Melita sulca* 141, *Megamphopus* sp. juvs. 2, *Microdeutopus schmitti* 30, *Microjassa litotes* 32, *Parapleustes pugettensis* 28, photid 1, *Photis conchicola* 6, *P. elephantis* 8, *Photis* spp. juvs. 133, *Podocerus brasiliensis* 2, *Pontogeneia rostrata* 1, stenothoids 2.

46–G–10, G–11, large calcareous worm tubes below water level: *Amphilochus neapolitanus* 3, *Aoroides columbiae* 79, *Corophium baconi* 1, *Elasmopus rapax mutatus* 16, *Elasmopus* sp. juvs. 16, *Ericthonius brasiliensis* 115, *Eurystheus thompsoni* 38, *Gitanopsis vilordes* 8, *Jassa falcata* thick 4, *Maera simile* 14, *Melita sulca* 66, *Microdeutopus schmitti* 102, *Microjassa litotes* 1, *Parapleustes pugettensis* 11, *Photis brevipes* 2, *Photis* sp. juvs. 244, *Stenothoe estacola* 3.

46–G–4, G–9, G–13a, G–14, K–3, K–4, nonquantitative samples of mixed red and brown algae and holdfasts below water level seaward of A–E grid: *Amphilochus litoralis* 90, *A. neapolitanus* 42, *Amphilochus* spp. 44, *Ampithoe lacertosa* 2, *A. ?tea* juvs. 3, *Ampithoe* sp. juvs. 3, *Aoroides columbiae* 36, *Cerapus tubularis* 19, *Elasmopus rapax mutatus* 83, *E. rapax serricatus* 95, *Ericthonius brasiliensis* 69, *Eurystheus thompsoni* 1, *Eusiroides monoculoides* 1, *Gitanopsis vilordes* 2, *Hyale rubra frequens* 329, *Ischyrocerus* sp. B 2, *Jassa falcata* thick 10, *J. falcata* thin 59, *Maera simile* 1, *Microdeutopus schmitti* 55, *?Microjassa claustris* 1, *Microjassa litotes* 264, *Neomegamphopus roosevelti* 6, *Parapleustes pugettensis* 53, *Photis brevipes* 5, *P. conchicola* 5, *P. elephantis* 6, *Photis* spp. juvs. 886, *Podocerus brasiliensis* 1, stenothoids 2.

46–G–1, wash of 2 stipes of *Egregia* sp.: *Amphilochus litoralis* 67, *Ampithoe ?tea* 112, *A. pollex* 1, *Elasmopus* sp. juv. 4, *Ericthonius brasiliensis* 1, *Eurystheus thompsoni* 1, *Hyale rubra frequens* 1958, *Ischyrocerus* sp. A 1, *Jassa falcata* thin 1, *Microjassa litotes* 1.

46–G–3, 1 liter of soft polychaete tubes: *Ampithoe* sp. juvs. 4, *Aoroides columbiae* 30, *Elasmopus* sp. juvs. 4, *Ericthonius brasiliensis* 39, *Eurystheus thompsoni* 12, *Eusiroides monoculoides* 2, *Jassa falcata* 2, *Lembos* sp. juv. 2, *Microdeutopus schmitti* 2, *Neomegamphopus roosevelti* 1, *Photis elephantis* 4, *Photis* sp. juv. 149.

46–G–6, *Laminaria* with holdfast, 10% of sample: *Aoroides columbiae* 18, *Ericthonius brasiliensis* 56, *Eurystheus thompsoni* 7, *Eusiroides monoculoides* 1, *Hyale* sp. juvs. 1, *Jassa falcata* 4, *Lembos* sp. juv. 1, *Liljeborgia* sp. 4, *Maera inaequipes* 1, *Maera* sp. 2, *Microjassa litotes* 1, *Neomegamphopus roosevelti* 21, *Parapleustes pugettensis* 2, photid 1, *Photis brevipes* 3, *P. elephantis* 1, *Photis* spp. juvs. 161, *Pontogeneia ?intermedia* 1.

46–G–7, 1 liter of *Phragmatopoma* masses: *Amphilochus neapolitanus* 5, *Aoroides columbiae* 29, *Cheiriphotis megacheles* 1, *Corophium baconi* 4, *Elasmopus* sp. juv. 1, *Ericthonius brasiliensis* 15, *Eurystheus thompsoni* 3, *Jassa falcata* 2, *Lembos* sp. juv. 2, *Leucothoe alata* 1, *Melita* *sulca* 1, *Microdeutopus schmitti* 4, *Parapleustes pugettensis* 1, *Photis brevipes* 2, *Photis* sp. juvs. 253, stenothoid juvs. 3.

46–G–12, 1 liter of tunicate colonies at base of *Phyllospadix* leaves: *Aoroides columbiae* 96, *Elasmopus antennatus* 17, *Ericthonius brasiliensis* 3, *Eurystheus thompsoni* 6, *Hyale rubra frequens* 5, *Jassa falcata* thick 17, *J. falcata* thin 12, *Jassa* spp. juvs. 11, *Lembos* sp. juv. 1, *Lysianassa dissimilis* 12, *Maera simile* 1, *Megamphopus effrenus* 13, *Neomegamphopus roosevelti* 7, *Netamelita cortada* 2, *Parapleustes pugettensis* 4, *Photis elephantis* 3, *P. conchicola* 1, *Photis* spp. juvs. 149, *Stenothoe estacola* 2, stenothoids 3.

46–K–1, ⅙ liter of tunicates and soft polychaete tubes: *Aoroides columbiae* 6, *Cheiriphotis megacheles* 2, *Corophium baconi* 4, *Elasmopus rapax serricatus* 6, *Ericthonius brasiliensis* 74, *Eurystheus thompsoni* 6, *Eusiroides monoculoides* 3, *Jassa falcata* thick 21, *Lembos macromanus* 4, *Lysianassa dissimilis* 2, *Maera inaequipes* 1, *Neomegamphopus roosevelti* 41, *Parapleustes pugettensis* 1, *Photis elephantis* 13, *Photis* sp. juvs. 124, *Polycheria osborni* 5, *Stenothoe estacola* 1, stenothoid 1.

46–K–2, 1 liter of sponges from undersurface of ledge facing surf: *Ampithoe pollex* 1, *Aoroides columbiae* 10, *Elasmopus rapax mutatus* 110, *Ericthonius brasiliensis* 1, *Eusiroides monoculoides* 1, *Hyale rubra frequens* 1, *Jassa falcata* thick 39, *Leucothoe alata* 11, *Parapleustes pugettensis* 1, *Photis conchicola* 1, *Photis* sp. juvs. 19, stenothoid juvs. 7.

Station 4, Corona del Mar, February 6, 1955, wash of sponge, *Spheciospongia* sp.: *Colomastix pusilla* 14, *Corophium baconi* 1, *Elasmopus* sp. 8, *Ericthonius brasiliensis* 19, *Jassa falcata* 75, *Leucothoe alata* 5, *Maera inaequipes* 1, *Parapleustes pugettensis* 31, *Photis brevipes* 72, *Podocerus brasiliensis* 2, *Stenothoe estacola* 29.

Station 6, Corona del Mar, February 6, 1955, wash of beds of *Phragmatopoma* sp.: *Allorchestes* sp. 1, *Colomastix pusilla* 1, *Corophium baconi* 18, *Elasmopus holgurus* 63, *Ericthonius brasiliensis* 38, *Eurystheus thompsoni* 92, *Jassa falcata* 61, *Lembos* sp. 7, *Liljeborgia* sp. 1, *Maera inaequipes* 15, *M. simile 3*, *Parapleustes den* 5, *Photis* cf. *conchicola* juvs. 246, *Stenothoe estacola* 22.

Station 45, La Jolla, California, November 11–13, 1962.

45–A–E, grid of 25 samples in *Phyllospadix*-pelvetiid-graciliarioid-coralline zone, see table 21 for synopsis, amphipods listed as individuals per square meter: *Ampelisca lobata* 4, *A. schellenbergi* 18, *Amphilochus litoralis* 149, *A. neapolitanus* 62, amphilochid juvs. 14, *Ampithoe lacertosa* 5, *A. plumulosa* 70, *A. pollex* 107, *A. simulans* 16, *A. tea* 7, *Ampithoe* spp. juvs. 49, *Aoroides columbiae* 408, *Cerapus tubularis* 498, *Cheiriphotis megacheles* 90, *Dulzura sal* 2, *Elasmopus antennatus* 485, *E. rapax mutatus* 48, *E. rapax serricatus* 1127, *Elas-*

mopus spp. juvs. 865, *Ericthonius brasiliensis* 250, *Gitanopsis vilordes* 5, *Heterophlias seclusus escabrosa* 11, *Hyale rubra frequens* 4890, *Ischyrocerus* sp. A 63, *Jassa falcata* thick 21, *J. falcata* thin 21, *Lembos macromanus* 11, *Lembos* sp. juvs. 4, *Lysianassa macromerus* 11, *Maera inaequipes* 4, *Megamphopus effrenus* 142, *M. martesia* 130, *Melita* sp. juvs. 4, *Microdeutopus schmitti* 503, *Microjassa litotes* 2177, *Paraphoxus spinosus* 303, *Parapleustes pugettensis* 44, *Parapleustes* sp. A 2, *Parapleustes* spp. juvs. 5, *Photis brevipes* 736, *P. conchicola* 589, *Photis* spp. juvs. 355, *Pleustes ?depressa* juvs. 4, *P. platypa* 5, *Podocerus* sp. juv. 2, *Polycheria osborni* 16, *Pontogeneia quinsana* 19, *P. rostrata* 44, stenothoid 2, stenothoid 4, *Synchelidium rectipalmum* 33, unknown crushed specimens 90.

45–F–G, grid of 22 samples of underrock substrates in *Phyllospadix*-pelvetiid zone, see table 22 for synopsis, amphipods listed as individuals per square meter: *Ampelisca lobata* 4, *Amphilochus neapolitanus* 28, *Ampithoe plumulosa* 2, *A. pollex* 58, *A. simulans* 8, *Ampithoe* spp. juvs. 2, *Aoroides columbiae* 60, *Cerapus tubularis* 4, *Cheiriphotis megacheles* 92, *Corophium baconi* 2, *Dulzura sal* 2, *Elsamopus rapax mutatus* 2, *E. rapax serricatus* 30, *Elasmopus* sp. juvs. 280, eophliantid 4, *Ericthonius brasiliensis* 10, *Eurystheus thompsoni* 4, *Eusiroides monoculoides* 4, *Gitanopsis vilordes* 12, *Heterophlias seclusus escabrosa* 38, *Hyale rubra frequens* 54, *Lembos* sp. juvs. 8, *Maera simile* 88, *Megamphopus effrenus* 2, *M. martesia* 6, *Melita sulca* 38, *Microdeutopus schmitti* 38, *Microjassa litotes* 98, *Orchomene magdalenensis* 2, *Paraphoxus spinosus* 6, *Parapleustes pugettensis* 24, *Photis brevipes* 2, *Photis* sp. juvs. 176, *Pleustes depressa* 2, *Pontogeneia quinsana* 2, *P. rostrata* 4, *Synchelidium rectipalmum* 2.

45–O–1, O–2, T–1, W–3, W–4, nonquantitative washes of coralline algae: *Amphilochus litoralis* 43, *A. neapolitanus* 9, *Ampithoe plumulosa* 11, *A. pollex* 39, *Ampithoe* sp. juvs. 95, *Aoroides columbiae* 87, *Cerapus tubularis* 1, *Cheiriphotis megacheles* 7, *Elasmopus antennatus* 70, *E. rapax serricatus* 170, *Elasmopus* sp. juvs. 46, *Ericthonius brasiliensis* 5, *Hyale rubra frequens* 1005, *Ischyrocerus* sp. B 2, *Megamphopus effrenus* 1, *M. martesia* 12, *Microdeutopus schmitti* 91, *Microjassa litotes* 115, *Paraphoxus spinosus* 1, *Parapleustes pugettensis* 5, *Parapleustes* sp. A 1, *Photis brevipes* 1, *Photis* sp. juvs. 138, *Pleustes ?depressa* 3, *Pontogeneia quinsana* 11, *P. rostrata* 7, *Pontogeneia* sp. juvs. 1.

45–M–4, 1/44th sq. m. of mat of brown, red, and coralline algae under *Phyllospadix* leaves, analyzed separately after cutting off *Phyllospadix* plants: *Amphilochus litoralis* 16, *A. neapolitanus* 2, *Ampithoe lacertosa* 4, *Ampithoe* sp. juvs. 2, *Cerapus tubularis* 2, *Corophium baconi* 2, *Elasmopus rapax serricatus* 348, *Ericthonius brasiliensis* 6, *Hyale rubra frequens* 269, *Ischyrocerus* sp. A 2, *Jassa falcata* thin 2, *Megam-*

phopus martesia 2, *Microdeutopus schmitti* 6, *Microjassa litotes* 16, *Photis* sp. juvs. 30, *Pleustes ?depressa* juvs. 2.

45–P–1, ¼th sq. m. of mitellid cirripedes on rock face above algal zone: *Hyale grandicornis californica* 2.

45–T–2, rock scrapings under platform overhang at sea edge on low tide, largely tunicates, barnacles, and one small sponge: amphilochid 1, *Cheiriphotis megacheles* 23, *Elasmopus* sp. 9, *Jassa falcata* 6, *Lysianassa pariter* 1.

45–W–1, sponge from overhang at sea edge on low water below water level: *Aoroides columbiae* 3, *Elasmopus* sp. juvs. 13, *Ericthonius brasiliensis* 1, *Jassa falcata* 27, *Lysianassa pariter* 4, *Megamphopus* sp. juvs. 3, *Microjassa claustris* 2, *Parapleustes pugettensis* 13, *Photis* sp. juvs. 1, *Polycheria osborni* 1.

45–W–2, 0.5 liter of mixed red algae from 0.16 m. below water in tidepool at low tide: *Ampithoe pollex* 2, *Aoroides columbiae* 1, *Ericthonius brasiliensis* 5, *Elasmopus rapax serricatus* 46, *Hyale rubra frequens* 16, *Jassa falcata* thin 5, *Megamphopus effrenus* 3, *M. martesia* 7, *Microdeutopus schmitti* 18, *Microjassa litotes* 5, *Parapleustes pugettensis* 1, *Photis elephantis* 56, *Synchelidium rectipalmum* 1.

45–W–5, scraping of calcareous sponge under ledge in surge channel: *Ampelisca schellenbergi* 1, *Ampithoe* sp. 1, *Aoroides columbiae* 3, *Elasmopus* sp. 3, *Ericthonius brasiliensis* 3, *Hyale rubra frequens* 2, *Jassa falcata* 46, *Leucothoe alata* 2, *Lysianassa pariter* 1, *Microjassa claustris* 45, *Parapleustes pugettensis* 11, *Polycheria osborni* 2.

Appendix II

Checklist of Californian Intertidal Amphipoda

Each species is cited with its original reference if described from the Californian area and one or more of the best modern references, including those with vouchers for intertidal records. Species found in this survey are marked anteriorly with asterisks. Brief distribution ranges are cited later, asterisks denoting firm range limits, either northern or southern. A list of provisional names and various synonyms follows.

***Accedomoera vagor** Barnard, herein. Cayucos, California.

Allogaussia recondita Stasek (1958). Moss Beach, California. Assigned provisionally to *Orchomene*, see Barnard (1964b).

***Allorchestes anceps** Barnard, herein. Carmel to Hazard Canyon reef,* California.

Allorchestes angusta Dana (1854), Barnard (1952a). California south to Laguna Beach,* rare south of Monterey Bay. Japan.

Ampelisca cristata Holmes (1908), Barnard (1954b, 1959). Tomales Bay, California to Costa Rica, rare in intertidal.

***Ampelisca lobata** Holmes (1908), Barnard (1954b). Puget Sound, Washington to Ecuador, 0–183 m. Caribbean Sea.

Ampelisca macrocephala Liljeborg, Barnard (1954b). Pan-boreal, primarily subintertidal in California to coastal shelf of Baja California in deep water. Reported by Hewatt (1946) from Santa Cruz Island intertidal.

***Ampelisca pugetica** Stimpson (1864), Barnard (1954b). Puget Sound, Washington to Gulf of California, Peru, 0–183 m., rare in intertidal.

***Ampelisca schellenbergi** Shoemaker (1933a, 1942), Barnard (1954b). Cayucos,* California, to pan-American tropics, rare in California.

Ampelisca venetiensis Shoemaker (1916), Barnard (1954b). Venice,* California to Ecuador, rare in California.

***Amphilochus litoralis** Stout (1912), Barnard (1962c). Monterey Bay to La Jolla, California.

***Amphilochus neapolitanus** Della Valle, Barnard (1959, 1962c). Cosmopolitan in warm seas, 0–80 m.

***Amphilochus picadurus** Barnard (1962c). Southern California, 3–41m.

***Ampithoe humeralis** Stimpson (1864), Barnard (1965a). Puget Sound, Washington to Guadelupe Island, Baja California.

***Ampithoe lacertosa** Bate, Barnard (1954a, 1965a). Kodiak, Alaska to Bahía Magdalena, Baja California. Japan.

**Ampithoe lindbergi* Gurjanova (see 1951), Barnard (1965a). Bering Sea to Corona del Mar,* California.

Ampithoe longimana Smith, Barnard (1959). In California known only from Newport Bay. Western Atlantic Ocean.

Ampithoe plea Barnard (1965a). Gulf of California.

Ampithoe plumulosa Shoemaker (1938), Barnard (1965a). British Columbia to Ecuador.

**Ampithoe pollex* Kunkel, Barnard (1954a, 1959, 1965a). Oregon to northern Baja California. Bermuda.

Ampithoe ramondi Audouin, Barnard (1965a). Pan-tropical, occurring as far north as San Mateo Pt., near Oceanside, California.

**Ampithoe simulans* Alderman (1936), Barnard (1954a, 1965a). Coos Bay, Oregon to La Jolla, California.

Ampithoe tea Barnard (1965a). Southern California.

Ampithoe valida Smith, Alderman (1936), Barnard (1954a, 1965a). Newport Bay, California, Coos Bay, Oregon, Moss Beach, California, rarely in open sea. Northwestern Pacific, Western Atlantic.

**Ampithoe* sp. ("*mea*" kind), Barnard (1965a). Coos Bay, Oregon to Corona del-Mar, California.

**Anamixis linsleyi* Barnard (1955b, 1959). Carmel to Newport Bay, California.

Anisogammarus confervicolus (Stimpson, 1857), Barnard (1954a), Shoemaker (1964). Brackish water from Alaska to San Diego, California, rare south of Monterey Bay.

Anisogammarus oregonensis Shoemaker (1944). Oregon rivers and lakes.

Anisogammarus pugettensis (Dana, 1853), Barnard (1954a). Brackish water from Pribilof Islands to Coos Bay, Oregon. Japan, Okhotsk, Chuckchi seas.

Anisogammarus ramellus (Weckel, 1907), Shoemaker (1942a), Barnard (1954a). British Columbia to Pt. Arena, California, brackish water.

**Aoroides columbiae* Walker (1898), Barnard (1954a). Puget Sound, Washington to Bahía de San Quintín, Baja California, 0–180 m. Japan.

**Atylus levidensus* Barnard (1956), Mills (1961). British Columbia to Hazard Canyon reef,* California.

Atylus tridens (Alderman, 1936), Mills (1961). British Columbia to southern Californian coastal shelf.*

**Batea lobata* Shoemaker (1926). Southern California, 0–9 m. Morro Bay.*

**Batea transversa* Shoemaker (1926). Southern California, 3–60 m.

**Calliopiella pratti* Barnard (1954a). Coos County, Oregon to Goleta,* California.

"*Calliopius laeviusculus*" (Krøyer), Barnard (1954a). Oregon and Washington, possibly a new species.

**Ceradocus spinicaudus* (Holmes, 1908), Barnard (1962b). Cape Arago, Oregon, to subintertidal depths of coastal shelf of southern California.

**Cerapus tubularis* Say, Barnard (1962a). Probably cosmopolitan in warm and cold-temperate seas.

**Cheiriphotis megacheles* (Giles), Barnard (1962a). Tropicopolitan, in eastern Pacific occurring north to Cayucos,* California.

Chelura terebrans Philippi, Barnard (1950). Woodborer in harbors, cosmopolitan in warm and cold-temperate seas, except northwestern Pacific.

**Chevalia aviculae* Walker, Barnard (1962a). Tropicopolitan, in eastern Pacific occurring north to Cayucos,* California.

**Colomastix pusilla* Grube, Barnard (1955a, 1959). Tropicopolitan.

Corophium acherusicum Costa, Shoemaker (1949). Cosmopolitan in harbors.

**Corophium baconi* Shoemaker (1934, 1949), Barnard (1959). Bering Sea to Peru, 0–55 m.

Corophium brevis Shoemaker (1949). Estuaries, Alaska to San Francisco Bay.

**Corophium californianum* Shoemaker (1934). Monterey Bay to Goleta, California, 8–88 m.

Corophium insidiosum Crawford, Shoemaker (1949), Barnard (1959). Harbors, possibly cosmopolitan.

Corophium oaklandense Shoemaker (1949). Oakland, California, estuary.

Corophium spinicorne Stimpson (1856), Shoemaker (1949). Estuaries, Alaska to Morro Bay,* California.

Corophium stimpsoni Shoemaker (1941b, 1949). Estuaries, Mendocino County to Monterey Bay, California.

**Corophium uenoi* Stephensen, Barnard (1952a, 1959). Morro Bay, California to Bahía de San Quintín, Baja California. Japan.

**Cymadusa uncinata* (Stout, 1912), Barnard (1965a). Friday Harbor, Washington, to Laguna Beach, California.

**Dulzura sal* Barnard, herein. Corona del Mar and La Jolla, California.

**Elasmopus antennatus* (Stout, 1913), Barnard (1962b). Carmel, California, to Bahía de San Ramon, Baja California.

**Elasmopus holgurus* Barnard (1962b). Cayucos to north Laguna Beach, California.

**Elasmopus rapax rapax* Costa, Barnard (1959, 1962b). Cosmopolitan in harbors and tropical open-seas.

**Elasmopus rapax mutatus* Barnard (1962b). Carmel to La Jolla, California.

**Elasmopus rapax serricatus* Barnard, herein. Carmel to La Jolla, California.

**Ericthonius brasiliensis* (Dana), Barnard (1953, 1959). Cosmopolitan in tropical to cold-temperate seas, 0–130 m.

**Ericthonius hunteri* (Bate), Barnard (1962a). Pan-boreal, in intertidal of eastern Pacific south to Cayucos,* California, thence southward on coastal shelf at least as far as San Diego, California.

**Eurystheus mamolus* (Barnard, 1962a). Monterey Bay to Goleta, California, 3–25 m.

**Eurystheus spinosus* Shoemaker (1942b). Cayucos, California, to Bahía Magdalena, Baja California.

**Eurystheus thompsoni* (Walker, 1898), Shoemaker (1955b), Barnard (1959). Puget Sound, Washington, to Bahía Magdalena, Baja California.

Eurystheus ventosa Barnard (1962a). Corona del Mar and Laguna Beach, California.

**Eusiroides monoculoides* (Haswell), Barnard (1964a). Circumtropical, in eastern Pacific Ocean as far north as Corona del Mar,* California.

**Fresnillo fimbriatus* Barnard, herein. Carmel and Cayucos, California.

**Gitanopsis vilordes* Barnard (1962c). Monterey Bay to La Jolla, California, 0–27 m.

**Heterophlias seclusus escabrosa* Barnard (1962b). Carmel to La Jolla, California; Bahía de Los Angeles, Baja California.

Hippomedon denticulatus (Bate), Sars (1895), Barnard (1954a), Gurjanova (1962). Oregon intertidal and one specimen at hand from intertidal of Albion, California, coll. by W. K. Emerson and J. L. Barnard, 1949.

**Hyale grandicornis californica* Barnard, herein. Carmel to La Jolla, California.

Hyale perieri (Lucas), Hewatt (1946). Santa Cruz Island, California.

**Hyale plumulosa* (Stimpson, 1857), Thorsteinson (1941). British Columbia to Playa del Rey, California.

**Hyale rubra frequens* (Stout, 1913). Oregon and California.

**Hyale rubra rubra* (Thomson), Hurley (1957), herein, in eastern Pacific known presently from Santa Catalina Island and Cedros Island.

**Ischyrocerus anguipes* Krøyer, Walker (1898, as *I. minutus*), Barnard (1954a). Pan-boreal, in eastern Pacific as far south as Hazard Canyon reef, California.

**Ischyrocerus* sp. A, herein. Cayucos to La Jolla, California.

**Ischyrocerus* sp. B, herein. Cayucos to La Jolla, California.

**Jassa falcata* (Montagu), Barnard (1959). Cosmopolitan except for Arctic seas.

**Lembos concavus* Stout (1913), Barnard (1962a). Southern California.

**Lembos macromerus* (Shoemaker, 1925), Barnard (1962a). Gulf of California to Cayucos, California.

**Lepidepecreum gurjanovae* Hurley (1963). Shallow water form at Goleta, California, 3 m.

**Leucothoe alata* Barnard (1959). Carmel to Bahía de San Ramón, Baja California, 0–11 m.

Leucothoe spinicarpa (Abildgaard), Barnard (1962c). Possibly cosmopolitan.

**Leucothoides pacifica* Barnard (1955b). Carmel to Newport Bay, California, 0–8 m.

**Lignophliantis pyrifera* Barnard, herein. Goleta, California.

**Liljeborgia geminata* Barnard, herein. Goleta, California, to Bahía de San Quintín, Baja California, 3–70 m.

**Lysianassa dissimilis* (Stout, 1913), Shoemaker (1942b). Pt. Conception, California, to Gulf of California, 0–41 m.

**Lysianassa macromerus* (Shoemaker, 1916). Cayucos to La Jolla, California.

**Lysianassa pariter* Barnard, herein. Cayucos to La Jolla, California.

Maera danae (Stimpson), Hewatt (1946). Santa Cruz, Island, California, otherwise pan-boreal and intertidal in cold-temperate seas; as *M. loveni* in Barnard (1962b).

**Maera inaequipes* (Costa), Alderman (1936), Barnard (1959). Californian form occurs from Moss Beach to La Jolla, California.

**Maera lupana* Barnard, herein. Goleta, California, 3 m.

**Maera simile* Stout (1913), Barnard (1959). Puget Sound, Washington, to Bahía de San Quintín, Baja California, 0–43 m.

**Maera vigota* Barnard, herein. Carmel and Cayucos, California.

**Mandibulophoxus uncirostratus* (Giles), Barnard (1960b). Tropical Indo-Pacific, in eastern Pacific as far north as Humboldt Bay, California, 0–18 m.

**Megaluropus longimerus* Schellenberg, Barnard (1962b). Californian form from Hazard Canyon to Bahía de San Ramón, Baja California, 0–27 m.

**Megamphopus effrenus* Barnard (1964a). Cayucos to La Jolla, California.

**Megamphopus martesia* Barnard (1964a). Carmel, California, to Bahía de San Cristóbal, Baja California, 0–84 m.

**Melita appendiculata* (Say) (=*M. fresneli*), Shoemaker (1955a). Tropicopolitan, rare in California as far north as Goleta.

Melita californica Alderman (1936). Moss Beach, California.

**Melita dentata* (Krøyer), Shoemaker (1955a). Pan-boreal, in California as far south as Corona del Mar but rare, 0–113 m.

**Melita sulca* (Stout, 1913). Friday Harbor, Washington, to Cedros Island, Baja California, 0–101 m.

Mesometopa esmarki (Boeck, 1871), Gurjanova (1951). San Francisco, California.

Mesometopa sinuata Shoemaker (1964). Coos Bay, Oregon, to Monterey Bay, California.

Metaceradocus occidentalis Barnard (1959). Newport Bay, California.

**Metaphoxus frequens* Barnard (1960b). Monterey Bay, California, to Isabel Island, Mexico, 0–458 m., rare in intertidal.

**Metaphoxus fultoni* (Scott), Barnard (1964b). Monterey Bay, California, to Bahía de San Cristóbal, Baja California, 0–170 m. Europe.

**Metopa cistella* Barnard, herein. Hazard Canyon reef, California.

**Microdeutopus schmitti* Shoemaker (1942b), Barnard (1959). Monterey Bay, California, to Cabo San Lucas, Baja California, 0–43 m.

**Microjassa claustris* Barnard, herein. Corona del Mar and La Jolla, California.

**Microjassa litotes* Barnard (1954c, 1962a). Carmel to Bahía de San Cristóbal, 0–157 m.

**Najna ?consiliorum* Derzhavin, Barnard (1962c), probably a new species. Intertidal in California as far south as Hazard Canyon reef,* subintertidal in southern California. [Japan Sea.]

**Neomegamphopus roosevelti* Shoemaker (1942b). Corona del Mar,* California, to Cabo San Lucas, Baja California, 0–42 m.

**Netamelita cortada* Barnard (1962b). Southern California, 0–20 m.

**Ocosingo borlus* Barnard (1964a). Monterey Bay, California, to Bahía de San Cristóbal, Baja California, 0–180 m., subintertidal in southern California.

**Oligochinus lighti* Barnard, herein. Pescadero Pt. (San Mateo County) California, to Goleta.*

**Orchomene magdalenensis* (Shoemaker, 1942b). La Jolla,* California, to Bahía Magdalena, Baja California, 0–11 m.

**Orchomene pacifica* Gurjanova, Barnard (1964b). Northwestern Pacific to Goleta,* California, southward submerging below intertidal, 3–183 m.

**Panoploea* (?) *hedgpethi* Barnard, herein. Southern California, 0–82 m.

**Parajassa angularis* Shoemaker (1942b). Carmel, California, to Bahía Magdalena, Baja California.

**Parallorchestes ochotensis* (Brandt), Barnard (1962c). Okhotsk Sea, Alaska, to Laguna Beach,* California.

**Paramoera mohri* Barnard (1952a). Carmel to Hazard Canyon reef, California.

**Paraphoxus heterocuspidatus* Barnard (1960b). Southern California and northern Baja California, 0–45 m., rare in intertidal.

280-102 O-69—6

Paraphoxus jonesi Barnard (1963). Near Pt. Conception, California, 0–18 m.

Paraphoxus obtusidens (Alderman, 1936), Barnard (1960b). Kurile Islands to Colombia, 0–180 m.

Paraphoxus spinosus Holmes, Barnard (1960b). Puget Sound, Washington, to Gulf of California, 0–73 m. Western Atlantic Ocean.

Paraphoxus stenodes Barnard (1960b). Pt. Conception, California, to Bahía de San Cristóbal, Baja California, 0–88 m.

Parapleustes commensalis Shoemaker (1952). From lobster at Santa Barbara, California.

Parapleustes den Barnard, herein. Corona del Mar, California.

Parapleustes nautilus Barnard, herein. Carmel to Goleta,* California, 0–3 m.

Parapleustes pugettensis (Dana, 1853), Barnard and Given (1960), Shoemaker (1964). Alaska, 62° N to La Jolla, California, 0–140 m.

Photis bifurcata Barnard (1962a). Puget Sound, Washington, to Bahía de San Cristóbal, Baja California, 0–93 m.

Photis brevipes Shoemaker (1942b), Barnard (1962a) (incl. *P. californica* as ident. by Barnard, 1954a). Coos Bay, Oregon, to Bahía Magdalena, Baja California, 0–135 m.

Photis californica Stout (1913), Barnard (1962a). Moss Beach, California (as *P. reinhardi* of Alderman, 1936), to Bahía de San Cristóbal, Baja California, 0–98 m.

Photis conchicola Alderman (1936), Barnard (1962a). Moss Beach to La Jolla, California.

Photis elephantis Barnard (1962a). Pt. Fermin,* California, to La Jolla. Galapagos Islands.

Pleonexes aptos Barnard, herein. Carmel, California.

Pleusirus secorrus Barnard, herein. Cayucos to La Jolla, California, and Santa Catalina Island, 0–46 m.

Pleustes depressa Alderman (1936). Cape Arago, Oregon, to ?La Jolla, California.

Pleustes platypa Barnard and Given (1960). Southern California, 0–55+ m.

Podocerus brasiliensis (Dana), Barnard (1953, 1959). Tropicopolitan, in eastern Pacific as far north as Carmel, California.

Podocerus cristatus (Thomson), Barnard (1962a). Indo-Pacific, in eastern Pacific as far north as Cayucos, California, 0–170 m.

Podocerus fulanus Barnard (1962a, 1959 as "sp."). Newport Bay, California, and Bahía de Los Angeles, Gulf of California.

Podocerus spongicolus Alderman (1936). Moss Beach, California.

Polycheria osborni Calman (1898), Skogberg and Vansell (1928), Alderman (1936, as *P. antarctica*). .Puget Sound, Washington, to Bahía de Los Angeles, Gulf of California. May be ecotype of *P. antarctica.*

Pontogeneia inermis (Krøyer), Barnard (1952a). Pan-boreal, in eastern Pacific recorded between British Columbia and Morro Bay, California.

**Pontogeneia intermedia* Gurjanova (see 1951). Northwestern Pacific Ocean; California south to Corona del Mar.

Pontogeneia ?minuta Chevreux, Barnard (1959, 1964b). Newport Bay, California, and Bahía de San Quintín, Baja California. Probably a new species.

**Pontogeneia quinsana* Barnard (1964b). La Jolla,* California to Bahía de San Quintín, Baja California.

**Pontogeneia rostrata* Gurjanova (see 1951), Barnard (1962b). Northwestern Pacific Ocean, in California and south to Bahía de San Quintín, Baja California, 0–100 m.

**Stenothoe estacola* Barnard (1962c). Southern California.

Stenothoe valida Dana, Barnard (1953, 1959). Tropicopolitan and in warm-temperate harbors.

**Stenothoides burbanki* Barnard, herein. Carmel and Hazard Canyon reef, California.

**Stenula incola* Barnard, herein. Hazard Canyon reef, California.

Sympleustes glaber (Boeck), Hewatt (1946). Santa Cruz Island, California, but possibly same as *S. subglaber* Barnard and Given (1960).

**Synchelidium rectipalmum* Mills (1962). British Columbia to Costa Rica, 0–183 m.

**Synchelidium shoemakeri* Mills (1962). British Columbia to coastal shelf of southern California, 0–183+ m.

**Synchelidium* sp. M, in MS. Southern California, 0–5 m.

**Tiron biocellata* Barnard (1962b). Monterey Bay, California, to Bahía de San Cristóbal, Baja California, 0–180 m.

List of Altered, Rejected and Provisional Names

Acanthogrubia uncinata Stout (1912) is removed to *Cymadusa.*

Allorchestes frequens Stout (1913) is removed to *Hyale rubra.*

Allorchestes ochotensis Brandt (1851) is removed to *Parallorchestes.*

Allorchestes oculatus Stout (1913) is removed to *A. angustus.*

Allorchestes plumulosus Stimpson (1857) is removed to *Hyale.*

Allorchestes pugettensis Dana (1853) is removed to *Hyale.*

Allorchestes seminuda Stimpson (1856), San Francisco, not subsequently recognized.

Ampelisca articulata Stout (1913) is removed to *A. lobata.*

Ampelisca typica (Bate), possibly intertidal in northern California but not confirmed.

Ampithoe corallina Stout (1912), possibly *A. simulans* female. If so, name must take priority.

Ampithoe dalli Shoemaker (1938) is removed to *A. simulans.*

Ampithoe femorata Krøyer, of Barnard (1952a) is removed to *A. lindbergi.*

Ampithoe scitula (Harford), of Hewatt (1946) is removed to *A. lacertosa.*

Ampithoe stimpsoni Boeck (1871), not clarified, probably *A. lacertosa.*

Amphithonotus occidentalis Stimpson (1864), possibly *Pleustes cataphractus.*

Amphithonotus septemdentatus Stimpson (1864), possibly *Melita dentata.*

Aoroides californica Alderman (1936) is removed to *A. columbiae.*

Aruga macromerus Shoemaker (1916) is removed to *Lysianassa.*

Caliniphargus sulcus Stout (1913) is removed to *Melita.*

Dexamine scitulus Harford (1877) is removed to *Ampithoe lacertosa.*

Dulichiella spinosa Stout (1912) is removed to *Melita appendiculata.*

Elasmopus brasiliensis (Dana), of Alderman (1936), no confirmation, possibly female of *E. antennatus.*

Ericthonius disjunctus Stout (1913) is removed to *E. brasiliensis.*

Ericthonius rapax Stimpson (1856) is removed to *E. brasiliensis.*

Eurystheus tenuicornis (Holmes) is removed to *E. thompsoni.*

Fimbriella robusta Stout (1913) is removed to *Eurystheus thompsoni.*

Gammaropsis tenuicornis Holmes (1904b) is removed to *Eurystheus thompsoni.*

Gammarus subtener Stimpson (1864) is removed to *Melita appendiculata,* see Shoemaker (1955a).

Grubia indentata Stout (1913) is removed to *Ampithoe pollex.*

Hyale frequens (Stout) is removed to *H. rubra frequens.*

Hyale hawaiensis (Dana)=*Parhyale.* Shoemaker (1956) does not further record this species from California (see Hewatt, 1946), only Baja California and his (1942b) reference to the species is really *Parhyale fascigera.*

Hyale pugettensis (Dana), not confirmed from California.

Hyalella azteca (Saussure). Freshwater only.

Incisocalliope newportensis Barnard (1959) is removed to *Parapleustes pugettensis.*

Iphimedia pugettensis Dana (1853) is removed to *Parapleustes.*

Ischyrocerus parvus Stout (1913) is possibly a synonym of *I. anguipes* but more probably is *Ischyrocerus* sp. A, reported herein.

Ischyrocerus minutus Liljeborg, of Walker (1898) is removed to *I. anguipes.*

Jassa pulchella Leach, of Stout (1913) is removed to *J. falcata.*

Leucothoe ?minima Schellenberg, of Barnard (1952a) is removed to *L. alata.*

Maera dubia Calman (1898) is removed to *M. danae.*

Maera spinicauda Holmes (1908) is removed to *Ceradocus.*

Maeroides thompsoni Walker (1898) is removed to *Eurystheus.*

Mandibulophoxus gilesi Barnard (1957) is removed to *M. uncirostratus.*

Mara (sic) *confervicola* Stimpson (1856) is removed to *Anisogammarus.*

Megamphopus mamolus Barnard (1962a) is removed to *Eurystheus.*

Melita fresneli (Audouin) of Shoemaker (1941b), Hewatt (1946) is removed to *M. appendiculata.*

Melita nitida Smith. Not confirmed from California, possibly representing *M. oregonensis.*

Melita palmata (Montagu) as identified from California only is removed to *M. sulca.*

Metopa esmarki Boeck (1871) is removed to *Mesometopa,* see Gurjanova (1951).

Microprotopus sp. (in Light, 1941), not confirmed, possibly *Parajassa angularis.*

Nannonyx dissimilis Stout (1913) is removed through *Aruga* to *Lysianassa.*

Neogammaropsis antennatus Stout (1913) is removed to *Elasmopus.*

Neophotis inaequalis Stout (1913) is removed to *Chevalia aviculae.*

Nototropis tridens Alderman (1936) is removed to *Atylus.*

Paramphithoe bairdi Boeck (1871) is removed to *Parapleustes pugettensis.*

Photis reinhardi Krøyer, of Alderman (1936) is removed to *P. californica.*

Phoxus grandis Stimpson (1857), possibly a senior synonym of *Paraphoxus milleri* (Thorsteinson, 1941) or *P. obtusidens* (Alderman, 1936).

Podoceropsis concava Shoemaker (1916) is removed to *Eurystheus thompsoni.*

Podocerus californicus Boeck (1871) is removed to *Jassa falcata.*

Polycheria osborni Calman (1898) and Skogsberg and Vansell (1928) is removed to *P. antarctica* by Alderman (1936) but revived herein.

Pontharpinia obtusidens Alderman (1936) is removed to *Paraphoxus.*

List of Sandhoppers

Orchestia georgiana Bousfield (1958a, 1961).
Orchestia traskiana Stimpson (1857), Bousfield (1961).
Orchestoidea californiana (Brandt, 1851), Bousfield (1958b, 1961).
Orchestoidea gracilis Bousfield and Klawe (1963).
Orchestoidea columbiana Bousfield (1958a, 1961).
Orchestoidea corniculata Stout (1913), Bousfield (1958b, 1961).
Orchestoidea benedicti Shoemaker (1930a), Bousfield (1958b).
Orchestoidea minor Bousfield (1958a, 1961).
Orchestoidea pugettensis (Dana, 1853), Bousfield (1961).
Parorchestia klawei Bousfield (1961).
Talitroides pacificus Hurley (1955), Bousfield (1961), inland.
Also described is *Orchestia californiensis* Dana (1854).

Systematics

Acanthonotozomatidae

A single pattern of sculpturing and body ornamentation is shared by almost all species of Acanthonotozomatidae. Distinctions among the 21 genera are found primarily in the mouthparts. That so many genera and their species could be based on a differentiation of mouthparts and gnathopods while retaining a common pattern of dorsal teeth and epimeral structure induces concern over the generic validity of the buccal distinctions. Only the genus *Odius* Liljeborg has a simplified sculpture and unmodified coxae. Specialization of the mouthpart bundle for piercing and sucking may have resulted in a loss of function of various parts not now under conservative genetic control. Intergeneric differences in mouthparts may therefore be non-conservative and only of specific value.

The species to be described below illustrates this concern. According to Hurley's (1954b) key, the new taxon should be assigned to *Pariphimedia* Chevreux (1906). Its first maxillary palp is short and uniarticulate. The new species differs from the type species of *Pariphimedia* by the incised lobes of the lower lip but in all other characters it fits the diagnosis of *Panoploea* Thomson. To create a new genus for a species sharing generic characters of *Panoploea* and *Pariphimedia* seems unwarranted, especially in view of the fact that the two genera differ by only two pairs of alternatives. Hence, the species is assigned to *Panoploea* in the belief that the first maxillary palp character represents a degenerative specialization whereas the lower lip character represents a *primordium.*

***Panoploea*(?) *hedgpethi*, new species**

Figures 1–2

Diagnosis.—Body of the "normal" form, with two dorsal teeth on each of pereonites 7, pleonites 1, 2, and 3; all pleonal epimera with one posteroventral tooth, third pleonal epimeron also with one upturned, posteromedial tooth slightly serrate ventrally, ventral tooth slightly serrate ventrally only on third pleonal epimeron, second and third epimera with posteromedial margins having faint suggestions of one rudimentary tooth; lateral view of pereonites

FIGURE 1.—*Panoploea* (?) *hedgpethi*, new species, "Velero" station 1407, figures from 3 females, approximately 5.5 mm.: *a*, head; *b*, upper lip; *c*, mandible; *d*, lower lip; *e,f,g*, maxilla 1; *h*, maxilla 2; *i*, maxilliped; *j*, articles 1–2 of antenna 1, medial; *k*, articles 2–4 of antenna 2, medial; *l,m*, gnathopods 1, 2.

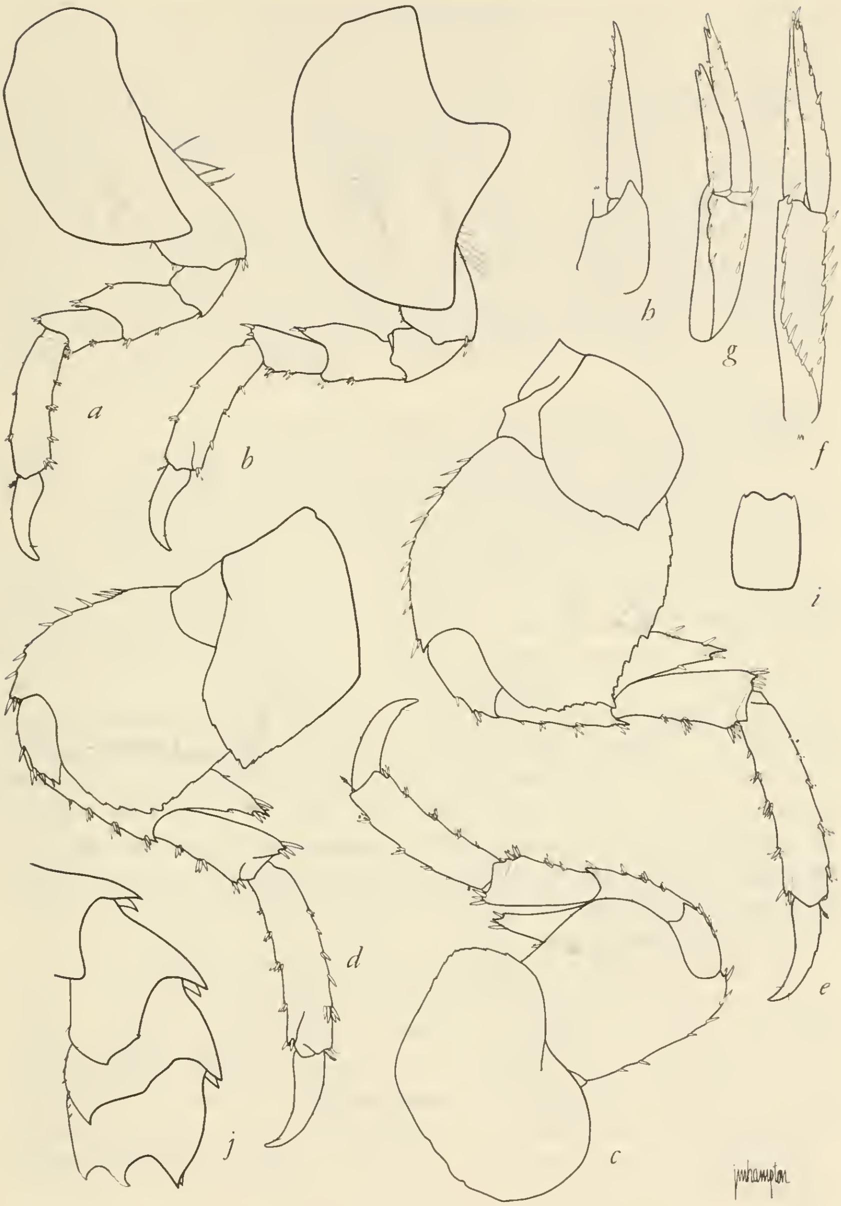


FIGURE 2.—*Panoploea* (?) *hedgpethi*, new species, "Velero" station 1407, female, 5.5 mm.: *a,b,c,d,e*, pereopods 1, 2, 3, 4, 5; *f,g,h*, uropods 1, 2, 3 (latter with outer ramus missing); *i*, telson; *j*, pereonite 7 and pleonites 1–3, left to right.

similar to *P. rickettsi* Shoemaker (1931); maxilla 1 with uniarticulate palp, apex of palp not reaching proximal spine of outer plate; posterior edge of coxa 5 not cuspidate, coxa 6 with very sharply quadrate posterior corner, coxa 5 with slight posterior cusp; proximal cusp on article 2 of pereopod 3 poorly developed, pereopod 4 with both one proximal and one distal posterior cusp of poor development; pereopod 5 with one moderately developed, posterodistal cusp on article 2; posterior processes of fourth articles of pereopods 3–5 reaching along fifth articles more than in *P. rickettsi;* apices of telsonic lobes bispinulate, medial projections very blunt and extending farther than lateral projections; article 2 of pereopod 3 poorly serrate, of pereopods 4–5 well serrate; distal ends of coxae 1–4 not extremely acute.

Holotype.—AHF No. 4115, female, 5.5 mm.

Type locality.—Velero Station 1407, Long Point to Willow Cove, Catalina Island, California, September 14, 1941, 33–24–00° N, 118–21–30° W, dredge at 30–45 fath. (55–82 m.), sand, algae.

Relationship.—This species fits *P. minuta* (Sars, 1895, pl. 133, fig. 1) in Hurley's (1954b) key but has more aspects of *P. rickettsi* Shoemaker (1931) than it does of *P. minuta.* Its posteromedial teeth of the first and second pleonal epimera are nearly obsolete (in *P. minuta* they are absent, in *P. rickettsi* they are strongly developed), the teeth of coxae 3–5 are not as fully developed as are those of *P. rickettsi* (absent in *P. minuta*) and the second articles of pereopods 3–5 are clearly similar to but not as fully developed as those of *P. rickettsi.* The first four coxae of *P. minuta* are very acute distally but in the present species and *P. rickettsi* they are blunter. The posteroventral corners of pereonites 6–7 are strongly produced in *P. rickettsi,* slightly less so in *P. hedgpethi,* and not produced in *P. minuta.*

The major feature of qualitative value is the uniarticulate first maxillary palp; it is biarticulate in both *P. rickettsi* and *P. minuta* and all other species of the genus *Panoploea.* The new species appears to be a derivative of *P. rickettsi* which has lost a palp article through fusion and has a reduction in ornamentation. It is not a stray aberration because several specimens are available from different localities.

Material.—Velero Stations 1407 (4), 1449 (4). Barnard Station 41 (1).

Records.—Goleta, 3 m., in *Macrocystis*-holdfast, rare; Catalina Island, 30–45 fath.; Newport Bay, California, harbor piling.

Ampeliscidae

Ampelisca lobata Holmes

Ampelisca lobata Holmes, 1908, pp. 517–518, fig. 25.—Shoemaker, 1942b, p. 7.—J. L. Barnard, 1954b, pp. 11–14, pls. 5, 6; 1964a, p. 214.
Ampelisca articulata Stout, 1913, pp. 639–640.

MATERIAL.—CAYUCOS: *Phyllospadix* grid (34 per sq. m.); cobbles; *Macrocystis* holdfast, rare. GOLETA: *Macrocystis* holdfast, 3 m., abundant; rock outcrop, 8 m., rare; submerged log, 8 m., abundant. LA JOLLA: short-tufted red algae (7 per sq. m.); *Phyllospadix*-coralline grid (4 per sq. m.); underrock grid (4 per sq. m.).

DISTRIBUTION.—Caribbean Sea; eastern Pacific Ocean from Ecuador to Puget Sound, 0–183 m.

Collections at hand from Puget Sound represent a new northern record. Apparently this species occurs at greater depths in the tropics than it does in higher latitudes but its strong association with plants, a strange habit for an ampeliscid, is probably correlated with its highest densities in very shallow waters. At Cedros Island, Baja California, it is replaced in the intertidal by its close relative, *A. schellenbergi* Shoemaker, which is more strongly confined to tropical waters than is *A. lobata*.

Ampelisca pugetica Stimpson

Ampelisca pugetica Stimpson, 1864, pp. 158–159.—J. L. Barnard, 1954b, pp. 49–51, pls. 35, 36; 1960a, p. 31, fig. 9; 1964a, p. 215.
Ampelisca californica Holmes, 1908, pp. 513–515, fig. 23.
Ampelisca gnathia Barnard, 1954b, pp. 46–48, pls. 33, 34.

MATERIAL.—GOLETA: *Macrocystis* holdfast, 3 m., rare.

DISTRIBUTION.—Caribbean Sea; eastern Pacific Ocean from Peru to Puget Sound, Washington, 0–183 m. An abundant species of soft bottoms in mid-depths of the Californian coastal shelf.

Ampelisca schellenbergi Shoemaker

Ampelisca schellenbergi Shoemaker, 1933a, pp. 3–5, figs. 1, 2; 1942b, p. 9—J. L. Barnard, 1954b, pp. 14–16, pls. 7, 8.

MATERIAL.—CAYUCOS: *Phyllospadix*-pelvetiid grid, abundant (56 per sq. m.). LA JOLLA: *Phyllospadix*-coralline grid, rare (18 per sq. m.); calcareous sponge (rare).

DISTRIBUTION.—Tropical pan-America, occurring as far north as Cayucos, California, in the Pacific Ocean. The abundance of this tropical species at Cayucos is surprising, considering its low frequency elsewhere to the north of Cedros Island, where it is the second most abundant amphipod in the *Phyllospadix* zone of the intertidal (after *Hyale* sp.).

Amphilochidae

Amphilochus litoralis Stout

Amphilochus litoralis Stout, 1912, pp. 136–140, fig. 78.—J. L. Barnard, 1962c, pp. 124–125, fig. 2.

MATERIAL.—CARMEL: rare in red algae of intertidal, abundant in red algae below intertidal zone; *Phyllospadix*-pelvetiid grid, scarce; polychaete tube-masses, rare; shell fragments and algae, rare; *Laminaria* and corallines, abundant. GOLETA: *Macrocystis* holdfast, 3 m., rare. PT. DUME: *Egregia*, rare. CORONA DEL MAR: *Phyllospadix*-coralline grid, scarce; loose rocks, rare; algae below water, abundant; *Egregia*-stipes, abundant; coralline algae, abundant. LA JOLLA: *Phyllospadix*-coralline grid, abundant (149 per sq. m.); short-tufted red algal platform, abundant (43 per sq. m.).

DISTRIBUTION.—Californian intertidal, Monterey Bay to La Jolla. Strongly associated with red algae and corallines, the color of the amphipod resembling that of the algae.

Amphilochus neapolitanus Della Valle

Amphilochus neapolitanus Della Valle: Chevreux and Fage, 1925, pp. 112–113, figs. 106–108.—J. L. Barnard, 1962c, p. 126, fig. 3.

MATERIAL.—CAYUCOS: *Phyllospadix*-pelvetiid grid, scarce (17 per sq. m.); buried cobbles, rare; *Macrocystis* holdfast, rare; coralline algae, rare. GOLETA: *Phyllospadix*-pelvetiid grid, rare. PT. DUME: short brown algae near surf, rare (33 per sq. m.); coralline algae, abundant (255 per sq. m.); loose rocks, scarce; *Egregia*, scarce; sponge, rare. CORONA DEL MAR: *Phyllospadix*-coralline grid, scarce (16 per sq. m.); loose rocks, scarce; calcareous worm tubes, rare; algae below water, moderately abundant; *Phragmatopoma*-tubes, scarce. LA JOLLA: *Phyllospadix*-coralline grid, moderately abundant (62 per sq. m.); underrock grid, moderately abundant (28 per sq. m.); coralline algae, scarce (compared with *A. litoralis*).

DISTRIBUTION.—Cosmopolitan in tropical and subtropical seas, 0–80 m.

Amphilochus picadurus J. L. Barnard

Amphilochus picadurus J. L. Barnard, 1962c, pp. 126–129, fig. 4.

MATERIAL.—GOLETA: *Macrocystis* holdfast, 3 m., rare; rock outcrop, 8 m., abundant.

DISTRIBUTION.—Southern California, 3–41 m.

Gitanopsis vilordes J. L. Barnard

Gitanopsis vilordes J. L. Barnard, 1962c, pp. 131–132, fig. 6.

MATERIAL.—CARMEL: *Phyllospadix*-pelvetiid grid, rare. CAYUCOS: buried cobbles, moderately abundant. PT. DUME: short brown algae, scarce. CORONA DEL MAR: underrock grid, rare; *Phyllospadix*-coralline grid, rare; loose rocks, moderately abundant; calcareous worm tubes, scarce. LA JOLLA: *Phyllospadix*-coralline grid, rare (5 per sq. m.); underrock grid, scarce (12 per sq. m.).

DISTRIBUTION.—California from Monterey Bay to La Jolla, 0–27 m. Dubious specimens of *Gitanopsis pusilloides* Shoemaker (1942b) are recorded from Campbell station 1F and in the *Phyllospadix*-coralline grid of Corona del Mar.

Ampithoidae

Ampithoe humeralis Stimpson

Amphithoe humeralis Stimpson, 1864, p. 156.—Calman, 1898, pp. 271–273, pl. 331, fig. 4.—Holmes, 1904b, p. 241.
Ampithoe humeralis: Stebbing, 1906, p. 636.—J. L. Barnard, 1954a, p. 29; 1965a, p. 7, figs. 2–3.

MATERIAL.—CAYUCOS: *Macrocystis* holdfast, rare; *Macrocystis* stipe, rare. HAZARD CANYON: *Egregia-Laminaria* holdfasts, rare. GOLETA: *Phyllospadix*-pelvetiid grid, rare.

DISTRIBUTION.—Puget Sound, Washington to Guadelupe Island, off Baja California. A northern species submerging below the intertidal zone in southern California. Its juveniles probably are more abundant in the intertidal than reported because juveniles of "northern" ampithoids have not been identified to species.

Ampithoe lacertosa Bate

Amphithoe lacertosa Bate: Bate, 1862, pp. 236–237, pl. 41, fig. 5.
Ampithoe lacertosa: Stebbing, 1906, pp. 633–634.—J. L. Barnard, 1954a, pp. 31–33, pls. 29, 30.—Nagata, 1960, pp. 175–176, pl. 16, figs. 95, 96.—J. L. Barnard, 1965a, pp. 9–12, figs. 4, 5 (with synonymy).

MATERIAL.—CAYUCOS: *Phyllospadix*-pelvetiid grid, scarce (6 per sq. m.). CORONA DEL MAR: algae below water, rare. LA JOLLA: *Phyllospadix*-coralline grid, rare (5 per sq. m.).

DISTRIBUTION.—Kodiak, Alaska, to Bahía Magdalena, Baja California; Japan, south to Shizueka Prefecture. A northern species occurring below the intertidal zone in southern California.

Ampithoe lindbergi Gurjanova

Amphithoe lindbergi Gurjanova, 1938, pp. 351–354, fig. 49; 1951, pp. 892–895, fig. 620.

Ampithoe femorata Krøyer: J. L. Barnard, 1952a, pp. 24–28, pls. 6, 7 (not Krøyer, 1845).
Ampithoe lindbergi: J. L. Barnard, 1965a, pp. 12–15, figs. 6, 7.

MATERIAL.—CARMEL: *Phyllospadix* below water, rare; *Egregia* stipes, scarce; algal holdfasts, scarce. CAYUCOS: *Macrocystis* holdfast, rare. HAZARD CANYON: *Egregia-Laminaria* holdfast, rare. GOLETA: *Macrocystis* holdfast, rare. PT. DUME: *Egregia* holdfasts, rare(?); *Egregia* stipes, moderately abundant. CORONA DEL MAR: *Phyllospadix*-coralline grid, rare.

DISTRIBUTION.—Bering Sea, Okhotsk Sea, Japan Sea; California from Carmel to Corona del Mar.

Ampithoe cf. *mea* Gurjanova

?*Amphithoe mea* Gurjanova, 1938, pp. 361–364, fig. 53; 1951, pp. 882–885, fig. 616.
Ampithoe eoa: J. L. Barnard, 1954a, pp. 27–28, pls. 25–26 (not Gurjanova, 1938).
Ampithoe sp., J. L. Barnard, 1965a, pp. 37–40, figs. 24, 25.

These specimens are assigned this name provisionally until their life history in southern California can be elucidated.

MATERIAL.—GOLETA: *Phyllospadix*-pelvetiid grid, moderately abundant (63 per sq. m.). PT. DUME: *Egregia* stipes and holdfasts, rare to scarce.

DISTRIBUTION IN EASTERN PACIFIC OCEAN.—Coos Bay, Oregon, and southern California.

Ampithoe plumulosa Shoemaker

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

MATERIAL.—LA JOLLA: coralline algae, scarce; *Phyllospadix*-coralline grid, scarce (70 per sq. m.).

DISTRIBUTION.—British Columbia to Ecuador. Apparently this is a species requiring continuous water immersion; abundant on floating docks in harbors of southern California.

Ampithoe pollex Kunkel

Amphithoe pollex Kunkel, 1910, pp. 92–94, fig. 36.
Ampithoe pollex: J. L. Barnard, 1954a, pp. 29–31, pls. 27, 28; 1959, p. 37; 1965a, pp. 22–25, figs. 13, 14.
Grubia indentata Stout, 1913, pp. 656–657.

MATERIAL.—CARMEL: cobble-pelvetiid zone, rare (8 per sq. m.). CAYUCOS: *Phyllospadix*-pelvetiid grid, moderately abundant (251 per sq. m.); sponge, abundant. HAZARD CANYON: algal turf on platform, abundant (330 per sq. m.); coralline clumps and brown algae, rare; sponge and tunicates, abundant; *Egregia* holdfasts, moderately abundant. PT. DUME: algal turf, abundant (154 per sq. m.); in *Phragmatopoma* reef, most abundant species (675 per sq. m.); loose rocks, moderately abundant (20 per sq. m.); *Egregia* holdfasts, rare; sandy sponge, rare. CORONA DEL MAR: *Phyllospadix*-coralline grid, 4th most abundant (476 per sq. m.); underrocks, most abundant (14 per sq. m.) loose rocks in tidepool, rare; *Egregia* stipes, rare; sponge, rare. LA JOLLA: underrock grid, abundant (58 per sq. m.); red algal ridge and platforms, very abundant (112 and 672 per sq. m.); sand inundated algae at high tide line, very abundant (7920 per sq. m.); *Phyllospadix*-coralline grid, scarce (107 per sq. m.); coralline algae, scarce; underwater red algae, rare.

DISTRIBUTION.—Bermuda; eastern Pacific Ocean from Oregon to northern Baja California.

Ampithoe simulans Alderman

Ampithoe simulans Alderman, 1936, pp. 68–70, figs. 44–47.—J. L. Barnard, 1954a, pp. 33–34, 1 fig; 1965a, pp. 27–30, figs. 17, 18.
Ampithoe dalli Shoemaker, 1938, pp. 19–22, fig. 2.

MATERIAL.—CARMEL: red algae, rare; tunicates and sponges, rare; cobble-pelvetiid grid, rare. CAYUCOS: *Phyllospadix*-pelvetiid grid, scarce (51 per sq. m.); buried cobbles, scarce; *Macrocystis* holdfast, abundant; *Laminaria* and corallines, abundant. HAZARD CANYON: *Egregia-Laminaria* holdfasts, scarce; *Egregia* holdfasts, rare. GOLETA: *Phyllospadix*-pelvetiid grid, scarce. LA JOLLA: *Phyllospadix*-coralline grid, scarce; underrock grid, scarce.

DISTRIBUTION.—Coos Bay, Oregon, to La Jolla, California. Probably at its southern intertidal limit south of Pt. Conception.

Ampithoe ?tea J. L. Barnard

?*Ampithoe tea* J. L. Barnard, 1965a, pp. 30–34, figs. 19–21.

These specimens are not fully typical of *A. tea* and require comparison to the instars of several other similar species such as *A. "mea,"* *A. plea*, and *A. lindbergi*.

MATERIAL.—PT. DUME: pelvetiid zone, scarce (35 per sq. m.).

Note on *Ampithoe corallina* Stout (1913)

This species, in view of its lower lip, gnathopods, and antennae, may represent *Ampithoe simulans* Alderman (1936) (=*A. dalli* Shoemaker, 1938). Stout described it as an adult male but its gnathopods have all appearances of a female. The slender lobules of the lower lip differentiate it from *A. pollex* Kunkel. A confusing feature, because of its resemblance to *A. lacertosa* Bate, is the slight indication of points on the pleonal epimera 2–3 of Stout's drawings but this condition is noted also for *A. simulans* by J. L. Barnard (1965a). No unquestionable adult male of *A. simulans* has been found in southern California during this survey, although subadult males and adult females have been identified. The writer hesitates to establish *A.*

corallina as the senior synonym of *A. simulans* because there is some confusion over a possible phenotype of *A. pollex*. Specimens of that phenotype have slender lobules on the lower lip but have been identified with *A. simulans*, nevertheless. Perhaps they represent a sibling species similar to *A. simulans* or a hybrid between *A. simulans* and *A. pollex*. The solution to this problem must be reserved until after the life histories of the organisms have been studied.

Cymadusa uncinata (Stout)

Acanthogrubia uncinata Stout, 1912, p. 146, figs. 81–83.
Paragrubia uncinata: Shoemaker, 1941b, p. 188.—Hewatt, 1946, p. 199.
Cymadusa uncinata: J. L. Barnard, 1965a, p. 40, figs. 26–28.

Material.—goleta: *Macrocystis* holdfast, 3 m. abundant.

Distribution.—San Juan Islands, Washington, to Laguna Beach, California. Apparently this is a northern species associated with giant kelps; collections at hand made by Dr. Erik Dahl show it to be very abundant in the Washington sound area.

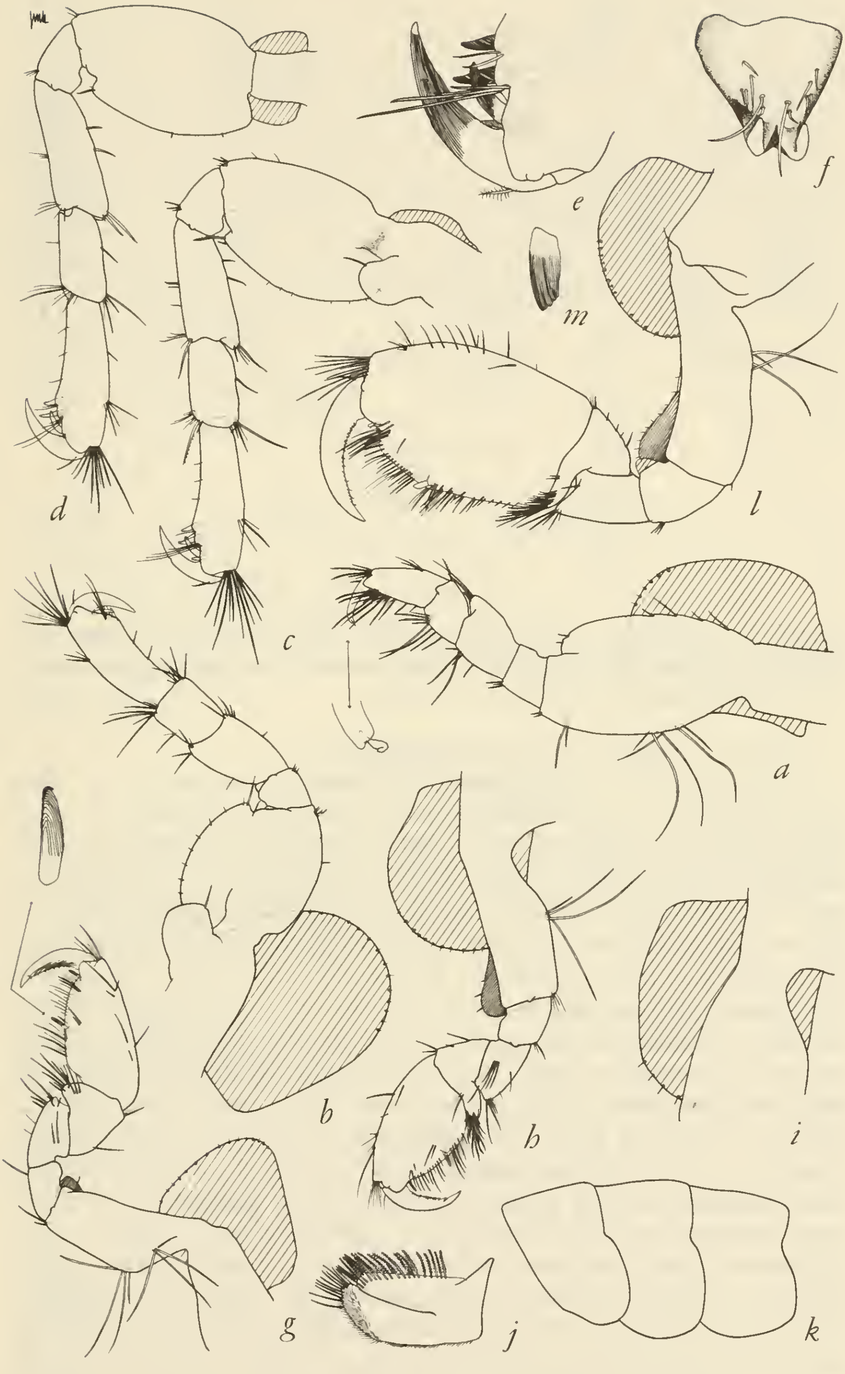
Pleonexes aptos, new species

Figures 3–4

Diagnosis of female.—Antenna 1 nearly as long as antenna 2, peduncles of both antennae short in comparison to *P. gammaroides*, peduncular article 5 of antenna 2 shorter than article 4; lateral cephalic lobe truncated; mandibular palp small, article 3 much shorter than article 2; lower lip with outer lobes strongly bilobed distally, lateral bilobation very long; gnathopods small, second scarcely stouter than first, palms very oblique and poorly defined from sloping posterior margins of article 6, each bearing one striated defining-spine, fifth article of gnathopod 2 with hind lobe more slender and projecting than on gnathopod 1; second articles of pereopods 3–5 each with distinct posteroventral lobe armed with one seta, sixth articles strongly expanded and essentially subchelate, the false palms bearing 2 straight proximal spines, followed distally by one large curved distal spine adjacent to one much smaller straight spine, all spines and dactyls striate; telson triangular, with 2 recurved, subacute, distal protrusions; major spines of uropod 3 striate.

Male.—Gnathopod 2 much larger than in female, article 6 nearly twice as long as broad, palm oblique, quadrately convex, much shorter than posterior margin of article 6, defined by one truncated, striate spine; antenna 2 larger and longer than in female, articles 4 and 5 of peduncle equal in length.

Figure 3.—*Pleonexes aptos*, new species, holotype, female, 6.0 mm., station 48–H–1: *a,b,c,d*, pereopods 1, 3, 4, 5; *e*, end of pereopod 4; *f*, telson; *g,h*, gnathopods 1, 2; *i*, coxa 4; *j*, maxilla 2; *k*, pleonites 1–3, left to right. Male, 7.0 mm., station 48–H–10: *l*, gnathopod 2; *m*, palmar spine of gnathopod 2.



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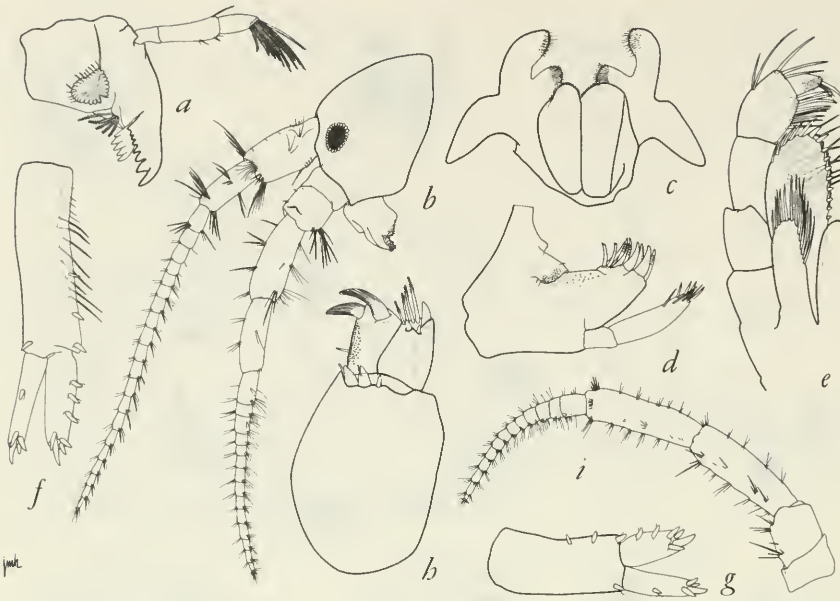

FIGURE 4.—*Pleonexes aptos*, new species, holotype, female, 6.0 mm., station 48–H–1: *a*, mandible; *b*, head and antennae; *c*, lower lip; *d*, maxilla 1; *e*, maxilliped; *f*,*g*,*h*, uropods 1, 2, 3. Male, 7.0 mm., station 48–H–10: *i*, antenna 2.

HOLOTYPE.—AHF No. 633, female, 6.0 mm.

TYPE LOCALITY.—Carmel Point, California, December 30–31, 1963, station 48–H–1, in algae collected below water at low tide.

RELATIONSHIP.—This species is closely related to *Pleonexes gammaroides* Bate (see Sars, 1895, pl. 207) but differs by (1) the somewhat more truncated lateral cephalic lobe; (2) the shorter peduncles of antennae 1 and 2 on the female; (3) the fifth article of the peduncle of antenna 2 on the female being shorter than article 4; (4) the smaller mandibular palp, with article 3 shorter than 2; (5) the smaller female gnathopods and male first gnathopod with their very oblique palms and short posterior margins of the sixth articles; (6) the presence of distinctly produced, small posterodistal lobes each armed with a seta on the second articles of pereopods 3–5; (7) the ampithoid-like lower lip; (8) the larger striated distal spines of the sixth articles on pereopods 3–5; (9) probably differences in the spination of the outer ramus of uropod 3 (unclear in *P. gammaroides*).

Pleonexes ferox Chevreux (see Chevreux and Fage, 1925) is a poor example of the genus and probably should be removed to *Ampithoe*. Its pereopods 3–5 are not as strongly modified in their distal expansions or spination as in either *P. gammaroides* or *P. aptos* and the telson is rounded and lacks distal protusions. The female gnathopods of *P. aptos* are more like those of *P. ferox* than of *P. gammaroides* but male gnathopod 2 of *P. ferox* has a long distally expanding hand with transverse palm and quadrate palmar process.

Pleonexes lessoniae Hurley (1954a) is undoubtedly in the correct genus in view of its telson and pereopods but it differs from *P. aptos* by the slender, almost simple gnathopod 1, with small transverse palm and a greatly overlapped dactyl which is similar to those species of *Ampithoe* such as *A. lindbergi* and *A. humeralis*. The palms of the pereopods differ from those of *P. aptos* in their shape and spination. The lower lip of *P. lessoniae* is quite different from those of the other two pleonexids, the outer lobes being very broad distally, truncate, and scarcely incised.

MATERIAL.—Stations 48–H–1 (3), 48–H–10 (8), CARMEL, algae below water, scarce.

Anamixidae

Anamixis linsleyi J. L. Barnard

Anamixis linsleyi J. L. Barnard, 1955b, pp. 28–30, figs. 2 a–d, f–m, o–w; 1959, p. 21.

MATERIAL.—CARMEL: algal holdfasts, rare.

DISTRIBUTION.—Carmel to Newport Bay, California; rarely encountered in the open sea; more common on tunicate foulings of harbor pilings.

Aoridae

Aoroides columbiae Walker

Aoroides columbiae Walker, 1898, p. 285, pl. 16, figs. 7–10.—Thorsteinson, 1941, pp. 83–84, pl. 6, figs. 65–66.—Hewatt, 1946, p. 204.—J. L. Barnard, 1954a, pp. 24–26, pl. 22; 1959, p. 33.—Nagata, 1960, p. 175, pl. 16, fig. 94.—J. L. Barnard, 1961, p. 180; 1964a, pp. 217–218.

Aoroides californica Alderman, 1936, pp. 63–66, figs. 33–38.—Hewatt, 1946, p. 204.

MATERIAL.—CARMEL: in the richer *Phyllospadix*-pelvetiid grid, 4th most abundant species (165 per sq. m.); red algae, moderately abundant (40 per sq. m.); *Macrocystis* holdfast below water, very abundant; coralline algae, scarce; tunicates and sponges, moderately abundant. CAYUCOS: *Phyllospadix*-pelvetiid grid, 2nd most abundant species (2622 per sq. m.); encrusting sponge, present to abundant; small red anemone, present; buried cobbles, very abundant; *Macrocystis* holdfast, very abundant; sand, rare; soft polychaete tubes, scarce to abundant; *Amaroucium* sp., abundant; sponge, moderately abundant. HAZARD CANYON: algal turf of platform, moderately abundant (89 per sq. m.); kelp holdfasts, abundant; sponges, scarce. GOLETA: *Phyllospadix*-pelvetiid grid, scarce (24 per sq. m.); *Macro-*

cystis holdfast, 3 m., rare. PT. DUME: brown algal turf, 3rd most abundant species (1450 per sq. m.); coralline algae, 3rd most abundant species (1390 per sq. m.); *Phragmatopoma* mass, moderately abundant (88 per sq. m.); on *Amaroucium* sp., abundant; loose rocks, moderately abundant; *Egregia* holdfasts, scarce; on *Anthopleura* sp., rare; sandy social tunicates, most abundant species. CORONA DEL MAR: *Phyllospadix*-coralline grid, 5th most abundant species (438 per sq. m.); loose rocks, very abundant (166 per sq. m.); calcareous worm tubes, very abundant; soft polychaete tubes, very abundant; *Laminaria* holdfast, abundant; *Phragmatopoma* masses, very abundant; tunicates, very abundant. LA JOLLA: *Phyllospadix*-coralline grid, moderately abundant (408 per sq. m.); underrock grid, moderately abundant (60 per sq. m.); red algal ridge, scarce (73 to 87 per sq. m.); sand-inundated algae at high tide line, 3rd most abundant species (1910 per sq. m.); sponge, rare; red algae, rare.

DISTRIBUTION.—Puget Sound, Washington to Bahía de San Quintín, Baja California, 0–180 m.; Japan. One of the most abundant amphipods, especially in the *Phyllospadix*-pelvetiid-coralline zones; occurring densely in many other sample sets and rarely in still others; despite its ubiquity in the study area it should be considered a cold-temperate species of the Oregonian province; it is somewhat eurybathic in view of its occurrence on soft bottoms of the coastal shelf of southern California to depths of 180 m.

Lembos concavus Stout

Lembos concavus Stout, 1913, pp. 651–653.—Shoemaker, 1941b, p. 187.—J. L. Barnard, 1962a, pp. 7–9, fig. 2.

MATERIAL.—GOLETA: *Macrocystis* holdfast, 3 m., abundant.

Lembos ?macromanus (Shoemaker)

?*Bemlos* (*Lembos*) *macromanus* Shoemaker, 1925, pp. 36–41, figs. 10–13.
Lembos macromanus: J. L. Barnard, 1962a, p. 9, fig. 3.

Specimens closely resembling those described by Shoemaker have been collected at Bahía de Los Angeles, Baja California, and figured in Barnard (1968). Individuals occurring along the coasts of Baja California and California north of Bahía de San Quintín may be referrable to this species but they are not as fully developed as those described by Shoemaker. Adults reach a larger size than those from the Gulf of California, but the male first gnathopod is retarded morphologically. Possibly *Lembos concavus* Stout is a senior synonym of this species, but J. L. Barnard (1962a) found a specimen matching Stout's incomplete description. It appears to have a short cusp at the posterior palmar edge of male gnathopod 1. The cusp fails to extend to the palmar tangent. That specimen may be an aberrant member of *L. macromanus*, but it differs from the latter in the setosity of article

6 of male gnathopod 2. *Lembos audbettius* J. L. Barnard (1962a) also fits Stout's description of *L. concavus*. Presumably additional adult specimens will be found in subintertidal samples and then these problems can be studied.

MATERIAL.—CAYUCOS: buried cobbles, scarce; *Macrocystis* holdfast, scarce. GOLETA: submerged log, 8 m., rare; *Macrocystis* holdfast, scarce. NEWPORT HARBOR: Velero stations 1449 (12), 1453 (2), on floating docks. CORONA DEL MAR: *Phyllospadix*-coralline grid, rare; soft polychaete tubes, rare; *Laminaria* holdfast, rare; *Phragmatopoma* mass, rare; tunicate colonies, rare; underrocks, scarce; tunicate and polychaete tubes, scarce. LA JOLLA: *Phyllospadix*-coralline grid, rare (15 per sq. m.).

Microdeutopus schmitti Shoemaker

Microdeutopus schmitti Shoemaker, 1942b, pp. 18–21, fig. 6.—J. L. Barnard, 1959, pp. 32–33, pl. 9; 1961, p. 180.

MATERIAL.—CAYUCOS: *Phyllospadix* holdfast, rare. GOLETA: *Macrocystis* holdfast, 3 m., abundant; rock outcrop, 8 m., rare; submerged log, 8 m., rare. CORONA DEL MAR: *Phyllospadix*-coralline grid, scarce (22 per sq. m.); loose rocks, scarce; calcareous worm tubes, abundant; soft polychaete tubes, rare; *Phragmatopoma* masses, scarce. LA JOLLA: *Phyllospadix*-coralline grid, abundant (503 per sq. m.); underrock grid, moderately abundant (38 per sq. m.); short-tufted red algal platform, moderately abundant (95 per sq. m.); coralline algae, moderately abundant; mixed red algae, scarce.

DISTRIBUTION.—Monterey Bay, California to Cape San Lucas, Baja California, 0–43 m. Abundant to 18 m. on the coastal shelf of southern California.

Neomegamphopus Shoemaker

Neomegamphopus Shoemaker, 1942b, pp. 35–36.

DIAGNOSIS.—Accessory flagellum 2-articulate; peduncular articles 1 and 2 of antenna 1 subequal in length, article 3 about 60% as long as article 1; antennae 1 and 2 equal in length; mandibular palp article 3 much shorter than article 2, apically truncate, stout; palp article 4 of maxilliped poorly claw shaped, armed apically with several large, short to medium setae; male gnathopod 1 with posterodistal tooth on article 5 projecting along and guarding article 6, the latter much narrower and shorter than article 5, poorly subchelate; gnathopod 2 in both sexes smaller than 1, not complexly subchelate but poorly subchelate, article 5 slightly longer than 6; pereopods 4 and 5 equal in length; uropod 3 with rami subequal to peduncle, inner ramus slightly longer than outer (!), outer ramus biarticulate, article 2 very small and armed with 2 long setae; telson broader than long, truncate or slightly excavate posteriorly depending on obliqueness of orientation.

Type species.—*Neomegamphopus roosevelti* Shoemaker (1942b).

Relationship.—This genus mimes *Microdeutopus* Costa in its male gnathopods but differs in the longer third peduncular article of antenna 1, the equal antennae 1 and 2, the short, truncate third mandibular palp article, the shape and armature of the maxillipedal dactyl, the abbreviated fifth pereopod, the biarticulate outer ramus of uropod 3 which is shorter than the inner ramus, and the shallow telson. It might be confused with *Acuminodeutopus* J. L. Barnard but differs in the third uropod having an elongated, not reduced inner ramus and by the structure of the third mandibular palp article. In contrast to *Microdeutopus* both *Neomegamphopus* and *Acuminodeutopus* have less disproportionate antennae and pereopod 5. *Neomicrodeutopus* Schellenberg has a uniramous third uropod.

Shoemaker carefully noted the intermixture of aorid and photid (=isaeid) characters of this genus, of which the third mandibular palp article is notably short in resemblance of *Megamphopus* in the Isaeidae. Despite Shoemaker's assignment of this genus to the Photidae (now Isaeidae), young male first gnathopods are so distinctly aorid that the genus is transferred to the Aoridae. Indeed, aorids and isaeids may not deserve familial separation, especially if the seas hold more species and genera of such character as *Neomegamphopus*.

***Neomegamphopus roosevelti* Shoemaker**

Figures 5–6

Neomegamphopus roosevelti Shoemaker, 1942b, pp. 36–38, fig. 13.—J. L. Barnard, 1962a, p. 10.

In the southern Californian intertidal this species has not been found in the fully adult male condition shown by Shoemaker. Its resemblance to *Microdeutopus schmitti* Shoemaker (1942b) and *Acuminodeutopus heteruropus* J. L. Barnard (1959) is confusing because young or subterminal males have gnathopod 1 resembling that of those species. Its small size, about 2.0 mm. in length, necessitates removal and mounting of the mandible or uropod 3 for identification according to statements made in the generic diagnosis above.

Material.—corona del mar: red algae below water, scarce; soft polychaete tubes, rare; tunicate colonies at base of *Phyllospadix*, scarce; tunicates and soft polychaete tubes, abundant; *Laminaria*, moderately abundant.

Distribution.—Cabo San Lucas, Baja California, to Corona del Mar, California, 0–42 m.

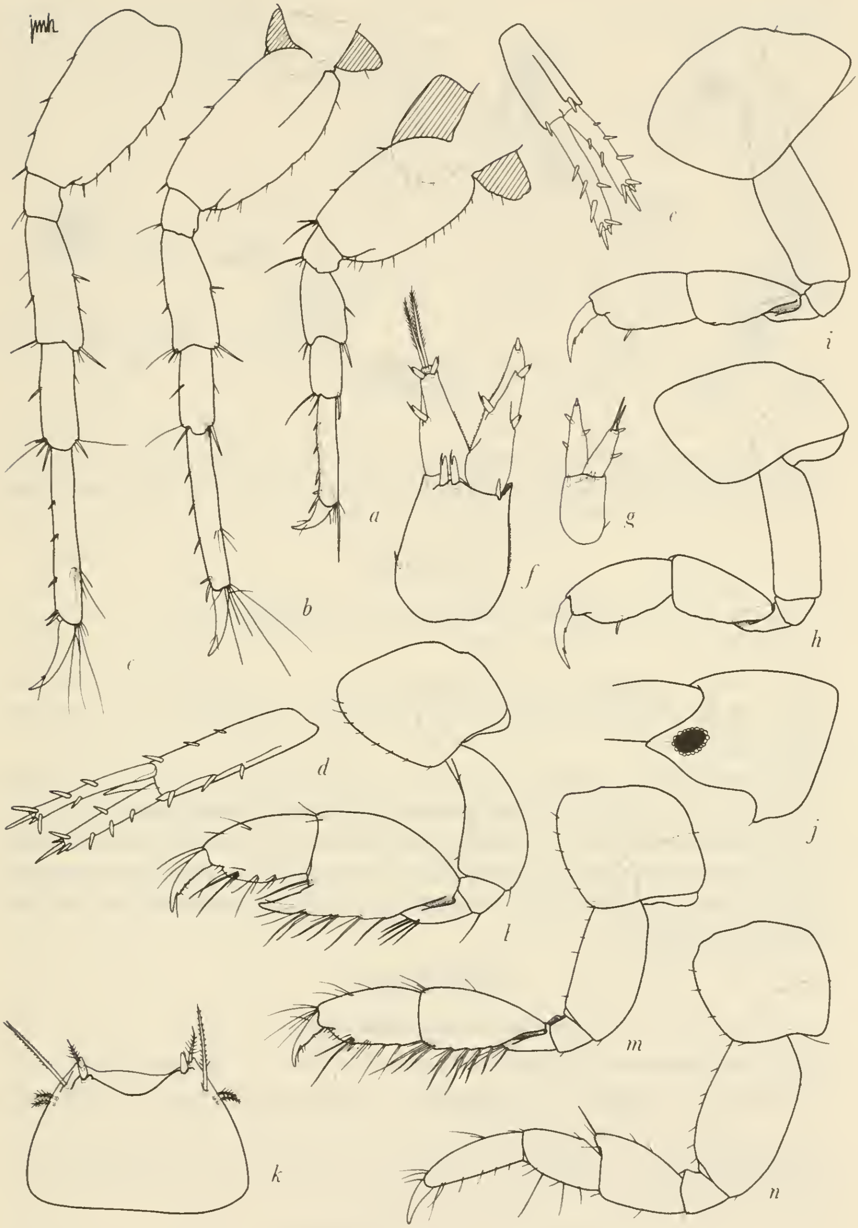

FIGURE 5.—*Neomegamphopus roosevelti* Shoemaker, female, 2.1 mm., station 46–K–1: *a,b,c,* pereopods 3, 4, 5; *d,e,f,g,* uropods 1, 2, 3, 3; *h,i,* gnathopods 1, 2, minus setae; *j,* head; *k,* telson. Male, 2.1 mm.: *l,m,* gnathopods 1, 2; *n,* pereopod 2.

Figure 6.—*Neomegamphopus roosevelti* Shoemaker, male, 2.1 mm., station 46–K–1: *a*, head; *b*, accessory flagellum; *c*, mandible. Female, 2.2 mm.: *d*, lower lip; *e,f*, maxilliped; *g,h*, maxillae 1, 2; *i*, pleonal epimera 1–3, left to right.

Atylidae

Atylus levidensus J. L. Barnard

Atylus levidensus J. L. Barnard: Mills, 1961, pp. 19–23, figs. 1, 4A.

Material.—carmel: *Phyllospadix*, very rare. cayucos: *Phyllospadix*-pelvetiid grid, scarce (16 per sq. m.). hazard canyon: *Phyllospadix*, rare.

Distribution.—British Columbia to Hazard Canyon, California. Abundant in the Puget Sound-Queen Charlotte Islands area but very rare in California from Monterey southward, probably limited north of Pt. Conception. This is one of the most striking species of amphipods in this region, because of its ochraceous, clean, textured surface similar to molded concrete.

Bateidae

Batea lobata Shoemaker

Batea lobata Shoemaker, 1926, pp. 18–21, figs. 12, 13.—J. L. Barnard, 1962b, p. 81.

Material.—goleta: *Phyllospadix*-pelvetiid grid, rare (5 per sq. m.). pt. dume: loose rocks, rare.

Distribution.—Southern California, 0–9 m.; on mud bottom in Morro Bay, California (material in hand).

Batea transversa Shoemaker

Batea transversa Shoemaker, 1926, pp. 13–18, figs. 8–11.—Hewatt, 1946, p. 204.—J. L. Barnard, 1962b, p. 80, fig. 6.

Material.—goleta: *Macrocystis* holdfast, 3 m., rare.

Distribution.—Possibly a tropical species with northern limits near Pt. Conception, rare in the intertidal of southern California but occurring abundantly in dredged samples from the Channel Islands off southern California in depths of about 60 m.; recorded from the mainland shelf in depths of 6 to 30 m.

Calliopiidae

Calliopiella pratti J. L. Barnard

FIGURES 7–8

Calliopiella pratti J. L. Barnard, 1954a, pp. 6–7, pls. 6–8.

Better materials than originally described permit a complete refiguring of this species.

MATERIAL.—CAYUCOS: *Phyllospadix*-pelvetiid grid, 4th most abundant species (1304 per sq. m.); scrapings of red anemone, present; buried cobbles, scarce; *Macrocystis* holdfast, rare; soft polychaete tubes, scarce; sponge and tunicate, scarce; shell fragments, present; *Laminaria* and corallines, scarce; *Amaroucium* sp., abundant. GOLETA: *Phyllospadix*-pelvetiid grid, rare (5 per sq. m.).

DISTRIBUTION.—Coos Bay, Oregon, to Goleta, California, intertidal. A northern species scarcely penetrating to the south of Pt. Conception; absent at Carmel presumably from lack of surf protection at that locality.

Notes on *Bouvierella* Chevreux (1900)

This genus is scarcely distinct from *Halirages* Boeck and indicates the close relationship of *Halirages* and *Atylopsis* Stebbing. The type species, *Bouvierella carcinophila* (Chevreux), differs from the type species, *Halirages fulvocinctus* (Sars), by the absence of dorsal segmental processes, the shorter telson and the shorter peduncle of uropod 3. *Halirages mixtus* Stephensen (1931) intergrades *H. fulvocinctus* and *Bouvierella carcinophila* by having an intermediate telson and peduncle of uropod 3 and by lacking dorsal segmental processes. Otherwise, all species of *Halirages* bear dorsal processes. *Bouvierella* is a blind, bathyal taxon; according to Chevreux the head has poorly produced lateral lobes and indeed his drawing is quite dissimilar to the heads of various species of *Halirages* which have an obsolescent lateral notch marking a distinct lateral lobe.

Halirages and *Bouvierella* differ from *Atylopsis* by the absence of inner lobes on the lower lip. Stephensen (1931) has held that the presence or absence of these lobes is of little generic value. Nevertheless, they remain the only significant character difference among several calliopiid genera.

By expanding the diagnosis of *Halirages* it would be possible to add *Bouvierella*, but that event must await reexamination of specimens of the latter genus in light of remarks made here.

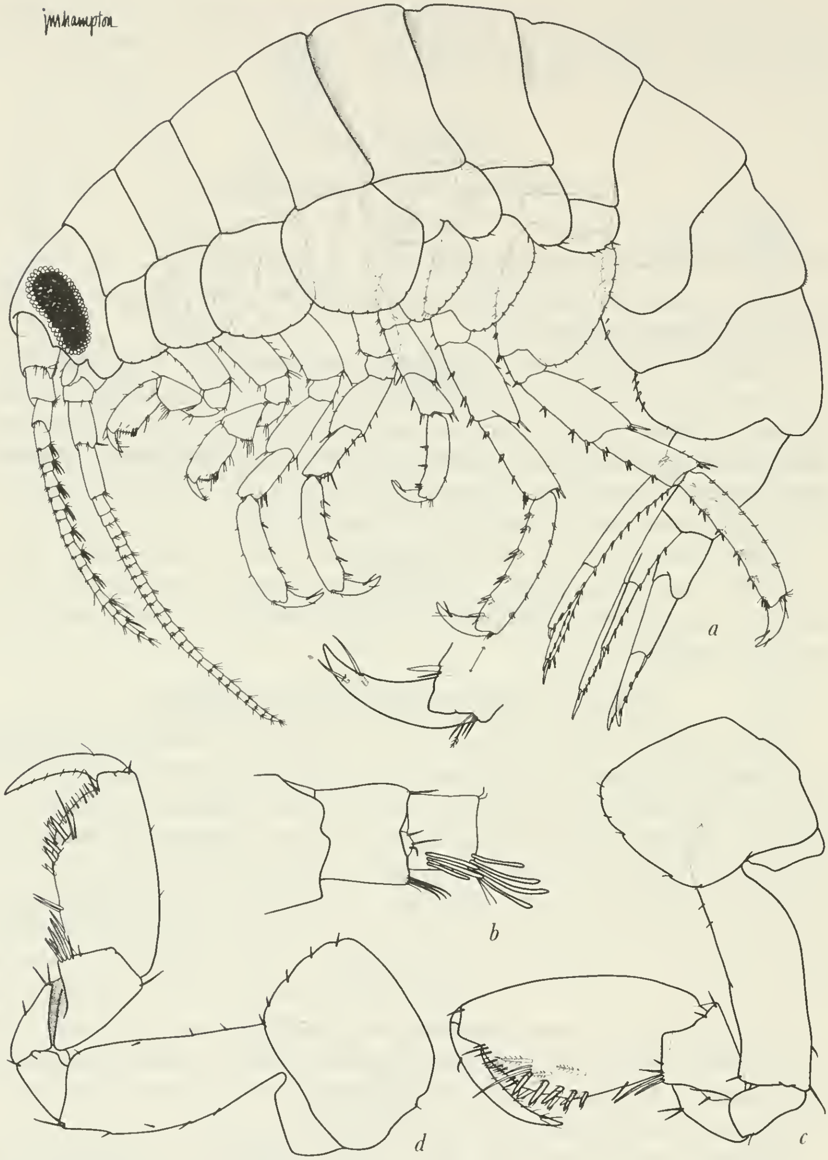

FIGURE 7.—*Calliopiella pratti* J. L. Barnard, female, 4.2 mm., station 48-H-10: *a*, lateral view. Male, 3.9 mm.: *b*, enlargement of medial surface of antenna 1 to show small articulated accessory flagellum; *c*,*d*, gnathopods 1, 2.

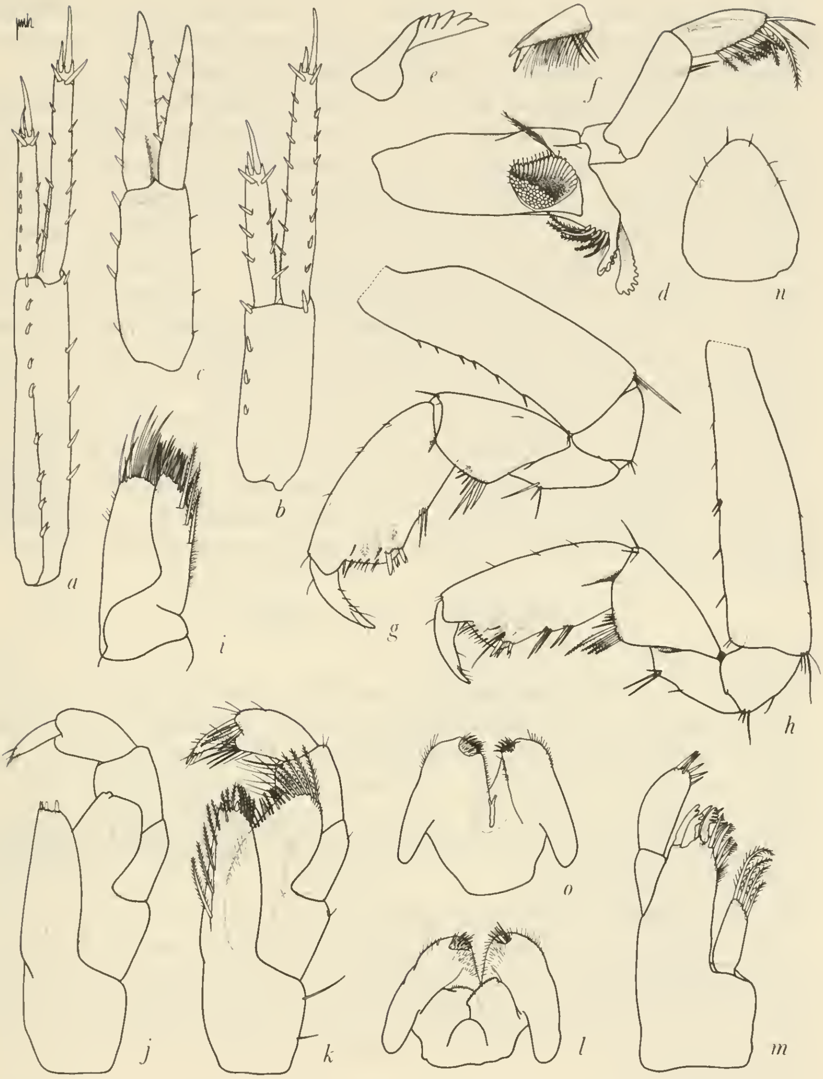

FIGURE 8.—*Calliopiella pratti* J. L. Barnard, female, 4.2 mm., station 48–H–10: *a,b,c*, uropods 1, 2, 3; *d*, mandible; *e,f*, left and right lacinia mobili of mandibles; *g,h*, gnathopods 1, 2; *i*, maxilla 2; *j,k*, maxilliped with and without setae; *l*, lower lip; *m*, maxilla 1. Male, 3.9 mm.: *n*, telson; *o*, lower lip. Two mountings of lower lip are shown for variations resulting from different mounting techniques.

The type species of a new genus to be described below is closely related to *Haliragesmixtus* and *Bouvierella carcinophila* but possesses a small, scale-like, semi-articulated accessory flagellum.

No species of *Haliragès* bears an accessory flagellum, except that *H. fulvocinctus* and *H. mixtus* have a broad distal process on article 3 of antenna 1. Other species of *Haliragès* and *Bouvierella* lack this process. It is similar to the structure found in some species of *Pontogeneia* (Eusiridae). In that family, J. L. Barnard (1964c) removed from *Pontogeneia* four species to be included in a new genus *Accedomoera*. All bear a distinct accessory flagellum. Retained in *Pontogeneia* were species lacking any accessory flagellum and those having a distal process on article 3 of antenna 1. Although the character distinction is minor, this course is followed in the present case. The alternate solution would be the removal of *H. mixtus* to *Bouvierella* and the inclusion of the species at hand in that genus. The present species cannot be assigned to *Haliragès* because of the short telson, the short peduncle of uropod 3, and the presence of an accessory flagellum. It differs from *Atylopsis* by the absence of inner lobes on the lower lip.

Oligochinus, new genus

Oligochinus Light, 1941 (*nomen nudum*).

Diagnosis.—Lower lip lacking inner lobes; gnathopods subchelate, articles 5 and 6 not elongated; palp of maxilla 1 normal, not reduced in size; pereopodal dactyls not pectinate; accessory flagellum distinct, very short, scale-like but articulate, not directly fused to chitinous edge of article 3 of antenna 1; telson short, deeply emarginate distally; peduncle of uropod 3 short; body lacking dorsal processes. Generic name masculine.

Type species.—*Oligochinus lighti*, new species.

Relationship.—Distinguished from *Haliragès* Boeck by the shortened telson and peduncle of uropod 3 and the presence of a distinct accessory flagellum; distinguished from *Bouvierella* Chevreux by the presence of a distinct accessory flagellum. See previous discussion for other details.

The writer has been able to recognize this entity by examining specimens labeled "Oligochinus" in the collections of the Department of Zoology, University of California, Berkeley (in the year 1951).

Oligochinus lighti, new species

Figures 9–10

Diagnosis.—With the characters of the genus.

Descriptive notes.—Posterior edges of pleonal epimera minutely serrate; posterior margins of coxae 1–4 with 1–3 long spines; males and females similar.

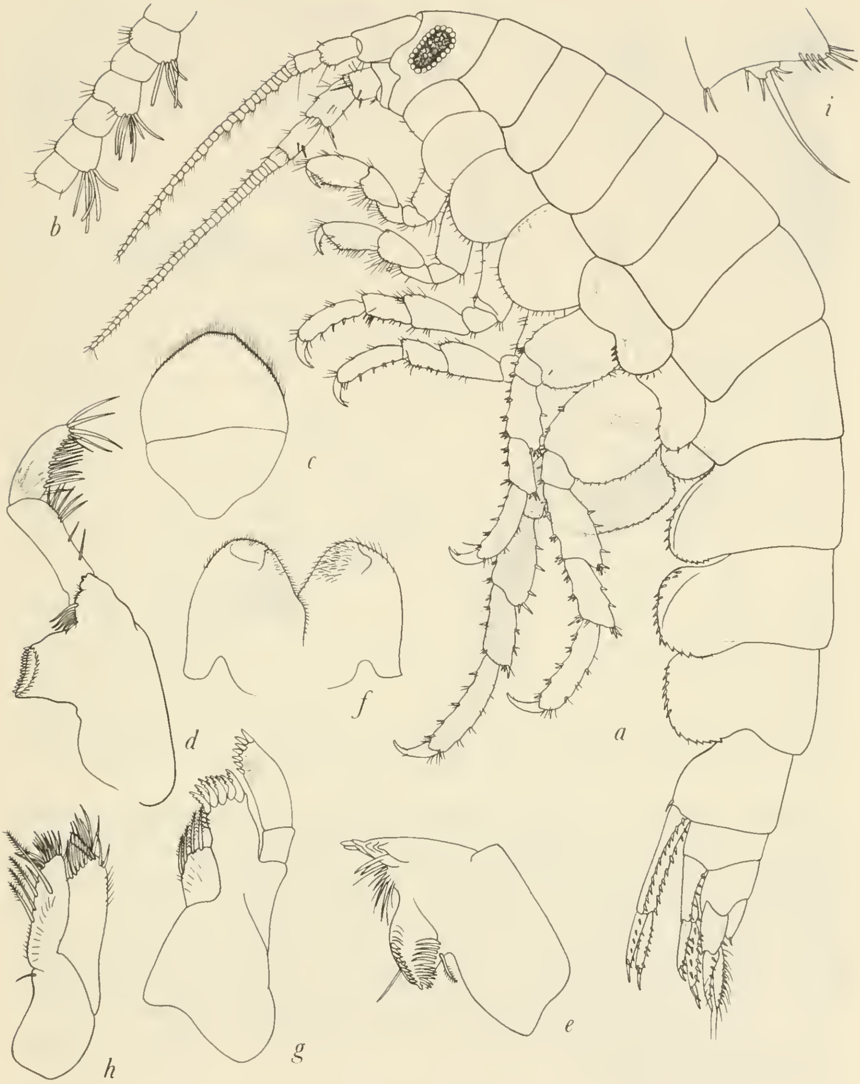

FIGURE 9.—*Oligochinus lighti*, new genus, new species, female, 8.0 mm., station 42–G–3: *a*, lateral view; *b*, enlargement of flagellar articles of antenna 1; *c*, upper lip, ventral edge up; *d,e*, mandible; *f*, lower lip; *g,h*, maxillae 1, 2; *i*, accessory flagellum attached to article 3 of antenna 1.

HOLOTYPE.—AHF No. 616, female, 8.0 mm.

TYPE LOCALITY.—Station 42–G–3, Hazard Canyon reef, California, algal turf on platform, December 8–9, 1961.

MATERIAL.—CARMEL: cobble-pelvetiid grid, most abundant species (644 per sq. m.); *Phyllospadix*-pelvetiid grid, fifth most abundant

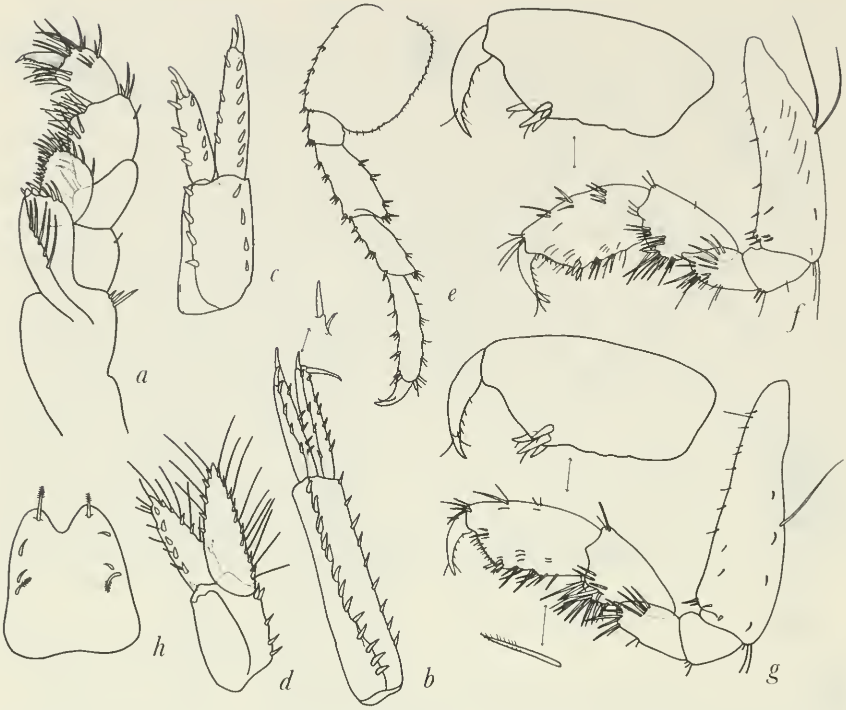

FIGURE 10.—*Oligochinus lighti*, new genus, new species, female, 8.0 mm., station 42–G–3: *a*, maxilliped; *b*,*c*,*d*, uropods 1, 2, 3; *e*, pereopod 5; *f*,*g*, gnathopods 1, 2; *h*, telson.

species (135 per sq. m.); algal holdfasts, scarce; coralline algae, scarce. CAYUCOS: *Phyllospadix*-pelvetiid grid, abundant (568 per sq. m.); polychaete tubes and sponge, rare; sponge, rare. HAZARD CANYON: kelp holdfasts, moderately abundant; algal turf on platform, most abundant (2677 per sq. m.); coralline algae, abundant; edge of ledge in sparse algae, most abundant; sponge and tunicates, scarce; *Egregia* holdfast, second most abundant. GOLETA: *Phyllospadix*, rare.

DISTRIBUTION.—Pescadero Point, California (Prof. Light) to Goleta, California, intertidal.

Colomastigidae

Colomastix pusilla Grube

Colomastix pusilla Grube: J. L. Barnard, 1955a, pp. 39–42, fig. 20 (with references); 1959, p. 19.—Ruffo, 1959, pp. 3–4.

MATERIAL.—CAYUCOS: sponge, rare. CORONA DEL MAR: sponge, *Spheciospongia* sp., moderately abundant; *Phragmatopoma* masses, rare. N. LAGUNA BEACH: Barnard station 16, August 31, 1950, abundant in sponge, *Leucetta losangelensis* de Laubenfels.

Distribution.—Cosmopolitan in tropical and temperate seas. The small body size, less than 2.0 mm., and slenderness of this species result in its loss through sorting screens utilized in this survey, hence the poor recovery of specimens.

Corophiidae

Cerapus tubularis Say

Cerapus tubularis Say: J. L. Barnard, 1962a, pp. 61–63, figs. 28, 29 (with synonymy); 1964a, p. 219.

Material.—CARMEL: *Phyllospadix*-pelvetiid grid, rare (5 per sq. m.). CAYUCOS: *Phyllospadix*-pelvetiid grid, rare (11 per sq. m.); *Laminaria* and corallines, rare. HAZARD CANYON: *Phyllospadix*, rare. COPONA DEL MAR: *Phyllospadix*-coralline grid, moderately abundant (106 per sq. m.); loose rocks, rare; mixed red-brown algae, scarce. LA JOLLA: *Phyllospadix*-coralline grid, moderately abundant (498 per sq. m.); short-tufted red algal turf, scarce (66 per sq. m.); underrock grid, rare (4 per sq. m.); coralline algae, rare.

Distribution.—Probably cosmopolitan in tropical and warm-temperate seas; collected in the eastern Pacific Ocean from Carmel, California to Bahía San Cristobal, Baja California, 0–37 m. The scarcity of this species north of Pt. Conception indicates that it may be near its northern limit in Monterey Bay. Forms a thick, pliable, striped, cylindrical tube open at both ends.

Corophium baconi Shoemaker

Corophium baconi Shoemaker, 1934, pp. 356–359, fig. 1; 1949, p. 82.—J. L. Barnard, 1959, p. 38; 1961, p. 182; 1964a, p. 219.

Material.—CAYUCOS: *Phyllospadix*-pelvetiid grid, rare (6 per sq. m.); *Macrocystis* holdfast, rare; *Amaroucium* sp., rare. CORONA DEL MAR: calcareous worm tubes, rare; sponge, *Spheciospongia* sp., rare; *Phragmatopoma* masses, moderately abundant. LA JOLLA: sand-inundated algae, at high-tide line, rare; underrock grid, rare (2 per sq. m.); corallines under *Phyllospadix*, rare.

Distribution.—Bering Sea to Peru, more common on benthos of coastal shelf of southern California, 9–55 m., than in the intertidal.

Corophium californianum Shoemaker

Corophium californianum Shoemaker, 1934, pp. 359–360, fig. 2; 1949, pp. 76–77.—J. L. Barnard, 1961, p. 182.

Material.—GOLETA: submerged log, 8 m., the most abundant species.

Distribution.—Originally described from Monterey Bay in 48 fath. (88 m.); this is the second record.

Corophium uenoi Stephensen

Corophium uenoi Stephensen, 1932, pp. 494–498, figs. 3, 4.—J. L. Barnard, 1952a, pp. 28–32, pls. 8, 9; 1959, p. 39.—Nagata, 1960, p. 178.—J. L. Barnard, 1961, p. 183; 1964b, p. 112, chart 16.

Material.—goleta: *Macrocystis* holdfast, 3 m., rare.

Distribution.—Japan; in the Californias an estuarine-lagoonal species in Morro Bay, Newport Bay, and Bahía de San Quintín.

Ericthonius brasiliensis (Dana)

Figure 24 f–i

Ericthonius brasiliensis (Dana): J. L. Barnard, 1955a, pp. 37–38 (with references).—Irie, 1957, p. 4, fig. 5.—Pillai, 1957, p. 60, fig. XVI, 3–7.—Oldevig, 1959, p. 114.—J. L. Barnard, 1959, p. 39; 1961, p. 183; 1964a, p. 219; 1964b p. 112, chart 17.

Pereopods 1 and 2 of Californian specimens, especially in females, have very stout, nearly subcircular second articles as shown in the figure. Specimens from more southerly latitudes, such as Bahía de San Quintín and Bahía de Los Angeles, Baja California, have narrower second articles, more typical of the drawings made by Sars (1895) and others in the literature.

Material.—carmel: *Phyllospadix*-pelvetiid grid, scarce (25 per sq. m.). cayucos: kelp holdfasts, moderately abundant; *Phyllospadix*-pelvetiid grid, scarce (128 per sq. m.); buried cobbles, scarce; *Macrocystis* holdfast, moderately abundant; sponge and tunicates, abundant to most abundant species; *Amaroucium* sp., scarce. hazard canyon: coralline algae, rare; sponge and tunicates, rare; kelp holdfasts, moderately abundant; hydroids, rare. goleta: *Phyllospadix*-pelvetiid grid, rare (5 per sq. m.); *Macrocystis* holdfast, 3 m., scarce; submerged log, 8 m., rare. pt. dume: short brown algae, rare; coralline algae, rare; sandy social tunicates, rare. corona del mar: *Phyllospadix*-coralline grid, moderately abundant (210 per sq. m.); underrock substrate, rare; loose rocks, moderately abundant; calcareous worm tubes, abundant; algae below water, moderately abundant; *Egregia* stipes, rare; soft polychaete tubes, abundant; *Laminaria* holdfast, abundant; *Phragmatopoma* masses, moderately abundant; sponge, rare; *Speciospongia* sp., moderately abundant. la jolla: *Phyllospadix*-coralline grid, moderately abundant (250 per sq. m.); short-tufted red algae, scarce (36 per sq. m.); underrock, scarce; coralline algae, rare; sponge, rare.

Distribution.—Cosmopolitan in tropical and warm-temperate seas, extending into cold temperate seas as far as Norway and Puget Sound (specimens at hand), a tube builder requiring protection from surf, often nestling in biogenic structures such as phragmatopomid masses, especially abundant in lagoons and estuarine mouths, 0–130 m.

Ericthonius hunteri (Bate)

Erichthonius hunteri (Bate): Sars, 1895, p. 605, pl. 216, fig. 2.—Holmes, 1908, p. 543.

Erichthonius Hunteri: Chevreux and Fage, 1925, pp. 254–256, fig. 363.

Ericthonius hunteri: Stebbing, 1906, p. 673.—Enequist, 1950, pp. 344–345, fig. 62.—Gurjanova, 1951, p. 951, fig. 662.—Shoemaker, 1955a, p. 68.—J. L. Barnard, 1962a, p. 63.

Dahl (1946) and Enequist (1950) differ on the problem of the identity of *Ericthonius hunteri* and *E. difformis* Milne Edwards; the present specimens are closer to that figured by Sars (1895) as *E. hunteri* than to *E. difformis.*

Material.—cayucos: *Phyllospadix*-pelvetiid grid, rare (9 per sq. m.).

Distribution.—A subarctic-boreal species submerging to deep waters of the shelf of southern California and probably with its southern intertidal limits near Pt. Conception.

Dexaminidae

Polycheria osborni Calman

Polycheria osborni Calman, 1898, pp. 268–269, pl. 32, fig. 2.—Skogsberg and Vansell, 1928, pp. 268–282, figs. 1–26.

Polycheria antarctica (Stebbing): Stebbing, 1906, pp. 520–521 (in part).—Alderman, 1936, p. 63.—J. L. Barnard, 1954a, p. 21.

The specimens are of the *Polycheria osborni* kind.

Material.—carmel: *Phyllospadix*-pelvetiid grid, rare (5 per sq. m.); algal holdfasts, rare; coralline algae, rare; tunicates and sponges, abundant. cayucos: *Phyllospadix*-pelvetiid grid, scarce (23 per sq. m.); soft polychaete tubes, moderately abundant; sponge, abundant; *Amaroucium* sp., scarce to abundant; sponge, rare. hazard canyon: sponge, abundant. corona del mar: tunicates and soft polychaete tubes, scarce. la jolla: *Phyllospadix*-coralline grid, scarce (16 per sq. m.); sponge, rare.

Distribution.—California, intertidal, burrowing in tunicates, especially *Amaroucium* sp. If *P. osborni* is a phenotype or race of *P. antarctica* then the species-complex is cosmopolitan.

Eophliantidae

***Lignophliantis*, new genus**

Diagnosis.—Each antenna with only one flagellar article; mandibular molar styliform; maxilla 1 lacking palp; pereonites lacking ventral flange; pleopods biramous, inner rami half as long as outer; pleonites 5–6 and telson fused together, telson undivided; uropod 3 composed only of peduncle, lacking rami. Generic name feminine,

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composed of words indicating an eophliantid with lignin in its alimentary tract.

Type species.—*Lignophliantis pyrifera*, new species.

Relationship.—This genus is unique in the Eophliantidae for its uncleft telson. Disregarding that, the genus comes closest to *Wandelia* Chevreux (see 1906) and *Ceinina* Stephensen (see Gurjanova, 1951) because of the poorly developed antennal flagella.

Lignophliantis pyrifera, new species

Figures 11, 12

Diagnosis.—With the characters of the genus.

Description.—No demarcation observed between pleonites 5–6 and telson; second antenna appearing to be attached directly to front of head at base of peduncular article 3, indicating fusion of articles 1–2 with head; gland cone of article 2 appearing to be represented by coniform projection at anteroventral corner of head; apices of uniarticulate antennal flagella bearing vestiges of small, fused, second article; gnathopods simple; pereonite 1 bearing small dorsal crest and elevated above head; cephalic attachment appearing to permit maximum rotation possible for burrowing; no epimeral demarcation seen on pleonites 1–3 except slightly on first; large pleopods attached directly to ventral surfaces of pleonites 1–3, without bases hidden as in most amphipods; mandibular palp of debateable structure, appearing to be a coalesced palp, considering its length, its curve and its apical spine; basally molar fused to mandibular body; first maxilla with 5 spines on outer plate, no palp detected.

Holotype.—AHF No. 617, ?sex, 1.4 mm.

Type locality.—Barnard station 41, Goleta, California, July 6, 1961, wash of rhizomes of *Macrocystis pyrifera* collected in depth of 3 m.

Remarks.—Eight specimens have been dissected and examined. The alimentary canals of most of these are full of lignin-like material, apparently composed of the rhizomes of the kelp; presumably the amphipod is a burrower. No brood lamellae or penial projections have been detected.

Material.—The type series, 15 specimens.

Eophliantid

Another species, probably of a new genus.

Material.—carmel: cobble-pelvetiid grid, rare. la jolla: *Phyllospadix*-coralline grid, rare.

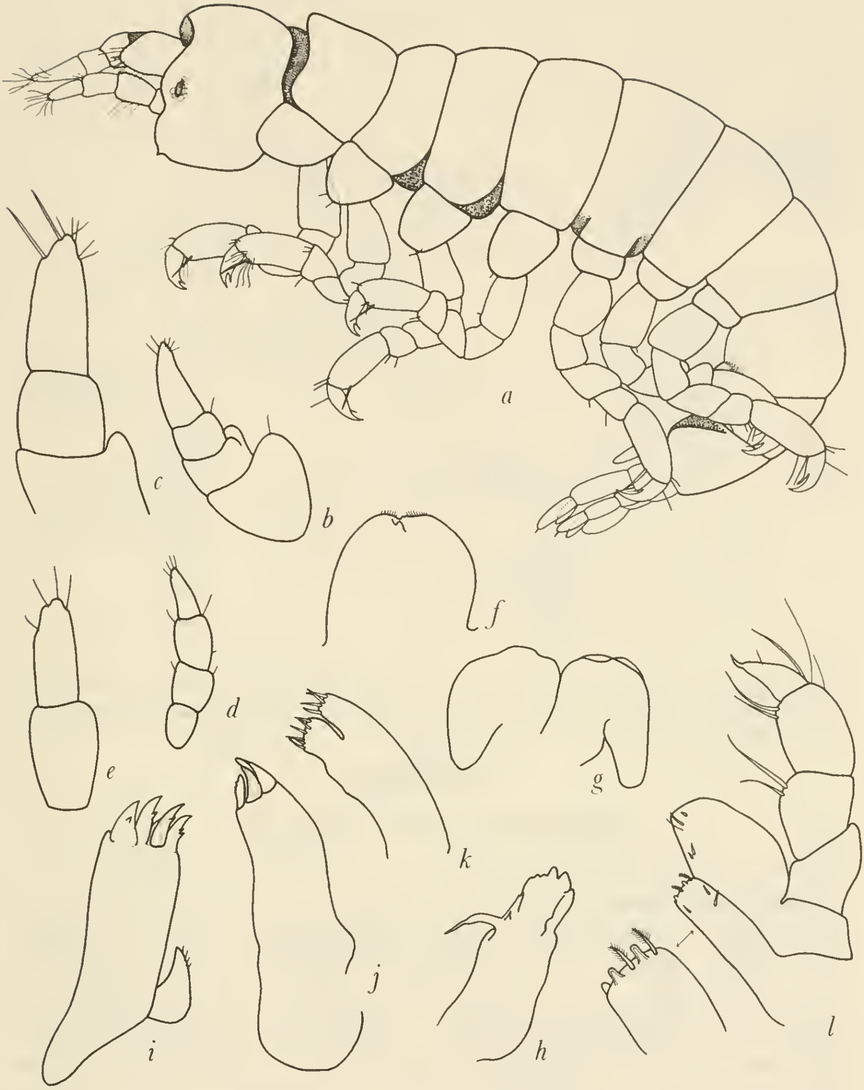

FIGURE 11.—*Lignophliantis pyrifera*, new genus, new species, ?sex, 1.4 mm., station 41: *a*, lateral aspect of animal, mouthparts removed; *b*,*c*, antenna 1; *d*,*e*, antenna 2; *f*, upper lip, ventral edge up; *g*, lower lip; *h*, mandible; *i*,*j*, maxilla 1, 2 views; *k*, maxilla 2; *l*, maxilliped.

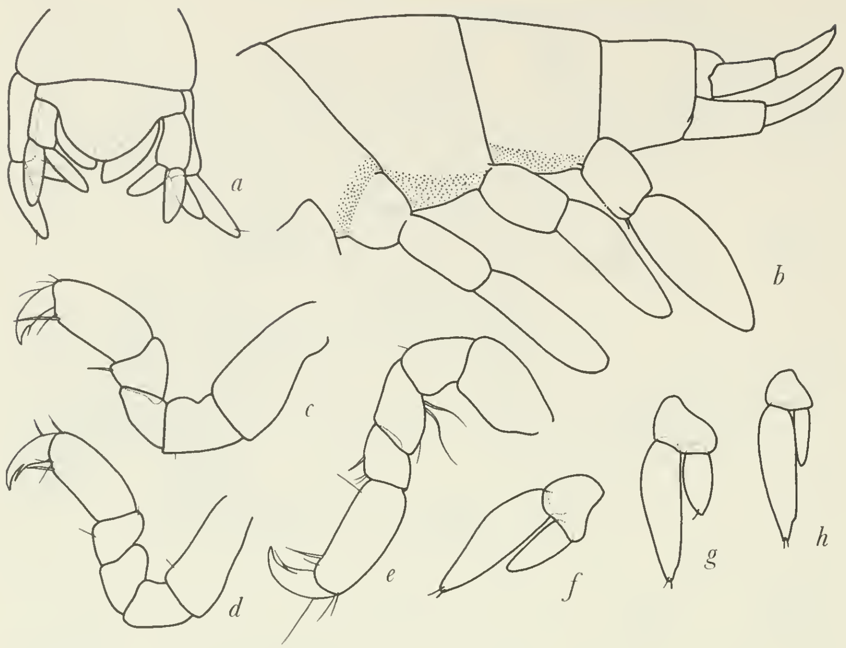

FIGURE 12.—*Lignophliantis pyrifera*, new genus, new species, ?sex, 1.4 mm., station 41: *a*, dorsal view of urosome; *b*, lateral view of pleon; *c*, gnathopod 1; *d,e*, pereopods 2, 5; *f,g,h*, pleopods 1, 2, 3.

Eusiridae

Accedomoera J. L. Barnard

Accedomoera J. L. Barnard, 1964c, p. 59.

This genus, erected for the type *Pontogeneia tricuspidata* Gurjanova (1938) with *P. mokyevskii* Gurjanova (1952) and *P. ushuiae* Schellenberg (1931), differs from *Pontogeneia* Boeck by the articulated, uniarticulate accessory flagellum. The genus forms a bridge to *Eusiroides* Stebbing from which it differs by the shorter accessory flagellum, the less strongly expanded sixth gnathopodal articles bearing distinct palms, and the very poorly developed, if not absent, inner lobes of the lower lip.

Accedomoera vagor, new species

FIGURES 13–14

DIAGNOSIS.—Body lacking dorsal processes; rostrum of moderate size, reaching about 40% along article 1 of antenna 1 but scarcely projecting in front of lateral cephalic lobes, slender, straight, tapering subacutely; lateral cephalic lobe quadrate, defined below by deep notch; eyes large, subreniform, black in alcohol; peduncle of antenna

FIGURE 13.—*Accedomoera vagor*, new species, female, 7.4 mm., station 32: *a*,*b*, gnathopods 1, 2. Male, holotype, 5.5 mm.: *c*,*d*, gnathopods 1, 2; *e*,*f*,*g*, uropods 1, 2, 3; *h*, telson.

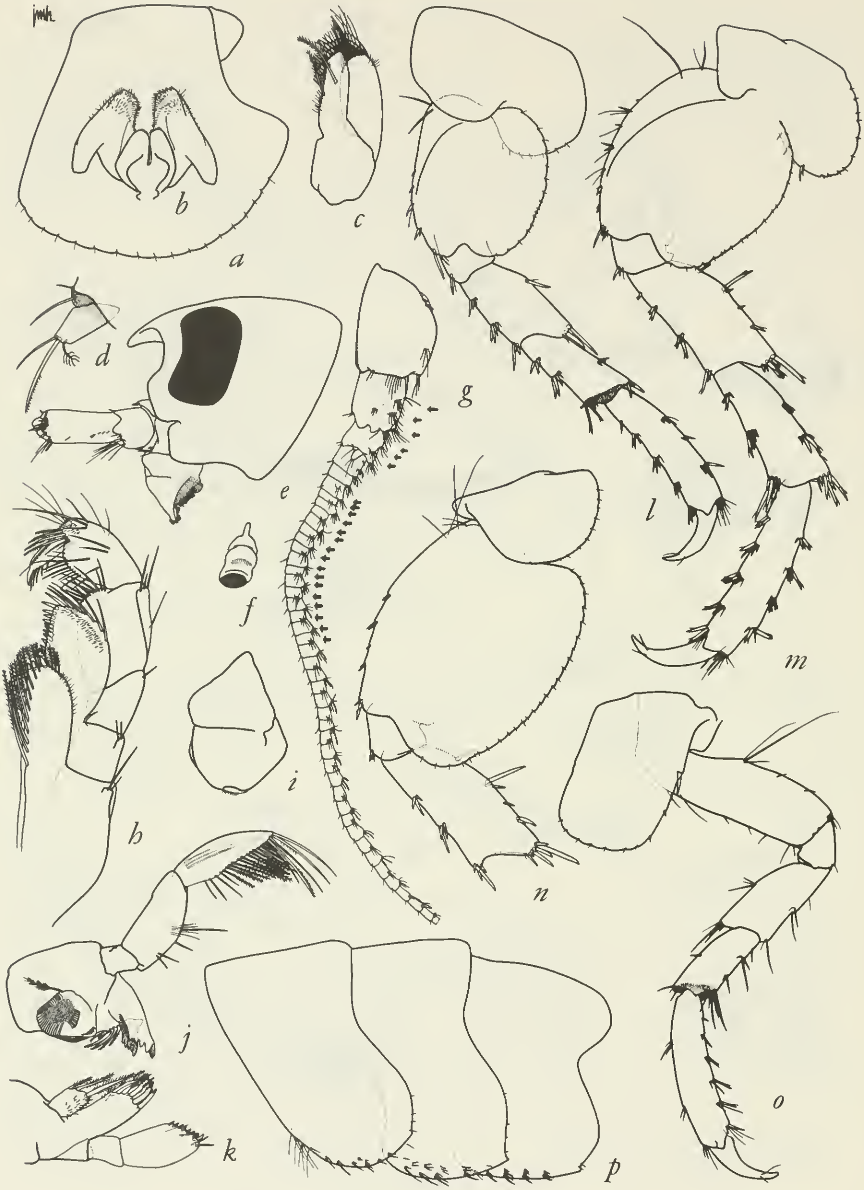

FIGURE 14.—*Accedomoera vagor*, new species, holotype, male, 5.5 mm., station 32: *a*, coxa 4; *b*, lower lip; *c*, maxilla 2; *d*, accessory flagellum; *e*, head; *f*, sense organ of first antenna, enlarged 5 times in comparison to antenna 1 of figure *g*; *g*, antenna 1, arrows pointing to attachments of sense organs of figure *f*, sense organs occurring to end of flagellum; *h*, maxilliped; *i*, upper lip; *j*, mandible; *k*, maxilla 1; *l,m,n,o*, pereopods 3, 4, 5, 1. Female, 7.4 mm.: *p*, pleonal epimera 1–3, left to right.

1 very short (see figure), articles successively shorter, article 2 especially ornamented mediodistally, article 3 with small, blunt, posterodistal process, accessory flagellum about as long as article 2 of primary flagellum, broad at base, armed with 3 setae; antennal peduncular articles 2–3 and flagellar articles armed with lantern-like, transparent sense organs [one of which is enlarged 5 times as inset next to antenna 1 in figure, otherwise not drawn but noted by arrows]; sense organs attached alternately marginal and submarginal and borne to full tip of flagellum, bases inserted in setal bundles as illustrated; antenna 2 missing on 3 known specimens; inner plate of maxilla 1 with 3 setae, successively smaller medioproximally; maxillipedal dactyls claw-like, distally constricted, armed medially with 5 short setae; coxa 1 nearly quadrate, scarcely expanded anterodistally, coxae 1–3 with 1–2 large posterior spines; gnathopods 1–2 in each sex very similar to each other, male gnathopods slightly larger and with shorter fifth articles and larger palmar spines, posterior lobes of fifth articles poorly developed, not projecting, trapezoidal, dactyls bearing 4–5 sets of 2 setae on inner margins, each pair of setae with one long and one short curved member; fifth articles about 80% as long as sixth in females, about 60% in males; sixth articles (hands) of male of medium expansion for genus, palms very oblique, shorter than posterior margins of article 6, defining corners armed with 4–5 large spines on base line becoming increasingly submarginal from proximal to distal extent; pleonal epimera 1–3 each with small tooth posteroventrally, posterior edges strongly convex, in exaggerated condition on epimeron 3; telson cleft slightly more than halfway.

Holotype.—AHF No. 6030, male, 5.5 mm.

Type locality.—Cayucos, California, July 15, 1960, intertidal reef algae collected by Dr. E. Yale Dawson (as Barnard station 32).

Material.—3 specimens from the type locality.

Relationship.—This species differs from *Accedomoera tricuspidata* (Gurjanova, 1938) and *A. ushuiae* (Schellenberg, 1931) in the lack of dorsal body processes and from *A. mokyevskii* (Gurjanova, 1952) by the narrower gnathopodal hands and larger rostrum.

Among species of *Pontogeneia* which it closely resembles are *P. intermedia* Gurjanova (1938, see 1951) and *P. rostrata* Gurjanova (1938, see 1951) from which species it differs by the strongly spinose defining corners of the gnathopods. In this respect it closely resembles *P. melanophthalma* Gurjanova (1938, see 1951) but that species has a smaller rostrum and a more elongated and spinose first antennal article 1. *Pontogeneia makarovi* Gurjanova (1951) also has spinose gnathopodal palmar corners and the new species may not be distinct from that although Gurjanova makes no mention of the presence of an accessory flagellum and the rostrum presumably is shorter; the posterior lobe of article 5 on gnathopod 2 is curved distally in *P. makarovi.*

Pontogeneia brevirostrata Bulycheva (1952) is somewhat similar to *A. vagor* in rostrum but has many minor differences: a less deeply cleft anterior cephalic notch below the lateral lobe, a deeper cleft in the telson, more slender gnathopods with longer fifth articles, longer peduncular articles of the first antenna, and an untoothed third pleonal epimeron with perfectly rounded posteroventral corner.

Eusiroides monoculoides (Haswell)

Eusiroides monoculoides (Haswell): J. L. Barnard, 1964a, pp. 221–222, fig. 1 (with synonymy).

Material.—corona del mar: loose rocks, scarce; algae below water, rare; soft polychaete tubes, rare; tunicates and polychaete tubes, rare; sponges, rare. la jolla: underrocks, rare.

Distribution.—Circumtropical, reaching northern limits in southern California at Corona del Mar, generally intertidal to 20 m.

Paramoera mohri J. L. Barnard

Fig. 15

Paramoera mohri J. L. Barnard, 1952a, pp. 16–19, pls. 3, 4.

A lateral aspect of this organism is shown in the figure.

Material.—Carmel Point, California, December 30–31, 1963, station 48–X–1, 7 specimens.

Distribution.—Carmel to Hazard Canyon reef, California, rare.

Pontogeneia intermedia Gurjanova

Figs. 16, 17

Pontogeneia intermedia Gurjanova, 1938, pp. 333–335, fig. 41; 1951, p. 722, fig. 502.

These specimens correspond generally to the figures published by Gurjanova and no special comments are necessary that are not shown by the figures presented herein.

Material.—carmel: algae below water, rare. cayucos: *Phyllospadix*-pelvetiid grid, scarce (56 per sq. m.). hazard canyon: algae *Rhodomela laryx*, rare; *Phyllospadix* on sand, rare. corona del mar: *Laminaria* sp., rare.

Distribution.—Japan Sea; California from Carmel to Corona del Mar.

Pontogeneia quinsana J. L. Barnard

Pontogeneia quinsana J. L. Barnard, 1964b, pp. 106–108, fig. 19, chart 7.

Material.—la jolla: *Phyllospadix*-coralline grid, rare (19 per sq. m.); underrocks, rare; coralline algae, scarce (11 per sq. m.).

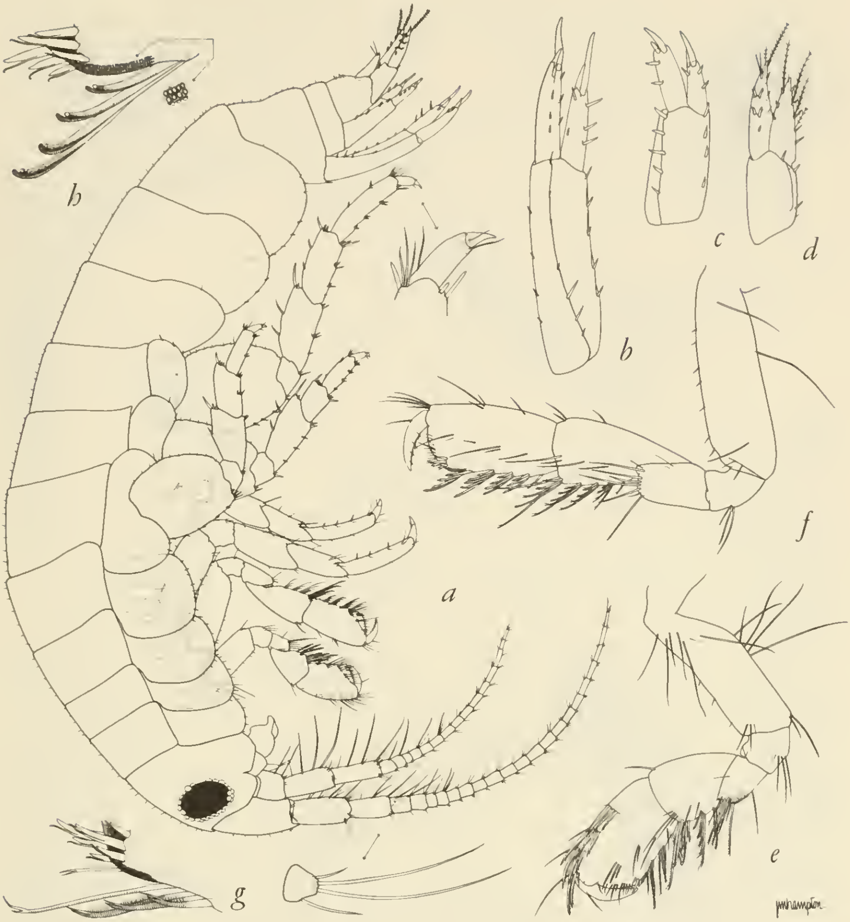

FIGURE 15.—*Paramoera mohri* J. L. Barnard, male, 3.6 mm., station 48–X–1: *a*, lateral view; *b,c,d*, uropods 1, 2, 3; *e,f*, gnathopods 1, 2, medial views; *g,h*, palmar corners of gnathopods 1, 2, enlarged.

DISTRIBUTION.—Probably a southern species, prominent at Bahía de San Quintín, Baja California, with northern limits at La Jolla.

Pontogeneia rostrata Gurjanova

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

The eyes of this species fade to a pale ochre or neutral translucence in alcohol. Labels on fig. 20 of Barnard (1964b) are reversed: D is gnathopod 2 and E is gnathopod 1.

MATERIAL.—CARMEL: algal holdfasts, rare. CAYUCOS: *Phyllospadix*-pelvetiid grid, moderately abundant (142 per sq. m.); buried cobbles,

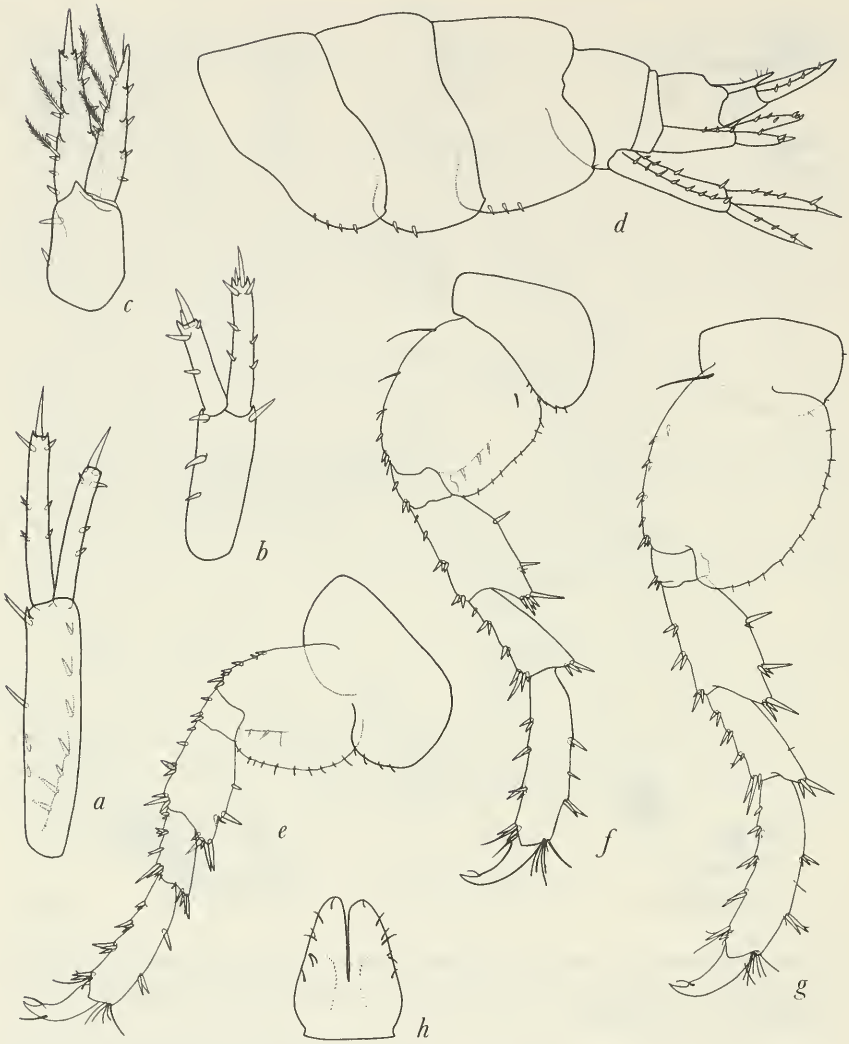

FIGURE 16.—*Pontogeneia intermedia* Gurjanova, male, 3.2 mm., station 42–T–8: *a,b,c*, uropods 1, 2, 3 (1 and 3 ventral views); *d*, pleon; *e,f,g*, pereopods 3, 4, 5; *h*, telson.

rare; *Macrocystis* holdfast, rare; shell fragments, scarce. HAZARD CANYON: algal turf on platform, moderately abundant (44 per sq. m.); *Egregia* holdfast, rare. GOLETA: *Phyllospadix*-pelvetiid grid, abundant (234 per sq. m.); *Macrocystis* holdfast, 3 m., moderately abundant. PT. DUME: short brown algae in pelvetiid zone, second most abundant

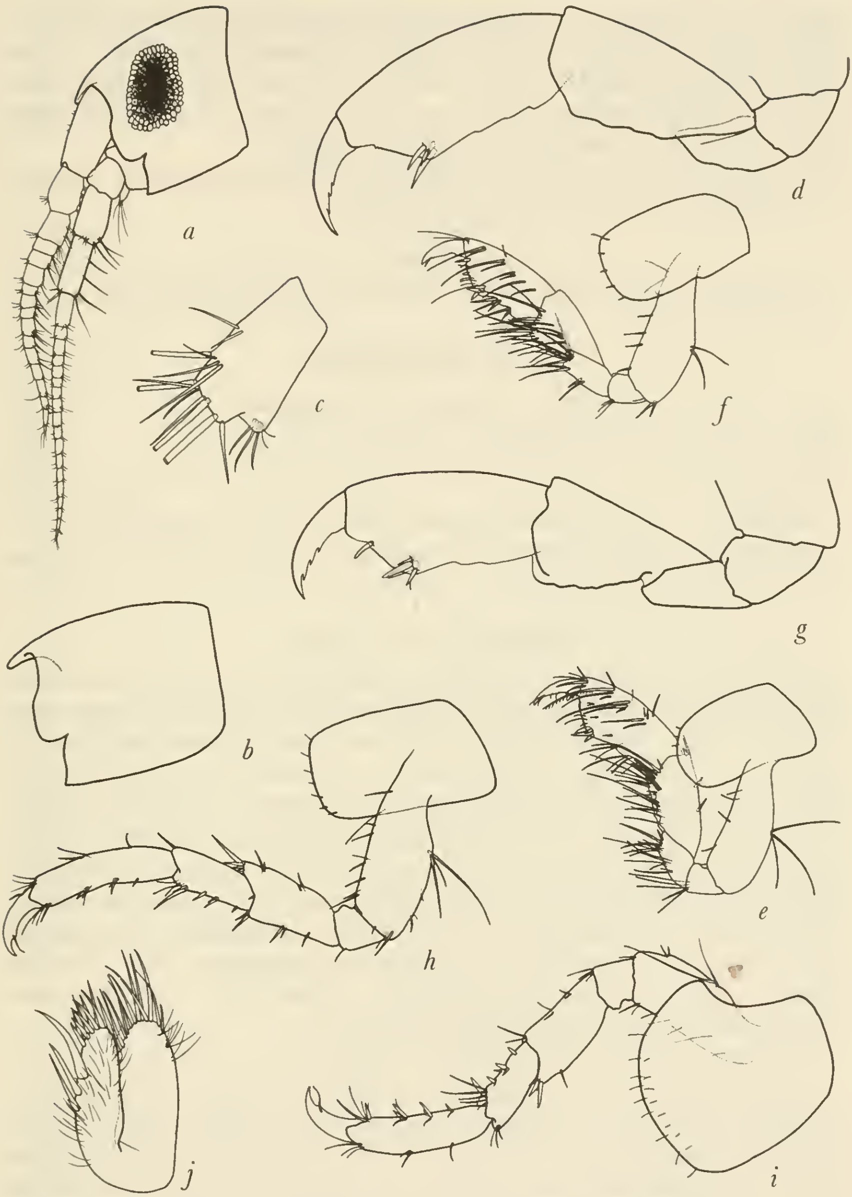

FIGURE 17.—*Pontogeneia intermedia* Gurjanova, male, 3.2 mm., station 42–T–8: *a*,*b*, head; *c*, article 3 of first antennal peduncle, medial view; *d*,*e*, gnathopod 1; *f*,*g*, gnathopod 2; *h*,*i*, pereopods 1, 2; *j*, maxilla 2.

species (1585 per sq. m.); coralline algae, second most abundant species (1480 per sq. m); loose rocks, abundant; *Egregia* sp., scarce; *Anthopleura elegantissima* bed, rare. CORONA DEL MAR: loose rocks, rare. LA JOLLA: *Phyllospadix*-coralline grid, scarce (44 per sq. m.); coralline algae, rare; underrock grid, rare (4 per sq. m.).

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

Eusirid

MATERIAL.—CORONA DEL MAR: underrock substrate, scarce.

Gammaridae

***Ceradocus spinicauda* (Holmes)**

Maera spinicauda Holmes, 1908, pp. 539–541, fig. 45.
Ceradocus spinicauda: J. L. Barnard, 1954a, pp. 18–19; 1962b, pp. 86–88, figs. 10, 11.

MATERIAL.—GOLETA: *Macrocystis* holdfast, 3 m., abundant.

DISTRIBUTION.—Intertidal at Cape Arago, Oregon to subintertidal on the coastal shelf of southern California.

***Dulzura*, new genus**

DIAGNOSIS.—Accessory flagellum 2-articulate; lower lip lacking inner lobes; mandibular palp article 3 slender, slightly longer than article 2, very slightly falciform; inner plates of maxillae 1 and 2 densely setose medially; gnathopod 1 subchelate, gnathopod 2 of either sex small, poorly subchelate; coxae short, overlapping, quadrate, coxa 4 not excavate posteriorly; pleonites 1–3 neither toothed nor spined; uropod 3 of melitid form, outer ramus greatly elongated, biarticulate, article 2 short, inner ramus very short, scale-like; telson deeply cleft, short. Generic name feminine, contrived, its root having basis in *dulcitas*, sweetness, referring to the possibility that the blind, albinid genus has origins in freshwater aquifers or has the appearance of organisms living in sweetwaters of caves.

TYPE SPECIES.—*Dulzura sal*, new species.

RELATIONSHIP.—As a melita-like organism, with characteristically elongated uropod 3, this genus differs from *Melita* Leach by the biarticulate outer ramus of uropod 3, the second article being longer than its neighboring spines and by the absence of inner lobes on the lower lip. It differs from *Melitoides* Gurjanova (1934, 1951) in the extension of uropod 3 well beyond the ends of uropods 1 and 2, the lack of inner lobes on the lower lip and the stouter, slightly falciform article 3 of the mandibular palp. The poorly developed gnathopod 2 is reminiscent of the condition in *Metaceradocus* Chevreux and *Megaluropus* Hoek, quite unlike *Melita* and *Melitoides*. *Netamelita*

J. L. Barnard (1962b) has different mouthparts: inner lobes present on the lower lip, inner plates of both pairs of maxillae bearing only terminal setae, palp article 3 of mandible simple, linear and setose only terminally.

Dulzura sal, new species

Figs. 18–19

Diagnosis.—With the characters of the genus.

Description.—Rostrum absent, lateral cephalic lobes obsolescent, side of head slightly convex, truncate, scarcely invaginated at antero-ventral corner; eyes absent; epistome rounded-truncate anteriorly; gnathopod 1 of the melita form, palm nearly transverse; gnathopod 2 of male larger than that of female, article 5 stouter and shorter relative to article 6, rounded but not distinctly lobed posteriorly, densely setose, article 6 nearly twice as long as 5, scarcely broader than 5, palm and posterior edge of article 6 confluent, densely setose, mediodistal face armed with 2 rows of 4 and 5 spines respectively, palm poorly defined by 2 medial spines, medial surface armed with bundles of setae marked in the accompanying figure by their bases only, dactyl with small scales on inner surface; second articles of pereopods 3–5 narrow; pleonite 4 with one small dorsal seta, pleonite 5 with pair of setae on each dorsolateral surface; uropod 2 with long combs of spines on mediodistal peduncular apex; other characters as in figures.

Holotype.—AHF No. 631, ovigerous female, 4.1 mm.

Type locality.—Station 45–T–3, November 11–13, 1962, wash of roots of *Phyllospadix* sp.

Material.—corona del mar: underrock substrate, scarce; *Phyllospadix*-coralline grid, rare (4 per sq. m.); loose rocks, rare. la jolla: *Phyllospadix*-coralline grid, rare; underrock grid, rare.

Elasmopus antennatus (Stout)

Neogammaropsis antennatus Stout, 1913, pp. 645–646.

Elasmopus antennatus: Shoemaker, 1941b, p. 187.—J. L. Barnard, 1962b, pp. 88–91, figs. 12, 13; 1964a, p. 222.

Adult males from Carmel station 48–H–6 have all characters of *E. antennatus*, including those of gnathopod 2, the telson, uropod 3, and the third pleonal epimeron, but article 2 of pereopod 5 is deeply serricate as in *E. rapax serricatus*, a subspecies described below.

Material.—carmel: *Macrocystis* holdfast, scarce; tunicates and sponges, most abundant species; wash of *Phyllospadix* roots, second most abundant species (variety with serricate pereopod 5). cayucos: *Phyllospadix*-pelvetiid grid, abundant (695 per sq. m.); *Macrocystis* holdfast, rare; new growth of brown alga, most abundant species.

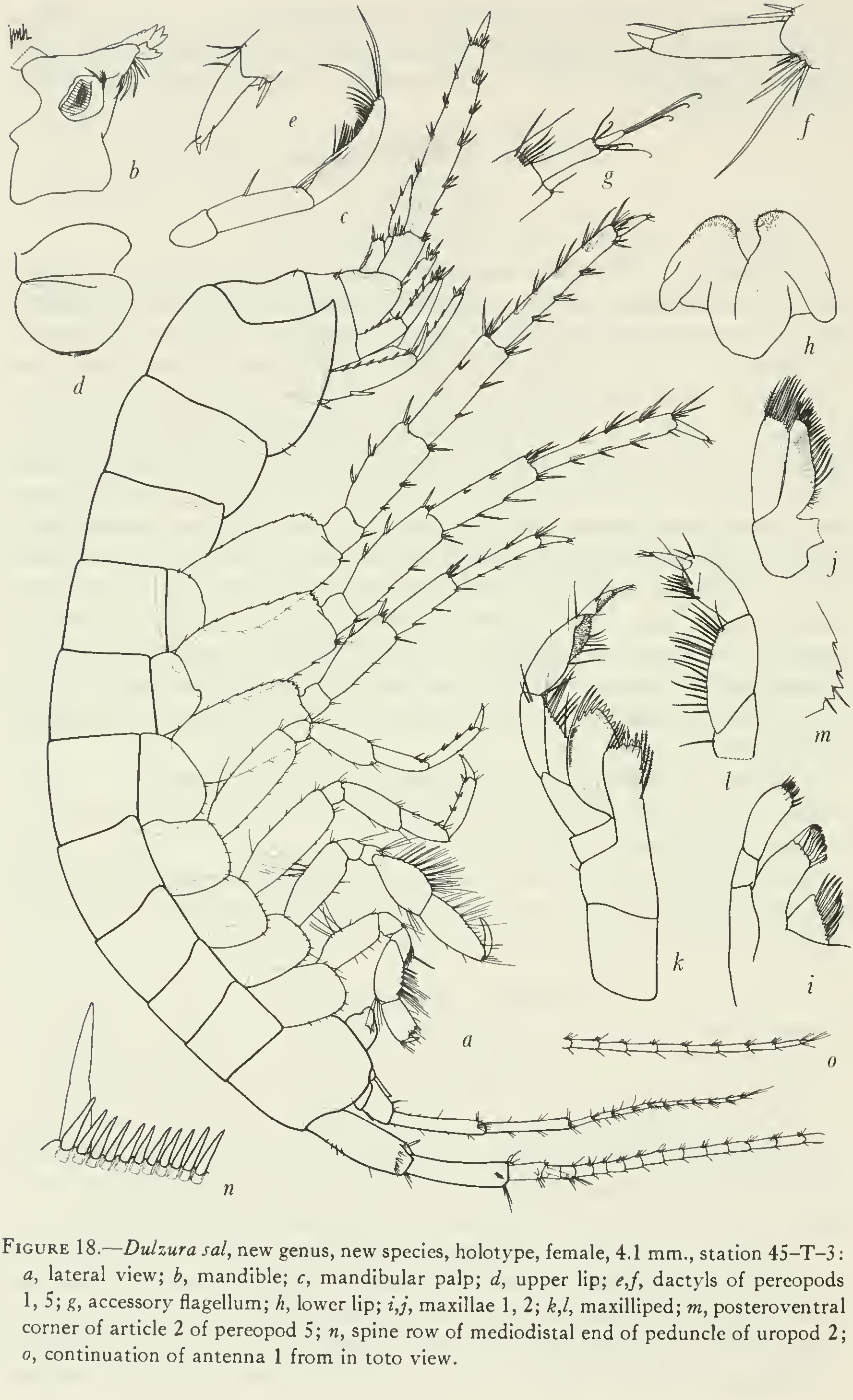

FIGURE 18.—*Dulzura sal*, new genus, new species, holotype, female, 4.1 mm., station 45-T-3: *a*, lateral view; *b*, mandible; *c*, mandibular palp; *d*, upper lip; *e,f*, dactyls of pereopods 1, 5; *g*, accessory flagellum; *h*, lower lip; *i,j*, maxillae 1, 2; *k,l*, maxilliped; *m*, posteroventral corner of article 2 of pereopod 5; *n*, spine row of mediodistal end of peduncle of uropod 2; *o*, continuation of antenna 1 from in toto view.

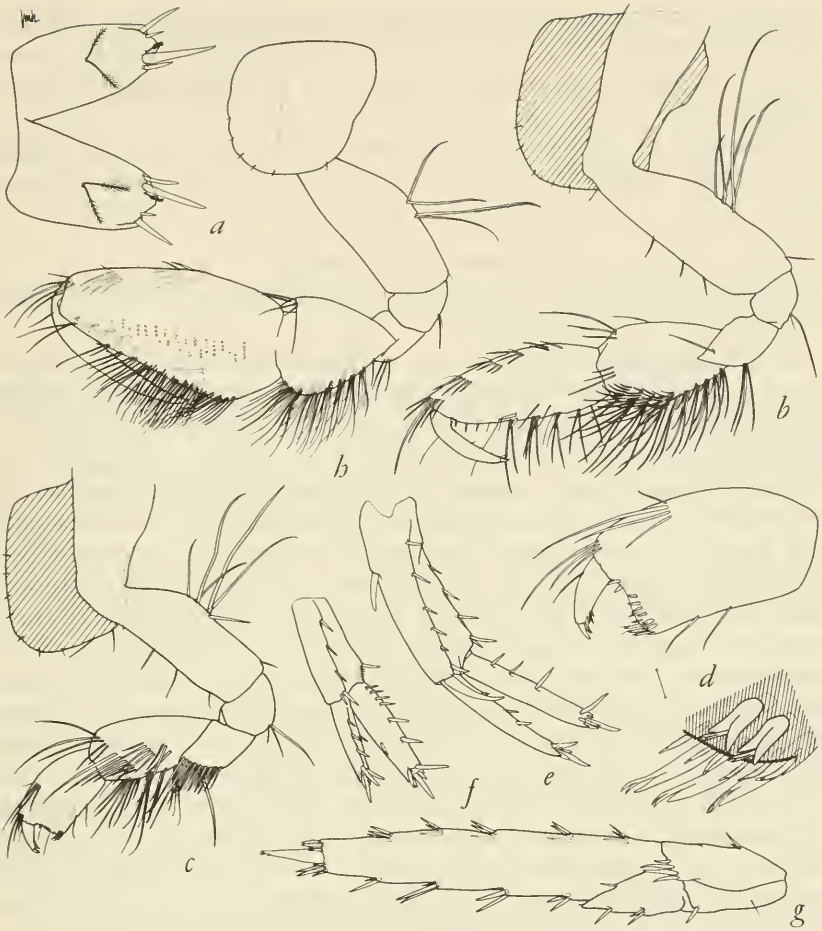

FIGURE 19.—*Dulzura sal*, new genus, new species, holotype, female, 4.1 mm., station 45–T–3: *a*, telson; *b*, gnathopod 2; *c*,*d*, gnathopod 1; *e*,*f*,*g*, uropods 1, 2, 3. Male, 3.9 mm., station 45–P–2; *h*, gnathopod 2.

GOLETA: submerged rock, 8 m., scarce. CORONA DEL MAR: tunicate colonies at base of *Phyllospadix*, abundant. LA JOLLA: *Phyllospadix*-coralline grid, abundant (736 per sq. m.); short-tufted red algae, scarce; coralline algae, moderately abundant.

DISTRIBUTION.—Carmel, California, to Bahía de San Ramón, Baja California, intertidal.

Elasmopus holgurus J. L. Barnard

Elasmopus holgurus J. L. Barnard, 1962b, pp. 91–94, figs. 14, 15.

MATERIAL.—CAYUCOS: *Macrocystis* holdfast, rare; *Amaroucium* sp., abundant; sponge, abundant. HAZARD CANYON: kelp holdfasts, abundant; holdfasts of *Egregia* and *Laminaria*, abundant; sponges, abundant. PT. DUME: *Amaroucium* sp., most abundant species; social sandy tunicates, rare. CORONA DEL MAR: *Phragmatopoma* masses, abundant.

DISTRIBUTION.—Cayucos, California, to north Laguna Beach, intertidal, especially in sponges, tunicates and beds of *Phragmatopoma* sp.

Elasmopus rapax Costa

Elasmopus rapax Costa: J. L. Barnard, 1955a, pp. 10–12, fig. 5 (with literature); 1962b, pp. 94–96, figs. 16, 17.

In the diagnostic key given below are described 6 forms of *Elasmopus rapax* in the California-Mexico region plus two other species of similar morphology, *E. antennatus* (Stout) and *E. holgurus* Barnard. The three forms of couplet 1 are probably "true" *E. rapax;* they have the normal inner ramus of uropod 3. The remainder, *E. holgurus*, *E. antennatus* and *E. rapax mutatus*, are distinguished by the shortened and narrowed inner ramus of uropod 3. Probably *E. antennatus* is a good species because of its lack of palmar processes on male gnathopod 2 but *E. holgurus* has the aspect of *E. rapax*. If *E. holgurus* is to stand as a good species, *E. rapax mutatus* may have to be elevated to full specific status and the other form of *E. rapax* with a short inner ramus may have to be described as a distinct species (*rapax* form II of Bahía de Los Angeles). Even so, three distinct morphs of true *rapax* exist in the region considered and others from extrinsic regions are known from the literature (see later statement). The writer set a precedent by describing *E. holgurus* at specific level, although it is no more distinct from *rapax* than is *E. rapax mutatus*. Rather than confuse the picture more, the writer maintains the status quo by continuing to use *E. rapax mutatus* as a trinomial and erects a trinomial for another subspecies which is so abundant and conspicuous that it requires nomenclatural distinction. Without life history studies it is impossible to determine whether these forms are distinct species, although their predominance in one sample or another indicates they have ecological exclusion.

Key to Californian and Mexican Forms of *Elasmopus rapax* and Related Species of *Elasmopus*

1. Inner ramus of uropod 3 equally as broad and long as outer ramus. In all three forms pereopod 5 has article 2 closely serrate and bearing long setae; palm of male gnathopod 2 with 3 processes, one near hinge, one in middle, and one submarginally at defining corner of palm; palmar setae sparse and evenly scattered; telsonic apices progressively developing into smooth protrusions with spines attached only laterally and decreasing relatively in size and number with age.

A. Palmar process near dactylar hinge on male gnathopod 2 bi- or trifid; tooth at posteroventral corner of third pleonal epimeron small, posterior edge smooth

Elasmopus rapax form I of Bahía de Los Angeles (Barnard, 1962b, fig. 16)

B. Palmar process near dactylar hinge of male gnathopod 2 simple; tooth at posteroventral corner of third pleonal epimeron large, posterior edge serrate

Elasmopus rapax of Alamitos Bay, California (Barnard, 1962b, fig. 17)

C. Palmar process near dactylar hinge of male gnathopod 2 simple, middle palmar tooth immediately adjacent to hinge process; tooth at posteroventral corner of third pleonal epimeron large, posterior edge serrate (some male specimens have gnathopod 2 palm and medial surface of article 6 slightly hollowed as in Elasmopus pocillimanus [Bate])

Elasmopus rapax form I of Tiburon Island ("Velero" sta. 1042)

1. Inner ramus of uropod 3 narrower and shorter than outer ramus **2**

2. Male gnathopod 2 palm bearing only a process near dactylar hinge. Dense palmar setae fully lining palmar margin; telson with narrowly-incised apices and 4–5 spines, medial apices sharp; pereopodal dactyls weakly constricted; pereopod 5 with closely serrate posterior edge bearing tiny setules . . . . . **Elasmopus antennatus** (see J. L. Barnard, 1962b, fig. 12)

2. Male gnathopod 2 palm bearing a middle process **3**

3. Telsonic apices in adults not truncate, incised, with medial portions protruding and subacute, spines short, few (2–3) in number and somewhat displaced laterally.

Male gnathopod 2 with a ridge, not a projecting process at defining corner, dense setae on posterior edge of article 6, not on palm; article 2 of pereopod 5 closely serrate and with minute setules on posterior edge; third pleonal epimeron slightly convex posteriorly, smooth, rounded-quadrate at posteroventral corner; pereopodal dactyls poorly constricted

Elasmopus rapax mutatus J. L. Barnard (1962b, fig. 18)

3. Telsonic apices strongly truncate, broad, bearing 6–8 long spines in adults . **4**

4. Male gnathopod 2 palm defined by projecting process, middle process an asymmetrical cone, setae scattered throughout palm and posterior edge of article 6; third pleonal epimeron of the "antennatus" morphology with moderately upturned tooth at posteroventral corner; pereopodal dactyls weakly constricted; pereopod 5 with posterior edge of article 2 closely serrate, bearing minute setules and an occasional long seta

Elasmopus holgurus J. L. Barnard (1962b, figs. 14, 15)

4. Male gnathopod 2 defined by small ridge bearing one spine, dense setae along posterior edge of article 6 and fully along palm to hinge process; posterior edge of article 2 on pereopod 5 deeply crenuloserrate (like pereopod 4 of Elasmopus pectenicrus [Bate]).

A. Third pleonal epimeron with slightly convex posterior edge, rounded-quadrate at posteroventral corner, sparsely serrate posteriorly; pereopodal dactyls strongly constricted; middle process of male gnathopod 2 palm short, broad, truncate . . . . **Elasmopus rapax serricatus**, n.ssp., of California, Bahía Magdalena and form II of Tiburon Island

B. Third pleonal epimeron of the "antennatus" morphology, posterior edge slightly convex, smooth, with medium-sized posteroventral tooth; pereopodal dactyls moderately constricted; middle palmar process of male gnathopod 2 very long and pointed

Elasmopus rapax form II of Bahía de Los Angeles (SIO–62–216)

280–102 O–69—9

Other Kinds of *Elasmopus rapax* in the Literature

1. Sars, 1895, pl. 183: Norway. Male gnathopod 2 palm with 3 processes, a rounded one at hinge closely adjacent to a narrow conical process, defining corner with a similar conical process; pereopodal dactyls weakly constricted; third pleonal epimeron rounded-quadrate posteriorly and sparsely serrate; article 2 of pereopod 5 poorly serrate and setulose posteriorly, nearly smooth; telsonic apices protruding smoothly medially, with 3 spines displaced laterally; inner ramus of uropod 3 not much shorter than but much narrower than outer.
2. J. L. Barnard, 1955a, fig. 5 and Walker, 1916: Hawaii and Brazil. Male gnathopod 2 palm like that of Sars (1895) but developing into a terminal adult with an additional palmar process on lateral surface of palm, very young specimens having a ridge but not a process at defining corner (like *E.r. mutatus*); telsonic apices either like Sars (1895) or evenly and moderately to broadly incised, with 4 long spines not strongly displaced laterally; second articles of pereopod 5 with or without long setae; an extreme aberrancy occurred on specimens from Honolulu Aquarium, with females duplicating male second gnathopods and with telsonic lobes incised apically. Uropod 3 and pereopodal dactyls not described.
3. Shoemaker, 1933a: Caribbean. Female with uncleft telson.
4. Chevreux and Fage, 1925: France. Like the Alamitos Bay form but article 2 of pereopod 5 lacking setae.

Special material.—Entrada Pt., Bahía Magdalena, Baja California, in algae, May 2, 1950, coll. Dr. John L. Garth and J. L. Barnard (2). "Velero" station 1042, Tiburon Island, Gulf of California, shore, 1940 (2 forms, 15 specimens). "Velero" station 1218, Laguna Beach, California, shore, 1941 (one specimen, *E. rapax serricatus*).

Elasmopus rapax mutatus J. L. Barnard

Elasmopus rapax mutatus J. L. Barnard, 1962b, pp. 96–98, fig. 18.

Material.—carmel: cobble-pelvetiid grid, second most abundant species (350 per sq. m.); coralline algae, abundant. cayucos: *Phyllospadix*-pelvetiid grid, moderately abundant (123 per sq. m.). hazard canyon: algal turf on platform, moderately abundant (97 per sq. m.); kelp holdfasts, abundant; sponge and tunicates, scarce; *Egregia* holdfast, most abundant species. pt. dume: short-tufted brown algae on vertical ledge face, abundant (197 per sq. m.); sandy sponge, very abundant; encrusted holdfast, very abundant. corona del mar: *Phyllospadix*-coralline grid, second most abundant species (3228 per sq. m.); calcareous worm tubes, scarce; red-brown algae below water, moderately abundant; sponge, very abundant. la jolla: short-tufted red algae, very abundant (1060+ per sq. m.); underrock grid, rare.

Elasmopus rapax serricatus, new subspecies

FIGURE 24 j–m

DIAGNOSIS OF MALE.—Accessory flagellum uni- or biarticulate; no body segments dorsally toothed; gnathopod 2 with oblique palm not distinct from posterior margin of article 6, strongly setose its full length adjacent to simple, large hinge process; middle palmar tooth situated just proximal to hinge process, truncate, lamellar, often transparent and difficult to see among dense setae; palm defined by small ridge bearing one spine and also difficult to see; second articles of pereopods 3–4 closely serrate posteriorly, poorly setose, article 2 of pereopod 5 strongly crenuloserrate (as in *E. pectenicrus* [Bate]); pereopodal dactyls moderately to strongly constricted distomedially; third pleonal epimeron like *E. rapax mutatus*, slightly convex posteriorly, posteroventral corner rounded-quadrate, posterior edge very sparsely and minutely serrate; inner ramus of uropod 3 shorter and narrower than outer (as in *E. rapax mutatus*); telson short, with truncate apices armed with 5–8 spines (4 in juveniles). Female with small gnathopod 2, see figure.

HOLOTYPE.—AHF No. 632, male, 8.0 mm.

TYPE LOCALITY.—Station 45–K–1, La Jolla, California, November 11–13, 1962, wash of *Phyllospadix* sp. on second ridge from sea.

RELATIONSHIP.—The preceding diagnostic keys show the relationship of this subspecies. It differs from *E. rapax mutatus* in its strongly crenuloserrate fifth pereopod which develops by increments from a strongly serrate condition in the young, similar to *E. rapax mutatus*. Young individuals may be identified by the truncate telsonic apices having at least 4 spines. Adults of more than one species of *Elasmopus* rarely occur in the survey samples; where so occurring, juveniles have not been specifically identified but for counting purposes split in proportion to adult frequency.

MATERIAL.—CARMEL: *Egregia* stipes, second most abundant species. PT. DUME: short-tufted brown algae on vertical ledge face, scarce (14 per sq. m.). CORONA DEL MAR: *Phyllospadix*-coralline grid, scarce (38+ per sq. m.); loose rocks, scarce; red-brown algae below water, moderately abundant; tunicates and soft polychaete tubes, scarce. LA JOLLA: *Phyllospadix*-coralline grid, third most abundant species (1714 per sq. m.); underrock grid, most abundant species (293 per sq. m.); short-tufted red algae, abundant (988+ per sq. m.); coralline algae, abundant; mixed red algae in tidepool, abundant.

Maera inaequipes (Costa)

Maera inaequipes (Costa): J. L. Barnard, 1959, pp. 25–26, pl. 5.

Positive identification of this Californian taxon will require comparison of growth stages with European topotypical populations.

MATERIAL.—CAYUCOS: *Amaroucium* sp., rare. GOLETA: *Macrocystis* holdfast, 3 m., rare. CORONA DEL MAR: tunicates and polychaete tubes, rare; *Spheciospongia* sp., rare; *Phragmatopoma* masses, moderately abundant. LA JOLLA: *Phyllospadix*-coralline grid, rare (4 per sq. m.).

Maera lupana, new species

FIGURE 20

DIAGNOSIS.—No body segments dorsally dentate; posterior edge of third pleonal epimeron nearly straight, posteroventral corner with small tooth; coxa 1 not serrate ventrally; article 6 of gnathopod 2 nearly twice as long as broad, palm slightly oblique, bearing 2 shallow excavations, 2 short, broad teeth and one tooth defining palm, article 7 with slight inner basal protuberance; no distal articles of pereopods broadened, article 7 with small accessory claw and setae; uropod 3 short, not extending beyond ends of uropods 1–2, with short, broad, but subacute rami; uropods stunted; telson short, each lobe broad and apically notched, both lobules acute, medial shorter and narrower than lateral; flagellar articles of antennae reduced to 4 or 5. Males and females identical. Maximum length, 4.0 mm.

HOLOTYPE.—AHF No. 618, male, 3.2 mm.

TYPE LOCALITY.—Barnard station 41, Goleta, California, July 6, 1961, rhizomes of *Macrocystis pyrifera*, 3 m. (110 specimens).

RELATIONSHIP.—Differing from most other species of *Maera* (see antenna 2 of *M. vigota* herein) by the greatly shortened antennal flagella; related to *M. simile* (Stout, see J. L. Barnard, 1959) and *M. smirnovi* (Bulycheva, 1952) but differing by the short antennae, the less oblique palm of gnathopod 2, and the very much shortened uropods.

MATERIAL.—The type locality, abundant.

Maera simile Stout

Maera simile Stout, 1913, pp. 644–645.—Shoemaker, 1942b, p. 12.—Hewatt, 1946, p. 199.—J. L. Barnard, 1959, pp. 24–25, pl. 4; 1964a, p. 222.

Maera inaequipes: Shoemaker, 1941b, p. 187.—J. L. Barnard, 1954a, pp. 16–18, pls. 16–17 (not Costa, 1851, see Stebbing, 1906, for reference).

Specimens of sample 46–G–8 are aberrant because of the distal amalgamation of the palmar teeth of male gnathopod 2.

MATERIAL.—CARMEL: *Phyllospadix*-pelvetiid grid, rare (5 per sq. m.); tunicates and sponges, rare; *Macrocystis* holdfast, rare. CAYUCOS: buried cobbles, rare; *Macrocystis* holdfast, moderately abundant; *Phyllospadix* roots, rare. HAZARD CANYON: holdfasts of *Egregia* and *Laminaria*, rare. GOLETA: *Macrocystis* holdfast, 3 m., very abundant;

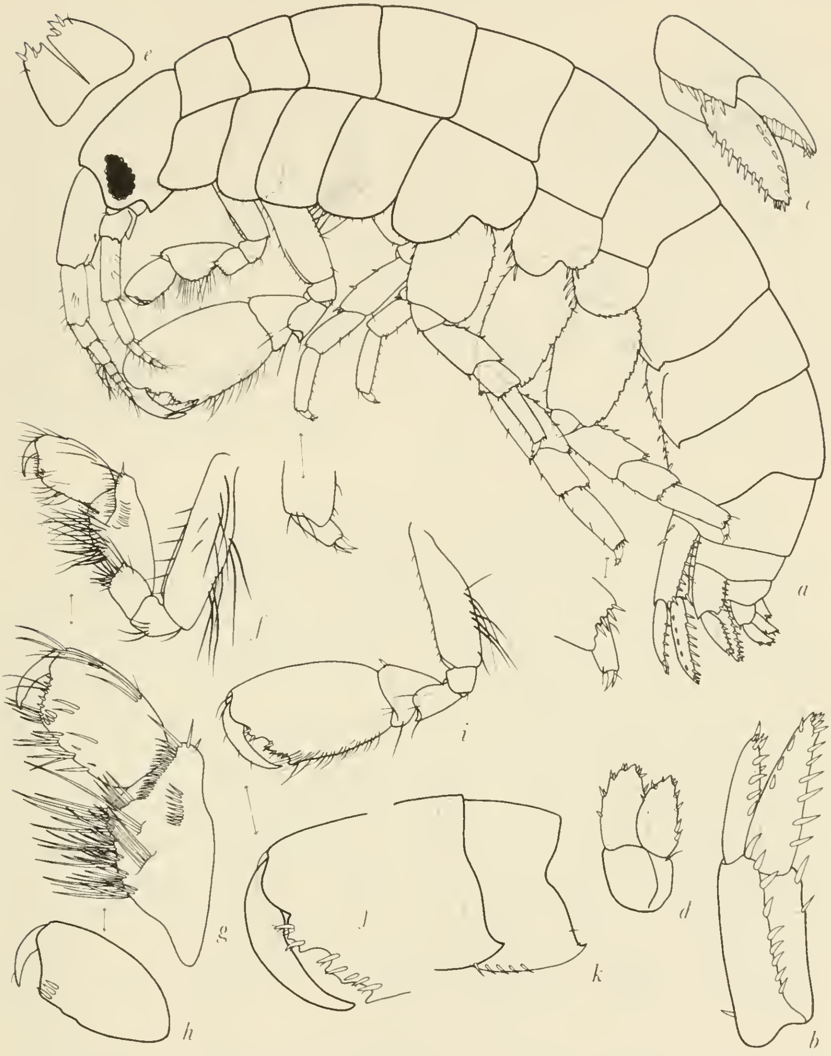

FIGURE 20.—*Maera lupana*, new species, female, 4.0 mm., station 41: *a*, lateral view; *b,c,d*, uropods 1, 2, 3; *e*, telson; *f,g,h*, gnathopod 1; *i,j*, gnathopod 2; *k*, pleonal epimera 2–3, left to right.

submerged log, 8 m., scarce. CORONA DEL MAR: loose rocks, moderately abundant; calcareous worm tubes, scarce; *Phragmatopoma* masses, scarce. LA JOLLA: underrock grid, abundant (88 per sq. m.).

DISTRIBUTION.—Puget Sound, Washington (material in hand) to Bahía de San Quintín, Baja California, 0–43 m.

Maera vigota, new species

FIGURE 21

DIAGNOSIS.—No body segments dorsally dentate; posterior edge of third pleonal epimeron smooth, slightly convex and sinuous, posteroventral corner prolonged into short tooth; coxa 1 not serrate ventrally; article 6 of gnathopod 2 nearly twice as long as broad, palm transverse, with deep excavation at dactylar hinge, remainder of palmar edge slightly concave, prolonged into short tooth at posterior corner, armed with short spines, article 7 with inner basal protuberance; no distal articles of pereopods broadened, article 7 lacking accessory claw but bearing accessory setae; uropod 3 short, scarcely exceeding uropod 2, rami broad, truncate; telson short, each lobe broad and deeply notched apically, medial lobule broader and less acute than lateral; flagellar articles of antenna 2 reduced to about 5. Males and females similar.

HOLOTYPE.—AHF No. 623, female, 8.0 mm.

TYPE LOCALITY.—Barnard station 43–B–2, Cayucos, California, January 5–6, 1962, on cobbles buried under small boulders.

RELATIONSHIP.—This species differs from *Maera pacifica* Schellenberg (1938) by the notched telsonic lobes, the shorter palmar tooth of gnathopod 2 and the absence of accessory claws on the pereopodal dactyls. From *M. rathbunae* Kunkel (1910) the new species differs in the notched telsonic lobes and the deeper palmar notch at the hinge of gnathopod 2. From *M. inaequipes* (Costa), as represented by Chevreux and Fage (1925), it differs by the proximal displacement of the palmar hinge-notch of gnathopod 2 and the lack of an accessory claw on the pereopodal dactyls. *Maera inaequipes,* as represented by J. L. Barnard (1959), may be a distinct taxon differing from the European type by the large lateral lobe and spinosity of article 2 on gnathopod 2 and the poorly notched apices of the telsonic lobes. *Maera vigota* differs from Californian *M.* "inaequipes" by the lack of accessory pereopodal claws, the absence of a distolateral lobe on article 2 of gnathopod 2, the uniformity of the sexes, the equivalent and strongly truncated rami of uropod 3 and the palmar configuration of gnathopod 2. One specimen of *M. inaequipes* from Newport Bay (J. L. Barnard, 1959) has the rami of uropod 3 equal to each other in size and two open sea specimens collected in southern California have also been found in this condition.

MATERIAL.—CARMEL: algal holdfasts, rare. CAYUCOS: buried cobbles, most abundant species; sponge and tunicates, moderately abundant; between apposed rocks and rocks and substrate, partially desiccated, abundant, pink in color.

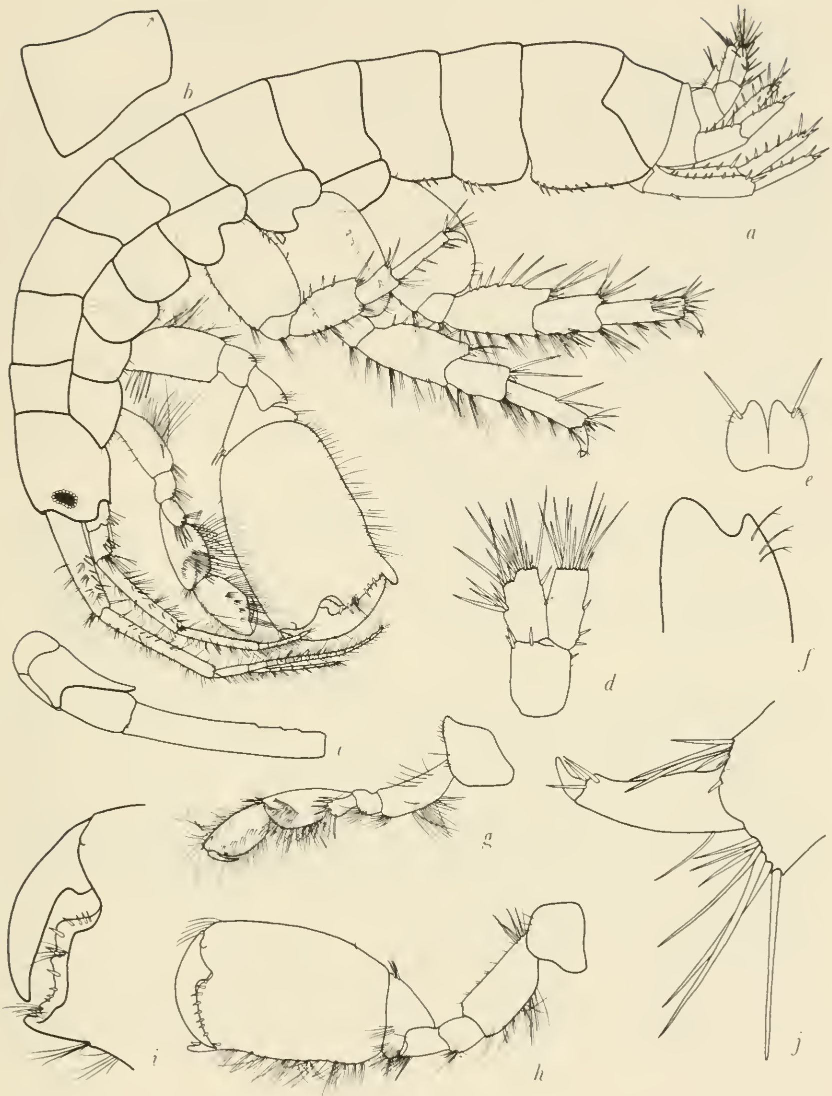

FIGURE 21.—*Maera vigota*, new species, holotype, male, 9.0 mm., station 43–B–2: *a*, lateral view; *b*, pleonal epimeron 2 of right side, arrow indicating posteroventral corner; *c*, base of antenna 2, medial, showing gland cone; *d*, uropod 3; *e*, telson; *f*, apex of one lobe of telson; *g*, gnathopod 1; *h*,*i*, gnathopod 2; *j*, end of pereopod 5.

Megaluropus longimerus Schellenberg

Megaluropus longimerus Schellenberg, 1925, pp. 151–153, fig. 14.—J. L. Barnard, 1962b, p. 103, figs. 20, 21; 1964a, p. 224.

A subspecies of *Megaluropus longimerus* has been described from the Gulf of California by Barnard (1968). The occurrence of subspeciation in the Pacific members of this species suggests that the Pacific population may be distinct from the West African types; unfortunately Schellenberg's material was not figured and minute details cannot be compared.

Material.—hazard canyon: *Phyllospadix*-pelvetiid grid, rare. goleta: *Anthopleura elegantissima* beds, rare.

Distribution in eastern Pacific Ocean.—Hazard Canyon, California to Bahía de San Ramón, Baja California, 0–27 m.; a subspecies is known from Bahía de Los Angeles, Gulf of California.

Melita appendiculata (Say)

Melita appendiculata (Say): Stebbing, 1906, p. 428.—Shoemaker, 1955a, p. 50.
Melita fresneli (Audouin): Stebbing, 1906, p. 423 (with literature).—Shoemaker, 1941b, p. 187.—Hewatt, 1946, p. 204.—J. L. Barnard, 1955a, pp. 13–14.

Material.—goleta: *Macrocystis* holdfast, 3 m., rare.

Distribution.—Tropicopolitan.

Melita dentata (Krøyer)

Melita dentata (Krøyer): Sars, 1895, pp. 513–514, pl. 181, fig. 1.—Walker, 1898, p. 282.—Shoemaker, 1930b, pp. 116–117 (with literature).—Gurjanova, 1951, pp. 749–750, fig. 518.—Shoemaker, 1955a, pp. 49–50.

Specimens from Friday Harbor, Washington, and southern California differ from Sars' drawings by the broader sinus and shorter tooth on the anteroventral corner of the head.

Material.—pt. dume: short brown algae, rare (11 per sq. m.); coralline algae, rare (9 per sq. m.).

Distribution.—Circumpolar subarctic-boreal, in the western Atlantic recorded as far south as Martha's Vineyard, and in the eastern Pacific as far south as Corona del Mar, California; depth range, 0–113 m.

Melita sulca (Stout)

Figures 22, 23

Calinipharqus sulcus Stout, 1913, pp. 641–642.
Melita palmata (Montagu): Shoemaker, 1941b, p. 187.—Hewatt, 1946, p. 199 (not Montagu, see Stebbing, 1906).

Diagnosis.—Urosomal segment 1 with one mediodorsal tooth, urosomal segment 2 with one pair of small dorsolateral teeth on each side, each pair enclosing one seta, all other segments dorsally smooth; male second gnathopodal palm expanded and setose as in *Melita palmata*, dactyl closing on subpalmar medial surface in ter-

FIGURE 22.—*Melita sulca* (Stout), male, 12.0 mm., La Jolla, California, coll. Dr. T. E. Bowman: *a*, lateral view with offset of accessory flagellum (normal and enlarged); *b*, gnathopod 1, medial view with setae, lateral view without setae; *c*, pereopod 3; *d*, uropod 3; *e*, telson. Female, 9.0 mm.: *f*,*g*, gnathopods 1, 2.

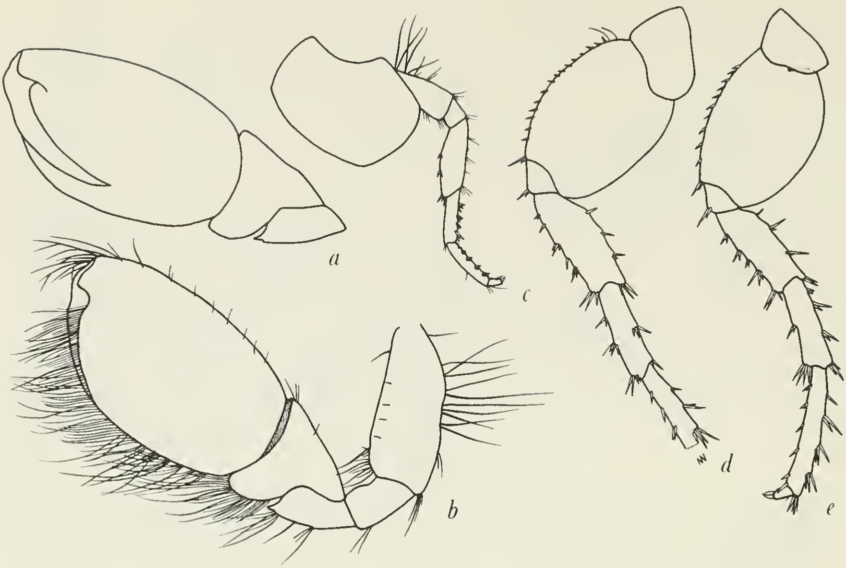

FIGURE 23.—*Melita sulca* (Stout), male, 12.0 mm., La Jolla, California, coll. Dr. T. E. Bowman: *a,b*, gnathopod 1, medial and lateral views; *c,d,e*, pereopods 2, 4, 5.

minal males, palm lacking teeth; gnathopod 1 of male with aberrant melita-form of articles 6 and 7, article 7 malformed; eyes present, dark; article 2 of pereopod 5 not produced posterodistally. Color gray to black.

RELATIONSHIP.—Differing from *Melita palmata* (Montagu) (see Sars, 1895, pl. 179) only by the possession of 4 teeth in 2 pairs on urosomal segment 2, not a single tooth on each side. From its faunistic relative, *M. desdichada* J. L. Barnard (1962b), which it resembles by its pleonal tooth formula, *M. sulca* differs by the aberrant male gnathopod 1 and the "palmata" kind of gnathopod 2.

MATERIAL.—Vicinity of Friday Harbor, Washington, numerous specimens in collections made by Dr. Paul L. Illg and Dr. Erik Dahl, 1951 to 1964; CARMEL: *Macrocystis* holdfast, scarce. CAYUCOS: buried cobbles, rare; in algae collected by Dr. E. Yale Dawson, July 15, 1960.

FIGURE 24.—Miscellaneous figures. *Hyale rubra rubra* (Thomson), station 36, Cedros Island, Baja California, male, 5.8 mm.: *a*, gnathopod 1; *b*, maxillipedal palp; *c*, end of maxillipedal palp article 4; *d*, uropod 3; *e*, dactyl of pereopod 5. *Ericthonius brasiliensis* Dana, station 130 at Bahía de Los Angeles, Baja California, male, 5.5 mm.: *f,g*, pereopods 1, 2; female, 6.5 mm.: *h*, pereopod 2; male, 3.3 mm., station 46–K–3, southern California: *i*, pereopod 1. *Elasmopus rapax serricatus*, new subspecies, station 45–K–1, male, 5.5 mm.: *j*, posterior edge of article 2 of pereopod 5; male, 8.0 mm.: *k*, pereopod 5; *l*, gnathopod 2, palmar setae denser than shown; *m*, telson. *Leucothoides pacifica* J. L. Barnard, female, 2.8 mm., station 48–H–3: *n*, gnathopod 1; *o*, detail of apposed edges of articles 5 and 6 of gnathopod 1; *p*, article 6 of gnathopod 1, enlarged; *q*, palm of gnathopod 2; *r*, gnathopod 2.


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HAZARD CANYON: *Egregia* holdfast, rare. PT. DUME: loose rocks, scarce. PALOS VERDES peninsula, near Bluff Cove, Nov. 11, 1946, coll. Dr. John L. Mohr; Whites Point, near Pt. Fermin, in algae, Oct. 12, 1947, coll. Dr. J. L. Mohr. MORRO BEACH, Orange County, April 4, 1947, coll. Dr. J. L. Mohr. CORONA DEL MAR: underrock substrate, abundant (14 per sq. m.); *Phyllospadix*-coralline grid, scarce (46 per sq. m.); loose rocks, abundant; calcareous worm tubes, abundant; *Phragmatopoma* masses, rare. LA JOLLA: underrock substrate, moderately abundant (38 per sq. m.); north of Bird Rock, tidepool, Nov. 18, 1948, coll. Dr. Thomas E. Bowman. BAJA CALIFORNIA at the following Velero "IV" stations:2022 and 2025, 10 miles W of Pta. Malarrimo, Sebastian Viscaino Bay, 27°49′00″ N, 114°43′00″ W, shore; 2066, Pta. Eugenia, shore; 1265, 2 miles SE of Cedros Island, 55 fath.; 1976, middle San Benito Island, shore, samples 1976 to 2066 coll. by Dr. John S. Garth and J. L. Barnard.

DISTRIBUTION.—Friday Harbor, Washington, to Cedros Island, Baja California, 0–101 m.

Netamelita cortada J. L. Barnard

Netamelita cortada J. L. Barnard, 1962b, p. 113, fig. 23.

MATERIAL.—CORONA DEL MAR: tunicate colonies at base of *Phyllospadix*, rare.

DISTRIBUTION.—Southern California, intertidal to 20 m.

Hyalidae

Allorchestes anceps, new species

FIGURES 25, 26

DIAGNOSIS OF MALE.—Antennae relatively short for an allorchestes, antenna 2 slightly longer than antenna 1, both pairs of antennae bearing dense bundles of short setae; palp of maxilla 1 reaching end of outer plate; article 5 of gnathopod 1 shorter than article 6, posterior lobe symmetrical, broad, apically rounded, article 4 with large, posterodistal process, article 6 relatively stout, slightly expanding distally, posterior edge armed with bundle of setae, palm straight, slightly oblique, defined by 2 stout spines, dactyl slender, weakly curved; gnathopod 2 with article 2 slightly expanding distally and forming a lamellar lateral lobe, posterior lobe of article 5 not curved, slender, posterior edge of article 6 with one setal bundle near palm, posterior edge and palm equal in length; all pereopodal dactyls bearing

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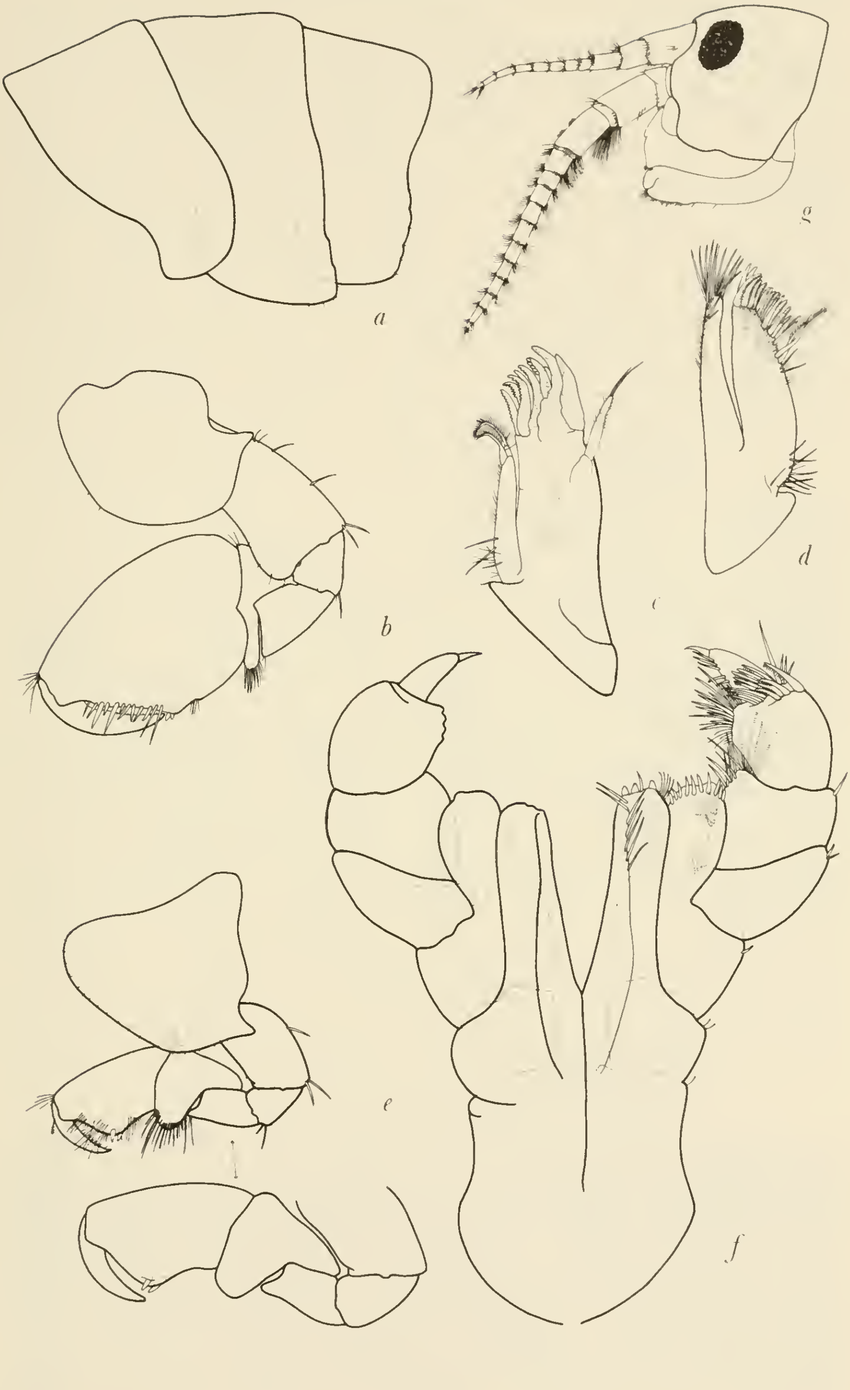
FIGURE 25.—*Allorchestes anceps*, new species, holotype, male, 8.0 mm., station 42–T–5: *a*, pleonal epimera 1–3, left to right; *b*, gnathopod 2; *c,d*, maxillae 1, 2; *e*, gnathopod 1; *f*, maxilliped. Male, 4.6 mm.: *g*, head.


a
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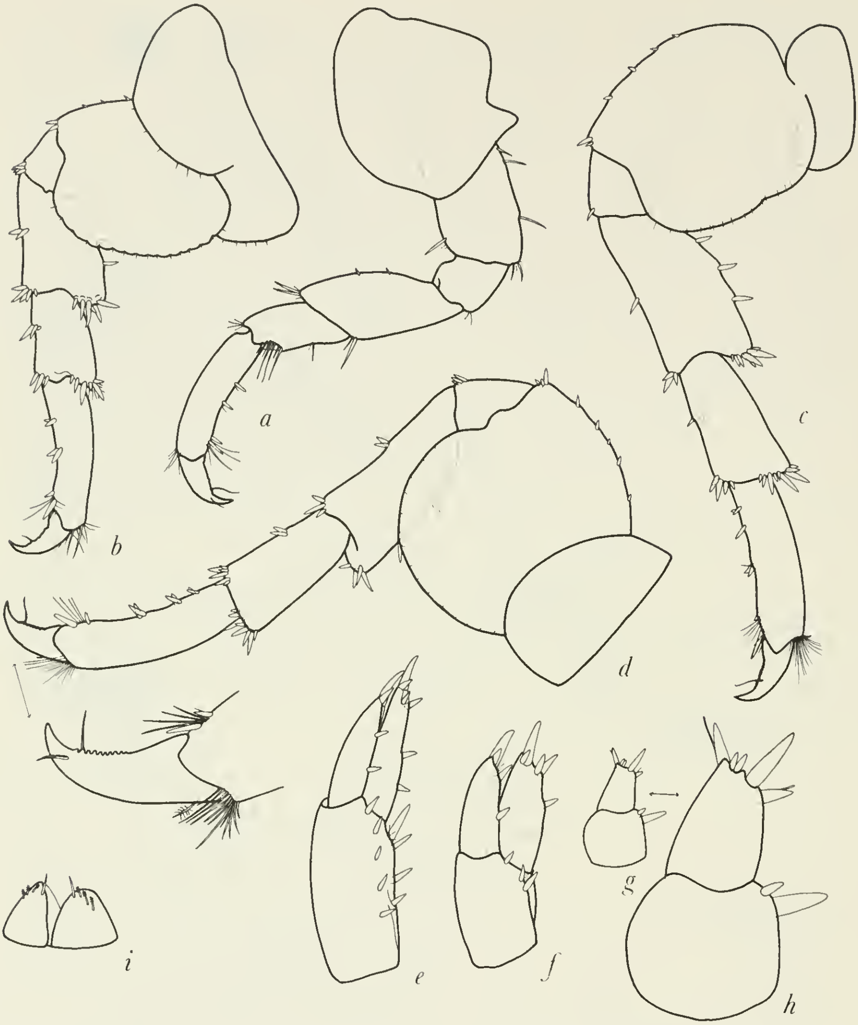

FIGURE 26.—*Allorchestes anceps*, new species, holotype, male, 8.0 mm., station 42-T-5: *a,b,c,d*, pereopods 2, 3, 4, 5; *e,f,g,h*, uropods 1, 2, 3, 3; *i*, telson.

one large inner seta and having inner edge of dactyl minutely castellate; article 5 of pereopods 1–5 much shorter than article 6; article 2 of pereopod 5 nearly circular, not strongly contrasted from second articles of pereopods 3–4; all pereopods with simple, well developed distal spine on article 6; pleonal epimeron 2 slightly protruding at posteroventral corner, but subquadrate; pleonal epimeron 3 slightly convex posteriorly, minutely notched, posteroventral corner subquadrate; uropods 1–3 short, stout, mediodistal spine of uropod 1 peduncle scarcely enlarged, peduncle of uropod 3 with 2 spines;

apices of telson somewhat blunt; coxae 1–4 with large posterior cusps.

Adult females have not been collected. Juveniles have poorly developed setal bundles on the antennae. Females may be difficult to separate from *Hyale grandicornis* but the third uropods should be comparable to those of male *A. anceps*.

Holotype.—AHF No. 619, male, 8.0 mm.

Type locality.—Barnard station 42–T–5, Hazard Canyon Reef, wash of *Egregia* holdfasts, December 8–9, 1961.

Relationship.—This species differs from *Allorchestes plumicornis* (Heller), as figured in Chevreux and Fage (1925), by the relatively equal, short antennae, the shorter and sparser setal bundles of antenna 2, the short fifth articles of the pereopods, the shape of the third pleonal epimeron, the circular shape of article 2 on pereopod 5, the shorter article 5 of gnathopod 1 having a distinct posterior lobe (male), and the larger posterior cusps of the anterior coxae.

Allorchestes plumicornis, as identified by Iwasa (1939) from Japan, appears to be distinct from the Mediterranean *A. plumicornis*, especially in the shape of article 2 on pereopod 5, the shape of gnathopod 1 in the male, especially the more slender dactyl, and the more equally proportionate antennae. Iwasa's specimens may represent *Allorchestes penicillatus* Stimpson (1855, see Stebbing, 1906, for reference), described also from Japan. The present species differs from Iwasa's depiction by the shape of article 2 on pereopod 5, which in Iwasa's material has a suboval lobe distally projecting rather strongly, by the short fifth articles of the pereopods, the larger cusps on the anterior coxae, the less sharply produced pleonal epimera, the smaller medial spine on the peduncle of uropod 1, the stronger inner castellations of the pereopodal dactyls, which apparently are only faintly suggested on Iwasa's diagrams, and by the larger process on article 4 of male gnathopod 1.

Material.—carmel: cobble-pelvetiid grid, abundant (50 per sq. m.). cayucos: *Phyllospadix*-pelvetiid grid, rare. hazard canyon: especially abundant on wave-dashed algal turf platform (30–60 per sq. m.).

Hyale grandicornis californica, new subspecies

Figures 27, 28

Diagnosis.—Eyes very large, black, nearly meeting dorsally; antenna 1 reaching about to end of first, or as much as third, flagellar article of antenna 2, flagellum of antenna 1 slightly longer than peduncle; antenna 2 less than half as long as body, flagellum slightly longer than peduncle, article 5 of peduncle about one third again as long as article 4; palp of maxilla 1 exceeding spine bases of outer plate; maxillipedal palp somewhat stouter than shown by Hurley

FIGURE 27.—*Hyale grandicornis californica*, new subspecies, holotype, male, 6.3 mm., station 42–E–2: *a*, head; *b,c*, gnathopods 1, 2; *d*, pleonal epimera 1–3, left to right; *e*, coxa 1; *f,g,h*, pereopods 3, 4, 5; *i,j,k,l*, ends of pereopods 2, 3, 5, 4 (latter turned to show spines and setal groups of article 6); *m*, uropod 3; *n,o*, pereopods 2, 1.

FIGURE 28.—*Hyale grandicornis californica*, new subspecies, male, 6.3 mm., station 42–E–2: *a,b,c*, uropods 1, 2, 3; *d*, gnathopod 1; *e*, end of maxillipedal palp; *f*, telson. Female, 6.2 mm.: *g,h*, gnathopod 1; *i,j*, gnathopod 2.

(1957, figs. 1–5), apical spine of article 4 stronger; coxae 1–4 with well defined but poorly projecting posterior cusps; article 5 of gnathopod 1 with blunt, projecting lobe of medium width, article 6 rectangular, not noticeably expanding distally, midposterior edge with declivity armed with setae sufficiently concentrated so as not to blend with those of palm, dactyl fitting palm; posterior edge of article 6 of male gnathopod 2 scarcely more than half as long as palm, article 6 not tapering distally, medial surface of article 6 near proximal end of palm with slight hollow and submarginal spinal armature, dactyl fitting palm, article 2 slightly expanded rectangularly at distal end; dactyls of all pereopods each bearing one large marginal seta faintly striate at base, portions of dactyls striate and with extremely minute castellations proximal to large seta, apices of dactyls with nail armed with minute seta, posterior edges of sixth articles of pereopods 1–2 with proximal setular armature, one subdistal group of setae and one spine, and one small distal spine, none of these spines conspicuously striate or enlarged; pereopods 3–5 with proximal, posterior spinal groups in addition to those described for pereopods 1–2; posterior edges of second articles of pereopods 3–5 slightly serrate, posterior edge of pereopod 4 lacking "fur", posterodistal edge on pereopod 5 perfectly rounded; posterior spines of fourth articles of pereopods 3–5 not intermingled with setae; first pleonal epimeron rounded behind, with bluntly quadrate posteroventral corner, second epimeron with sinuate posterior edge and bluntly projecting ventral tooth, third epimeron also sinuate but ventral tooth obsolescent; uropod 1 lacking interramal spine, outer ramus with 2–3 marginal spines and several apical spines, uropod 2 with 1–2 marginal spines on outer ramus, uropod 3 with ramus (not including apical spines) slightly shorter than peduncle, ramus with one subdistal, lateral spine; mouthparts otherwise as described by Hurley (1957). Female gnathopods as figured.

Holotype.—AHF No. 6110, male, 6.3 mm.

Type locality.—Barnard station 42–E–2, Hazard Canyon reef, flat platform 0.66 m. above surge channel, December 8–9, 1961.

Relationship.—The types of *Hyale grandicornis* (Krøyer) from Valparaiso, Chile, were examined and redescribed by Stephensen (1949). Without the work of Hurley (1957) and reference to Iwasa (1939) the present material would have been described as a new species, rather than as a subspecies of *H. grandicornis*. The types are very distinct in their possession of a furry posterior edge on article 2 of pereopod 4, the nearly straight posterior edges of the second and third pleonal epimera, the weakly pointed posterior cusps of the first four coxae, the short fifth article of pereopod 4, the elongated hand of the first gnathopod having its posterior setae widely spread, the absence of marginal spines on the outer rami of uropods 1–2 and the absence of a subdistal spine on the ramus of uropod 3. Hurley's *H. grandicornis* f. *novizealandiae* differs from the Valparaisan material in all of these characters except possibly the sharp coxal cusps. He found, however, a forma *thomsoni* which has a furry pereopod 4, only one marginal spine on the outer rami of uropods 1–2 and no subdistal spine on the ramus of uropod 3. He united *H. novizealandiae* with *H. grandicornis* through this form. Stephensen also was of the opinion that his specimens, from Tristan da Cunha, which lack fur on pereopod 4 but have the broader spread of posterior setae on gnathopod 1, sharper cusps on the coxae, a slightly shorter first antenna combined with no spines on the outer uropodal rami, were assignable to *H. grandicornis*.

Other problems also were noted by Stephensen. He was of the opinion (as evidenced by his synonymy) that Iwasa's *H. novizealandiae* might not belong with *H. grandicornis*, in view of the absence of "fur" on pereopod 4, of spines on the outer rami of uropods 1–2 and of the strongly tapering hand of male gnathopod 2. Stephensen had New Zealand specimens which he also rejected from *H. grandicornis* on the basis of a longer first antenna, a longer dactyl of gnathopod 1 (this is unclear to the writer), the lack of fur on the posterior edge of pereopod 4, and, indeed, the absence of spines on the outer rami of the uropods. But Stephensen already had included in *H. grandicornis* his Tristan specimens lacking pereopodal fur.

One point not considered by earlier workers is the very sharp posterodistal corner of article 2 on pereopod 5 which is characteristic of the type specimens figured by Stephensen. He writes that the Tristan specimens have that article more strongly rounded below than in the types; Hurley's figure of f. *novizealandiae* has it rounded and the present specimens as well as those of Iwasa have it perfectly rounded. Hurley does not mention its condition in f. *thomsoni*.

The specimens at hand are very like those figured by Iwasa, with remarkable similarity in the third uropods, the pleonal epimera, maxillae 1–2, the pereopods, and in some characters of the gnathopods. However, article 6 of the male second gnathopod in Iwasa's figure tapers considerably, the male first gnathopod has the posterior setae of article 6 located more distally and nearly at the palmar corner (the female gnathopod is more like the representation herein), and the coxal cusps are slightly sharper.

The various forms assignable to *H. grandicornis* seem to be divisible into at least two groups: (1) the *novizealandiae* form of New Zealand, Japan, and California, lacking fur on pereopod 4, with a strongly rounded ventral edge of article 2 on pereopod 5, spines occurring on the outer rami of uropods 1–2, the presence of a subdistal spine on the ramus of uropod 3, strongly sinuous second and third pleonal epimera; and (2) the *grandicornis* form of Chile, combining fur on pereopod 4 with no marginal spines on the outer rami of the uropods, straight or scarcely sinuous second and third pleonal epimera, and the absence of a subdistal spine on the ramus of uropod 3. A *grandicornis*-like form also occurs in New Zealand, and one might speculate whether it exists there as a sibling species. South Africa apparently has a *novizealandiae* form (K. H. Barnard, 1916) which may have gene flow with the *grandicornis* form because of the frequent mixture of spines and setae on the fourth articles of pereopods 3–5. A good intermediate form with *grandicornis*-like gnathopods combined with *novizealandiae* pereopods occurs at Tristan da Cunha. Two major cycles in gene distribution may occur in this species complex, a great circle among Japan, California, and New Zealand and a circum-antiboreal cycle among New Zealand, South America, and South Africa (with Tristan da Cunha individuals showing a stronger tie to South America than to South Africa). The South African *novizealandiae* forms may be related to a continuation of the Japan-California circle which has been carried westward through the Indian Ocean. More study of the possible co-occurrence of phenotypes is required in South America and Japan as well as California. Collections from California do not reveal a *grandicornis* form and, strangely, the specimens at hand are extremely few in comparison to the enormously abundant *Hyale rubra frequens*.

Material.—carmel: cobble-pelvetiid grid, second most abundant species (54 per sq. m.); *Ulva* sp., present. hazard canyon: algal turf, moderately abundant (30 per sq. m.). playa del rey lagoon (near Santa Monica), November 14, 1960 (9 specimens). la jolla: goose-neck barnacles, present.

Distribution.—Carmel, California to La Jolla; so rarely occurring south of Pt. Conception that presumably the species is assignable to the Oregonian province.

Hyale plumulosa (Stimpson)

Hyale plumulosa (Stimpson): Thorsteinson, 1941, pp. 55–56, pl. 1, figs. 10–15.

Material.—hazard canyon: algal turf, rare (11 per sq. m.).

Hyale rubra rubra (Thomson)

Figure 24 a–e

Hyale rubra (Thomson): Hurley, 1957, pp. 910–913, figs. 30–50 (with synonymy).

These few specimens are like *H. rubra frequens* as described below, with similar gnathopod 2, and with a general aspect almost identical to that figured by J. L. Barnard (1962c) except as follows: all pereopods with distalmost spine on article 6 faintly striate, posterior setal row on article 6 of gnathopod 1 broadly spread, setae longer, ramus of uropod 3 slightly shorter and apex of maxillipedal palp article 4 with a bundle of long setae. These characters correspond to those figured for *H. rubra* by Hurley (1957).

Material.—Barnard station 36, Cedros Island, Baja California, 2 miles southeast of north point, March 21, 1959, 1 specimen in intertidal wash of *Phyllospadix* sp. "Velero III" station 1370, White Cove, Santa Catalina Island, southern California, kelp holdfasts on shore north of pier, June 20, 1941, 2 specimens.

Hyale rubra frequens (Stout), new combination

Hyale rubra (Thomson): Hurley, 1957, pp. 910–913, figs. 30–50 (with synonymy).
Allorchestes frequens Stout, 1913, pp. 650–651.
Hyale nigra (Haswell): J. L. Barnard, 1962c, pp. 153–156, figs. 19, 20 (not Haswell, 1880 nor other references to *H. nigra* and *H. niger*).

No definite assignment of *H. nigra* to *H. rubra* is made except for the *H. frequens* component listed by Barnard (1962c), although *H. nigra* as shown sketchily by Schellenberg (1928), by Haswell (1880), and described by Stebbing (1906) probably represent *H. rubra* also.

Diagnosis.—Differing from the New Zealand subspecies as reviewed by Hurley (1957) in the following characters: dactyli of pereopods 1–5 very minutely serrated; only the distalmost spine of article 6 of pereopods 1–5 very minutely striated; article 2 of male gnathopod 2 stouter distally; posterior setae of article 6 on female gnathopods 1–2 and male gnathopod 1 less abundant and more sharply confined to a narrow space; distal setae of article 4 of maxillipedal palp shorter; ramus of uropod 3 very slightly longer.

Barnard (1962c) synonymized *Hyale frequens* (Stout, 1913) with *Hyale nigra* Haswell (1880) on the basis of Schellenberg's (1928) review of the latter. Further study of *H. frequens* in comparison with *H. rubra* (Thomson), as reviewed by Hurley (1957), reveals such a close identity that it is proposed to establish *H. frequens* as a subspecies of that entity. *Hyale nigra* also may be identical to *H. rubra.* Indeed, *H. nigra* is not well known, not having been reviewed from its type area, east Australia, except presumably by Stebbing (1906) who added sufficient detail to make one believe he saw specimens of the species. Schellenberg (1928) also examined specimens of *H. nigra* from Australia. That slight differences of male gnathopod 2 occurring between *H. rubra* and *H. nigra,* as stated by Stebbing, are valid, is tempered by the knowledge that mounting positions of the appendage can vary.

The distinctions between individuals of the Californian *Hyale* presumed to be *H. frequens* Stout, and Hurley's figures are minor but of sufficient degree to warrant subspecific allocation. The individuals are contrasted to a single male collected at Cedros Island, Baja California, reported above, which is assigned to *Hyale rubra rubra.*

Hyale camptonyx (Heller), as figured by Chevreux (1911) and Chevreux and Fage (1925), is a difficult species to assess in light of variations occurring in pereopod 5 and the maxillipedal dactyl by various authors. That species must be clarified in relation to Hurley's analysis of *H. rubra.*

Hyale schmidti (Heller), as figured by Chevreux (1900) under the name *H. camptonyx* and by Chevreux (1911) and Chevreux and Fage (1925), differs from *H. camptonyx* and *H. rubra* apparently by the short apical setae of the maxillipedal dactyl, although there are indications in the 1925 paper that the apical setae were cut off in the printing of the figure. Gnathopod 1 of the male is drawn very differently in the several papers. Possibly this led Iwasa (1939) to identify some Japanese specimens with *H. schmidti* but if the representation of Chevreux and Fage is correct the two populations are quite different. Iwasa's specimens have most of the aspects of *H. rubra* as figured by Hurley (1957) except for the male first gnathopod which in Japanese specimens has a stouter base of article 6 and a much narrower posterior lobe of article 5. In several ways Iwasa's material is better identified with *H. camptonyx*, but from those species already mentioned it differs by the shorter second male antenna and from *H. rubra* by the poorly developed coxal cusps, narrower lobes of the fifth articles of the female gnathopods, the narrower space occupied by the posterior setae of the sixth articles and the occurrence of a double set of setae on female gnathopod 2.

MATERIAL.—CARMEL: cobble-pelvetiid grid, fourth most abundant species (20 per sq. m.); *Phyllospadix*-pelvetiid grid, most abundant species (365 per sq. m.); algal holdfasts, most abundant species; coralline algae, abundant; *Postelsia* stipe, abundant; *Ulva* sp., present; tunicates and sponges, abundant. CAYUCOS: *Phyllospadix*-pelvetiid grid, most abundant species (7507 per sq. m.); *Macrocystis* holdfast, rare; buried cobbles, rare; soft polychaete tubes, rare; sponge, rare; *Amaroucium* sp., abundant. HAZARD CANYON: kelp holdfasts, most abundant species; algal turf on platform, second most abundant species (419 per sq. m.); *Egregia* stipes, most abundant species; coralline algae, most abundant species. GOLETA: *Phyllospadix*-pelvetiid grid, most abundant species (10,300 per sq. m.); *Anthopleura elegantissima* bed, most abundant species (but low in density); *Egregia laevigata*, abundant. PT. DUME: brown algae, most abundant species (4355 per sq. m.); coralline algae, most abundant species (10,400 per sq. m.); pelvetiid zone, most abundant species (1360 per sq. m.); short-tufted brown algae on vertical face, second most abundant species (202 per sq. m.); *Phragmatopoma* masses, fourth most abundant species (147 per sq. m.); *Amaroucium* sp., rare; loose rocks, abundant; *Egregia* holdfast, most abundant species, stipes also most abundant species; sandy social tunicates, rare; sponge, rare. CORONA DEL MAR: *Phyllospadix*-coralline grid, most abundant species (9100 per sq. m.); loose rocks, most abundant species; *Egregia* stipes, most abundant species; tunicates, rare; sponge, rare. LA JOLLA: *Phyllospadix*-coralline grid, most abundant species (4890 per sq. m.); underrock substrate, eighth most abundant species (54 per sq. m.); short-tufted red algae on pitted substrate, most abundant species (13,350 per sq. m.); sand-inundated algae at high tide line, most abundant species (16,100 per sq. m.); coralline algae, most abundant species; sponge, rare.

DISTRIBUTION.—Oregon; Monterey Bay to La Jolla, California, associated with plants, the most abundant intertidal species of amphipod.

Najna ?consiliorum Derzhavin

Najna ?consiliorum Derzhavin: J. L. Barnard, 1962c, pp. 157–160, figs. 21, 22.

MATERIAL.—CARMEL: algal holdfasts, scarce; *Egregia* stipes, moderately abundant; *Postelsia* stipe, rare; *Macrocystis* stipe, rare. HAZARD CANYON: *Egregia* stipes, rare.

Parallorchestes ochotensis (Brandt)

Allorchestes ochotensis Brandt: Holmes, 1904b, pp. 233–234, fig. 118.

Parallorchestes ochotensis: Shoemaker, 1941a, pp. 184–185.—J. L. Barnard, 1952a. pp. 23–24, pl. 5, fig. 1; 1954a, p. 24.

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

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

MATERIAL.—CARMEL: *Phyllospadix*-pelvetiid grid, moderately abundant (85 per sq. m.). CAYUCOS: *Phyllospadix*-pelvetiid grid, abundant (727 per sq. m.); shell fragments, rare; new growth of brown algae, moderately abundant. HAZARD CANYON: algal turf on platform, moderately abundant (105 per sq. m.); coralline algae, rare; *Egregia-Laminaria* holdfasts, scarce; *Phyllospadix* on sand, abundant; *Rhodomela laryx*, very abundant. PT. DUME: short brown algae, abundant to most abundant species (167, 340, and 1200 per sq. m.); coralline algae, moderately abundant (555 per sq. m.); *Phragmatopoma* masses, rare (15 per sq. m.); loose rocks, rare; *Egregia* holdfasts, moderately abundant.

DISTRIBUTION.—Okhotsk Sea, Kurile Islands, Alaska; Pacific coast of America south to Laguna Beach, California.

Isaeidae (=Photidae)

Cheiriphotis megacheles (Giles)

Cheiriphotis megacheles (Giles): J. L. Barnard, 1962a, p. 17, fig. 4 (with literature); 1964a, p. 237.

MATERIAL.—CAYUCOS: *Phyllospadix*-pelvetiid grid, abundant (239 per sq. m.); *Laminaria*-corallines, rare. PT. DUME: brown algae on vertical face, rare (?). CORONA DEL MAR: loose rocks, rare; *Phragmatopoma* masses, rare; tunicates and soft polychaete tubes, rare. LA JOLLA: underrock substrate, fourth most abundant species (92 per sq. m.); *Phyllospadix*-coralline grid, scarce (90 per sq. m.); coralline algae, scarce; sponge and tunicates, most abundant species.

Distribution.—Tropical Indo-Pacific with northern limit in eastern Pacific at Cayucos, California.

Chevalia aviculae Walker

Chevalia aviculae Walker: J. L. Barnard, 1962a, pp. 17–20, fig. 5 (with literature); 1964a, p. 236.

Material.—cayucos: *Phyllospadix*-pelvetiid grid, scarce (62 per sq. m.); *Macrocystis* holdfast, moderately abundant; sand under boulder, rare; *Phyllospadix* roots, scarce. goleta: *Macrocystis* holdfast, 3 m., abundant; submerged log, 8 m., rare.

Distribution.—Tropicopolitan, occurring haphazardly in southern California as far north as Cayucos, California.

Eurystheus mamolus (J. L. Barnard,) new combination

Figures 29, 30

Megamphopus mamolus J. L. Barnard, 1962a, pp. 23–26, fig. 9.

This species is transferred to *Eurystheus* now that specimens with first antennae have been collected. The accessory flagellum has 3 articles. This shift in classification again points to the provisional but unsatisfactory arrangement of various photid (=isaeid) genera as reviewed and revised by Barnard (1962a). Better detail of some of the appendages, especially pereopod 3, is figured herein. Females are difficult to identify and are far more numerous than males which are easy to recognize by their distinctive, posteriorly-lobed second coxae. Article 2 of the male first pereopod becomes thickened and lobate distally in contradistinction to the second male pereopod and both pereopods 1 and 2 of females.

Material.—goleta: submerged log, 8 m., scarce; *Macrocystis* holdfast, 3 m., abundant.

Distribution.—Monterey Bay to Goleta, California, 3–25 m.

Eurystheus spinosus Shoemaker

Figure 31

Eurystheus spinosus Shoemaker, 1942b, pp. 30–32, fig. 11.

All specimens lack antennae and pereopod 5 and most of the specimens lack all of pereopods 3–5. They are difficult to separate from females and juveniles of *Megamphopus martesia* J. L. Barnard (1964a). Male pereopod 3, having an expanded and strongly spinose article 4, is very distinctive. On females the article is less expanded, poorly spinose, and more like that of *M. martesia*. The eyes of adult *M. martesia* are very large but in the questionable youthful specimens from Baja California, identified by Barnard (1964a), the eyes approx-

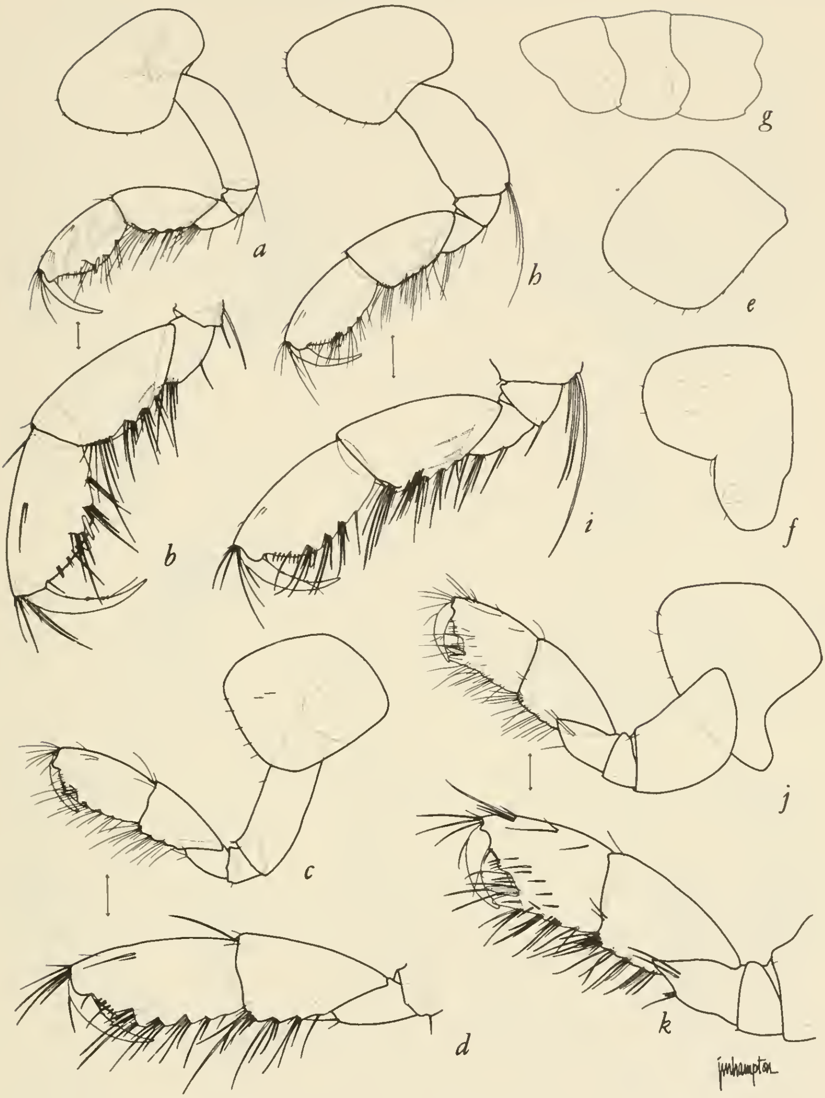

FIGURE 29.—*Eurystheus mamolus* (J. L. Barnard), female, 3.4 mm., Campbell station 5: *a*, *b*, gnathopod 1; *c*, *d*, gnathopod 2; *e*, *f*, coxae 4, 5; *g*, pleonal epimera 1–3, left to right. Male, 3.2 mm.: *h*, *i*, gnathopod 1; *j*, *k*, gnathopod 2.

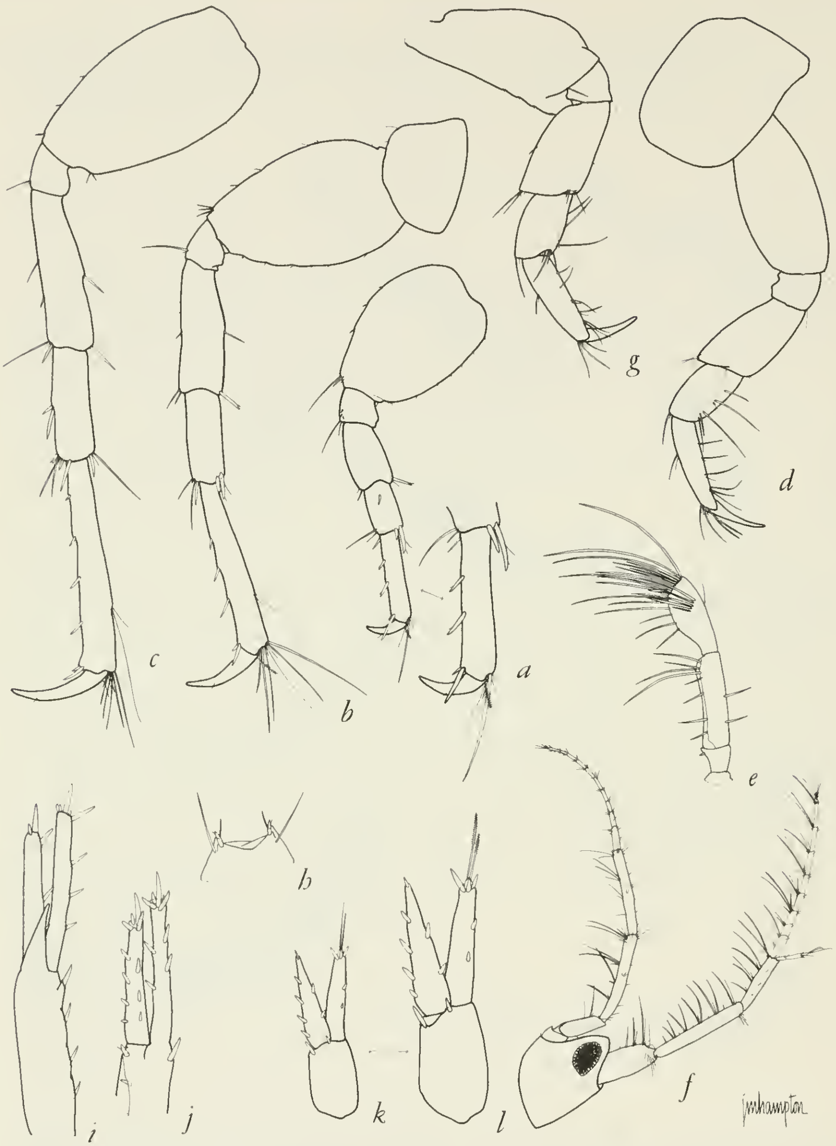

FIGURE 30.—*Eurystheus mamolus* (J. L. Barnard), female, 3.4 mm., Campbell station 5: *a*, *b*, *c*, pereopods 3, 4, 5; *d*, pereopod 1; *e*, mandibular palp; *f*, head. Male, 3.2 mm.: *g*, pereopod 1; *h*, telson; *i*, *j*, *k*, *l*, uropods 1, 2, 3, 3.

imate those of *E. spinosus* as figured herein and by Shoemaker. The epistome of adult *M. martesia* is strongly attenuated but that of *E. spinosus* is much shorter and blunter; in young *M. martesia*, as identified by Barnard (1964a), the epistome is intermediate in attenuation

FIGURE 31.—*Eurystheus spinosus* Shoemaker, male, 2.8 mm., station 38–A–2: *a*, pereopod 1; *b*, pereopod 3, minus coxa; *c*, right gnathopod 2, medial view; *d*, left gnathopod 2, lateral view; *e*, ventrodistal end of outer ramus of uropod 1; *f*, *g*, *h*, uropods 1, 2, 3; *i*, head and epistome-upper lip complex; *j*, enlarged view of posterior edge of pleonal epimeron 3.

and sharpness. The gnathopods of some young individuals of *M. martesia* are like those of *E. spinosus* and some of the former specimens may have been misidentified because of this similarity. The third uropods of *M. martesia* appear to have longer, more slender rami than those of *E. spinosus*, but without dissecting and mounting the uropods in precisely replicated planes this characteristic is not useful for identification. Because the writer is not satisfied with the identifications of all specimens in both species he has not removed the uropods in anticipation that further study of large suites of adults of the two species will reveal other, more reliable characters.

There is no evidence that *M. martesia* is the terminal adult of *E. spinosus*. Transformation of male gnathopod 2 from one condition to the other would be of extraordinary degree but this situation must be considered. Because the only specimen of *M. martesia* having a first antenna is identified with reservations, the generic allocation must remain dubious also.

Material.—cayucos: *Phyllospadix*-pelvetiid grid, abundant (209 per sq. m.); soft polychaete tubes, rare; sponge, moderately abundant; *Amaroucium* sp., scarce.

Distribution.—A southern species, described from Bahía Magdalena, Baja California, apparently with its northern limits at Cayucos, California; not collected in southern California, its abundance at Cayucos possibly resulting from sea warming of the late 1950's or its existence as a northern disjunct.

Eurystheus thompsoni (Walker)

Eurystheus thompsoni (Walker): Shoemaker, 1955b, p. 59 (with synonymy).—J. L. Barnard, 1959, p. 36, pl. 11; 1961, p. 182.

Material.—carmel: algal holdfasts, rare; tunicates and sponges, rare. cayucos: *Phyllospadix*-pelvetiid grid, scarce (168 per sq. m.); buried cobbles, scarce; *Macrocystis* holdfast, abundant; sponge, rare. hazard canyon: kelp holdfasts, moderately abundant; algal turf, rare; *Egregia-Laminaria* holdfasts, moderately abundant; sponge, scarce. goleta: *Macrocystis* holdfast, 3 m., abundant. pt. dume: loose rocks, rare; sandy social tunicates, rare. corona del mar: *Phyllospadix*-coralline grid, rare (12 per sq. m.); loose rocks, rare; calcareous worm tubes, moderately abundant; *Egregia* stipe, rare; soft polychaete tubes, scarce; *Laminaria* holdfast, scarce; *Phragmatopoma* masses, scarce; tunicates, scarce; *Phragmatopoma* masses, most abundant species. la jolla: underrock grid, rare.

Distribution.—A cold-temperate species of northeastern Pacific, rare in intertidal of southern California, but moderately abundant on coastal shelf benthos; Puget Sound, Washington, to the Gulf of California, in southern Baja California as the variety *lobata*.

Megamphopus effrenus J. L. Barnard

Figures 32, 33

Megamphopus effrenus J. L. Barnard, 1964a, pp. 238–239, figs. 8, 9.

Material.—cayucos: *Phyllospadix*-pelvetiid grid, scarce (92 per sq. m.); soft polychaete tubes, scarce. corona del mar: *Phyllospadix*-coralline grid, scarce (8 per sq. m.); tunicates at base of *Phyllospadix*, moderately abundant. la jolla: *Phyllospadix*-coralline grid, moderately abundant (142 per sq. m.); short-tufted red algae, scarce (44 per sq. m.); underrock grid, rare; corallines, rare; mixed red algae below water, scarce.

Distribution.—La Jolla to Cayucos, California, intertidal.

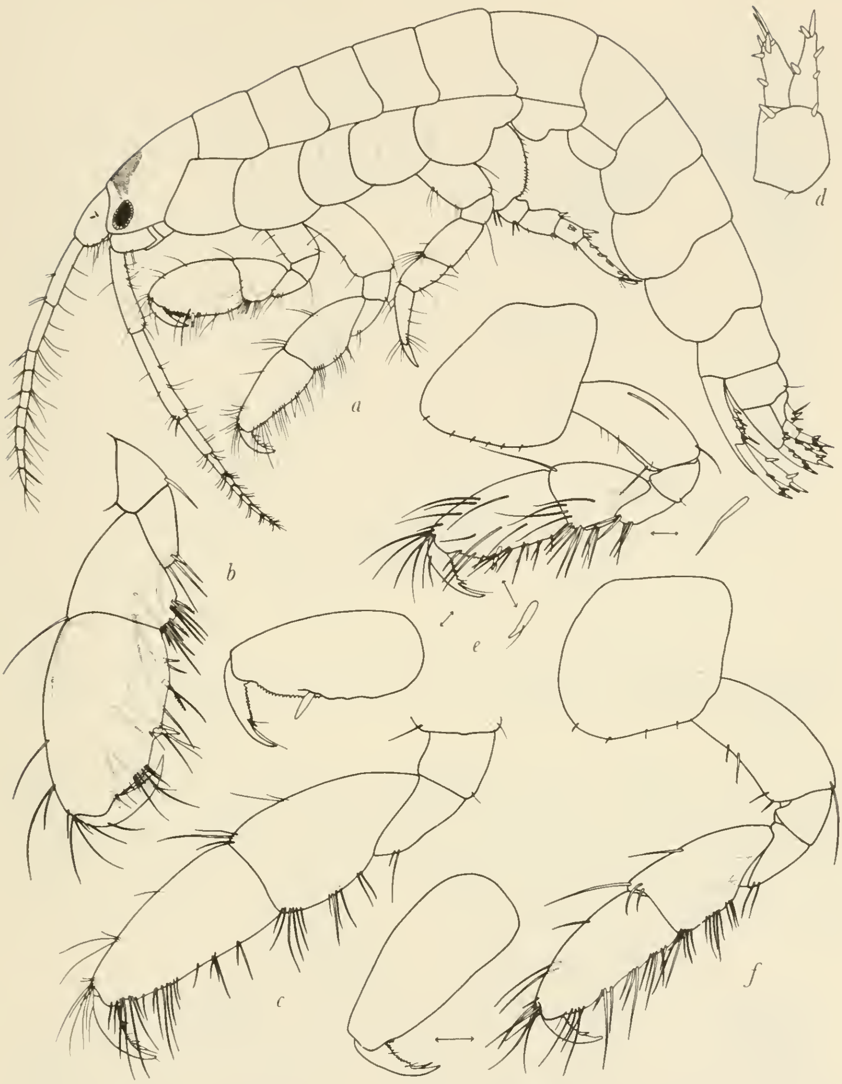

FIGURE 32.—*Megamphopus effrenus* J. L. Barnard, male, 3.7 mm., station 38–C–3: *a*, lateral view; *b*, *c*, gnathopods 1, 2; *d*, uropod 3. Male, holotype, 2.6 mm.: *e*, *f*, gnathopods 1, 2.

Megamphopus martesia J. L. Barnard

FIGURES 34, 35

Megamphopus martesia J. L. Barnard, 1964a, pp. 239–240, figs. 10, 11.

MATERIAL.—CARMEL: *Macrocystis* holdfast, abundant; *Egregia* stipes, rare; *Phyllospadix* roots, scarce; algal holdfasts, scarce; tunicates and sponges, rare. CORONA DEL MAR: *Phyllospadix*-coralline

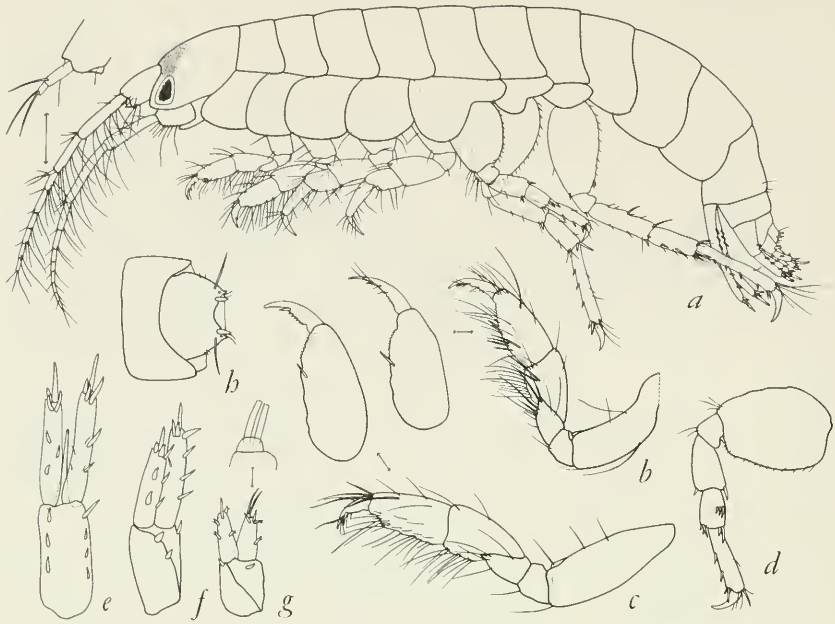

FIGURE 33.—*Megamphopus effrenus* J. L. Barnard, female, 3.4 mm., station 34: *a*, lateral view; *b*, *c*, gnathopods 1, 2; *d*, pereopod 3; *e*, *f*, *g*, uropods 1, 2, 3; *h*, telson attached to pleonite 6.

grid, rare. LA JOLLA: *Phyllospadix*-coralline grid, moderately abundant (130 per sq. m.); underrock grid, scarce; coralline algae, scarce; mixed red algae below water, scarce.

DISTRIBUTION.—Carmel, California, to Bahía de San Cristóbal, Baja California, intertidal to 84 m.

Photis bifurcata J. L. Barnard

Photis bifurcata J. L. Barnard, 1962a, pp. 30–31, fig. 10; 1964a, p. 240.

MATERIAL.—CARMEL: *Phyllospadix*-pelvetiid grid, moderately abundant (85+ per sq. m.). CAYUCOS: *Phyllospadix*-pelvetiid grid, fifth most abundant species (1362 per sq. m.); buried cobbles, rare; soft polychaete tubes, abundant; sponge, rare to abundant. GOLETA: *Macrocystis* holdfast, 3 m., moderately abundant; submerged rock, 8 m., moderately abundant.

DISTRIBUTION.—Puget Sound, Washington (specimens at hand), to Bahía de San Cristóbal, Baja California, 0–93 m.

Photis brevipes Shoemaker

Photis brevipes Shoemaker, 1942b, pp. 25–27, fig. 9.—J. L. Barnard, 1962a, pp. 31–33, fig. 11; 1964a, pp. 240–241.
Photis californica: J. L. Barnard, 1954a, pp. 26–27, pls. 23, 24 (not Stout, 1913).

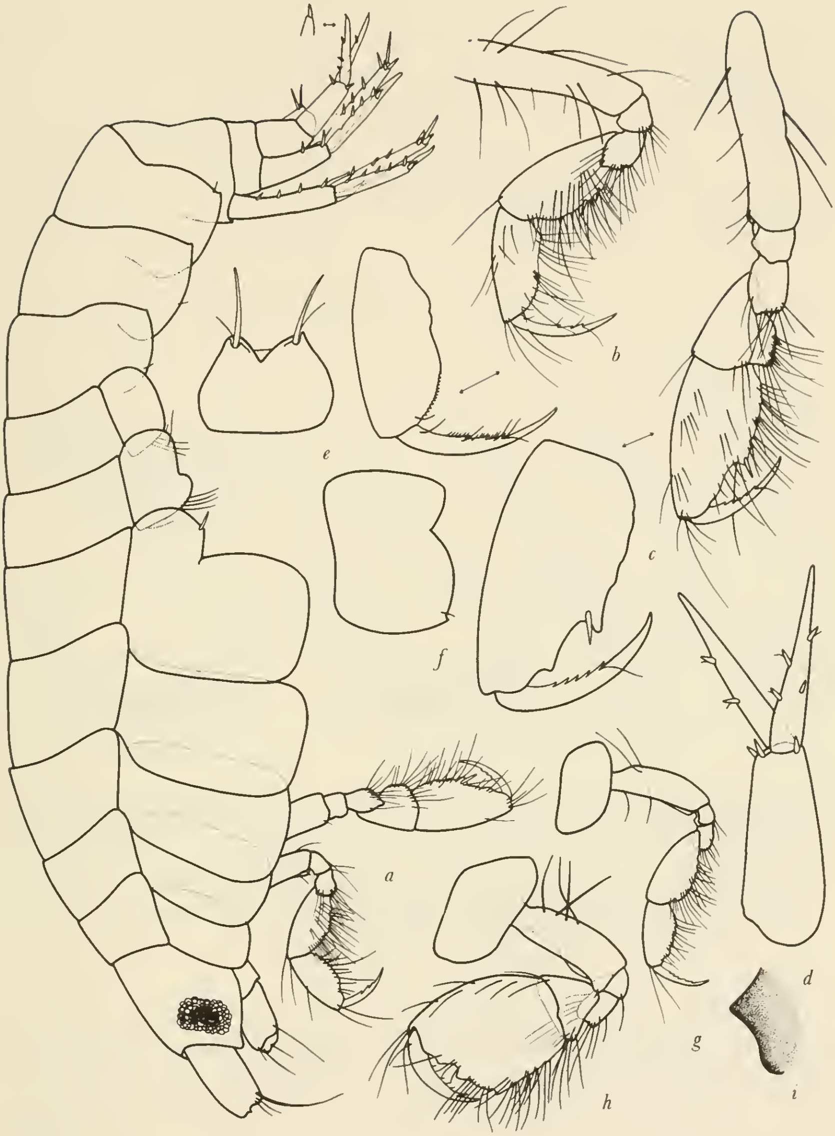

FIGURE 34.—*Megamphopus martesia* J. L. Barnard, female, 3.0 mm., "Velero" station 6181, Bahía de San Cristóbal, Baja California: *a*, lateral view; *b*, *c*, gnathopods 1, 2; *d*, uropod 3; *e*, telson; *f*, left pleonal epimeron 3. Male, holotype, 3.0 mm.: *g*, *h*, gnathopods 1, 2; *i*, epistome.

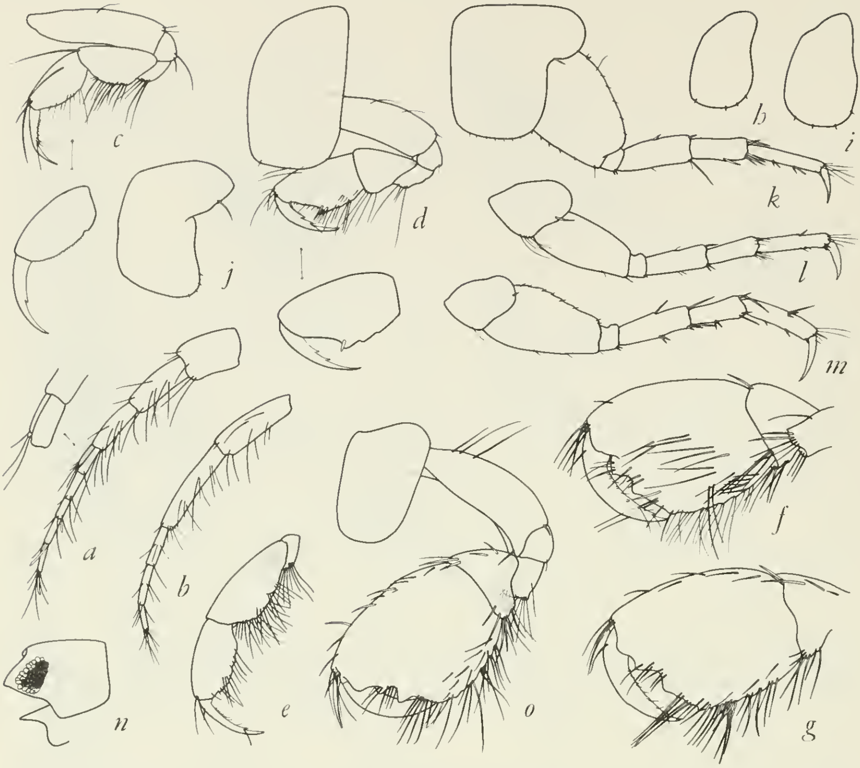

FIGURE 35.—*Megamphopus martesia* J. L. Barnard, female, 3.0 mm., "Velero" station 6181, Bahía de San Cristóbal, Baja California: *a*, *b*, antennae 1, 2; *c*, *d*, gnathopods 1, 2. Male holotype, 3.0 mm.: *e*, gnathopod 1; *f*, medial view of gnathopod 2; *g*, lateral view of gnathopod 2; *h*, *i*, *j*, coxae 3, 4, 5. Female, 3.0 mm., "Velero" station 6192, Bahía de Playa Maria, Baja California: *k*, *l*, *m*, pereopods 3, 4, 5. Male, 3.5 mm., "Velero" station 5737, southern California: *n*, cephalon; *o*, gnathopod 2.

MATERIAL.—CAYUCOS: *Phyllospadix*-pelvetiid grid, third most abundant species (1671 per sq. m.); buried cobbles, rare. GOLETA: *Macrocystis* holdfast, 3 m., abundant; submerged log, 8 m., abundant. CORONA DEL MAR: *Phyllospadix*-coralline grid, moderately abundant (2 + 51 juvs. per sq. m.); calcareous worm tubes, most abundant species (including juveniles); *Laminaria* holdfast, abundant; *Phragmatopoma* masses, most abundant species; sponge, *Spheciospongia* sp., abundant. LA JOLLA: *Phyllospadix*-coralline grid, fourth most abundant species (935 per sq. m.); red algal platform, abundant (22 + 614 juvs. per sq. m.); underrock substrate, abundant (2 + 176 juvs. per sq. m.); coralline algae, abundant.

Distribution.—Coos Bay Oregon to Bahía Magdalena, Baja California, 0–135 m.

Photis californica Stout

Photis californica Stout, 1913, pp. 654–656.—J. L. Barnard, 1962a, pp. 33–36, figs. 12, 13; 1964a, p. 241.

Material.—cayucos: *Phyllospadix*-pelvetiid grid, rare.

Distribution.—Moss Beach, California, to Bahía de San Cristóbal, Baja California, 0–98 m.

Photis conchicola Alderman

Photis conchicola Alderman, 1936, pp. 66–67, figs. 39–43.—J. L. Barnard, 1962a, pp. 36–39, figs. 14, 15.

Material.—carmel: algal holdfasts, scarce (9+ per sq. m.); tunicates and sponges, rare. cayucos: *Phyllospadix*-pelvetiid grid, abundant (814 per sq. m.); sponge, rare to abundant; red anemones, rare; buried cobbles, rare; *Macrocystis* holdfast, moderately abundant (1 + 128 juvs. per sq. m.); shell fragments, scarce; *Laminaria* and corallines, abundant. hazard canyon: kelp holdfasts, second most abundant species; algal turf on platform, scarce (44 per sq. m.); sponge, abundant. goleta: submerged rock, 8 m., moderately abundant. corona del mar: *Phyllospadix*-coralline grid, abundant (30 + 577 juvs. per sq. m.); loose rocks, abundant; sponge, moderately abundant; *Phragmatopoma* masses, most abundant species. la jolla: *Phyllospadix*-coralline grid, fifth most abundant species (745 per sq. m.).

Distribution.—Moss Beach, San Mateo County, California, to La Jolla.

Photis elephantis J. L. Barnard

Photis elephantis J. L. Barnard, 1962a, pp. 39–43, figs. 16, 17.

Material.—pt. fermin: Barnard station 30, January 18, 1950, abundant in wash of loose rocks. corona del mar: *Phyllospadix*-coralline grid, abundant (34+654 juvs. per sq. m.); loose rocks, abundant; soft polychaete tubes, most abundant species (incl. juvs.); *Laminaria* holdfast, abundant; tunicates and soft polychaete tubes, most abundant species. la jolla: mixed red algae below water, abundant.

Distribution.—Southern California; a slightly different morph from the Galapagos Islands is in hand.

***Photis* sp.**

A species with unifurcate hand of male gnathopod 2 in resemblance of *Photis bifurcata* J. L. Barnard.

Material.—goleta: *Macrocystis* holdfast, 3 m., scarce.

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Ischyroceridae

Ischyrocerus anguipes (Krøyer)

FIGURE 37 j–l

Ischyrocerus anguipes (Krøyer): Sars, 1895, pp. 588–589, pl. 209.—Gurjanova, 1951, pp. 915–916, fig. 634.—J. L. Barnard, 1954a, p. 35, pls. 32, 33.

The only adult specimens at hand are those from Bodega Bay. They differ from Sars' figures only in the slight bilobation of the second gnathopodal palmar process on terminal adult males; several variations of the outer ramus of uropod 3 are shown in the figures; however, most of the specimens have only 3 large, blunt denticles on the outer ramus of uropod 3, as shown by Sars.

MATERIAL.—BODEGA BAY, Horseshoe Cove, Oct. 8, 1963, 100+ specimens collected by Mr. Robert Sikora, University of California at Berkeley. CARMEL: algal holdfasts, scarce; *Phyllospadix* roots below water, scarce; *Macrocystis* stipe, rare; tunicates and sponges, scarce. CAYUCOS: *Amaroucium* sp., abundant. HAZARD CANYON: coralline algae on sandy holes, rare.

DISTRIBUTION.—A boreal northeastern Atlantic species, recorded in the eastern Pacific Ocean from Oregon south to Hazard Canyon Reef, California.

Ischyrocerus species A and B

FIGURES 36, 37 a–i

Two species of *Ischyrocerus*, neither identifiable with *Microjassa litotes* J. L. Barnard or *I. anguipes* (Krøyer), occur in sufficient numbers in the Californian intertidal to warrant some recognition at this time. Primarily they occur as juveniles or females, occasionally with a subadult male specimen scarcely differentiated from females. No male is sufficiently adult to permit nomenclatural fixation. Presumably adults of these species live below the intertidal zone or in some habitat not explored in this survey.

Ischyrocerus sp. A is a thin-bodied species somewhat similar to the thin form of *Jassa falcata* (see below); its third uropod is difficult to separate from that of *I. anguipes* as the denticles on the outer rami of both taxa are large, but in *Ischyrocerus* sp. A they usually exceed 3 in number and occur in 2 parallel rows. Unlike *Iscyhrocerus anguipes* the eyes of *Ischyrocerus* sp. A are very small, even if the transparent peripheral ommatidia are included in the eye diameter; the coxae are short in both males and females (see figures). A male second gnathopod shown herein is sufficiently adult to suggest that of *I. anguipes.*

Ischyrocerus sp. B is a thick-bodied species similar to *I. anguipes;* its eyes are as large as those of *I. anguipes* and its coxae are long but the small size of the denticles on the outer ramus of uropod 3 are

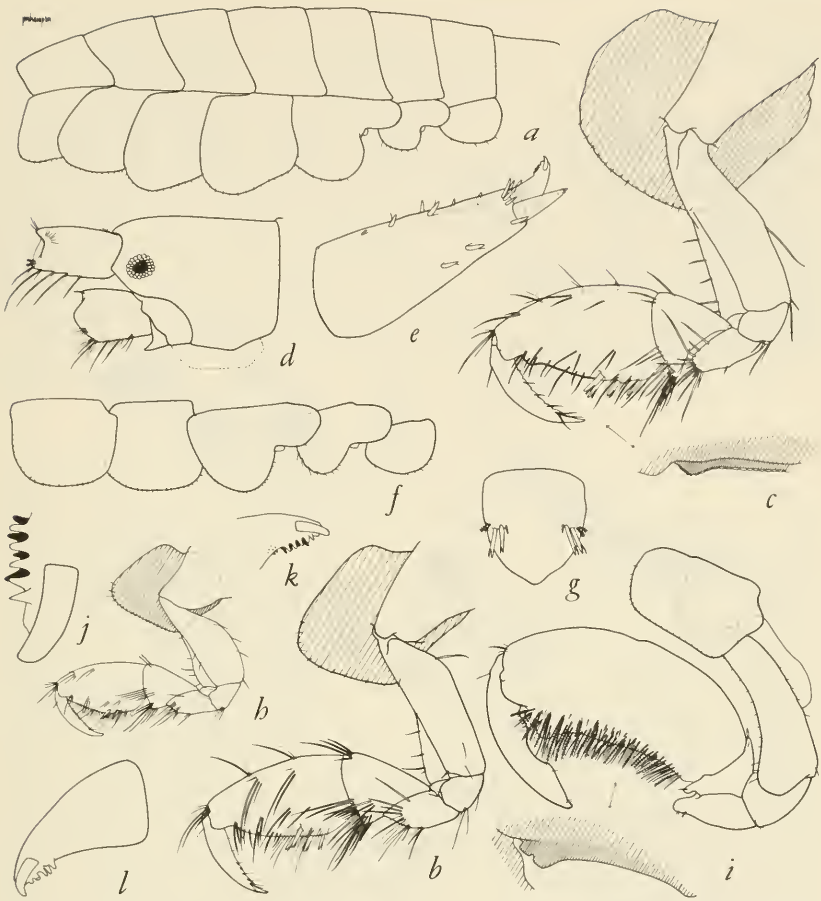


FIGURE 36.—*Ischyrocerus* sp. A, female, 3.8 mm., station 45–C–4: *a*, pereon and coxae; *b*, *c*, gnathopods 1, 2. Male, 5.1 mm., station 39–K–1: *d*, head; *e*, uropod 3; *f*, coxae 3–7, left to right as attached to organism; *g*, telson; *h*, *i*, gnathopods 1, 2; *j*, *k*, ornamentation of outer ramus of left uropod 3; *l*, ornamentation of outer ramus of right uropod 3.

distinctive. The figures show the denticles as seen microscopically under oil-immersion magnification; without that resolution they appear in figure 37c as a series of small, sharp projections.

One might assume from Stout's (1913) description of *I. parvus* that *Ischyrocerus* sp. A is identifiable with that species because of similarities in short coxae and small eyes.

MATERIAL OF *Ischyrocerus* sp. A.—CAYUCOS: *Phyllospadix*-pelvetiid grid, abundant (311 per sq. m.); nodose pink tunicates, rare. HAZARD CANYON: algal turf on platform, moderately abundant (122+per sq. m.); *Rhodomela laryx*, rare; *Egregia-Laminaria* holdfasts, scarce. GOLETA: *Phyllospadix*-pelvetiid grid, abundant (705 per sq. m.). PT. DUME: *Egregia* holdfast, rare. CORONA DEL MAR: loose rocks, rare;

FIGURE 37.—*Ischyrocerus* sp. B, male, 3.4 mm., station 27: *a*, coxae 3–7, left to right as attached to organism; *b*, uropod 3; *c*, outer ramus of uropod 3 with unresolved appearance of denticles; *d*, gnathopod 2; *e*, head; *f*, rami of uropod 3 resolved under oil immersion magnification; *g*, gnathopod 1. Female, 3.2 mm.: *h*, *i*, gnathopods 1, 2. *Ischyrocerus anguipes* Krøyer, specimens from Horseshoe Cove, Bodega Bay, California, August 10, 1963, coll. R. Sikora: *j*, *k*, *l*, outer rami of uropod 3 of 3 individuals.

red algae below water, rare; *Egregia* stipe, rare. LA JOLLA: *Phyllospadix*-coralline grid, scarce (63 per sq. m.); coralline-red algal mat under *Phyllospadix* leaves, rare.

DISTRIBUTION OF *Ischyrocerus* sp. B.—CAYUCOS: buried cobbles, rare; nodose pink tunicates, moderately abundant; sponge, scarce; *Amaroucium* sp., abundant. HAZARD CANYON: hydroid *Aglaophenia* sp., abundant; sponge, abundant; vertical face with sponges, rare. GOLETA: *Phyllospadix*-pelvetiid grid, abundant (176 per sq. m.); *Phyllospadix* on sand, rare. PT. DUME: pelvetiids, rare (9 per sq. m.). PT. FERMIN: *Egregia* holdfast, present (Barnard sta. 21). CORONA DEL MAR: red algae below water, present. LA JOLLA: coralline algae, rare.

Jassa falcata (Montagu)

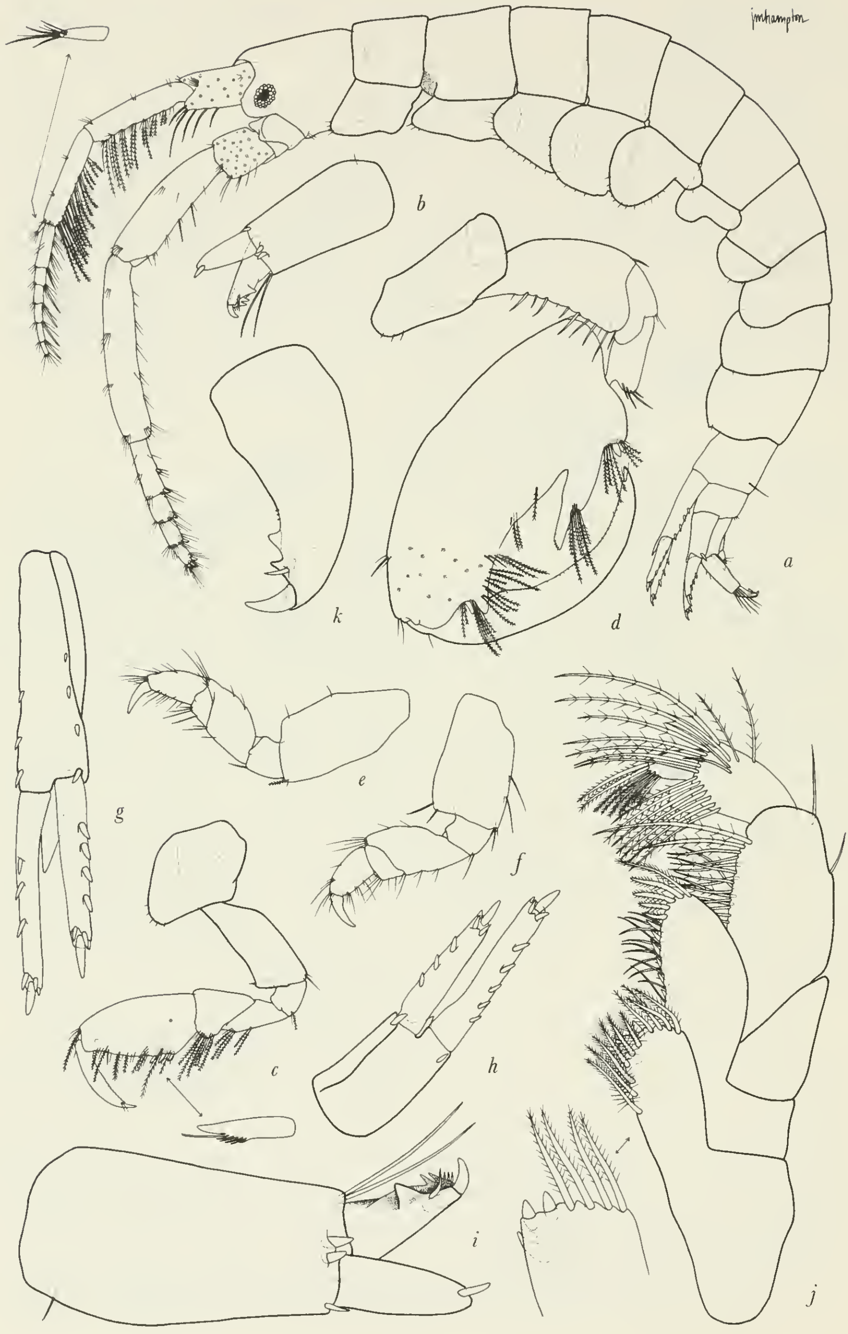
FIGURES 38, 39

Podocerus falcatus (Montagu): Sars, 1895, pp. 594–595, pl. 212.
Podocerus odontonyx Sars, 1895, pp. 597–598, pl. 213, fig. 2.
Jassa falcata: Sexton and Reid, 1951, pp. 30–47, pls. 4–30 (with synonymy).—J. L. Barnard, 1959, p. 37.

Besides several of the numerous forms of this species described by Sexton and Reid the Californian populations are dominated frequently by another form. This thin-bodied form is distinct from all others by the shorter anterior coxae, the more slender body, and the poorly retained body pigment which almost completely disappears in alcohol leaving the specimens pale beige instead of purplish-brown. The male first coxae are rounded at their anteroventral corners and are not pointed as in the typical thick-bodied forms; the second gnathopods are very slender and the posterior tooth of article 6, which varies so much in other forms of the species, is consistently short and armed with 2 stout spines. Article 2 of the accessory flagellum, if it is really present, is so short as to be obsolescent. The ventrodistal end of the first uropodal peduncle lacks any but a vestige of the long process observed in thick-bodied forms.

Pigment spots are shown on the drawing of the thin-bodied phenotype; on thick-bodied forms the pigment is diffused except for the bases of the antennae. In earlier times this thin-bodied form would have been described as a distinct species. Nomenclatural distinction, if necessary, should await life history studies because Sexton and Reid found numerous forms developing from a single clutch of eggs. Perhaps in remote geographic areas *Jassa falcata* has phenotypes not observed on English shores.

In both normal and thin-bodied phenotypes the inner plate of the maxilliped has a large and a small ventral tooth (outer or below)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not described by earlier workers and the molar of the mandible has a large accessory flake as illustrated herein.

The third uropod of *Jassa falcata* is highly characteristic, making it possible to recognize the numerous forms of the species which in juvenile stages are otherwise difficult to separate from the several species of *Ischyrocerus*. The peduncle and rami are rather short for most ischyrocerids. The inner ramus is flat and bears a single, stout, distal spine; the outer ramus has a long, curved, basally immersed distal spine and 2 sharp, flattened accessory cusps proximal to the spine. The cusps are large and slightly reverted proximally; no known species of *Ischyrocerus* has this configuration. One of the accessory blades may be smaller than the other and one or two rows of minute setules as well as a small accessory spine may occur in various growth stages. On the thick-bodied form illustrated herein the distal accessory blade has become divided, a rare aberrancy.

Material of thick-bodied form.—carmel: cobble-pelvetiid surface, rare (2 per sq. m.); *Phyllospadix*-pelvetiid grid, moderately abundant (35 per sq. m.); algal holdfasts, abundant; *Macrocystis* stipe, rare; tunicates and sponges, moderately abundant. cayucos: *Phyllospadix*-pelvetiid grid, abundant (633 per sq. m.); buried cobbles, rare; polychaete tubes and sponges, moderately abundant; sponge, rare. hazard canyon: algal turf on platform, moderately abundant (33 per sq. m.); *Egregia-Laminaria* holdfasts, rare; sponges, rare; *Egregia* holdfasts, moderately abundant; coralline algae, rare. goleta: *Phyllospadix*-pelvetiid grid, abundant (236 per sq. m.); *Macrocystis* holdfast, rare. pt. dume: short brown algae, rare (11 per sq. m.); *Egregia* holdfast, rare; sandy social tunicates, rare. corona del mar: *Phyllospadix*-coralline grid, rare (10 per sq. m.); loose rocks, scarce; calcareous worm tubes, rare; soft polychaete tubes, rare; *Laminaria* holdfast, scarce; *Phragmatopoma* masses, rare to abundant; sponges, abundant; tunicates and polychaete tubes, moderately abundant. la jolla: *Phyllospadix*-coralline grid, scarce (21 per sq. m.); short-tufted red algae, scarce (22 per sq. m.); sand-inundated algae at high tide line, abundant (1012 per sq. m.); sponge, most abundant species.

Material of thin-bodied form.—carmel: *Phyllospadix* roots, rare. cayucos: tidepool of *Phyllospadix*, scarce; *Phyllospadix* roots, moderately abundant; *Amaroucium* sp., scarce. hazard canyon:

Figure 38.—*Jassa falcata* (Montagu), thick form, male, 3.9 mm., station 38–A–3: *a*, lateral view of body and coxae; *b*, uropod 3; *c*, *d*, gnathopods 1, 2; *e*, *f*, pereopods 1, 2; *g*, *h*, *i*, uropods 1, 2, 3; *j*, maxilliped. Male, 5.0 mm., Horseshoe Cove, Bodega Bay, California, August 10, 1963, coll. R. Sikora: *k*, uropod 3.

FIGURE 39.—*Jassa falcata* (Montagu), thin form, male, 3.7 mm., station 46–A–4: *a*, lateral view of body and coxae; *b*, end of gnathopod 2; *c*, *d*, pereopods 3, 4; *e*, gnathopod 1. Male, 5.8 mm., station 39–H–2: *f*, pereopod 1; *g*, *h*, uropod 3; *i*, mandible; *j*, *k*, uropods 1, 2; *l*, mandibular molar with surrounding sketch for orientation; *m*, pereopod 2; *n*, *o*, gnathopods 1, 2.

algal turf on platform, moderately abundant (61 per sq. m.); *Phyllospadix* on sand, present; vertical face with sponges, present. PT. DUME: pelvetiid grid, second most abundant species (343 per sq. m.); *Egregia* holdfast, rare. CORONA DEL MAR: *Phyllospadix*-coralline grid, abundant (178 per sq. m.); *Egregia* stipe, rare; tunicate colonies at base of *Phyllospadix* leaves, moderately abundant. LA JOLLA: *Phyllospadix*-coralline grid, moderately abundant (121 per sq. m.).

DISTRIBUTION.—Ubiquitous in all shallow seas except in high polar regions.

The Genera *Microjassa* Stebbing and *Parajassa* Stebbing

Two species of ischyrocerids from southern California, *Microjassa* (or "Ischyrocerus") *litotes* J. L. Barnard (1954c and 1962a) and a new species to be described in sequel, are difficult to classify. *Microjassa litotes* was originally described in *Microjassa* but later transferred by Barnard (1962a) to *Ischyrocerus* primarily because coxa 5 is larger than coxa 6; there might have been justification in pointing out the well developed and lanceolate inner plate of maxilla 1 which contrasts with the vestigial plate of the type species, *Microjassa cumbrensis* (Stebbing), as well as with that of *M. macrocoxa* Shoemaker (1942b). Nevertheless, *M. litotes* shares with the type species of *Microjassa* a similar accessory flagellum (uniarticulate but elongate, in contrast to the genus *Ischyrocerus*), as well as shortened first and fifth coxae, the fifth not being as strongly shortened as in the type microjassid. The other species of *Microjassa* to be described is even more difficult to classify because all specimens lack antennae necessary for observation of the accessory flagellum. In other ways the new species is even more aberrant as a microjassid than is *M. litotes*. Its fifth coxa is as long as the fourth, although the first is shortened in both sexes. Unlike *M. litotes*, however, it shares an expanded mandibular palp article 3 with *M. cumbrensis*.

In order to show the relationships of *M. litotes* and *M. claustris*, the genera *Parajassa*, *Microjassa*, *Ischyrocerus* and *Jassa* are reviewed in the accompanying table (p. 160). One other shallow water ischyrocerid, *Isaeopsis* K. H. Barnard is not included because it is easily distinguished from the others by its subchelate pereopods.

The usefulness of the following characters in a generic classification is nil: mandibular palp article 3, the shape and setosity of maxillipedal palp article 4, and the condition of the inner plate of maxilla 1. Only the type, of the several species of *Parajassa*, has an expanded third mandibular palp article like that of the type species of *Ischyrocerus* and *Jassa*. The type species of *Microjassa* has the expanded article but 2 of the 4 species do not. The short, blunt maxillipedal palp article 4, with several setae spread on its mediodistal margin, is typical of the type species of all 4 genera (*Microjassa* being somewhat questionable) but *Microjassa macrocoxa* has a very distinct situation, a large spine attached to a slender article. Coxa 1 is consistent among the species of the genera as so arranged, being shortened only in *Microjassa;* coxa 5 is not consistent, being of medium length in *M.*

Characteristics of some ischyrocerid genera and species. + and 0 are positive and negative signs for the characters; "2" indicates accessory flagellum 2-articulate.

	Maxillipedal palp-4 broad, "setose"	Coxa 1 much shorter than 2	Coxa 5 much shorter than 4	Accessory flagellum vestigial	Inner plate maxilla 1 lanceolate	Mandibular palp-3 expanded
Parajassa pelagica, type species	+	0	0	+	+	+
Parajassa tristanensis	+	0	0	+	+	0
Parajassa georgiana	+	0	0	+	+	0
Parajassa angularis	+	0	0	+	+	0
Microjassa claustris, n.sp.	+	+	0	?	+	+
Microjassa litotes	+	+	+	1	+	0
Microjassa cumbrensis, type species	+0	+	+	1	0	+
Microjassa macrocoxa	0	+	+	1	0	0
Ischyrocerus spp.	+	0	0	2	+	+
Jassa spp.	+	0	0+	2	+	+

litotes and as long as coxa 4 in *Microjassa claustris*, n.sp. The accessory flagellum apparently is highly conservative, being of 2 articles in *Ischyrocerus* and *Jassa*, of one elongated article in *Microjassa* and being vestigial or absent in *Parajassa*. Unfortunately, the accessory flagellum of *M. claustris*, n.sp., is unknown. Nevertheless, that species is better placed in *Microjassa* than in the other genera where changes in diagnoses to permit shortened first coxae would be needed. This decision is made even though *M. claustris* differs from the type species of *Microjassa* by its long coxa 5 and its well developed inner plate of maxilla 1. It shares the first condition with *M. litotes* and is intergraded by *M. litotes* in the second character. Both of those species of *Microjassa* probably do not warrant generic recognition at this time; that recognition would be based on the inner plate of maxilla 1 as contrasted to *Microjassa* and on coxa 1 as contrasted to *Parajassa* and other ischyrocerids. The two species do not stand directly between *Parajassa* and *Microjassa*. Parajassas have become specialized by the reduction of the accessory flagellum, whereas microjassas have become specialized by the reduction in size of coxae and the inner plate of maxilla 1. The two species under question have (or are presumed to have) the first maxilla of *Parajassa* combined with the coxae and accessory flagella of *Microjassa*. The assortment of mandibular palps and maxillipeds among the genera indicates a complexity which might result in nomenclatural proliferation if all character differences were used at a generic level.

Microjassa claustris, new species

FIGURES 40, 41

DIAGNOSIS.—Rostrum and lateral cephalic lobe projecting equally, lateral lobe subfalciform and subacute; eyes large; mouthparts

FIGURE 40.—*Microjassa claustris*, new species, male, 1.8 mm., station 45–W–5: *a*, gnathopod 2. Female, 2.6 mm.: *b*, pleonal epimera 1–3, left to right; *c*, *d*, gnathopods 1, 2. Male, holotype, 1.9 mm.: *e*, head; *f*, *g*, gnathopods 1, 2.

FIGURE 41.—*Microjassa claustris*, new species, holotype, male, 1.9 mm., station 45–W–5: *a*, uropod 3; *b*, uropod 1; *c*, coxae 1 and 2 (1 drawn inside of 2); *d, e, f, g, h*, coxae 3, 4, 5, 6, 7; *i*, mandible. Female, 2.6 mm.: j, uropod 3; *k*, coxae 1–7, left to right; *l*, telson.

similar to those of *Parajassa angularis* Shoemaker (1942b) except for expanded third mandibular palp article (see figure herein); inner plate of maxilla 1 well developed as in *P. angularis;* maxillipedal palp article 4 short as in *P. angularis* and armed medially with 4–5 setae; coxa 1 in male about 60% as long as coxa 2, in female about 75%; coxa 5 in both sexes as long as coxa 4, coxae 6–7 not longer than posterior lobe of coxa 5; gnathopod 1 small and similar in both sexes, poorly developed in comparison to *Microjassa cumbrensis* (Stebbing and Robertson, 1891), article 5 slightly less than 60% as long as article 6, the latter moderately expanded, palm about equal to posterior margin of article 6, defined by 3 spines (2 lateral, 1 medial); gnathopod 2 of female similar to 1 but article 5 shorter; gnathopod 2 of male with elongated and enlarged sixth article, palm and posterior margin of article 6 confluent, armed distally with 2 humps, proximally with a poorly developed, slightly reverted, blunt process at joint with article 5, palm sparsely setose, dactyl reaching slightly more than halfway along palm, inner margin sinuous, article 5 very small, posterior lobe narrow, short; pereopods, except for coxae, missing on all specimens; pleonal epimera each slightly convex posteriorly, posteroventrally produced into small blunt tooth becoming larger and blunter successively from segments 1 to 3; outer rami of uropods 1–2 shorter than inner, ventrodistal end of peduncle of uropod 1 bearing acute process; uropod 3 elongated, rami about 25% as long as peduncle, outer ramus bearing 3 distolateral cusps, apical cusp not an immersed or articulated spine, proximal cusp with tiny accessory bristle, margin proximal to proximal cusp minutely scaly, inner ramus simple, straight, bearing one basally immersed articulated spine, lateral margin scaly; telson short, subtriangular, apically blunt, armed with 2 dorsal spines and several marginal setules.

Holotype.—AHF No. 624, male, 1.9 mm.

Type locality.—Station 45–W–5, La Jolla, California, November 11–13, 1962, scraping of calcareous sponge under ledge in surge channel.

Relationship.—The foregoing table shows the relationship of this species to others of *Microjassa* and those of *Parajassa*. It differs from all species assigned to *Microjassa* by the long fifth coxa. It differs from the type species, *M. cumbrensis*, by the well developed inner plate of maxilla 1, the presence of only 3 cusps on the outer ramus of uropod 3, and in the poor development of the proximal and distal processes of the male second gnathopodal palm. The new species differs from *M. macrocoxa* Shoemaker (1942b) in the distally subquadrate coxae in the male, the longer fifth article of male gnathopod 1 and of the female gnathopods, the poorly developed posterior lobe of that article, by the relatively longer peduncle and shorter rami of uropod 3, and, very radically, by male gnathopod 2 and its shape, which in *M. macrocoxa* has a cheliform palmar process and an accessory process distal to that on the large palmar excavation. *Microjassa claustris* differs from *M. litotes* J. L. Barnard in the long fifth coxa, the fewer and larger cusps of the outer ramus of uropod 3, the large dorsal telsonic spines, the longer fifth articles of male gnathopod 1 and of the female gnathopods and the broad expansion of mandibular palp article 3.

Material.—corona del mar: ?algae below water, rare (questionable identification). la jolla: sponge from overhang below water, rare; calcareous sponge under ledge, second most abundant species.

Microjassa litotes J. L. Barnard

Microjassa litotes J. L. Barnard, 1954c, pp. 127–130, pls. 35, 36.
Ischyrocerus litotes: J. L. Barnard, 1962a, pp. 53–56, figs. 23, 24; J. L. Barnard, 1964a, pp. 226–227.

Material.—carmel: *Phyllospadix*-pelvetiid grid, moderately abundant (70 per sq. m.); algal holdfasts, moderately abundant;

Macrocystis holdfast, rare; tunicates and sponges, moderately abundant. CAYUCOS: *Phyllospadix*-pelvetiid grid, abundant (956 per sq. m.); buried cobbles, scarce; *Macrocystis* holdfast, moderately abundant; soft polychaete tubes, rare; sponge, rare to scarce; *Amaroucium* sp., abundant. HAZARD CANYON: *Egregia-Laminaria* holdfasts, rare. GOLETA: *Phyllospadix*-pelvetiid grid, rare (2 per sq. m.); *Macrocystis* holdfast, scarce; submerged rock, 8 m., moderately abundant; submerged log, 8 m., scarce. PT. DUME: coralline algae, rare (9 per sq. m.). CORONA DEL MAR: *Phyllospadix*-coralline grid, moderately abundant (152 per sq. m.); loose rocks, scarce; calcareous worm tubes, rare; algae below water, abundant; *Egregia* stipes, rare; *Laminaria* holdfast, rare. LA JOLLA: *Phyllospadix*-coralline grid, second most abundant species (2177 per sq. m.); underrock substrate, abundant (98 per sq. m.); short-tufted red algal ridge, moderately abundant (117 per sq. m.); coralline algae, abundant.

DISTRIBUTION.—Carmel, California, to Bahía de San Cristóbal, Baja California, 0–157 m.; a major intertidal species, small in body size, rare at unprotected localities, scarce on coastal shelf benthos, up to 3.1 individuals per sq. m. at 55 m. depth.

Parajassa angularis Shoemaker

Parajassa angularis Shoemaker, 1942b, pp. 41–44, figs. 14, 15.—J. L. Barnard, 1962a, p. 58, figs. 26, 27.

MATERIAL.—CARMEL: coralline algae, rare; algae below water, rare; *Phyllospadix* roots, rare. CAYUCOS: *Laminaria* and corallines, rare.

DISTRIBUTION.—Bahía Magdalena, Baja California, to Carmel, California.

Leucothoidae

Leucothoe alata J. L. Barnard

Leucothoe alata J. L. Barnard, 1959, pp. 19–20, pl. 1; 1962c, p. 132, figs. 7 D, E, F; 1964a, p. 227.

MATERIAL.—CARMEL: *Phyllospadix* roots, rare; tunicates and sponges, rare. CAYUCOS: buried cobbles, rare; polychaete tubes and sponge, rare; sponge and tunicates, moderately abundant; sponge, abundant; *Phyllospadix* roots, rare. HAZARD CANYON: hydroids and algae, scarce to rare; sponge, most abundant species. GOLETA: submerged log, 8 m., rare. PT. DUME: *Egregia* holdfasts, scarce; sandy social tunicates, moderately abundant. CORONA DEL MAR: *Phragmatopoma* masses, rare; sponge, scarce to abundant. LA JOLLA: calcareous sponge, rare.

DISTRIBUTION.—Carmel, California to Bahía de San Ramón, Baja California, 0–11 m.

Leucothoides pacifica J. L. Barnard

FIGURE 24 n–r

Leucothoides pacifica J. L. Barnard, 1955b, pp. 26–28, figs. 1, 2 e, h, n; 1959, p. 21.

This species was distinguished from *Leucothoides pottsi* Shoemaker (1933b) especially by the bulging palm of male gnathopod 2 on the assertion that Shoemaker's description was based on a male. Further investigation of female *L. pacifica* reveals terminal development of a concave palm similar to that of *L. pottsi* and casts doubt on the sex of the type of *L. pottsi*. Notwithstanding, the female gnathopod 2 of *L. pacifica* has a shorter posterior edge of article 6 than that of *L. pottsi*, the lateral cephalic lobes are rounded, not quadrate, and the peduncle of uropod 1 is longer than that of *L. pottsi*.

MATERIAL.—CARMEL: algal holdfasts, rare; tunicates and sponges, rare. CAYUCOS: buried cobbles, scarce; *Macrocystis* holdfast, rare; sponge, rare. GOLETA: submerged log, 8 m., rare.

DISTRIBUTION.—Carmel to Newport Bay, California, 0–8 m.

Liljeborgiidae

Liljeborgia geminata, new species

FIGURE 42

Liljeborgia kinahani (Bate): J. L. Barnard, 1962b, p. 83; 1964a, p. 228 (not Bate, see Stebbing, 1906).

DIAGNOSIS.—With the aspect of *L. kinahani* (Bate, see Sars, 1895, pl. 188, fig. 1); eyes very large, irregular in outlines; lateral cephalic lobes narrow, strongly projecting; antennal flagella with numerous short, broad articles; coxa 1 expanded distally, coxa 3 narrowed distally, coxa 4 with broad, moderately deep posterior excavation; gnathopod 1 with article 2 broadest at middle, palms of gnathopods evenly convex, although gnathopod 2 in some large specimens (4.5+ mm) having faint suggestion of sinuous excavation; posterior edges of sixth articles of pereopods 1–2 with 6–8 small spines; second articles of pereopods 3–5 relatively broad, posterior edges serrate, distal serrations enlarged; third pleonal epimeron with distinct sinus above small posteroventral tooth, epimera 1–2 with tooth at posteroventral corners; uropodal spination shown in figures; pleonites 1–2 dorsally with 3 small teeth each, middle tooth largest; pleonite 3 lacking dorsal teeth, with medial slit; pleonites 4–5 each with or without small single tooth; telson with relatively symmetrical apical notches on each lobe, each notch with one long spine.

The largest specimen available is a male, 8.7 mm., from station 1340; it fits the above diagnosis but lacks the distinct sinus above the tooth on the third pleonal epimeron, has a broader cephalic lobe, very short telsonic spines and larger serrations of pereopods 3–5.

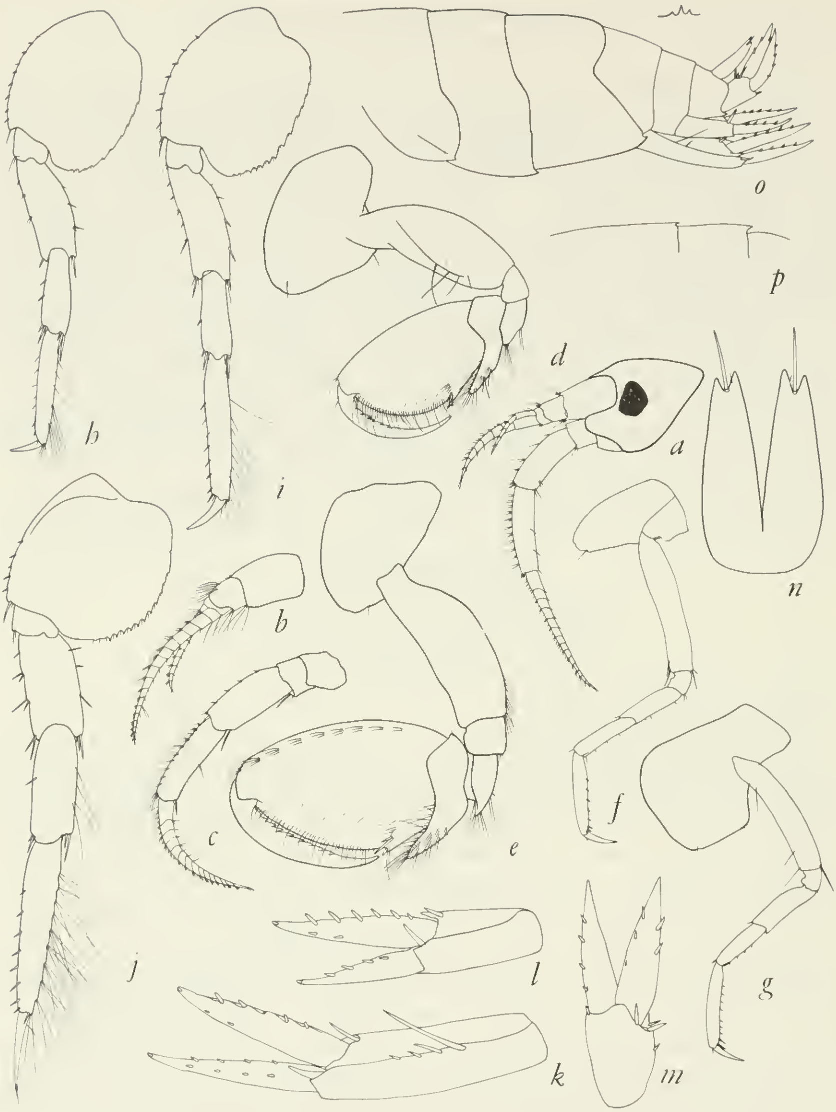

FIGURE 42.—*Liljeborgia geminata*, new species, holotype, male, 4.9 mm., station 41: *a*, head; *b,c*, antennae 1, 2; *d,e*, gnathopods 1, 2, medial views; *f,g,h,i,j*, pereopods 1, 2, 3, 4, 5; *k,l,m*, uropods 1, 2, 3; *n*, telson; *o*, pleon, offset showing dorsoposterior edges of pleonites 1–2. Male, 5.0 mm.: *p*, lateral view of dorsal edge of pleonites 4, 5, 6.

Holotype.—AHF No. 611, male, 4.9 mm.

Type locality.—Barnard station 41, Goleta, California, wash of rhizomes of *Macrocystis pyrifera*, 3 m. depth, July 6, 1961.

Discussion.—The morphological differences among the species of *Liljeborgia* belonging to the group *aequabilis-akaroica-kinahani-longicornis-macrodon-mixta-octodentata* are rather weak. Without comparative studies of the species other than *aequabilis* and *akaroica* of New Zealand, the standards set by Hurley (1954b) cannot be evaluated. His excellent description and figures of *L. aequabilis* Stebbing reveal the following distinctions from *L. kinahani* of the northeastern Atlantic: (1) the slight sinuosity of the palm of gnathopod 2; (2) presumably the evenness of the teeth of pleonites 4–5; (3) the somewhat greater distal narrowing of coxae 2 and 3; (4) the stronger spination of the uropods (especially uropod 3); (5) the dense spination of article 6 on pereopods 1–2; (6) the distal narrowing of article 2 on pereopod 5 with a slightly more distinct posterodistal lobe; (7) the distal expansion of coxa 1; (8) the greater disparity in length and size of each of the paired distal cusps on each telsonic lobe; (9) the relatively shorter distal spine of each telsonic lobe; (10) the very much shorter, more numerous articles of the antennal flagella.

Liljeborgia akaroica is described by Hurley as differing from *L. aequabilis* in the following characters: (1) the non-sinuous palm of gnathopod 2 (assumed herein); (2) the narrowness of the incision on the third pleonal epimeron; (3) the presence of only 1, not 2, distal setae on the inner plate of maxilla 1; (4) the presence of a distal claw-spine on maxillipedal palp article 4; (5) the slight spinal differences on uropod 1. Character 1 is like *L. kinahani*, character 2 differs from *L. kinahani*, and the other points are unknown for *L. kinahani*. A variety of *L. akaroica* is characterized especially by the reduction in number and increase in length of major posterior spines on article 6 of pereopods 1 and 2 and the finely combed articular margin.

The group of species to which *L. geminata* belongs is characterized by the presence of 3 dorsal teeth on pleonites 1–2, no teeth on 3, 1 tooth on 4 and 5. The variability of teeth as shown in *L. geminata* and *L. cota* J. L. Barnard (1962b) suggests that grouping by use of pleonal tooth formulas is unreliable; possibly closer relationships may be shown between species having 1 or 3 teeth on pleonites 1–2 than between pairs of species having 3 teeth.

Not all of the characters used by Hurley have been described for the other species in the group; for those only a few characters or combinations can be utilized as distinctions from *aequabilis-akaroica-kinahani*.

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Liljeborgia macrodon Schellenberg (1931) is characterized grossly by the large serrations on the second articles of pereopods 3–5, the non-sinuous palm of gnathopod 2 and the deep sinus on the third pleonal epimeron.

Liljeborgia octodentata Schellenberg (1931) is characterized by the breadth of the poorly developed sinus of the third pleonal epimeron, and the non-sinuous palm of gnathopod 2.

Liljeborgia mixta Schellenberg (1925) has a well developed sinus on the third pleonal epimeron, a distally expanded first coxa and large eyes; apparently it differs from *L. kinahani* in the shape of article 2 on gnathopod 1, that in *L. kinahani* being most widely expanded near its proximal end.

Liljeborgiella (=*Liljeborgia*) *longicornis* Schellenberg (1931) has a short claw-like dactylus on pereopod 5 (the generic character of *Liljeborgiella*), larger teeth of pleonites 4–5 than in the other species of the group, a medium-sized sinus of the third pleonal epimeron, a highly distinctive gnathopod 2 with enormous, curved dactyl, and a distally expanded first coxa.

Liljeborgia geminata differs from *L. kinahani* by the slightly smaller teeth on pleonites 4–5 and especially by their equal size on both segments; in *L. kinahani* the tooth of pleonite 4 is much longer than that of pleonite 5. Some specimens of *L. geminata* lack any teeth on pleonites 4–5. The extent of variability in *L. cota*, as shown by J. L. Barnard (1962b) and in manuscripts in press, indicates the unreliability of tooth formulas as specific characters. Hence these differences are not considered to be of sufficient degree to distinguish *L. geminata* and *L. kinahani*. Coxa 1 is broader distally in *L. geminata* than it is in *L. kinahani*. The articles of the antennal flagella are shorter and more numerous, the eyes are much larger and more irregular in outline, the sinus of the third pleonal epimeron is more distinct, the posterior edges of the sixth articles of pereopods 1–2 have more spines, the lateral cephalic lobe is narrower and more projecting, the third uropods are more spinose, coxa 4 has a broader, deeper posterior excavation, article 2 of gnathopod 1 is not expanded proximally, the shapes of the second articles of pereopods 3–5 differ, as do their serrations, and the remaining articles of the pereopods are stouter and shorter than in *L. kinahani*. Although these character differences are minor, the combination of so many has specific value.

In a parallel way, *L. mixta* Schellenberg (1925), from West Africa, differs from *L. kinahani* by the enlarged eyes, the second article of gnathopod 1, the third pleonal epimeron, and the first coxa. Because other characters are not known for *L. mixta* there is no other way to differentiate *L. geminata* than by these minor characters.

Liljeborgia geminata differs from *L. marcinabrio* J. L. Barnard (1968), from the Gulf of California, by the subcircular, not reniform eyes, the broader second articles of pereopods 3–5, the vestigial dorsal teeth on pleonites 4–5 and in the evenly projecting subapices of each telsonic lobe.

MATERIAL.—GOLETA: *Macrocystis* holdfast, 3 m., rare; submerged log, 8 m., rare. VELERO records: San Pedro Bay, near Los Angeles, California, 18–19 fm.; Tanner Bank, 38 fm.; Santa Cruz Island, 23 fm.

DISTRIBUTION.—Goleta, California, to Bahía de San Quintín, Baja California, 3–70 m.

Lysianassidae

Fresnillo, new genus

DIAGNOSIS.—Mouthparts not distinctly forming conical bundle below head but genus otherwise related to those with this character; upper lip and epistome amalgamated, forming a large, conspicuously setose anterior lamina; mandible lacking molar, palp attached quite proximally, apex of mandibular body with conical projection; lower lip not resolved; maxillae not clearly delineated, apparently rather degenerate (see discussion below); inner plates of maxilliped each a conical, unarmed projection, outer plates scarcely more than a broadened, quadrate extension of parent articles, palp triarticulate; accessory flagellum uniarticulate; gnathopod 1 simple; gnathopod 2 lacking article 7; uropods 1–2 with inner rami reduced to short styluses; third uropod formed of rugulose peduncle lacking rami; telson entire, elongated; head telescoped into pereonite 1 with eye partially covered by the segment and coxa 1. Generic name masculine, contrived.

TYPE SPECIES: *Fresnillo fimbriatus*, new species.

RELATIONSHIP.—This genus and *Ocosingo* J. L. Barnard (1964a) comprise a pair of genera from the eastern Pacific and northern hemisphere related to the pair of genera *Acontiostoma* Stebbing and *Stomacontion* Stebbing from the southern hemisphere. The latter two now appear to be synonymous because of the discovery of intergrading species (see later discussion). The eastern Pacific pair differs from that in the southern hemisphere by the more complete reduction of the inner rami of uropods 1–2 and the loss of article 7 on gnathopod 2. *Fresnillo* differs from *Ocosingo* in the degenerate maxillae and the poorly developed outer plates of the maxilliped.

Acontiostoma Stebbing is presently monotypic while *Stomacontion* has 5 species, but among those 5 are 2 showing intergradation with *Acontiostoma*. *Stomacontion capense* K. H. Barnard (1916) lacks any first maxillary palp, whereas the type species of *Acontiostoma* has a uniarticulate and that of *Stomacontion* a biarticulate palp. *Stomacontion insigne* K. H. Barnard (1932) has a uniarticulate first maxillary palp combined with a vestigial fourth maxillipedal palp article, so obfuscating the generic definitions. Both of these species, in addition, have the first coxa subconically narrowed below, indicating that they represent a pair of interrelated species grossly divergent from *Acontiostoma* and *Stomacontion*. Indeed, one could establish new genera for both of them or provide four subgeneric names under *Acontiostoma* to denote the four kinds of taxa mixed in this complex.

Fresnillo fimbriatus, new species

Figures 43, 44

Diagnosis.—With the characters of the genus.

Description.—Article 1 of antenna 1 crested, article 3 triangular, article 2 of peduncle and article 1 of flagellum touching, accessory flagellum forming a small scale armed with 2 setae; eye formed of few large, subquadrate ommatidia surrounding a dense, dark mass of pigment; maxillae not clearly analyzed, these appendages or their presumed figments badly shriveled, poorly chitinized (dissected in 5 specimens), the presumed first maxillae by merit of their orientation appearing to have lateral lobes representing uniarticulate palps, outer plates medial to palps bearing in some aspects a minute appendage; by assuming a reversal in the direction of pointing one might assume the palp to be the inner plate and the small appendage on the outer plate to be a palp but this is contrary to the expected orientation; maxilla 2 possibly formed of two tiny appendages (plates) attached to a broad basal piece (see figures); gnathopod 1 simple, article 6 much longer than 5; gnathopod 2 similar to that of *Ocosingo*, article 6 bearing tasselled setae, apex of article 6 excavated and lacking article 7, appearing to have duct leading from basal glandular area (possibly used as poison gland or having a commensal property); body and coxae covered with minute setules, pleonites 3–4 elevated acutely above, pleonites 5–6 very small but distinct; uropod 3 claviform, bearing papillations and lacking any

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Figure 43.—*Fresnillo fimbriatus*, new genus, new species, holotype, ?sex, 1.2 mm., station 38–F–1: *a*, lateral view; *b*, antenna 1; *c*, antenna 2; *d*, enlargement of article 3 of antenna 1 peduncle showing triangular shape and one view of attached accessory flagellum; *e*, accessory flagellum of antenna 1 after being turned from its position in figure *d; f*, side of head and mouthpart bundle below, the setose piece representing a lateral view of epistome-upper lip complex, stippled piece representing mandibular palp; *g*, mandible; *h*, an unidentified mouthpart; *i*, *j*, two mouthparts believed to be second maxillae, the definitive pieces represented as tiny apical lobules, each pair of lobules as inner and outer lobes; *k*, *l*, *m*, various mouthparts identified as first maxillae from several individuals; *n*, *o*, views of maxilliped; IP=inner plate; OP=outer plate; P=base of palp; *p*, *q*, gnathopod 1.

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FIGURE 44.—*Fresnillo fimbriatus*, new genus, new species, holotype, ?sex, 1.2 mm., station 38–F–1: *a*, *b*, gnathopod 2; *c*, enlargement of article 6 of gnathopod 2 showing one tassel-seta, medial glandular tissue and terminal ornamentation (article 7 is absent); *d*, *e*, *f*, *g*, *h*, pereopods 1, 2, 3, 4, 5; *i*, *j*, uropod 1, 2; *k*, *l*, dorsal and lateral views of uropod 3 and telson.

ramal vestige; antenna 2 with peduncular article 3 produced medial to article 4; flagella of both antennal pairs with 4 articles.

HOLOTYPE.—AHF No. 612, ?sex, 1.2 mm.

TYPE LOCALITY.—Barnard station 38–F–1, Cayucos, California, wash of *Amaroucium* sp., underside of cavern, July 1, 1961.

MATERIAL.—CARMEL: *Phyllospadix*-pelvetiid grid, rare. CAYUCOS: *Phyllospadix*-pelvetiid grid, rare (3 per sq. m.); buried cobbles, rare; soft polychaete tubes, rare; sponge, rare; *Amaroucium* sp. scarce.

DISTRIBUTION.—Carmel and Cayucos, California.

Lepidepecreum ?gurjanovae Hurley

Figures 45, 46

?*Lepidepecreum gurjanovae* Hurley, 1963, pp. 49–53, figs. 13, 14.

This species differs from *Lepidepecreum alectum* Gurjanova (1962) by the rounded, not acuminate dorsal processes of pleonites 3 and 4, and the distinct, acute posterodorsal tooth of pleonite 1, but it resembles *L. alectum* particularly in the hooked distal spines of pereopods 1–2. *Lepidepecreum kasatka* Gurjanova (1962) is another close relative also having acute processes on pleonites 3 and 4. *Lepidepecreum vitjazi* Gurjanova (1962) bears acute processes of pleonites 3–4 and long, attenuated lateral cephalic lobes.

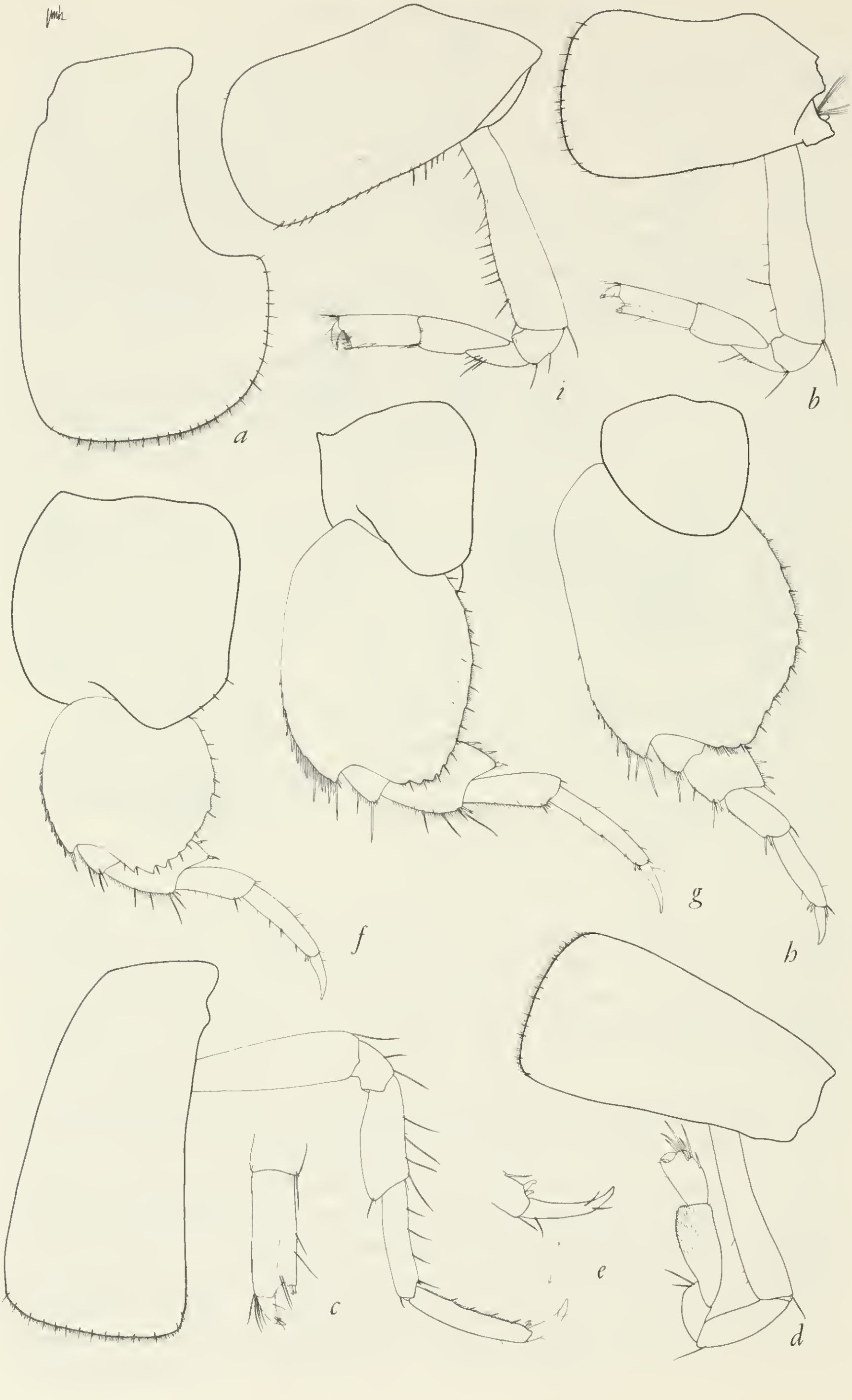
Although it closely approximates *L. eoum* Gurjanova (see 1951 and 1962) the present material apparently differs by the presence of the hooked spines on the distal ends of the sixth articles of pereopods 1–2. Gnathopod 1 of *L. eoum* appears to be stouter and longer than in the present species.

The shallow water specimen at hand (station 41) differs from Hurley's (1963) representation by the almost perfectly quadrate third pleonal epimeron lacking any tooth, by the less acute dorsal process of pleonite 4, by the presence of hooked spines of pereopods 1–2 which may be represented on Hurley's "Pr. 1" drawing of figure 14, by the acuminous palm of gnathopod 2, and the stronger serrations on the posterior edges of the second articles of pereopods 3–5.

The similarity of the present shallow water specimen to *L. foraminiferum* Stebbing (1888) is remarkable, especially in the strongly serrate pereopods 3–5, but apparently *L. foraminiferum* lacks the hooked distal spines of pereopods 1–2.

Specimens at hand from the Californian coastal shelf in depths of 15 to 135 m. differ from Hurley's type in 1720 m. by the flat-topped, occasionally slightly rising dorsal edge of the process of pleonite 4, the perfectly straight posterior edge, the rounded-quadrate posteroventral corner of the third pleonal epimeron, and the very slightly larger dorsal teeth of pleonites 1–2. Deep water specimens, like that specimen of shallow water, have the large hooked spines of pereopods 1–2, but they differ from the shallow water individual by the nearly smooth edges of the second articles of pereopods 3–5 in resemblance to Hurley's figures of *L. gurjanovae*. Three forms of this lepidepecreum thus occur, Hurley's type drawings and the presently reported deep and shallow water specimens. The latter two kinds are assigned provisionally to *L. gurjanovae* until more materials from depths of 0–15 and 135–1500 m. can be studied.

Material.—goleta: *Macrocystis*-holdfast, 3 m., rare (1 specimen). Southern Californian coastal shelf, 31 specimens in 18 samples, depths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of 15 to 135 m. CARMEL: *Macrocystis* holdfast, rare, doubtful identification.

DISTRIBUTION.—3 kinds: (1) Carmel and Goleta, *Macrocystis* holdfasts, 0–3 m.; (2) southern Californian coastal shelf, 15–135 m.; (3) typical forms described by Hurley, 256–1720 m., northeastern Pacific Ocean from southern California (33° N) to British Columbia (50° N).

"*Lysianassa*" Milne Edwards, provisional synonymy

FIGURE 47

"*Lysianassa*" Milne Edwards: Stebbing, 1906, p. 37 (with synonymy).
?*Socarnella* Walker, 1904, p. 239.
Lysianopsis Holmes, 1905, p. 475.—Hurley, 1963, pp. 67–73 (with synonymy).
Aruga Holmes, 1908, pp. 504–505.
Arugella Pirlot, 1936, pp. 259–260.
Shoemakerella Pirlot, 1936, pp. 264–265.
Pronannonyx Schellenberg, 1953, pp. 107–108.

GROUP DIAGNOSIS, CONSERVATIVE FEATURES.—Accessory flagellum more than 2-articulate, articles 2–3 of first antennal peduncle rather elongate for the family; mouthpart bundle quadrate in outline from lateral view, not conical; upper lip and occasionally epistomal area lamellar and projecting anteriorly from buccal bundle, upper lip and epistome separated by definite incision, slit or sinus; mandible with distinct, untoothed cutting edge except for one blunt lateral process, molar small, conical, not triturative, setulose, occasionally absent; mandibular palp 3-articulate, attached proximal to molar position; lower lip lacking inner lobes; maxilla 1 bearing 2 or fewer setae on medial lobe, setae never falcate, palp with 2 articles; maxillipedal lobes normal for the family, palp 4-articulate; gnathopod 1 simple; coxa 1 subequal to coxa 2, never covered by coxa 2, coxa 3 not much larger than coxa 2, anterior coxae otherwise normal for the family; pereopods simple; uropods all developed, biramous, rami of first 2 pairs subequal; telson entire or slightly emarginate; gills apparently simple, unplaited.

VARIABLE CHARACTERS.—Epistome either produced forward as a lamellar plate similar to upper lip or not, upper lip often slightly stunted in species having produced epistome; mandibular molar present or absent; mandibular palp article 1 elongated or not; setae of inner lobe of maxilla 1 varying from 0 to 2 in number; spines of outer plate of maxilla 1 in two groups, outer and inner groups of similar types or distinct types; plates of maxilla 2 highly variable in size and shape; maxillipedal palp variable in shape and length of

FIGURE 45.—*Lepidepecreum ?gurjanovae* Hurley, female, 4.0 mm., station 41: *a*, coxa 4; *b*, *c*, gnathopod 1; *d*, gnathopod 2; *e*, *f*, *g*, *h*, pereopods 1, 3, 4, 5. Male, 5.2 mm., "Velero" station 5880: *i*, gnathopod 1.

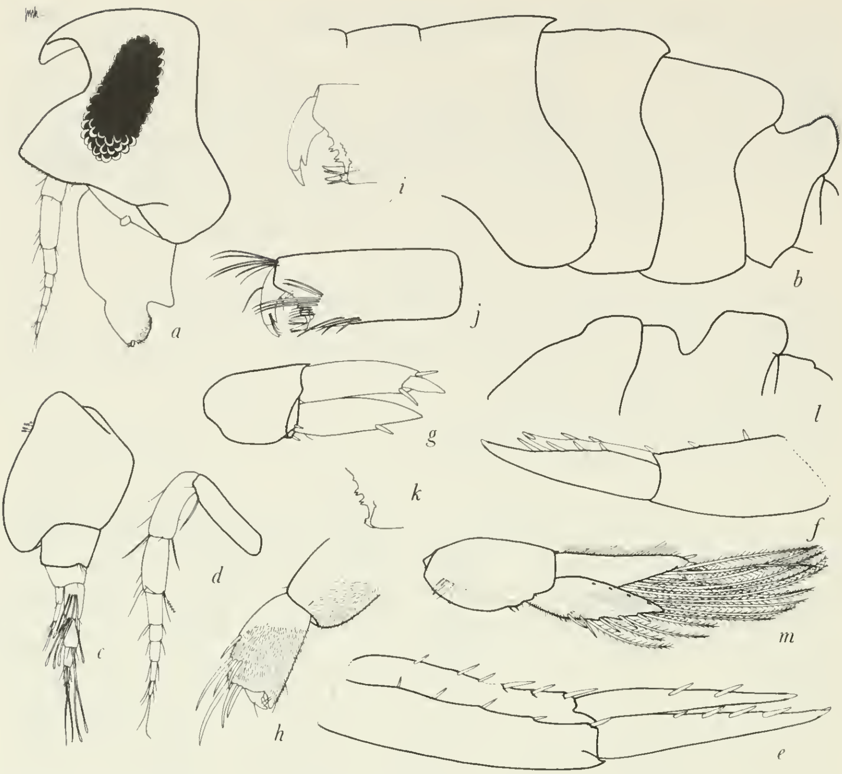

FIGURE 46.—*Lepidepecreum ?gurjanovae* Hurley, female, 4.0 mm., station 41: *a*, head and epistome-upper lip complex; *b*, pleon, lateral view, left side; *c*, *d*, antennae 1, 2; *e*, *f*, *g*, uropods 1, 2, 3; *h*, gnathopod 2. Male, 5.2 mm., "Velero" station 5880: *i*, *j*, *k*, gnathopod 1; *l*, pleonites 3–6, lateral, left side, dorsal margins; *m*, uropod 3.

articles; pereopods 1 and 2 with or without a large distal spine on article 6; third pleonal epimeron variable in shape; inner ramus of uropod 2 constricted or not; outer ramus of uropod 3 uni-or biarticulate; peduncle of uropod 3 simple or formed variably into a lamelliform plate laterally; inner ramus of uropod 3 variable in length but always more than half as long as outer ramus; telson entire or emarginate.

REMARKS.—The obscurity of the type species, *Lysianassa costae* Milne Edwards (1830, see Stebbing, 1906, for reference), with its type locality in the Gulf of Naples, apparently has led to a conception of the genus based on *L. plumosa* Boeck, as analyzed by Sars (1895) "mistakenly" under the name of *L. costae*. Stebbing (1906) did not consider any of the species described from the Mediterranean subsequent to 1830 to be *L. costae*, although Pirlot (1933) believed *L. costae* to be a senior synonym of *L. bispinosa* Della Valle (1893). Nine other

FIGURE 47.—Mouthparts and appendages of various species of *Lysianassa*. *L. dissimilis* (Stout), Bahía de Los Angeles, Baja California: *a*, pereopod 5; *b*, pleonal epimeron 3; *c*, epistome-upper lip complex; *d*, inner lobe of maxilla 1; *e*, uropod 3; *f*, outer plate of maxilla 1. *Lysianassa oculata*, juvenile, southern California: *g*, outer lobe of maxilla 1; *h*, inner lobe of maxilla 1. *Lysianassa holmesi*, Bahía de San Quintín, Baja California: *i*, outer plate of maxilla 1; *j*, inner lobe of maxilla 1.

species have been described from the Mediterranean, those marked with asterisks being obscure: *Lysianassa septentrionalis* * (Della Valle, 1893) [=*L. plumosa* fide Stebbing, 1906], *L. bispinosa* (Della Valle, 1893) [later removed to *Arugella* by Pirlot, 1939], *L. longicornis* Lucas, *L. spinicornis* * (Costa), *L. loricata* * (Costa), *L. filicornis* * (Costa) [the latter three considered by Stebbing (1906) as possible synonyms of *L. longicornis*, but there are obvious discrepancies in this thinking if one examines original figures and descriptions], *L. ceratina* (Walker) [considered a synomyn of *L. longicornis* and originally described from outside the Mediterranean], *L. punctata* (Costa) and *L. pilicornis** Heller. Hence, the detection of *L. costae* will be a difficult task and until it is recognized there can be little nomenclatural rearranging in this and associated genera. But there appears to be a good case for submerging several genera in the *Lysianassa*-complex if *L. plumosa* and *L. costae* are found to be congeneric. Hurley (1963), in a most interesting discussion, has set in motion the recombination of these genera by fusing *Aruga* Holmes and *Shoemakerella* Pirlot with *Lysianopsis* Holmes.

In order to show variations of other species and genera, the following diagnosis, based on *L. plumosa* Boeck, as analyzed by Sars (1895: pl. 16), is given as an interim model:

Diagnosis of *Lysianassa plumosa* Boeck.—Upper lip forming a linguiform lobe strongly projecting anterior to buccal bundle, epistome poorly produced but distinctly lamelliform; mandibular cutting edge smooth except for a lateral incision delineating a boss, molar distally located, small, conical, setulose, palp attached distinctly proximal to molar, article 1 elongated and nearly as long as article 3; inner lobe of maxilla 1 lacking distal setae, outer lobe with a single kind of serrate spines (but with only 7 occurring in Sars' figure, thus indicating a second smaller set may be present); outer lobe of maxilla 2 half as broad as inner; article 4 of maxillipedal palp slender, about 40% as long as article 3; gnathopod 2 with subchelate palm, not minutely chelate; coxa 1 quite broad, nearly concealing all mouthparts, expanded distally; uropod 2 apparently with inner ramus not constricted; uropod 3 slender, long, peduncle longer than telson, not forming a lamellar plate, rami slender, slightly shorter than peduncle; telson linguiform, entire, apex slightly convex.

Other species appearing to be typical in most of these generic characters are (1) *L. cinghalensis* (Stebbing, 1897), which, however, has a constricted inner ramus of uropod 2, and which, being based on a male, has an elongated second antennal flagellum and setose rami of uropod 3; (2) *L. variegata* (Stimpson), based on Stebbing (1888), differing from *L. plumosa* in the strongly notched telson, the narrower outer lobe of maxilla 2 (appearing to have been drawn in an oblique position), with typical male antenna 2 and uropod 3; (3) *L. punctata* (Costa), as based on Della Valle (1893), differing by the incised telson, the asymmetrical expansion of article 2 on pereopod 3, the presence of an attenuated, blunt posterior lobe on coxa 4 and a slightly aberrant maxillipedal palp; (4) *L. dartevillei* Ruffo (1953).

Species with a slight modification of the upper lip-epistomal complex are *L. longicornis* Lucas (as shown by Chevreux and Fage, 1925), including provisionally *L. ceratina* (Walker): the upper lip projects only slightly in front of the epistome because the latter is formed into a short keel projecting along with the upper lip; uropod 2 has a constricted inner ramus but uropod 3 is normal.

Species with a slight modification of uropod 3 are: (1) *L. coelochir* (Walker, 1904) with the peduncle slightly lamelliform laterally but as elongated as in *L. plumosa*, gnathopod 2 with strongly excavate palm, uropod 2 possibly with constricted inner ramus; (2) *L. urodus* (Walker and Scott, 1903), a species appearing to be distinct from *L. cinghalensis* by the shapes of pereopods 3–5.

Species with a strong modification of uropod 3 are: (1) *L. falcata* Stephensen (1933b) with the peduncle slightly lamelliform and slightly shortened gnathopod 2 with a bulky palmar projection, gnathopod 1 strongly subfalcate and uropod 2 lacking a constriction; (2) *L. hummelincki* Stephensen (1933b), with uropod 3 strongly shortened, the peduncle lamellar, gnathopod 2 minutely chelate, and uropod 2 possibly with a slight constriction; (3) *L. bonairensis* Stephensen (1933a) with uropod 3 in the male having the nonlamelliform peduncle but the appendage being strongly shortened, gnathopod 2 minutely chelate, uropod 2 unconstricted, upper lip and epistome together projecting equally, the lobe of the upper lip being shorter than in other species of the genus.

Other taxa presently assigned to *Lysianassa* are: (1) *L. hypocrita* Ruffo (1953), highly aberrant in its greatly shortened fourth articles of the maxillipedal palps and in the peculiar second maxillae, reminiscent of certain stegocephalids having a geniculately connected outer plate; probably this species deserves generic recognition; (2) *L. anomala* Nicholls (1938) with its apparently coalesced upper lip and epistome lacking a demarcating sinus; probably this species is referable to *Parambasia* (if correctly conceived of by Stephensen, 1927).

Except for the substitute model, *L. plumosa*, only *L. cinghalensis* of those species assigned to *Lysianassa*, has any tendency to the greatly elongated article 1 of the mandibular palp, but indeed it forms a perfect intergrade between *L. plumosa* and the other species.

A number of species in allied genera, some of which were assigned formerly to *Lysianassa* are now discussed.

Lysianassa bispinosa (Della Valle, see Chevreux and Fage, 1925) was transferred to *Arugella* by Pirlot (1939). Based on the type species, *Arugella heterodonta* Pirlot (1936), the diagnosis of that genus, in outline comparable to that of *L. plumosa*, would be as follows:

Diagnosis of *Arugella* Pirlot (1936).—Upper lip forming a linguiform lobe projecting in front of epistome; mandibular cutting edge with a deep incision delineating a lateral boss, molar located rather distally, small, subconical, setulose, palp attached quite proximal to molar, article 1 not elongated, about half as long as article 3; inner lobe of maxilla 1 lacking long distal setae, bearing small setules, outer lobe with 2 sets of spines, one set of normally serrated spines and a smaller set of apically bifid spines; outer lobe of maxilla 2 about half as broad as inner; article 4 of maxillipedal palp about 15–20% as long as article 3, relatively stout; gnathopod 2 with minutely chelate palm; coxa 1 very broad but not concealing mouthparts, expanded distally; uropod 2 with constricted inner ramus; uropod 3 moderately stout, short, peduncle subequal to telson in length, partially expanded into a lamellar plate laterally, rami slender, short, not longer than peduncle; telson linguiform, entire, apex slightly convex.

Arugella differs from *L. plumosa* in uropod 3, but several species now assigned to *Lysianassa* intermediate the differences and some species of *Lysianassa* are identical with *Arugella* in this character. The dimorphism of spines on maxilla 1 forms the principal difference between *Lysianassa* and *Arugella* but that may be figmentary if Sars failed to illustrate them for *L. plumosa*. *Lysianassa falklandica* K. H. Barnard (1932) apparently was transferred to *Arugella* by Pirlot (1939) on the presumption of a close relationship to *A. bispinosa*

The genus "*Shoemakerella*", as diagnosed in sequel, is figmentary in the sense, as pointed out by Hurley (1963), that Pirlot (1936) designated *Lysianassa nasuta* Dana as its type and assumed that *Lysianax cubensis* Stebbing (1897) was a junior synonym of *L. nasuta*. Thus, the diagnosis of the genus is in reality based on *L. cubensis* and the type species, *L. nasuta*, remains obscure.

Diagnosis of *Shoemakerella* "*nasuta*" (Dana) of Pirlot (1936), not Dana (=*Lysianax cubensis* Stebbing, 1897 as senior synonym).—Upper lip forming a linguiform lobe projecting in front of epistome; mandibular cutting edge with a deep incision delineating a lateral boss, molar located rather distally, practically obsolete, forming a small hump armed with a stout seta, otherwise setulose, palp attached proximal to molar, article 1 not elongated, about half as long as article 2; inner plate of maxilla 1 lacking setae, outer plate with a single kind of spine; outer lobe of maxilla 2 half as broad as inner, the inner lobe especially flabellate; article 4 of maxillipedal palp nearly half as long as article 3, relatively stout; gnathopod 2 with subchelate palm; coxa 1 very broad, nearly concealing mouth-parts, expanded distally; uropod 2 with constricted inner ramus; uropod 3 stout, short, peduncle subequal to telson in length, lamelliform laterally, rami slender, short, not longer than peduncle; telson linguiform, entire, apex truncate and slightly concave.

The provisonal *Shoemakerella* differs from *L. plumosa* by the short uropod 3, its lamilliform peduncle, the flabellate inner lobe of the second maxilla, the short first mandibular palp article and the obsolescent mandibular molar. It is connected to *Lysianassa* by *L. hummelincki* but the mouthparts of that species have not been described. It differs from *Arugella* by the single kind of spine on the outer plate of maxilla 2.

Diagnosis of *Lysianopsis alba* Holmes (see 1905).—Upper lip forming a linguiform lobe projecting in front of epistome; mandibular cutting edge with a deep incision delineating a lateral boss, molar medially located, small, projecting, subconical, setulose, palp attached distinctly but not greatly proximal to molar, article 1 not elongated, half as long as article 3; inner plate of maxilla 1 bearing 2 terminal setae, outer plate with essentially 2 types of spines, one large serrated kind, one smaller kind with bifid or trifid apices (but not as small as in *Arugella*); lobes of maxilla 2 subequal in breadth; article 4 of maxillipedal palp about 40% as long as article 3; gnathopod 2 with slightly chelate palm; coxa 1 very broad, partially concealing mouthparts, expanded distally; uropod 2 with constricted inner ramus; uropod 3 stout, short, peduncle apparently subequal to telson, lamelliform laterally, rami slender, not longer than peduncle; telson linguiform, entire, apex convex.

Until Hurley (1963) submerged *Aruga* and *Shoemakerella*, the genus *Lysianopsis* was monotypic. *Aruga* differed from it only by the elongated second antennae of the male and *Shoemakerella* primarily by the flabellate inner lobe of maxilla 2.

Diagnosis of *Aruga oculata* Holmes (1908).—Article 2 but not article 3 of antenna 1 extraordinarily long for the family Lysianassidae (both articles 2–3 elongated in the other genera related to *Lysianassa*); upper lip forming a linguiform lobe projecting in front of epistome; mandibular cutting edge with accessory lobe not conspicuously set off by incision, molar moderately large, setulose, palp attached at proximal end of molar, article 1 elongated and nearly as long as article 3; inner plate of maxilla 1 with 2 long setae, outer plate with 2 sets of serrated spines; lobes of maxilla 2 equal in breadth; article 4 of maxillipedal palp about half as long as article 3, slender; gnathopod 2 minutely chelate; coxa 1 very broad, partially concealing mouthparts, expanded distally; uropod 2 with constricted inner ramus; uropod 3 relatively slender, peduncle distolaterally lamelliform, rami equal to peduncle in length; telson truncated, apex slightly concave.

Aruga included *A. dissimilis* (Stout, 1913), *A. holmesi* J. L. Barnard (1955c), *A. oculata* Holmes (1908), *A. subantarctica* Schellenberg (1931), and *A. macromerus* Shoemaker (1916).

Diagnosis of *Pronannonyx minimus* Schellenberg (1953).—Upper lip forming a linguiform lobe in front of epistome; mandibular cutting edge unknown, molar apparently distally located, very small, lobular, palp attachment unknown, article 1 elongated, nearly as long as article 3; outer plate of maxilla 1 with 2 sets of spines, one set normally serrated and other set smaller and apically bifid; maxilla 2 with plates equally slender; maxillipedal palp scarcely exceeding apex of outer plate, article 4 nearly half as long as article 3 and very slender; gnathopod 2 minutely chelate; coxa 1 very broad but not concealing all of mouthparts, slightly expanded distally; uropod 2 apparently with unconstricted inner ramus; uropod 3 stout, short, peduncle subequal to outer ramus, inner ramus about two thirds as long as outer ramus, peduncle lamellar distolaterally; telson linguiform, entire, apex convex. Genus monotypic.

Diagnosis of *Parambasia forbesi* Walker and Scott (1903).—Upper lip and epistome undescribed; mandibles unclear; maxillae not described; article 4 of maxillipedal palp apparently half as long as article 3; gnathopod 2 with slight indication of chelation; coxa 1 very broad, apparently concealing all mouthparts, expanded distally; uropod 2 apparently with unconstricted inner ramus; uropod 3 relatively slender, rami slightly shorter than peduncle, latter with scarce indication of becoming lamellar distally; telson linguiform, entire, apex convex.

The absence of notes on the upper lip suggests that it is inconspicuous and perhaps fused with the epistome, as it appears to be in *Parambasia* (?) *rossii* Stephensen (1927). Hurley (1963) writes that this is true of New Zealand parambasias and suggests that *Pseudambasia* Stephensen (1927) is a synonym of *Parambasia*.

The upper lip of *Socarnella* Walker (1904) is undescribed and that genus cannot be related clearly to the other genera discussed herein. It has been assumed from its name that the gills are strongly plaited as in *Socarnes*. If they are not and the upper lip is socarnid-like (=lysianassid-like also) then *Socarnella* could be relegated to *Lysianassa*.

Parawaldeckia Stebbing, erected for *Nannonyx thomsoni* Stebbing, which apparently is not a junior synonym of *Lysianassa kidderi* Smith, differs from the known species of *Lysianassa* by the reduced inner ramus of uropod 3, in resemblance to *Nannonyx* Sars. A new species of *Lysianassa* to follow intergrades *P. thomsoni* and *Lysianassa* in the condition of uropod 3 but the extreme reduction of the inner ramus of *P. thomsoni* warrants a retention of the genus.

Nannonyx Sars (see 1895) differs from the other genera being discussed by the complete fusion of the epistome and upper lip, the lack of any sinus in that complex, and the slight protrusion of the upper part of the complex in front of the lower part.

Paralibrotus Stephensen (1923) has shortened articles 2 and 3 of the peduncle of antenna 1, the upper lip-epistome complex is intermediate between that of *Nannonyx* and *Lysianassa* (in its lesser projection and less clearly defined divisory sinus), the mandibular palp is attached nearly level with the molar, and coxa 4 lacks a posteroventral quadrate lobe.

Key to Genera Related to *Lysianassa plumosa*

1. Inner plate of maxilla 2 flabelliform . . . . **Shoemakerella**
   Inner plate of maxilla 2 not flabelliform 2

2. Lobes of maxilla 2 equal in breadth 3
   Inner lobe of maxilla 2 nearly twice as broad as outer 4
3. Male antenna 2, flagellum greatly elongated . . . **?Pronannonyx** and **Aruga**
   Male antenna 2, flagellum not longer than in female . . . . . **Lysianopsis**
4. Maxilla 1, outer plate with 2 kinds of spines . . . . **Arugella**
   Maxilla 1, outer plate with 1 kind of spines . . . . **"Lysianassa"**

As shown in the diagnoses and key above, the genera allied to *Lysianassa plumosa* display a bewildering array of morphological intergradations suggesting the necessity for their reduction to, at best, subgeneric positions. Even this status fails a test as the following discussion intends to show. Unfortunately, "official" implementation of this revision cannot be activated until the type species of *Lysianassa* is rediscovered and described adequately. The characteristics used to distinguish the genera in the past are as follows:

MAXILLA 1.—The inner plate bears no primary setae in *Lysianassa plumosa*, *Shoemakerella*, and *Arugella*, and 2 setae in *Lysianopsis*, *Aruga*, and ?*Pronannonyx*. The outer plate bears a single set of serrated spines in *L. plumosa* and *Shoemakerella*, an accessory set of partially bifid, slightly smaller spines in *Lysianopsis*, *Aruga*, and *Pronannonyx*, and an accessory set of very small bifid spines in *Arugella*. The drawings of the various type species generally show 7 large spines but only in *Lysianopsis*, *Arugella*, *Aruga*, and *Pronannonyx* have the additional 4 spines been discovered, leading to the suggestion that they may be present in the remaining genera and species but were overlooked or considered to be spines of the subsequent instar. *Arugella* was characterized by its exceedingly slender, bifid set of secondary spines, but intergradation to stout, serrated spines is seen in several other species: *Aruga oculata*, *A. dissimilis*, and *Lysianassa pariter*, n.sp.

MAXILLA 2.—The inner plate of *Shoemakerella* is broadly flabellate and twice as broad as the outer plate. That of *Lysianassa plumosa* is sublanceolate and twice as broad as the outer plate. The inner plate of *Arugella* and *Pronannonyx* is similar to that of *L. plumosa* but is only slightly broader than the outer plate. Both *Lysianopsis* and *Aruga* bear subequally broad plates. The conditions of this mouthpart in *Shoemakerella*, *L. plumosa*, and *Lysianopsis-Aruga* are sufficiently distinct for generic segregation, but *Arugella* forms a transitional stage between *Lysianassa* and *Aruga-Lysianopsis*. To a degree this reduces the significance of the condition in *Shoemakerella*. *Lysianassa hypocrita* is highly aberrant in its second maxilla.

MAXILLIPED.—The very short, nearly vestigial fourth maxillipedal palp article in *Arugella heterodonta* might be significant generically, but there is considerable variation in the length of that article in the other genera. *Lysianassa hypocrita* resembles *Arugella* in this regard

280-102 O-69—13

and so does *L. bonairensis*. Hurley (1963) suggests that the latter should be transferred to *Socarnella*. On the other hand, the suggested aggregation of all of these species and genera would necessitate removal of monotypic *Socarnella*, with its type *S. bonnieri*, to *Lysianassa* if reexamination of it proves the simplicity of its gills and the lysianassid-like upper lip and epistome.

Uropod 2.—There is a difference of opinion as to the generic value of the constriction of the inner ramus. Stebbing (1906) cited its presence as a generic character, but the type species of *Lysianassa* is obscure, and *L. plumosa*, as drawn by Sars (1895), lacks such constriction, although Sars is known to have overlooked this condition in other species of amphipods. Hurley (1963) attributes considerable significance to this constriction in his key to the subfamily Lysianassinae, thus segregating *Pronannonyx* and *Socarnella* from the *Lysianassa*-complex. Gurjanova (1962) considers such ornamentation as interspecific in her analysis of the genus *Anonyx* and shows significant intraspecific transitions in the development of this character. Thus, it is regarded as of no generic value in *Lysianassa* and its allies.

Uropod 3.—A plethora of variation and intergradation in this appendage, from a long to short and from a simple to lamelliform peduncle, indicates the uselessness of the extreme conditions as generic characters. Just those species now assigned to *Lysianassa* show most of the extremes. The uni- or biarticulate condition of the outer ramus, with its intergrading stage shown by Hurley (1963) for *Lysianopsis alba*, is considered to be of no generic significance, although Hurley utilizes the variable in his key to Lysianassinae to distinguish several genera (e.g., *Socarnes* as opposed to *Socarnopsis* in train from couplet 11, p. 66).

Upper lip and epistome.—The upper lip of all the genera is produced forward strongly, although it is conspicuously shorter in *Aruga dissimilis*, for example, and in several species such as *A. dissimilis*, *Lysianassa bonairensis*, and *L. longicornis* the epistome projects in varying degrees along with the upper lip. There is no qualitative point at which to separate generically these examples of intergradation, despite J. L. Barnard's (1955c) hesitation in regard to *Aruga dissimilis*.

Kinds of *Lysianassa*.—A number of subdivisions of *Lysianassa* may be seen in the accompanying table and these could be subdivided further using characters of maxillae, maxilliped, male second antennae, and uropod 2. Because the lamelliform state of the peduncle of uropod 3 is so variable each group has been further divided only to categories A and B.

Division 1 A–B has no available subgeneric appellation unless *Lysianassa costae* proves to belong to the group; division 2 A–B has 3 generic names available, *Arugella*, *Shoemakerella*, and *Pronannonyx*, and possibly a fourth, *Lysianassa*, if *L. costae* proves to be the senior synonym of *L. bispinosa;* division 3 A–B has *Aruga* as a name but division 4 is composed only of *Aruga dissimilis*.

Apparently no well known Mediterranean species has characters similar to Sars' analysis of *L. plumosa* (having a 2-articulate outer ramus of uropod 3); presuming one of those is *L. costae* the type species of *Lysianassa* will represent a point of departure from all other species assigned to it as of 1940, except *L. coelochir*.

Divisions of "Lysianassa"

Division	*Characters*	*Species*
1 A	Uropod 3, outer ramus 1-articulate Uropod 3, peduncle not lamelliform Epistome as long as upper lip	Lysianassa bonairensis [1] Lysianassa ceratina Lysianassa longicornis
1 B	Uropod 3, outer ramus 1-articulate Uropod 3, peduncle lamelliform Epistome as long as upper lip	Aruga macromerus Lysianassa pariter, n.sp.
2 A	Uropod 3, outer ramus 1-articulate Uropod 3, peduncle not lamelliform Upper lip projecting farther than epistome	Lysianassa cinghalensis Lysianassa dartevillei (Lysianassa hypocrita) Lysianassa variegata
2 B	Uropod 3, outer ramus 1-articulate Uropod 3, peduncle lamelliform Upper lip projecting farther than epistome	Lysianassa coelochir Arugella heterodonta Lysianassa falcata Arugella bispinosa Shoemakerella cubensis [2] Pronannonyx minimus (Socarnella bonnieri)
3 A	Uropod 3, outer ramus 2-articulate Uropod 3, peduncle not lamelliform Upper lip projecting farther than epistome	Lysianassa plumosa (model of genus herein)
3 B	Uropod 3, outer ramus 2-articulate Uropod 3, peduncle lamelliform Upper lip projecting farther than epistome	Aruga oculata Lysianopsis alba [3] (=L. hummelincki) Aruga holmesi Aruga subantarctica Arugella falklandica
4	Uropod 3, outer ramus 2-articulate Uropod 3, peduncle not lamelliform Epistome as long as upper lip	Aruga dissimilis

[1] Possibly equals *Scocarnella*, fide Hurley (1963) in view of unconstricted inner ramus of uropod 2.

[2] Equals *Shoemakerella nasuta* of Pirlot, not Dana.

[3] Hurley (1963) confirms the 2-articulate condition of uropod 3 outer ramus.

NOTE.—Table does not include *L. punctata* (Costa), *L. costae* Milne Edwards, and *L. nasuta* Dana.

Summary of remarks on *Lysianassa*.—Interspecific intergradations of upper lip, epistome, uropod 3, uropod 2, gnathopod 2, maxillipeds, and maxillae 1–2 prevent use of their alternate extreme conditions as generic characters in the *Lysianassa*-complex. Intergradation has been demonstrated also in the length of article 1 of the mandibular palp and there is little qualitative value in the mandibular molars. Some species of *Lysianassa* may have to be segregated generically because of their second maxillae (*L. hypocrita*), but there appears to be sufficient variation in the length of the fourth maxillipedal palp article to render its generic significance useless. The elongation of the second antennal flagellum in males of *Aruga* may have subgeneric value as has been suggested for *Harpinia* and *Harpiniopsis* in the Phoxocephalidae by J. L. Barnard (1958) and for *Aruga* and *Lysianopsis* by J. L. Barnard (1955c). The writer suggests a need for provisional fusion of all of the genera as listed in the synonymy at the beginning of this discussion in anticipation that *Lysianassa costae*, the type species, will fall into the scheme as developed.

If variations in articulation of outer rami of uropod 3 are to be ignored in the group of genera placed in the new subfamily Lysianassinae by Hurley (1963), as well as the constriction of the inner ramus of uropod 2, the generalized shape of maxilla 2 and the condition of the maxillipedal dactyl, then the distinctions of other genera allied to *Lysianassa* must be justified in ways other than so conveniently arranged by Hurley. Each of the genera *Nannonyx*, *Parawaldeckia*, *Paralibrotus* and *Parambasia* have been so distinguished in previous paragraphs.

Key to Californian Species of *Lysianassa*

1. Pereopods 1 and 2 with an enlarged distal spine on article 6 . . **L. macromerus**
   Pereopods 1 and 2 lacking an enlarged distal spine on article 6 2
2. Epistome projecting as far as upper lip 4
   Upper lip projecting much farther than epistome 3
3. Third pleonal epimeron slightly convex posteriorly . . . . **L. holmesi**
   Third pleonal epimeron posteriorly produced into a quadrate plate . **L. oculata**
4. Inner ramus of uropod 3 one third as broad and about five eighths as long as outer ramus, peduncle strongly expanded laterally, outer ramus uniarticulate . . . . **L. pariter**
   Inner ramus of uropod 3 nearly as broad and about four fifths as long as outer ramus, peduncle unexpanded laterally, outer ramus biarticulate **L. dissimilis**

Lysianassa dissimilis (Stout), new combination

Figure 47 a–f

Nannonyx dissimilis Stout, 1913, pp. 638–639.

Aruga dissimilis: Shoemaker, 1942b, p. 7, fig. 2.—J. L. Barnard, 1955c, pp. 100–103, pl. 29, figs. g, i.—Gurjanova, 1962, pp. 297–299, fig. 97.—J. L. Barnard, 1964a, p. 230.

Lysianopsis (?) *dissimilis:* Hurley, 1963, pp. 76–77, fig. 21d.

This species was collected originally by Stout from kelp holdfasts at Laguna Beach, California; apparently it does not inhabit the intertidal zone of that area and it is very scarce at Corona del Mar and La Jolla on either side. Instead, *L. macromerus* has been found to predominate in the intertidal of southern California. At first, *L. pariter*, a new species, was believed to be *A. dissimilis*. There are few identifying clues in the description given by Stout, but Shoemaker (1942b) redescribed *A. dissimilis* from Bahía Magdalena, 700 miles to the south. Specimens similar to his are at hand from Bahía de Los Angeles in the Gulf of California and from Pt. Conception, California, in a depth of about 18 meters. That Shoemaker's specimens represent what Stout described is supported by Stout's description of a biarticulate outer ramus of uropod 3 slightly exceeding the length of the inner ramus. This would eliminate *L. pariter* from consideration as Stout's species, even though she placed *A. dissimilis* originally in the genus *Nannonyx* Sars. The inner ramus of uropod 3 of *Nannonyx* and of *L. pariter* is significantly shorter than the outer ramus and the peduncle is more strongly expanded than in *A. dissimilis*.

That Shoemaker (1916) in his erection of *Aruga macromerus* also was not describing *Nannonyx dissimilis* Stout is shown in the uniarticulate outer ramus of uropod 3; otherwise there is nothing in Stout's meagre description to distinguish the two species.

Material.—goleta: *Macrocystis* holdfast, 3 m., rare. pt. dume: *Amaroucium* sp., scarce; loose rocks, rare. corona del mar: tunicate colonies at base of *Phyllospadix* leaves, moderately abundant; tunicates and soft polychaete tubes, rare. la jolla: *Phyllospadix*-coralline grid, scarce (11 per sq. m.).

Distribution.—Pt. Conception, California, southward to the tip of Baja California, and in the Gulf of California at Bahía de Los Angeles, 0–41 m. A moderately rare species, possibly associated with tunicates or sponges, but several gut analyses of the amphipod show contents of sand and silt particles.

Lysianassa macromerus (Shoemaker), new combination

Figures 48, 49

Aruga macromerus Shoemaker, 1916, pp. 157–158.—Gurjanova, 1962, pp. 296–297.
Lysianopsis (?) *macromerus* Hurley, 1963, p. 77.

Diagnosis.—Epistome lamellar, produced forward as keel slightly exceeding rather short plate of upper lip, notch between epistome and upper lip rather short for genus; mandibular palp attached proximal to molar but not as proximally as in most members of genus; inner plate of maxilla 1 with one long distal seta, outer plate with primary

FIGURE 48.—*Lysianassa macromerus* (Shoemaker), female, 5.0 mm., station 39–K–4: *a*, lateral view; *b*, epistome-upper lip complex; *c*, mandible; *d*, lower lip; *e*, *f*, maxillae 1, 2; *g*, maxilliped; *h*, inner lobe of maxilliped and enlargement of apical edge; *i*, end of maxillipedal palp; *j*, *k*, gnathopods 1, 2; *l*, end of gnathopod 2.

set of 7 serrated spines and secondary set of 3 slightly smaller, asymmetrically bifid (singly-serrate) spines; plates of maxilla 2 rather stout, short, inner plate about two thirds as broad as outer plate; palp of maxilliped greatly exceeding outer plate, article 4 of normal

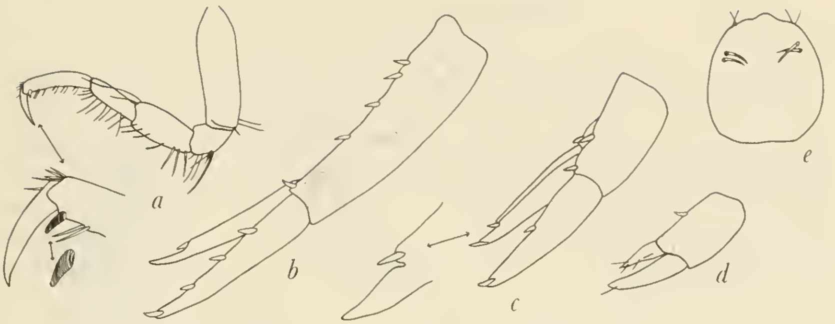

FIGURE 49.—*Lysianassa macromerus* (Shoemaker), female, 5.0 mm., station 39–K–4: *a*, pereopod 2; *b*, uropod 1; *c*, uropod 2; *d*, uropod 3; *e*, telson.

dimensions (not shortened as in *Arugella heterodonta* Pirlot); gnathopod 2 chelate; a large striated spine present on posterodistal end of article 6 of pereopods 1–2; pereopods 3–5 rather short, second articles unusually asymmetrical and broad, fourth articles broad, each with long posterior process nearly reaching end of article 5; article 5 about half as long as article 6; pleonal epimera 1–2 each with small tooth at posteroventral corner, third epimeron slightly convex posteriorly, rounded-quadrate at ventral corner, epimeron not prolonged posteriorly as in *Aruga oculata* Holmes; inner ramus of uropod 2 with marginal constriction; uropod 3 short, peduncle scarcely lamelliform, outer ramus equal to peduncle in length, uniarticulate, inner ramus about two thirds as long as outer ramus; telson entire, slightly convex apically.

MATERIAL.—CAYUCOS: *Phyllospadix*-pelvetiid grid, rare (6 per sq. m.). HAZARD CANYON: algal turf on platform, rare (6 per sq. m.). GOLETA: *Phyllospadix*-pelvetiid grid, second most abundant species (1588 per sq. m.). PT. DUME: short brown algae, fourth most abundant species (1020 per sq. m.); coralline algae, fifth most abundant species (1285 per sq. m.); pelvetiids, scarce (18 per sq. m.); short greenish brown algae, fourth most abundant species (176 per sq. m.); *Phragmatopoma* masses, scarce (73 per sq. m.); loose rocks, most abundant species; *Egregia* holdfasts, second most abundant species; in bed of *Anthopleura elegantissima*, very abundant. CORONA DEL MAR: *Phyllospadix*-coralline grid, scarce (28 per sq. m.); loose rocks, moderately abundant. LA JOLLA: sand-inundated algae at high tide line, fifth most abundant species (367 per sq. m.).

DISTRIBUTION.—Cayucos, California, to La Jolla, especially abundant in harsh environments as at Pt. Dume and Goleta and in sand-inundated algae at high tide line as at La Jolla.

Lysianassa pariter, new species

FIGURES 50, 51

DIAGNOSIS.—Epistome lamellar, produced forward as keel nearly as far as rather short plate of upper lip, notch between epistome and upper lip deep; mandibular palp attached well proximal of small setulose molar; inner plate of maxilla 1 slender, acute, with one seta attached subterminally, outer plate with primary set of 7 serrated spines and secondary set of 4 small serrated to bifid spines; plates of maxilla 2 subequal in width; maxillipedal palp greatly exceeding outer plate, article 4 of normal dimensions; gnathopod 2 chelate; pereopods 1–2 lacking large distal spine on article 6; pereopods 3–5 short, each of articles 4–6 much shorter than in *L. dissimilis* (Stout), posterior and ventral margins of expanded plate of article 2 merging uniformly, ventral edge bearing several setae, fourth articles of medium to poor expansion, fifth articles about two thirds to three quarters as long as sixth; pleonal epimeron 1 rounded at posteroventral corner, epimeron 2 with small tooth, epimeron 3 produced posteriorly as subquadrate plate; inner ramus of uropod 2 with marginal constriction; peduncle of uropod 3 expanded enormously as lamellifrom plate, outer ramus shorter than peduncle, uniarticulate, bearing 2 (1 in juveniles) stout spines, inner ramus slightly more than half as long as outer ramus, bearing one marginal spine; overall surface area of inner ramus about one fifth that of outer ramus, thus being unusually small; telson entire, apically truncate.

HOLOTYPE.—AHF No. 621, male, 5.7 mm.

TYPE LOCALITY.—Station 43–E–3, Cayucos, California, in dendritic sponge under rock, January 5–6, 1962.

RELATIONSHIP.—This species differs from *Lysianassa dissimilis* (Stout) (see Shoemaker, 1942b) by the uniarticulate outer ramus of uropod 3, the very short inner ramus, the more strongly expanded peduncle of uropod 3, the shorter pereopods with shorter articles, the lack of a sinus on the posteroventral margin of article 2 of pereopod 5, the presence of setae on the ventral edge of that article and the smaller secondary spines on the outer plate of maxilla 1.

Lysianassa pariter is not referrable to *Nannonyx* Sars, despite its reduced inner ramus of uropod 3 because of the lamellar and produced prebuccal parts bearing a dividing sinus. The species forms a perfect intergrade from *Lysianassa* to the type *Parawaldeckia thomsoni* Stebbing, the latter having an inner ramus of uropod 3 reduced to one third the length of the outer.

MATERIAL.—CAYUCOS: nodose pink tunicate under rocks, abundant; sponge under same rock, rare. LA JOLLA: tunicate and sponge scrapings under platform, rare.

DISTRIBUTION.—Cayucos to La Jolla, California.

FIGURE 50.—*Lysianassa pariter*, new species, male, 5.7 mm., station 43–E–3: *a*, *b*, antennae 1, 2; *c*, head and epistome-upper lip complex; *d*, mandible; *e*, maxilla 1, spination of inner plate broken; *f*, outer plate of maxilla 1; *g*, inner plate of maxilla 1; *h*, maxilla 2; *i*, *j*, maxillipeds; *k*, pleonal epimera 1–3, left to right. Another specimen, station 45–W–1: *l*, left pleonal epimeron 3.

Ocosingo borlus J. L. Barnard

FIGURES 52, 53

Ocosingo borlus J. L. Barnard, 1964a, p. 231, figs. 5, 6.

MATERIAL.—CARMEL: algal holdfasts, rare; *Phyllospadix* roots below water, rare; tunicates and sponges, rare. CAYUCOS: *Phyllo-*

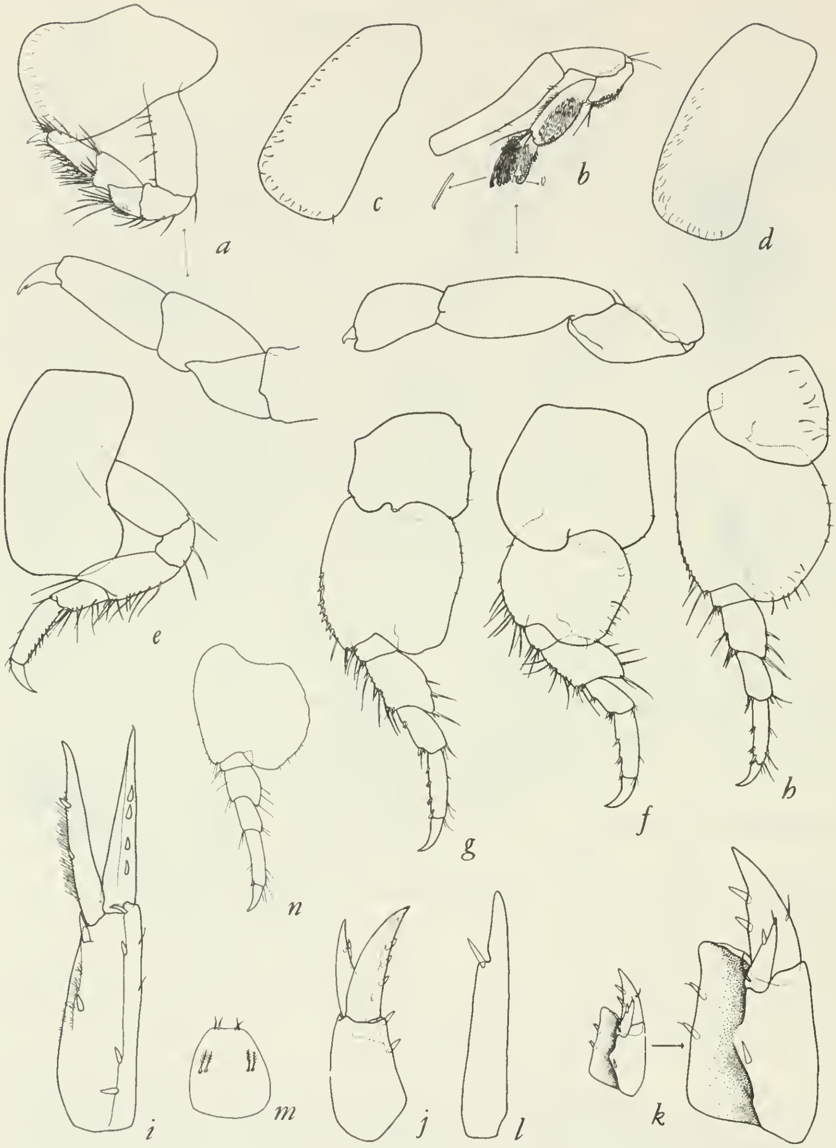

FIGURE 51.—*Lysianassa pariter*, new species, male, 5.7 mm., station 43-E-3: *a*, *b*, gnathopods 1, 2; *c*, *d*, coxae 2, 3; *e*, *f*, *g*, *h*, pereopods 2, 3, 4, 5; *i*, *j*, *k*, uropods 1, 2, 3; *l*, inner ramus of uropod 3; *m*, telson. Juvenile specimen, station 45-W-1: *n*, pereopod 5.

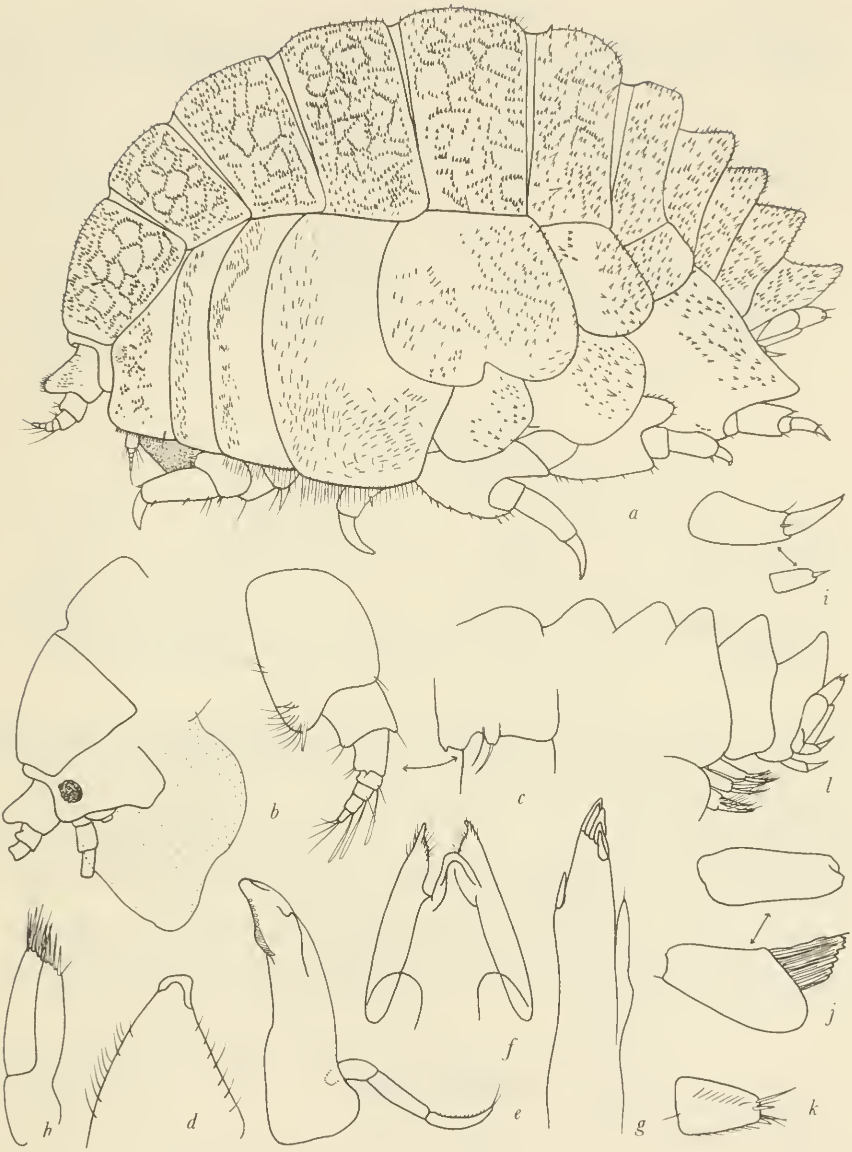

FIGURE 52.—*Ocosingo borlus* J. L. Barnard, male, 2.0 mm., holotype, "Velero" station 6206, Bahía de San Ramón, Baja California: *a*, lateral view; *b*, head and outline of mouthpart bundle; *c*, antenna 1; *d*, upper lip; *e*, mandible; *f*, lower lip; *g*, *h*, maxillae 1, 2; *i*, uropod 1; *j*, uropod 3; *k*, telson.

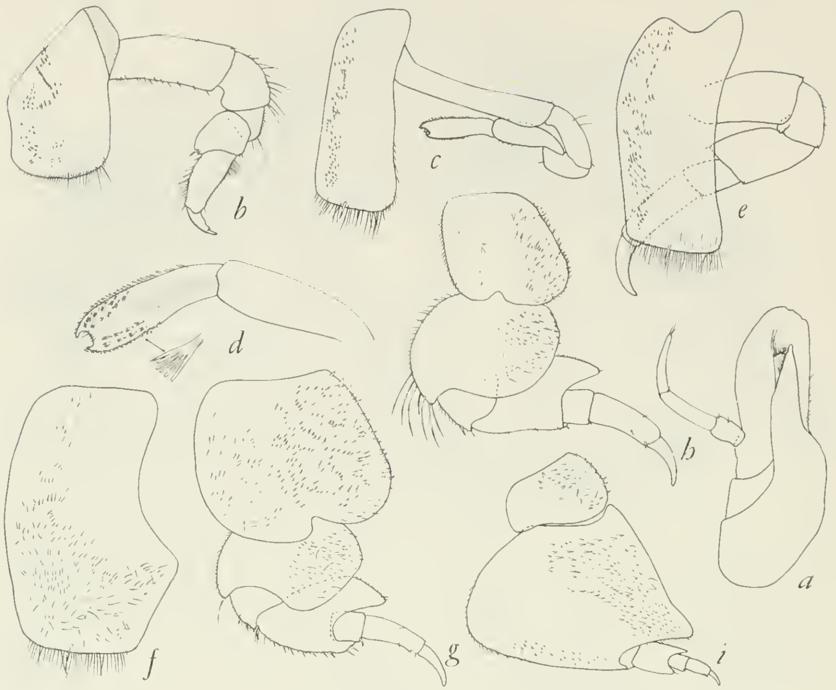

FIGURE 53.—*Ocosingo borlus*, J. L. Barnard, male, 2.0 mm., holotype, "Velero" station 6206, Bahía de San Ramón, Baja California: *a*, maxilliped; *b*, gnathopod 1; *c*, *d*, gnathopod 2; *e*, pereopod 1; *f*, coxa 4; *g*, *h*, *i*, pereopods 3, 4, 5.

spadix-pelvetiid grid, rare (3 per sq. m.); *Macrocystis* holdfast, rare; polychaete tubes and sponge scrapings, rare; sponge, rare to scarce; *Amaroucium* sp., abundant.

DISTRIBUTION.—Monterey Bay, California, to Bahía de San Cristóbal, Baja California, 0–180 m., submerging below intertidal levels south of Pt. Conception.

Orchomene magdalenensis (Shoemaker)

Orchomenella magdalenensis Shoemaker, 1942b, pp. 4–7, fig. 1.—Gurjanova, 1962, pp. 181–182, fig. 56.

Orchomene magdalenensis: J. L. Barnard, 1964a, pp. 231–232; 1964b, p. 95, fig. 12, chart 2.

Tryphosa magdalenensis: Hurley, 1963, pp. 132–133.

Although Hurley (1963) has transferred this species to *Tryphosa*, that genus is well characterized by the tapering first coxa which *O. magdalenensis* does not have.

MATERIAL.—LA JOLLA, underrocks, rare.

DISTRIBUTION.—Bahía Magdalena, Baja California, to La Jolla, California; in Bahía de Los Angeles, Gulf of California (specimens at hand); depth range, 0–11 m. This and the following species, *O. pacifica*, are a closely related pair meeting in southern California, *O. pacifica* slightly overlapping the former's range by submergence.

Orchomene pacifica (Gurjanova)

Orchomenella pacifica Gurjanova, 1951, p. 287, fig. 155; 1962, pp. 174–177, figs. 52, 53.
Orchomene pacifica: J. L. Barnard, 1962b, p. 92, fig. 13.

MATERIAL.—GOLETA: *Macrocystis* holdfast, 3 m., rare.

DISTRIBUTION.—Japan Sea to coastal shelf of southern California, in southern California on the shelf mainly in depths of 46 to 183 m., one record at 3 m. (above).

Oedicerotidae

Synchelidium sp. M

A species to be described as new in a paper in preparation; characterized by miniaturized pleonite 2.

MATERIAL.—GOLETA: *Macrocystis* holdfast, 3 m., rare; *Egregia laevigata*, rare.

DISTRIBUTION.—Coastal shallows of southern California, 0–5 m. especially on sand bottoms just seaward of surf zone.

Synchelidium shoemakeri Mills

Synchelidium shoemakeri Mills, 1962, pp. 15–17, fig. 4.

MATERIAL.—GOLETA: *Phyllospadix*-pelvetiid grid, rare.

DISTRIBUTION.—British Columbia to coastal shelf of southern California, 0–183+ m.

Synchelidium rectipalmum Mills

Synchelidium rectipalmum Mills, 1962, pp. 17–19, fig. 5.

MATERIAL.—LA JOLLA: *Phyllospadix*-coralline grid, scarce (33 per sq. m.); underrock substrate, rare.

DISTRIBUTION.—British Columbia to Costa Rica (specimens at hand), 0–183 +m.

Phliantidae

Heterophlias seclusus escabrosa J. L. Barnard

Heterophlias seclusus Shoemaker, 1933b, pp. 250–252, figs. 4, 5.
Heterophlias seclusus escabrosa J. L. Barnard, 1962b, pp. 79–80, fig. 5.

These specimens show 9–10 subrounded castellations on the anterior edge of the rostrum from dorsal view, not described for the stem subspecies and overlooked by Barnard (1962b). They are present on Barnard's original material but are less well developed than in these large specimens 3.5–3.8 mm. long.

MATERIAL.—CARMEL: *Macrocystis* holdfast, rare. GOLETA: *Macrocystis* holdfast, 3 m., abundant. LA JOLLA: underrock substrate, moderately abundant (38 per sq. m.); *Phyllospadix*-coralline grid, scarce (11 per sq. m.).

PACIFIC DISTRIBUTION.—Cayucos to La Jolla, California; Bahía de Los Angeles, Baja California (specimen at hand).

Phoxocephalidae

Mandibulophoxus uncirostratus (Giles)

Mandibulophoxus uncirostratus (Giles): J. L. Barnard, 1957, pp. 435–436; 1960b, p. 359 (with synonymy).
Mandibulophoxus gilesi J. L. Barnard, 1957, pp. 433–435, figs. 1, 2.

MATERIAL.—EUREKA area, California: Clam Beach, 41°00′36″ N, 124°06′36″ W, July 17, 1958 (1 specimen); Samoa, 40°47′53″ N, 124°11′23″ W, June 16, 1958 (4 specimens), collections by Dr. George H. Allen, Humboldt State College; GOLETA: sand on shore, intertidal, present.

DISTRIBUTION.—Madras coast; Ceylon; southern Californian coastal shelf and north to Clam Bay, Eureka, California, 0–18 m., on sand bottoms, especially in or near surf zone.

Metaphoxus frequens J. L. Barnard

Metaphoxus frequens J. L. Barnard, 1960b, pp. 304–306, pls. 51, 52; 1964a, p. 242.

MATERIAL.—GOLETA: wash of transition zone between pure *Phyllospadix* and pelvetiids, rare.

DISTRIBUTION.—Monterey Bay, California, to Isla Isabel, Mexico, generally 13–458 m., here at 0 m.

Metaphoxus fultoni (Scott)

Metaphoxus fultoni (Scott): J. L. Barnard, 1960b, p. 304 (with synonymy); 1964b, p. 103, fig. 18.

MATERIAL.—GOLETA: *Macrocystis* holdfast, 3 m., rare.

DISTRIBUTION.—Northeastern Atlantic from northern British Isles into Mediterranean at Naples; eastern Pacific Ocean from Monterey Bay, California, to Bahía de San Cristóbal, Baja California, 0–170 m.

Paraphoxus heterocuspidatus J. L. Barnard

Paraphoxus heterocuspidatus J. L. Barnard, 1960b, pp. 224–226, pls. 19, 20; 1964b, pp. 103–105.

The largest specimen of this series, a female, 5.2 mm., from station 39–H–2, differs from the subintertidal populations of southern California by the increased breadth of the fourth and fifth articles of pereopods 3 and 4, and by the evenly developed, intersimilar, and small teeth of article 2 of pereopod 5.

MATERIAL.—GOLETA: *Phyllospadix*-pelvetiid grid, scarce (15 per sq. m.). PT. DUME: short brown algae, scarce (44 per sq. m.); loose rocks, rare; *Egregia* holdfast, rare.

DISTRIBUTION.—Pt. Conception, California, to Bahía de San Quintín, Baja California, 0–45 m.

Paraphoxus jonesi J. L. Barnard

Paraphoxus jonesi J. L. Barnard, 1963, pp. 463–464, fig. 7.

MATERIAL.—GOLETA: sand on shore, present.

DISTRIBUTION.—Southern California, 0–18 m. on sand bottoms.

Paraphoxus obtusidens (Alderman)

Pontharpinia obtusidens Alderman, 1936, pp. 54–56, figs. 1–13, 19.
Paraphoxus obtusidens: J. L. Barnard, 1960b, pp. 249–259, pls. 33–37 (with synonymy); 1964a, p. 244.

MATERIAL.—HAZARD CANYON: algal turf on platform, scarce (22 per sq. m.). GOLETA: *Phyllospadix*-pelvetiid grid, scarce (12 per sq. m.); sand on shore, present. PT. DUME: short brown algae, rare (18 per sq. m.).

DISTRIBUTION.—Kurile Islands to Colombia, South America, 0–180 m.

Paraphoxus spinosus Holmes

Paraphoxus spinosus Holmes, 1905, pp. 477–478, fig. 12.—Shoemaker, 1925, pp. 26–27.—J. L. Barnard, 1960b, pp. 243–249, pls. 29–31; 1964b, p. 105.

MATERIAL.—CARMEL: Pelvetiid-*Phyllospadix* grid, rare (10 per sq. m.). CAYUCOS: *Phyllospadix*-pelvetiid grid, moderately abundant (332 per sq. m.); buried cobbles, rare; sand under boulder, very abundant; new growth brown algae, abundant. HAZARD CANYON: *Egregia-Laminaria* holdfasts, rare; *Phyllospadix* on sand, moderately abundant; coralline algae, rare; sponge, moderately abundant. GOLETA: *Phyllospadix*-pelvetiid grid, moderately abundant (88 per sq. m.); *Macrocystis* holdfast, 3 m., rare. PT. DUME: short brown algae, moderately abundant to second most abundant species (35 to 154 to 343 per sq. m.); coralline algae, rare (18 per sq. m.); *Amaroucium* sp., rare; loose rocks, rare; *Egregia* holdfast, rare. CORONA DEL MAR: underrock substrate, rare; *Phyllospadix*-coralline grid, rare (4 per sq. m.). LA JOLLA: *Phyllospadix*-coralline grid, moderately abundant (303 per sq. m.); short-tufted red algae, scarce (29 per sq. m.); sand-inundated algae at high tide line, rare (59 per sq. m.); underrock grid, rare (6 per sq. m.); coralline algae, rare.

DISTRIBUTION.—Western Atlantic Ocean; eastern Pacific Ocean from Puget Sound, Washington, to Gulf of California, 0–73 m. but generally shallower than 35 m.

Paraphoxus stenodes J. L. Barnard

Paraphoxus stenodes J. L. Barnard, 1960b, pp. 221–224, pls. 17, 18; 1964a, pp. 244–245.

MATERIAL.—GOLETA: *Phyllospadix*-pelvetiid grid, scarce (10 per sq. m.).

DISTRIBUTION.—Pt. Conception, California, to Bahía de San Cristóbal, Baja California, 5–88 m., rare in intertidal.

Pleustidae

Parapleustes Buchholz

Key to *Parapleustes*

1. Body with dorsal teeth 2
   Body lacking dorsal teeth 3
2. One pleonite with dorsal tooth . . . . **P. monocuspis**
   Two pleonites with dorsal teeth . . . . **P. bicuspis**
3. Pereopods 1–2 with sixth articles slightly inflated, furnished densely with spines to form grasping appendage . . . . **P. commensalis**
   Pereopods 1–2 simple 4
4. Gnathopods lacking posterior lobes on fifth articles 5
   Gnathopods bearing distinct posterior lobes on fifth articles 6
5. Gnathopodal palms very oblique, palm on second gnathopod 65% as long as posterior margin of article 6 . . . . **P. assimilis**
   Gnathopodal palms less oblique than above, palm on second gnathopod 30% as long as posterior margin of article 6 . . **P. pacificus, johanseni, oculatus**
6. Gnathopodal palms with broad, shallow medial tooth . . . . . . **P. major**
   Gnathopodal palms with minute cusp or no teeth 7
7. Antenna 1 not longer than first 4 body segments 8
   Antenna 1 longer than first 5 body segments 9
8. Sixth articles of gnathopods suboval . . . . **P. gracilis**
   Sixth articles of gnathopods rectangular . . . . **P. nautilus**, n.sp.
9. Eye triangular . . . . **P. trianguloculatus**
   Eye round, reniform or oval 10
10. Gnathopods densely setose, palms indistinct from posterior margins of sixth articles . . . . **P. den**, n.sp.
    Gnathopods poorly setose, palms distinct 11
11. Third pleonal epimeron with distinct posteroventral tooth, palms of gnathopods lacking sharp medial cusp . . . . **P. sinuipalma**
    Third pleonal epimeron sharply quadrate or with scarcely distinct prolongation, palms of gnathopods with sharp medial cusp. **P. derzhavini, pugettensis**

Notes: Literature on *Parapleustes mielcki* (Sokolowsky) not seen.
Possibly *P. pacifica* and *P. johanseni* are synonyms of *P. oculatus*.
Possibly *P. derzhavini* is a synonym of *P. pugettensis*.

References on next page.

Parapleustes den, new species

FIGURE 54

DIAGNOSIS.—Eyes reniform; lateral cephalic lobes obtuse; antenna 1 longer than first 5 body segments; body lacking dorsal processes; pereopods 1–2 not formed into spinose grasping organs; gnathopods large for genus, fifth articles bearing densely setose posterior lobes, palms not distinct from posterior margins of sixth articles, lacking medial cusps, densely setose; telson linguiform; pleonal epimeron 3 slightly sinuous posteriorly, prolonged acutely at posteroventral corner.

HOLOTYPE.—AHF No. 559, male, 8.0 mm.

TYPE LOCALITY.—Barnard station 6, Corona del Mar, California, wash of masses of *Phragmatopoma* sp., February 6, 1955.

MATERIAL.—16 specimens from the type locality.

RELATIONSHIP.—The densely setose gnathopods lacking distinct palms distinguish the species from all others in the genus except for the dorsally processiferous *Parapleustes monocuspis* (Sars, 1895) and *P. bicuspis* (Krøyer, see Sars, 1895).

Parapleustes nautilus, new species

FIGURE 55

DIAGNOSIS.—Eyes oval, small; lateral cephalic lobes obtuse; antennae not longer than first 4 body segments; body lacking dorsal processes; pereopods 1–2 not formed into spinose grasping organs; gnathopods medium in size for genus, fifth articles with blunt, rather broad, short posterior lobes, sixth articles rectangular, palms oblique but shorter than posterior margins of sixth articles, palms smooth, lacking microscopic teeth or processes, defined by 3 spines, posterior margins of sixth articles with another set of proximopalmar spines; pereopods and uropods short; telson linguiform; third pleonal epimeron with nearly straight but slightly sinuous posterior edge, ventral corner weakly quadrate.

References:
Parapleustes assimilis (Sars, 1895, as *Paramphithoë*)
Parapleustes bicuspis (Krøyer): Sars (1895, as *Paramphithoë*)
Parapleustes commensalis Shoemaker (1952)
Parapleustes den J. L. Barnard, n.sp., herein
Parapleustes derzhavini (Gurjanova, 1938, as *Neopleustes*)
Parapleustes gracilis Buchholz: Sexton (1909)
Parapleustes johanseni Gurjanova (1951)
Parapleustes major (Bulycheva, 1952, as *Neopleustes*)
Parapleustes monocuspis (Sars, 1895, as *Paramphithoë*)
Parapleustes nautilus J. L. Barnard, n.sp., herein
Parapleustes oculatus (Holmes, 1908, as *Neopleustes*)
Parapleustes pacificus (Walker, 1898, as *Paramphithoë*)
Parapleustes pugettensis (Dana): Barnard and Given (1960), Shoemaker (1964)
Parapleustes sinuipalma Dunbar (1954)
Parapleustes trianguloculatus Bulycheva (1952)

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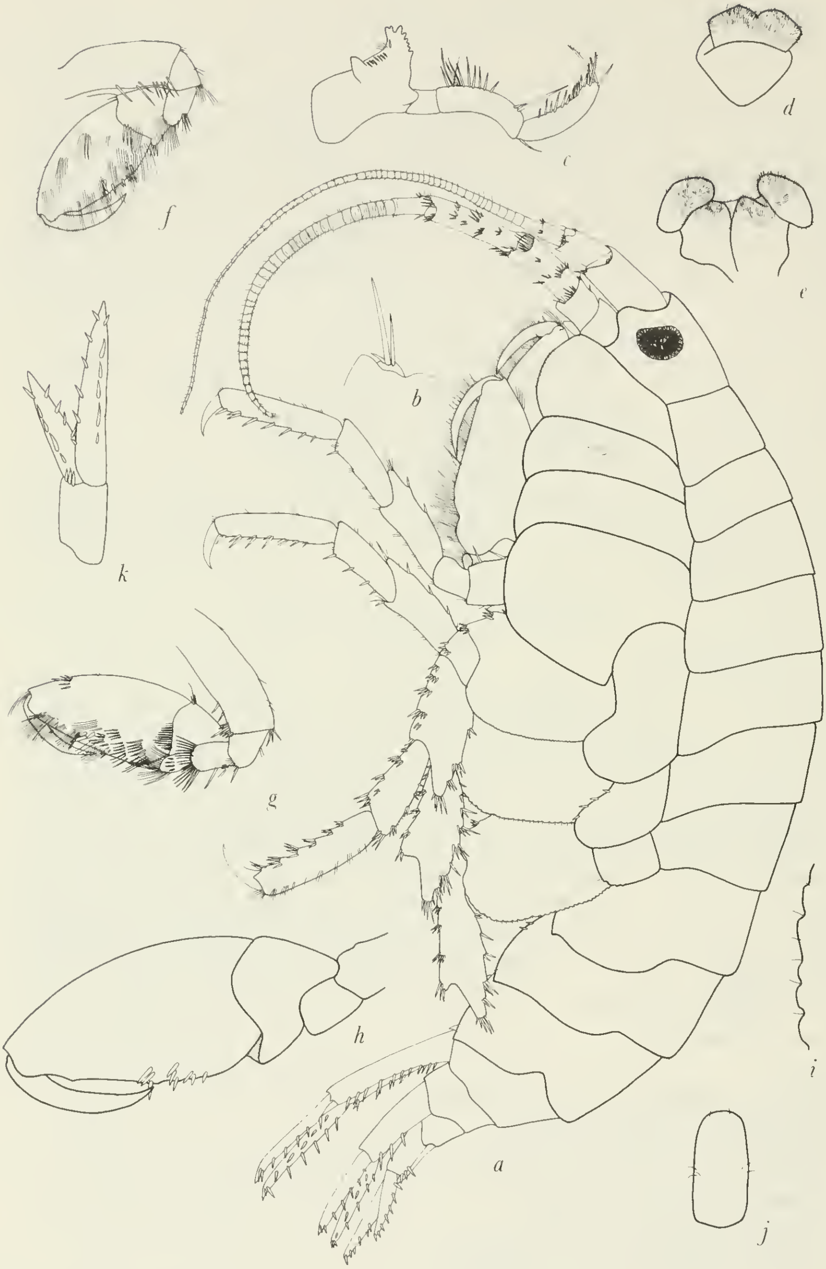
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HOLOTYPE.—AHF No. 613, female, 3.2 mm.

TYPE LOCALITY.—Station 38–D–2, Cayucos, California, *Phyllospadix*-pelvetiid grid, July 1, 1961.

RELATIONSHIP.—Because of its short antennae this species bears close relationship to *Parapleustes gracilis* Buchholz (see Sexton, 1909) and *Paramphithoë brevicornis* Sars (1895, pl. 124, fig. 2) but differs from those species by the rectangular, not oval hands of the gnathopods and the shorter and blunter posterior lobes of the fifth articles of the gnathopods. In the shapes of the gnathopods this species approaches *P. assimilis* (Sars, 1895, pl. 124, fig. 1) but differs by the short antennae, uropods, and percopods, compact body and slightly better developed posterior lobes of article 5 on the gnathopods.

Another relative, *P. oculatus* (Holmes, 1908) [see Barnard and Given, 1960, with possible synonyms *Paramphithoe pacifica* Walker, 1898, and *Parapleustes johanseni* Gurjanova, 1951] is distinguished by its longer antennae, pereopods, uropods, and smaller gnathopods. Possibly *P. nautilus* is synonymous with *P. trianguloculatus* (Bulycheva, 1952). The gnathopods of the two species are similar except for the very narrow, projecting, posterior lobes on the fifth articles of *P. trianguloculatus*. This is a poor qualitative character because with improper mounting and low-power observation the posterior lobes in the present material appear more slender than they actually are. When carefully traced under high-power microscopy their elongation is observed to be overemphasized by the bases of the dense setal bundles. The eye of *P. trianguloculatus* is triangular.

At first sight this species is easily confused with a geographic partner, *Parapleustes pugettensis* (Dana, see Barnard and Given, 1960; Shoemaker, 1964), but its body is more compact, palpably more solid, more opaque and less shiny, its antennae are shorter, its gnathopods are distinctive, all of its appendages are shorter, and it retains for a long time (1+ year) in alcohol (and more vividly in formaldehyde) a pinkness, often splashed with various shades of blue and purple. Its heavier chitinization permits clear observation of its segmental lines in contrast to *P. pugettensis*.

MATERIAL.—CARMEL: cobble-pelvetiid surface, scarce (18 per sq. m.); *Phyllospadix*-pelvetiid grid, abundant (105 per sq. m.); algal holdfasts, rare; coralline algae, rare; tunicates and sponges, rare. CAYUCOS: *Phyllospadix*-pelvetiid grid, rare (16 per sq. m.). HAZARD CANYON: algal turf on platform, 4th most abundant species (200

FIGURE 54.—*Parapleustes den*, new species, male, 8.0 mm. station 6: *a*, lateral view; *b*, accessory flagellum; *c*, mandible; *d*, upper lip, ventral edge up; *e*, lower lip; *f*, gnathopod 1; *g*, *h*, gnathopod 2; *i*, enlargement of posterior edge of article 2 on pereopod 3; *j*, telson; *k*, uropod 3.

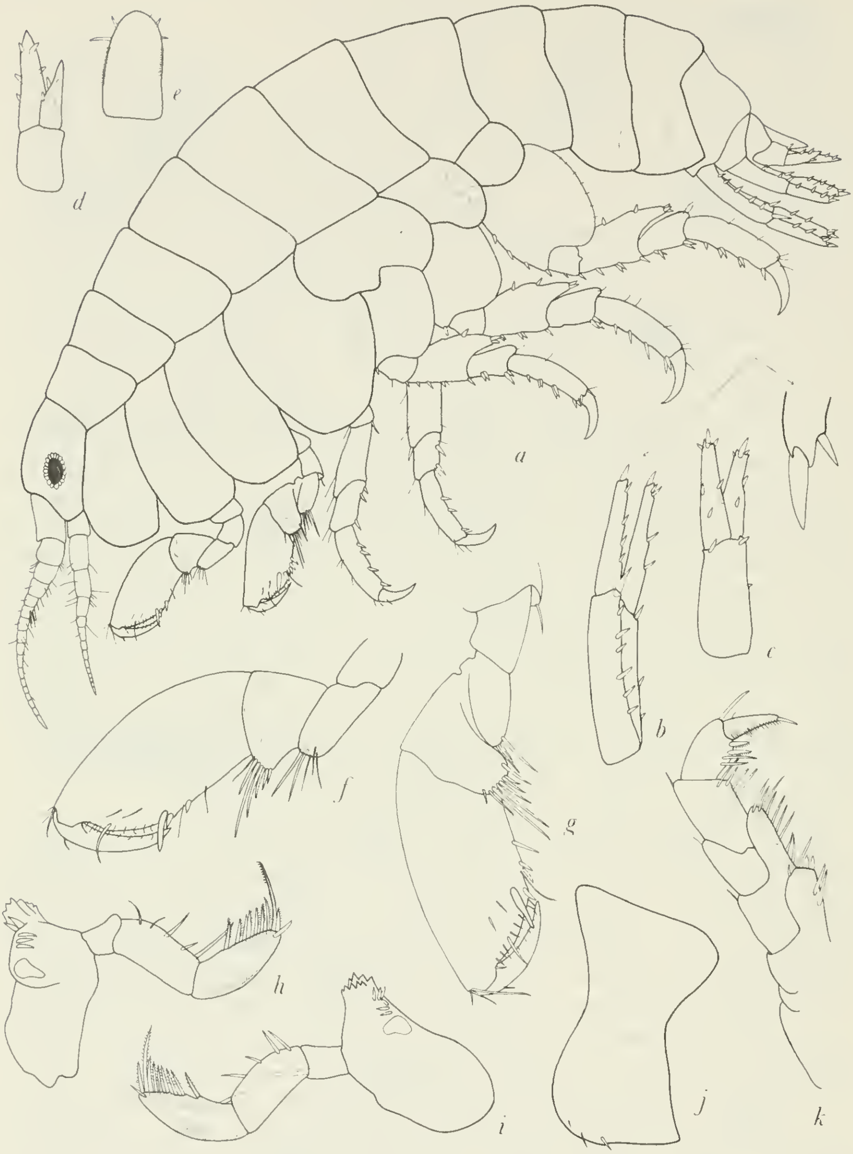


FIGURE 55.—*Parapleustes nautilus*, new species, female, 3.4 mm., station 38–D–2: *a*, lateral view; *b*,*c*,*d*, uropods 1, 2, 3; *e*, telson; *f*,*g*, gnathopods 1, 2; *h*,*i*, mandibles; *j*, pleonal epimeron 3; *k*, maxilliped.

per sq. m.); coralline algae, scarce; ledge with sparse algae, moderately abundant; sponges and tunicates, present; *Egregia-Laminaria* holdfasts, scarce; hydroids and algae, scarce; sponge, moderately abundant; *Rhodomela laryx*, scarce. GOLETA: *Macrocystis* holdfast, 3 m., rare.

DISTRIBUTION.—Carmel to Goleta, California, 0–3 m.

Parapleustes pugettensis (Dana)

Parapleustes pugettensis (Dana): Barnard and Given, 1960, pp. 43–45, fig. 4 (with synonymy).—J. L. Barnard, 1961, p. 178.—Shoemaker, 1964, pp. 410–413, fig. 10.

MATERIAL.—CARMEL: tunicates and sponges, rare. CAYUCOS: *Phyllospadix*-pelvetiid grid, scarce (56 per sq. m.); buried cobbles, rare; *Macrocystis* holdfast, scarce; soft polychaete tubes, rare; sponge, scarce; *Amaroucium* sp., scarce. HAZARD CANYON: kelp holdfasts, abundant; algal turf on platform, scarce (55 per sq. m.); *Egregia-Laminaria* holdfasts, moderately abundant; hydroids and algae, abundant; sponge, moderately abundant; *Phyllospadix* on sand, abundant; coralline algae, rare. GOLETA: pelvetiids, rare. PT. DUME: short brown algae, rare to scarce (9 to 44 per sq. m.); coralline algae, scarce (158 per sq. m.); *Phragmatopoma* masses, rare (15 per sq. m.); loose rocks, rare; *Egregia* holdfasts, moderately abundant; sandy social tunicates, present to abundant. CORONA DEL MAR: *Phyllospadix*-coralline grid, scarce (22 per sq. m.); loose rocks, scarce; calcareous worm tubes, scarce; algae below water, scarce; *Laminaria* holdfast, rare; *Phragmatopoma* masses, rare; tunicate colonies at base of *Phyllospadix* leaves, rare; tunicates and polychaete tubes, rare; sponge, rare; *Spheciospongia* sp., rare. LA JOLLA: short red algae on pitted substrate (58 per sq. m.); *Phyllospadix*-coralline grid, scarce (44 per sq. m.); underrock grid, scarce (24 per sq. m.); coralline algae, rare; sponge, abundant.

DISTRIBUTION.—West coast of Alaska, 62°54′ N, south to La Jolla, California, 0–140 m.

Parapleustes species A

Two tiny specimens less than 2.0 mm. in length from samples 45–C–1 and 45–T–1 resemble *Parapleustes nautilus* in general appearance but the hands of the gnathopods are longer, more slender and the palms are somewhat more transverse.

MATERIAL.—LA JOLLA: *Phyllospadix*-coralline grid, rare.

Pleusirus, new genus

DIAGNOSIS.—Mandibular molar obsolete, lacking grinding surface; maxillipedal palp article 3 not produced; antennae long, peduncle of antenna 1 very short; gnathopods well developed, eusirid in structure, fifth articles long and bearing broad posterior lobes of medium depth, sixth articles attached to the produced apices of fifth articles. Generic name masculine, combining characters of pleustids and eusirids.

TYPE SPECIES.—*Pleusirus secorrus*, new species.

RELATIONSHIP.—The eusirid-like gnathopods of this species are distinctive among the Pleustidae, thus warranting erection of a new genus. In antennae, mandibles and maxillipeds the genus approximates *Parapleustes* Buchholz. *Pleusirus* is not assignable to the Calliopiidae because of the characteristic pleustid lower lip. In the Calliopiidae the genus *Sancho* Stebbing has a second gnathopod which is sub-eusirid in structure but the first gnathopod is not.

Pleusirus secorrus, new species

FIGURES 56, 57

DIAGNOSIS.—With the characters of the genus.

DESCRIPTION.—Only 4 specimens are available, all having antennae or pereopods largely broken, with only one set of antennae being available; antennae long, peduncle of antenna 1 very short and stout for the family; rostrum of medium size, about as in *Parapleustes* and *Neopleustes;* eyes subcircular to oval; upper lip slightly and asymmetrically incised; mandibular molar evident only as slight bulbous ridge running proximally from spine row; left mandible with enormous, flabellate lacinia mobilis (it has been examined carefully and is not a structure of the next instar), lacinia mobilis of right mandible, if present, not distinct from spines of spine-row; outer plate of maxilla 1 with 9 spines of characteristic placement and morphology (see figure), palp 2-articulate; inner plate of maxilliped with medially located, subterminal spine on outer face, apex with 2 blunt medial spines, one middle seta and one sharp lateral spine, outer plate poorly spinose; pereopodal dactyls smooth except for one small, deeply immersed subterminal seta; second articles of pereopods 3–5 smooth posteriorly; body lacking dorsal processes; other parts typical of pleustids shown in figures.

HOLOTYPE.—AHF No. 622, ovigerous female, 3.5 mm.

TYPE LOCALITY.—Station 43–B–2, Cayucos, California, January 5–6, 1962, on four cobbles buried under boulders.

MATERIAL.—CAYUCOS: buried cobbles, rare. GOLETA: *Macrocystis* holdfast, 3 m., rare. LA JOLLA, one specimen collected by Dr. R. J. Menzies, June 14, 1947. CATALINA ISLAND: "Velero" station 1871, 25 fm.

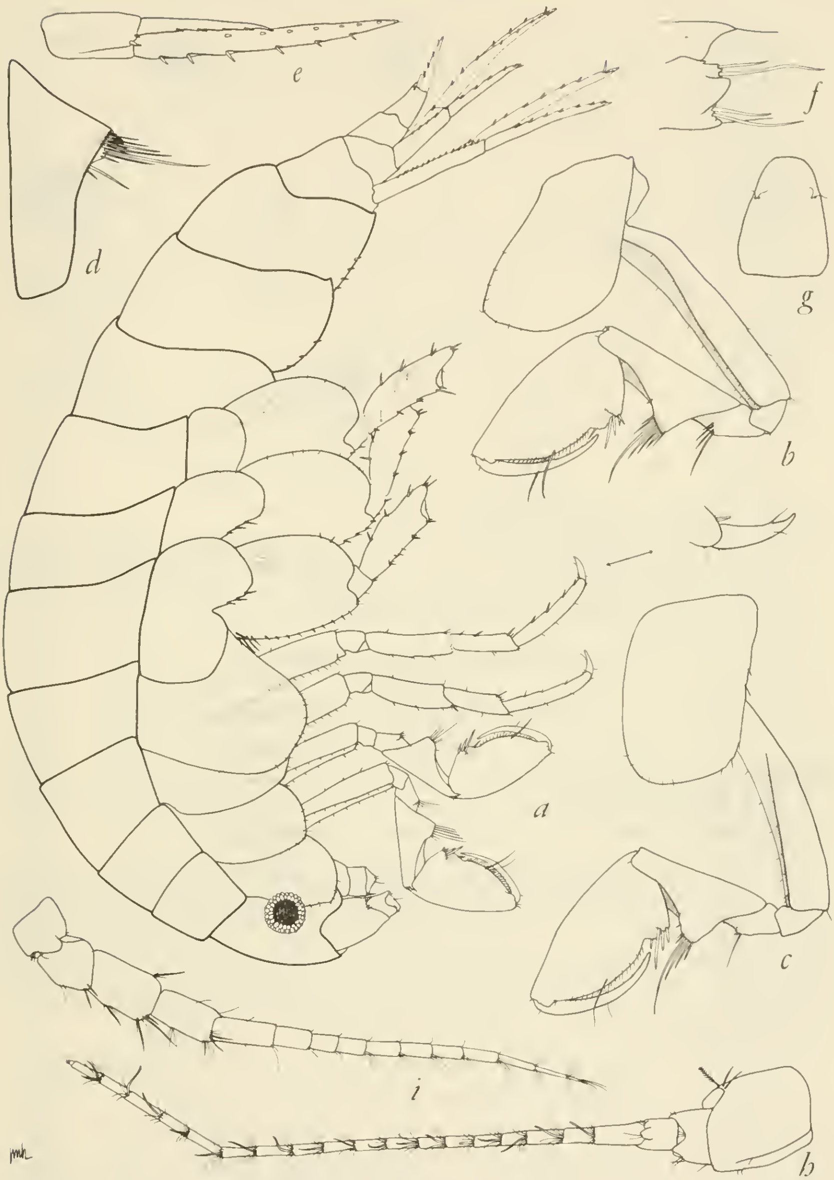


FIGURE 56.—*Pleusirus secorrus*, new genus, new species, female, 3.5 mm., station 43–B–2: *a*, lateral view; *b,c*, gnathopods 1, 2; *d*, article 5 of gnathopod 1; *e*, uropod 3; *f*, medial surface of article 3 of antenna 1 showing fused accessory flagellum; *g*, telson; *h,i*, antennae 1, 2.

FIGURE 57.—*Pleusirus secorrus*, new genus, new species, female, 2.5 mm., Campbell station 5: *a*, head and epistome-upper lip complex; *b*, pereopod 5; *c*, upper lip. Specimen, station 1871: *d,e*, maxilla 1; *f*, maxilla 2; *g*, shape of outer lobe of maxilla 2; *h*, lower lip. Female, 3.5 mm., station 43–B–2: *i,j*, mandibles; *k*, maxilliped.

Pleustes depressa Alderman
and
Pleustes platypa Barnard and Given

FIGURE 58

Pleustes depressus Alderman, 1936, pp. 56–58, figs. 14–18.—Hewatt, 1946, p. 199.—J. L. Barnard, 1954a, p. 9.
Pleustes platypa Barnard and Given, 1960, pp. 41–42, fig. 1.

Pleustes platypa shows some evidence of gene flow with *P. depressa* in its variable rostrum, ranging from the very elongated shape shown in the type series to the shorter kind shown in the figures herein; nevertheless, the two species remain distinguished everywhere but at the La Jolla locality by the shape of the dorsal segmental teeth which are rounded in *P. depressa* and sharp in *P. platypa.*

The dorsal segmental teeth are highly variable in development in *P. platypa* as shown in the accompanying table (p. 207).

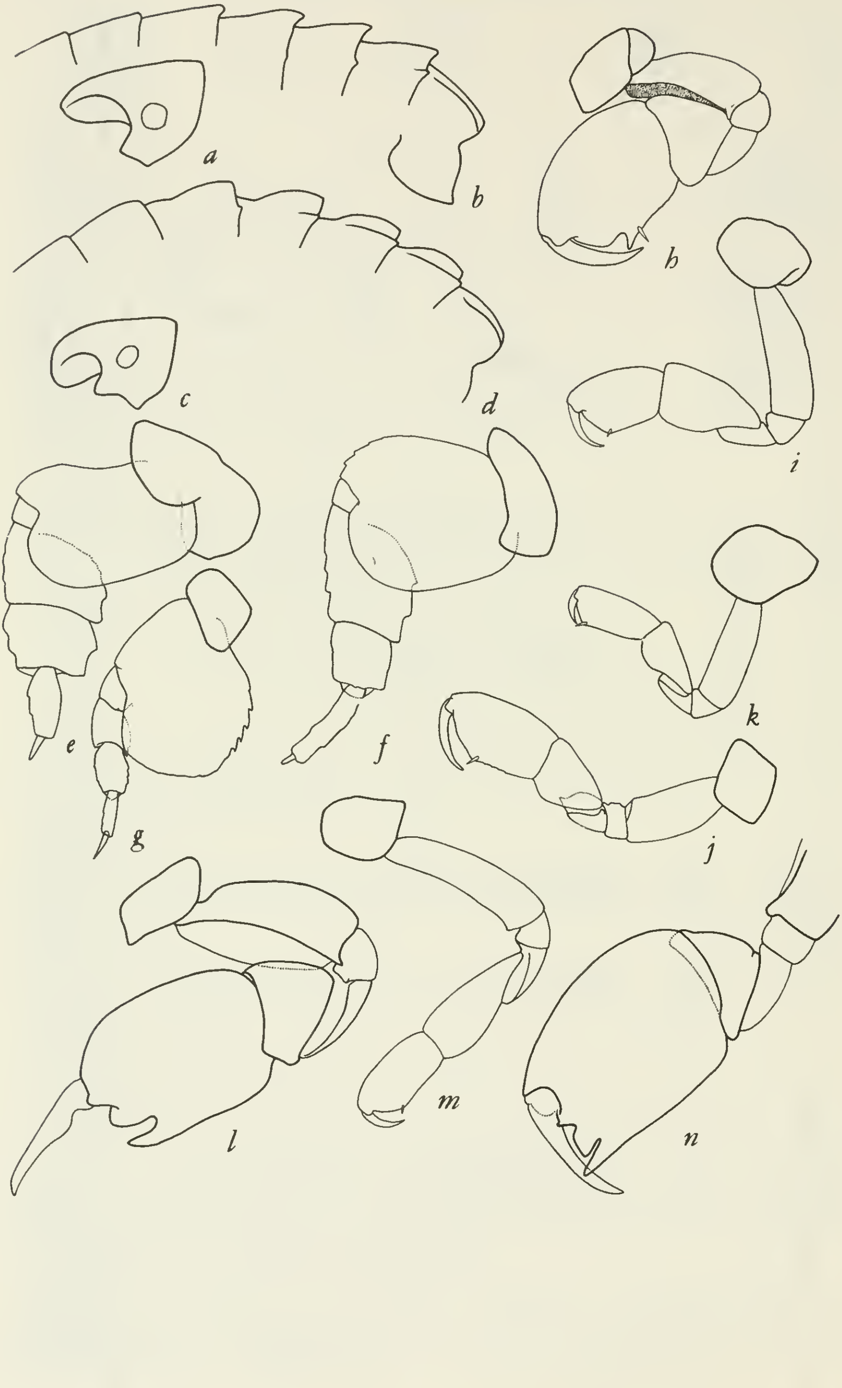
To some extent the Pt. Conception zoogeographic boundary holds good for these two species, *P. depressa* being confined north of the point and *P. platypa* south of the point, except at La Jolla. Specimens from La Jolla lack dorsal teeth and have rostra similar to *P. depressa* but all are juveniles 2.6 to 3.4 mm. long.

A preliminary examination of specimens at hand from Puget Sound, Washington, indicates the extreme plasticity of specific characters and suggests the possibility that the southern species may be linked with those of the Arctic-boreal in a common epigenotype.

Variation in rostrum and segmental teeth of *Pleustes platypa* Barnard and Given, from "Velero" samples of Allan Hancock Foundation

				Dorsal teeth					Lateral tooth (one side)				
				Pereon			Pleon		Pereon			Pleon	
Sample	*Sex*	*Length mm.*	*Rostrum*	*5*	*6*	*7*	*1*	*2*	*5*	*6*	*7*	*1*	*2*
1871	F	6. 0	X0	0	0	X	X	sl.	0	0	0	0	sl.
1871	F	4. 5	0X	0	sl.	X	X	0	0	0	0	0	0
1871	F	3. 5	0X	0	sl.	X	X	0	0	0	0	0	sl.
1871	F	5. 5	0X	0	sl.	XX	XX	X	0	0	0	0	sl.
1871	F	5. 0	0	0	sl.	XX	XX	X	0	0	0	sl.	sl.
1407	M	6. 0	X0	0	sl.	X	X	sl.	0	0	sl.	X	X
2280	F	10. 0	00	0	sl.	X	X	X	0	sl.	X	XX	XX
1871	F	6. 0	0X	0	X	XX	XX	XX	0	0	0	sl.	X
1871	F	5. 5	0X	0	X	XX	XX	XX	0	0	0	X	XX
1871	F	6. 0	0X	0	X	XX	XX	XX	0	0	0	X	XX
1409	F	7. 0	0	0	X	XX	XX	XX	0	0	sl.	sl.	X
1871	F	7. 0	0X	0	X	XX	XX	XX	0	0	sl.	X	XX
1871	F	6. 0	0X	0	X	XX	XX	XX	0	0	sl.	X	XX
1407	F	8. 5	00	0	X	XX	XX	XX	0	0	X	XX	XX
1871	F	6. 5	X0	sl.	XX	XX	XX	XX	0	0	sl.	X	XX
1871	F	6. 0	0X	X	XX	XX	XX	XX	0	0	0	sl.	X
1871	F	6. 5	0X	X	XX	XX	XX	X	0	0	sl.	X	XX
1871	F	7. 0	0	X	XX	XX	XX	XX	0	X	X	XX	XX

Symbols: For rostrum, 00=like *P. depressa;* X0=like *P. platypa* as figured herein; 0,0X=intermediates between above two types. For dorsal teeth, 0=absent; sl.=like figures of *P. platypa* herein, pereon segment 5; X=like figures of *P. platypa* herein, pereon segment 6; XX=like figures of *P. platypa* herein, pleon segment 1. For lateral teeth, 0=absent; sl.=like figures of *P. platypa* herein, pereon segment 7; X=like figures of *P. platypa* herein, pleon segment 1; XX=like figures of *P. platypa* herein, pleon segment 2.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MATERIAL OF *P. depressa*.—CARMEL: algae below water, rare. CAYUCOS: *Phyllospadix*-pelvetiid grid, scarce (17 per sq.m.); *Macrocystis* holdfast, rare; shell fragments, rare. LA JOLLA: *Phyllospadix*-coralline grid, rare; underrock grid, rare; coralline algae, rare. COOS BAY, OREGON, "Velero" station 1489 (1 specimen).

MATERIAL OF *P. platypa*.—LA JOLLA: *Phyllospadix*-coralline grid, rare. CATALINA ISLAND: "Velero" stations 1407 and 1871, 25–45 fm., 16 specimens. SANTA BARBARA ISLAND: "Velero" stations 1409 and 2280, 26–60 fm., 3 specimens.

Pleustes sp.

MATERIAL.—CARMEL: algae below water, scarce.

Podoceridae

Podocerus brasiliensis (Dana)

Podocerus brasiliensis (Dana): J. L. Barnard, 1962a, p. 67, fig. 30 (with synonyimy); 1964a, pp. 245–246.

MATERIAL.—CARMEL: *Phyllospadix* roots, rare; tunicates and sponges, rare. CAYUCOS: buried cobbles, rare; *Macrocystis* holdfast, rare; sponge, rare. HAZARD CANYON: *Egregia-Laminaria* holdfasts, scarce; hydroid, rare; sponge, scarce. GOLETA: *Macrocystis* holdfast, 3 m., rare; submerged rock, 8 m., abundant; submerged log, 8 m., rare. PT. DUME: coralline algae, rare (9 per sq. m.). CORONA DEL MAR: *Phyllospadix*-pelvetiid grid, rare; loose rocks, rare; *Spheciospongia* sp., rare.

DISTRIBUTION.—Cosmopolitan in tropical and warm temperate seas, with northern record in eastern Pacific Ocean here at Carmel, California; occurring to maximum depth of 12 m. in southern California.

FIGURE 58.—*Pleustes platypa* Barnard and Given, *P. depressa* Alderman, *Paraphoxus heterocuspidatus* J. L. Barnard, and *Lembos macromanus* (Shoemaker). *Pleustes platypa*, female, 6.0 mm., "Velero" station 1871: *a*, head; *b*, pereonites 4–7 and pleonites 1–3, lateral, left to right. *Pleustes depressa*, female, 8.5 mm., "Velero" station 1489: *c*, head; *d*, pereonites 4–7 and pleonites 1–3, lateral, left to right. *Paraphoxus heterocuspidatus*, female, 5.2 mm., station 39–H–2: *e,f,g*, pereopods 3, 4, 5. *Lembos macromanus*, male, 8.0 mm., station 43–B–3: *h,i*, gnathopods 1, 2, minus setae. Female, 11.0 mm., "Velero" station 1453: *j,k*, gnathopods 1, 2, minus setae. Male, 10.0 mm., "Velero" station 1453: *l,m*, gnathopods 1, 2, minus setae. Male, 9.0 mm., Bahía de Los Angeles, Baja California: *n*, gnathopod 1, minus setae.

Podocerus cristatus (Thomson)

Podocerus cristatus (Thompson): J. L. Barnard, 1962a, pp. 67–69, figs. 31, 32 (with references); 1964a, p. 246.

MATERIAL.—CAYUCOS: *Phyllospadix*-pelvetiid grid, scarce (17 per sq. m.); sponge, rare.

DISTRIBUTION.—Probably ubiquitous in tropical and warm temperate seas of the Indo-Pacific region, northern record in eastern Pacific Ocean here at Cayucos, California; occurring in depths of 0–170 m. in southern California.

Stenothoidae

Metopa cistella, new species

FIGURES 59, 60

DIAGNOSIS.—Eyes large; lateral cephalic lobe broad, well-projecting, pectoriform; epistomal keel rather short, broad, tapering subacutely, far exceeding small mamilliform projection of upper lip; antennae of medium length for the genus, equal, peduncular articles of antenna 1 successively shorter, peduncle of antenna 2 relatively stout; body dorsally smooth, lacking ridges or keels; coxa 4 very elongated for the genus; mandibular palp 3-articulate, article 3 vestigial; inner plates of maxilliped fused together, with scarcely any terminal separation, each lobe with secondary contiguous lobe on inner face; articles 5 and 6 of gnathopod 1 equal in length, slender, article 5 lacking posterior lobe, article 6 tapering, lacking palm, posterior edge with about 5 long setae, dactyl about one third as long as article 6, inner margin setose, neither articles 5–6 extremely elongated and both of about equal width; male gnathopod 2 of medium expansion, palm oblique, slightly shorter than posterior margin of article 6, palm defined by one small cusp and bearing one similar middle cusp and 2 small ones near dactylar hinge; female gnathopod 2 with slightly simpler palmar ornamentation (see figure); pereopodal dactyls about half as long as sixth articles, smooth except for minute distal setule; article 2 of pereopod 4 of medium expansion for the genus, of pereopod 5 fully expanded, fourth articles of pereopods 4–5 scarcely expanded and with short posterodistal lobes not reaching halfway along fifth articles; uropod 3 with ramus slightly shorter than peduncle, its 2 articles equal in length; telson with 2 lateral spines on each side.

HOLOTYPE.—AHF No. 6128, male, 2.3 mm.

TYPE LOCALITY.—Station 42, Hazard Canyon reef, California, December 8–9, 1961, diving sample 4, algae below water.

RELATIONSHIP.—Many species of *Metopa* would resemble this species if male gnathopods, which may not be mature, are disregarded.

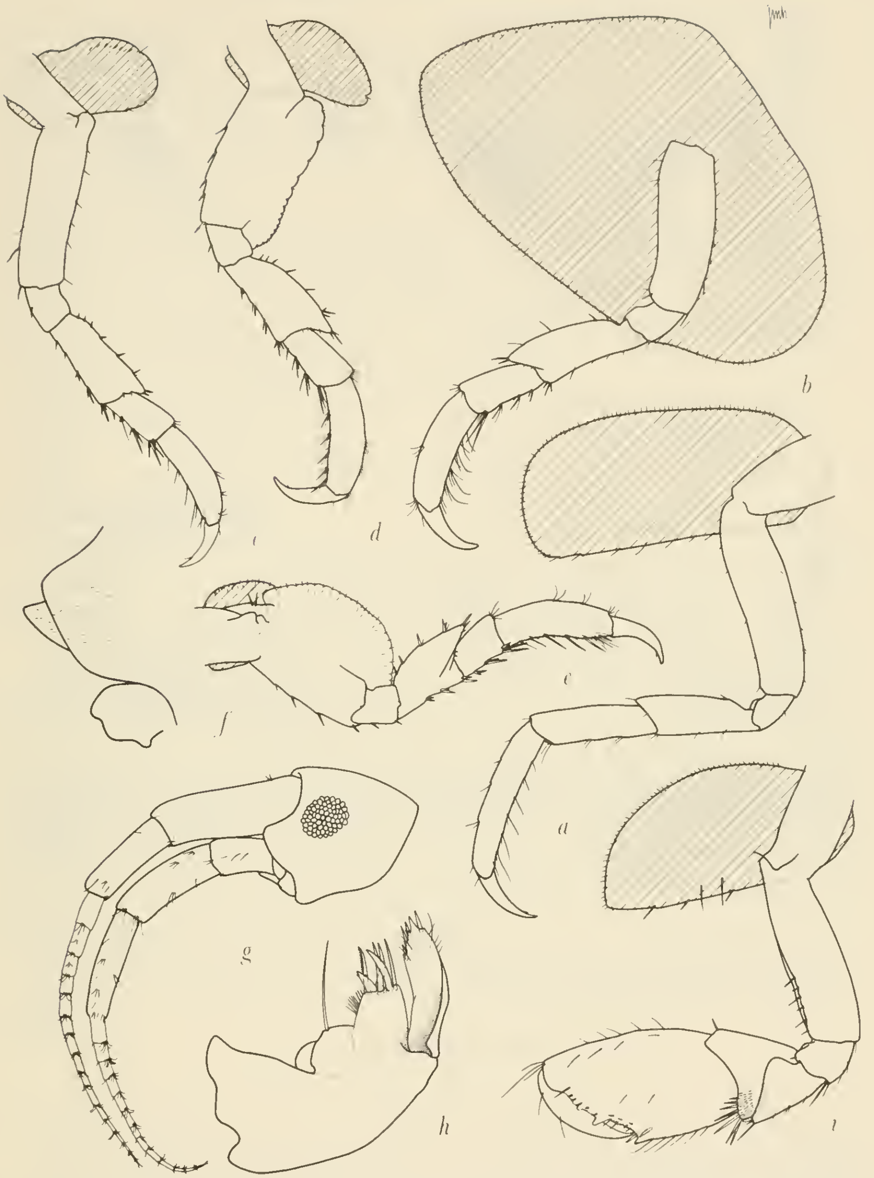

FIGURE 59.—*Metopa cistella*, new species, holotype, male, 2.3 mm., station 42-diving: *a,b,c,d,e*, pereopods 1, 2, 3, 4, 5; *f*, lateral cephalic lobe (largest), with epistome behind and upper lip below; *g*, head; *h*, maxilla 1; *i*, gnathopod 2.

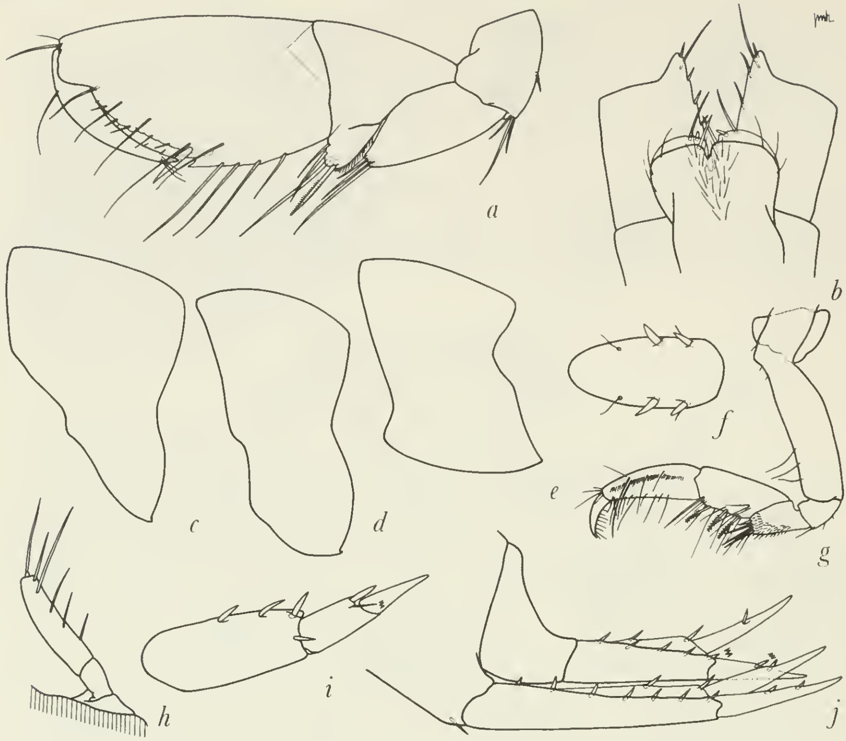

FIGURE 60.—*Metopa cistella*, new species, female, 2.2 mm., station 42-diving: *a*, gnathopod 2; *b*, inner and outer lobes of maxillipeds. Holotype, male, 2.2 mm.: *c,d,e*, pleonal epimera 1, 2, 3, left lateral; *f*, telson; *g*, gnathopod 1; *h*, mandibular palp; *i*, uropod 3; *j*, uropods 1 and 2 as attached to body.

The following species are distinguished from *M. cistella* by one or two characters listed:

Metopa wiesi Gurjanova (see 1951): article 4 of pereopod 5 strongly expanded and with long posterior lobe.

Metopa pusilla Sars (1895): eyes much smaller, article 3 of uropod 3 as long as article 1.

Metopa affinis Boeck (see Sars, 1895): coxa 4 much smaller, telson lacking spines, palm of male gnathopod 2 nearly transverse.

Metopa sinuata Sars (1895): article 4 of pereopod 5 much broader and with longer posterior lobe, antennae shorter.

Metopa tenuimana Sars (1895) is very close but coxa 4 is smaller, posterior lobe of article 4 of pereopod 5 is longer.

Metopa bruzelii (Goës) (see Sars, 1895), same as for *M. tenuimana.*

Metopa propinqua Sars (1895), same as for *M. tenuimana.*

Metopa angustimana Gurjanova (see 1951): article 4 of pereopod 5 broader and longer.

Metopa derjugini Gurjanova (see 1951) is very similar to the new species but has pereopodal dactyls about two thirds as long as the sixth articles and deeply separated inner maxillipedal lobes.

Metopa spinicoxa Shoemaker (1955a) may be more closely related to *M. cistella* than is *M. derjugini. Metopa spinicoxa* has a broad coxa 4 anteroposteriorly, bears a first gnathopod similar to that of *M. cistella,* a male gnathopod 2 which could be a stage in the development of *M. cistella,* equal antennae, the second antenna being stout (especially noted by Shoemaker), and large eyes. *Metopa spinicoxa* differs from *M. cistella* by the longer projection of the lower lip which equals that of the epistome, by the broader and more strongly produced fourth articles of pereopods 4 and 5 and by the full expansion of article 2 of pereopod 4.

MATERIAL.—HAZARD CANYON: *Egregia* holdfast, rare; algal turf on platform, rare (11 per sq. m.); present on algae below water, collected by diver.

Stenothoe ?estacola J. L. Barnard

FIGURE 61

?*Stenothoe estacola* J. L. Barnard, 1962c, p. 149, fig. 17.

No adults as fully developed as the male shown by Barnard (1962c) have been collected in the present survey. The original material was obtained at Pt. Fermin and Corona del Mar in mass washes of sponges, phragmatopomids, and corallines. Presumably the specimens assigned herein belong with that species, subadult males having gnathopod 2 in a youthful stage, showing minutely a single middle palmar hump, two of which occur in the adult originally described. All of the subadult specimens have antenna 1 very slightly longer


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than antenna 2 (by the length of 2 flagellar articles), and all members of the type series (reexamined), except the figured holotype, correspond. None of the present specimens, subadult females and males, has the pectinal rows on article 2 of the third uropodal ramus but faint indications of their presence are seen. Gnathopods of both sexes differ in their medial and lateral aspects rather strongly and several views contrasted to those drawn by Barnard (1962c) are included herein. The second maxilla has the inner and outer plates attached in tandem; the outer plate of maxilla 1 has only 6 spines, the size and arrangement of which seem unusual but which are duplicated in other species of stenothoids; the outer plate of the maxilliped is obsolete, the slight projection that is present being hidden by a spine, the inner plates being strongly fused at their bases but separated for about half their theoretical lengths.

MATERIAL.—GOLETA: *Phyllospadix*-pelvetiid grid, scarce (10 per sq. m.). PT. DUME: short brown algae, abundant (176 per sq. m.); coralline algae, abundant (330 per sq. m.); green-brown algae, rare; *Egregia*, rare. PT. FERMIN: Barnard station 23, October 21, 1949, abundant in calcareous algae. CORONA DEL MAR: *Phyllospadix*-coralline grid, rare (4 per sq. m.); calcareous worm tubes, rare; tunicate colonies at base of *Phyllospadix* leaves, rare; tunicates and polychaete tubes, rare. LA JOLLA: sample 45–K–1 (1). CATALINA ISLAND: "Velero" station 1370, shore, 4 specimens.

DISTRIBUTION.—Goleta to La Jolla, California, intertidal.

Stenothoides burbanki, new species

FIGURES 62, 63

DIAGNOSIS OF MALE.—Lateral cephalic lobe disymmetrically sinuous, with a blunt point apically; eyes small, nearly round; epistome forming acute keel on front of head, below which upper lip projecting forward acutely as far as epistome; antennae short, first with remarkably short, stout peduncle, article 2 slightly more than one third as long as article 1, article 3 very short, bearing remnants of partially articulated, poorly developed accessory flagellum; gnathopod 1 simple, relatively stout, article 4 produced posteriorly along posterior edge of article 5 in a blunt, spinose lobe, articles 5 and 6 equal in length, article 5 not lobed posteriorly, posterior edge of article 6 acting as palm, bearing 3 large spines, middlemost spine defining the theoretical palm by its apposition to apex of

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FIGURE 61.—*Stenothoe estacola* J. L. Barnard, male, 2.5 mm., station 46–G–10: *a*,*b*, mandible; *c*,*d*, gnathopods 1, 2; *e*,*f*, maxillae 1, 2; *g*, maxilliped, palp terminally unflattened; *h*, upper lip; *i*, outer lobe of maxilla 1. Female, 2.4 mm., station 47–B–3: *j*, uropod 3; *k*,*l*, gnathopod 1, lateral and medial views; *m*, gnathopod 2; *n*, maxillipedal palp, flattened.

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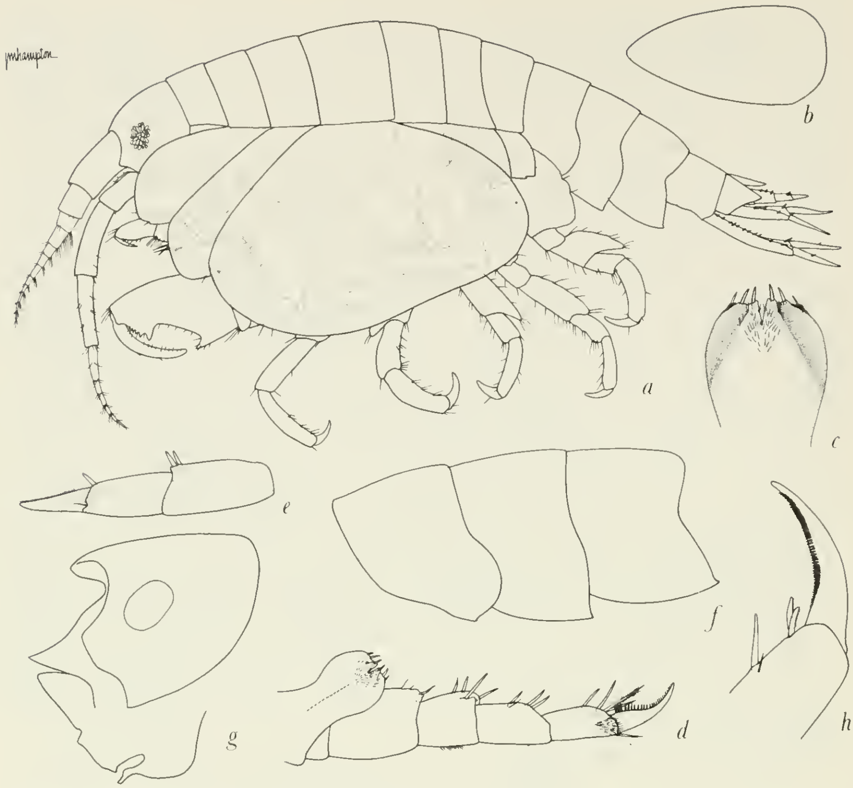

FIGURE 62.—*Stenothoides burbanki*, new species, male, 2.6 mm., station 42–T–7: *a*, lateral view; *b*, telson; *c*, inner lobes of maxillipeds; *d*, maxilliped; *e*, uropod 3; *f*, pleonal epimera 1–3, left to right, lateral. Female, 2.3 mm.: *g*, head; *h*, dactyl of pereopod 1.

dactyl; gnathopod 2 of medium size for a male of family, article 5 with moderately slender, spinose posterior lobe scarcely projecting beyond posterior tangent of appendage, article 6 with oblique palm, with serrate and toothed distal process, remainder of palm a flat excavation defined by one cusp, dactyl failing to reach end of palm; dactyls of all pereopods with inner margins minutely pectinate; second articles of pereopods 3–4 slender, of pereopod 5 broadened, the latter posteriorly flattened, ventral lobe short, broadly rounded; article 4 of pereopods 3 and 5 broad and strongly produced, of pereopod 4 more slender and poorly produced; coxa 4 very large and long, ventral edge slightly sinuous; pleonal epimera each with one very small posteroventral tooth; urosomal segments 2 and 3 solidly coalesced; the 3 articles of uropod 3 (peduncle, ramus–1, ramus–2) consecutively very slightly shorter; telson lacking marginal spines; mandible lacking palp, bearing one seta at its expected position; first maxillary palp uniarticulate; inner plates of maxilliped with

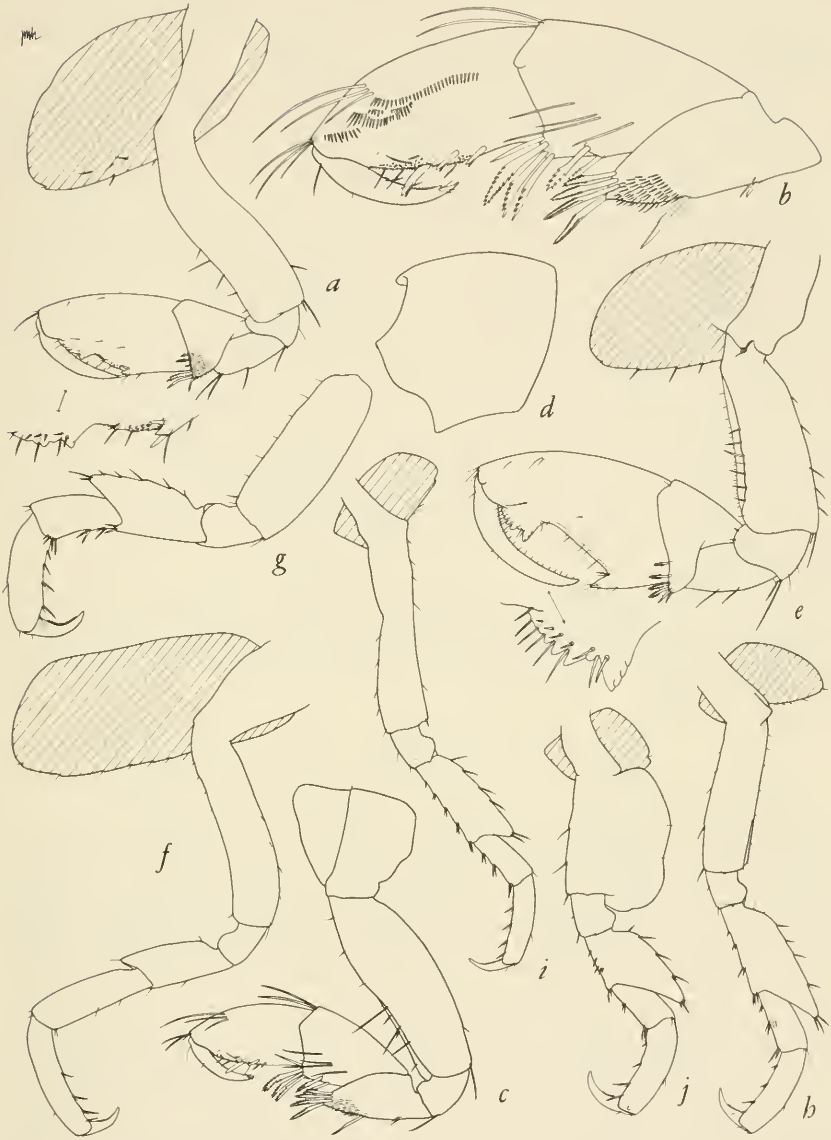

FIGURE 63.—*Stenothoides burbanki*, new species, female, 2.3 mm., station 42–T–7: *a*, gnathopod 2. Male, 2.6 mm.: *b,c*, gnathopod 1; *d*, head; *e*, gnathopod 2; *f,g,h,i,j*, pereopods 1, 2, 3, 4, 5.

bulbous basal expansion (armed with setules) fusing the 2 plates together on inner surface, demarcation line occurring on outer surface.

FEMALE.—Gnathopod 2 smaller than in male, palm of similar form but poorly excavated, divided into 3 sections, proximally a flat section followed by a rounded excavation and distally bearing the small, flat, serrated, and toothed hinge process.

Holotype.—AHF No. 614, male, 2.5 mm.

Type locality.—Station 42–T–7, Hazard Canyon, California, December 8–9, 1961, wash of *Egregia* holdfasts.

Relationship.—This species differs from *Stenothoides bicoma* J. L. Barnard (1962c), the only other species of the genus known from California (in depths of 11 to 110 m.), by the very short antennae, the stout first gnathopod, and the lack of spines on its telson.

All other species of the genus are believed to have a mandibular palp. The only other species that *S. burbanki* approximates is *S. slastnikovi* (Gurjanova, 1948, see 1951) of the Bering Sea and in which gnathopods 1 and 2 are almost identical in shape to those at hand, but the first gnathopod of *S. slastnikovi* has several very thick setae on the palmar area rather than short, stout spines, and the telson bears spines. Apparently the short antennae are similar. The new species may deserve only subspecific separation from *M. slastnikovi.*

Material.—carmel: tunicates and sponges, rare. hazard canyon: algal turf on platform, scarce (44 per sq. m.); *Egregia-Laminaria* holdfasts, scarce; *Phyllospadix* on sand, scarce; coralline algae, scarce.

Stenula incola, new species

Figures 64, 65

Diagnosis.—Upper lip deeply incised, lobes subquadrangular; mandibular palp of the elongated form in the genus; eyes well-developed, circular; lateral cephalic lobe small, narrow, subacute; antenna 1 extending only as far as distal end of peduncle of antenna 2; gnathopod 1 with palm of condition intermediate between distinct subchelation and complete simplicity, poorly defined by discrete spine, article 6 proximally broad; gnathopod 2 of adult male with large, stout sixth article, palm oblique, longer than posterior margin of article 6, bearing flat area with 6 large serrations increasing in size posteriorwards at hinge area, followed by trapezoidal excavation defined by large cusp; coxa 4 very large, long, subovate, ventrally sinuous; pereopods 1–2 dissimilar to each other in structure, first slender, with articles 4, 5, 6 successively slightly longer, second with stout and apically broadened article 4, article 5 shorter than either 4 or 6 and intermediate in width; article 6 slightly longer than axis of 4; article 2 of pereopod 4 of medium expansion, that of pereopod 5 very broad, subcircular; fourth articles of pereopods 3–5 successively broader and more strongly produced distally; dactyls of all pereopods armed on inner edges with small denticles,

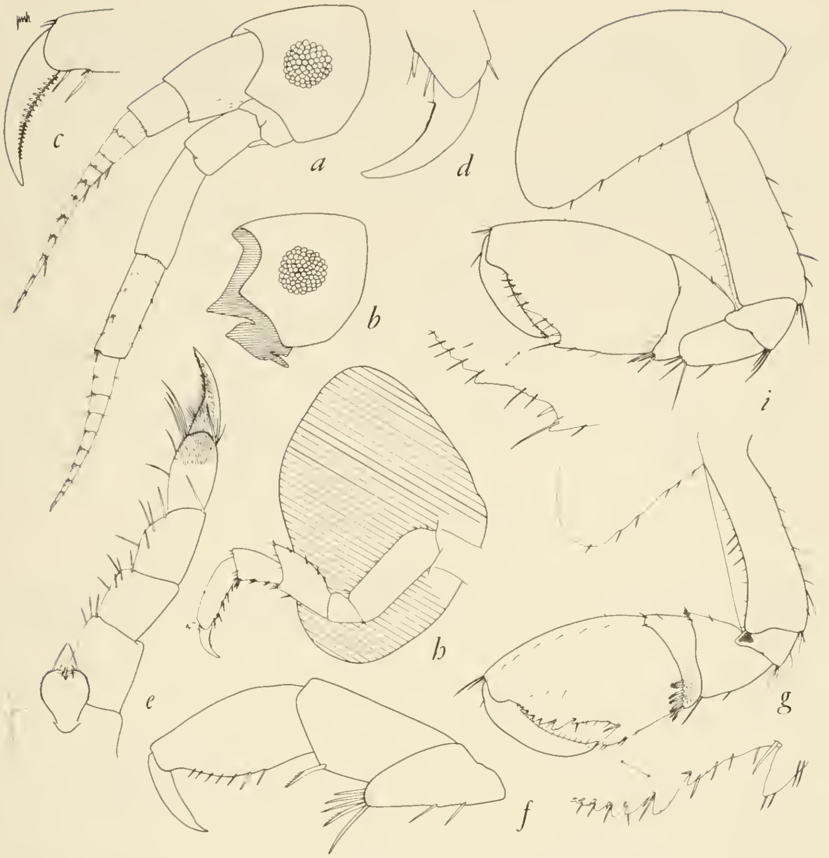

FIGURE 64.—*Stenula incola*, new species, male, 2.8 mm., station 42–G–2: *a,b*, head; *c,d*, dactyls of pereopods 1, 5; *e*, maxilliped; *f*, gnathopod 1; *g*, gnathopod 2; *h*, pereopod 2. Male, 2.2 mm., station 42–T–7: *i*, gnathopod 2.

those denticles of pereopods 1 and 2 largest and occurring as double row; commencing with pereopod 2 the denticles merge with very small distal serrations, serrations lacking on pereopod 5; pereopod 2 bearing small "pin-cushion buttons" on posterior edges of articles 5 and 6; telson elongated, tapering apically, lacking spines, bearing 2 minute setules; uropod 3 with its 3 articles decreasing in length in the order 1, 3, 2. Female unknown.

HOLOTYPE.—AHF No. 615, male, 2.8 mm.

TYPE LOCALITY.—Hazard Canyon, California. December 8–9, 1961, algal turf on platform of intertidal.

RELATIONSHIP.—Male gnathopod 2 of this species resembles that of *Stenula bassarginensis* (Gurjanova, see 1951) but the new species

FIGURE 65.—*Stenula incola*, new species, male, 2.8 mm., station 42–G–2: *a,b,c*, uropods 1, 2, 3; *d*, dactyl and part of article 6 of pereopod 2, offset showing fuzzy-button enlarged; *e*, maxilla 2; *f*, mandible; *g,h,i,j*, pereopods 1, 3, 4, 5; *k*, outer lobe of maxilla 1; *l*, upper lip; *m*, telson; *n*, gnathopod 1; *o*, mandibular palp.

lacks telsonic spines and *S. bassarginensis* has a more distinctly subchelate gnathopod 1 because article 6 is narrowed proximally, thus providing a discrete defining corner to the distally expanded palmar area. *Stenula incola* has the long mandibular palp similar to that of *S. beringiensis* (Gurjanova, see 1951) but it is poorly setose, the telson lacks spines and article 6 of gnathopod 1 is more densely and irregularly setose than in *S. beringiensis*. *Stenula ratmanovi* (Gurjanova, see 1951) has a short mandibular palp and a very large spine defining the palm of gnathopod 1. *Stenula latipes* (Chevreux and Fage, 1925) is closely related to *S. incola* but the mandibular palp is very short, the male second gnathopod has article 6 more elongated and the palm regularly oblique, serrated and shorter than the posterior margin of article 6; the first gnathopod has a less distinct palm with a larger spine at the theoretical defining limit; the upper lip is less deeply incised. The other known species of *Stenula* (see list in Barnard, 1962c) are much further removed from the new entity than those discussed above.

MATERIAL.—HAZARD CANYON: algal turf on platform, rare; *Egregia* holdfasts, rare.

Synopiidae

Tiron biocellata J. L. Barnard

Tiron biocellata J. L. Barnard, 1962b, p. 75, fig. 2; 1964a, p. 247.

MATERIAL.—LA JOLLA: short-tufted algal ridge, rare.

DISTRIBUTION.—Monterey Bay, California, to Bahía de San Cristóbal, Baja California, 0–180 m.

Talitridae

Orchestia sp.

MATERIAL.—LA JOLLA: sand-inundated algae at high tide line, scarce (88 per sq. m.).

LITERATURE CITED

Alderman, A. L.

1936. 5.5 Some new and little known amphipods of California. Univ. California Publ. Zoöl., vol. 41, pp. 53–74, figs. 1–51.

Barnard, J. L.

1950. The occurrence of *Chelura terebrans* Philippi in Los Angeles and San Francisco harbors. Bull. So. California Acad. Sci., vol. 49, pp. 90–97, pls. 32, 33.

1952a. Some Amphipoda from central California. Wasmann Jour. Biol., vol. 10, pp. 9–36, pls. 1–9.

1952b. A new amphipod of the genus *Ceradocus* (*Denticeradocus*) from Lower California. Bull. So. California Acad. Sci., vol. 51, pp. 55–59, pls. 11–13.

1952c. A new species of amphipod from Lower California (genus *Eriopisa*). Pacific Sci., vol. 6, pp. 295–299, figs. 1–2.

1953. On two new amphipod records from Los Angeles harbor. Bull. So. California Acad. Sci., vol. 52, pp. 83–87, pl. 15.

1954a. Marine Amphipoda of Oregon. Oregon State Monogs., Studies in Zoology no. 8, pp. 1–103, pls. 1–33, 1 fig.

1954b. Amphipoda of the family Ampeliscidae collected in the eastern Pacific Ocean by the *Velero III* and *Velero IV*. Allan Hancock Pac. Expeds., vol. 18, pp. 1–137, pls. 1–38.

1954c. A new species of *Microjassa* (Amphipoda) from Los Angeles harbor. Bull. So. California Acad. Sci., vol. 53, pp. 127–130, pls. 35, 36.

1955a. Gammaridean Amphipoda (Crustacea) in the collections of Bishop Museum. Bernice P. Bishop Mus., Bull. 215, pp. 1–46, pls. 1–20.

1955b. Two new spongicolous amphipods (Crustacea) from California. Pacific Sci., vol. 9, pp. 26–30, figs. 1, 2.

1955c. Notes on the amphipod genus *Aruga* with the description of a new species. Bull. So. California Acad. Sci., vol. 54, pp. 97–103, pls. 27–29.

1956. Two rare amphipods from California with notes on the genus *Atylus*. Bull. So. Calif. Acad. Sci., vol. 55, pp. 35–43, pls. 12–14.

1957. A new genus of phoxocephalid Amphipoda (Crustacea) from Africa, India, and California. Ann. Mag. Nat. Hist., ser. 12, vol. 10. pp. 432–438, figs. 1–4.

1958. Revisionary notes on the Phoxocephalidae (Amphipoda), with a key to the genera. Pacific Sci., vol. 12, pp. 146–151.

1959. Estuarine Amphipoda. *In* Ecology of Amphipoda and Polychaeta of Newport Bay, California, *by* J. L. Barnard and D. J. Reish. Allan Hancock Found. Publs., Occ. Pap. no. 21, pp. 13–69, pls. 1–14.

1960a. New bathyal and sublittoral ampeliscid amphipods from California, with an illustrated key to Ampelisca. Pacific Nat., vol. 1, no. 16, pp. 1–36, figs. 1–11.

1960b. The amphipod family Phoxocephalidae in the eastern Pacific Ocean, with analyses of other species and notes for a revision of the family. Allan Hancock Pac. Expeds., vol. 18, pp. 175–368, pls. 1–75, 1 chart.

1961. Relationship of Californian amphipod faunas in Newport Bay and in the open sea. Pacific Nat., vol. 2, pp. 166–186, figs. 1–2.

1962a. Benthic marine Amphipoda of southern California: families Aoridae, Photidae, Ischyroceridae, Corophiidae, Podoceridae. Pacific Nat., vol. 3, pp. 1–72, figs. 1–32.

1962b. Benthic marine Amphipoda of southern California: families Tironidae to Gammaridae. Pacific Nat., vol. 3, pp. 73–115, figs. 1–23.

1962c. Benthic marine Amphipoda of southern California: families Amphilochidae, Leucothoidae, Stenothoidae, Argissidae, Hyalidae. Pacific Nat., vol. 3, pp. 116–163, figs. 1–23.

1963. Relationship of benthic Amphipoda to invertebrate communities of inshore sublittoral sands of southern California. Pacific Nat., vol. 3, pp. 437–467, figs. 1–7.

1964a. Los anfipodos bentonicos marinos de la costa occidental de Baja California. Rev. Soc. Mexicana Hist. Nat., vol. 24, pp. 205–274, figs. 1–11, 5 tables.

1964b. Marine Amphipoda of Bahia de San Quintin, Baja California. Pacific Nat., vol. 4, pp. 55–139, figs. 1–21, 17 charts, 13 tables.

1964c. Revision of some families, genera and species of gammaridean Amphipoda. Crustaceana, vol. 7, pp. 49–74, 2 tables.

1965a. Marine Amphipoda of the family Ampithoidae from southern California. Proc. U.S. Nat. Mus., vol. 118, no. 3522, pp. 1–46, figs. 1–28.

1965b. Marine Amphipoda of atolls in Micronesia. Proc. U.S. Nat. Mus., vol. 117, pp. 459–552, figs. 1–35.

1968. Gammaridean Amphipoda of Bahia de Los Angeles, Baja California. Trans. San Diego Soc. Nat. Hist. In press.

Barnard, J. L., and Given, R. R.

1960. Common pleustid amphipods of southern California, with a projected revision of the family. Pacific Nat., vol. 1, pp. 37–48, figs. 1–6.

Barnard, K. H.

1916. Contributions to the crustacean fauna of South Africa. 5.—The Amphipoda. Ann. So. African Mus., vol. 15, pp. 105–302, pls. 26–28.

1932. Amphipoda. Discovery Repts., vol. 5, pp. 1–326, pl. 1, figs. 1–174.

Bate, C. S.

1858. On some new genera and species of Crustacea Amphipoda. Ann. Mag. Nat. Hist., ser. 3, vol. 1, pp. 361–362.

1862. Catalogue of the specimens of amphipodous Crustacea in the collection of the British Museum, London, iv + 399 pp., pls. 1, 1a, 2–58.

Bate, C. S., and Westwood, J. O.

1863. A history of the British sessile-eyed Crustacea. London: John Van Voorst, vol. 1.

Boeck, A.

1871. Bidrag til Californiens Amphipodefauna. Vidensk.-Selsk. Forhand. for 1871, 22 pp., pl. 1 [reprint].

Bousfield, E. L.

1958a. Distributional ecology of the terrestrial Talitridae (Crustacea: Amphipoda) of Canada. Proc. 10th Int. Congr. Entomol., vol. 1, pp. 883–896, figs. 1–10.

Bousfield, E. L.
1958b. Notes on the amphipod genus *Orchestoidea* on the Pacific coast of North America. Bull. So. California Acad. Sci., vol. 56, pp. 119–129, pls. 24, 25.
1961. New records of beach hoppers (Crustacea: Amphipoda) from the coast of California. Nat. Mus. Canada, Bull. no. 172, pp. 1–12, figs. 1–4.

Bousfield, E. L., and Klawe, W. L.
1963. *Orchestoidea gracilis*, a new beach hopper (Amphipoda: Talitridae) from Lower California, Mexico, with remarks on its luminescence. Bull. So. California Acad. Sci., vol. 62, pp. 1–8, figs. 1–2.

Brandt, F.
1851. Krebse. Dr. A. Th. v. Middendorff's Reise in den äussersten Norden und Osten Sibiriens. Band II. Zoologie. Theil I. Wirbellose Thiere. St. Petersburg, Krebse, pp. 79–148, pl. 6.

Bruce, J. R., Colman, J. S., and Jones, N. S. (eds.)
1963. Marine Fauna of Isle of Man and its surrounding seas, 2nd ed., pp. ix + 307, 5 charts. Liverpool University Press.

Buchanan, J. B.
1957. The bottom fauna communities across the continental shelf off Accra, Ghana (Gold Coast). Proc. Zool. Soc. London, vol. 130, pp. 1–56, pl. 1, figs. 1–10.

Bulycheva, A. I.
1952. Novye vidy bokoplavov (Amphipoda, Gammaridea) iz Japonskogo Morja. Akad. Nauk. SSSR, Trudy Zool. Inst., vol. 12, pp. 195–250, figs. 1–39 (in Russian).
1957. Morskie bloxi morej SSSR i sopredel'nyx vod (Amphipoda-Talitroidea). Opred. po Faune SSSR, Akad. Nauk vol. 65, pp. 1–185, figs. 1–66.

Calman, W. T.
1898. On a collection of Crustacea from Puget Sound. Ann. New York Acad. Sci., vol. 11, pp. 259–292, pls. 31–34.

Chevreux, E.
1900. Amphipodes provenant des campagnes de l'*Hirondelle* (1885–1888). Rés. Campagne Sci. Albert Ier, Monaco, vol. 16, pp. i–iv, 1–195, pls. 1–18.
1906. Crustacés amphipodes. Expédition Antarctique Francaise (1903–1905) commandée par le Dr Jean Charcot. Sci. Nat.: Doc. Sci., pp. 1–100, figs. 1–56. Paris, Masson et Cie, Éds.
1911. Campagnes de la Melita. Les amphipodes d'Algerie et de Tunisia. Mém. Soc. Zool. France, vol. 23, pp. 145–285, pls. 6–20.

Chevreux, E., and Fage, L.
1925. 5. 5 Amphipodes. Faune de France, vol. 9, pp. 1–488, figs. 1–438.

Dahl, E.
1946. The Amphipoda of the Sound. Pt. 2. Aquatic Amphipoda, with notes on changes in the hydrography and fauna of the area. Kungl. Fysiog. Sällsk. Handl. N.F., vol. 57, no. 16, pp. 1–49, figs. 1–5.

Dana, J. D.
1853–55. Crustacea II. U.S. Expl. Exped. . . ., vol. 14, pp. 691–1018, atlas of 96 pls.
1854. Catalogue and descriptions of Crustacea collected in California by Dr. John L. Le Conte. Proc. Acad. Nat. Sci., Philadelphia, vol. 7, pp. 175–177.

Della Valle, A.
1893. Gammarini del Golfo di Napoli. Fauna und Flora des Golfes von Neapel. . . ., Monog. 20, xi and 948 pp., atlas of 61 pls.
Dunbar, M. J.
1954. The amphipod Crustacea of Ungava Bay, Canadian eastern Arctic. Jour. Fisheries Res. Board, Canada, vol. 11, pp. 709–798, figs. 1–42, 1 table.
Ekman, S.
1953. Zoogeography of the sea. London: Sidgwick and Jackson, Ltd.
Enequist, P.
1950. Studies on the soft-bottom amphipods of the Skagerak. Zool. Bidrag från Uppsala, vol. 28, pp. 297–492, figs. 1–67, 6 charts.
Garth, J. S.
1955. The case for a warm-temperate marine fauna on the west coast of North America. *In* Essays—in honor of Captain Allan Hancock, pp. 19–27. Univ. So. California Press, Los Angeles.
Gurjanova, E.
1934. Neue Formen von Amphipoden des karischen Meeres. Zool. Anz., vol. 108, pp. 122–130, figs. 1–6.
1938. Amphipoda, Gammaroidea of Siaukhu Bay and Sudzukhe Bay (Japan Sea). Repts. Japan Sea Hydrobiol. Exped. Zool. Inst. Acad. Sci. USSR in1934, pt. 1, pp. 241–404, figs. 1–59 (in Russian with English title and summary).
1948. Amphipoda Tixogo Okeana II. Stenothoidae dal'nevostochyx morei. Pamjati Akad. Sergeja Alekseevicha Zernova, Akad. Nauk SSSR, pp. 287–325, figs. 1–21 (in Russian).
1951. Bokoplavy morej SSSR i sopredel'nykh vod (Amphipoda-Gammaridea). Akad. Nauk SSSR, Opredel. po Faune SSSR, vol. 41, pp. 1–1029, figs. 1–705 (in Russian).
1952. Novye vidy bokoplavov (Amphipoda, Gammaridea) iz dal'nevostochnykh morei. Trudy Inst. Zool., Akad. Nauk SSSR, vol. 12, pp. 171–194, figs. 1–17.
1962. Bokoplavy severnoi chasti Tixogo Okeana (Amphipoda-Gammaridea) chast' 1. Akad. Nauk SSSR, Opredel. po Faune SSSR, vol. 74, pp. 1–440, figs. 1–143 (in Russian).
Harford, W. G. W.
1877. Description of three new species of sessile-eyed Crustacea, with remarks on Ligia occidentalis. Proc. California Acad. Sci., vol. 7, pp. 116–117.
Haswell, W. A.
1880. On some additional new genera and species of amphipodous crustaceans. Proc. Linn. Soc. New South Wales, vol. 4, pp. 319–350, pls. 18–24.
Hewatt, W. G.
1946. Marine ecological studies on Santa Cruz Island, California. Ecol. Monog., vol. 16, pp. 185–210, figs. 1–2.
Holmes, S. J.
1904a. On some new or imperfectly known species of west American Crustacea. Proc. California Acad. Sci., ser. 3, Zool., vol. 3, pp. 307–324, pls. 35–37.
1904b. Amphipod crustaceans of the Expedition. Harriman Alaska Exped., pp. 233–246, figs. 118–128. New York: Doubleday, Page & Co.

Holmes, S. J.
1905. The Amphipoda of southern New England. Bull. U.S. Bureau of Fisheries, vol. 24, pp. 459–529, pls. 1–13, numerous figs.
1908. 5.5 The Amphipoda collected by the U.S. Bureau of Fisheries steamer, "Albatross," off the west coast of North America, in 1903 and 1904, with descriptions of a new family and several new genera and species. Proc. U.S. Nat. Mus., vol. 35, pp. 489–543, figs. 1–46.

Hurley, D. E.
1954a. Studies on the New Zealand amphipodan fauna No. 5. *Pleonexes lessoniae*, a new species of the family Ampithoidae. Trans. Roy. Soc. New Zealand, vol. 81, pp. 619–626, figs. 1–2.
1954b. Studies on the New Zealand amphipodan fauna No. 9. The families Acanthonotozomatidae, Pardaliscidae and Liljeborgiidae. Trans. Roy. Soc. New Zealand, vol. 82, pp. 763–802, figs. 1–14.
1955. Studies on the New Zealand amphipodan fauna No. 8. Terrestrial amphipods of the genus *Talitrus* Latr. Pacific Sci., vol. 9, pp. 144–157, figs. 1–4.
1957. Studies on the New Zealand amphipodan fauna No. 14.—The genera *Hyale* and *Allorchestes* (family Talitridae). Trans. Roy. Soc. New Zealand, vol. 84, pp. 903–933, figs. 1–9.
1963. Amphipoda of the family Lysianassidae from the west coast of north and central America. Allan Hancock Found. Publs., Occ. Pap. no. 25, pp. 1–165, figs. 1–49.

Irie, H.
1957. Tube-building amphipods occurring at the "wakame" (a species of brown algae: *Undaria pinnatifida*) grounds of Simabara, Nagasaki Prefecture. 長崎大学水産学部研究報告, vol. 4, pp. 1–6, figs. 1–6.

Iwasa, M.
1934. A new amphipod (*Parhyale kurilensis*, n.sp.) from Urup. Jour. Fac. Sci., Hokkaido Imp. Univ., ser. 6, Zool., vol. 3, pp. 1–7, pls. 1–2, 1 fig.
1939. Japanese Talitridae. Jour. Fac. Sci. Hokkaido Imp. Univ., ser. 6, Zool., vol. 6, pp. 255–296, pls. 9–22, figs. 1–27.

Krøyer, H.
1845. Karcinologiske Bidrag. Naturhist. Tidsskrift, vol. 1, pp. 283–345, pls. 1–3, pp. 453–638, pls. 6, 7.

Kunkel, B. W.
1910. The Amphipoda of Bermuda. Trans. Connecticut Acad. Arts Sci., vol. 16, pp. 1–116, figs. 1–43.
1918. The Arthrostraca of Connecticut. Connecticut Geol. Nat. Hist. Surv., vol. 6, Bull. 26, pt. 1, Amphipoda, pp. 15–181, figs. 1–55.

Light, S. F.
1941. Laboratory and field text in Invertebrate zoology. Palo Alto: Stanford Univ. Press.

MacGinitie, G. E.
1935. Ecological aspects of a California marine estuary. Amer. Midl. Nat., vol. 15, pp. 629–765.

Mills, E. L.
1961. Amphipod crustaceans of the Pacific coast of Canada. I. Family Atylidae. Nat. Mus. Canada, Bull. 172, pp. 13–33, figs. 1–4.

MILLS, E. L.

1962. Amphipod crustaceans of the Pacific coast of Canada. II. Family Oedicerotidae. Nat. Hist. Paps. Nat. Mus. Canada, no. 15, pp. 1–21, figs. 1–6.

NAGATA, K.

1960. Preliminary notes on benthic gammaridean Amphipoda from the *Zostera* region of Mihara Bay, Seto Inland Sea, Japan. Publ. Seto Mar. Biol. Lab., vol. 8, pp. 163–182, figs. 1–2, pls. 13–17.

NICHOLLS, G. E.

1938. Amphipoda Gammaridea. Australasian Antarctic Exped. 1911–14. Sci. Rep., ser. c.-Zool. and Bot., vol. 2, pt. 4, pp. 1–145, figs. 1–67.

OLDEVIG, H.

1959. Arctic, subarctic and Scandinavian amphipods in the collections of the Swedish Natural History Museum in Stockholm. Göteborgs Kungl. Vetenskaps- Vitterhets-Samhälles Handl., ser. 6, ser. B, vol. 8, no. 2, pp. 1–132, pls. 1–4.

PEARSE, A. S.

1932. Inhabitants of certain sponges at Dry Tortugas. Carnegie Inst., Washington [D.C.], Publ. 435, pp. 117–124, pls. 1–2.

PILLAI, N. K.

1957. Pelagic Crustacea of Travancore. III. Amphipoda. Bull. Centr. Res. Inst., Univ. Travancore, vol. 5, pp. 29–68, figs. 1–18.

PIRLOT, J. M.

1936. Les amphipodes de l'expédition du Siboga. Deuxième partie. Les amphipodes gammarides. II.—Les amphipodes de la mer profonde. 3. Addendum et partie générale. III.—Les amphipodes littoraux. 1. Lysianassidae, Ampeliscidae, Leucothoidae, Stenothoidae, Phliantidae, Colomastigidae, Ochlesidae, Liljeborgiidae, Oedicerotidae, Synopiidae, Eusiridae, Gammaridae. Siboga-Exped., Mon. 33e, pp. 237–328, figs. 102–146.

1939. Resultats scientifiques des croisieres du Navire-Ecole Belge "Mercator". III. Amphipoda. Mem. Mus. Roy. Hist. Nat., Belg., ser. 2, fasc. 15, pp. 47–80, figs. 1–7.

PLYMOUTH MARINE FAUNA

1957. Marine Biol. Assoc. U.K., 3rd ed., xliii and 458 pp., 4 charts.

RICKETTS, E. F., and CALVIN, J.

1952. Between Pacific Tides. Joel W. Hedgpeth, ed. Stanford: Stanford University Press (3rd. ed.).

RUFFO, S.

1953. Studi sui crostacei anfipodi—XXXIII Anfipodi raccolti sulle coste dell' Angola e del Congo Belga dal Dr E. Dartevelle. Rev. Zool. Bot. Afr., vol. 47, nos. 1–2, pp. 120–136, figs. 1–5.

1959. Contributo alla conoscenza degli anfipodi del Mar Rosso (1). Sea Fisheries Res. Sta., Haifa, Bull. no. 20, pp. 1–36, figs. 1–6.

SARS, G. O.

1895. Amphipoda. An account of the Crustacea of Norway with short descriptions and figures of all the species, vol. 1, pp. i-viii and 1–711, 240 pls., 8 suppl. pls.

SCHELLENBERG, A.

1925. Crustacea VIII: Amphipoda. *In* W. Michaelsen's Beiträge zur Kenntnis der Meeresfauna Westafrikas, vol. 3, pt. 4, pp. 111–204, figs. 1–27.

SCHELLENBERG, A.
1928. Report on the Amphipoda. Zool. Res. Cambridge Exped. Suez Canal, 1924. Trans. Zool. Soc. London, vol. 22, pp. 633–692, figs. 198–209.
1931. Gammariden und Caprelliden des Magellangebietes, Südgeorgiens und der Westantarktis. Further Zool. Res. Swedish Antarctic Exped. 1901–1903, vol. 2, no. 6, pp. 1–290, 1 pl., 136 figs.
1936. Zwei neue Amphipoden des Stillen Ozeans und Zwei: Berichtigungen. Zool. Anz., vol. 116, pp. 153–156, fig. 1.
1938. Litorale Amphipoden des tropischen Pazifiks. . . . Kungl. Svenska Vetenskapakad. Handl., ser. 3, vol. 16, no. 6, pp. 1–105, figs. 1–48.
1953. Ergänzungen zur Amphipodenfauna Südwest-Afrikas nebst Bemerkungen über Brutraumbildung. Mitth. Zool. Mus. Berlin, vol. 29, pp. 107–126, figs. 1–7.

SEXTON, E. W.
1909. Notes on some Amphipoda from the north side of the Bay of Biscay. Families Pleustidae and Eusiridae. Proc. Zool. Soc. London, 1909, pp. 848–879, pls. 80, 81, figs. 278–279.

SEXTON, E. W., and REID, D. M.
1951. The life-history of the multiform species Jassa falcata (Montagu) (Crustacea Amphipoda) with a review of the bibliography of the species. Jour. Linn. Soc. London, vol. 42, Zool., pp. 29–91, pls. 4–30.

SHOEMAKER, C. R.
1916. Descriptions of three new species of amphipods from southern California. Proc. Biol. Soc. Washington [D.C.], vol. 29, pp. 157–160.
1925. The Amphipoda collected by the United States Fisheries Steamer "*Albatross*" in 1911, chiefly in the Gulf of California. Bull. American Mus. Nat. Hist., vol. 52, pp. 21–61, figs. 1–26.
1926. Amphipods of the family Bateidae in the collection of the United States Museum. Proc. U.S. Nat. Mus., vol. 68, no. 2626, pp. 1–26, figs. 1–16.
1930a. Descriptions of two new amphipod crustaceans (Talitridae) from the United States. Jour. Washington Acad. Sci. [D.C.], vol. 20, pp. 107–114, figs. 1–3.
1930b. The Amphipoda of the Cheticamp Expedition of 1917. Contr. Canadian Biol. Fisheries, n.s., vol. 5, no. 10, pp. 1–141, figs. 1–54.
1931. A new species of amphipod crustacean (Acanthonotozomatidae) from California, and notes on Eurystheus tenuicornis. Proc. U.S. Nat. Mus., vol. 78, no. 2861, pp. 1–8, figs. 1–4.
1933a. Amphipoda from Florida and the West Indies. American Mus. Nov., no. 598, pp. 1–24, figs. 1–13.
1933b. Two new genera and six new species of Amphipoda from Tortugas. Paps. Tortugas Lab., Carnegie Inst. Washington [D.C.], Publ. 435, pp. 245–256, figs. 1–8.
1934. Two new species of *Corophium* from the west coast of America. Jour. Washington Acad. Sci. [D.C.], vol. 24, pp. 356–360, figs. 1–2.
1938. Three new species of the amphipod genus *Ampithoe* from the west coast of America. Jour. Washington Acad. Sci. [D.C.], vol. 28, pp. 15–25, figs. 1–4.

Shoemaker, C. R.
1941a. A new genus and a new species of Amphipoda from the Pacific coast of North America. Proc. Biol. Soc. Washington [D.C.], vol. 54, pp. 183–186.
1941b. On the names of certain California amphipods. Proc. Biol. Soc. Washington [D.C.], vol. 54, pp. 187–188.
1942a. Notes on some American fresh-water amphipod crustaceans and descriptions of a new genus and two new species. Smithsonian Misc. Colls., vol. 101, no. 9, pp. 1–31, figs. 1–12.
1942b. Amphipod crustaceans collected on the presidential cruise of 1938. Smithsonian Misc. Colls., vol. 101, no. 11, pp. 1–52, figs. 1–17.
1944. Description of a new species of Amphipoda of the genus *Anisogammarus* from Oregon. Jour. Washington Acad. Sci. [D.C.], vol. 34, pp. 89–93, figs. 1–2.
1949. The amphipod genus *Corophium* on the west coast of America. Jour. Washington Acad. Sci. [D.C.], vol. 39, pp. 66–82, figs. 1–8.
1952. A new species of commensal amphipod from a spiny lobster. Proc. U.S. Nat. Mus., vol. 102, pp. 231–233, fig. 83.
1955a. Amphipoda collected at the Arctic Laboratory, Office of Naval Research, Point Barrow, Alaska, by G. E. MacGinitie. Smithsonian Misc. Colls., vol. 128, no. 1, pp. 1–78, figs. 1–20.
1955b. Notes on the amphipod crustacean *Maeroides thompsoni* Walker. Jour. Washington Acad. Sci. [D.C.], vol. 45, p. 59.
1956. Observations on the amphipod genus Parhyale. Proc. U.S. Nat. Mus., vol. 106, pp. 345–358, figs. 1–4.
1964. Seven new amphipods from the west coast of North America with notes on some unusual species. Proc. U.S. Nat. Mus., vol. 115, pp. 391–430, figs. 1–15.

Skogsberg, T., and Vansell, G. H.
1928. Structure and behavior of the amphipod, Polycheria osborni. Proc. California Acad. Sci., ser. 4, vol. 17, pp. 267–295, figs. 1–26.

Smith, R. I., Pitelka, F. A., Abbott, D. P., and Weesner, F. M., eds.
1954. Intertidal invertebrates of the central California coast. Berkeley and Los Angeles: Univ. California Press.

Stasek, C. R.
1958. A new species of *Allogaussia* (Amphipoda, Lysianassidae) found living within the gastrovascular cavity of the sea-anemone *Anthopleura elegantissima*. Jour. Washington Acad. Sci. [D.C.], vol. 48, pp. 119–126, figs. 1–2.

Stebbing, T. R. R.
1888. Report on the Amphipoda collected by H.M.S. Challenger during the years 1873–76. *In* Great Britain. Rept. Sci. Res. Voy. H.M.S. Challenger during the years 1873–76. Zool. vol. 29, pp. i–xxiv, 1–1737, 210 pls. [3 vols.].
1897. Amphipoda from Copenhagen Museum and other sources. Trans. Linnaean Soc. London, ser. 2, Zool., vol. 7, pp. 25–45, pls. 6–14.
1906. Amphipoda I. Gammaridea. Das Tierreich, vol. 21, pp. i–xl, 1–806, figs. 1–127.

Stebbing, T. R. R., and Robertson, D.
1891. On four new British Amphipoda. Trans. Zool. Soc. London, vol. 13, pp. 31–42, pls. 5, 6.

Stephensen, K.
1923. Crustacea Malacostraca. V. (Amphipoda. I.) Danish Ingolf-Exped., vol. 3, no. 8, pp. 1–100.
1927. Crustacea from the Auckland and Campbell Islands. Papers from Dr. Th. Mortensen's Pacific Expedition 1914–16. XL. Vid. Medd. Dansk Nat. Foren., vol. 83, pp. 289–390, figs. 1–33.
1931. Crustacea Malacostraca. VII. (Amphipoda. III.). Danish Ingolf-Exped., vol. 3, pp. 179–290, figs. 54–81, charts 32–51.
1932. Some new amphipods from Japan. Annot. Zool. Japon., vol. 13, pp. 487–501, figs. 1–5.
1933a. Fresh- and brackish-water Amphipoda from Bonaire, Curaçao, and Aruba. Zoologische Ergebnisse einer Reise nach Bonaire, Curaçao und Aruba im Jahre 1930. No. 8. Zool. Jahrb., Syst., vol. 64, pp. 414–436, figs. 1–8.
1933b. Amphipoda from the marine salines of Bonaire and Curaçao. Zoologische Ergebnisse einer Reise nach Bonaire, Curaçao und Aruba im Jahre 1930. No. 9. Zool. Jahrb., Syst., vol. 64, pp. 437–446, figs. 1–4.
1949. The Amphipoda of Tristan da Cunha. Res. Norwegian Sci. Exped. to Tristan da Cunha 1937–1938, no. 19, pp. 1–61, figs. 1–23.

Stimpson, W.
1856. On some Californian Crustacea. Proc. California Acad. Nat. Sci., vol. 1, pp. 95–99.
1857. The Crustacea and Echinodermata of the Pacific shores of North America. Jour. Boston Soc. Nat. Hist., vol. 6, pp. 1–92, pls. 18–23.
1864. Descriptions of new species of marine Invertebrata from Puget Sound, collected by the naturalists of the Northwest Boundary Commission, A. H. Campbell, Esq., Commissioner. Proc. Acad. Nat. Sci., Philadelphia, [vol. 16], pp. 153–165.

Stout, V. R.
1912. Studies in Laguna Amphipoda. First Ann. Rept. Laguna Mar. Lab., pp. 134–149, figs. 74–84.
1913. Studies in Laguna Amphipoda. Zool. Jahrb., Syst., vol. 34, pp. 633–659, figs. 1–3.

Thorsteinson, E. D.
1941. New or noteworthy amphipods from the North Pacific coast. Univ. Washington Publ. Oceanog., vol. 4, pp. 50–96, pls. 1–8.

Walker, A. O.
1898. Crustacea collected by W. A. Herdman, F.R.S., in Puget Sound, Pacific coast of North America, September, 1897. Proc. Trans. Liverpool Biol. Soc., vol. 12, pp. 268–287, pls. 15, 16.
1904. Report on the Amphipoda collected by Professor Herdman, at Ceylon, in 1902. Suppl. Rept., Ceylon Pearl Oyster Fisheries—1904—no. 17, pp. 229–300, pls. 1–8.
1916. Edriophthalma from South America. Ann. Mag. Nat. Hist., ser. 8, vol. 17, pp. 345–346, 1 fig.

Walker, A. O. and Scott, A.
1903. II.—Decapod and sessile-eyed crustaceans from Abd-el-kuri. Nat. Hist. Sokotra and Abd-el-Kuri, pp. 216–232, pls. 14A, 14B.

Weckel, A. L.
1907. The fresh-water Amphipoda of North America. Proc. U.S. Nat. Mus., vol. 32, pp. 25–58, figs. 1–15.

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