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ALLAN HANCOCK PACIFIC EXPEDITIONS

VOLUME 21

PART 1

BRACHYURA OF THE PACIFIC
COAST OF AMERICA
OXYRHYNCHA

TEXT

BY

JOHN S. GARTH



THE UNIVERSITY OF SOUTHERN CALIFORNIA PRESS
LOS ANGELES, CALIFORNIA

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Hans F. Kuck

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BY
JOHN S. GARTH

To Hans Kuck
with sincere regards
and best wishes

John S. Garth
Dec. 23, 1992

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GENERAL DISCUSSION

Introduction

The quarter century following the appearance in 1925 of the Rathbun monograph, "The Spider Crabs of America", has been a period of intensive exploration in the eastern Pacific, unrivaled since the pioneer investigations of the United States Exploring Expedition, the *Hassler*, and the *Albatross*, and in some respects exceeding them in productivity. Numerous well-organized and splendidly equipped expeditions have converged upon the Gulf of California, the Bay of Panama, and the Galapagos Islands, accompanied by carcinologists of a younger generation whose experience in the field has found expression in a growing body of literature in which distributional, ecological, and behavioristic factors are emphasized. The establishment of the Allan Hancock Foundation as a permanent repository for the marine invertebrates obtained by the *Velero III* and *Velero IV* has served to attract to the west coast other major collections gathered during this most fertile period.

The publication by Balss (1929) of a suggested revision of the Oxyrhyncha invited changes in the classification adopted by Rathbun, which was essentially that of Alcock (1895). The use of the male first pleopod as a taxonomic character, revived by Stephensen (1945) after a period of neglect since Brocchi (1875), provided a fertile field for investigation. It is not surprising, therefore, that the application to this large mass of specimen material of a new analysis and an improved technique should result in a clarification of the interrelationships of the genera and species of Pacific American Majidae and the placing of their systematics on a firmer basis than has been possible heretofore.

If a single example may be chosen to illustrate the great strides that have been made in our knowledge of the occurrence of majid species in the eastern tropical Pacific, let it be the genus *Podochela*, of which Rathbun (1925) was unable to list a member south of Cape San Lucas, with the exception of *P. margaritaria* of the Galapagos Islands. With the addition of new species described by Finnegan (1931), Garth (1939, 1940, and the present volume), and the extension of range of species previously reported from the Lower California-Gulf of California region, the number of species of *Podochela* known to inhabit eastern Pacific waters has been increased to 10, a number equaling the representation of the genus in the western Atlantic. To cite a similar example from among the Parthenopidae, the genus *Parthenope* Weber was represented from the eastern Pacific in the collections of the U. S. National Museum as recently as 1925 by an even dozen specimens, of which nine were of

the single species *P. exilipes*, collected by the *Albatross* off Lower California, in the Bay of Panama, and in the Galapagos Islands. As a result of *Velero III* collecting, the range of this species has been extended to Peru, while *P. depressiuscula* and *P. excavata*, represented by specimens from Panama only, became known from numerous localities. In addition, two species known only from the literature, *P. hyponca* and *P. triangula*, were rediscovered, while still another species is made known in these pages.

Source of Materials

The cruises of the *Velero III* from 1931 to 1941 and of the *Velero IV* from 1949 to 1955, in which W. L. Schmitt, F. C. Ziesenhenné, and the writer participated as carcinological collectors, have been the principal source of the specimen material herein reported. However, the restriction of the activities of the Allan Hancock Pacific expeditions to the territory between San Francisco, California, and San Juan Bay, Peru, including offshore islands, has necessitated drawing upon other sources for material from north and south of these limits. Thus specimens from Alaska and from Chile collected by the *Albatross* have been made available by the U. S. National Museum, specimens from Galapagos and Juan Fernandez Islands collected by the *Hassler* have been loaned by the Museum of Comparative Zoology, and specimens from the recent Lund University Chile Expedition collected by professors E. Dahl and H. Brattström have been made available in advance of publication in the official expedition reports.

Supplementing *Velero III* material are collections from Peru obtained by W. L. Schmitt while traveling under a Walter Rathbone Bacon Fellowship of the Smithsonian Institution in 1926; from Ecuador by R. Paessler in 1895 (courtesy Hamburg Museum); from Panama by students of Elinor D. Robson in 1939; from Acapulco, Mexico, by C. L. Hubbs in 1946 and E. Y. Dawson in 1947; and from the Gulf of California by S. A. Glassell in 1940, by C. L. Hubbs (J. Rodriguez, collector) in 1947, by B. W. Halstead in 1949, and by W. N. Smith, II, in 1951. From the west coast of Lower California are specimens from San Ignacio Lagoon collected by M. W. Johnson in 1950, from Scammon Lagoon, Cedros Island, and Guadalupe Island by M. W. Williams in 1946, and from Guadalupe Island by C. L. Hubbs in 1946 and 1950.

From the southern California-Channel Islands area are early collections of the *Anton Dohrn* made by A. B. Ulrey, P. L. Greeley, P. S. Barnhart, and Elmer Higgins, dating back to the Venice Marine Labora-

tory, precursor of the Allan Hancock Foundation; and collections made by T. A. and Beatrice L. Burch from 1939 to 1941, containing dredged specimens from Santa Monica Bay. Others contributing material from this area and north to Monterey are K. O. Emery, C. L. Hubbs, I. A. McCulloch, R. J. Menzies, J. L. Mohr, R. Morrison, C. L. Wright, and F. C. Ziesenhenné.

From northern California are collections made at Tomales Bay by P. B. Quyle and F. Gale in 1946, in Marin and Sonoma Counties by R. J. Menzies in 1948-1949, in Sonoma County by L. O. Miles in 1949-50, and in Mendocino County by W. K. Emerson and J. L. Barnard in 1949.

Material from Oregon was provided by a Hancock Foundation field trip to Coos Bay in the summer of 1942. Material from Washington came from the University of Washington Oceanographic Laboratories, Friday Harbor, E. F. Swan and D. L. Ray, in 1948-49; from Walla Walla College Biological Station, Anacortes, B. W. Halstead and H. C. Coffin, in 1949-51; and from the University of Washington Oceanographic Laboratories, Seattle, J. W. Slipp, in 1951.

Specimens from British Columbia were obtained by the writer while a guest aboard the Pacific Biological Laboratory ship *Investigator*, operating in Burrard Inlet near Vancouver in 1949. Comparative material from Arctic Alaska was provided from Point Barrow by G. E. MacGinitie in 1950.

In addition to material sent to him at the University of Southern California, the writer has examined specimens in the following Pacific Coast institutions at which collections of Brachyura are kept: San Diego Museum of Natural History, San Diego; Los Angeles Museum of History, Science, and Art, Los Angeles; Hopkins Marine Station, Pacific Grove; Stanford Museum of Natural History, Palo Alto; California Academy of Sciences, San Francisco; University of Washington Oceanographic Laboratories, Friday Harbor; and Provincial Museum, Victoria, B. C.

Method of Study

In reviewing the species of majid crabs from the Pacific coast of the Americas it was deemed unnecessary to repeat the early work of M. J. Rathbun, who in 1896 visited the principal museums of Europe, examining the types of J. C. Fabricius at Copenhagen, of Herbst at Berlin, of Saussure at Geneva, of H. and A. Milne Edwards at Paris, and of Miers at London, and established the identity of specimens then in the

collections of the U. S. National Museum with New World species described by these authors. Therefore the writer has confined his personal investigations to the Smithsonian collection, and to collections of other institutions of eastern North America in which crustacean type material is located; namely, the Museum of Comparative Zoology at Harvard, the New York Zoological Society and the American Museum of Natural History in New York, and the Philadelphia Academy of Sciences. At each of these institutions specimens collected by the *Velero III* were compared with types or with previously determined material, and in this way the identity of specimens in the collection of the Allan Hancock Foundation with species described or identified by early American carcinological workers was established. Basic to the Hancock Foundation collection is a set of specimens determined for F. C. Ziesenne and the writer prior to 1937 by the late Miss Rathbun and containing most of her west coast brachyuran species.

Although the European types were not reexamined, letters of inquiry concerning the safety of type collections were directed to institutions in the principal cities of Europe, several of which were subjected to aerial bombardment in World War II. Favorable replies were received from curators in London, Paris, Hamburg, Turin, and Geneva. The absence of a direct report from Naples leads to the belief that the types of Cano have been destroyed, a circumstance attested to by Dr. Lucia Rossi of the Turin Museum.

The early west coast collections were destroyed by a series of major catastrophes: the types of Lockington in the California Academy of Sciences by the San Francisco earthquake and fire in 1906; the Chilean collection of Porter by the Valparaiso earthquake and fire of the same year; the Mexican collection of A. Milne Edwards by the shelling of Paris in 1870; and the west coast material of Stimpson, sent him by the Smithsonian Institution, by the Chicago fire of October 8, 1871. Less spectacular, but equally effective, were the slow disintegrative processes which in time claimed the types of Bell in Britain and of Dana in America.

The destruction of types raises the question of establishing substitute types, called neotypes, a practice gaining favor among systematists and in the writer's opinion clearly justified in the case of many west coast brachyuran species. However, in view of the recommendations of the Fourteenth International Congress of Zoology, and in deference to the opinions of his colleagues, the writer has refrained from designating

neotypes except when required for stability or for the solution of a nomenclatorial problem.

Although their types are no longer extant, the classic descriptions of Bell, Dana, Stimpson, and A. Milne Edwards, together with those of H. Milne Edwards, Miers, Faxon, and S. I. Smith, whose types escaped destruction, are still available, although found in books and journals which are becoming increasingly rare and difficult to obtain. Because of their excellence, as well as their historic interest, a number of these early descriptions have been incorporated in the account which follows, modified only to the slight extent needed to bring their often antiquated terminology into conformity with present day usage and into harmony with the original portions of the text.

Unfamiliar with the North Atlantic fauna and without access to the large collections of the east coast or of Europe, the west coast worker has labored under a distinct handicap. For the westward course of civilization and of science decreed that European species should become known before eastern American, and they in turn before western American. In many cases a Pacific species is described only in those minor particulars in which it differs from a related and earlier described Atlantic form. Such dependent or satellite descriptions have here been recast in such a way as to attribute to the Pacific species, independently of the Atlantic one, those characters shared in common. The Pacific worker, therefore, may proceed with confidence, knowing that he will not be required to consult either descriptions or specimens to which he does not have ready access for the identification of his material.

Acknowledgment

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the Royal Netherlands Museum, respectively, for facilitating the study through the loan of valuable material or the comparison of specimens with inaccessible types, and to Drs. Marc André, S. C. Ball, A. Lemos de Castro, A. Panning, and Lucia Rossi, curators of collections in the museums of Paris, New Haven, Rio de Janeiro, Hamburg, and Turin, for information concerning type and other specimens in their custody, grateful appreciation is expressed. To Anker Petersen, former staff artist, Allan Hancock Foundation, for color notes on living specimens and to Mr. Petersen and Glennis Sayers Clements for the meticulous pen-and-ink drawings which illumine the printed text, to Daniel Chapman, William Fortin, Royford George, and Mervin Slawson, photographers, and to Beatrice La Rue Burch, Victoria Louise Smith, and Janet Haig, successive research assistants, for help in cataloguing the collection and in compiling the bibliography, and to Miss Haig and Robert E. Arnal for their careful translations from the French, my warmest thanks. Finally, to Dr. E. Yale Dawson and the late Dr. Raymond C. Osburn for their identifications of the algal and bryozoan associates, respectively, of the decorator crabs, due acknowledgment is made.

In Memoriam

Among those who rendered significant service in the identification of new and obscure forms described in these pages, and whose names will always be identified with Pacific Brachyura, are four who did not live to see this work completed:

| | |
|---------------------|-------------|
| Mary J. Rathbun | 1860 - 1943 |
| Steve A. Glassell | 1884 - 1948 |
| Alida M. Buitendijk | 1903 - 1950 |
| Heinrich Balss | 1886 - 1957 |

SYSTEMATIC DISCUSSION

Historical Review

Since the original definitive work by H. Milne Edwards (1834), there have been four major revisions of the oxyrhynchous crabs of world-wide scope, those of Dana (1851b), Miers (1879c), Alcock (1895), and Balss (1929). Between each of the dates mentioned the number of genera to be considered was progressively increased: before Miers by Stimpson, before Alcock by A. Milne Edwards, and before Balss by Rathbun. Since, with the exception of Dana and, to a minor extent, Miers, describer and reviewer were not the same person, each subsequent reviewer was confronted by a confusion less and less of his own contriving.

It should not be inferred from the foregoing statement that each revision was revolutionary in character, completely upsetting the existing arrangement, nor that the workers whose efforts were purely descriptive were therefore irresponsible. Rather, each review rested securely upon its predecessor by a generation, and it was only when the newly discovered species and the genera erected to receive them failed to find accommodation within the existing framework that the higher concepts of subfamily and family were redefined. In a field which in the last century and a quarter has witnessed such intense activity, this periodic bursting of bounds was inevitable.

The classification employed at present may be traced directly to the three tribes proposed by the elder Milne Edwards (1834), whose *Macropodiens* and *Maiens* became the *Maiinea* of Dana and of Miers, the latter settling upon three families, the *Inachidae*, *Maiidae*, and *Pericoridae*, rather than Dana's five. Reduced to subfamilies and increased to four by Alcock, who withdrew the *Acanthonychinae* from the *Inachinae*, these are the primary subdivisions of Rathbun (1925) and other latter-day workers. The *Parthenopiens* of Milne Edwards have been given equal rank with his other two tribes since the time of Dana. In some respects Alcock's work represented a return to the earlier writers, particularly Dana; however, his four subfamilies of the *Maiidae* were an improvement on Dana's five families of the *Maioida*, and his genera were distributed in a more natural manner. The system continued to suffer, however, from the predilection of Miers and Alcock for an arrangement based upon orbital configuration alone.

It is perhaps too soon to determine whether the system proposed by Balss (1929) will rank with those of his distinguished predecessors, or will lapse into desuetude with those of De Haan (1833-50) and Strahl

(1861). The fact that it is based not on one character, but on multiple characters, each the manifestation of a sound developmental principle, argues well for its widespread use. In brief, Balss recognizes four criteria of development which may be looked for in each of the Alcockian subfamilies: (1) the presence of the interantennular spine, which is the true rostrum of the zoea, the so-called rostrum of the adult being a secondary outgrowth of the front (*vide* Cano); (2) the degree of fusion of the paired rostral horns along the median line to form a single beak or rostrum; (3) the amount of coalescence of the abdominal segments in the two sexes; and (4) the presence or absence of a supplementary spine ("Interkalardorn") between the pre- and postorbital spines. The most primitive genera in each group would then be characterized by having an interantennular spine, a double rostrum, seven free abdominal segments in both sexes, and a spine intercalated between the inner and outer orbital spines. (This is true of *Macrocheira* of the Inachinae, of *Notolopas* of the Pisinae, and of *Maiopsis* of the Majinae. It is not true of any genus of the Acanthonychinae, all of which lack the intercalated spine.)

The nature and extent of dislocation of the present (Rathbun) arrangement caused by the application of this system to the New World forms is best illustrated by the Inachinae, where *Eurypodius* is lifted from its time-honored position next *Oregonia* and placed beside *Macrocheira*, the most primitive member of the group. At the same time the order of the remaining genera is reversed, the subfamily attaining its highest development with long-limbed, long-beaked forms like *Podochela* and *Stenorynchus*, rather than with short-horned, doubly-rostrate *Colodes*, with which the present arrangement ends.

In extending the system of classification proposed by Balss and in adapting it for the first time to the American brachyuran fauna, the writer has seen fit to retain for practical reasons the subfamilial designations of Alcock, with the exception of the Ophthalmiinae, withdrawn by Balss from the Majinae, where it constituted the subsection Stenocionopoida of Alcock, and the restricted subfamily Majinae, called by Alcock the Maioida. This is done to take advantage of Stephensen's (1945) analysis by subfamilies of the male pleopods, and because of belief that the presence or absence of a single spine, even though it be the intercalated orbital spine, does not in itself constitute sufficient grounds for the setting up of new subfamilies. Rather, this would appear to be inherent in the process of evolution of the orbit, which, according to Balss, is proceeding independently, but along parallel lines, in each of the Alcockian sub-

families. In each subfamily of the Majidae as presently constituted, with the exception of the Acanthonychinae, it should be possible to separate on the one hand genera with this character, and on the other hand genera without this character, as Balss has done in the Inachinae with his groups Macrocheiroidea and Camposcioidea. His division of the Pisinae of Alcock into Pisinae *sensu restr.* and Hyasteniinae, and his separation of the Macrocoelominae from the Mithracinae on the strength of this one character appear inconsistent with the principles expressed and are not herein adopted. Nor do the groupings suggested by the male first pleopods support a division along these lines. Those wishing to make use of the subfamilies of Balss, insofar as they further divide the Pisinae and Mithracinae as here recognized, will find them given as subdivisions in the keys to these subfamilies, where they form natural groupings of genera.

In addition to the characters proposed by Balss in the work cited, the writer considers of equal importance the shape of the male abdomen and the structure of the male first pleopod. On the strength of these characters, plus some evidence of similarity of larval stages, a new subfamily, the Oregoniinae, has been erected. To *Oregonia*, type genus and primitive member, are united *Hyas* and *Chionoecetes*, which share with *Oregonia* the broad and deeply inserted terminal segment of the male abdomen and a male first pleopod with filamentous setae. The subfamily is of circum-Arctic distribution, extending into temperate waters on the east and west coasts of North America and Eurasia. Its placement in the systematic arrangement may be questioned; however, it is the Acanthonychinae and Ophthalmiinae that are the anomalous groups, the interpolation of which should not be allowed to obscure the relationship of the Inachinae through the Oregoniinae to the Pisinae.

The Parthenopidae have been considered a small and somewhat insignificant family, both in numbers of species and individuals, particularly as represented on the American west coast. That this was due in part to insufficient collecting may be judged from the fact that as recently as 1925 Rathbun had no specimen material with which to illustrate *Parthenope* (*Parthenope*) *hyponca* (Stimpson), *Parthenope* (*Pseudolambrus*) *triangula* (Stimpson), *Solenolambrus arcuatus* Stimpson, or *Aethra scruposa scutata* Smith and was obliged to reproduce figures from the early literature. With the exception of the last named species, which is still a rarity, these are now represented among Hancock collections by extensive series from the mid-American mainland, while several species unknown to Miss Rathbun, including *Daldorfa garthi* Glassell, *Hetero-*

crypta colombiana Garth, and a *Parthenope* (*Pseudolambrus*) species herein described, now bring the total representation for the family from the eastern Pacific to nine genera and 16 species. In point of abundance *Heterocrypta occidentalis* (Dana) has proven to be a dominant species on sandy bottom within its range, as a glance at the table of material examined for this species will demonstrate.

The Hymenosomidae, according to Alcock (1900), are "small marine and estuarine [crabs] having a curious superficial resemblance to some of the Oxyrhynch crabs of the Inachine subfamily." Their systematic position is still somewhat uncertain. There are authors who, following Milne Edwards (1837, p. 28), have placed them among the Catometopa near the Pinnotheridae, or near the Mictyridae, as did Alcock (1900, p. 291). Others, notably Ortmann (1893, p. 31) and Rathbun (1925, p. 561), have followed De Haan (1839, p. 75) in placing them in the Oxyrhyncha near the Majidae. It is the latter course that is adopted here, albeit without prejudice to possible future phylogenetic studies. Only one American species is involved, the remaining members of the family being Australian or Asiatic.

Sexual Dimorphism

The dissimilarity of the sexes among the Majidae has led to a number of instances in which male and female of the same species were originally described as two species and as often as not placed in different genera. Classic examples are *Oregonia gracilis* (male) and *O. hirta* (female) of Dana, combined by Smith (1880), *Erileptus spinosus* (male) and *Anasimus rostratus* (female) of Rathbun, combined by Schmitt (1921), *Libinia smithi* Miers (male) and *L. hahni* A. Milne Edwards (female), combined as *Libidoclaea smithi* by Rathbun (1925), and, in all probability, *Temnonotus granulatus* (female) and *T. simplex* (male) of A. Milne Edwards, as suggested by Rathbun (1925, p. 343).

In the present volume *Epialtus minimus* (male) of Lockington and *E. crenulatus* (female) of Rathbun are combined, as are her *Euprognatha bifida* (male) and *Batrachonotus nicholsi* (female), the former name in each case taking precedence. Her *Epialtus peruvianus*, 1923a (male), and *Eupleurodon peruvianus*, 1924a (female), are combined as *Eupleurodon peruvianus*, 1923. The importance of such consolidation is best understood when one considers that, apart from these now unmasked females, the genera *Anasimus* and *Batrachonotus* are unrepresented in the Pacific.

Occasionally the dissimilarity of the sexes had the opposite result in that male and female of two different species were combined as one. A case in point is *Eucinetops lucasi* Stimpson, which was subsequently divided by Rathbun (1923a), the females remaining *E. lucasi* and the males becoming *E. rubellula*, a division further recognized herein by the establishment of neotypes for the resultant species.

Characters subject to sexual dimorphism in the Majidae include the degree of enlargement of the cheliped, the height of the palm, the size of the gape between the fingers, and the presence or absence of an interdigital tooth or teeth; the relative length of the walking legs, particularly those of the anterior pairs; the shape and number of free somites of the abdomen; and the number and modification of structure of the pleopods. Since these are among the most useful characters taxonomically, the sex of the holotype becomes an important consideration in cases of disputed identity of a species. Unfortunately, Rathbun (1925) does not include this information in her section on type locality and type, but includes it rather in her tables of material examined. It has therefore been necessary to ascertain the sex of the type specimen in the case of types not seen by her in the preparation of her monograph. This has been done by consulting the literature, or, in the few instances in which the original description failed to specify sex, by requesting reexamination of types by curators of institutions retaining their custody.

Although the number of free abdominal somites in the two sexes is one of the most clear-cut of generic distinctions, this important information was included by Rathbun (*op. cit.*) for both sexes in but 40 per cent of the majid genera treated. In another 16 per cent it is given for one sex or the other, while in 44 per cent of the genera it is omitted entirely. It has been possible in all but a very few American genera to ascertain the number of free abdominal somites in both sexes and to include this information in the generic descriptions given, thus permitting the convenient grouping of genera within their subfamilies for key and diagnostic purposes. The adoption of any system of classification based upon sexual characters has certain disadvantages where the material to be identified is of the sex opposite to that described. The experienced worker will therefore take into account supplementary generic and specific characters, and will consult the older, more highly artificial keys when necessary.

Growth and Sexual Maturity

Dr. Pierre Drach of the Faculty of Science, University of Paris, in a recent communication stated that the common European species of *Majidae* achieve sexual maturity only following the last molt, which he terms the puberty molt. It is at this time that the male chelipeds suddenly increase in size and the female abdomen broadens to encompass most of the sternum, becoming convex externally. While it cannot be stated unequivocally that this is true of the common North American species, for lack of life history studies, its extension to the fauna under consideration as a working theory or hypothesis is most helpful in explaining some of the phenomena noted in the section on Growth and Development in the pages that follow. Among the *Acanthonychinae*, for example, males of *Taliepus nuttalli* (Randall) in the 37-61 mm length range show no cheliped enlargement, while in a 106 mm male the chelipeds are grossly enlarged. The single ovigerous female, 83 mm long, is evidence that the smaller males are pre-puberal, and that sexually mature males must lie in the 83-106 mm range. Again, in the *Ophthalmiinae*, the discrepancy between the short cheliped found to be characteristic of our males of *Pitho picteti* (Saussure), the type of which was described as long-armed, and the customarily long cheliped of *P. quinquedentata* Bell, might be due only to the absence of a post-puberal male from our series of the former species.

Dr. Drach also pointed out that changes in the male first pleopod may occur at puberty, including a sudden lengthening of the appendage and its reinforced sclerotization. It should be borne in mind in this connection that while an attempt was made to figure pleopods from mature specimens only, in numerous cases such specimens were not available, necessitating the figuring of immature males. Where after figuring the pleopod of an immature male, a mature male has become available, as in the case of *Taliepus marginatus* (Bell) from among Lund University Chile Expedition collections, discrepancies have been observed that are best explained on this pre- and post-puberal basis. This does not mean that the pleopod is any the less useful as a taxonomic character because of changes that may take place with growth, but rather that in a number of species pre- and post-puberal forms of the male pleopod may have to be taken into account. The extent and nature of such change will become apparent from studies made in the *Oregoniinae*, of which pleopods of males from two year-classes of *Chionoecetes bairdi* Rathbun (Plate I, figs. 6 and 9) are illustrated. From this comparison it will be seen that

the accompanying male pleopods of *C. angulatus* Rathbun and *C. tanneri* Rathbun are those of immature, the pleopod of *C. opilio* (O. Fabricius) of mature, specimens.

The Male First Pleopod

While the study of the male first pleopods was undertaken with the thought that differences encountered would be of value in separating species of doubtful distinctness, an unexpected result has been the discovery of general similarities at generic and subfamilial levels. The Inachinae, with the removal of *Oregonia*, are remarkably uniform with respect to pleopod. The Acanthonychinae are clearly of two types: those with a scyriiform pleopod, related to *Chorilia* of the Pisinae, on the one hand, and those with an epialtiform pleopod on the other. The Pisinae, with the removal of *Hyas* and *Chionoecetes*, are also of two main types, the scyriiform and the pisiform, while a third type relates *Neodoclea* and *Libinia* to *Stenocionops* and *Macrocoeloma* of the Majinae, *sensu lato*.

The writer would make further present use of these pleopod groupings, which in the Acanthonychinae, Pisinae, and Majinae cut across recognized subfamilial lines, except for two important considerations: (1) in each subfamily as now constituted there are two or more genera with anomalous pleopods which are not assignable with any certainty to any of the above groupings; and (2) the premature application of any new system to the New World segment of the Majidae without the inclusion of the Old World segment as well might add to the confusion which it is hoped to correct.

It is equally apparent from a study of the pleopods that some genera, as well as subfamilies, are diphyletic. This is most apparent in *Rochinia*, where *R. vesicularis* alone has a scyriiform pleopod, whereas the remaining species examined have the pisiform pleopod. Other genera, like *Hemus*, show no uniformity, each of the three species of *Hemus* examined having a pleopod of a strikingly different type. Still other genera, such as *Mithrax*, which conform in the main, have aberrant species, notably *M. belli* and *M. nodosus*, which have completely anomalous pleopods. Use of this character, therefore, has been approached with extreme caution, and has been employed to effect major systematic change only when substantiated by some more firmly established character.

Regarding the terminology employed in discussing the male first pleopod, the writer can do no better than to quote Tweedie (1940, p. 88): "The terminology used in describing the structure and orientation

of the first pleopod of the male is based on that employed by Gordon (1937, pp. 152, 154) and refers to the position of the pleopod *in situ*, *i. e.*, before it is removed for examination and figuring. The concave surface that lies against the thoracic sternal segments is called the sternal surface, a figure showing which is said to be drawn from the sternal aspect. The opposite side, lying against the abdomen, is referred to as the abdominal surface." Tweedie recognizes in *Sesarma* an outer and an inner abdominal facet, the former lying against the inner surface of the abdominal segments, the latter against the hinder part of the alimentary canal. For the sake of uniformity he uses the right pleopod, which for *Sesarma* is figured resting on the outer abdominal facet.

It was convenience, rather than a desire for uniformity, that led the writer to adopt essentially the same system. The procedure followed is to place the specimen ventral side up in the dissecting tray with its head toward the observer. The abdomen is then lifted with forceps held in the left hand, while the first pleopod is teased out with a dissecting needle held in the right hand. It is thus the right pleopod that is under the worker's right hand, and the sternal aspect that is exposed as it is lifted and tilted backward. In examining large numbers of specimens the pleopod need not be removed; merely allowing the abdomen to fall back into its accustomed place will often serve to hold the reverted pleopod in a position suitable for study.

After drawings of the entire first pleopod throughout the subfamily Inachinae had been made, it was found that most of the significant differences occurred in the terminal portion. The first drawings were therefore discarded in favor of a more detailed set, and only the terminal portion was figured for the remaining subfamilies. It was similarly found that the male second pleopod, a minute structure in the Majidae, presented no characters of taxonomic value, although its size and diversity among the Parthenopidae require that in that family it receive consideration along with the first.

Summary of Additions and Changes

The subfamily Oregoniinae is proposed to receive the genus *Oregonia* (ex Inachinae) and the genera *Hyas* and *Chionoecetes* (ex Pisinae).

The genus *Paradasygyius* is proposed to receive *Dasygyius depressus* (Bell) and its Atlantic cognate, *D. tuberculatus* Lemos de Castro (1949). The genus *Epialtoides* is proposed to receive those species of *Epialtus*, *sensu lato*, having five, rather than six, free male abdominal segments.

The generic descriptions of *Euprognatha* and of *Tyche* are emended to accommodate species added since their erection or described as new herein.

The following species are described as new: *Podochela veleronis* (previously referred to by MS name), *Pugettia hubbsi*, *Epialtoides paradigmus*, *Collodes robsonae*, *Hemus finneganae*, *Tyche clarionensis*, *T. galapagensis*, and *Parthenope (Pseudolambrus) stimpsoni*. A new name, *Thyrolambrus glasselli*, is proposed for the species formerly known as *T. rathbunae* Balss (= *T. erosus* Rathbun).

The following full species have been reduced to subspecies: *Mithrax (Mithrax) clarionensis* Garth, a subspecies of *M. (M.) sinensis* Rathbun; *Libidoclaea smithi* (Miers), a subspecies of *L. granaria* Milne Edwards and Lucas. Raised from synonymy, *Pyromaia mexicana* Rathbun becomes a subspecies of *P. tuberculata* (Lockington).

Lectotypes have been selected for *Epialtus dentatus* Milne Edwards, currently known as *Taliepus dentatus* (Milne Edwards), *Neodoclea boneti* Buitendijk, and *Microphrys weddelli* Milne Edwards.

Neotypes have been designated for the following species: *Eucinotops lucasi* Stimpson, *E. rubellula* Rathbun, *Libinia setosa* Lockington, *Micro-rhynchus gibbosus* Bell, herein called *Collodes gibbosus* (Bell), *Micro-rhynchus depressus* Bell, herein called *Paradasygyius depressus* (Bell), *Libinia rostrata* Bell, and *Mithrax denticulatus* Bell.

Species for which corrected or restricted type localities are given are *Collodes gibbosus* (Bell), *Paradasygyius depressus* (Bell), *Mithrax (Mithraculus) denticulatus* Bell, and *Leiolambrus punctatissimus* (Owen).

The genus *Dasygyius* Rathbun (= *Neorhynchus* A. Milne Edwards) (= *Micro-rhynchus* Bell) becomes a subjective synonym of *Collodes* Stimpson with the discovery that the type species of the two are congeneric. Of the available names *Collodes*, being older than *Dasygyius*, is retained for the genus.

The genus *Chorilibinia* Lockington falls to *Stenocionops* Desmarest with the transfer of its type species, *Chorilibinia angusta* Lockington, to *Stenocionops*.

As suggested by Balss (1929, p. 16, footnote), the genus *Anaptychus* Stimpson, preoccupied, falls to *Ala* Lockington [not *Anaptychoides* Strand (1928, p. 40)], the type species becoming *Ala cornuta* (Stimpson).

The following species are made synonyms for the first time: *Batrachonotus nicholsi* Rathbun, a synonym of *Euprognatha bifida* Rathbun;

Stenocionops contigua (Rathbun), a synonym of *S. angusta* (Lockington); *Eupleurodon peruvianus* Rathbun (1924a), a synonym of *Epialtus peruvianus* Rathbun (1923a), which, when transferred to *Eupleurodon*, becomes *Eupleurodon peruvianus* (Rathbun, 1923a); *Mithrax (Mithrax) sonorensis* Rathbun, a synonym of *Herbstia camptacantha* (Stimpson); *Epialtus crenulatus* Rathbun, a synonym of *E. minimus* Lockington; *Mithrax (Mithrax) orcutti* Rathbun, a synonym of *M. (M.) armatus* Saussure; *Podochela barbarentis* Rathbun, a synonym of *P. lobifrons* Rathbun.

Species adequately illustrated for the first time are *Podochela angulata* Finnegan, *Eupleurodon trifurcatus* Stimpson, and *Herbstia pubescens* Stimpson. Figured for the first time are male first pleopods of all Pacific American genera and of most Pacific American species of Majidae, and first and second pleopods of all Pacific American genera and species of Parthenopidae and Hymenosomidae, the only previous figures being those of *Eurypodius latreillei* by Brocchi (1875), of *Oregonia gracilis* by Shen (1932), and of *Pitho* species by Rathbun (1925).

Territory Covered

The Pacific coast of North and South America, from Bering Strait to the Strait of Magellan, together with outlying island groups, constitutes the geographical area under consideration. However, since several of the boreal species treated occur on the Asiatic coast as well, and since several of the austral species occur also on the Atlantic coast of South America, citations to the extralimital occurrences of such Pacific species have been included in the appropriate synonymies.

In the case of tropical species that occur also in the Atlantic, this has not been done for two reasons: first, because, with the increasing refinement of systematic investigation, such species are becoming constantly fewer in number; and second, because such references more appropriately belong in a contemplated separate report on the collections of the *Velero III* in the Caribbean in 1939. Studies on the Atlantic Majidae have proceeded concurrently with those on the Pacific and a consistent method of treatment will be applied to both segments of the family. The few Atlantic genera not represented in the Pacific have been included in the keys here presented with a view toward obviating the necessity of their subsequent repetition.

Boreal Pacific species occurring on both Asiatic and North American coasts:

- Oregonia gracilis* Dana
Chionoecetes opilio (O. Fabricius)
Hyas coarctatus Leach

Austral species occurring on both Pacific and Atlantic coasts of South America:

- Eurypodius latreillei* Guérin
Leurocyclus tuberculatus (Milne Edwards and Lucas)
Libidoctaea granaria Milne Edwards and Lucas

Tropical American species occurring regularly and in equal abundance on both sides of the Isthmus of Panama:

- Inachoides laevis* Stimpson
Acanthonyx petiveri Milne Edwards

Pacific American species reported as occurring in the Atlantic on the strength of a single record: (The Atlantic record is here considered extralimital.)

- | | |
|--|-----------------|
| <i>Taliepus marginatus</i> (Bell) | Brazil |
| <i>Notolopas lamellatus</i> Stimpson | Beaufort, N. C. |
| <i>Libinia rostrata</i> Bell | Brazil |
| <i>Microphrys weddelli</i> Milne Edwards | Guadaloupe |

Atlantic American species reported as occurring in the Pacific on the strength of a single record: (The Pacific record is here considered extralimital.)

- | | |
|--|---------------|
| <i>Leucippa pentagona</i> Milne Edwards | Magdalena Bay |
| <i>Epialtus bituberculatus</i> Milne Edwards | Chile |
| <i>Libinia emarginata</i> Leach | San Francisco |

Faunal Relationships

Separated from Australasia by the Central Pacific oceanic barrier, the Pacific coast of North and South America is the most isolated continental coastline in the world. Nevertheless, where it approaches the Asiatic mainland very closely at its northern terminus, some faunal interchange occurs, both via the Aleutian Island chain and at Bering Strait. Several species of boreal Pacific Majidae, among them *Oregonia gracilis*, *Hyas coarctatus*, and *Chionoecetes opilio*, are common to American and Asiatic coasts, while the last two named range northward and eastward through Beaufort Sea and Davis Strait to the North Atlantic.

At the opposite terminus of this continuous coastline, in the Cape Horn region, the so-called "antiboreal" species communicate with the South Atlantic via the Strait of Magellan, ranging northward to southern Brazil. Among these may be mentioned *Eurypodius latreillei*, (?) *Taliepus marginatus*, *Leurocyclus tuberculatus*, and *Libidoclaea granaria*. There is no American majid common to Antarctica (cf. Pfeffer, 1890), but *Paramithrax baeckstroemi* of Juan Fernandez Island is closely related to *P. peroni* of New Zealand and was earlier referred to that species (Lenz, 1902).

On the other hand, certain tropical Pacific species, among them *Acanthonyx petiveri*, *Notolopas lamellatus*, *Inachoides laevis*, and *Microphrys weddelli*, are known to occur in, or have been attributed to, the tropical Atlantic as well. The Pacific and Atlantic portions of their ranges are no longer continuous and, following the evolutionary pattern of the vast majority of majid species, the respective populations are already on their way to becoming distinct, albeit homologous, species.

It will be seen, therefore, that the boreal Pacific American fauna relates itself most closely to the Asiatic Pacific and circum-Arctic, whereas the austral Pacific American fauna is continuous with the South American Atlantic. The tropical Pacific American fauna relates itself to the tropical Atlantic American by means of cognate or geminate species, and, by means of its genera, to the tropical faunas of the world.

Extensions of Range*

MAJIDAE

Eurypodius latreillei Guérin. From "Peru" (general) north to Independencia Bay, Peru.

Eucinetops lucasi Stimpson. Gulf of California: from Puerto Refugio, Angel de la Guarda Island, north to Cholla Bay, Sonora; from Santa Inez Bay south to Cabeza Ballena.

Eucinetops panamensis Rathbun. Gulf of California: from San Francisquito Bay north to Pond Island; from Perlas Islands, Panama, south to La Libertad, Ecuador.

Euprognatha bifida Rathbun. Lower California: from Cedros Island north to San Benito Islands; from Gorda Banks, Gulf of California, south to Port Utria, Colombia [*Askoy*], and to Cape San Francisco, Ecuador.

Collodes gibbosus (Bell). First mainland records: Piñas Bay, Panama, to Cape Pasado, Ecuador [*Askoy*]. Previously known only from the Galapagos Islands.

Collodes granosus Stimpson. Gulf of California: from La Paz south to Cabeza Ballena and from Isabel Island south to Cape Pasado, Ecuador [*Askoy*], and Santa Elena Bay, Ecuador.

Collodes tenuirostris Rathbun. Lower California: from Abrejos Point north to Cedros Island; Gulf of California: from Santa Inez Bay south to Espiritu Santo Island, thence south to Sechura Bay, Peru.

Collodes tumidus Rathbun. Gulf of California: from La Paz north to Angel de la Guarda Island, and from Arena Bank south to Cabeza Ballena.

Paradasygygius depressus (Bell). Gulf of California: from La Paz Bay north to Ensenada de San Francisco, Sonora; from Wafer Bay, Cocos Island, Costa Rica, north to Port Parker, Costa Rica, and south to Utria Bay, Colombia [*Askoy*], and Cape Corrientes, Colombia.

Pyromaia tuberculata (Lockington). From Monterey Bay north to Tomales Bay, California; from Perlas Islands, Panama, south to Utria Bay, Colombia [*Askoy*], and Cape Corrientes, Colombia.

Erileptus spinosus Rathbun. From La Jolla north to Point Santa Barbara, California, and from Abrejos Point south to Magdalena Bay, Lower California. Channel Islands: from Santa Rosa Island north to

*Records of the *Askoy* (Garth, 1948) are also given, since they serve to confirm, and often extend, the southern limit of range as determined by the *Velero III*.

San Miguel Island, and from Santa Catalina Island south to San Clemente Island. Gulf of California: from Santa Inez Bay north to Rocky Point, Sonora, and south to Gorda Banks. Extralimital: Islas Ladroneas, Panama.

Inachoides laevis Stimpson. From Magdalena Bay north to Cedros Island, Lower California; Gulf of California: from Santa Inez Bay north to Rocky Point, Sonora; from Bay of Panama north to Tenacatita Bay, Mexico, and south to Málaga Bay, Colombia [Askoy], and Cape San Francisco, Ecuador.

Podochela lobifrons Rathbun. Channel Islands: from Santa Catalina Island south to San Clemente Island; from Cedros Island, Lower California, north to Point Mugu, California, and south to San Cristobal Bay, Lower California; Guadalupe Island; Gulf of California: from Santa Inez Bay north to Angel de la Guarda Island, and from Arena Bank south to Gorda Banks.

Podochela latimanus (Rathbun). Gulf of California: from Patos Anchorage north to Rocky Point, Sonora, and from Puerto Escondido south to San Lorenzo Channel.

Podochela hemphilli (Lockington). Channel Islands: from Santa Catalina Island north to San Miguel Island and south to San Clemente Island; Guadalupe Island; Gulf of California: from La Paz north to Angel de la Guarda Island; from Arena Bank south to Cabeza Ballena, thence south to Cape Corrientes, Colombia.

Podochela angulata (Finnegan). From Gorgona Island, Colombia, north to Port Utria, Colombia [Askoy], and Port Parker, Costa Rica; south to 00°55'N [Askoy] and La Libertad, Ecuador.

Podochela vestita (Stimpson). Lower California: from Cape San Lucas north to Hughes Point, Santa Maria Bay; Gulf of California: from Adair Bay north to Rocky Point, Sonora, and from Santa Inez Bay south to Los Frailes, thence south to Gorgona Island, Colombia, and Ecuador, 01°07'N [Askoy].

Stenorynchus debilis (Smith). Gulf of California: from Patos Anchorage north to Consag Rock; from Guaymas Bay, Sonora, south to Gorda Banks; from Panama Bay north to Revilla Gigedo Islands, Mexico.

Pitho picteti (Saussure). Scammon Lagoon and San Ignacio Lagoon, Lower California; Gulf of California: from Cape Tepopa north to Tepoca Bay, Sonora.

Pitho sexdentata Bell. Gulf of California: from Santa Inez Point north to Tiburon Island and south to Cabeza Ballena; from Port Parker, Costa Rica, south to Manta Bay, Ecuador.

Tyche lamellifrons Bell. From Acapulco, Mexico, south to 01°07'N, Ecuador [*Askoy*], and Salango Island, Ecuador.

Mimulus foliatus Stimpson. From Monterey Bay south to Point Arguello, California; Santa Rosa and Santa Cruz Islands.

Pugettia producta (Randall). From Santa Rosalia Bay south to Ascunción Point, Lower California.

Pugettia richi Dana. From San Diego, California, south to Geronimo Island, Lower California; Channel Islands with the exception of Anacapa Island.

Pugettia gracilis Dana. From Farallon Islands south to Pacific Grove, California.

Pugettia dalli Rathbun. Channel Islands: from Santa Cruz Island north to San Miguel Island; from San Geronimo Island south to Thurloe Head, Lower California.

Pugettia venetiae Rathbun. Channel Islands: from Santa Catalina Island north to San Miguel Island and south to San Clemente Island; Guadalupe Island.

Taliepus nuttalli (Randall). Guadalupe Island.

Taliepus marginatus (Bell). From Independencia Bay north to Chincha Islands, Peru.

Sphenocarcinus agasizi Rathbun. From Cocos Island, Costa Rica, north and east to Bahia Honda, Panama.

Acanthonyx petiveri Milne Edwards. From Magdalena Bay north to Santa Maria Bay, Lower California.

Epialtus minimus Lockington. Lagoon Head, Lower California, and (?) Acapulco, Mexico; Gulf of California: from Patos Island north to Angel de la Guarda Island; from San José Island south to Espiritu Santo Island.

Epialtoides hiltoni (Rathbun). From Laguna Beach, California, south to Magdalena Bay, Lower California; Guadalupe Island.

Eupleurodon peruvianus (Rathbun). From Ferrol Bay (Chimbote), Peru, north to Salinas, Ecuador.

Scyra acutifrons Dana. From San Diego, California, south to San Carlos Point, Lower California; Channel Islands: from Santa Rosa Island north to San Miguel Island and south to San Clemente Island.

Loxorhynchus grandis Stimpson. From Santa Catalina Island north to Santa Rosa and Santa Cruz Islands.

Loxorhynchus crispatus Stimpson. From Santa Catalina Island south to San Clemente Island.

Chorilia longipes longipes Dana. From Point Sur south to San Pedro, California; Channel Islands: from Santa Rosa Island south to Santa Catalina Island.

Rochinia vesicularis (Rathbun). From Gorda Banks, Gulf of California, north to San Benito Islands, Lower California.

Pelia tumida (Lockington). Channel Islands: from Santa Catalina Island north to Santa Cruz Island; Gulf of California: from Adair Bay south to Cabeza Ballena; Lower California: Guadalupe Island; from Magdalena Bay south to Petatlan Bay, Mexico.

Pelia pacifica A. Milne Edwards. From Bahia Honda, Panama, south to Zorritos Light, Peru.

Pisoides edwardsi (Bell). From Iquique, Chile, north to San Nicolas Bay, Peru (not Panama).

Notolopas lamellatus Stimpson. Gulf of California: from Rocky Point, Sonora, south to Point Piaxtla, Sinaloa; from Corinto, Nicaragua, north to Tenacatita Bay, Mexico; from Balboa, Panama, south to Málaga Bay, Colombia [Askoy], and to Santa Elena Bay, Ecuador.

Notolopas mexicanus Garth. From White Friars north to Tenacatita Bay, Mexico.

Herbstia camptacantha (Stimpson). Gulf of California: from San Pedro Bay, Sonora, north to Pond Island; from Coronados Island south to Espiritu Santo Island. From Mazatlan south to Tangola Tangola Bay, Mexico.

Herbstia pubescens Stimpson. From Manzanillo, Mexico, south to Octavia Bay, Colombia, and La Plata Island, Ecuador [Askoy].

Herbstia tumida (Stimpson). From Gorgona Island, Colombia, south to Santa Elena Bay, Ecuador.

Herbstia parvifrons Randall. From Santa Catalina Island north to Santa Cruz Island; Guadalupe Island.

Libinia mexicana Rathbun. Gulf of California: from Shoal Point near the mouth of the Colorado River south to San Ignacio Bay, Sinaloa.

Lissa tuberosa Rathbun. Magdalena Bay, Lower California; Gulf of California: from San Lorenzo Channel north to Tortuga Island, and south to Octavia Bay and Utria Bay, Colombia [Askoy].

Lissa aurivilliusi Rathbun. Lower California: from Magdalena Bay north to Santa Maria Bay; Gulf of California: from Arena Bank north

to Angel de la Guarda Island, and south to Cabeza Ballena, thence south to Santa Elena Bay, Ecuador.

Maiopsis panamensis Faxon. From Bay of Panama north and west to Clarion Island, Mexico.

Ala cornuta (Stimpson). Gulf of California: from Tepoca Bay, Sonora, north to Cholla Bay, Sonora; from Perlas Islands, Panama, south to Utria Bay, Colombia [*Askoy*].

Mithrax (Mithrax) tuberculatus Stimpson. Gulf of California: from Arena Bank north to Carmen Island; from Panama south to La Libertad, Ecuador.

Mithrax (Mithrax) armatus Saussure. From Mazatlan north to Los Frailes, Gulf of California.

Mithrax (Mithrax) sinensis Rathbun. Gulf of California: from San Esteban Island north to Angel de la Guarda Island, and south to Esmeraldas, Ecuador [*Askoy*], and La Plata Island, Ecuador.

Mithrax (Mithrax) pygmaeus Bell. From Port Parker, Costa Rica, north to Socorro Island and Isabel Island, Mexico, and from Perlas Islands, Panama, south to Esmeraldas, Ecuador [*Askoy*], and La Plata Island, Ecuador.

Mithrax (Mithrax) spinipes (Bell). Gulf of California: from San José Island north to Agua Verde Bay. Nuez Island, Cocos Island, Costa Rica.

Mithrax (Mithraculus) denticulatus Bell. Gulf of California: from Coronados Island north to San Francisquito Bay; from Arena Bank south to Cabeza Ballena; from Chamela Bay north to Isabel Island, Mexico.

Teleophrys cristulipes Stimpson. Lower California: from Cape San Lucas north to Santa Maria Bay; Gulf of California: from El Mogote north to Agua Verde Bay. From Gorgona Island, Colombia, south to Manta Bay and La Plata Island, Ecuador [*Askoy*].

Teleophrys tumidus (Cano). From Paita north to Zorritos Light and from Sechura Bay south to Independencia Bay, Peru.

Microphrys platysoma (Stimpson). Gulf of California: from La Paz Bay south to Cabeza Ballena; from Panama Bay south to Gorgona Island, Colombia [*Askoy*], and to Santa Elena Point, Ecuador.

Microphrys triangulatus (Lockington). Gulf of California: from Agua Verde Bay north to Isla Partida; from Cerralvo Island south to Bahia Honda, Panama.

Microphrys branchialis Rathbun. From Abreojos Point north to Dewey Channel, Lower California; Gulf of California: from Guaymas, Sonora, north to Angeles Bay, and south to Santa Elena Bay, Ecuador.

Stenocionops ovata (Bell). From Bay of Panama south to Santa Elena Bay, Ecuador.

Stenocionops beebei Glassell. Santa Maria Bay, Lower California; Gulf of California: from Cape Pulmo north to Angel de la Guarda Island.

Macrocoeloma villosum (Bell). Gulf of California: from Santa Inez Point south to Agua Verde Bay.

Thoe sulcata sulcata Stimpson. Gulf of California: from Arena Bank south to Cabeza Ballena.

Thoe sulcata panamensis Nobili. From Gorgona Island, Colombia, south to Salinas, Ecuador.

PARTHENOPIDAE

Parthenope (Parthenope) hyponca (Stimpson). From Mazatlan, Mexico, south to Salango Island, Ecuador (*Velero III*), and W of Cape Santa Elena [*Askoy*].

Parthenope (Platylambrus) exilipes (Rathbun). From Bay of Panama south to Lobos de Afuera Islands, Peru. Revilla Gigedo Islands: Socorro Island.

Parthenope (Platylambrus) depressiuscula (Stimpson). From Manzanillo north to Isabel Island, Mexico; from Panama south to Málaga Bay, Colombia [*Askoy*], and Santa Elena Bay, Ecuador.

Parthenope (Pseudolambrus) triangula (Stimpson). Lower California: from Cape San Lucas north to Magdalena Bay; Gulf of California: from Cape San Lucas north to Puerto Escondido; Revilla Gigedo Islands: Socorro and Clarion; La Plata Island, Ecuador.

Parthenope (Pseudolambrus) excavata (Stimpson). Gulf of California: from Santa Inez Bay north to Puerto Refugio, Angel de la Guarda Island; from Panama (general) to Taboga Island, Panama (specific).

Thyrolambrus glasselli Garth (= *T. erosus* Rathbun). Lower California: from Cape San Lucas north to Magdalena Bay; Gulf of California: from San Lorenzo Channel north to San Marcos Island; from Cape San Lucas south to Gorgona Island, Colombia (*Velero III*), and off Esmeraldas, Ecuador [*Askoy*]. Revilla Gigedo Islands: Clarion Island.

Daldorfia garthi Glassell. From off Nicaragua south to Octavia Bay, Colombia. Galapagos Islands: from Sullivan Bay, James Island, north to Tower Island.

Solenolambrus arcuatus Stimpson. From Panama north to Tepoca Bay, Gulf of California, Mexico; from Panama south to Cape Pasado [Askoy] and Santa Elena Bay, Ecuador.

Leiolambrus punctatissimus (Owen). From Gorgona Island, Colombia, south to off Esmeraldas [Askoy] and Salango Island, Ecuador.

Mesorhoea belli (A. Milne Edwards). Lower California: from Abrejos Point north to San Juanico Bay; from Panama Bay south to off Cape Corrientes, Colombia (*Velero III*), and off Esmeraldas, Ecuador [Askoy].

Cryptopodia hassleri Rathbun. Lower California: from Magdalena Bay north to Santa Maria Bay; Gulf of California: north to Puerto Refugio, Angel de la Guarda Island, thence south to Malaga Bay, Colombia [Askoy], and Santa Elena Bay, Ecuador.

Heterocrypta macrobrachia Stimpson. Lower California: from Magdalena Bay north to Santa Maria Bay; Gulf of California: north to Rocky Point, Sonora; from "Mexico" south to off Cape Pasado [Askoy], and Santa Elena Bay, Ecuador.

Heterocrypta occidentalis (Dana). California: from Gulf of the Farallones north to Drakes Bay (*N. B. Schofield*); Channel Islands: from Santa Catalina and San Clemente Islands west to San Nicolas Island; Lower California: from Los Coronados Islands south to Dewey Channel, opposite Pta. Eugenio; Gulf of California: Outer Gorda Bank.

Heterocrypta colombiana Garth. From Port Utria, Colombia, south to off Esmeraldas, Ecuador [Askoy].

Method of Treatment

Pertinent information concerning each species treated is presented under the following headings:

Synonymy: Every known citation in the literature, with the following exceptions: (1) lists which enumerate species without giving specific localities, *e. g.*, Glassell, 1934; (2) Atlantic records for the few species common to both oceans; (3) purely systematic discussions involving no change in nomenclatorial status; and (4) non-systematic papers dealing with physiological, embryological, or other experimental aspect.

Type: The specimen material upon which the species rests, together with the present location of such material, if extant.

Type locality: The geographical site from which the type material was obtained, together with the name of the collector, if known.

Localities subsequently reported: Each published record of occurrence since discovery, arranged in geographical sequence, followed by

the collector's name, and, in parentheses, the name of the responsible author. Excepting records designated as "extralimital" or "fossil", the first and last entry may be taken as delimiting the presently accepted range of the species.

Cognate species: The congener most nearly related to the Pacific species under consideration, usually its Atlantic analogue.

Diagnosis: The attributes most useful in separating the species from its Pacific congeners and upon which a key might be based. A brief description of the male first pleopod is included.

Description: The most complete characterization of the species available. Where the description is taken wholly or in large part from the literature, the original author's name appears in parentheses following the last paragraph. Where modern terms have been substituted for archaic, the substituted words or phrases are enclosed in brackets. Where other significant alterations have been made, including changes in the author's sentence structure to conform with the abbreviated or "telegraphic" style used in the original portions of this work, the word "modified" follows the author's name.

Material examined: Specimens are first listed by source, if from collections other than those of the Allan Hancock Foundation, then by locality, from north to south. If three or more stations are involved, reference is made to a table in the appendix in which supplementary records are listed. Station numbers, unless otherwise indicated, are those of the *Velero III* and *Velero IV*. The last two figures following the hyphen denote the year of the expedition. Station numbers are consecutive throughout and, with the exception of Galapagos stations, separately treated (Garth, 1946), expedition year and date of collection correspond.

Measurements: A standard set of twelve measurements is used throughout: length of carapace, width of carapace, length of rostrum, width of rostrum, length of cheliped, length of chela (manus plus immovable finger), length of dactyl (movable finger), height of palm, and length of walking legs 1, 2, 3, and 4. (See also Explanation of Measurements).

Color in life: Notes made from living specimens, although unpublished, are credited to Anker Petersen, former staff artist, in recognition of his efforts in this connection and to distinguish them from the published notes of Crane and others. Colors are based on Ridgway, "Color Standards and Color Nomenclature" (1912).*

*For a modern appraisal of Ridgway's color standards, see Hamly (1949).

Habitat: Following a resume of published habitat notes, data concerning the substratum from which Hancock expedition specimens were recovered are evaluated.

Depth: To the bathymetric range previously recorded is added any vertical extension of range noted in connection with the study of the present collection.

Size and sex: The size range of the species as represented by the material examined, from the smallest young to the largest adult of each sex, with due regard to populations of varying mean sizes in widely dispersed localities. While the significant changes which take place with growth, such as enlargement of the cheliped in the male and the broadening of the abdomen in the female preparatory to egg-bearing, are duly recorded, it is recognized that growth, as a continuous process, was not observed during this study.

Breeding: The season at which ovigerous females were encountered in the various latitudes. Males were not inspected for the presence of spermatozoa.

Remarks: Here are discussed relationships, reasons for taxonomic changes proposed, significance of names, and a variety of other subjects. A final sentence is devoted to extension of range.

Explanation of Measurements

Measurements were taken by means of a dial caliper and are given in millimeters.

The length of the carapace is measured along the median line from the posterior margin to the tip of the rostrum in specimens having a single rostral spine, and to a perpendicular connecting the tips of the rostral spines in specimens having a double rostral spine.

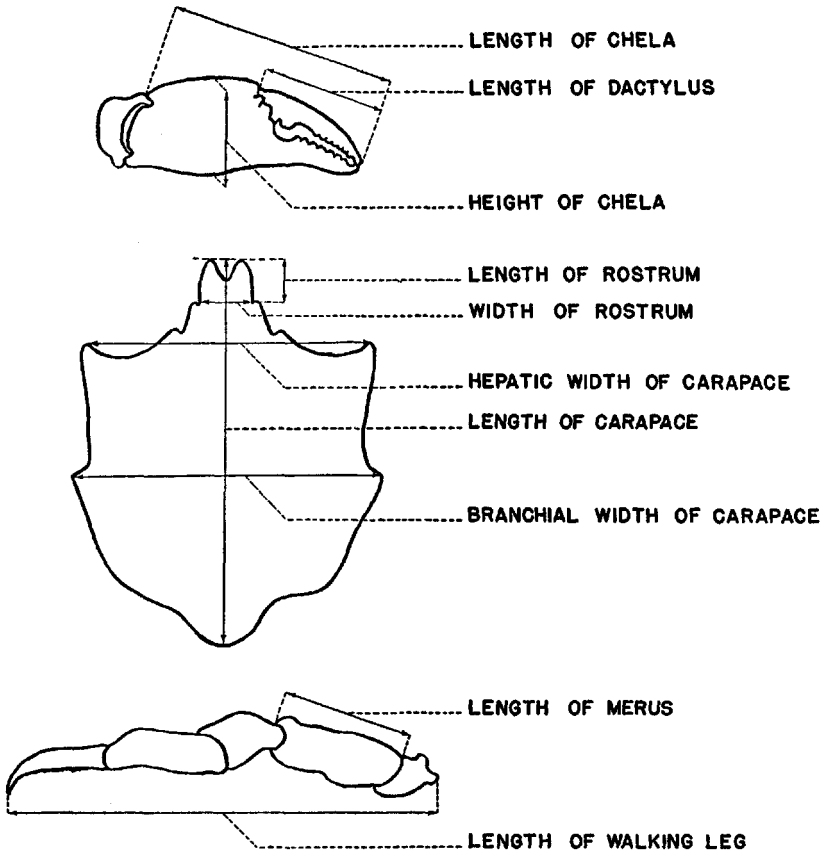
The width of the carapace is measured at the widest part, usually branchial, and is exclusive of lateral spines. In the Acanthonychinae both hepatic and branchial width are given.

The length of the rostrum is measured along the midline from the level of the hiatus between the preorbital spine (if present) and the base of the rostrum, to the tip of the rostrum.

The width of the rostrum is measured at its base unless the sides are concave, in which case it is measured at its narrowest part.

The length of the entire cheliped and of the walking legs is measured along the lower margin from the base of the coxa to the tip of the dactyl.

The length of individual segments (merus, carpus, propodus, dactylus) is measured along the upper margin, as is the length of the chela. The height of the chela is measured at its greatest convexity.



Abbreviations

Institutions in which specimens consulted in the preparation of this study are deposited have been abbreviated as follows:

| | |
|------------|---|
| A.H.F. | Allan Hancock Foundation, University of Southern California |
| B.M.N.H. | British Museum (Natural History) |
| C.A.S. | California Academy of Sciences |
| H.M.S. | Hopkins Marine Station, Stanford University |
| M.C.Z. | Museum of Comparative Zoology, Harvard University |
| N.R.S. | Naturhistoriska Riksmuseet, Stockholm |
| N.Y.Z.S. | New York Zoological Society |
| R.M.N.H. | Rijksmuseum van Natuurlijke Historie, Leiden |
| S.D.M.N.H. | San Diego Museum of Natural History |
| U.S.N.M. | United States National Museum |
| Z.M.H. | Zoologisches Museum, Hamburg |

Superfamily OXYRHYNCHA

Oxyrhyncha or *Maiioidea* Alcock, 1895, p. 159, + *Hymenosomidae* Alcock, 1900, p. 280. *Oxyrhyncha* Borradaile, 1907, p. 479. Rathbun, 1925, p. 10.

Carapace more or less narrowed in front, and usually produced to form a rostrum; branchial regions considerably developed, hepatic regions small. Epistome usually large; buccal cavity quadrate, with the anterior margin usually straight. Branchiae almost always nine in number on either side; their efferent channels open at the sides of the endostome or palate. Antennules longitudinally folded. (Alcock)

KEY TO THE FAMILIES OF THE SUPERFAMILY OXYRHYNCHA (after Borradaile)

- 1a. Carapace thin and flat. Chelipeds not long or specially mobile or with fingers bent at an angle with the hand. Male opening sternal. No orbits. Second article of antennal stalk slender, fused with epistome but not with front. No hooked hairs *Hymenosomidae*
- 1b. Carapace not thin and flat. Chelipeds either mobile or powerful, with bent fingers. Male opening coxal

- 2a. Chelipeds specially mobile, rarely much greater than the other legs, or with fingers bent at an angle on the hand. Second article of antenna well developed, generally fused with epistome and often with front. Orbits generally more or less incomplete. Hooked hairs almost always present Majidae
- 2b. Chelipeds not specially mobile, usually much longer and heavier than the other legs, and with fingers bent on the hand at an angle toward the side on which the fixed finger is set. Second article of antennae small, short, and not fused with epistome or front. Orbits well made. Hooked hairs almost always wanting Parthenopidae

Family *HYMENOSOMIDAE*

Hymenosomidae Stimpson, 1858, p. 108. Ortmann, 1893, p. 31. Alcock, 1900, pp. 285, 291, and 385. Borradaile, 1907, p. 480. Rathbun, 1925, p. 561.

Hymenosomatidae Stebbing, 1905, p. 49. Stephensen, 1945, p. 217.

Carapace thin, flat, triangular or subcircular, not very well calcified, usually produced to form a horizontal rostrum. Antennular fossae shallow and ill defined. Antennal peduncle slender. Buccal cavern square; epistome sometimes nearly as long as broad. The ischium of the external maxillipeds well developed; the palp articulating near the anteroexternal angle of the merus; the exognath slender and partly or entirely concealed. Male openings sternal. (Alcock)

Carapace thin and flat. Chelipeds not long or specially mobile or with fingers bent at an angle with the hand. Male openings sternal. No orbits; [eyes exposed and little retractile]. Second [segment] of antennal stalk slender, fused with epistome but not with front. No hooked hairs. (Borradaile)

Pleopod 1 varying, especially in the apex. Pleopod 2 short. (Stephensen)

Genus *HALICARCINUS* White

Halicarcinus White, 1846, p. 178. Alcock, 1900, p. 291. Rathbun, 1925, p. 561.

Liriopea Nicolet, 1849, p. 158; type: *Hymenosoma leachi* Guérin, 1838 = *Halicarcinus planatus* (Fabricius), by subsequent designation of Rathbun (1925).

Type: Cancer planatus Fabricius, 1787, type of *Halicarcinus* White by original designation.

Description: Epistome of considerable length. Antennules unconcealed by front. No interantennular septum. Merus and ischium of outer maxillipeds subequal.

Restricted to the southern hemisphere. The single American species belongs to the antiboreal zone of Ekman and occurs also on certain Antarctic islands.

***Halicarcinus planatus* (Fabricius)**

Plate 1, Figs. 1-2

?*Cancer orbiculus* Fabricius, 1775, p. 402; type locality, New Zealand; type questionably in British Museum. (See *Remarks* below.)

Cancer planatus Fabricius, 1775, p. 403.

Leucosia planata, Fabricius, 1798, p. 350.

Halicarcinus planatus, White, 1846, p. 178, pl. 2, fig. 1. Dana, 1852, p. 385; 1855, atlas, pl. 24, figs. 7a, 7b. Cunningham, 1871, p. 492. Targioni-Tozzetti, 1872a, p. 393; 1872b, p. 465; 1877, p. 176, pl. 10, figs. 4, 4a-f. Miers, 1881, p. 70. Cano, 1888, pp. 164, 176; 1889, pp. 94, 98, 249. Pfeffer, 1890, p. 545. Ortmann, 1893, p. 31; 1911, p. 660. Rathbun, 1898, p. 609; 1910, p. 570; 1925, p. 563, pl. 202, fig. 5; pl. 283. Stebbing, 1900, p. 524, pl. 36B; 1914, p. 271. Lenz, 1902, p. 755. Lagerberg, 1905, p. 25. Doflein and Balss, 1912, p. 35. Porter, 1917, p. 95; 1925, p. 316; 1936a, p. 151; 1936b, p. 337. Garth, 1957, p. 32.

Liriopea leachii Nicolet, 1849, p. 160; 1854, atlas, pl. 1, figs. 1-1f; type locality, Chile; type not extant.

Liriopea lucasii Nicolet, 1849, p. 161; type locality, Chile; type not extant.

?*Halicarcinus pubescens* Dana, 1851c, p. 253; type locality, Eastern Patagonia; type not extant. Milne Edwards, 1853, p. 223.

?*Halicarcinus ovatus*, Cano, 1888, pp. 164, 177 (Not *H. ovatus* Stimpson, 1858)

Halicarcinus planatus var. *pubescens*, Ortmann, 1893, p. 32.

Type: Holotype not in British Museum, *vide* Dr. I. Gordon. (See *Remarks* below)

Type locality: Tierra del Fuego.

Pacific localities subsequently reported, with collectors: Chile: "Chile" (Nicolet); Bahia de Taltal, A. Capdeville (Porter, 1925); Valparaiso, Copenhagen Museum (Rathbun, 1925); Tumbes, L. H. Plate (Lenz); Bay of Talcahuano (Porter, 1936b); [Puerto] Montt and Calbuco, L. H. Plate (Lenz); Chiloe Island, L. Moreira (Rathbun, 1925); Puerto Lagunas, *Vettor Pisani* (Cano, 1889); Taitao, Mus. Nac. Chile Exped. (Porter, 1917); Port Otway [Puerto Barroso] and Latitude Cove, *Albatross* (Rathbun, 1898); Trinidad Channel, 4 fathoms, and Cockle Cove, 2-32 fathoms, *Alert* (Miers); Puerto Bueno, Smith Channel, Hamburger Magalhaensischen Sammelreise (Doflein and Balss); Strait of Magellan, *Caracciolo* (Cano, 1888), Steinman, Pohl, and *Gazelle* (Ortmann, 1893), 21 and 21.9 fathoms, *Albatross* (Rathbun, 1898); Mayne Harbor, Port Churruca, and Borja Bay, *Albatross* (Rathbun, 1898); Laredo Bay and Sandy Point [Punta Arenas], *Albatross* (Rathbun, 1898); Sandy Point, 12-15 fathoms, *Nassau* (Cunningham), 9-10 fathoms, *Alert* (Miers), L. H. Plate (Lenz), J. B. Hatcher (Ortmann, 1911), Hamburger Magalhaensischen Sammelreise (Doflein and Balss); Seno Almirantazgo, L. H. Plate (Lenz); Elizabeth Island, 6 fathoms, *Alert* (Miers); Nassau Bay, Fuegia, U. S. Expl. Exped. (Dana), "West Patagonia", *Magenta* (Targioni-Tozzetti, 1872a), "Canali Patagonici", *Caracciolo* (Cano, 1888). For additional localities in the Strait of Magellan see Cunningham (1871); for additional localities in Tierra del Fuego see Doflein and Balss (1912).

Atlantic analogue: None. The species itself occurs at the Atlantic entrance to the Strait of Magellan and in the Falkland Islands.

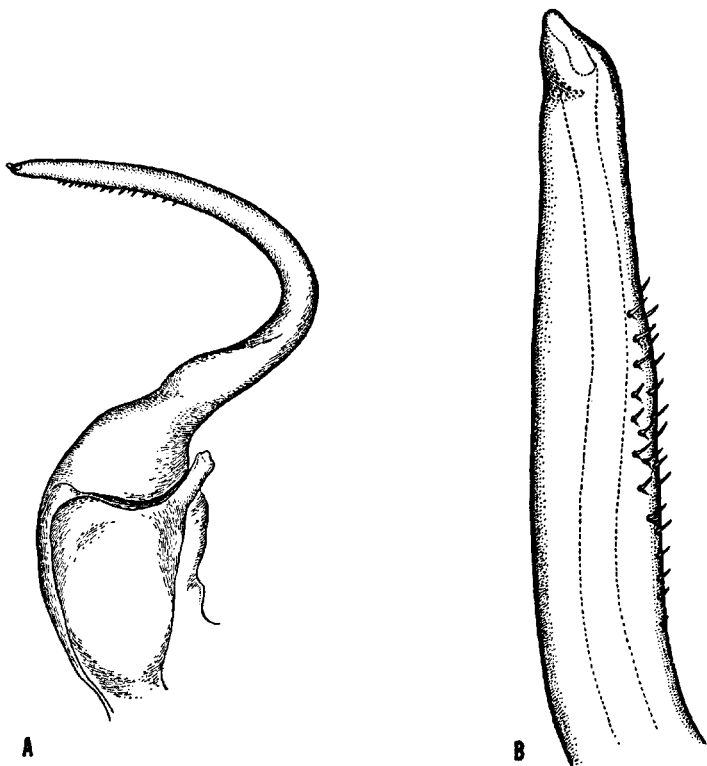
Diagnosis: Median frontal tooth a little smaller and less advanced than lateral teeth. Lateral carapace teeth situated below marginal rim. Upper distal tooth of merus of cheliped obsolescent. Dactyls of ambulatory legs moderately curved. Male first pleopod strongly bent and spirally twisted, a linear row of subterminal setae.

Description: Carapace distinctly broader than long, ovate, narrowed before; flat or even depressed, surrounded except the marginal teeth by a sharp rim; median grooves linear, the branchial groove strongly angled, the gastrocadiac groove bent slightly backward at the middle; a median cardiac groove. Three similar frontal teeth, the median somewhat smaller. Two lateral teeth forming angles below the marginal rim; the posterior of these teeth well developed and acute; the anterior smaller and variable, usually obtuse, sometimes acute, sometimes obsolescent on one or both sides.

Chelipeds stout, especially in male; palms swollen, fingers nearly horizontal, gaping slightly in basal half, prehensile margins denticulate, a tooth on the dactyl within the gape. Legs slender, diminishing in length from the first to the fourth pair, the longer pairs exceeding the chelipeds; dactyli flattened, not very slender, moderately curved.

Abdomen of male constricted between the sixth and seventh segments, the seventh segment subtriangular. (Rathbun, 1925)

Male first pleopod bent at an angle greater than 90° and in addition spirally twisted. About two dozen short setae arranged in two or three linear rows subterminally. Terminal aperture slightly eccentric. Bulbous base excavated and grooved abdominally to receive the diminutive second pleopod. [Compare Gordon's (1940) figures of *Elamena* species and of *Halicarcinus whitei* (Miers).]



TEXT FIGURES

1. *Halicarcinus planatus*, 14.1 mm male (L.U.C.E. Sta. M 115). A. Pleopods 1 and 2 *in situ*, $\times 15$. B. Tip of pleopod 1, $\times 85$.

Material examined: 176 specimens from 33 Lund University Chile Expedition localities. (See Table 1) From Punta Liles, Bahía San Vicente, to Punta Santa Maria, near Agua Fresca, Estrecho de Magallanes, Chile. In addition, 1 young specimen from Taltal, Chile, R. Paessler, 1889 (Z.M.H. No. K 26808), and 1 female from Macquarie Island, SW of New Zealand, December 2, 1949, Marshall Laird (gift of L. R. Richardson).

Measurements: Largest specimen, male: length 14.1 mm, width 17.3 mm, rostrum 0.7 mm, width of front 3.1 mm, cheliped 24.7 mm, chela 16.0 mm, dactyl 9.5 mm, height of palm 9.2 mm, ambulatory legs 29, 27.5, 25.5 and 22 mm respectively. Ovigerous female: length 11.4 mm, width 13.6 mm.

Color in life: Slaty blue to reddish brown, legs banded. (Mawson Exped.) Grayish brown with spots of different color. (Lund Univ. Chile Exped.)

Habitat: Under stones and kelp. (Stebbing) An integrant member of the interesting *Macrocystis* fauna. (Lagerberg) Rather common in the lower part of the littoral, under stones, and in rock pools. (Lund Univ. Chile Exped.)

Depth: To 270 meters. (Doflein and Balss) Lund University Chile Expedition specimens were dredged in the Golfo de Ancud at 60 meters and in the Seno Reloncaví at about 170 meters. In the Strait of Magellan region, however, they were shore collected exclusively, as they were frequently in the more northerly portion of their range. The species presents a classic example of what might be called "polar emergence."

Size and sex: Males from Concepción and Chiloe measured from 4.5 to 5.1 mm, non-ovigerous females from 3.9 to 6.8 mm, ovigerous females from 3.5 to 5.8 mm, and young to 2.3 mm or smaller. Males from Strait of Magellan measured 8.3 to 14.1 mm, non-ovigerous females from 5.3 to 11.6 mm, ovigerous females from 7.6 to 11.4 mm, and young to 3.7 mm. The small males from the north are listed as young.

Breeding: Ovigerous females were encountered by the Lund University Chile Expedition at Bahía de Ancud in November, at Seno Reloncaví in November, January, February, and March, at Canal Chacao in February, at Estero Reloncaví in April, and at Estrecho de Magallanes in May.

Remarks: In a letter dated 28 May 1957, Dr. I. Gordon states that there is no specimen in the British Museum of *Halicarcinus planatus* that can be identified as the Banksian type of Fabricius. There is in the dry collection a poorly preserved fragment labeled "*Cancer orbiculus*

Fab. Entom. p. 402 n. 13" of which the front half of the carapace is missing, as are all of the legs except the chela. This has been stuck onto the fragmentary specimen in such a way as almost completely to hide the abdomen; Dr. Gordon believes, however, that the specimen is a male. It is not labeled "Banks collection", nor is it indicated as type in any way.

Since the species ranges from Taltal, Chile, through the Strait of Magellan to the Falkland Islands, thence eastward via the Antarctic islands of South Orkney, Prince Edward, Kerguelen, Macquarie, Campbell, and Auckland to New Zealand, the writer sought comparative material from Professor L. R. Richardson of Victoria College, Wellington, and obtained a specimen from Macquarie Island, in the latitude of Cape Horn. According to Dr. Richardson, *Halicarcinus planatus* is a rarity in New Zealand, where it has been confused until recently with a more common species characterized as *H. innominata* Richardson (1949).

Family MAJIDAE¹

Maiadae Samouelle, 1819, p. 88.

Majidae Richters, 1880, p. 141. Rathbun, 1925, p. 10.

Maiidae Alcock, 1895, p. 160. Borradaile, 1907, p. 480.

Inachidae Rathbun, 1905, p. 11.

Chelipeds specially mobile, rarely much greater than the other legs, or with fingers bent at an angle on the hand. Second article of antenna well developed, generally fused with epistome and often with front. Orbits generally more or less incomplete. Hooked hairs almost always present. Male openings coxal. (Borradaile)

Palp of the external maxillipeds articulated either at the summit or at the anterointernal angle of the merus. (Alcock)

Pleopod 1 greatly exceeding pleopod 2 in length.

KEY TO THE SUBFAMILIES OF THE FAMILY MAJIDAE

- 1a. Eyes either without orbits, or with incomplete or commencing orbits
- 2a. Male abdomen terminally broadened, seventh segment subquadrate and inserted deeply into sixth segment. Male first pleopod longitudinally grooved, with rows of filamentous setae on either side of groove . . . Oregoniinae

¹Retention of the family name MAJIDAE is contingent upon exercise by the International Commission on Zoological Nomenclature of its plenary powers in validating the name *Maja* Lamarck, 1801, and in designating as its type species *Cancer squinado* Herbst, 1788, as requested by Dr. L. B. Holthuis (Bull. Zool. Nomencl., vol. 12, pp. 123-128, 1956).

- 2b. Male abdomen not terminally broadened, seventh segment subtriangular and not inserted deeply into sixth segment. Male first pleopod exceedingly varied, but not as in 1a
- 3a. Eyes without orbits; eyestalks generally long, either non-retractile, or retractile against the sides of the carapace, or against an acute postocular spine affording no concealment. Basal antennal article extremely slender and usually long *Inachinae*
- 3b. Eyes with incomplete or commencing orbits. Basal antennal article not extremely slender
- 4a. Eyes without true orbits, lacking a postocular cup
- 5a. Eyestalks long; orbit partially protected by a hornlike supraocular spine or by a jagged postocular tooth, or by both. Body often truncate in front *Ophthalmiinae*
- 5b. Eyestalks short, little movable, and either concealed by a supraocular spine, or sunk in the sides of the rostrum. Basal antennal article truncate-triangular . . . *Acanthonychinae*
- 4b. Eyes with commencing orbits having, in addition to the supraocular spine, a large, cupped postocular process into which the eye retracts. Eyestalks short *Pisinae*¹
- 1b. Eyes with nearly complete or complete orbits. Basal antennal article very broad
- 6a. Basal antennal article not specially expanded to form a floor to the orbit, which is formed by a supraocular hood, an intercalated spine, and a postocular cup . . . *Majinae, s. restr.*
- 6b. Basal antennal article expanded to form a floor to the orbit, which is formed by the aforementioned spines, although the intercalated spine may be present or absent . . . *Mithracinae*¹

Subfamily **INACHINAE**

Inachinae Alcock, 1895, pp. 160, 162, 168. Rathbun, 1925, p. 11. Balss, 1929, p. 3.

Inachidae Stebbing, 1910, p. 283.

¹The further division of the *Pisinae* into *Pisinae, sensu restr.*, and *Hyasteniinae*, and of the *Mithracinae* into *Mithracinae proper* and *Macrocoelominae* according to the presence or absence of the intercalated spine, as proposed by Balss (1929), is not here adopted.

Inachinae Camposcioidea Stephensen, 1945, p. 218 [error for *Camposcioidea* Balss].

Eyes without orbits; eyestalks generally long, either non-retractile, or retractile against sides of carapace, or against an acute postocular spine affording no concealment. Basal article of antennae extremely slender throughout its extent, and usually long. (Alcock, modified)

Pleopod 1 not very stout; straight or curved, apically tapering, but apex most varying (hairy, spinose, naked, etc.; acute, blunt, bifid, etc.). Pleopod 2 short. (Stephensen)

The genus *Oregonia* has been removed from the Alcockian subfamily because of its rectangular male abdomen and filamentous first pleopod.

With respect to the subdivisions proposed by Balss (1929), the genus *Eurypodius* alone among those treated allies itself with the more primitive Macrocheiroidea, while the remaining Pacific American genera find their affinities with the Camposcioidea.

The sequence of genera reflects a gradual loss or reduction in number of parts: from double to single rostrum; from presence to absence of both the interantennular and supplementary orbital spine; and from the greater to the lesser number of free abdominal somites.

KEY TO THE AMERICAN GENERA OF THE SUBFAMILY *Inachinae*
ALCOCK (based on Balss)

(Pacific genera are indicated by bold face type and are treated in this volume)

- 1a. A spine intercalated between pre- and postorbital spines (Macrocheiroidea Balss)
- 2a. Seven free abdominal segments in both sexes; interantennular spine present **Eurypodius**
- 2b. Six free abdominal segments in both sexes *Achaeopsis*
- 1b. No spine intercalated between pre- and postorbital spines (Camposcioidea Balss)
- 3a. Seven free abdominal segments in both sexes; rostrum double
 - 4a. Eyestalks long, slender, exposed from bulbous bases; rostrum short; ambulatory legs of first pair not elongated **Eucinetops**
 - 4b. Eyestalks short, thick; rostrum long; ambulatory legs of first pair greatly elongated **Anomalothir**
- 3b. Six free abdominal segments in male, five in female
 - 5a. Rostrum double (except in *Collodes tenuirostris*)

- 6a. Interantennular spine present and conspicuous (except in *Euprognatha bifida*)
 - 7a. Eystalks slender; 3 erect median spines *Arachnopsis*
 - 7b. Eystalks not slender
 - 8a. Seven long capitate spines . . . *Aepinus*
 - 8b. Fewer than 7 carapace spines
 - 9a. Spine of basal antennal article equally advanced with front . **Euprognatha**
 - 9b. Spine of basal antennal article not equally advanced with front *Batrachonotus*
- 6b. Interantennular spine absent or inconspicuous **Collodes**
- 5b. Rostrum single
 - 10a. Merus of outer maxilliped as broad as ischium, palpus of moderate size
 - 11a. Postorbital tooth large, curving around eye
 - 12a. Carapace depressed; first leg noticeably shorter than others . **Paradasygius**
 - 12b. Carapace not depressed; first leg longer than others **Pyromaia**
 - 11b. Postorbital tooth small, or if large, not curving around eye
 - 13a. Sex dimorphism involving shape of carapace, size and location of postorbital spine. Male cheliped extremely elongated **Erileptus**
 - 13b. Sex dimorphism not involving shape of carapace, size and location of postorbital spine. Male cheliped not of unusual length
 - 14a. Carapace rough with spines and tubercles; legs not subprehensile *Anasimus*
 - 14b. Carapace smooth; legs subprehensile **Inachoides**
 - 10b. Merus of outer maxilliped often narrower than ischium, palpus large and coarse

- 15a. Rostrum considerably less than postrostral length, basal antennal article often longitudinally sulcate *Podochela*
- 15b. Rostrum approaching or surpassing postrostral length, basal antennal article not longitudinally sulcate
- 16a. Carapace nodulous; a long spine at end of merus of ambulatory legs; rostrum few spined . . . *Metoporphaphis*
- 16b. Carapace smooth; spine at end of merus of ambulatory legs no longer than others; rostrum multispinose *Stenorynchus*

Genus EURYPODIUS Guérin

Eurypodius Guérin, 1825b, p. 700, footnote; 1828, p. 350. Milne Edwards, 1834, p. 283. Dana, 1851b, p. 431; 1852, p. 100. Miers, 1879c, p. 646; 1886, p. 21. Rathbun, 1925, p. 80.

Type: Eurypodius latreillei Guérin, by subsequent designation of Guérin (1828).

Description: Carapace elongate-triangular, moderately convex, and spinous or tuberculate above; a distinct postorbital but no preorbital spine. Spines of rostrum contiguous, at least in part of their length. Antennae visible in dorsal view at sides of rostrum; peduncular articles slender. Merus of maxillipeds distally truncate, bearing the next article at its anterointernal angle. Chelipeds of male well developed, with the palm compressed or turgid and the fingers distally acute. Ambulatory legs considerably elongate, with the penultimate articles more or less dilated and compressed; the dactyls slightly arcuate, shorter than the propodites, and reflexible against their inferior margins. Abdomen seven-segmented [in both sexes]. (Rathbun, 1925, after Miers, 1886)

Range: Independencia Bay, Peru, to Rio de Janeiro, Brazil, via the Strait of Magellan and Cape Horn. 4-175 fathoms. Contains but two species.

KEY TO THE SPECIES OF *Eurypodius*

- 1a. Rostrum horizontal, spines contiguous. No spine on upper orbital margin. Ambulatory legs broadened and compressed . *latreillei*
- 1b. Rostrum inclined upward, spines divergent. A spine on upper margin of orbit. Ambulatory legs slender . . . *longirostris*

Eurypodius latreillei Guérin

Plate B, Fig. 1; Plate 2, Fig. 1

- Eurypodius latreillii* Guérin, 1828, p. 354, pl. 14, figs. 1-11; 183—, pl. 11, fig. 1; 1831, pl. 2, figs. 1-11; 1838, p. 25. Bell, 1835b, p. 169; 1836, p. 40. Milne Edwards, 1836, pl. 34*bis*, figs. 1, 1a-b. White, 1847, p. 2. Dana, 1852, p. 104; atlas, 1855, pl. 3, figs. 1a-c. Smith, 1869, p. 33. Cunningham, 1871, p. 491. Rathbun, 1898, p. 571; 1910, p. 571; 1925, p. 80, pls. 30, 31, 215. Stebbing, 1900, p. 527; 1914, p. 260. Doflein and Balss, 1912, p. 36. Porter, 1936a, p. 151; 1936b, p. 337.
- Eurypodius latreillia*, Milne Edwards, 1834, p. 284.
- Eurypodius cuvieri* Audouin, in deHaan, 1839, pl. H.
- Eurypode tuberculeux* Eydoux and Souleyet, 1842 (or 1843), pl. 1, figs. 7-9.
- Eurypodius audouinii* Milne Edwards and Lucas, atlas, 1842, pl. 1, figs. 1-6; 1843, p. 3; type locality, Chile; type in Paris Museum. Nicolet, 1849, p. 123. Dana, 1852, p. 104. Cunningham, 1871, p. 491. A. Milne Edwards, 1891, p. 16. Porter, 1902, p. 290.
- Eurypodius latreillei*, Milne Edwards and Lucas, 1843, p. 4. Targioni-Tozzetti, 1877, p. 9, pl. 1, figs. 14-20. Miers, 1879c, p. 646; 1881, p. 64; 1886, p. 22, pl. 4, figs. 3, 3a. A. Milne Edwards, 1880a, p. 10; 1891, p. 10. Cano, 1888, pp. 163, 164; 1889, pp. 98, 171. Pfeffer, 1890, p. 545. Ortmann, 1893, p. 38; 1911, p. 660. Rathbun, 1894, p. 59. Murray, 1895, p. 1140. Coutière, 1900, p. 238. Lenz, 1902, p. 755. Porter, 1902, p. 289; 1903, p. 148; 1917, p. 95. Lagerberg, 1905, p. 17. Garth, 1957, p. 19.
- Eurypodius tuberculatus* Eydoux and Souleyet, 1844 (or 1845), p. 221; type localities, Peru and Chile; type in Paris Museum.
- Eurypodius andouinii* [for *audouinii*], White, 1847, p. 2.
- Eurypodius latreillia*, Nicolet, 1849, p. 123.
- Eurypodius septentrionalis* Dana, 1851a, p. 270; type locality, Nassau Bay, Fuegia; types not extant; 1852, p. 101; atlas, 1855, pl. 2, figs. 6a-d. Cunningham, 1871, p. 491.
- Eurypodius brevipes* Dana, 1851a, p. 270; type locality, Nassau Bay, Fuegia; types not extant; 1852, p. 103; atlas, 1855, pl. 2, figs. 7a-c. Cunningham, 1871, p. 491.
- Eurypodius audouini*, Targioni-Tozzetti, 1872a, p. 390; 1872b, p. 461; 1877, p. 16, pl. 1, figs. 1-3, 7, 9, 12, 13, 21.
- Paramithrax peronii*?, Targioni-Tozzetti, 1872a, p. 390; 1872b, p. 461. Not *P. peronii* Milne Edwards, 1834.

Eurypoda sp. ? (from Patagonia) Brocchi, 1875, p. 90, pl. 19, figs. 177, 178. Stephensen, 1945, p. 218.

Eurypodius danae Targioni-Tozzetti, 1877, p. 15; type locality, Valparaíso; type not extant.

Eurypodius quiriquinensis Yañez, 1948, p. 61; type locality, Isla Quiriquina, Chile; 1951, p. 347.

Type: Male holotype in Paris Museum, length 62 mm, width 43 mm.

Type locality: "Les îles Malouines" [Falkland Islands], Lesson and Garnot, collectors.

Pacific localities subsequently reported, with collectors: Peru: "Peru" *Bonite* (Eydoux and Souleyet). Chile: "Chile" A. d'Orbigny (Milne Edwards and Lucas), (Nicolet); Iquique and Cavancho, L. H. Plate (Lenz); Coquimbo (Porter, 1902); Coquimbo and Herradura, F. T. Delfin (Porter, 1903); Valparaíso, H. Cuming (Bell), A. d'Orbigny (Milne Edwards and Lucas), *Magenta* (Targioni-Tozzetti), C. E. Porter (Porter, 1902); Bahía de Concepción, near Talcahuano (Porter, 1936a); Isla Quiriquina, Bahía de Concepción, E. P. Reed (Yañez); Calbuco, 10-15 fms, L. H. Plate (Lenz); Taitao, Mus. Nac. Chile Exped. (Porter, 1917); Punta Tres Montes, Chiloë, and Port Otway [Puerto Barroso], *Nassau* (Cunningham); Port Otway (Porter, 1902); Trinidad Channel, 30 fathoms, and Puerto Bueno, 4 fathoms, *Alert* (Miers, 1881); Puerto Bueno and Puerto Lagunas, *Vettor Pisani* (Cano, 1889); Puerto Bueno, *Caracciolo* (Cano, 1888); Mayne Harbor and Latitude Cove, *Albatross* (Rathbun, 1898); Smith Channel [Canal Smyth], Hamburger Magalhaensischen Sammelreise (Doflein and Balss); Magellan Strait, *Alert* (Miers, 1881), 9, 55, and 70 fathoms, *Challenger* (Miers, 1886), *Vettor Pisani* (Cano, 1889), Steinmann, Pöhl (Ortmann, 1893); Laredo Bay, *Albatross* (Rathbun, 1894); Punta Arenas [Magallanes], *Vettor Pisani* (Cano, 1889), L. H. Plate (Lenz), Hamburger Magalhaensischen Sammelreise (Doflein and Balss), J. B. Hatcher (Ortmann, 1911); Port Famine [Paso Famine?], *Challenger* (Miers, 1886); Seno [del] Almirantazzo, L. H. Plate (Lenz); Beagle Channel and Port Cook, Miss. Sci. Cap Horn (A. Milne Edwards).

Atlantic analogue: None. An austral species occurring in both Pacific and Atlantic oceans via the Strait of Magellan and around Cape Horn.

Diagnosis: Rostral spines contiguous. Postorbital spine prominent, not curving around eye. Propodi of ambulatory legs posteriorly broadened and compressed, dactyli jack-knifing against their distal portion. A conical spine on first abdominal somite.

Description: Surface pubescent. Carapace rough with tubercles and short spines; five median spines: two gastric, one genital, one cardiac, and one above the posterior margin. Branchial region surmounted by a spine, with a row of smaller spines extending obliquely from it to the inner angle; margin anteriorly spinous; a spine near the anteroexternal angle, with an irregular row extending backward above the margin. Hepatic region with a spine near the inner angle and one or two on the margin. Gastric region with a stout marginal spine behind the post-orbital spine, and a dorsal row of spinules extending forward to each rostral horn. Many spines sometimes replaced by tubercles; two tubercles side by side on the genital and the intestinal regions.

Rostral horns stout, tapering distally, contiguous, usually less than one-third the length of postrostral portion of carapace, curving downward toward the tips. Horns with either a buttonhole interspace or slightly divergent in the terminal portion. A strong, spine-pointed, interantennular tooth. Orbital arch unarmed. A conical spine or tubercle on first segment of abdomen.

Merus and carpus of chelipeds tuberculate and spinous; merus triangulate, more or less swollen, upper margin spinous, the row of spines continued on the carpus. Manus roughly granulate, either wide and swollen or narrow and compressed (a less developed form); fingers gaping for more than half their length, dactylus with a large tooth midway of its length; immovable finger with a smaller basal tooth; these teeth much reduced in the narrow form of manus. The two forms of cheliped found in individuals of the same size and from the same locality.

Propodus of ambulatory legs usually greatly exceeding carpus in length, but occasionally carpus nearly equalling or even exceeding propodus. The latter dilated below and the distal half of this expansion, where the dactylus closes, margined with a thick fringe of hair. Dactylus, as a rule, more than half the length of the propodus. (Rathbun, 1925, modified)

Description of the male pleopods: Two pairs of male appendages, the first pair formed of a piece quite strongly curved on the outside, presenting at its extremity a small prolongation forming nearly a right angle with the general direction of the appendage (fig. 177 of the original). The second pair of appendages small, formed of two pieces, the second curving on the outside in a very open hook (fig. 178 of the original). (Brocchi, 1875, p. 90)

In the first variety (var. α), which is to be regarded as the typical form, as shown by Guérin-Méneville's original figure, the palm is moder-

ately compressed, more slender, considerably longer than broad, not turgid, and the fingers are without strong tubercles on the inner margins. In the second variety (var. β) the palm is shorter and much more turgid, the fingers have between them (when closed) a much larger hiatus, and the dactylus and sometimes the lower finger (pollex) is armed, on its margin, near the base, with a strong, rounded tubercle. This form has usually, but not invariably, a more slender carapace and longer rostrum. . . . It is not a character peculiar to the old and large males, . . . and as it is impossible to say to which of the two varieties the females in the collection are to be referred, I refrain from applying to them distinctive appellations. (Miers, 1886, p. 22)

Material examined: A total of 425 specimens from 9 Hancock expedition stations. (See Table 2) Independencia and San Nicolas bays, Peru. An additional 14 specimens from 6 Hamburg Museum localities, plus 144 specimens from 19 Lund University Chile Expedition localities. The former are distributed from Arica to Coronel, Chile, the latter from Canal Calbuco, Golfo de Ancud, to Pta. Santa María, Estrecho de Magallanes.

Measurements: Largest Hancock expeditions specimen, a male from station 829-38: length 58.7 mm, width 39.5 mm, rostrum 15.4 mm, cheliped 85 mm, chela 35 mm, dactyl 16 mm, walking legs 156, 145, 133, and 123 mm, respectively. Female: length 38.5 mm, width 26 mm. The largest specimen on record is apparently a 69 mm male without rostrum collected by the Mission Scientifique Cap Horn (A. Milne Edwards, 1891). A 68 mm male with rostrum intact and a 53.5 mm ovigerous female are included among Lund University Chile Expedition collections from St. M21, Canal Calbuco, Golfo de Ancud.

Color: "In the fresh state this crustacean should be of a greenish-brown color." (Guérin) An excellent colored illustration appears in Milne Edwards (1836, pl. 34 *bis*, fig. 1). Unfortunately, no color notes were taken of living Hancock Expedition or Lund University Chile Expedition specimens.

Habitat: Recovered from bottoms of sand or sandy mud with associated shell or rock. Large individuals among Hancock expeditions specimens were decorated with an alga which on the basis of sterile material could be identified by Dr. E. Yale Dawson only as either *Rhodymenia corallina* (Bory) Greville or *R. howeana* Dawson. Lagerberg (1905) enumerates various epizooites, including sponges, hydroids, bryozoans, and tube worms. Lund University Chile Expedition specimens were covered with the sponges *Haliclona topsenti* (Thiele), *H.*

foraminosa (Thiele), *Halichondria* sp., *Amphilectus fucorum* (Esper), and *Iophon proximum* (Ridley), as determined by Dr. M. Burton, the bryozoan *Beania magellanica* (Busk), as determined by Dr. I. Vigeland, and the ascidian *Paramolgula gregaria* (Lesson), as determined by Dr. W. G. Van Name.

Depth: Hancock expeditions specimens were dredged in from 5-25 fathoms, Lund University Chile Expedition specimens commonly in from 5-45 m, exceptionally in 250-300 m. Specimens from Estrecho de Magallanes, however, were collected intertidally, an example of polar emergence of a mid-latitude deep-water form.

Breeding: Ovigerous females were collected by Hancock expeditions at Independencia Bay, Peru, on January 14 and February 9-10, and at Viejas Island, Peru, on January 12. The proportion of ovigerous to total females collected was greatest at station 832-38, where 10 of 17 females were with ova. This suggests that breeding was well advanced in February, which is Southern Hemisphere summer. Ovigerous females were collected by the Lund University Chile Expedition at Estero Reloncaví on April 1 and in the Golfo de Quetalmahué on May 4, where 100 percent of the females were in berry.

Remarks: One has only to consult the extensive synonymy above to realize that *Eurypodius latreillei* has been described and redescribed many times, each author in turn believing that the specimen or specimens before him represented something unique among Crustacea, whereas all were but differing manifestations of a highly variable organism. Milne Edwards and Lucas (1843) and A. Milne Edwards (1891) each recognized two species, the second being *E. audouini*. Dana (1851a, 1852) and Targioni-Tozzetti (1877) each recognized three species, the former describing *E. brevipes* and *E. septentrionalis* in addition to the parent species, the latter proposing *E. danae* while according separate treatment to *E. audouini* and *E. latreillei*. Cunningham (1871) carried this trend to the ultimate in recognizing four species, although himself describing none. It was Miers (1881), followed by Ortmann (1893), who initiated the present trend in synonymy by considering all specimens then in the British Museum as representing a single species, although even he could not refrain from designating two varieties of the male, α and β , which designations, further perpetuated by Coutière (1900), are repeated above because of their historical interest. (See *Description*, above)

A neo-Milne Edwardsian tendency to return to two named forms is apparent in the recent designation of a form closely resembling *Eurypodius audouini* as *E. quiriquinensis* Yañez. While the writer agrees

with Dr. Yañez that the ultimate status of *E. latreillei*, whether as one species or more than one, should rest with persons having access to abundant fresh material, it is his hope that such a final study will be attempted by someone as thoroughly versed in the literature as, and possessed of an array of comparative material not less extensive than that available to, Miers, Lagerberg, or Rathbun.

The excellent review of the species by Lagerberg (1905) should be supplemented by the discussion of Stebbing (1914), who corrects the spelling of an otherwise impeccable synonymy while noting that Lagerberg erroneously credited H. Milne Edwards, instead of Guérin, with the Crustacea of the *Coquille*. In an earlier paper Stebbing (1900) expressed regret that Miers, writing in 1881 and 1886, failed to include reference to Targioni-Tozzetti (1877), on whose work his opinion would have been invaluable. Stebbing also presents convincing evidence to the effect that Dana (1855) may have relied too strongly on his memory in assigning fig. d of plate 3 to *Eurypodius latreillei* in the explanation of plates after the original drawings had been destroyed by fire.

Other items gleaned from a review of the historical treatment accorded the species include an early reference to the genus as occurring in the Indian Ocean (H. Milne Edwards, 1834), whereas the only species known at that time was *Eurypodius latreillei* of the Falkland Islands (Philippi, 1894, p. 266). This may account for Smith's (1869) reference to an East Indian locality for the species, for many a New Englander of his day held similarly vague ideas concerning the geographical position of "les îles Malouines."

The collections of the *Velero III* are drawn from a relatively narrow sector of the species range and do not exhibit the extremes of variation shown in series from more widely separated localities. The collections of the Hamburg Museum from north Chile and those of the Lund University Chile Expedition from south Chile are therefore opportunely come by. While the possibility of correlating intraspecific variation with geographical distribution is an intriguing one, it is not proposed here to alter the present systematic arrangement. The contribution made by the *Velero III* collections is rather to define with greater precision the northern limit of range of the species on the Pacific coast of South America, substituting Independencia Bay for the more general designation "Peru" that has obtained since the voyage of the *Bonite* (Eydoux and Souleyet, 1842-43).

The accompanying illustration of the male first pleopod (Plate B, fig. 1) supports the withdrawal by Balss (1929) of *Eurypodius* from

its systematic position next *Oregonia* and its placement by him in the more primitive macrocheiroid section of the subfamily Inachinae. It is not, however, the first illustration of the gonopods of *Eurypodius latreillei*, which were described and figured by Brocchi (1875, p. 90, figs. 177, 178).

Eurypodius longirostris Miers

Plate B, Fig. 2

Eurypodius longirostris Miers, 1886, p. 23, pl. 5, figs. 1, 1a. Pfeffer, 1890, p. 545. Stebbing, 1900, p. 527. Rathbun, 1925, p. 83, pl. 35, figs. 1, 2. Garth, 1957, p. 21.

Eurypodius longirostris Murray, 1895, p. 1152.

Type: Male holotype, in British Museum, length including rostrum 30 mm, width 15 mm.

Type locality: Lat. 50° 08' 30" S, Long. 74° 41' 00" W, 175 fathoms, *Challenger* station 308. The designation "off the coast of Chiloe" (Miers, 1886) is in error, due to confusion of *Challenger* station 308 with 303. (Cf. Murray, 1895, pp. 1138, 1149).

Localities subsequently reported: None. Known only from the type locality above, correctly described as Tom Bay, east coast of Madre de Dios Island, Wide Channel, Magallanes, Chile.

Atlantic analogue: None. A Subantarctic, abyssal species.

Diagnosis: Rostrum sharply inclined, spines laterally divergent. A small spine on upper margin of orbit in addition to postocular spine. Interantennular spine prominent, deflexed. Ambulatory legs slender. Otherwise as in *Eurypodius latreillei*.

Description: Rostrum of the male remarkably reflexed, bent upward at an angle of nearly 45° to the front, with the spines toward their apices laterally divergent from one another. Body and limbs thinly pubescent, carapace narrow in proportion to its length, with spines disposed as commonly in specimens of *Eurypodius latreillei* of the same size and sex, *e. g.*, two upon the gastric, one upon the cardiac, one on each branchial region and one on the posterior margin, besides some smaller granules on the sides of the hepatic and branchial regions. A small spine on upper margin of the orbit, besides the postocular spine. Spines of the rostrum considerably exceeding half the length of the carapace, contiguous at the base, but in the distal third of their length curving laterally and outward; a strong spine on the interantennular septum. Eyes, antennae, and maxillipeds of the same form as in *Eurypodius latreillei*. Chelipeds with palms not turgid, as in young males of the typical variety (α) of that species, but compressed, fingers

acute, without teeth, and without any intramarginal hiatus when closed; merus and carpus with a few distant granules on the upper margins. The ambulatory legs very imperfect and their dimensions [unascertainable], but evidently slender and considerably elongated, with the penultimate [segments] larger than the preceding and very little dilated.

An immature female, dredged at the same locality and depth, has the rostrum scarcely at all reflexed and somewhat shorter, with the spines less divaricate at the apex; the chelipeds and ambulatory legs clothed with a denser pubescence; the latter much less elongated. This specimen, although distinguished by the narrower carapace and more elongated rostrum, much more resembles the typical *Eurypodius latreillei* than does the male. (Miers, 1886, modified)

Material examined: None. The male and female in the British Museum (Natural History) were reexamined at the request of the writer by Dr. I. Gordon, from whose notes and sketches the following information was derived:

Male: The small spine on the orbital border lies between the rim of the eye socket and the postocular spine, as in *Eurypodius latreillei*. The propodus of the walking legs is compressed, although less so than in the companion species. The male first pleopod is as figured, although spinulation could not be determined due to the condition of the specimen. The female is immature, without perforate genital pores. The chelipeds exceed the rostrum by about three-fifths of the chela. The rostrum is slightly over one-fourth the total carapace length, its tip soft and slightly bent. (See also measurements below.)

Measurements: Male holotype: length of carapace to base of rostrum about 19 mm, length of rostrum about 11 mm, width of carapace a little over 15 mm, length of cheliped nearly 32 mm. (Miers) Female: length including rostrum 16.3 mm plus (probably 16.5), width 9.6 mm, rostrum 4.4 mm, detached walking leg (number uncertain): merus plus next small segment 12.6 mm, carpus 6.6 mm, propodus 8.7 mm, width 1.7 mm, dactylus 4.8 mm.

Color in life: Not known.

Habitat: Blue mud.

Depth: 175 fathoms. In view of the much lesser depth of 77.5 fathoms which represents the lower limit of range of *Eurypodius latreillei*, the deeper habitat may be said to be a specific character of *E. longirostris*. A similar distinction obtains in boreal Pacific waters in connection with *Oregonia gracilis* and *O. bifurca*, the latter being the deep water species.

Remarks: As noted by Murray in the *Challenger* Summary (1895, p. 1152), *Eurypodius longirostris* from station 308 was one of the prizes of the *Challenger* Expedition, having been obtained at no other locality. The small male and immature female in the British Museum remain the only specimens known of this exceedingly rare species.

Genus ANOMALOTHIR Miers

Anomalopus Stimpson, 1871b, p. 124. A. Milne Edwards, 1879, p. 187.

Anomalothir Miers, 1879c, p. 648; name substituted for *Anomalopus*, preoccupied. Rathbun, 1925, p. 23.

Type: The Atlantic *Anomalopus furcillatus* Stimpson, 1871, type of *Anomalopus* Stimpson by monotypy.

Description: Carapace very much elongated, almost subcylindrical; rostrum very long, slender, bifid. Eyes without orbits; preorbital spine small, acute; postocular spine minute. External antennae exposed from above; basal [article] narrow. Antennular fossae large. Epistome two-thirds as long as broad. Merus of external maxillipeds without any notch at interior angle where palpus is inserted; external angle sharply prominent. Chelipeds in female shorter than carapace. Ambulatory [legs] of first pair very long, twice as long as carapace, with the dactylus nearly straight, and three-fourths as long as [propodus]. Ambulatory legs of posterior two pairs shorter and stouter than those of anterior two, and with prehensile extremities; those of [next to last] pair shorter than those of last pair. (Stimpson, modified)

Rathbun (1925) adds that the rostral horns are contiguous for half their length or more, the chelipeds in adults are longer than the carapace, and the abdomen consists of seven segments in both sexes.

Range: In the Pacific known only from the Galapagos Islands and by a single species; in the Atlantic known from Cape Lookout, North Carolina, to the island of Grenada in the West Indies, and by two species, one of which is analogous to the Pacific form. 20-160 fathoms.

Anomalothir hoodensis Garth

Plate B, Fig. 3

Anomalothir hoodensis Garth, 1939, p. 9, pl. 1, figs. 1-4; 1946, p. 368, pl. 64, figs. 1, 2.

Type: Female holotype, A.H.F. No. 381, length 10.8 mm, width 5.6 mm.

Type locality: North of Hood Island, Galapagos Islands, 140-160 fathoms, *Velero III* station 817-38.

Additional localities recorded, with collectors: Galapagos Islands: off Daphne Minor, 70-80 fathoms, Barrington Island, 48 and 73 fathoms, north of Hood Island, 20-40 fathoms, *Velero III* (Garth, 1946).

Atlantic analogue: *Anomalothir frontalis* (A. Milne Edwards).

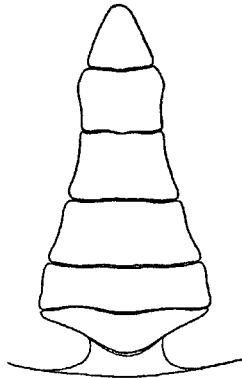
Diagnosis: Postorbital spine longer than preorbital. Third leg slightly shorter than fourth. A single spine on carpus of cheliped. Merus of third leg entire. Carapace little produced posteriorly; no tubercle in front of posterior margin. Tip of male pleopod bluntly pointed, aperture with a spine-fringed lip.

Description: Carapace pyriform, smooth and bare, regions faintly indicated. Cardiac area slightly more elevated than gastric. Rostrum curving gently downward, length little more than twice breadth, horns cleft to base but contiguous the greater part of their length, diverging slightly in distal third and bearing a row of short setae on outer margins. Basal article of antenna visible in dorsal view. Preorbital spine minute, postorbital spine prominent. Eyes large, eyestalks constricted at base of cornea. A few scattered spinules on hepatic, pterygostomial, and branchial areas. Posterior margin but little protruding; no spine or tubercle at posterior median angle.

Merus of cheliped armed with five stout spines beneath. Carpus with a superodistal spine. Manus moderately inflated in female; dactyl three-fourths as long as propodus; fingers gaping in a broad oval. First ambulatory leg much the longest, over twice length of carapace, including rostrum; second leg one and two-fifths times length of carapace; third and fourth legs shorter, subequal, the third being slightly shorter than the fourth, its merus less robust. Dactyl of first leg more than four-fifths length of propodus, that of second leg three-fourths propodal length; dactyls of legs three and four little more than half as long as those of leg two, dactyli of all legs save those of the first pair dentate.

Antennae extending beyond rostrum, basal article narrow, antennal spine minute. Merus of third maxilliped rounded at outer angle; ischium and merus spinulose along inner border, segments of palpus shortened, robust. (Garth, 1939, condensed)

Male abdomen widest at base of third segment, narrowing to middle of sixth segment, seventh segment narrowly triangular. (See text-fig. 2)



2. *Anomalothir hoodensis*, male allotype (*Velero III* Sta. 817-38), abdomen, x 15.

Male pleopod 1 with apex bluntly pointed, aperture gaping widely, lip fringed with about a dozen spinules. (Plate B, fig. 3)

Material examined: For a listing of 8 specimens from 5 Galapagos stations see Garth (1946, p. 368).

Measurements: Female holotype: length 10.8 mm, width 5.6 mm, rostrum 3.4 mm, width 1.5 mm, cheliped 12.6 mm, first ambulatory leg 21.8 mm, remaining legs 16, 9, and 10 mm, respectively. Male allotype: length 9.6 mm, width 5.0 mm.

Color in life: See Garth (*op. cit.*).

Habitat: Sand bottom, often with shell or mud.

Depth: 20-160 fathoms.

Breeding: Nothing is known concerning the cycle, all Hancock expedition females collected in January, 1938, having been sterile.

Remarks: Although *Anomalothir hoodensis*, because of its analogous relationship to the Atlantic *A. frontalis*, may be expected to occur in the Bay of Panama, it was encountered by the *Velero III* only in the Galapagos Islands, where it is a rarity. Only eight specimens are known, all of them obtained on a single cruise. Because the possible diagnostic importance of the male pleopod was not at that time appreciated, a female was selected as the holotype. The accompanying figure of the male copulatory appendage (Plate B, fig. 3) supplies the key and diagnostic characters needed to relate *A. hoodensis* to the remaining species of *Anomalothir* and the genus *Anomalothir* to the remaining genera of the subfamily Inachinæ.

Genus **EUCINETOPS** Stimpson

Eucinetops Stimpson, 1860b, p. 191. A. Milne Edwards, 1875, p. 119.

Miers, 1879c, p. 644. Rathbun, 1901, p. 55; 1925, p. 84.

Type: Eucinetops lucasi Stimpson, by monotypy.

Description: Rostrum small, bifid, little deflexed. Eyes very long, greatly exceeding margins of carapace. Orbits small, encircling only base of ocular peduncles; external angle acute, spiniform; superior margin singly fissured, destitute of teeth or spines. Antennular fossae not deep, margins obtuse and rounded. Basal article of external antennae small, armed with a minute tooth at external angle; movable part depressed, first and second articles rather broad. Epistome very short or lacking. External maxillipeds resembling those of *Micippa*, but with external angle of merus more prominent, internal angle less sinuous; palpus basally thickened; exognath exceeding endognath in front. (Stimpson)

Rathbun (1925) avoids the reference to *Micippa* as follows: Merus of outer maxilliped subtriangular, outer front angle prominent, distal margin longest; palpus very short and stout, terminal article much narrower than the others.

Range: Cholla Bay, Sonora, Mexico, to La Libertad, Ecuador; occurs also in the West Indies (Bahama Banks, Jamaica, Puerto Rico). Two of the three Pacific species are restricted to the Gulf of California and/or adjacent waters. Shore to 1 fathom.

Remarks: With respect to the Gulf of California *Eucinetops* two conclusions are possible: either the antennal article is variable and *E. rubellula* belongs within the *E. lucasi* series; or else the rostrum is variable, Stimpson's specimens exhibiting the opposite extreme to that shown by Hancock expedition material, and Rathbun's separation of the Stimpson male as *E. rubellula* was justified. (See following species accounts). If any individuals among the considerable series of *E. lucasi* showed even a slight tendency toward attenuation of the outer angle of the first movable article of the antenna, the first view might be held. However, all *Velero III* specimens show an abrupt, horizontal termination of this article and otherwise show little tendency to approach the *E. rubellula* male. On the other hand, a specimen in the collections of the U. S. National Museum, here proposed as neotype of *E. rubellula*, upholds the distinctive antennal character and the toothless and gapeless finger of Stimpson's figured specimen (1860b, pl. 2, fig. 3). Available material, therefore, is regarded as corroborating the relationships arrived

at by Rathbun (1923a, p. 73; 1925, p. 84, ff.), who had only the brief and inadequate descriptions of Stimpson and Lockington before her. The distinctive pleopod of *E. rubellula* (Plate B, fig. 6) supports this view.

KEY TO THE PACIFIC SPECIES OF *Eucinetops*

- 1a. Rostral horns simple, acute or rounded but always deeply separated, eyestalks extending well beyond postorbital spine
- 2a. First movable segment of antenna narrowly rectangular, fingers of adult male gaping. Male pleopod with a sharp lateral projection *lucasi*
- 2b. First movable segment of antenna strongly produced at external angle, fingers of adult male not gaping. Male pleopod with a small, rounded lateral projection . . . *rubellula*
- 1b. Rostral horns spine-tipped, basally joined for two-thirds of their length, cornea extending only beyond postorbital spine, first movable segment of antenna short and broad. Male pleopod with a spinulose thumb process *panamensis*

***Eucinetops lucasi* Stimpson**

Plate A, Fig. 7; Plate B, Fig. 4; Plate 3, Fig. 1

Eucinetops lucasii Stimpson, 1860b, p. 191, female, not pl. 2, fig. 3, male. A. Milne Edwards, 1875, p. 119. Miers, 1879c, p. 644. Rathbun, 1925, p. 85. Crane, 1937, p. 54, pl. 2, figs. 5, 6. Steinbeck and Ricketts, 1941, p. 466.

Peltinia longioculis Lockington, 1877c, p. 76; type locality, Lower California; male holotype not extant.

Type: Female holotype, length 9.1 mm, width 6.9 mm, no longer extant. Male neotype, A.H.F. No. 494, from one mile northeast of Cabeza Ballena, Lower California, Mexico, shore, March 11, 1949, *Velero IV* station 1727-49.

Type locality: Cape St. [San] Lucas, Lower California, Mexico; John Xantus, collector.

Localities subsequently reported, with collectors: Mexico: Lower California: "Lower California," type locality of *Peltinia longioculis* (Lockington); Gulf of California: Puerto Refugio and Concepción Bay (Steinbeck and Ricketts); Santa Inez Bay, *Zaca* (Crane).

Atlantic analogue: None.

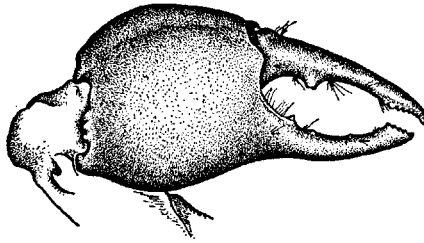
Diagnosis: Rostral horns strong, sharp, and cleft more than half way to bases. Postorbital spine similarly attenuated. Eyestalks long,

slender, reaching beyond postorbital spine by nearly half their length. First movable segment of antenna longer than broad, outer angle not produced. Fingers of adult male gaping, one tooth in gape. Male pleopod with a large triangular lateral projection.

Description: Carapace broadly rounded posteriorly, narrowing to base of orbits anteriorly, hairy, and tuberculate on raised portions only. Cardiac area with three larger tubercles in a backward-pointing triangle, a rectangular tubercle leading to the gastric region. Gastric region high, straight-sided, and surmounted by a transverse row of five tubercles, the median most advanced. Branchial regions swollen, tuberculate, a sharp spine directed laterally and upwardly at each posterolateral angle; in front of this and well within the lateral margins an irregular line of sharpened tubercles leading forward to the base of the postorbital spine, interrupted slightly by the shallow groove delimiting the hepatic from the branchial area. A rectangular tubercle half way between each posterolateral spine and the tuberculate intestinal region. In addition to the principal tuberculations mentioned, scattered tubercles and masses of hooked hairs occurring on all elevated regions, the depressions between them being largely smooth and bare. Rostral horns acute, straight margined, separated nearly to their bases, and each surmounted by a double row of hooked hairs. Eystalks long, slender, tapering abruptly from bulbous bases, and extending considerably beyond the acute and strongly divergent postorbital spines. Basal antennal segment broad, a sharp tooth at its anteroexternal angle; first free segment narrowly rectangular, about twice as long as broad, falling short of the tip of the rostrum, and heavily fringed with long hairs along its outer margin. Merus of third maxilliped triangular, deeply notched for the insertion of the palpus, anteroexternal angle acute, prominent.

Chelipeds of adult male slightly longer than carapace, and slightly shorter than the first ambulatory legs. Merus of chelipeds massive, smooth, cylindrical, a cluster of tubercles on its outer proximal margin. Carpus with a prominent outer and suggested inner crest, with a shallow sulcus between them. Manus high, crested, smooth, bare, and marbled, tapering distally; fingers long, slender, gaping in an elongate oval, movable finger with a broad tooth near its base, immovable finger slightly deflexed, one sharp tooth opposite digital tooth and one or more smaller teeth nearer the tip, fingers meeting at extremities only.

Ambulatory legs diminishing regularly in length from first to last, densely clothed with clavate hairs interspersed with long fine hairs, a



3. *Eucinetops lucasi*, male (Tiburon Island, Gulf of California), chela, x 6.5.

row of hooked hairs along their anterior margins, dactyli strongly curved, tips corneous.

Male abdomen composed of seven free segments, the last triangular, tip rounded. Male pleopod 1 with a transparent lateral projection extended terminally to oppose the sharply pointed tip. (Plate B, fig. 4)

Female similar to male except for undeveloped chelipeds and shorter legs.

Material examined: 47 specimens from 20 Hancock expeditions stations, all in the Gulf of California. (See Table 3) These range from Angel de la Guarda Island to Cabeza Ballena, Lower California. In addition, one specimen from Cholla Bay and three specimens from Cholla Point, Sonora, Mexico, collected by B. W. Halstead and S. A. Glassell, respectively; 30 specimens from Agua Dulce Bay, Tiburon Island, collected by W. N. Smith, II; and one specimen each from Bahía de Bocochoibampo, Sonora, and Bahía de la Paz, collected by E. Yale Dawson.

Measurements: Male neotype, length 11.0 mm, width 8.1 mm, rostrum 1.8 mm, width 2.3 mm, cheliped 11.4 mm, chela 6.0 mm, dactyl 3.0 mm, height of palm 3.4 mm, ambulatory legs 12.2, 9.4, 8.0, and 6.9 mm, respectively. Female: length 12.5 mm, width 9.8 mm.

Color in life: Not recorded. Crane (1937, p. 54) notes a conspicuous banding and marbling of both chelipeds and ambulatory legs in alcoholic specimens.

Habitat: On sandy bottom with weed. (Crane) Associated with the hatchet clam *Pinna*. (Steinbeck and Ricketts) *Velero III* and *Velero IV* specimens were obtained most frequently from shore collecting on rocky substratum, and on two occasions were cracked from heads of

living *Pocillopora* coral. The male neotype was covered with a filamentous alga identified by E. Yale Dawson as *Cladophora hesperia* S. and G.

Depth: Intertidal, with the exception of one *Zaca* station in one fathom and one *Velero IV* station at the same depth.

Size and Sex: Specimens range in size from a 5.0 mm male cracked from coral to one of 14.3 mm, which is considerably larger than the 11.0 mm proposed neotype, and the largest specimen on record. Ovigerous females of from 7.0 mm to 12.5 mm are present in the series.

Breeding: Females with ova were encountered by Hancock expeditions in the Gulf of California in March, by William Neil Smith, II, at Tiburon Island in mid-June, when 15 of 16 females collected were in berry, and by E. Yale Dawson at La Paz in November.

Remarks: As compared to *Eucinetops panamensis*, *E. lucasi* is more rotund, especially in the branchial areas. The longitudinal row of spinulous tubercles is well within the lateral margins, instead of appearing to delimit them. The tubercles of the carapace are restricted to the prominent areas instead of being scattered generally. The rostral horns are cleft nearly to their bases instead of less than half way. The postorbital spine is acute and slender instead of equilaterally triangular. The first movable antennal article, while broad, is seldom as broad as the rostral spine. The eyestalks are longer and extend considerably beyond the postorbital spine. The male first pleopod has an attenuated flange opposite its sharp tip in place of a slight swelling opposite a blunt tip. (Cf. Plate B, figs. 4 and 5)

It will be seen from the above description that the *Eucinetops* characterized agrees more closely with Lockington's description of *Peltinia longioculis*, which was based upon a male specimen, than with Stimpson's description of the female *Eucinetops lucasi*, particularly as regards the long eyestalk and the cheliped. (Stimpson's male specimen was of another species and became the type of Rathbun's *E. rubellula*.) It departs from both, however, in that the rostral spines are acute, not blunt, in the proposed neotype and in the large majority of the specimens examined. Hancock expedition material therefore supports the conclusion that the rostrum is variable and that Stimpson's specimen was abnormal in this respect. This was the conclusion reached by Crane (1937, p. 54) in reporting two Gulf of California specimens obtained by the *Zaca*. Because of the desirability of establishing the several *Eucinetops* species on the firm characters afforded by the male cheliped and male first pleopod, a neotype of the opposite sex to Stimpson's type was selected.

The locality from which it was obtained, an extensive reef one mile northeast of Cabeza Ballena, is not more than four miles from Cape San Lucas, the type locality, and would have been accessible to John Xantus, the collector, afoot or on horseback.

***Eucinetops rubellula* Rathbun**

Plate A, Figs. 1-6; Plate B, Fig. 6

Eucinetops lucasii Stimpson, 1860b, p. 192, male, pl. 2, fig. 3; not *E. lucasii* female.

Eucinetops rubellula Rathbun, 1923a, p. 73; 1925, p. 86, pl. 219, fig. 6.

Type: Male holotype, length 8 mm, width 6.2 mm, not extant. Male neotype, U. S. N. M. No. 74440, from Mazatlán, Sinaloa, Mexico, February, 1930, H. N. Lowe, collector.

Type locality: Cape St. [San] Lucas, Lower California, Mexico; John Xantus, collector.

Diagnosis: Rostral horns small, rounded, widely and deeply separated. Eyestalks long, moderately slender, and overreaching short, subacute postorbital spines by more than half their length. First movable antennal article narrow, strongly produced externally. Fingers of adult male meeting without gape. Male first pleopod with minute, rounded lateral projection. Carapace posteriorly margined.

Description: Carapace subrectangular, almost devoid of tubercles, branchial and intestinal regions broadly rounded, gastric and cardiac regions elevated and surmounted with hooked hairs. Rostrum short, horns divergent, outer edges subparallel, tips rounded, separated by a U as broad as one of the horns, each with a longitudinal row of hooked hairs above and a transverse row of straight hairs beneath. Eyestalks long, slender, little constricted medially, overreaching the acute, spine-tipped postocular tooth by more than half their length. Cardiac and gastric regions raised, nontuberculate, and delimited from the adjacent branchial and hepatic regions and from each other by shallow depressions, giving the carapace an uneven appearance. Hepatic regions tumid. Intestinal region projecting strongly backwards, entire posterior edge of carapace conspicuously margined. Three or four small, sharp tubercles in a longitudinal line at each lateral branchial angle, a row of hooked hairs, some arising from granulous bases, continuing forward onto the hepatic region. A prominent cluster of hooked hairs on each epigastric and epibranchial region. Basal antennal article broad, a minute spine

externally; first movable segment narrow at base, widening distally into a remarkable external flange extending almost as far anteriorly as the end of the similarly broadened second free segment, outer margin hairy. (Plate A, fig. 4) Ischium of third maxilliped narrowly rectangular, inner margin spinulose and hairy; merus equilaterally triangular, deeply notched inwardly for the reception of the palpus, externally broadly produced, a line of hairs parallel to its anterior margin.

Male chelipeds inflated; merus cylindrical, narrowing towards distal extremity; carpus with a faintly suggested crest; manus smooth, compressed, and crested, an external row of hairs just below crest and sparse single hairs elsewhere, tapering distally, digital portion occupying only about one-third of total length; fingers slender, pointed, meeting without gape, tips crossing, pollex with a sinuous cutting edge, dactylus without a tooth, a few clusters of hairs on inner surfaces.

Walking legs short, stout, nongranulate, hairy, with clusters of hooked hairs on anterior margins of merus and carpus of all but the last; length of legs decreasing regularly and gradually from first to last; dactylus of first leg almost as long, of fourth leg fully as long as its propodus, dactyli curved, tips horny.

Male abdomen with seven free segments, broadest at base of third, narrowest at base of sixth, broadening slightly at middle of sixth segment, then narrowing to the triangular tip. Male first pleopod with tip pointed, a minute, rounded lateral projection.

The female of the species is unknown.

Measurements: Male neotype: length 5.0 mm, width 3.9 mm, rostrum 0.5 mm, eyestalks 1.1 mm, cheliped 5.0 mm, chela 2.0 mm, dactyl 0.8 mm.

Remarks: Considering that Stimpson's figure belies his description as to narrowness, the specimen characterized above and proposed as neotype of *Eucinetops rubellula* may be regarded as fulfilling his description of the male of *E. lucasi* (which became the type of Rathbun's species) in all particulars except the rostral horns, which are rounded, rather than acutely pointed. Being larger (8 mm as against 5 mm), Stimpson's specimen was undoubtedly more mature, and so presented to better advantage the larger cheliped with its more compressed and crested manus. The red patch on the dactyls of the ambulatory legs is wanting, and in the opinion of this writer should not have been considered diagnostic, for Stimpson's specimen, if extant, would no longer

be expected to show it, considering the rapidity with which color fades in alcohol.

It is to be hoped that a larger male specimen of *Eucinetops rubellula* will soon be found, and that the female of the species will be made known in subsequent explorations. The selection of a neotype from a locality other than the type locality is not a recommended procedure. However, both Mazatlán and Cape San Lucas lie in the same latitude, although on opposite sides of the Gulf of California.

***Eucinetops panamensis* Rathbun**

Plate A, Fig. 8; Plate B, Fig. 5; Plate 3, Fig. 2

Eucinetops panamensis Rathbun, 1923a, p. 73; 1923b, p. 633; 1925, p. 87, pl. 23, figs. 3, 4, text-figs. 22, 23. Steinbeck and Ricketts, 1941, p. 466. Crane, 1947, p. 71. Garth, 1948, p. 22.

Type: Holotype male, length 10.5 mm, width 8.5 mm, M.C.Z. No. 2040.

Type locality: Pearl [Perlas] Islands, Bay of Panama; S. W. Garman, collector.

Localities subsequently reported, with collectors: Mexico: Gulf of California: San Francisquito Bay, *Albatross* (Rathbun, 1925); San Carlos Bay (Steinbeck and Ricketts); Costa Rica: Port Parker, Piedra Blanca, Uvita, *Zaca* (Crane); Bay of Panama: [Bahía] Honda, *Zaca* (Crane).

Atlantic analogue: *Eucinetops blakiana* Rathbun.

Diagnosis: Rostral horns short, broad, joined basally for two-thirds of their length, each tipped with a spine. Postorbital spines triangular. Eystalks of moderate length, only corneas extending beyond postorbital spines. First movable segment of antenna broad as long, and broad as adjacent rostral spine. Carapace tuberculate, branchial and hepatic row of tubercles defining lateral margins. Male first pleopod with a spinous thumb process.

Description: Carapace high on the median line and strongly tuberculate there; three large tubercles covering the cardiac region and a smooth oblong tubercle forming a bridge to the gastric region; a large, median intestinal tubercle. Branchial regions also tuberculate. Lateral angle marked by a small but strong spine; anterolateral margin nearly straight, tuberculate, interrupted slightly between the hepatic and branchial regions. Rostrum one-third as wide as the fronto-orbital distance, divided less than half way into two shallow triangular teeth, each tipped with a small sharp curved spine. Postocular tooth large.

triangular, almost equilateral, obliquely upturned. Eyes exceeding postocular tooth by little more than length of cornea; stalks not tapering. First movable segment of antenna very large, as wide as half the rostrum, furnished on its anteroexternal margin with a row of long hairs.

Chelipeds shorter than next leg, chelae tapering distally, fingers narrowly gaping in proximal half. Ambulatory legs hairy; dactyl strongly curved, terminating in long, pale, horny spines. (Rathbun, 1925, modified)

Material examined: 9 specimens from 7 Hancock stations. (See Table 4) From the south shore of Tiburon Island, Gulf of California, Mexico, to La Libertad, Ecuador. Also one male from *Askoy* station 2, Perlas Islands (Garth, 1948, p. 22), and one male paratype from Perlas Islands, S. W. Garman (U.S.N.M. 55120).

Measurements: Largest specimen, a male: length 12.6 mm, width 9.9 mm, rostrum 2.2 mm, cheliped 11.5 mm, chela 5.4 mm, dactyl 2.5 mm, ambulatory legs 12, 11, 9, and 7 mm, respectively. Female: length 7.1 mm, width 5.4 mm.

Color in life: Carapace and ambulatories forest green above; manus mottled forest green and greenish-yellow; dactyls white; under parts of body entirely bluish-white striped transversely with broken lines of purplish-blue; underside of ambulatories forest green; eggs orange. (Crane)

Habitat: Usually in tidepools, rarely under low-tide stones. Bits of weed and sand grains attached to carapace and chelipeds of 16 specimens found in a single small patch of fine green algae. (Crane) Hancock specimens were all collected between tide levels and almost all are covered with a minute, filamentous alga.

Depth: Shore.

Size and sex: Specimens range in size from young of 2.5 mm to the 12.6 mm male measured above, which is the largest specimen on record. A 6.3 mm female carries ova.

Breeding: Crane reports eggs from Costa Rica in February and March. *Velero III* collectors obtained a single ovigerous female from Colombia in January, 1935.

Remarks: Hancock expeditions specimens from Pond and Tiburon Islands in the Gulf of California confirm the *Albatross* record from San Francisquito Bay, Gulf coast of Lower California. This is not out of keeping with what is known of distribution of tropical Pacific species, since the Panamic fauna extends well within the Gulf of California. However, the contemporaneous existence there of *Eucinetoys panamensis*

with *E. lucasi* and *E. rubellula*, one or both of which must be considered endemic, is remarkable. None of the three seems overly abundant; in fact, *E. rubellula* is exceedingly rare.

The male first pleopod (Plate B, fig. 5) is distinctive, having a blunt thumb process, liberally studded with short spines, opposed to the finger-like terminal projection.

The range of the species is extended as a result of *Velero III* exploration from the Perlas Islands of Panama to Punta Santa Elena, Ecuador, the village of La Libertad being situated on Santa Elena Bay.

Genus EUPROGNATHA Stimpson

Euprognatha Stimpson, 1871b, p. 122. A. Milne Edwards, 1878, p. 182. Miers, 1879c, p. 645. Rathbun, 1901, p. 57; 1925, p. 95.

Type: The Atlantic *Euprognatha rastellifera* Stimpson, 1871, by monotypy.

Description: Carapace pyriform. Rostrum short, bifid, horns minute and divergent. Interantennular spine present, either salient and pointing forward and downward at a much lower level than rostrum, or rudimentary. Basal antennal article narrowly triangular, with an outer and an inner granulate or dentate crest; armed at anterior extremity with a slender spine reaching forward as far or nearly as far as do the rostral horns; movable part of antenna exposed from its insertion. A spine or tubercle on orbital arch. Eye peduncle short, with a tubercle at the emargination of cornea. Postocular spine reaching beyond extremity of eye. Merus of external maxillipeds somewhat L-shaped, strongly produced beyond insertion of palpus in front and at posterointernal angle. Abdomen of male with last two segments coalesced.

Chelipeds with palms dilated; fingers in the male slightly gaping. Ambulatory legs of first pair much the longest, the others decreasing regularly in length. Dactyli long and slender, more than half the length of propodal [segments]. These crabs almost naked, the ambulatory legs with a few curled setae above. (Rathbun, modified)

In conformity with Balss (1929), the presence or absence of an interantennular spine is here considered a generic character. Unquestionably the spine is present in *Euprognatha*, of which *E. rastellifera* is the type. Rathbun's subsequent modification (1901, 1925) of the original description to admit a species described as without an interantennular spine is therefore inadmissible, and *E. bifida*, if actually lacking this character as Rathbun believed, could scarcely find lodgment in Stimp-

son's genus. Examination of *E. bifida*, however, reveals the presence of the interantennular spine, although in much reduced form. The second and third sentences in the first paragraph above represent a return to the original description in this particular, while allowing equally well for Rathbun's Pacific species. Keys, diagnoses, and descriptions of species have been modified accordingly.

Range: From San Benito Islands, Lower California, and Tepoca Bay, Gulf of California, Mexico, to Cape San Francisco, Ecuador. Socorro, Clarion, Cocos, and Galapagos Islands. 1-150 fathoms. Occurs also in the Atlantic, from off Nantucket Island, Massachusetts, to Grenada and Barbados in the West Indies.

KEY TO THE PACIFIC AMERICAN SPECIES OF *Euprognatha*

- 1a. Interantennular spine rudimentary, antennal spines equally advanced with front. Postocular tooth slender. Two spines at intestinal level. Chelipeds of adult male little more than twice the length of carapace. Lateral projection of male first pleopod a semicylindrical lobe *bifida*
- 1b. Interantennular spine salient, antennal spines exceeding front. Postocular tooth a broad lobe. One spine at intestinal level. Chelipeds of adult male almost four times carapace length. Lateral projection of male first pleopod a low arcuate flap *granulata*

Euprognatha bifida Rathbun

Plate B, Fig. 8; Plate 3, Fig. 3

Euprognatha bifida Rathbun, 1893b, p. 231; 1923b, p. 633; 1925, p. 103, pl. 34, figs. 5, 6. Crane, 1937, p. 55. Garth, 1948, p. 22.

Batrachonotus nicholsi Rathbun, 1894, p. 55; type locality, Gulf of California; female holotype, U.S.N.M. No. 18107; 1898, p. 570; 1925, p. 127, pl. 39, figs. 5-8.

Type: Male holotype, U.S.N.M. No. 17335, length 9 mm, width 7 mm.

Type locality: Off San Josef [José] Island, Gulf of California, Mexico, 33 fathoms, *Albatross* station 3001.

Localities subsequently recorded, with collectors: Mexico: Lower California: Off Cedros Island, 33 meters, Scripps Institution (Rathbun, 1925); middle of east side of Cedros Island, *Albatross* (Rathbun, 1923b); off Abreojos Point, 48 fathoms, Magdalena Bay, 12 and 15

fathoms, and off Cape San Lucas, 31 fathoms, *Albatross* (Rathbun, 1925); Magdalena Bay, shore, *Zaca* (Crane); Gulf of California: northwest of Cape Tepopa, 45 fathoms, type locality of *Batrachonotus nicholsi*, also 145 fathoms, and southeast of Tiburon Island, 29 fathoms, *Albatross* (Rathbun, 1925); Santa Inez Bay, 30-35 fathoms, Arena Bank, 33-45 fathoms, Gorda Banks, 40-45 fathoms, and San Lucas Bay, 2-20 fathoms, *Zaca* (Crane); Panama: Piñas Bay, 14-33 meters, *Askoy* (Garth); Colombia: Utria Bay [Port Utria], 12-22 meters, *Askoy* (Garth).

Atlantic analogue: Euprognatha rastellifera Stimpson.

Diagnosis: Interantennular spine obsolescent, antennal spines equally advanced with front. Postocular tooth slender, spine-tipped. Two spines horizontally placed at intestinal level in males, often reduced to bead granules in females. Chelipeds of adult male little more than two times length of carapace. Male first pleopod with a semicylindrical lobe protecting orifice.

Description: Carapace conspicuously and coarsely granulate; a spine on gastric, cardiac, and branchial regions and on first segment of abdomen; two spines on intestinal region. Postocular tooth with slender tip. Frontal teeth small, triangular, subacute. Antennal spines slender, directed obliquely forward, equally advanced with the front; a shallow, subtriangular, interantennular plate [with a reduced] spine. A short spine on orbital arch. Lateral margins spinous; one hepatic spine, two prominent branchial spines, and one spine on pterygostomian ridge, visible in dorsal view just behind the hepatic region.

An oblique arched lamina at each end of epistome. Sternum of male and abdomen of female coarsely granulate; in both a granulate raised A-shaped ridge at anterior end of sternum.

Legs covered with spiniform granules, larger on margins of chelipeds. Palm inflated; fingers moderately gaping in proximal three-fourths. First pair of ambulatory legs a little more than twice as long as carapace. (Rathbun, 1925, modified)

Material examined: A total of 1,145 specimens from 117 stations. (See Table 5) From San Benito Islands, Lower California, and Tepoca Bay, Gulf of California, Mexico, to Cape San Francisco, Ecuador. Socorro, Clarion, and Cocos Islands.

Measurements: Largest specimen, a male: length 12.4 mm, width 11.0 mm, rostrum 1.0 mm, cheliped 17.7 mm, chela 7.3 mm, dactyl 3.8 mm, ambulatory legs 24, 17, 14.5, and 11 mm, respectively. Female: length 7.8 mm, width 6.1 mm.

Color in life: Pale gray. (Crane)

Habitat: Analysis of the bottom types from which *Euprognatha bifida* was dredged shows a primary breakdown into sand 58 per cent, mud 20 per cent, coral and coralline 14 per cent, and rock 8 per cent. A secondary breakdown of the sand bottoms shows shell present 22 per cent of the time. Mud and rock were accompanied by sand more frequently than not. This compares well with Crane (1937, p. 55), who reported it usually on sandy bottoms, or on bottoms of sand and crushed shell.

Depth: Hancock expeditions specimens were obtained in from 1 to 90 fathoms. All 14 occurrences in depths of over 50 fathoms were in the Gulf of California or at Clarion Island.

Size and sex: Only the 1949 *Velero IV* cruise material has been subjected to measurement, and among these none was found as long as the 15.3 mm male recorded by Rathbun (1925). Males range in size from 2.8 mm to 9.6 mm, females from 4.8 mm to 9.1 mm, the smallest as well as the largest being ovigerous.

Breeding: Females with ova have been taken off Lower California from March through May, in the Gulf of California from January through April, off Mexico south of Cape Corrientes in March and in May, off Costa Rica and Panama in February, and off Colombia in January. 19 of 21 female specimens from one Costa Rican station were ovigerous.

Remarks: While visiting the U. S. National Museum in 1940 the writer compared Hancock expeditions specimens from *Velero III* station 699-37, Gulf of California, with the holotype male of *Euprognatha bifida* (U.S.N.M. No. 17335) and with the photographed specimen of *Batrachonotus nicholsi* (U.S.N.M. No. 21869), a female. (The types of the latter species, also females (U.S.N.M. No. 18107), are small, dry specimens, and do not lend themselves well to study.) The photographed specimen was found to be a spine-for-spine duplicate of the holotype of *E. bifida*, while the types of *Batrachonotus nicholsi* are believed to represent merely a tuberculate form of *Euprognatha bifida* which occurs frequently in female and young male specimens. In this form the tubercles of the carapace are larger and more beadlike, fewer in number, and disposed on the elevations only, the intervening sulci being smooth and bare. The cardiac prominence resembles a berry. The paired intestinal spines are reduced to bead granules, as are most of the other carapace spines, including the gastric, branchial, and supraorbital. Of the remaining series of specimens referred by Rathbun (1925, p. 128)

to *Batrachonotus nicholsi*, only the male bearing U.S.N.M. No. 21872 appears to be a counterpart of this form of female; but even here the granules are beginning to be elevated on slender stalks. The remaining specimens, most of which are females, have the long carapace spines and the attenuated postorbital spines characteristic of *Euprognatha bifida*.

A special word is in order regarding extensive Hancock expeditions material from the Gulf of California, since it is critical with respect to the status of *Batrachonotus nicholsi*. It is only in the northern part of the Gulf, which is the type locality for *B. nicholsi*, that one commonly finds females of this form associated with males of the *Euprognatha bifida* type. In the southern part of the Gulf, as at Cabeza Ballena, all but one or two of the largest males as well as all females of a series of 19 individuals are of the *Batrachonotus nicholsi* type as well, while a series of 19 specimens from an intermediate locality, Ildefonso Island, are typical *Euprognatha bifida* in both sexes. Material from San Esteban Island, station 562-36, shows a progression from typical *Batrachonotus nicholsi* females with the granulate intestinal region to males having first a single, then a cleft spine, and finally, the double intestinal spines of typical *Euprognatha bifida*. One might with justification paraphrase the paragraphs on *Variations* given by Rathbun (1925, p. 97) with reference to the Atlantic species, *Euprognatha rastellifera*, substituting for *E. rastelliferae marthae* the tuberculate form erroneously designated as *Batrachonotus nicholsi*, and for *E. rastellifera acuta* the typical *E. bifida*. As with the Atlantic species, however, emphasis should be placed on the concluding sentence: "None of these forms is entirely restricted to its own range, they overlap one another, and two forms may occur in the same haul."

Although the exhaustive series of *Euprognatha bifida* obtained by Hancock expeditions shows variations equaling the imposing array of material marshalled by Rathbun (1925, pp. 98-101) under *E. rastellifera*, it is not proposed to burden the Pacific species with a like number of subspecific names. The types already selected are not extreme, for neither is typical *Euprognatha bifida* as spinulose, nor is typical *Batrachonotus nicholsi* as tuberculate as specimens which may be found. Furthermore, both type localities lie within the Gulf of California, whereas the species ranges from Lower California to Ecuador. Could one form, the spinulose, for example, be said to predominate in the north and the other, the tuberculate, in the south, occasion might be taken to retain *nicholsi* as a subspecies. However, since both forms occur throughout the range, it seems preferable to synonymize *B. nicholsi*

completely. The male first pleopods (Plate B, fig. 8), which intergrade perfectly, tend to support this view.

***Euprognatha granulata* Faxon**

Plate B, Fig. 9; Plate 5, Fig. 1

Euprognatha granulata Faxon, 1893, p. 149; 1895, p. 6, pl. 1, figs. 1, 1a. Rathbun, 1925, p. 104, pl. 35, figs. 5, 6. Garth, 1946, p. 372, pl. 53, figs. 1-6.

Type: Two female cotypes, M.C.Z. No. 4477; cotype length 7 mm, width 6 mm.

Type locality: Near Cocos Island, Costa Rica, 52 fathoms, *Albatross* station 3369.

Localities subsequently reported, with collectors: Ecuador: Galapagos Islands, 20-150 fathoms, *Velero III* (Garth).

Atlantic analogue: None.

Diagnosis: Interantennular spine salient, antennal spines exceeding rostral in length. Postocular tooth a broad lobe, anteriorly lacinate, ventrally concave. A single median intestinal spine. Chelipeds of adult male almost four times length of carapace. Orifice of male first pleopod protected by a low, arcuate flap or fold.

Description: Carapace coarsely granulate; two erect blunt spines in median line of carapace, one on the gastric, the other on the cardiac area; a transverse row of four or five small tubercles in front of the gastric spine; a spine near the middle of each branchial area, with a smaller lateral spine below and a little in advance of it; the hepatic area bearing a short, blunt spine on its most prominent part; three or four prominent tubercles on the angle dividing the hepatic and pterygostomian regions. Antennary spine very long, reaching beyond the rostral horns; the three horns of the rostrum (interantennular and lateral) about equal in length; supraorbital spines well developed, and, like the antennary and three rostral spines, conspicuously granulated. Postorbital spines even more coarsely tuberculated, their margins appearing lacinated when viewed from above. Surface of abdomen thickly set with beadlike tubercles; the first segment bearing a prominent granulated spine, a rudimentary spine on each of the three following segments. Chela slender, covered with small tubercles; the remaining segments of the cheliped and the ambulatory appendages furnished with small spines, tubercles, and scattered curled setae. (Faxon, 1893, modified)

The male differs from Faxon's description of the female (above) in the following particulars: Ratio of length to breadth of carapace

greater, the male measuring 10 mm by 7.7 mm, the female 7 mm by 6 mm. Chelipeds elongated to almost four times the length of the carapace, the chela occupying over half this length. Ambulatory legs correspondingly attenuated and decreasing regularly in length from first to last. A third median spine present on the intestinal region in addition to the gastric and cardiac spines. Pterygostomial region clearly visible in dorsal view between postorbital lobe and hepatic spine. Under side of postorbital lobe concave. Outer maxilliped with a triangular merus sharply produced at anterointernal angle, broadened toward anteroexternal angle, and but weakly grooved for insertion of the thickened and compressed palpus. Abdomen widest opposite third segment and narrowest at union of fifth and sixth, the last two segments being fused. A well-developed spine present on the first segment, and rudimentary spines on the following two, rather than three, segments. (Garth, 1946)

The lobe protecting the orifice of the male first pleopod is low and resembles an arc cut from a much larger disc. (Plate B, fig. 9)

Material examined: For a complete listing of 104 specimens from 15 Galapagos stations see Garth (1946, p. 373).

Measurements: Largest specimen, a male: length 10.0 mm, width 7.7 mm, rostrum 1.5 mm, cheliped 38.0 mm, chela 19.7 mm, dactyl 4.2 mm, ambulatory legs 21.8, 15.2, 13.3, and 11.8 mm, respectively.

Color in life: See Garth (*loc. cit.*).

Habitat: Sand bottom, often associated with shell, mud, nullipore, and coral.

Depth: 20-150 fathoms.

Breeding: Oviparous females were found at Tagus Cove, Albemarle Island, Galapagos, in December, and northeast of Charles Island, Galapagos, in February.

Remarks: Although dredging was accomplished by the *Velero III* in 1938 off Nuez Island, a satellite of Cocos Island, in 31-50 fathoms, and at Chatham Bay, Cocos Island, in 40-70 fathoms, the type locality failed to yield *Euprognatha granulata* as anticipated. All Hancock expedition specimens of Faxon's ornately decorated species were obtained in the Galapagos Islands and have been previously reported.

Since the published illustrations of the male (Garth, 1946, pl. 53) did not include a figure of the first pleopod, opportunity is taken to rectify the omission in the present report with Plate B, figure 9. The photographed pair are from station 792-38.

Genus COLLODES Stimpson

Microrhynchus Bell, 1835a, p. 88; type: *M. gibbosus* Bell, by subsequent designation of Miers (1879c, p. 651); 1836, p. 40. Dana, 1851b, p. 427.

Neorhynchus A. Milne Edwards, 1879, p. 186 (name substituted for *Microrhynchus*, preoccupied).

Collodes Stimpson, 1860b, p. 193; type: *C. granosus* Stimpson, by monotypy. A. Milne Edwards, 1878, p. 175. Miers, 1879c, p. 645. Alcock, 1895, p. 189. Rathbun, 1901, p. 55; 1925, p. 105.

Dasygyius Rathbun, 1897, p. 164 (name substituted for *Neorhynchus*, preoccupied); 1925, p. 137.

Type: Collodes granosus Stimpson, by monotypy.

Description: Carapace ovate-triangular. Rostrum short, entire, or bifid with the lobes approximated. Eyes of moderate length, retractile against a large, triangular postocular process separated from supraorbital arch by a deep, open, marginal fissure. Basal antennal article narrow, a little curved, anteriorly bidentate, one tooth placed behind the other, movable part long, exposed. Merus of outer maxillipeds obcordate, broad as ischium, deeply incised on distal margin, internal angle prominent, acute. Chelipeds of moderate size. Ambulatory legs short, prehensile, dactyli slender, equal in length to propodi, and retractile against them. Abdomen of male with six, of female with five segments. (Stimpson, as modified by Alcock and by Rathbun)

The present difficulty with respect to the two species originally described by Bell as *Microrhynchus gibbosus* and *M. depressus* arises not so much from the fact that they are not congeneric, as Bell supposed, but that *M. gibbosus*, the species which on rediscovery allies itself with members of the genus *Collodes* Stimpson, rather than *Microrhynchus depressus*, the species that stands alone, was arbitrarily chosen by Miers (1879c, p. 651) as the type of Bell's genus. Such a designation, once made, is as binding on subsequent reviewers as if included in the original description, according to Article 30 of the International Rules of Zoological Nomenclature, paragraphs f and g. Had Miers chosen *M. depressus* as type instead, it might have been possible to preserve the name *Dasygyius* Rathbun as the latest in a series of substitutions for *Microrhynchus* Bell. Under the Rules, therefore, the present writer has no option but to suppress *Dasygyius* Rathbun, 1897, in favor of the earlier *Collodes* Stimpson, 1860, and to erect a new genus to accommodate the otherwise nameless *Microrhynchus depressus*. A petition to the International Commission on Zoological Nomenclature for a suspension of

the Rules in this case was considered, but action was withheld on the advice of Waldo L. Schmitt, with Fenner A. Chace, Jr., concurring.

Range: From Cedros Island, west coast of Lower California, and Cape Tepoca, Gulf of California, Mexico, to Sechura Bay, Peru; occurs also in the Atlantic from Marthas Vineyard, Massachusetts, to Gulf of San Matias, Patagonia, with an interrupted range between Martinique and Cape Frio, Brazil. Shallow water to a depth of 145 fathoms; in the Atlantic to 373 fathoms. The species from India referred to this genus by Alcock (1895, p. 189) is doubtfully congeneric with the American forms.

KEY TO THE PACIFIC AMERICAN SPECIES OF *Collodes*

- 1a. Carapace with median spines, rostrum simple or bifid
 - 2a. Rostrum bifid
 - 3a. Outer margin of basal antennal article denticulate *tenuirostris*, young
 - 3b. Outer margin of basal antennal article granulate or entire
 - 4a. Carapace coarsely granulate *granosus*
 - 4b. Carapace mostly smooth *robsonae*
 - 2b. Rostrum simple *tenuirostris*, adult
- 1b. Carapace without median spines, rostrum bifid
 - 5a. Carapace smooth except for four elevated tubercles forming a diamond near center *tumidus*
 - 5b. Carapace covered with pearly granules *gibbosus*

Collodes gibbosus (Bell), new combination

Plate C, Figs. 1-7; Plate E, Fig. 1; Plate 3, Fig. 4

Microhynchus gibbosus Bell, 1835a, p. 88; 1836, p. 41, pl. 8, figs. 1, 1a-c. Miers, 1879c, p. 651.

Neorhynchus gibbosus A. Milne Edwards, 1879, p. 187.

Dasygyius gibbosus Rathbun, 1910, p. 571; 1925, p. 138, pl. 274, figs. 1-4. Boone, 1927, p. 134, fig. 36. Garth, 1946, p. 375; 1948, p. 23.

Type: Male holotype, length 12.7 mm (not 15.2 mm if 1 line = 2.12 mm), width 10.6 mm, originally deposited in the Museum of the Zoological Society of London, but no longer extant, as ascertained by correspondence with the British Museum (Natural History). Female neotype, U.S.N.M. No. 100921, from Salango Island, Ecuador, 12 fathoms, January 18, 1935, *Velero III* station 396-35.

Type locality: The locality cited by Bell, Galapagos Islands, 6 fathoms, sandy mud, H. Cuming, collector, is considered erroneous (See Remarks below). In view of this circumstance, and in keeping with the Copenhagen Decisions in Zoological Nomenclature (1953, p. 27, par. 2), the type locality is hereby corrected to Salango Island, Ecuador, a mainland locality at which Cuming is known to have made collections, and from which the species has been subsequently recovered.

Localities subsequently reported, with collectors: Panama: Piñas Bay, 14-33 meters; Guayabo Chiquito, 24-64 meters; Colombia: Ardita Bay, 34-43 meters; Ecuador: Off Cape Pasado, 18 meters; all specimens collected by the *Askoy* Expedition (Garth, 1948).

Atlantic analogue: None.

Diagnosis: Rostrum minute, bifid. Carapace convex, covered with bead tubercles largest and most distinct on branchial regions. Median spines lacking; a conical tooth on first abdominal segment of male. Postorbital spine large, blunt, smooth, anterior margin straight or convex. Basal antennal article with a granulate ridge. Merus of third maxilliped cordiform. Male first pleopod with five or six longer spines near apex, lip of orifice contoured, not protruding.

Description: Carapace broadly pyriform, gibbous, rounded; regions elevated, and separated by rather deep furrows; surface covered, particularly on each branchial region, with numerous distinct rounded tubercles resembling very minute pearls. Rostrum very small and bifid. Orbits wide, and with a hollow at the outer side for lodgment of eyes when at rest, though not deep enough to conceal them entirely. Small fissure dividing the upper margin of the orbit from the rostrum, and another externally from the tooth of its outer angle. Eyes larger than their peduncles.

External antennae half as long as body, [basal article] as long as rostrum, with a tooth at the outer angle. Internal antennae [antennules] lodged in a single cavity, open in front, bounded above by rostrum, and on each side by the [basal article] of the external antennae. [Maxillipeds] resembling those of *Camposcia* except for the [merus] of the [endognath] being more heart-shaped, and deeply notched for the attachment of the long and greatly developed movable palp.

Abdomen of the male with seven [segments] [this is not borne out by the illustration], each having an elevation in the center: the first, wholly apparent when viewed from above, somewhat quadrate, with a small tubercular tooth in the center; the second very short; the third much broader than the rest, and the remainder abruptly narrower.

First pair of legs [chelipeds] thicker than, but not much more than half as long as, the others; surface granulated; hand rounded, and terminated by arched fingers meeting only at the apex, and denticulated there. The four posterior pairs of legs on the average nearly twice the length of the body, diminishing in the order 3 . 4 . 2 . 5 [or 2 . 3 . 1 . 4, excluding the cheliped]; cylindrical and hairy; nails long, slender, and but slightly arched. (Bell, 1836, modified)

Material examined: 20 specimens from 5 Hancock expedition stations. (See Table 6) From Piñas Bay, Panama, to Salango Island, Ecuador. Also 13 additional specimens from 5 *Askoy* Expedition stations (Garth, 1948, p. 23).

Measurements: Female neotype: length 7.3 mm, width 6.1 mm. *Askoy* Expedition male: length 13.0 mm, width 10.7 mm, cheliped 14.3 mm, chela 6.2 mm, dactyl 3.2 mm, ambulatory legs 23, 26.5, 25, and 21 mm, respectively.

Color in life: Not recorded. Color in alcohol yellowish-white. (Bell)

Habitat: Green sandy mud, gray mud. (Garth)

Depth: Hancock specimens were dredged in from 12 to 20 fathoms. *Askoy* specimens were from 14 to 64 meters.

Breeding: The single ovigerous female was obtained in late January at Piñas Bay, Panama.

Remarks: A female specimen from Salango Island, Ecuador, station 396-35, was taken by the writer to the U. S. National Museum in 1937, where it was decided in consultation with M. J. Rathbun and W. L. Schmitt that it agreed with the description and figures of *Microrhynchus gibbosus* Bell at least as well as did a specimen of *M. depressus* Bell (U.S.N.M. No. 18143) with the description and figures of that species, with due allowance for artistic inaccuracies in both instances. Subsequently, in 1939, specimens from Piñas Bay, Panama, station 439-35, were compared with a young male (U.S.N.M. No. 73441) collected by H. N. Lowe at Acapulco, Mexico, which, although lacking carapace spines, had been determined by Rathbun as *Collodes granosus* Stimpson. It was later discovered that the specimen from station 396-35 and the specimens from station 439-35 were identical and that *Microrhynchus gibbosus*, if correctly identified, was at least congeneric with *Collodes granosus*, if the two were not actually conspecific.

Evidence as to the identity of Hancock expeditions material with *Collodes gibbosus* is here presented in the form of detailed figures of a male specimen from Cape San Francisco, Ecuador, station 216-34 (Plate C, figs. 1-5, 7). Comparison is invited with the original illustrations

(Bell, 1836, pl. 8, figs. 1-1c), or with their reproductions in Rathbun (1925, pl. 274, figs. 1-4), particularly the figures of the male abdomen and chela. It was because of these features that the Cape San Francisco specimen, a male, rather than the Salango Island specimen, a female, was selected for illustration. The female from Salango Island, however, has been selected as the neotype on the advice of L. B. Holthuis, who pointed out the advantage of having as neotype a specimen collected from the type locality as restricted below.

Equally mature and of comparable size are a male specimen from Cape San Francisco, station 850-38 (Plate E, fig. 1; Plate 3, fig. 4), and an *Askoy* Expedition male from Ardita Bay, Colombia (Garth, 1948, p. 23). Measurements of the walking legs given above, but not included in the *Askoy* report, are in the required descending order of length (2 . 3 . 1 . 4), although this character is subject to variation depending on sex, asymmetry and regeneration of appendages.

The absence of *Collodes gibbosus* from the Galapagos fauna and the possible reasons therefore have already been discussed (Garth, 1946, p. 375). Localities at which Cuming, who obtained the specimens on which Bell's studies rest, is also known to have collected include La Plata and Salango Islands in Ecuador, as well as several islands in the Bay of Panama (Carpenter, 1857). Contemporaneous Cumingiana (Merrill, 1926; St. John, 1940) contains enough references to his laxity with respect to written records to justify the assumption of an exchange of labels between Galapagan and mainland specimens in the case of possibly eight out of ten species likewise attributed to the islands but not since found there, if indeed the specimens had written labels to begin with (Cf. Garth, 1946, p. 343). In short, the provenance of most of Bell's west coast species is, and always was, that little known stretch of South American coastline between Cape Mala, Panama, and Punta Santa Elena, Ecuador, now designated as the Panama Bight. The restriction of the type locality of *C. gibbosus* to Salango Island, Ecuador, a particular locus within this larger territory, and the selection of the Salango Island specimen as neotype, give pointed recognition to this fact.

The male specimen collected by H. N. Lowe at Acapulco (U.S.N.M. No. 73441) is believed by the writer, because of its lack of carapace spines, to represent this species rather than *Collodes granosus* Stimpson, as identified by Rathbun. Apart from this possible record, *Collodes gibbosus* has not been taken north of Central America. *C. granosus* Stimpson, on the other hand, occurs from the Gulf of California to

Ecuador. Where the two species occur together, as off San José Light, Guatemala, where they came up in the same dredge haul (station 930-39), they can be separated without difficulty.

Collodes granosus Stimpson

Plate E, Fig. 2; Plate 3, Fig. 5

Collodes granosus Stimpson, 1860b, p. 194, pl. 2, fig. 4. A. Milne Edwards, 1878, p. 177. Miers, 1879c, p. 645. Rathbun, 1898, p. 569; 1923b, p. 633; 1925, p. 106, pl. 36, figs. 1, 2; pl. 217, fig. 1. Garth, 1948, p. 23.

Type: Female holotype, length 9.1 mm, width 8.1 mm, no longer extant, *vide* Rathbun (1925), and believed to have perished with Stimpson's collections in the Chicago fire of 1871. Female neotype: A.H.F. No. 495, from $1\frac{3}{4}$ miles northeast of Cape San Lucas, Lower California, Mexico, 10 fathoms, March 11, 1949, collected by the *Velero IV* at station 1724-49.

Type locality: Cape St. [San] Lucas, Lower California, Mexico, John Xantus, collector.

Localities subsequently reported, with collectors: Mexico: Lower California: Cape San Lucas, *Albatross* (Rathbun, 1923b); Gulf of California: east of La Paz, 10 fathoms, *Albatross* (Rathbun, 1898); Ecuador: off Cape Pasado, 18 and 27 meters, *Askoy* (Garth).

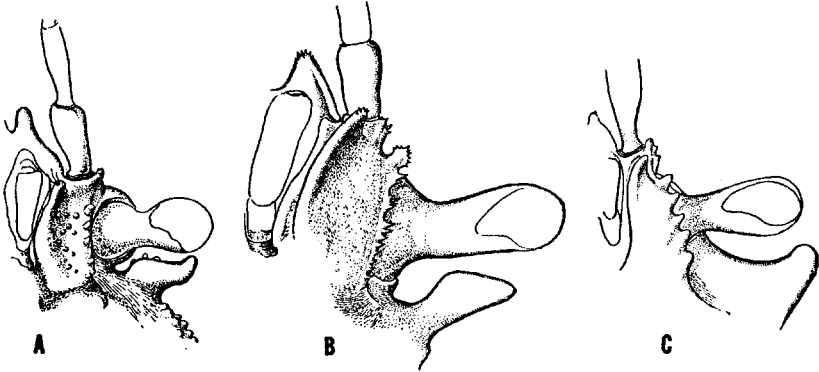
Atlantic analogue: *Collodes trispinosus* Stimpson.

Diagnosis: Rostrum pyramidal, tip bifid. Carapace conspicuously granulated, particularly on branchial regions, depressions smooth and bare. Three median spines, one gastric, one cardiac, and one abdominal. Postorbital spine large, outer margin granulate, inner margin concave, curving around eye. Basal antennal article with external margin coarsely granulate, internal margin entire. Male first pleopod swollen opposite spermiducal pore, a cluster of longer spines near tip.

Description: Carapace nearly naked, conspicuously granulated, especially on the branchial regions; granules rather large and distinctly prominent. An erect obtuse spine on the gastric region, one on the cardiac, and one on the basal [segment] of the abdomen. The anterior half of the cardiac region and the sulci or depressed parts of the carapace generally, smooth and glabrous. Rostrum subtriangular, fissured; tip minutely bifid. A minute tooth on the superior arch of the orbit. Chelipeds [of the female] weak. Ambulatory [legs] rather depressed, ciliated, dactyli hairy. Margin of sternum raised around the

egg cavity, . . . female abdomen strongly indurated, outer surface covered with closely set granules. (Stimpson, modified slightly)

Cheliped of male more robust than that of female; palm high, tapering distally, inner surface granulate, outer surface smooth and bare; fingers slender, gaping in a broad oval for basal three-fifths, touching along crenulate edges for distal two-fifths; propodus noticeably convex, a low molariform tooth in gape on dactylus.



4. Lower orbits of *Collodes* species. A. *C. granosus*, x 12.5. B. *C. tumidus*, x 12.5. *C.C. tenuirostris*, x 1.25. (For *C. gibbosus* see Plate C, fig. 4; for *C. robsonae* see Plate D, fig. 6).

Material examined: A total of 132 specimens from 26 Hancock stations, of which 10 were in the southern part of the Gulf of California, including Isabel Island. (See Table 7) From near Punta Piaxtla, Sinaloa, to Santa Elena Bay, Ecuador, but conspicuously absent from the offshore islands. In addition three *Askoy* specimens from half a degree south of the Equator (Garth, 1948, p. 23).

Measurements: Female neotype: length 9.0 mm, width 7.2 mm. Largest specimen, a male: length 11.8 mm, width 10.1 mm.

Color in life: Carapace white, lightly covered with dull yellowish brown. A violet gray area on gastric region and around [gastric] spine. A violet gray area around large [cardiac] spine. Eye dark blackish purple. Ambulatory legs white. Ventral side pale smoke gray with pure white granules on abdomen. (Petersen, of a female from Secas Islands, Panama)

Habitat: A primary breakdown of bottom types at stations from which this species was obtained by dredging shows sand 50 per cent, mud 22 per cent, coral and coralline 18 per cent, and rock 10 per cent.

A secondary breakdown shows sand present with the mud more often than not, and shell present with rock in two of three instances. *Askoy* specimens were from mud and live shell bottom (Garth, 1948).

Depth: 2-30 fathoms.

Breeding: Ovigerous females were encountered in the Gulf of California in March and April, off Guatemala in March, and off Ecuador in January and February. Nine of twelve females recovered from Ecuadorean waters were gravid, indicating a cycle culminating in late Southern Hemisphere summer.

Size and sex: The largest specimen previously known was the 9.7 mm female recorded by Rathbun (1925). Males from the lot from which the neotype was taken measured from 9.3 to 11.8 mm, females (all ovigerous), from 7.4 to 9.9 mm.

Remarks: The synonymy of *Collodes* Stimpson and *Dasygyius* Rathbun, here proposed, depends on evidence earlier developed that *Collodes granosus*, type species of the former, is congeneric with *Dasygyius gibbosus*, rediscovered type species of the latter genus, for which a neotype has been proposed. Since *Collodes granosus* is likewise without surviving type specimen material, and is involved in the resolution of the same taxonomic problem, it appears consistent with the provisions of the Copenhagen Decisions on Zoological Nomenclature (1953, p. 28, par. 34) that a neotype should be established for that species also. Fortunately, there is available for this purpose in the Hancock collections a female from the type locality, Cape San Lucas (*Velero IV* station 1724-49), that agrees in all particulars with the original description above. It is accordingly designated the neotype of *Collodes granosus* Stimpson.

Collodes tenuirostris Rathbun

Plate E, Fig. 3; Plate 6, Fig. 5

Collodes tenuirostris Rathbun, 1893b, p. 230; 1898, p. 569; 1925, p. 113, pl. 37, text-fig. 35. Crane, 1937, p. 55.

Collodes, doubtful species, Rathbun, 1894, p. 53.

Type: Male holotype, U.S.N.M. No. 17333, length 11.5 mm, width 8 mm.

Type locality: Gulf of California, Mexico, Lat. 30° 16' N, Long. 113° 05' W, 36 fathoms, *Albatross* station 3018. [Off Cape Tepoca]

Localities subsequently reported, with collectors: Mexico: west coast of Lower California: off Abreojos Point, 48 fathoms, and Magdalena

Bay, 51 fathoms, *Albatross* (Rathbun, 1898) ; Gulf of California: northwest of Cape Tepopa, 145 fathoms, *Albatross* (Rathbun, 1925) ; Santa Inez Bay, 33-35 fathoms, *Zaca* (Crane).

Atlantic analogue: Collodes rostratus A. Milne Edwards.

Diagnosis: Rostrum a tuberculate spine arising from a dome-shaped base; a similar abdominal spine posteriorly directed. Carapace heavily and unevenly granulate, especially on branchial regions; one gastric and one cardiac spine or tubercle. Postorbital tooth large, anterior margin straight or slightly concave. Basal antennal article with inner lamina, outer margin coarsely denticulate. Fingers of adult male gaping widely at base. Tip of male first pleopod slender, lateral lobe not prominent.

Description: Carapace slightly pubescent; unevenly granulate with unequal granules, the largest ones on the summit of the branchial regions, which have the greatest number of granules; a few small granules on cardiac and gastric regions; more on the hepatic regions; lateral and posterior margins covered with small granules. Four median capitate spines, one at end of rostrum, one gastric, one cardiac, and one directed obliquely backward and upward on the first abdominal segment. A supraorbital tubercle; a rather broad postorbital lobe directed obliquely forward. Basal antennal segment with a prominent inner lamina ending in a lobe and an outer margin cut into numerous denticles. The male sternum granulate on the cheliped segment near the abdomen and especially on the most protuberant parts; granules few on other segments except close to abdominal cavity. Female abdomen roughened with numerous but separated granules.

Chelipeds slender; outer margin of merus armed with about eight stout spinules, other margins finely spinulose, also the inner margin of the carpus; manus nearly smooth; fingers narrowly gaping in basal half. Legs long-hairy, the hairs retaining large quantities of mud. (Rathbun, 1925)

The diagnosis above applies to mature specimens. The bifid rostrum of the very young persists in some individuals up to 10-12 mm and may be retained as a bituberculate tip to the single spine in even the largest specimens. While the old are very granulate and tuberculate, the young may be almost as smooth of carapace as *Collodes tumidus*. Considerable variation exists with respect to the cardiac spine, which may be upstanding, as in the case of typical *C. granosus*, or reduced to a tubercle. However, the spine on the first abdominal segment is always present and always elongated, and, along with the difference in curvature

of the postorbital tooth, is a character most useful in separating young specimens with a bifurcate rostrum and smooth carapace from *C. tumidus*.

The fingers of the adult male gape more widely at the base than is shown by Rathbun (1925, text-fig. 35a), a circumstance attributable to the larger size of the Hancock specimen, which measures 26.2 mm in length as compared to but 18.8 mm.

Material examined: 92 specimens from 32 Hancock expeditions stations, 20 of which were in the Gulf of California. (See Table 8) From Cedros Island, west coast of Lower California, and Tepoca Bay, Gulf of California, Mexico, to Sechura Bay, Peru.

Measurements: Largest specimen, male: length 26.2 mm, width 21.1 mm, rostrum 2.0 mm, cheliped 37 mm, chela 16 mm, dactyl 8.1 mm, ambulatory legs 56, 50, 44, and 39 mm, respectively. Ovigerous female: length 21.5 mm, width 18.1 mm.

Color in life: Not recorded.

Habitat: Bottom types at 26 stations on which information is available show an overwhelming preference on the part of this species for a sandy substratum, sand being recorded in 65 per cent of the cases, with shell associated in 5 of 17 stations. The remaining 35 per cent were divided as follows: mud 16 per cent, rock 12 per cent, and organic bottom (coral and coralline) 8 per cent. Crane (1937) reported mud and crushed shell bottom.

Depth: Hancock expeditions specimens were obtained in from 3-90 fathoms. This is less than the extreme depth of 145 fathoms recorded by Rathbun (1925, table, p. 111).

Breeding: Ovigerous females were encountered in the Gulf of California in January, February, and March, and from the west coast of Lower California in March and April, but were not recovered from any of the more southerly stations.

Remarks: On the basis of the considerations mentioned in the supplementary descriptive note above, Hancock expeditions specimens from Panama, Colombia, and Ecuador, earlier catalogued as *Collodes tumidus*, were clearly demonstrated to be *C. tenuirostris* instead. Of considerable interest from the standpoint of geographical distribution is the fact that *C. tenuirostris*, possessing an Atlantic analogue in *C. rostratus*, is the species which might have been expected to occur in the Bay of Panama.

The range of the species is extended northward to Cedros Island, west coast of Lower California, and southward to Sechura Bay, Peru.

Collodes tumidus Rathbun

Plate E, Fig. 4; Plate 3, Fig. 6

Collodes tumidus Rathbun, 1898, p. 569, pl. 41, fig. 1; 1923b, p. 633; 1925, p. 121, pl. 40, figs. 1, 2; pl. 218, fig. 5; text-fig. 47. Crane, 1937, p. 56.

Type: Male holotype, U.S.N.M. No. 21571, length 11.6 mm, width 9.5 mm.

Type locality: Magdalena Bay, Lower California, Mexico, 12 fathoms, *Albatross* station 2831.

Localities subsequently reported, with collectors: Mexico: Lower California: middle of east side of Cedros Island, *Albatross* (Rathbun, 1923b); Gulf of California: east of La Paz, 10 fathoms, *Albatross* (Rathbun, 1898); Arena Bank, 35 fathoms, *Zaca* (Crane).

Atlantic analogue: *Collodes inermis* A. Milne Edwards.

Diagnosis: Rostrum minute, bifid. Carapace smooth and bare except for scattered granules posteriorly and laterally and hooked hairs on gastric and branchial areas. Four setose tubercles forming a diamond, one gastric, one cardiac, and two inner branchial. Postorbital tooth large, anterior margin convex and spinulose. Basal antennal article with outer lobe and marginal teeth spinulose. Tip of male first pleopod thickened, lateral lobe exerted.

Description: Carapace granulate along the posterior and lateral margins, the granules large on the hepatic regions and reaching forward a little on the branchial and cardiac regions; a few granules also between the orbits. Four tubercles near the middle of the carapace at the most elevated portions, one gastric, one cardiac, the other two at the inner angles of the branchial regions. Otherwise the central part of the carapace smooth. Front bidentate, the teeth triangular, blunt, and separated by a space subequal to either tooth. Postorbital tooth slightly curved, convex forward, shorter than the eye. Basal antennal article broad, inner or lower edge entire, outer edge unevenly dentate, upper and lower terminal lobes equally advanced. Male sternum and elevations of first three abdominal segments finely granulate; otherwise the abdomen in both sexes nearly smooth.

Chelipeds of adult male slightly enlarged. Palm narrowing perceptibly near the distal end. Fingers gaping to near the tips, dactylus with an enlarged tooth near the base, fixed finger with a similar tooth marking the proximal third. Ambulatory legs rather stout. (Rathbun, 1925)

Material examined: 35 specimens from 14 Hancock expeditions stations, all but two in the Gulf of California. (See Table 9) From Puerto Refugio, Angel de la Guarda Island, to 1¼ miles southwest of Cabeza Ballena, Gulf of California; Magdalena Bay, west coast of Lower California, Mexico.

Measurements: Largest specimen, a male: length 13.3 mm, width 10.5 mm, rostrum 1.0 mm, cheliped 14.7 mm, chela 6.5 mm, dactyl 3.9 mm, ambulatory legs 23, 21.5, 20, and 18 mm, respectively. Female: length 10.8 mm, width 8.8 mm.

Color in life: Not recorded.

Habitat: Data regarding bottom type are available for 10 stations, of which 7, or 70 per cent, were sand or sand with shell. Crane (1937, p. 56) reports coarse sand with weed.

Depth: Hancock expedition specimens were from 11-70 fathoms, extending the previously known range of from 12-35 fathoms.

Breeding: The three ovigerous female specimens were all taken in March, no later collecting in the Gulf of California having been attempted.

Remarks: Although this species has been known almost since the time of its discovery to occur on the west coast of Lower California at Cedros Island as well as at Magdalena Bay, it was not encountered by Hancock expeditions outside of the Gulf of California until 1949, when specimens were obtained from the type locality. Previous to this date all small inachine crabs of smooth carapace dredged on the Pacific side of the peninsula were either the single-rostral spined *Inachoides laevis* or the double-spined young of *Collodes tenuirostris*. The latter was separated from *C. tumidus* by the characters mentioned under supplementary descriptive notes for that species. The Hancock Foundation series of *C. tumidus* is not as large as might be desired and contains no male more mature than the specimen figured by Rathbun (1925, text-fig. 47), so that it is impossible to say whether or not the chela illustrated represents the maximum development attained by this species.

***Collodes robsonae*, new species**

Plate D, Figs. 1-6; Plate 4, Fig. 1

Type: Female holotype, A.H.F. No. 397, from Venado, Canal Zone, April 5, 1939, collected by students of Elinor D. Robson of Balboa, Canal Zone.

Measurements: Female holotype: length 29.6 mm, width 22.9 mm, rostrum 1.7 mm, width 2.2 mm, cheliped 28.5 mm, chela 11.0 mm, dactyl 6.8 mm, ambulatory legs 48, 51, 48, and 40 mm, respectively.

Diagnosis: Rostrum small, tip bifid. Carapace hairy but non-granulate; two median spines, one gastric, one cardiac. Postorbital tooth broad at base, anterior margin concave. Basal antennal article with inner margin produced as a thin blade. Legs stout, smooth, margins hairy.

Description: Carapace subpyriform, convex, regions separated by pilose depressions, nongranulate, but with minute punctae forming linear striations on branchial and intestinal portions. Rostrum small, horizontal, sides converging gradually to bidentate tip, teeth minutely denticulate, intervening sinus U-shaped, a granular swelling at base between anterior margins of orbit. Postorbital tooth broad at base, anterior margin proximally convex, then sharply concave opposite cornea of eye, tooth set off from base of eyestalk by a deep and narrow fissure. Gastric and cardiac areas smooth and glabrous, each surmounted by an erect spine, that of cardiac region longer by one third, a horizontal row of hairs across anterior gastric region. Hepatic regions small, crowded forward and downward by large branchial regions, one or two granules at apex of each. Branchial regions, though swollen, not protruding beyond general outline of carapace and set off from genital area by deeply pitted grooves. Inner metabranchial areas sculptured with a fine-lined pattern of pits and grooves. Intestinal region not produced posteriorly, bearing two minute granules side by side. A raised, thickened postero-lateral marginal ridge.

Basal antennal article smooth, produced inwardly and downwardly as a flange with an entire margin culminating in an anterior tooth extending forward nearly as far as the tip of the rostrum, external margin also culminating in a tooth, a few granules at midpoint opposite base of eyestalks. Antennal flagella long, between one-third and one-half carapace length. Merus of external maxilliped cordiform, deeply notched to receive three-segmented palp, which is coarse and hairy. A double row of granules on each pterygostomial region.

Cheliped of female feeble, hand slender, fingers meeting without gape. Walking legs exceptionally robust, dorsal surfaces smooth and porcellanous, anterior and posterior margins fringed with long, silken hairs. Dactyli equaling or exceeding propodi in length, curving but slightly except at extreme tips.

Female abdomen without a spine but with a suggestion of a low tubercle on first segment, middle portion of second and each succeeding segment raised, only this center portion retaining indications of metameres in the fused terminal portion, comprising somites 5-7.

Remarks: This species finds its closest affinities with *Collodes tumidus*, with which it shares the nongranulate carapace and bifid rostrum. However, it is much larger than any specimen of *C. tumidus* to come to our attention, being in fact larger than the largest *C. tenuirostris* from the Gulf of California. Of greater importance, it lacks several of the diagnostic characters of *C. tumidus*, notably the inner branchial tubercles which, with the gastric and cardiac tubercles (not spines), form a diamond on the dorsum of that species. With respect to the erect gastric and cardiac spines it resembles *C. granosus*, an extremely granulate species. The large postorbital spine with its convex-concave anterior margin and the smooth basal antennal article with its entire margins appear to this writer to justify the erection of a new species on these salient characters, although it would be preferable, for the sake of the pleopod, if a male were available to serve as the holotype.

The proposed new species is named for Elinor D. Robson, by whose students at Ancon High School, Canal Zone, it was collected.

According to James Zetek, resident manager, Canal Zone Biological Area, the name "Venado" applies equally to Venado Beach and to the offshore island with which it is connected at extreme low tide. Both lie inside the Canal Zone western boundary, immediately east of the Panamanian village of Camarón.

Genus PARADASYGIUS, new genus

Type: Microrhynchus depressus Bell.

Description: Carapace depressed, tuberculate. Rostrum short, simple. Postorbital spine large, curving around eye, separated by a slight interruption from inner orbital margin. Eyes large, flattened, retractile. Basal antennal article with an external tooth visible at sides of rostrum, inner margin dentate or entire; antennal flagellum long, hairy. Merus of external maxillipeds narrow at base, cordiform. Epimeral plates prominent. Chelipeds short, merus curved, manus inflated in male, subtriangular to subglobular. Ambulatory legs of second and third pair subequal in length and longer than those of fourth pair; first pair noticeably shorter and conspicuously hairy; hairs adapted to collecting and retaining particles of mud and detritus; meri horizontally compressed; dactyli long, slender, unarmed. Sternum a flattened disc except for a round swelling at base of chelipeds and, in advance of this, a stout spine between maxillipeds.

Male abdomen with six segments; first segment with or without a conical spine; sides of last two segments subparallel; extremity widened and rounded. Female abdomen with five free segments, fused fifth to seventh segment broader than long, flattened, nearly covering sternum.

Contains but two species: *Paradasygyius depressus* (Bell), Pacific, and *P. tuberculatus* (Lemos de Castro), Atlantic.

Range: Eastern Pacific from Ensenada de San Francisco, Sonora, Mexico, to Cape Corrientes, Colombia. Erroneously attributed to the Galapagos Islands. Western Atlantic at Mucuripe, Fortaleza, Ceará, Brazil. 5-80 fathoms.

***Paradasygyius depressus* (Bell), new combination**

Plate E, Fig. 5; Plate 4, Fig. 2

Microrhynchus depressus Bell, 1835a, p. 88; 1836, p. 42, pl. 8, figs. 2, 2d-f.

Neorhynchus depressus A. Milne Edwards, 1879, p. 187. Rathbun, 1894, p. 73.

Dasygyius depressus Rathbun, 1898, p. 570; 1910, p. 571; 1925, p. 138, pl. 1; pl. 274, figs. 5-8. Boone, 1927, p. 135, fig. 37. Crane, 1937, p. 56. Garth, 1946, p. 375; 1948, p. 24.

Dasygius depressus Boone, 1930a, p. 78, pl. 22.

Type: Female holotype, length 12.7 mm, width 12.7 mm, originally in the Museum of the Zoological Society of London, no longer extant, as ascertained by correspondence with the British Museum (Natural History). Male neotype: A.H.F. No. 398, from 10 miles southwest of Secas Islands, Panama, 30 fathoms, March 27, 1939, *Velero III* station 944-39.

Type locality: The locality cited by Bell, Galapagos Islands, 6 fathoms, sandy mud, is considered erroneous (See *Remarks* below, and also under *Collodes gibbosus*). In keeping with the provisions of the Copenhagen Decisions in Zoological Nomenclature (1953, p. 27, par. 2), the type locality is hereby corrected to Bay of Panama, in which Hugh Cuming is known to have made collections.

Localities subsequently recorded, with collectors: Mexico: Gulf of California: La Paz Bay, 21 and 26.5 fathoms, *Albatross* (Rathbun, 1894, 1898); Gorda Banks, Arena Bank, and Santa Inez Bay, 29-60 fathoms, *Zaca* (Crane); Costa Rica: Wafer Bay, Cocos Island, inshore, *Ara* (Boone, 1930a); Panama: Piñas Bay, 14-33 meters, and Guayabo Chiquito, 24-64 meters, *Askoy* (Garth, 1948); Colombia: Ardita Bay, 34-43 meters, Octavia Bay, 24-28 meters, and Utria Bay [Port Utria], 12-22 meters, *Askoy* (Garth, 1948).

Atlantic analogue: Paradasygyius tuberculatus (Lemos de Castro, 1949).

Diagnosis: Carapace depressed, finely granulate, rostrum simple. Chelae of male turgid, dactyl without large basal tooth. Legs long, cylindrical, hairy, first ambulatory shortest. A large conical spine on male first abdominal segment. Male first pleopod thickened, tapering gradually to apex, which is provided with several longer spinules, orifice elongate, lip little projecting.

Description: Carapace depressed, covered with fine granulations with here and there occasional larger ones; a short stout spine near the margin of the branchial region. Epimeral plates well developed and produced in a spine between the second and third, and third and fourth ambulatory legs. Rostrum triangular, tipped with a small, slightly capitate spine. Eyes large, flattened. Basal antennal article with dentate margins, terminating in two teeth, the outer the longer, incurved at tip. Second article (or first movable article) of the antennules exceeding in length the fossa, and in large specimens exceeding the rostrum. Maxillipeds rather widely separated; ischium with a shallow sulcus; merus strongly cordiform, very narrow at base.

Chelipeds of male stout, granulate; margins of merus tuberculate; palm inflated, subglobular; fingers narrowly gaping at base, finely crenulate in the gape, crenate along meeting edges; dactylus with a notch at base. Chelipeds of female weaker than legs, palms not swollen. The ambulatory legs [in the female] diminishing in the order 3, 2, 4, 1, three and two being nearly the same length; granulate and hairy, the first pair conspicuously hairy with a fringe of hair on either side; the hairiness diminishing from the first to the fourth pair, and the granulation diminishing from the proximal to the distal end of each leg; dactyli unarmed.

First segment of abdomen armed with a long, horizontal, conical, acute spine. In the male the sides of the last two segments subparallel, the extremity broadly rounded. In the mature female the last or fused segment much wider than long, almost covering the sternum laterally, the distal margins straight or slightly concave. Sternum of male flat, except in front of the chelipeds; there, in both sexes, a smooth swelling and anterior to that a small spine between the maxillipeds. (Rathbun, 1925, modified)

Material examined: 104 specimens from 33 Hancock expeditions stations, of which 19 were in the Gulf of California. (See Table 10) From Ensenada de San Francisco, mainland side, and outside Concepción

Bay, Lower Californian side of the Gulf of California, to Cape Corrientes, Colombia. An additional 36 specimens from 5 *Askoy* Expedition stations in southern Panama and Colombia.

Measurements: The following figures are given in tabular form for ease in comparing the largest male and largest female in the Hancock collections, the former from *Velero III* station 941-39, the latter from station 936-39: (Measurements in mm)

| | Male | Female |
|--------------------|------|--------|
| Carapace | | |
| Length | 27.7 | 21.6 |
| Width | 27.7 | 21.6 |
| Rostrum | | |
| Length | 2.0 | 1.7 |
| Width | 2.0 | 1.7 |
| Cheliped | 39.5 | 20.9 |
| Chela | 17.6 | 8.0 |
| Dactyl | 9.6 | 4.7 |
| First walking leg | 55 | 30 |
| Second walking leg | 83 | 45 |
| Third walking leg | 80 | 48 |
| Fourth walking leg | 70 | 43 |

It will be noted that the length and breadth of carapace, as well as the length and width of the rostrum, are equal in both sexes. The weakly developed cheliped of the female is readily apparent. The apparent difference in descending order of leg lengths (3 . 2 . 4 . 1 in the female and 2 . 3 . 4 . 1 in the male) is probably unimportant, as both the measured male and the male neotype show asymmetry as regards the relative length of legs 2 and 3.

Color in life: Entire crab pinkish with olive-gray pubescence, except for manus and dactyls of cheliped, which are pure white. Eggs coral-red. (Crane)

Habitat: With data on bottom type available from 30 stations, it was found that mud bottom predominates over sand bottom in the proportion of 60 to 40 per cent. However, sand was also a constituent in over a third of the mud bottom stations. The *Askoy* found the species occurring in gray or green sand or mud (Garth, 1948). *Zaca* expedition specimens were found usually on mud bottoms, occasionally with sand or rock, according to Crane (1937), who refers also to their sluggish habit.

Depth: *Velero III* specimens were obtained in from 5-55 fathoms, exceptionally in 80 fathoms.

Size and sex: Males in the present series range in size from 8.5 to 27.7 mm, the latter being the largest on record, females from 6.2 to 24.8 mm, ovigerous females from 14.0 to 16.3 mm. It should be noted, however, that a 16.4 mm male from the Gulf of California, of a size corresponding to the ovigerous females, which are from the Gulf of California also, has well developed chelae, while specimens of larger size, from the Bay of Panama and Costa Rica, including the male neotype, may retain the slender chelae usually associated with sexual immaturity.

Breeding: As noted above, ovigerous females were encountered only in the Gulf of California. March was the month in which egg-bearing was observed.

Remarks: Although the *Zaca* obtained a larger number of specimens from the Gulf of California, the *Velero III* dredged the species from a greater number of stations and extended the known range north to Ensenada de San Francisco, near Guaymas, Sonora, Mexico. The records of the *Askoy* in southern Panama and Colombia were confirmed and stations in northern Panama and Costa Rica were added. It is assumed that the species will be found to occur between Port Parker, Costa Rica, and the Gulf of California wherever soft mud and fine sand occur.

While the identity of the species has not been in doubt since its recovery by the *Albatross* in the Gulf of California (Rathbun, 1894), its taxonomic status had to await the rediscovery of *Collodes gibbosus*, which Bell also included in his genus *Microrhynchus*, and which Miers, by subsequent designation, made its type. Since the solution of the taxonomic problem involved both species, as well as Stimpson's *Collodes granosus*, and since all are without surviving type material, it appears within the intent of the Copenhagen Decisions in Zoological Nomenclature (1953, p. 28, par. 34) that a neotype should be established for each. The specimen selected as neotype for *Microrhynchus depressus* (see above) is of the opposite sex from the holotype, and while of large size, retains the slender chelipeds of the immature male. With these exceptions, both of which are provided for in the conditions for the establishment of neotypes (*Ibid.*, p. 28, par. 35), the proposed neotype agrees with the description of Rathbun (1925) given above, which is based on the description and figures of Bell (1836).

Evidence that the species does not occur in the Galapagos Islands, to which it was originally attributed, has been set forth previously on

two occasions (Garth, 1946, p. 375; 1948, p. 24). The choice of the Bay of Panama as the newly designated type locality is based upon the known range of the species, plus the fact that Hugh Cuming, who obtained the nonextant holotype, is known to have made collections at Taboga Island and at Saboga Island, Perlas Islands (Carpenter, 1857, p. 179).

Genus **PYROMAIA** Stimpson

Pyromaia Stimpson, 1871b, p. 109. A. Milne Edwards, 1879, p. 197.
Rathbun, 1925, p. 127.

Apiomaia von Martens, 1873, p. 182; name substituted for *Pyromaia*.
Miers, 1879c, p. 651.

Type: The Atlantic *Pyromaia cuspidata* Stimpson, 1871, by monotypy.

Description: Carapace pyriform, convex, rough with tubercles and spines; rostrum simple, well developed; supraorbital spine usually present; postorbital spine large, distant from the ocular cavity, and curved around end of eye, tip directed forward. Basal article of outer antennae long and narrow, tapering anteriorly; movable portion very slender. Epistome a little wider than long. Buccal cavity not completely filled by the outer maxillipeds; ischium with its inner distal portion strongly advanced; merus cordate, with a prominent narrow lobe on the inner side. Chelipeds of moderate length, merus triangulate, manus swollen, fingers long and curving inward. Ambulatory legs very long and slender, cylindrical, decreasing successively in length from first to fourth pair; dactyli long and slightly curved.

Abdomen of male with the last two segments, of female with the last three segments, fused. (Rathbun)

Range: From Tomales Bay, Marin County, California, to Cape Corrientes, Colombia, including the Gulf of California; in the Atlantic from Cape Lookout, North Carolina, through Florida Strait to Yucatan Channel. Shore to 225 fathoms. The single Pacific species is not strictly analogous to either of the Atlantic forms, being intermediate in some respects between them and *Inachoides*.

Pyromaia tuberculata (Lockington)

Pyromaia tuberculata mexicana (Rathbun), new combination
Plate E, Fig. 7; Plate 6, Figs. 1, 2

Inachus tuberculatus Lockington, 1877a, p. 30. Miers, 1886, p. 19, footnote.

Microrhynchus (Inachus) tuberculatus, Lockington, 1877c, p. 64.

?*Inachoides brevirostrum* Lockington, 1877c, p. 75; type locality, Magdalena Bay, Lower California; types not extant. Streets and Kingsley, 1877, p. 105.

Inachoides magdalenensis Rathbun, 1893b, p. 228; type locality, off Santa Margarita Island; male holotype U.S.N.M. No. 17337; 1898, p. 571; 1904, p. 171. Nininger, 1918, p. 39, figs. 11, 12.

Neorhynchus mexicanus Rathbun, 1893b, p. 233; type locality, Gulf of California; male holotype U.S.N.M. No. 17350, length 14.5 mm, width 12 mm.

Dasygyius tuberculatus, Rathbun, 1898, p. 570; 1904, p. 172, pl. 10, figs. 3, 3a, text-fig. 92; 1910, p. 571. Holmes, 1900, p. 27. Weymouth, 1910, p. 27, pl. 3, fig. 8. Hilton, 1916, p. 71, fig. 13.

Inachoides tuberculatus, Schmitt, 1921, p. 199, text-figs. 123a, 123b. Rathbun, 1923b, p. 633. Johnson and Snook, 1927, p. 365, fig. 317.

Pyromaia tuberculata, Rathbun, 1925, p. 133, pl. 40, fig. 3; pl. 218, figs. 1-4; 1926, p. 22, pl. 1, fig. 1 (fossil). Crane, 1937, p. 56. Ricketts and Calvin, 1939, p. 249. Garth, 1948, p. 23.

Collodes granosus, Boone, 1930a, p. 76, pl. 21, figs. A, B; not *C. granosus* Stimpson.

Type: Holmes (1900, p. 27), who examined Lockington's types in the California Academy of Sciences before their destruction, gives the following measurements: male: length .75, width .55, first leg 1.55 inches. Female: length .56, width .38, first leg .94 inches.

Type locality: Mouth of San Diego Bay, California, 8 fathoms, Henry Hemphill, collector.

Localities subsequently recorded, with collectors: California: Monterey Bay, 45 fathoms (Weymouth); off Venice, between Venice and Rocky Point, between Point Vicente and Point Fermin, San Pedro, *Anton Dohrn* (Rathbun, 1925); San Pedro, E. P. Chace, H. N. Lowe (Rathbun, 1925); off Wilmington, 27 fathoms, *Albatross* (Rathbun, 1904, 1925); Long Beach and Alamitos Bay, H. N. Lowe (Rathbun, 1904, 1925); Newport Bay, *Anton Dohrn* (Rathbun, 1925); Balboa (Hilton); Laguna Beach, 12-15 fathoms (Nininger); San Diego Bay, 3.5-6.75 fathoms, *Albatross* (Rathbun, 1904, 1925), S. J. Holmes (Rathbun, 1925); south of San Diego Bay, 22 fathoms, *Albatross* (Rathbun, 1925). Fossil: California Pleistocene: Deadman Island, San Pedro; Signal Hill (Los Cerritos); Spanish Bight, San Diego Bay (Rathbun, 1926).

West coast of Lower California: W. J. Fisher (Lockington); Santa Rosalia Bay, A. W. Anthony (Rathbun, 1925); Santa Maria Bay, *Albatross* (Rathbun, 1923b); Magdalena Bay, 3 fathoms, type locality of *Inachoides brevirostrum* (Lockington), C. R. Orcutt (Rathbun, 1925); off Santa Margarita Island, 47 fathoms, *Albatross*, type locality of *Inachoides magdalenensis* (Rathbun, 1893b); Abreojos Point to Cape San Lucas, 5.5 to 66 fathoms, *Albatross* (Rathbun, 1898).

Gulf of California: near Consag Rock, 20 fathoms, *Albatross*, type locality of *Neorhynchus mexicanus* (Rathbun, 1893b). [For additional *Albatross* records see Rathbun (1925, p. 135).] Santa Inez Bay, 25-35 fathoms, *Zaca* (Crane).

Costa Rica: Punta Arenas, *Ara* (Boone, as *Collodes granosus*).

Panama: Bay of Panama, 7 and 16 fathoms, *Albatross* (Rathbun, 1898); Perlas Islands, *Ara* (Boone, as *Collodes granosus*).

Colombia: Utria Bay [Port Utria], 12-22 meters, *Askoy* (Garth).

Atlantic analogue: Not strictly analogous to either of the Atlantic members of the genus, *Pyromaia cuspidata* Stimpson or *P. arachna* Rathbun.

Diagnosis: Carapace broadly pyriform, three median tubercles or spines: one gastric, one cardiac, and one intestinal. Rostrum a simple spine of variable length. Supraorbital arch with a tubercle at summit. Postorbital spine large, curving around eye in adult. Anteroexternal spine of basal antennal article incurving. Male cheliped shorter than all, or all but last pair of walking legs, manus subglobular. Dactyls long, little curved, smooth in adult, spinulose in young. Tip of male first pleopod rounded, a partial constriction opposite rimmed orifice.

Description: Carapace broadly triangular, pyriform, convex; surface granulate and tuberculate, with fine pubescence; tubercles tending to become spinous on lateral margins and on summit of branchial regions; on median line a spiny tubercle on the posterior part of gastric region, and a stout, spinelike tubercle on cardiac and on intestinal region. The median spines present in adult males becoming tuberculate in females and in smaller specimens, and the gastric tubercle often absent. A shorter spinelike tubercle on first abdominal segment, pointing upward and backward. Rostrum acute; tips of postorbital spines pointing forward; upper margin of orbit prominent but without supraocular spine. Basal antennal article with outer margin prolonged into a slightly incurved spine. Sternum conspicuously granulate or tuberculate, pubescent, deeply grooved between segments.

Chelipeds of male short, rather stout, granulate; hand broad, inflated; fingers nearly as long as palm, gaping at base. Chelipeds of female more slender than in male; margins of hand parallel; fingers slightly gaping. (Schmitt, 1921, modified)

Ambulatory legs slender, similar, diminishing in length from first to fourth pair; dactyli moderately curved, almost smooth. (Rathbun, 1925)

The following significant paragraph is extracted from Rathbun (1925, p. 136):

"Young: In the adult, the postorbital tooth is large and curves partly about the eye, as in typical *Pyromaia*; in the young, however, the postorbital tooth is smaller and more slender than in the adult and is directed outward and very little forward, the dactyls of all the ambulatory legs are, relative to their propodites, shorter and more curved than in the adult, and armed with spinules, that is, they are more prehensile. The young, therefore, are typical *Inachoides*."

In addition to the typical form described above, two and perhaps three races are restricted to well-defined portions of the species range. One of these is represented by specimens from the northern part of the Gulf of California, from San Felipe on the peninsula side to Guaymas on the side of the Mexican mainland. In it the rostrum is short, the branchial regions swollen, the neck stout, the granules many and coarse, and the hand swollen and bare. *Neorhynchus mexicanus* Rathbun (male holotype, U.S.N.M. No. 17350) is of this form and, in view of its morphological distinctiveness and geographical isolation, its removal from synonymy with *Pyromaia tuberculata tuberculata* and its designation as *P. tuberculata mexicana*, new subspecies, is here proposed.

A second form is represented by Crane's specimens from Santa Inez Bay and by Hancock expeditions material from outside Concepción and Angeles Bays on the Gulf coast of Lower California. In this form the rostral spine is long and the gastric and cardiac spines upstanding. Rathbun (1925) calls it variety A, adding that the legs are particularly long and slender, the granules few, and the postorbital tooth points outward. Sufficient material from the Bay of Panama is not available from which to determine whether the two specimens designated by Rathbun (*loc. cit.*) as variety B are identical with one of the above or should be considered as representing a third race of this polytypic species. The situation is further complicated in that specimens not extreme in either respect occur off California, in the Gulf of California at localities other than those mentioned, and off Colombia.

Material examined: A total of 682 specimens from 118 stations or unnumbered localities, of which 29 were in the Gulf of California. Of this number 102 specimens from 11 Gulf of California stations may be designated as subspecies *Pyromaia tuberculata mexicana*. (See Table 11) From Tomales Bay, Marin County, California, to off Cape Corrientes, Colombia, including the entire Gulf of California. In addition to the above, one male specimen from San Bartolome Bay, Lower California, Mexico, December 16, 1916, surface haul with lampara net [?], *Albatross* (C.A.S.), and one female specimen from Utria Bay, Colombia, *Askoy* expedition (Garth, 1948).

Measurements: Comparative measurements of specimens of like sex and size are arranged in tabular form to emphasize the difference in proportion between typical *Pyromaia tuberculata* and *P. t. mexicana*. (Measurements in mm.)

| | <i>P. tuberculata</i> | <i>P. t. mexicana</i> |
|---------------------------------------|-----------------------|-----------------------|
| | Male | Male |
| Length of carapace, including rostrum | 15.7 | 18.8 |
| Length of rostrum | 2.5 | 0.8 |
| Width of rostrum | 1.8 | 1.8 |
| Length of carapace without rostrum | 13.2 | 18.0 |
| Width of carapace | 12.3 | 17.1 |
| Length of cheliped | 21.3 | 29.0 |
| Length of chela | 9.7 | 13.0 |
| Length of dactyl | 5.2 | 7.3 |
| First walking leg | 36 | 47 |
| Second walking leg | 33.3 | 46 |
| Third walking leg | 31.7 | 43 |
| Fourth walking leg | 28.5 | 38 |

It will be noted that the principal difference lies in the length of the rostrum, and that when this is subtracted from total length the disparity in size of the two specimens increases. However, *P. t. mexicana* continues to exhibit the greater proportional width to length.

The figure used to illustrate the species by Rathbun (1904; 1925, pl. 218) and by Schmitt (1921) is that of the male holotype of *Neorhynchus mexicanus*, and as such does not represent the typical form that occurs off California and the west coast of Lower California. (See Pl. 6, fig. 1)

Color in life: Not recorded. Boone (1930a, p. 76) reports of *Ara* specimens (as *Collodes granosus* Stimpson): "rich creamy yellow; eyes black," which is customary for specimens in alcohol.

Habitat: Rocky bottom covered with weeds. (Lockington) "The hydroids on the Balboa [California] piles were swarming with these peculiar spider-like crabs." (Nininger) Wharf piling; protected piles. (Ricketts and Calvin) Soft mud with shell to firm sand, with or without weed. (Crane) Often abundant on the piling in harbors, as at San Pedro, where it may be seen crawling slowly about among the tunicates (*Ciona*) and the seaweeds growing on the wharf piles and floats. Covers body with foreign growth. (Johnson and Snook) In the 71 stations of the present study for which data on bottom type are available, the primary breakdown is sand 55 per cent, mud 27 per cent, rock 17 per cent, and coralline one per cent. Of the sand bottom stations nearly one third were with shell, while of the mud bottoms fully one-half were with sand or sandy mud.

Depth: In the Gulf of California from shore to 35 fathoms, off southern California from shore to 225 fathoms, the latter nearly four times the maximum depth of 66 fathoms given by Rathbun (1925). Intertidal collections were at extreme low tide at the entrances to Mission Bay, San Diego County, and Newport Bay, Orange County, California.

Breeding: Egg-bearing females were encountered off southern California in every month from February to November, with but a slight increase in frequency during the summer months. In the Gulf of California, with collections from January to April, the preponderance of ovigerous females was in March. No gravid females were encountered by Hancock expeditions south of Mexico, although Boone (1930a, p. 76) reports (as *Collodes granosus*) egg-bearing females from Costa Rica in February.

Size and sex: The largest specimen on record is the 21.7 mm male reported by Rathbun (1925).

Remarks: With the additional evidence provided by the male first pleopod (Plate E, fig. 7), it is difficult to resist the temptation to return this species to *Inachoides*, where it was once placed by both Schmitt (1921) and Rathbun (1923b). However, certain considerations restrain the writer from so doing, at least for the present. Among these may be mentioned the important general characters which relate the species to *Pyromaia* as exemplified by its type species, *P. cuspidata* Stimpson: the large postorbital spine which curves around the eye and the remarkably long walking legs which exceed the cheliped in length, together with their attenuated and almost smooth dactyls. To be sure, these are characters which appear in the adult and not in the young, as noted by

Rathbun in the paragraph quoted above, whereas the key to relationship of divergent forms is often to be found in their developmental stages. In support of the position taken, it should be noted that the male first pleopod of *P. tuberculata*, so similar in many respects to that of *Inachoides microrhynchus*, resembles no less that of *Erileptus spinosus*, which for reasons even more compelling must remain in another genus.

The extension of range of the species from Monterey Bay to Tomales Bay, north of San Francisco, California, deserves special comment. A specimen sent the writer by Robert J. Menzies of Pacific Marine Station, Dillon Beach, was recovered from the nets of fishing boats that do not leave Tomales Bay and so could not have been taken at a more southerly locality.

Genus ERILEPTUS Rathbun

Erileptus Rathbun, 1893b, p. 226; 1925, p. 68.

Type: Erileptus spinosus Rathbun, by monotypy.

Description: Carapace pyriform, convex, regions well defined; rostrum simple, slender; postorbital and supraorbital spines present. Sexes differing in shape of carapace, postorbital spine and cheliped. Basal article of antennae long and narrow, with spine at distal end. Anterointernal lobe of ischium of outer maxilliped large and strongly advanced; merus subtriangular, the anterior margin the longest; outer, or principal, margin of next article nearly as long as outer margin of merus and almost straight until near distal end where it forms an elbow; terminal article unusually long. Chelipeds of male extremely long. Ambulatory legs very slender, decreasing in length from first to fourth pair and in male much shorter than chelipeds. (Rathbun, 1925)

Abdomen of male with six, of female with five segments.

Range: From San Miguel Island and Point Santa Barbara, California, to Entrada Point, Magdalena Bay, Lower California, Mexico; in the Gulf of California from Rocky Point, Sonora, to Gorda Banks. Extralimital: Ladrones Islands, Panama. 2-300 fathoms. Contains but one species.

Erileptus spinosus Rathbun

Plate E, Fig. 8; Plate 5, Fig. 2

Erileptus spinosus Rathbun, 1893b, p. 227; 1904, p. 171, pl. 10, fig. 1; 1925, p. 68, pls. 212, 213, text-fig. 18. Holmes, 1900, p. 21. Weymouth, 1910, p. 27, pl. 3, fig. 7. Crane, 1937, p. 54.

Anasimus rostratus Rathbun, 1893b, p. 227; type locality, northwest of Cedros Island, off Lower California, 58 fathoms; female holotype, U.S.N.M. No. 17340; 1904, p. 171, pl. 10, fig. 4. Weymouth, 1910, p. 27.

Anasimus spinosus, Schmitt, 1921, p. 196, text-figs. 121a, 121b.

Type: Male holotype, U.S.N.M. No. 17341, length 10 mm, width 6 mm.

Type locality: Off San Diego, California, 36 fathoms, *Albatross* station 2934.

Localities subsequently reported, with collectors: California: Off Santa Rosa Island, 38-55 fathoms, and off San Nicolas Island, 32-33 fathoms, *Albatross* (Rathbun, 1925); Santa Catalina Island: Catalina Harbor, W. H. Dall (Rathbun, 1904); Catalina and Isthmus harbors, *Anton Dohrn*, and off Santa Catalina Island, 50 fathoms, H. N. Lowe (Rathbun, 1925); off La Jolla, 30-39 fathoms, Scripps Institution (Rathbun, 1925). Mexico: west coast of Lower California: west of Los Coronados Islands, 50 fathoms, *Agassiz* (Rathbun, 1925); northwest of Cedros Island, 58 fathoms, type locality of *Anasimus rostratus*, *Albatross* (Rathbun, 1893b); off Abreojos Point, 48 fathoms, *Albatross* (Rathbun, 1925). Gulf of California: Santa Inez Bay, 60 fathoms, *Zaca* (Crane).

Atlantic analogue: None. A Pacific north temperate species.

Diagnosis: Sexes markedly dissimilar. Rostrum a slender spine half as long as postrostral portion of carapace in male, shorter in female. Two median spines, one gastric, one cardiac; one long branchial spine. Postorbital spine small. Chelipeds very long, from three to four times length of carapace in male, only one and a half times carapace length in female. A spine on first abdominal somite.

Description: Male: Carapace spinous; two spines on the median line, one on posterior part of the gastric region and the other on the cardiac region; one long spine on the branchial region, with a small one in front of it and two on the margin; a spine on the margin of the hepatic region and two very small ones arranged transversely on the gastric region; a slender spine on the orbital arch. Rostrum slender, spinulose on the margins, about one-half the length of the postfrontal portion of the carapace. Postorbital spine small, at some distance behind the eye. Abdomen bearing a spine on the first segment. Chelipeds nearly three times as long as the carapace, granulate; merus one-spined above at the anterior margin; hand slender, slightly flattened vertically, increasing in width toward the distal end; dactyl and pollex arched, gaping for

one-half their length. Ambulatory legs decreasing regularly in length from the first to the fourth; fourth pair a little more than one-half the length of the first. (Rathbun, 1893b)

Female: Carapace with two median spines, one on the posterior part of the gastric region and one on the cardiac region. Two spines on each branchial region and, almost in line with these, one on each protogastric lobe. Lateral margins spinulose. Surface pubescent. Rostrum slender, spinulose on the margins, curving upwards for its distal half. A prominent supraorbital spine. The first article of the abdomen carrying a spine; the second article, one much smaller. Basal antennal [article] very long and narrow, terminating in a spine, spinulose on the margins, without a prominent tubercle. Chelipeds very weak; margins of merus spinulose; a slender spine above near the carpus; hand granulous; fingers nearly as long as palm, in contact. Ambulatory legs slender, pubescent, decreasing in length but little from the first to the fourth pair; dactyls spinulose below. (Rathbun, 1893b, modified, of *Anasimus rostratus*)

The length of the rostrum is subject to considerable variation. The 11 mm specimen measured above has a well-developed rostrum of 3.6 mm, but an individual from station 1271-41, also a male, measuring but 9.1 mm in length, has a 3.6 mm rostrum also. It is a particularly spinulose individual, and the tip of the rostrum is bispinate. The females of the species, with their shorter rostrum and shorter legs, are difficult to tell from females of *Inachoides laevis*. Fortunately the ranges of the two species are well delimited on the open Pacific coast, although they overlap in the Gulf of California.

Material examined: A total of 1,551 specimens from 156 stations. (See Table 12) From San Miguel Island and Point Santa Barbara, California, to Magdalena Bay, Lower California, and from Rocky Point, Sonora, to Gorda Bank in the Gulf of California. Extralimital: Panama.

Measurements: Largest specimen, a male, length 11.0 mm, width 6.8 mm, rostrum 3.6 mm, cheliped 35.4 mm, merus 13.6 mm, chela 16.6 mm, dactyl 3.9 mm, legs 23.3, 17.2, 15.5, and 13.5 mm, respectively. Ovigerous female: length 5.7 mm, width 4.0 mm.

Color in life: Not noted. In alcohol, chelipeds and legs conspicuously banded and marbled. (Crane)

Habitat: Analysis of the 130 stations at which *Erileptus spinosus* was taken for which data on bottom type are available reveals a primary breakdown as follows: sand 55 per cent, mud 20 per cent, rock 20 per cent, coral and coralline 5 per cent. The secondary breakdown reveals

shell associated with the sand in fully one-third of the cases. This corresponds with the findings of Crane (1937, p. 54), who records mud and crushed shell bottom.

Depth: An almost unbelievable bathymetric range of from 2 to 300 fathoms is shown by *Velero III* specimens, as compared with the previously accepted 21-60 fathom limitation (Crane, *op. cit.*). All but six stations, however, are under 100 fathoms.

Size and sex: The formidable series of over 1,500 individual specimens has not been analyzed in this particular, except for data given under measurements above. The largest specimen on record is an 11.5 mm male reported by Rathbun (1925).

Breeding: Off the coast of southern California and northern Lower California, where collecting has been concentrated, ovigerous females have been recovered in every month of the year. There is a low in the frequency curve in January and a high in August and September, with a secondary rise in April. These data have not been corrected for the probable greater collecting activity during the summer months. In the Gulf of California, where spring collecting has been the rule, egg-bearing females were encountered sparingly in January, February, and March.

Remarks: The great disparity existing between the sexes with respect to the length of the anterior pair of legs, and particularly of the chelipeds, led Rathbun to believe that she was dealing with two species belonging to different genera. The males she described as *Erileptus spinosus*, creating a new genus to receive them; the females she described as *Anasimus rostratus*, as noted in the synonymy above. Such an error could hardly have occurred if both males and females had been present in either type series. Fortunately, this lapse was discovered by Miss Rathbun herself, while working over material sent her from the Venice Marine Laboratory of the University of Southern California, the correction being made in subsequent papers. (Schmitt, 1921; Rathbun, 1925)

For a species having its center of distribution off the southern California-Lower California coast, *Erileptus spinosus* turns up in unexpected places. The first intimation of its occurrence in the Gulf of California was when the *Zaca* obtained fourteen specimens in a single dredge haul in 60 fathoms off Punta Concepción (Crane, 1937, p. 54), a record which has been abundantly confirmed by *Velero III*. More recently, in 1939, a dredge haul in 54 fathoms three miles south of the Ladrones Islands,

Panama, included a single male specimen, indicating that *E. spinosus* is to be looked for in the intervening territory, and perhaps as far south as Ecuador.

Genus **INACHOIDES** Milne Edwards and Lucas

Xiphus Eydoux and Souleyet, 1842 (or 1843), pl. 1, figs. 1-6; type:

X. margaritifère Eydoux and Souleyet.

Inachoides Milne Edwards and Lucas, 1842, pl. 4, figs. 2, 2a-m; 1843, p. 4. Eydoux and Souleyet, 1844 (or 1845), p. 219. Dana, 1851b, p. 432; 1852, p. 83. A. Milne Edwards, 1879, p. 198. Rathbun, 1925, p. 59.

Type: Inachoides microrhynchus Milne Edwards and Lucas, by monotypy.

Description: Carapace triangular, pointed in front, broad and swollen behind. Rostrum short and styliform, always simple. Orbits entire; their superior angle very small and the eye not retractile. Basal article of the external antennae narrow, the unprotected movable flagellum inserted on the sides of the rostrum. Epistome large and nearly quadrilateral; merus of the external maxillipeds notched in front for the insertion of the palp, its anteroexternal angle rounded. Chelipeds of the male swollen; ambulatory legs of moderate length and terminated by styliform dactyls. Abdomen of the male formed of seven articles; that of the female numbers only five, the fifth, sixth and seventh being united. (A. Milne Edwards)

The following supplementary information is given by Rathbun: Postorbital tooth present, small, and pointing outward; preorbital spine present or absent. Basal antennal article with an anteroexternal tooth. First pair of ambulatory legs longest, subprehensile, the propodal segments more or less enlarged distally; dactyli curved, folding against propodi.

With respect to the characteristic terminal modification of the propodus the description of Milne Edwards and Lucas is beautifully explicit: The legs . . . have their penultimate article prolonged posteriorly in a lamination, on the rounded margin of which slides, as on a pulley, the last article or the tarsus.

Range: From Cedros Island and Scammon Lagoon, west coast of Lower California, and Rocky Point, Gulf of California, Mexico, to Chonos and Chiloe, Chile; in the Atlantic from Deadmans Bay, Florida, to Desterro, Brazil. 1.5 to 56 fathoms.

KEY TO THE PACIFIC SPECIES OF *Inachoides*

- 1a. Carapace smooth and bare. Postorbital spine inconspicuous, antennal spines divergent. Tip of male first pleopod sharply triangular. A small species *laevis*
- 1b. Carapace tuberculate and granulate. Postorbital spine prominent, antennal spines incurving. Tip of male first pleopod broadly rounded. A moderately large species . . . *microrhynchus*

Inachoides microrhynchus Milne Edwards and Lucas

Plate E, Fig. 9; Plate 6, Fig. 3

Xiphus margaritifère Eydoux and Souleyet, 1842 (or 1843), pl. 1, figs 1-6.

Inachoides microrhynchus Milne Edwards and Lucas, atlas, 1842, pl. 4, figs. 2, 2a-m; 1843, p. 5. Eydoux and Souleyet, 1844 (or 1845), p. 219. Miers, 1879c, p. 646; 1881, p. 65. Cano, 1889, pp. 98, 171. Rathbun, 1910, pp. 533, 570, pl. 36, fig. 1; 1925, p. 60, pl. 22, figs. 1, 2; text-fig. 16. Garth, 1957, p. 18.

Inachoides microrhynchus [for *microrhynchus*], Nicolet, 1849, p. 126.

Inachoides inornatus A. Milne Edwards, 1873a, p. 253 (77); type locality, "les îles Viti" [Valparaíso, *vide* Ortmann]; type if extant, one of two females in Museum Godeffroy, Hamburg. Ortmann, 1893, p. 38. Rathbun, 1910, p. 570.

Type: Male holotype in Paris Museum, length 30 mm, width 21 mm.
Type locality: Coast of Chile.

Localities subsequently recorded, with collectors: Peru: Sechura Bay, 5-6 fathoms, R. E. Coker (Rathbun, 1910); Paracas Bay, *Hassler* (Rathbun, 1925); Chile: Cobija, *Bonite* (Eydoux and Souleyet); Coquimbo (Miers, 1881); Caldera, *Hassler* (Rathbun, 1925); Valparaíso (Ortmann), also *Hassler* (Rathbun, 1925); Puerto Lap. [Puerto Lagunas?], Chonos and Chiloe, *Vettor Pisani* (Cano).

Atlantic analogue: None. A Pacific south temperate species.

Diagnosis: Carapace with tubercles and granules surmounting gastric, cardiac, and branchial regions. Postorbital spines large, anterior margins horizontal. Antennal spines straight or incurving at tips. Pollex of male chela not bent, a tooth at midpoint. Tip of male first pleopod broadly rounded. Size large as compared to *Inachoides laevis*.

Description: The carapace, of a clear bottle-green, armed with a granulous rostrum, slightly swollen at its extremity and presenting a well marked depression between the ocular cavities; these latter with their

superior margins armed on each side with a strong spiny projection. The regions, strongly pronounced, covered with tubercles very close to each other, especially in the hepatic, pterygostomian, and branchial regions; on these latter the tubercles divided into two series, one situated near the margin of the carapace; the other occupying its superior surface, and the space existing between these two series entirely smooth. The other regions, such as the gastric and the cardiac, a little less projecting than the preceding: the first armed anteriorly on each side with a strong spine, situated near the external orbital angle, and above it presenting a transverse row of little tubercles, two median ones much more projecting than the others; the second, or the cardiac region, armed with one tubercle; the first [= third, or external] pair of maxillipeds covered with fine granulations; the sternal plastron also covered with fine granulations, disposed in transverse lines. The abdomen of the male, as also that of the female, entirely smooth and presenting a slight longitudinal projection in its median part. The legs, finely granulate, covered with a short and dense grayish down. (Milne Edwards and Lucas, modified)

Chelipeds of male strong, about one and a half times length of carapace; palms swollen; fingers narrowly gaping except near the extremities; an enlarged tubercle near middle of fixed finger. Ambulatory legs shorter than the chelipeds in adult males; upper surface of propodites terminating in a rounded lobe, produced beyond the articulation of the falciform dactyli. Basal segment of antenna with two finely granulate crests meeting in an acute anteroexternal tooth visible at the sides of the rostrum. (Rathbun, 1925)

Material examined: A total of 711 specimens from 13 *Velero III* stations. (See Table 13) From Sechura Bay to Independencia Bay, Peru.

Measurements: Largest specimen, a male: length 19.6 mm, width 15.6 mm, cheliped 32 mm, chela 14.8 mm, dactyl 7.2 mm, legs 31.5, 25.3, 22.3, and 17.5 mm, respectively. Female: length 12.3 mm, width 10.0 mm.

Color in life: Clear bottle-green. (Milne Edwards and Lucas)

Habitat: Dredged most frequently on bottoms of sand with shell, less frequently on bottoms of rock or mud. On the sandy bottom of Independencia Bay, Peru, it was difficult to say which of two species of Inachinae, *Inachoides microrhynchus* or *Eurypodius latreillei*, was the more abundant. Time and again the small dredge disgorged a teeming mass of spider crabs, interspersed with an occasional large *Cancer polyodon* or *C. plebejus*. To maintain its dominance over the larger species, it

was necessary for *Inachoides microrhynchus* to be present in great numbers, and at one station 420 specimens were taken.

Depth: 5-18 fathoms.

Size and sex: The 30 mm male holotype is the largest specimen on record. The largest male and female in the Sechura Bay series are the measured pair above. However, females carrying eggs were found which measured no more than 5.6 mm in length. Sex was readily determinable in the smallest specimens present, 4.4 mm males and 4.0 mm females.

Breeding: At the time of the 1935 Hancock expedition to Peru, mid-January, approximately one-half of the females examined were with ova, the proportions being 14 out of 28 in one series, 5 out of 11 in another, and 4 out of 9 in a third. At the time of the 1938 expedition, February 10-15, 8 of 11 females examined in one lot had the full complement of eggs and the remainder gave evidence of having but recently shed them. January and February are mid-summer months in the Southern Hemisphere, corresponding to July and August in the Northern Hemisphere.

Remarks: The northern limit of range of the species appears to be Sechura Bay, although dredging in the Gulf of Guayaquil might extend this somewhat. It is quite well established through specimens obtained by the *Velero III* that the species of *Inachoides* occurring north of Punta Santa Elena, Ecuador, is *Inachoides laevis*.

To one coming from California to Peru, the similarity between *Inachoides microrhynchus* and *Pyromaia tuberculata* (Lockington) is striking. It is therefore not surprising to find that the relationship is more than superficial, extending to the orbits and to the dactyli of the young (see Rathbun, 1925, p. 136), and, as here shown, to the male pleopod (Plate E, fig. 9). Fortunately there is no overlap in the ranges of the two species, permitting segregation on a geographical basis.

Although written more than a century ago, the lucid French description of the elder Milne Edwards, quoted above, bears critical judgment by modern standards, and needs only to be supplemented as regards cheliped and antennal article to be entirely acceptable.

Inachoides laevis Stimpson

Plate E, Fig. 6; Plate 6, Fig. 4

Inachoides laevis Stimpson, 1860b, p. 192. A. Milne Edwards, 1879, p. 200. Rathbun, 1910, p. 570; 1925, p. 61, pl. 22, figs. 3-6 (part: not synonymy, not text-fig. 17; Lower Californian and Panamanian specimens only). Crane, 1937, p. 53. Garth, 1948, p. 22.

Type: Male cotype, M.C.Z. No. 1247, length 11.4 mm (not 10.7 mm if 1 in = 25.4 mm), width 8.1 mm.

Type locality: Panama, Rev. J. Rowell, collector.

Pacific localities subsequently reported, with collectors: Mexico: Lower California: Magdalena Bay, C. R. Orcutt (Rathbun); Gulf of California: Santa Inez Bay, 29 fathoms, Zaca (Crane); Bay of Panama: Panama, Sternbergh (Rathbun); Colombia: Malaga Bay, 2-5 fathoms, Askoy (Garth). Atlantic records omitted as being doubtfully of this species (See remarks below).

Atlantic analogue: *Inachoides forceps* A. Milne Edwards (See Remarks below).

Diagnosis: Carapace smooth and bare, no tubercles on gastric or dorsal portion of branchial regions and only a few granules on lateral margins; a single cardiac tubercle. Postorbital spine inconspicuous, antennal spines divergent. Antennular fossae dorsally discernible as two translucent oval patches. Pollex of male chela bent at middle, a strong basal tooth. Tip of male first pleopod sharply triangular. Size small.

Description: Carapace mostly smooth, and covered with a soft pubescence easily removed. Gastric and branchial regions protuberant, rounded, glabrous; cardiac with a single median tubercle; hepatic conical, armed at the apex with a short, deflexed spine. Rostrum rather long, with a styliform extremity as long as the thicker, tapering basal half. Postocular spine very small, blunt. . . . Two or three tubercles on the inferolateral regions in front of the bases of the chelipeds. Outer maxillipeds with a sharp longitudinal denticulated ridge on the ischium; anterointerior corner of the [merus] sharply projecting forwards. Dactyli of the posterior three pairs of [legs] falciform, equal. (Stimpson)

Basal antennal article traversed by an oblique ridge, minutely denticulate; stout anteroexternal spine exposed to dorsal view.

Chelipeds of male massive; merus long, cylindrical, with a spinulous inner surface; carpus also spinulous internally; palm stout, widest at middle, inner surface spinulous and noticeably more convex than smooth outer surface, spinules irregularly arranged except along inferior border, there forming a row; fingers equally curving, a large tooth at base of deflexed pollex, narrow gape occupied by comblike bristles to which particles of mud adhere.

First pair of walking legs longer and more slender than remaining pairs, dactyli straighter; last three pairs of legs subequal in length, dactyli nearly as long as the respective propodi and curving.

As noted by Rathbun (1925, p. 63) with respect to a specimen from Magdalena Bay, Lower California (U.S.N.M. No. 50641), a sharp supraorbital tubercle is present in Hancock expeditions specimens from Rocky Point to Puerto Refugio, Angel de la Guarda Island, Gulf of California, and in Kenyon-Williams expedition specimens from Cedros Island and Scammon Lagoon, west coast of Lower California. This condition is associated with a longer rostrum, a sharp hepatic spine, which may exhibit accessory spinules, and a sharp-granulate sternum, the granules extending onto the bases of the cheliped and walking legs. A subspecific designation might well be applied to this form, which appears to predominate among specimens from northern localities.

Material examined: A total of 122 specimens from 49 stations. (See Table 14) From Cedros Island and Scammon Lagoon to Magdalena Bay, west coast of Lower California, and from Rocky Point, Gulf of California, Mexico, to La Libertad, Ecuador.

Measurements: Largest specimen, male: length 8.8 mm, width 6.1 mm, cheliped 16 mm, chela 7.4 mm, dactyl 3.5 mm, second walking leg 10.6 mm (others missing). Female: length 7.7 mm, width 5.7 mm.

Color in life: Light Sudan brown with a strong yellow-green hue. Propodi and dactyli of ambulatory legs cream color. Ventral side pale greenish-yellow. (Petersen, of a male from Taboga Island, Panama)

Habitat: Crushed shell mud with a little weed. (Crane, 1937, p. 53) Black mud and gray sand. (Garth, 1948) Sand bottom in nearly 60 per cent of the cases, with shell also present in about one-third of these. Mud, with sand also present more often than not, accounts for the bulk of the remainder.

Depth: 1½ to 25 fathoms, exceptionally to 56 fathoms. One shore station in the upper reaches of the Gulf of California, where tidal ranges are extreme.

Size and sex: The smallest specimens in the Hancock series are approximately 2.5 mm in length and are by no means post-larval. Sex can be determined readily in all of them. The small size of egg-bearing females is remarkable, one 3.5 mm specimen earlier labeled "young" proving to be ovigerous. 4.0 mm is average size for gravid females, 5.5 mm maximum. Large males reach 8.5 and 8.8 mm, not as large, however, as the 9.6 mm male reported by Crane (1937), nor as the male cotype, a 10.7 mm specimen.

Breeding: All females of a small series taken at La Libertad, Ecuador, in February were ovigerous, as were nearly all females from numerous lots from Costa Rica in the same month. Pre-zoeae ready for

hatching could be seen through the transparent egg membranes of a female from Costa Rica taken March 26.

Remarks: In view of the fact that increasingly fewer species of *Brachyura* are found to be common to the Atlantic and Pacific oceans as time goes on, the writer departs from the synonymy of Rathbun (1925) and returns to the concept of Stimpson's *Inachoides laevis* as a purely Pacific species, unencumbered by the addition of A. Milne Edwards's *I. forceps* and *I. obtusus* and of Rathbun's *I. intermedius*. These latter may well represent named varieties of a single Atlantic species standing in an analogous relationship to *I. laevis*, which has similar, if unnamed, varieties of its own.

Since the name *Inachoides laevis* Stimpson belongs *a priori* to the species as represented in the Pacific, the writer does not consider it incumbent upon him to discuss in this, a Pacific paper, the status of the Atlantic forms grouped by Rathbun under the same name. In a forthcoming report dealing with Hancock Caribbean material the question will be reopened and at that time supporting evidence for the specific identity of the Atlantic analogue in the form of pleopod studies will be introduced.

As contrasted with the gregariousness of *Inachoides microrhynchus*, which was dredged by the hundreds in the bays of Peru, *I. laevis* occurs sparingly but over a much wider territory. The largest number of stations at which it was obtained was in Costa Rica, where conditions for its existence seem highly favorable; the greatest number of individuals from any one dredge haul was 13 specimens taken at Tenacatita Bay, Mexico.

Genus PODOCHELA Stimpson

Podochela Stimpson, 1860b, p. 194. Rathbun, 1925, p. 31.

Podonema Stimpson, 1860b, p. 197; type: *P. riisei* (Stimpson), 1860 = *Podochela riisei* Stimpson, by subsequent designation of Miers (1879c, p. 644).

Driope Desbonne, 1867, p. 2; type: *D. falcipoda* Desbonne, 1867 = *Podochela riisei* Stimpson, by monotypy.

Acrorhynchus A. Milne Edwards, 1879, p. 189; type: *A. depressus* A. Milne Edwards, 1879 = *Podochela grossipes* Stimpson, by original designation.

Anisonotus A. Milne Edwards, 1879, p. 195; type: *A. curvirostris* A. Milne Edwards, 1879 = *Podochela curvirostris* (A. Milne Edwards), by monotypy.

Coryrhynchus Kingsley, 1879b, p. 585 (name substituted for *Podonema*, preoccupied).

Ericerus Rathbun, 1893b, p. 223; type: *E. latimanus* Rathbun, 1893, by monotypy.

Ericerodes Rathbun, 1897, p. 164 (name substituted for *Ericerus*, preoccupied).

Type: The Atlantic *Podochela grossipes* Stimpson, 1860, type of *Podochela* Stimpson by subsequent designation of Miers (1879c, p. 643).

Description: Carapace depressed, elongate-triangular, strongly produced in front. Gastric region narrow, tumid. Rostrum short, entire, triangular or arcuate. Eyes long, nonretractile, transversely projecting. Basal antennal article narrow, longitudinally sulcate, apex narrow, nondentate; flagellum slender, bare. Merus of external maxillipeds much shorter than ischium, apices obtuse or produced, internal apex more or less incised, palp joined at summit of merus. Epistome very long. Chelipeds of moderate size, merus curved, margins hairy. Legs very long, subprehensile, often furnished with a more or less cheliform hand. Dactyli of ambulatory legs of the first pair very slender and unhooked, those of the remaining pairs falciform. Sternum of female deeply concave, margin elevated, laminate, forming a capsule. First abdominal segment rather large, second, third, and fourth very short; fifth, sixth, and seventh segments coalesced. [Sternum of male either nearly smooth or deeply channeled between segments. Male abdomen with sixth and seventh segments coalesced.] (Stimpson, with additions to include the male sex)

The genus as characterized above at a time when but three Atlantic species, *Podochela grossipes*, *P. macrodera*, and *P. riisei*, were known, has been broadened by the inclusion of a large number of species, indubitably related, among which are recognized forms having the rostrum prolonged into a spine which may equal the postrostral length of the carapace, forms having the basal antennal article convexly ridged, and by one or more species in which the dactyl of the first, as well as of the remainder of the walking legs, is curved and spinulous. The chelipeds of the males of most species are known to become ponderously inflated; indeed it is possible that this is a trait common to all members of the genus, were material available to show it. A postorbital lobe or granule, which when present is located some distance from the eye, is a constant and useful descriptive feature.

Since no single character may be relied upon to distinguish one species of *Podochela* from another, and since specimens examined are all

too often females or immature, frequently with appendages missing, it has been found desirable to base keys and diagnoses on a combination of characters. Over twenty have been found useful, although some apply to one or two species only. Of these may be mentioned the ratio of the length of the rostrum and of the first ambulatory leg to the postrostral length of the carapace, the ratio of the dactyli of the first and fourth ambulatory legs to their respective propodi, the presence or absence of a postorbital lobe or granule, the presence of cardiac and gastric tubercles and the number of the latter, the nature of the hepatic and pterygostomial protuberances, the contour and surfacing of the branchial areas, the extent of encroachment of the carapace towards the bases of the ambulatory legs, the degree of inflation of the male manus and the shape of the gape between the fingers (a late developing character), the concave or ridged contour of the basal antennal article, the amount of internal projection of the merus of the external maxilliped, the degree of approximation of the sternal plates and the texture of their surface, the number of median tubercles on the first abdominal segment, the number of clusters of curved hairs that may be counted along the propodus of the first leg, and the peculiarities of the dactyli of the various pairs of walking legs. Since existing descriptions are usually too brief to cover all the desired points, it has been found necessary to supplement them to a considerable extent in the accounts of species to follow.

Range: From Monterey Bay, California, to Santa Elena Bay, Ecuador, including the Gulf of California; Guadalupe Island; Revilla Gigedo, Cocos, and Galapagos Islands; occurs also in the Atlantic from North Carolina to Pernambuco, Brazil; Bermudas. Shore to a depth of 125 fathoms; in the Atlantic to 201 fathoms.

"*Podonema* peut-être d'espèce nouvelle," Bouvier (1895, p. 8), is a *Podochela* which cannot be placed with certainty because of the meager data given.

KEY TO THE PACIFIC SPECIES OF *Podochela*

- 1a. Rostrum long, ending in a spine, usually entire, but with tip occasionally bifurcate
- 2a. Only one tubercle on first abdominal segment
- 3a. First ambulatory leg long and slender, its propodus unarmed
- 4a. A conspicuous postorbital tubercle; dactylus of fourth leg equal to five-eighths of propodal length
 *hemphilli*

- 4b. Postorbital tubercle inconspicuous or wanting; dactylus of fourth leg nearly equaling propodal length *angulata*
- 3b. First ambulatory leg shorter and stouter, its propodus spinulous
 - 5a. Rostral spine entire, almost equal to postrostral length *latimanus*
 - 5b. Rostral spine bifurcate, shorter than 5a, size small *veleronis*, n. sp.
- 2b. Two median tubercles on first abdominal segment
 - 6a. Rostral spine entire, equal to one-half to three-fifths postrostral length; hepatic spine strap-shaped *lobifrons* [= *barbarensis*]
 - 6b. Rostral spine terminally bifid, shorter than 6a; hepatic spine cylindrical. Galapagos only *schmitti*
- 1b. Rostrum short, not ending in a spine, usually entire, but exceptionally bilobate
 - 7a. Rostrum thin, hood-shaped, and hollow beneath
 - 8a. Median carina not apparent; a postorbital granule; sternum vermiculate *vestita*
 - 8b. Median carina sharp; no postorbital granule; sternum granulate. Galapagos only *margaritaria*
 - 7b. Rostrum thick, subtriangular, not hollow beneath; legs subprehensile *ziesenhenei*

***Podochela hemphilli* (Lockington)**

Plate H, Fig. 6; Plate 7

Microrhynchus hemphillii Lockington, 1877a, p. 30.

Inachoides (Microrhynchus) hemphillii, Lockington, 1877c, p. 75.

Inachoides hemphillii, Streets and Kingsley, 1877, p. 104.

Podochela tenuipes Rathbun, 1893b, p. 224; type locality, Catalina Harbor, Santa Catalina Island, California; male holotype U.S.N.M. No. 17505.

Podochela hemphillii, Rathbun, 1898, p. 569; 1904, p. 171, pl. 10, fig. 2; 1923b, p. 633; 1925, p. 49, pl. 18; pl. 209, fig. 2. Holmes, 1900, p. 17. Weymouth, 1910, p. 26, pl. 2, fig. 6. Schmitt, 1921, p. 195, text-fig. 120. Crane, 1937, p. 51.

Podochela hemphillii, Nininger, 1918, p. 39, fig. 14.

Type: Male holotype, length 19 mm, width 8.4 mm, originally deposited in C.A.S.; no longer extant.

Type locality: Bay of San Diego, California, 7 fathoms, Henry Hemphill, collector.

Localities subsequently reported, with collectors: California: Monterey Bay (Weymouth); San Luis Obispo (Lockington); off Venice, Santa Monica Bay, and Isthmus Harbor, Santa Catalina Island, *Anton Dohrn* (Rathbun, 1925); Catalina Harbor, Santa Catalina Island, W. H. Dall (Rathbun, 1893b: type of *Podochela tenuipes*); Laguna Beach (Nininger), 12-15 fathoms, W. A. Hilton (Rathbun, 1925); San Diego Bay, 1-2 fathoms, Scripps Institution (Rathbun, 1925); Mexico: west coast of Lower California: off Cedros Island, off Santa Margarita Island, Magdalena Bay, off Point Marque [Marquis], and Cape San Lucas, 10-47 fathoms, *Albatross* (Rathbun, 1893b, 1898, 1925); Gulf of California: La Paz, San José Island, Amortiguado Bay, Puerto Escondido, and Mulege Bay, W. J. Fisher (Lockington); San Esteban Island, American Museum (Rathbun, 1923b); off Cape San Miguel, 45 fathoms, Lt. H. E. Nichols, U.S.N. (Rathbun, 1925); Arena Bank, 0.5 to 50 fathoms, *Zaca* (Crane).

Atlantic analogue: *Podochela gracilipes* Stimpson.

Diagnosis: Rostrum long, ending in a spine. A minute postorbital granule. First ambulatory leg two and one-half times total length of carapace, propodus unarmed. Only one tubercle on first abdominal segment. Propodi of all walking legs bent slightly forward. Dactylus of fourth leg five-eighths times length of its propodus. Fingers of male cheliped gape in a broad oval. Curved hair count 10-12 along propodus of first leg.

Description: Carapace pyriform; gastric region prominent, rounded, and bearing tufts of curved setae; hepatic regions tumid, bearing two pointed tubercles, the larger one above and in front of the smaller; cardiac region separated by shallow grooves from the branchial and bearing a prominent elevation; branchial regions flattened or tumid. Rostrum variable in length, sometimes broadly, sometimes narrowly triangular, acute, and bearing two double rows of curved setae above. No supraocular tooth or spine; the area between the two projecting rims of the orbits concave; no tooth at the posterior margin of the orbit, but sometimes a small one a short distance behind it. Eyestalks constricted at the middle and bearing a few setae at the subacute tip. Basal antennal [article] with a longitudinal ridge on its posterior half or two-thirds with a groove on either side. Ischium of maxillipeds with a shallow, longitudinal groove; merus narrower than ischium, the internal angle produced, and the surface strongly concave from side to side.

Chelipeds in the male robust; merus incurved and having an outer spiny ridge; carpus with a posterior spine on the upper side; hand oblong, incurved, palm inflated, fingers gaping at base and meeting along the distal half or two-thirds of their length; generally several small, spiny projections on the surface of the hand, more conspicuous along the edges, especially the lower. In the female the chelipeds smaller and more slender, the hands subcylindrical, and the fingers nearly straight.

Legs very long and slender, and furnished with tufts of long setae, those on the upper side being curved; dactyls slender, falciform, those of the first pair about one-third the length of the propodi, and a little more slender but not more curved than the others; in the two posterior pairs the dactyls about one-half the length of the propodi.

Abdomen of the male six-[segmented] from the fusion of the last two [segments]; first two [segments] visible from above; the first [segment] much wider but not so wide as the second; the second, third, and fourth [segments] decreasing successively in width but of nearly equal length; the fifth longer than the preceding and the sixth oblong, rounded at the tip, and much longer than any of the others; the sides of the abdomen behind the second [segment] concave and at the middle of each [segment] a conical protuberance, the last [segment] bearing traces of two. In the female the abdomen large and rounded and composed of five [segments] from the fusion of the last three, fitting loosely over the thin, laminate rim enclosing the greater portion of the sternum. Sternum and ventral surface of the abdomen both hollowed out, thus forming a quite capacious chamber for holding the ova. (Schmitt, modified, after Holmes)

Material examined: A total of 623 specimens from 133 stations, of which 44 were in the Gulf of California. (See Table 15) From San Miguel Island, California, to Magdalena Bay, Lower California; from Angel de la Guarda Island to Isabel Island, Gulf of California; Clarion Island; Cocos Island, Costa Rica; Panama; Colombia.

Measurements: Largest specimen, a male: length 33.6 mm, width 22.4 mm, rostrum 6.7 mm, cheliped 45 mm, chela 21.5 mm, dactyl 11.8 mm, height of palm 9.8 mm, first ambulatory leg 78 mm, second 63 mm, third 52 mm, fourth 45 mm. Ovigerous female: length 18.5 mm, width 11.5 mm. The largest specimen on record is the 34 mm male (not the type) reported by Lockington (1877c).

Color in life: Dorsal surface of carapace clear, pale olive buff with a broad solid band of carmine along each side. Two oblong patches of carmine on cardiac region and two smaller patches on intestinal region.

Chelipeds yellowish cream color and almost transparent. First two ambulatory legs bright carmine, color fading towards dactyl; second pair with a little carmine on merus only, other segments clear and transparent. Visible dorsal portion of abdomen bright carmine; other segments of abdomen banded with reddish brown. Pterygostomian region dark red; other areas of ventral surface clear creamy white. Eyes dark olive buff. (Petersen, of a male from Santa Maria Bay, Lower California)

Habitat: Sand bottom in 47 per cent of the stations for which data on bottom type are available, followed by rock and mud bottom, with sand often secondarily present. Coralline, nullipore, and coral are also represented in descending order of frequency. Crane (1937) noted various types of bottom ranging from sandy and rocky to muddy, with algae usually present.

Depth: Shore to 55 fathoms, exceptionally to 80-90 fathoms, the latter depth in the Gulf of California and off Magdalena Bay only.

Breeding: Along the southern California coast, where collecting has been carried on by the *Velero III* in practically every month of the year, the largest numbers of females with ova have been found in July, August, and September. In the Gulf of California, where collecting by Hancock expeditions has been restricted to the first quarter of the year, gravid females have been found from late January to late March, but in sparing numbers.

Remarks: The first pair of legs alluded to by Lockington in the original description are the chelipeds, while the second pair of legs mentioned by him are the first pair referred to in the description above and elsewhere in this paper. These Lockington described as more than three times the length of the *postrostral* portion of the carapace. According to the measurements given, their length would be something less than two and one-half times the total length of the carapace, including the rostrum. This fact was apparently overlooked by Rathbun (1925, p. 49), whose diagnosis of the species is therefore misleading.

The description of Holmes, here given in preference to that of Rathbun because of Holmes's familiarity with Lockington's material, should be supplemented slightly. The length of the rostrum, while variable within the species, may be regarded for the purpose of comparison with other species as approximately one-fourth the postrostral portion of the carapace in the adult male. The male sternum is smooth in texture, the sternal plates closely approximated, and there is a prominent pair of setose tubercles opposite the coxae of the chelipeds.

Exception to the above description, and to that of Rathbun (1925, p. 49), is taken in minor detail. The dactyli of the first pair of walking legs are to their propodi in the ratio of 1:3.8, or nearer one-fourth than one-third of their length, while those of the fourth pair are five-eighths times their propodi, instead of one-half. These discrepancies were of no great import until it became necessary to distinguish *Podochela hemphilli* from *P. angulata*, a species unknown to Holmes and undescribed at the time of Rathbun's writing. It should also be pointed out that the segments of the male sternum, while separated to some extent, are by no means as deeply separated as are those of *P. vestita*, for example.

Podochela angulata Finnegan

Plate F, Figs. 1-6; Plate H, Fig. 3; Plate 8, Fig. 6

Podochela angulata Finnegan, 1931, p. 617, text-fig. 3. Garth, 1948, p. 21.

Type: Female holotype, in British Museum, length 9 mm, width 7 mm.

Type locality: Gorgona Island, Colombia, *St. George* expedition.

Localities subsequently reported, with collectors: Colombia: Utria Bay [Port Utria], 12-22 m, *Askoy* (Garth); Ecuador: Lat. 00° 55' N, Long. 80° 08' W, 36-54 m, *Askoy* (Garth).

Atlantic analogue: *Podochela gracilipes* Stimpson.

Diagnosis: Rostrum of intermediate length, ending in a blunt spine. Postorbital granule inconspicuous or wanting. First ambulatory leg three and one-half times carapace length, including rostrum, dactyl unarmed and equaling one-third the length of propodus. One tubercle on first abdominal segment. Dactylus of fourth walking leg almost equaling propodus. Male cheliped somewhat inflated. Curved hair count 22-24.

Description: Since the original description (Finnegan, 1931, p. 617) is in its entirety a comparison with two Atlantic species, *Podochela grossipes* and *P. macrodera* Stimpson, and since these two species are not available to the majority of west coast workers, a new description, based upon the large male from Utria Bay, Colombia, obtained by the *Askoy* expedition and figured on Plate F, is here presented:

Carapace narrowly triangular, regions shallowly delimited, surface smooth and bare except for customary hooked hairs arranged in well defined tracts. Rostrum surmounted by two double rows of curved setae, broad at base, tapering rapidly to midpoint, continued forward as a thickened, blunt spine with a rounded tip; length of rostrum between

one-third and one-fourth postrostral portion of carapace. Orbits without ornamentation, their margins subparallel; postorbital granule minute, not visible in dorsal view. Gastric region swollen, two median setose tubercles forming a small diamond with two lateral clusters of hooked hairs. Cardiac region less prominent and with a single median tubercle. Hepatic regions small, tumid, hair-tipped, a cluster of hooked hairs on their anterolateral margins. Branchial regions depressed, traversed by a longitudinal row of curved hairs, and flaring considerably towards the bases of the ambulatory legs.

Basal antennal article with a thickened ridge extending obliquely from inner proximal to outer distal margin, first two free segments cylindrical, the second overreaching rostrum by half its length. External maxilliped with merus subtriangular (rather than subquadrilateral, as shown in Finnegan, text-fig. 3B), anterointernal angle produced as a thin blade, margins spinulous. Sternal plates not deeply separated; sternum with two setose tubercles in advance of abdomen.

Chelipeds both finely and coarsely pubescent; merus abruptly bent, carpus with a few spines or spinules; manus moderately inflated, fingers meeting with a narrow gape, gape without teeth for its basal third, teeth alternating. First ambulatory leg three and one-half times length of carapace, its dactylus slender, unarmed, and equal to one-third the length of the propodus; dactyli of remaining legs falcate, spinulous. Second, third, and fourth ambulatory legs decreasing in proportion to carapace length in the ratios of 2.8, ?, and 1.6 to one. Dactyl of fourth ambulatory leg nearly as long as propodus, that of the male measuring 2.2 mm as compared with a propodus of 3.0 mm.

Male abdomen widest opposite second segment, narrowing rapidly to base of fused sixth and seventh segments, the sides of which are subparallel; first segment with a single large tubercle, remaining somites each with a cluster of hairs in lieu of a tubercle.

Material examined: 18 specimens from 12 Hancock stations. (See Table 16) These range from Puerto Culebra, Costa Rica, to La Libertad, Ecuador, and include a male and female from the type locality, Gorgona Island, Colombia. Additional material consists of a male and an ovigerous female from the *Askoy* expedition.

Color in life: Entire carapace and legs ecru olive with a few scarlet-red blotches around cardiac region. Eyes dull reddish lavender. Ventral side ecru olive with numerous tiny black dots. Maxillipeds rich orange dotted with black. (Petersen, of a male from Secas Islands, Panama)

Measurements: Largest specimen, a male from *Velero III* station 945-39: length 12.6 mm, width 9.1 mm, rostrum 2.0 mm, width 1.7 mm, cheliped 15.6 mm, chela 7.2 mm, dactyl 3.5 mm, height of palm 2.6 mm, ambulatory legs 38.8, 29.4, 25.5, and 19.5 mm, respectively. Female, same station: length 11.0 mm, width 8.1 mm.

Habitat: Most frequently encountered on a bottom of sand with shell or nullipores. Less frequently found on bottoms of sandy mud or rock. Finnegan (*op. cit.*) lists shells, dead coral, and gravel overgrown by Polyzoa [Bryozoa] and Lithothamnia.

Depth: 5-35 fathoms.

Breeding: An ovigerous female was taken by the *Askoy* off Ecuador in April. (Garth, 1948)

Remarks: The *Velero III* series includes a topotype male and female from station 223-34. The female specimen, although small, agrees well with Finnegan's figure and description of the female holotype. The *Askoy* expedition specimens, male and female, are used for purposes of illustration with permission of Mr. John Armstrong of the American Museum of Natural History.

As mentioned in the *Askoy* report (Garth, 1948, p. 21), a male specimen from the type locality, Gorgona Island, Colombia, was sent to the British Museum for comparison with the female holotype, along with a female specimen from Secas Islands, Panama, previously identified as *Podocheila angulata* by Mary J. Rathbun. The opinion expressed by Isabella Gordon was that the male was undoubtedly *P. angulata*, and the female, although representing the opposite extreme in rostral development, was probably of the same species also. She volunteered the information that the rostrum of the holotype might have been damaged at some time during the life of the crab and reaffirmed that most of the appendages are missing.

A specimen from station 213-34, La Plata Island, determined by Mary J. Rathbun as *Podocheila angulata*, is definitely not of this species, as it has a prominent postorbital spine, no lateral flare to the carapace, a bifid rostrum, and a dactylus of leg 4 which falls considerably short of equaling the propodus in length. It is listed under material examined of *P. veleronis*.

***Podochela veleronis*, new species**

Plate G, Figs. 1-7; Plate H, Fig. 5; Plate 8, Fig. 2

Podochela veleronis (Garth MS) Garth, 1948, p. 22.

Type: Male holotype and female allotype, Cat. No. 393, Allan Hancock Foundation, from Maria Magdalena Island, Tres Marias Islands, Mexico, 3-5 fathoms, May 9, 1939; one male and two female paratypes, same locality and date; specimens collected by Allan Hancock expedition of 1939 at *Velero III* station 971-39.

Diagnosis: Carapace smooth, broad at base, branchial regions anteriorly tuberculate. Tip of rostrum bifurcate. Neck narrow; a small postorbital tooth. Ridge of basal antennal article lamellate. First walking leg two times length of carapace, dactyli of all legs spinulose. Dactyl of fourth leg three-fifths times propodus. Curved hair count 4. A small species.

Description: Carapace broad, pyriform, superficially glabrous in appearance but microscopically covered with fine pile and occasional clusters of hooked hairs. Regions delimited by smooth, bare depressions. Gastric region moderately turgid, bearing one small tubercle with a second faintly suggested, and traversed by two rows of hooked hairs, one anteriorly, the other posteriorly. Cardiac region highest, conical, the cone surmounted by a tubercle. Hepatic region small, obtusely toothed. Branchial regions extensive and slightly elevated, bearing a double row of curved hairs more longitudinally than transversely directed, and with two or three small tubercles on their anterolateral margins. Carapace slightly flaring toward ambulatories. Pterygostomian region similarly armed with small tubercles, some visible in dorsal view. Rostrum prolonged into a stout spine twice as long as basal width, and nearer one-third than one-fourth postrostral length; tip bifurcate, two double rows of yellow hooked hairs above. Eyes borne on short, thick stalks, corneas ovoid, scarcely acuminate. A small postorbital tooth nearer eyestalk than hepatic tooth. Basal antennal article narrowing anteriorly, median ridge well defined, lamellate; inner margin recurving. Antennae little longer than rostrum, first free segment short. Ischium of third maxilliped with anterointernal angle sharpened but not produced; merus broader than long, produced at inner angle into a sharp, thin blade; first segment of palpus compressed at right angles to merus, bearing two spinules on its outer and a lobe on its inner margin.

Chelipeds roughened with spines and tubercles, hairy; merus with three lobes on outer inferior margin, three spines on inner; carpus

spinulose; manus hairy, somewhat inflated, fingers gaping at base, gape suboval. First ambulatory leg of male no more than twice the length of carapace; legs two to four decreasing regularly in length, carpi and propodi of approximately equal length and thickened distally. Each dactyl, including that of the first leg, strongly curved, armed with about a dozen cylindrical spinules in a double row, regularly spaced and equally advanced excepting the most distal, which is twice as long as the others and extends downward almost as far as the curved, amber nail (see Pl. G, fig. 6). Dactyl of first leg equal to three-fifths length of propodus; dactyl of fourth leg equaling three-fourths propodal length.

Sternal plates smooth, not deeply separated from each other; sternum of male bearing two whitened tubercles in advance of abdomen. Two smaller but similar tubercles in sequence on outer surface of third maxillipeds. First segment of male abdomen with two small tubercles followed by a median tubercle; abdomen widest opposite second segment, narrowing abruptly to middle of fifth segment; sides subparallel to middle of coalesced sixth and seventh segments; tip triangular.

Female carapace foreshortened; cheliped lacking roughness of male; chelae slender, dactyls meeting without gape; sternum lacking paired tubercles.

Material examined: In addition to the type series from the Tres Marias Islands, Mexico, the writer has before him an additional 13 specimens from Hancock expedition stations ranging from Los Frailes, Gulf of California, Mexico, to La Plata Island, Ecuador (see Table 17), plus one specimen collected by E. Y. Dawson at Barra Navidad, Jalisco, one specimen collected by C. L. Hubbs at Acapulco, Mexico, and four specimens from three *Askoy* expedition stations in Colombia and Ecuador (Garth, 1948, p. 22).

Measurements: Male holotype: length, including rostrum, 7.3 mm, rostrum 1.7 mm, width 5.25 mm, cheliped 7.0 mm, chela 3.0 mm, dactyl 1.6 mm, first ambulatory leg 14.0 mm, dactyl 1.7 mm, second, third, and fourth ambulatory legs 10.0, 8.8, and 7.5 mm, respectively. Female allotype: length 5.7 mm, width 4.3 mm, first ambulatory leg 10.8 mm.

Habitat: An *Ulva* association is mentioned in one instance.

Depth: 1-15 fathoms.

Remarks: A male specimen from La Plata Island, Ecuador, sent to M. J. Rathbun in 1936, was returned labeled *Podochela hemphilli* (Lockington). It was not until 1938 that ovigerous females were obtained which demonstrated that specimens of 6 and 7 mm length were

adult, rather than immature, as would have been the case had they been *P. hemphilli*. The proposed new species is therefore a small species, whereas *P. hemphilli* becomes quite large (29 mm or more). Furthermore, the length of the first walking leg in *P. hemphilli* is fully two and one-half times the length of the carapace, including the rostral horn, while that of the new species is not over two times the carapace length. Lastly, the dactyl of the first walking leg in *P. hemphilli* is slender and unarmed, and dissimilar to the dactyli of the remaining pairs, while that of *P. veleronis* is stout and spinulose, and similar to the dactyli of the remaining pairs.

The new species takes its name from the laboratory cruiser *Velero III*, which during the ten years between 1931 and 1941 contributed materially to our knowledge of the distribution of the genus *Podochela* in the eastern tropical Pacific.

***Podochela latimanus* (Rathbun)**

Plate H, Fig. 4; Plate 8, Fig. 4

Ericerus latimanus Rathbun, 1893b, p. 224.

Podochela latimanus Rathbun, 1924c, p. 377; 1925, p. 56, pl. 21, text-fig. 14. Crane, 1937, p. 52. Steinbeck and Ricketts, 1941, p. 466.

Type: Male holotype, U.S.N.M. No. 17324, length 26 mm, width 12 mm.

Type locality: Off Adair Bay, Gulf of California, Mexico, 11 fathoms, *Albatross* station 3024.

Localities subsequently reported, with collectors: Gulf of California: Patos Anchorage, 4.5 fathoms, Fred Baker (Rathbun, 1924c); Concepción Bay, *Albatross* (Rathbun, 1893b); Santa Inez Bay, 1-35 fathoms, *Zaca* (Crane); El Mogote, Puerto Escondido (Steinbeck and Ricketts).

Atlantic analogue: None. A Gulf of California endemic species.

Diagnosis: Rostral spine almost equaling postrostral length. A small postorbital tubercle. First ambulatory leg one and two-thirds times length of carapace, its propodus one and two-thirds times the length of the spiny, curved dactylus. One prominent tubercle on first abdominal segment. Dactylus of leg four five-sevenths times length of propodus. Manus of male cheliped inflated, fingers gaping. Carapace smooth and bare. Curved hair count 4. A large species.

Description: Male: Cardiac region elevated, conical; branchial regions swollen, a tubercle on their anterolateral margin; gastric region

with two median tubercles, the anterior the smaller; hepatic region not prominent, bearing a marginal tubercle; pterygostomial ridge with a tubercle; postorbital tubercle small, midway between orbit and buccal cavity. Rostrum a triangulate, acuminate spine nearly as long as the remainder of carapace, posteriorly hollow beneath, anteriorly upturned. Orbital arch thickened. Basal antennal article partially visible from above, a tooth at its anteroexternal angle, from this a convex ridge extending backward and inward; flagellum visible at sides of rostrum. Surface of maxillipeds spinulose.

Inner surface of chelipeds spinulose; outer margin of merus irregularly lobed; a spine at distal end above and on inner side; carpus with a stout external, and also anterior, spine. Palm dilated, fingers gaping; in the gape a truncate and a spiniform tooth on the dactyl and a triangular tooth on the immovable finger. First pair of ambulatory legs about one and two-thirds, second pair one and one-third, times the total length of the carapace; fourth pair not so long as the carapace. Propodus slightly thickened distally, about one and two-thirds times the length of the dactylus in the first pair and one and a half times the length of the dactylus in the remaining pairs.

Sternum having very slight depressions between the segments, and two stout cylindrical spines tipped with a granule at the base of the chelipeds. A tubercle on first abdominal segment. (Rathbun, 1925, modified)

Material examined: A total of 54 specimens from 23 stations, all in the Gulf of California. (See Table 18) These are distributed from Rocky Point, Sonora, to La Paz Bay, Gulf of California, and from shore to 30 fathoms. In addition, Patos Island Anchorage, Gulf of California, Mexico, April 23, 1921, 4.5 fathoms, Fred Baker, collector, 1 female (of 2 males and 2 females identified by Mary J. Rathbun), C. A. S.

Measurements: Largest specimen, a male, rostrum broken near tip: length 25.3 mm, width 16.6 mm, cheliped 34.2 mm, chela 16.3 mm, dactyl 8.3 mm, first ambulatory leg 51.6 mm, propodus 10.6 mm, dactylus 6.4 mm, remaining legs detached and fragmentary. Female: length 18.3 mm, width 10.0 mm, rostrum 6.8 mm. Largest complete specimen, male: length 20.6 mm, width 9.5 mm, rostrum 9.3 mm, width 1.8 mm, cheliped 15.7 mm, chela 6.9 mm, dactyl 3.8 mm, height of palm 2.0 mm, ambulatory legs 31.3, 27.5, 23.6, and 19.8 mm, respectively.

Color in life: Not recorded. The following notes on specimens in alcohol are taken from Crane (1937, p. 52): Uniformly yellow buff, more or less speckled with black in the sulci between regions and on the

ventral surface. Close to the margin of the last abdominal segment in each female were two conspicuous dark circles, the two in the middle being the larger. Fingers of chelipeds with scarlet bar at or near tip in both sexes.

Habitat: Of the 23 stations from which specimens were obtained, four of which were shore stations, the substratum was rock in 9 instances, sand in 7, and coralline in 4, with sandy mud and coral accounting for one station each. Crane (*op. cit.*) records muddy or shelly sand with weed.

Depth: Shore to 35 fathoms.

Size and sex: 14 specimens from two stations in the vicinity of Puerto San Carlos, Sonora, equally divided as to sex, show males ranging in size from 7.8 to 19.9 mm, females from 9.5 to 17 mm, those from 14.5 to 17 mm bearing ova. Crane (*op. cit.*) records a 28 mm male.

Breeding: Ovigerous females were encountered in March and early April.

Remarks: *Podochela latimanus* offers proof, if such be needed, that the Gulf of California can and does support an endemic species of *Podochela* along with one member of the genus, *P. vestita*, which ranges southward to the Bay of Panama, another, *P. lobifrons*, which ranges northward to middle California, and still another, *P. hemphilli*, which ranges both north to California and south to Panama and beyond. At first it was thought to represent merely a giant race of the widely ranging species here designated as *P. veleronis*, with which it shares many common characters. Such a parallel is to be found in the case of *Pyromaia tuberculata* (Lockington), of which Gulf of California specimens attain remarkable size, due presumably to unusually favorable ecological conditions. However, detailed comparison of the two revealed that the longer rostrum of *Podochela latimanus* persists in even small specimens, a male with a postrostral length of only 7.2 mm having a rostrum 3.8 mm long, while a 7.3 mm specimen of *P. veleronis* has a rostral length of only 1.5 mm. The antennal flagellum of *P. latimanus* is also longer, particularly the first movable segment, which in *P. veleronis* is short and stout. When mature male specimens are compared, the 7.3 mm specimen of *P. veleronis* shows an inflated manus with a suboval gape, while to show the inflated palm with its elongate gape and three teeth requires a specimen of *P. latimanus* of 23 mm or over. It was also observed that females of *P. veleronis* of only 5 and 6 mm were commonly ovigerous, while the smallest gravid female of *P. latimanus* measured

10.5 mm. Lastly, the dactyl of the fourth ambulatory leg, which approximately equals in length its propodus in *P. veleronis*, falls considerably short of this in *P. latimanus*.

***Podochela lobifrons* Rathbun**

Plate H, Fig. 1; Plate 8, Fig. 1

Podochela (Coryrhynchus) lobifrons Rathbun, 1893b, p. 226.

Podochela barbarentis Rathbun, 1924a, p. 1; type locality, off Brockway Point, Santa Rosa Island, California, 38-45 fathoms, *Albatross* station 4431; male holotype, U.S.N.M. No. 48256; 1925, p. 54, pl. 20, figs. 3, 4, text-fig. 13. Crane, 1937, p. 51.

Podochela lobifrons Rathbun, 1925, p. 57, pl. 11, figs. 3, 4, text-fig. 15.

Type: Male holotype, U.S.N.M. No. 17331, length 20.5 mm, width 18 mm.

Type locality: Off Abreojos Point, Lower California, Mexico, 58 fathoms, *Albatross* station 3044.

Localities subsequently recorded, with collectors: California: off Brockway Point, Santa Rosa Island, 38-45 fathoms, type locality of *Podochela barbarentis*, *Albatross* (Rathbun, 1924a); off Santa Catalina Island, 50 fathoms, H. N. Lowe (Rathbun, 1925). Mexico: west coast of Lower California: west of Los Coronados Islands, 48-50 fathoms, Scripps Institution (Rathbun, 1925); Cedros Island, 60 fathoms, *Zaca* (Crane); Gulf of California: Arena Bank and Santa Inez Bay, 1-50 fathoms, *Zaca* (Crane). [All the above as *Podochela barbarentis* Rathbun.]

Atlantic analogue: None. A Pacific north temperate species.

Diagnosis: Rostral spine from one-half to three-fifths carapace length. A small postorbital spine. Hepatic and pterygostomian regions tipped by a strap-shaped spine. First ambulatory leg three times length of carapace, including rostrum, its slender, unarmed dactyl equaling one-third of the propodal length. Two median tubercles on first abdominal segment. Dactylus of fourth leg equal to two-thirds length of propodus. Manus of male inflated, one tooth in gape. Curved hair count 16-18. Sternum deeply grooved.

Description: A hairy species. Cardiac region with a large conical elevation; two median gastric tubercles, the anterior the smaller; two blunt median tubercles on first segment of abdomen. A prominent strap-shaped spine on hepatic region; a small, similar one on the pterygostomian ridge, and a still smaller, postorbital spine; some spinules in

front of the angles of the buccal cavity, a few visible in dorsal view. Orbital arch finely spinulose. Rostrum a long, slender, gradually diminishing spine, varying from three-fifths, in the largest, to one-half, in the smallest, as long as the postrostral portion of the carapace. Antennae overreaching the rostrum, filiform, the movable articles of the peduncle, as well as the flagellum, unusually slender; the basal article with laminate anterior and outer margins, the latter spinulose.

Chelipeds moderately enlarged, spinulose, especially on and near the margins, and hairy, the hairs entangling mud, foraminifera, etc. A spine at outer distal end of merus; a stout, spinuliferous knob on outer surface of carpus; chela widest behind middle of palm, thence tapering to end of fingers; gape correspondingly narrow, one tooth on the dactyl at middle of gape occasionally somewhat enlarged. First ambulatory leg three times (in large specimens) as long as carapace with rostrum; merus and propodus equal, nearly twice as long as carpus and three times as long as dactylus; dactylus very slender and slightly curved. Dactyli of remaining legs falcate. In the second leg the carpus and propodus equal, nearly two-thirds as long as merus, and two and a half times as long as dactylus.

The sternum deeply grooved between segments, the tubercles in line with base of chelipeds very large and flattened anteroposteriorly. (Rathbun, 1925, modified, of *Podocheila barborensis*)

Supplementary description: Merus of external maxilliped subcordiform, longitudinally grooved, outer angle obtusely rounded, inner angle acutely produced as a thin blade, margins spinulose, and inserting deeply into the hairy and spinulose ischium; palpus coarse, pediform, first two segments inflated, first prismatic, terminal segment slender, cylindrical; all segments hairy.

Male abdomen with two median setose tubercles on first segment, segments 2-4 smooth and bare, segments 5 and 6 (including fused 7th) hairy and tuberculate, tip broadly triangular.

Material examined: 107 specimens from 40 stations, of which 19 are California, 13 west coast of Lower California, and 8 Gulf of California. (See Table 19) From Point Mugu, California, to San Cristobal Bay, Lower California, and from the north end of Angel de la Guarda Island to Outer Gorda Bank, Gulf of California. 18-110 fathoms in the open Pacific; 51-125 fathoms in the Gulf of California.

Measurements: Largest complete specimen, a male: length 20.9 mm, width 11.2 mm, rostrum 8.3 mm, cheliped 21.8 mm, chela 8.7 mm, dactyl 4.8 mm, first ambulatory leg 64 mm, second 49 mm, third 41

mm, and fourth 33.8 mm. Largest specimen, male: length 21.5 mm, width 12.5 mm, rostrum 7.5 mm. Ovigerous female: length 18.3 mm, width 10.9 mm, rostrum 4.7 mm.

Color in life: Unrecorded. Color in alcohol pale ochre, the chelipeds conspicuously banded with reddish in both sexes. (Crane, of *Podochela barbarensis*)

Habitat: Sand bottom in fully 50 per cent of the cases, often with shell included. Rock bottom in 25 per cent, with mud and coral accounting for the remainder. Crane (1937, p. 51) records sand and rocks with weed.

Depth: 18-125 fathoms; shoalward to one fathom, according to Crane (*op. cit.*).

Breeding: Females with ova were encountered most frequently in the open Pacific in June, July, and August; however, there are three February records and one January record from insular localities. An ovigerous female measuring 11.0 mm was dredged at Gorda Bank, Gulf of California, in March, along with males measuring 9.8 to 12.8 mm.

Remarks: The following note of Rathbun (1925, p. 57) concerning the holotype is pertinent to the discussion: "The type and only specimen known is of large size and in a very soft shelled condition. The front is very short and bilobed; in spite of the symmetry of the lobes, it is probable that the rostrum has been accidentally abbreviated, as the basal antennal article extends far beyond it and the antennular cavities are anteriorly incomplete."

The writer's request for a reexamination of the holotype elicited the following notes from Dr. F. A. Chace, Jr., curator of marine invertebrates, U. S. National Museum: The rostrum is probably deformed as noted by Miss Rathbun, but the only indication of this is the incomplete antennary cavities. It is so symmetrical that it appears undamaged. The postorbital lobe is spikelike in dorsal view, broad-tipped in posterior view (especially on the right side), with some denticles and many hooked hairs. There are two gastric tubercles in the midline, the posterior much the larger and almost domelike. The cardiac region is depressed due to the soft-shelled condition of the specimen, but it is apparently merely dome-shaped without a distinct tubercle. The hepatic and pterygostomial prominences are spatulate, denticulate distally. The branchial regions are largely smooth, but with a few widely scattered tubercles, especially at the margins. The basal antennal segment is convexly ridged ventrally. The merus of the maxillipeds is produced

internally. There are two sharply granulate tubercles on the midline of the first abdominal somite. The propodi of the first ambulatory legs have 18 groups of curved hairs on one side and 23 on the other, not 14, as shown in Miss Rathbun's figure (1925, text-fig. 15).

These supplementary notes make it possible to compare the holotype of *Podochela lobifrons* with other Pacific species on a more detailed basis than heretofore. Points of similarity suggesting identity of *P. lobifrons* and *P. barbarentis* are the two median tubercles on the first abdominal segment, the spatulate hepatic and pterygostomial prominences, the long first ambulatory legs, approximately three times the length of the carapace, the single tooth in the gape of the mature male cheliped, and the curved hair count of 18 or better. Granting that the rostrum of *P. lobifrons* has been broken and repaired, there remains only the difficulty of reconciling the large, spike-like postorbital spine with the usually small spine of *P. barbarentis*. The writer feels that this may be attributable to the very soft condition of the holotype, and has therefore made *P. barbarentis* a synonym of the earlier Rathbun species.

The discontinuous distribution exhibited by *Podochela lobifrons*, namely, southern California and west coast of Lower California, northern part, and Gulf of California, is shared by a number of north temperate brachyuran species. Although having approximately the same horizontal range as *P. hemphilli*, *P. lobifrons* is essentially a deep water species, occurring most frequently in depths of 50 fathoms and over. It thus competes ecologically with *P. hemphilli*, a shallow water species, only in the comparatively narrow vertical zone in which their ranges overlap.

Podochela schmitti Garth

Plate H, Fig. 2

Podochela schmitti Garth, 1939, p. 11, pl. 2, figs. 1-4; 1946, p. 371, pl. 64, figs. 3, 4.

Type: Male holotype, A.H.F. No. 382, length 12.8 mm, width 7.9 mm.

Type locality: North of Hood Island, Galapagos, 20-40 fathoms, *Velero III* station 814-38.

Localities subsequently recorded, with collectors: Galapagos Islands: Chatham, Albemarle, Daphne Major, James, and Barrington Islands, 20-80 fathoms, *Velero III* (Garth, 1946).

Atlantic analogue: None. A Galapagos endemic species.

Diagnosis: Rostral spine moderately long, terminally bifid. A prominent, lacinate, postorbital spine. Hepatic and pterygostomian regions tipped with a cylindrical spine. First ambulatory leg between two and a half and three times length of carapace, its dactylus not quite one-third propodal length. Two median tubercles on first abdominal segment. Dactylus of fourth leg two-thirds propodal length. Male manus inflated, one tooth in gape. Curved hair count 14. Galapagos only.

Description: Carapace smooth, pyriform, elevations separated by shallow grooves. One cardiac and one gastric tubercle; in front of the latter a smaller tubercle. Gastric region smooth, rounded, bearing four tufts of setae arranged in a rectangle. Branchial regions flattened, traversed by a longitudinal row of curved setae. Hepatic and pterygostomian regions tumid, each bearing a short, cylindrical spine. Rostrum acuminate, tip bifurcate, length equal to one-fourth post-rostral portion of carapace. Orbits spinulous; postorbital spine large, outer margin lacinate.

Basal antennal article narrow, externally spinulous, internally bearing a compressed ridge. Antennae long and slender, second movable article reaching tip of rostrum. Merus of third maxilliped with inner angle produced into a thin, triangular blade. Segments of male sternum deeply separated; two prominent tubercles at base of chelipeds. First abdominal segment bearing two median setose tubercles.

Chelipeds of male robust, hairy, and spinulous. Merus trihedral, curved lower margin armed with spines. Palm inflated, roughened, spinules in rows; fingers gaping broadly at basal half, a prominent tooth on movable finger. First ambulatory leg equal to two and one-half times the length of carapace, including rostrum, its dactyl straight and approximately one-third the propodal length. Second ambulatory little more than half the length of the first, third and fourth legs subequal; dactyls of legs two, three, and four falcate and from one-half to two-thirds the length of their respective propodi.

Female chelae slender, fingers almost meeting when closed, finely dentate, curving inward. First ambulatory leg twice the length of the carapace.

Material examined: 20 specimens from 10 Galapagos stations (see Garth, 1946, p. 371). Darwin Bay, Tower Island, Galapagos, shore, February 24, 1933, *Velero III* station 97-33, 1 young male.

Measurements: Male holotype: length 12.8 mm, width 7.9 mm, rostrum 2.8 mm, width 1.4 mm, cheliped 14.6 mm, chela 6.1 mm, dactyl 3.3 mm, first ambulatory leg 34 mm, propodus 12 mm, dactyl

3.7 mm, second, third, and fourth legs 18.8, 17.3, and 13.0 mm, respectively. Female paratype: length 12.3 mm, width 7.6 mm.

Color in life: Deep olive buff. (Petersen)

Habitat: Sandy bottom, associated at times with rock, mud, shell, nullipore, and coral.

Depth: 20-80 fathoms. Collected once intertidally.

Breeding: Ovigerous females ranging in size from 7.2 mm to 10.0 mm were obtained in the months of December and January.

Remarks: Caution must be exercised with respect to the first of the key characters given, that of the bifid rostrum; for experience has shown that several species of *Podochela*, notably *P. latimanus* when young and *P. veleronis* as adults, exhibit this character. With two median tubercles on the first abdominal segment, *P. schmitti* is most closely related to *P. lobifrons* (= *P. barbarentis*) of southern California, northern Lower California, and the Gulf of California. The best criteria for distinguishing one from the other are the ultimate length of the rostral spine, which in mature *P. lobifrons* may attain half or three-fifths the postrostral length of the carapace, and the shape of the hepatic and pterygostomial spines, which are compressed or strap-shaped in *P. lobifrons* but perfectly cylindrical in *P. schmitti*. This separation from *P. lobifrons* is a more important one than the distinction from *P. hemphilli* made in the original description (Garth, 1939, p. 13), for it is *P. angulata*, rather than *P. schmitti*, which complements *P. hemphilli* in equatorial latitudes.

Podochela vestita (Stimpson)

Plate H, Fig. 7; Plate 8, Fig. 3

Podonema vestita Stimpson, 1871a, p. 97.

Podochela vestita, A. Milne Edwards, 1879, p. 195. Miers, 1886, p. 11. Rathbun, 1925, p. 42, pl. 14. Crane, 1937, p. 52, pl. 1. Garth, 1948, p. 21.

Podochela (Coryrhynchus) mexicana Rathbun, 1893b, p. 225; type locality, off Adair Bay, Gulf of California, 11 fathoms; male holotype, U.S.N.M. No. 17330.

Type: The female holotype, length 13.2 mm, width 11.7 mm, was included among Stimpson's west coast material destroyed in the Chicago fire of 1871.

Type locality: Cape St. [San] Lucas, Lower California, Mexico; John Xantus, collector.

Localities subsequently reported, with collectors: Mexico: Gulf of California: off Adair Bay, 11 fathoms, *Albatross* (Rathbun, 1893b; type of *Podochela (C.) mexicana*); Arena Bank and Santa Inez Bay, 11-35 fathoms, *Zaca* (Crane); Ecuador: 01° 07' N, 79° 53' W, 9-27 m, *Askoy* (Garth).

Atlantic analogue: *Podochela riisei* Stimpson.

Diagnosis: Rostrum thin, hood-shaped, without median carina. A postorbital granule. Basal antennal article concave ventrally, outer edge bilobed. First ambulatory leg two and two-thirds to two and three-fourths times carapace length, dactyl between one-fifth and one-sixth the propodal length. Last pair of legs unusually long, dactyl one-half propodal length. Manus of adult male swollen, fingers gaping. Sternal plates deeply separated, bases of legs vermiculate. Curved hair count 6-8.

Description: A species with short neck, very high gastric region, two prominent gastric tubercles, cardiac tubercle uncommonly large, laminate, the lamina continued forward in a blunt ridge; a large, laminate, hepatic lobe, a thin pterygostomial ridge bearing a small lobe. Rostrum short, arcuate, thin. Basal antennal article anteriorly narrowed, margins thin, outer margin broadly bilobed.

Chelipeds of a probably immature male [holotype of *Podochela (C.) mexicana*] feeble, palms slightly swollen, fingers meeting. Legs slender; first one less than three times as long as carapace, its propodus slender, about seven times as long as dactylus; dactylus unarmed, slenderer, and less curved than in the other legs; fourth leg about as long as carapace; second, third, and fourth legs similar, diminishing successively, as do also their propodal segments; propodal segments a little thickened distally, that of the second leg three times as long as dactylus, that of the fourth leg twice as long as dactylus, that of the third leg intermediate; the three dactyli of the same size and form.

Sternum and basal segments of legs vermiculated. Sternal segments in the form of raised plates with sharp edges and separated by deep depressions. (Rathbun, 1925, modified)

Merus of the third maxilliped noticeably longer than broad, its anterointernal angle distinctly produced and sharpened. Dactyli of all the walking legs falcate, those of the second to fourth pairs denticulate as well. A single tubercle on the first abdominal segment. Paired tubercles in advance of the abdomen and at the base of the chelipeds wanting, but their place taken by an obtusely angled, spinulose ridge. Orbital margins hairy and finely denticulate.

Supplementary description: The following is not necessarily at variance with the earlier descriptions of Stimpson and of Rathbun, but will serve to translate their generalities into specific terms. The relatively short rostrum occupies between one-sixth and one-seventh of the postrostral portion of the carapace, the ratio in the male being 1: 6.33, in the female 1: 6.45. The first ambulatory leg is less than three times the total length of the carapace, the ratio in the male being 2.61:1, in the female 2.75:1. The dactylus of the first ambulatory leg is between one-fifth and one-sixth the length of its propodus, the ratio being 1:5.5 in both sexes. The dactylus of the fourth leg occupies slightly less than half the length of its propodus in the male, slightly more than half in the female. The gradual shortening of the walking legs, which decrease regularly in the male in the ratio of 2.6, 2.2, 1.8, and 1.6 times the carapace length, and the relative attenuation of the hinder pair is characteristic of the species. The number of clusters of curved hairs which may be counted along the anterior margin of the propodus of the first walking leg varies from 6 to 8.

In arriving at the foregoing proportions, a female specimen of 14.9 mm and a male of 12.6 mm were used. The latter, while larger than the specimen measured by Rathbun, is by no means mature. Crane (1937, p. 52) records a male and female from the Gulf of California measuring 21.5 mm and 20.0 mm, respectively. In view of the absence of specimens of similar size among Hancock expedition material, the following is extracted from her description:

"The rostrum, instead of being rounded, is bilobed in all the specimens, the lobes being conspicuous and unequal in the large male and female; . . . along the margins of the rostrum is a row of spinules . . . The vermiculations [of the sternum] are spinulose, especially in the large specimens.

"The cardiac protuberances of the adults are higher and more compressed and scarcely continued forward; the hepatic and pterygostomial lobes are relatively more developed; the outer margin of the basal antennal article is more conspicuously bi-lobed; and, finally, the manus of the adult male is considerably, instead of slightly, swollen, the fingers gaping instead of meeting at the base."

Crane asserts that the characters mentioned as at variance with earlier descriptions may be attributed to the greater age of the specimens. With this the present writer agrees, and, having examined the large male from *Zaca* station 136, would add that the bilobation of the front is not as striking a character as one might be led to believe from

Crane's description, quoted above, being but a slight emargination caused by failure of the two sides of the front to fuse completely along the midline.

Material examined: (See Table 20) A total of 41 specimens from 25 stations, ranging from Hughes Point, Lower California, and Rocky Point, Sonora, Mexico, to Gorgona Island, Colombia, and including Socorro Island. The largest series, from Isabel Island, Mexico, contains 7 males and 4 females, the remaining stations but one or two specimens each. In addition to the above, a male specimen from Arena Bank, Gulf of California, Mexico (N.Y.Z.S. No. 36,697) (Crane, 1937, p. 52).

Measurements: Largest specimen, a female: length 14.9 mm, width 11.9 mm, rostrum 2.0 mm, cheliped 17.5 mm, chela 6.5 mm, dactyl 3.8 mm, legs 41, 30.5, 26.5, and 25.3 mm, respectively. Male specimen: length 12.6 mm, width 9.8 mm.

Color in life: Adults, reddish-brown, the chelae speckled with scarlet. Young male, pale buffy-yellow; chelae speckled with scarlet; bases of ambulatories tinged with pink. (Crane)

Habitat: Recovered most frequently from sandy bottoms, often with shell or nullipores present; less frequently encountered on bottoms of coralline algae, sandy mud, and coral. Crane (1937, p. 52) gives sandy bottoms with weed.

Breeding: Ovigerous females were taken in March, April, and May in the northern, or Gulf of California, portion of the range, and in January and February in the southern, or Colombia, portion.

Depth: Hancock expeditions material is from 2-30 fathoms (an Ildefonso Island specimen, from 50 fathoms, is young and of questionable identity).

Remarks: A concave basal antennal article is common to the subdivision of the genus characterized by a hood-shaped rostrum, which includes the Atlantic *Podochela riisei*, *P. sidneyi*, and *P. algicola*, as well as the Pacific *P. vestita* and *P. margaritaria*. It would appear that none of its describers have done justice to this striking feature, due either to their familiarity with this character as exhibited in Atlantic species, or to the failure of their Pacific material to exhibit it to the perfection seen in *Velero III* specimens. As viewed from the ventral aspect, the basal article appears semicylindrical, the concavity broadest at the base. If a tiny probe is inserted into this concavity, the lamelli-form processes of the two margins curl upward about it, that of the inner surface a single, that of the outer surface a double lobe.

The range of the species is extended northward to Hughes Point on the west coast of Lower California and to Rocky Point in the Gulf of California, westward to the Revilla Gigedo Islands, shoreward to 2 fathoms, and downward to 50 fathoms. The irregularity of distribution should be noted: south of Tres Marias Islands, Mexico, there is no record of occurrence to Secas Islands, Panama. An *Askoy* capture (Garth, 1948) extends the *Velero III* series southward from Colombia to Ecuador.

***Podochela margaritaria* Rathbun**

Plate H, Fig. 8

Podochela margaritaria Rathbun, 1902b, p. 283, pl. 12, fig. 2; 1910, p. 570; 1925, p. 43, pl. 15; pl. 209, fig. 1. Boone, 1927, p. 132, fig. 35. Garth, 1946, p. 369, pl. 64, figs. 5, 6.

Type: Male holotype, U.S.N.M. No. 24834, length 15 mm, width 11 mm.

Type locality: Tagus Cove, Albemarle Island, Galapagos Islands, 12 fathoms, Hopkins-Stanford expedition.

Localities subsequently reported, with collectors: Galapagos Islands: Albemarle, James, Marchena [Bindloe], Indefatigable, and Hood Islands, 3-70 fathoms, *Velero III* (Garth).

Atlantic analogue: None.

Diagnosis: Rostrum thin, hood-shaped, a sharp median carina. Postorbital granule wanting. Basal article of antenna concave ventrally. First ambulatory leg two and three-quarters times carapace length, dactyl between one-fifth and one-sixth length of propodus. Male manus inflated, spinulose, but not gaping. Sternal plates separated, sternum and bases of legs granulate. Curved hair count 8. Galapagos only.

Description: Carapace about one and a third times as long as wide, gastric and cardiac regions very high, each surmounted by a tubercle. Hepatic region with a prominent tubercle projecting downward below the lateral line. No postorbital lobe. Front long and hood-shaped, posterior part flat and thick, the anterior and outer part thin, hollow beneath and with a sharp median crest above. Marginal crests of the basal segment of the antennae thin and finely denticulate. Pterygostomial region armed with a tubercle. Sternum and outer portions of the abdomen covered with pearly granules.

Palms of the chelipeds strongly inflated; fingers narrowly gaping when closed. Ambulatory legs diminishing rapidly and uniformly in

length from the first to the fourth. Dactyli varying little in length; the distal portion of the propodi of last three pairs slightly thickened and curved. (Rathbun, 1902b, modified)

The brief last paragraph of the original description was later expanded as follows: Basal antennal article narrowed anteriorly, deeply concave, lateral margins prominent. Chelipeds moderately roughened, chiefly on the margins, a few tubercles on the carpus, manus swollen, fingers narrowly gaping except near tips. Legs of moderate length, first pair two and a half [two and three-fourths] times length of carapace, dactylus short, slender, curved, propodus five times as long as dactylus. Remaining legs respectively twice, one and two-thirds and one and a half times the carapace length; dactyli of similar length and curvature, the second a little slenderer. Propodites distally thickened and bent upward, the amount of thickening increasing from second to fourth leg. The second propodus two and a half times its dactylus, the third twice, and the fourth a little less than twice its dactylus. (Rathbun, 1925)

Supplementary description: The merus of the external maxilliped is produced at the anterointernal angle. There is a single tubercle on the mid-line of the first abdominal segment of the male, and a pair of tubercles in advance of the abdomen and opposite the coxae of the chelipeds.

Material examined: 50 specimens from 24 Galapagos stations (see Garth, 1946, p. 369).

Measurements: Largest male, rostrum damaged: length 14.3 mm, width 12.1 mm, cheliped 20.2 mm, chela 9.2 mm, dactyl 4.7 mm, first ambulatory leg 42.4 mm. Ovigerous female: length 15.6 mm, width 12.4 mm (largest specimen of record).

Color in life: Frontal, gastric, and cardiac areas brick red. Branchial areas a little lighter and with a few light patches. Chela carrot red. Ventral side dark coral pink. Eye brownish black. (Petersen)

Habitat: Rock, sand, shell, coral, and nullipore bottoms. (Garth)

Depth: 3-70 fathoms.

Breeding: Ovigerous females of a size range from 7.9 to 15.6 mm were dredged by the *Velero III* in the months of December and January.

Remarks: A Galapagos endemic species, *Podochela margaritaria* is undoubtedly related to American mainland forms through *P. vestita*, from which it may be distinguished by its more sharply produced and medially carinate rostrum, by the absence of a postorbital granule, and by the granulate, rather than vermiculate, sternum of the male. The

female is described (Garth, 1946, p. 371) as having a sternum consisting of a series of convoluted ridges leading to the bases of the walking legs in the manner of *P. vestita*. A single specimen of *Podochela* from the Revilla Gigedo Islands which has evolved along parallel lines, but of which insufficient material exists upon which to base a separate species, is included with material examined under *P. vestita*.

Podochela ziesenhennei Garth

Plate H, Fig. 9; Plate 8, Fig. 5

Podochela ziesenhennei Garth, 1940, p. 58, pl. 13, figs. 1-6.

Type: Male holotype, U.S.N.M. No. 78780, length 11 mm, width 7.8 mm.

Type locality: Tenacatita Bay, Jalisco, Mexico, 4-10 fathoms, *Velero III* station 122-33.

Additional localities reported, with collectors: Ecuador: Salango Island, 8 fathoms, *Velero III* (Garth).

Atlantic analogue: None. (See *Remarks* below)

Diagnosis: Rostrum short, thick, triangular. Carapace triangular; gastric region high and broad. Hepatic regions little projecting; no outward flare at base of ambulatories. Basal antennal article broad, ridged. First walking leg two and one-quarter times carapace length, dactylus almost half as long as propodus. Propodi of legs three and four falcate and with a thumb process against which dactyli fold. Male manus short and high, swollen, but not gaping. Curved hair count 9.

Description: Carapace narrowly triangular, branchial and intestinal regions depressed. Rostrum thick, bluntly triangular, length and breadth subequal, two double rows of short, curved setae. Orbits circular, unarmed; a minute postorbital granule. Hepatic regions projecting but little beyond lateral contour. Gastric region high, broad, surmounted by four groups of setae arranged in a rectangle but with no median tubercle. Cardiac elevation small, nontuberculate, and set off from branchial and intestinal areas. Branchial regions low, traversed by a longitudinal row of curved setae, sides not produced laterally to cover insertions of ambulatory legs. Body and appendages densely pilose.

Antennae visible at sides of rostrum; basal article broad, traversed by a median ridge; flagellum short, second free segment overreaching rostrum. External maxilliped with merus longer than broad, sides diverging anteriorly, anterointernal angle not produced, internal margin spinulose. Two low hairy ridges on sternum opposite coxae of chelipeds in place of usual tubercles.

Cheliped of male one and one-sixth times as long as carapace. Merus half as broad as long, inferior border hairy. Carpus without spines but with an inner setose margin. Manus tumid, length and height subequal, outer surface convex, pilose, margins setaceous. Fingers short, hairy, denticulate, meeting with a gape in the proximal two-thirds with one tooth of the dactyl conspicuous. Cheliped of female slightly less than length of carapace, hand more slender, fingers longer, almost meeting when closed.

Ambulatory legs relatively short and stout. First leg of male twice as long as carapace, dactyl one-third as long as propodus. Second, third, and fourth legs decreasing in order. Dactyli of all legs, including first, falcate, inner margins denticulate. Propodi of legs three and four stout, as strongly curved as their dactyli, each with a basal tuft of hair suggesting a thumb process against which the dactyl folds. (Garth, 1940, abridged)

Male abdomen with a prominent tubercle on first segment.

Supplementary description: To afford a more direct means of comparison with other species treated, the following additional information is given. The length of the rostrum in proportion to the postrostral portion of the carapace varies from one-sixth in the type specimen, a male, to one-twelfth in a 9.5 mm female, the ratios being 1: 6.18 and 1:12.4, respectively. The length of the first ambulatory leg as compared to the total length of the carapace is two and a quarter times in the male and one and three-quarters times in the female, the ratios being 2.27:1 and 1.73:1, respectively. The ratio of the first ambulatory leg to its propodus is 2.27:1 in the male and 2.77:1 in the female, which is more than the one-third mentioned in the original description. The proportion of the dactyl of the fourth ambulatory leg to its propodus is approximately 4:5. The number of clusters of curved hairs which may be counted along the propodal segment of the first leg is 9 in the female.

Material examined: 10 specimens from 7 stations, including three in Mexico and one each in Costa Rica, Panama, Colombia, and Ecuador. (See Table 21)

Measurements: Male holotype: length 11.0 mm, width 7.8 mm, cheliped 13.0 mm, chela 5.4 mm, dactyl 2.4 mm, first leg 26.0 mm. Female: length 9.5 mm, width 7.4 mm, rostrum 0.7 mm, cheliped 10.0 mm, chela 4.0 mm, dactyl 1.7 mm, legs 16.5, 13.3, 12.8, and *ca.* 9.0 mm.

Color in life: Not known.

Habitat: Rocky bottom in three of five instances, the others being sand and sand with mud.

Depth: Shore to 10 fathoms.

Breeding: An ovigerous female measuring 8.0 mm was obtained at Playa Blanca, Costa Rica, in February, 1935, and an 11.0 mm female at Acapulco, Mexico, in February, 1954.

Remarks: The early confusion of this species with *Podochela angulata* and this author's care to distinguish one from the other (Garth, 1940, p. 60) appear to have been unnecessary now that Finnegan's species has been identified with certainty and the male described. Actually, *P. angulata* is very close to *P. hemphilli*, whereas *P. zeisenhennei* bears little resemblance to either, having a blunt rostrum and short, stout legs with falcate dactyls. The strikingly dissimilar male first pleopod (Plate H, fig. 9) bears out this difference. Its relatives are rather *P. grossipes* and *P. macrodera* of the Atlantic; but it does not appear to be strictly analogous to either.

Genus STENORYNCHUS Lamarck²

Leptopodia Leach, 1815a, p. 15; type: *Maia sagittaria* Leach, 1814=
Cancer seticornis Herbst, 1788. Not *Leptopodia* Leach, 1814, p. 431=*Macropodia* Leach, 1814.

Stenorynchus Lamarck, 1818, p. 236 (part). Rathbun, 1897, p. 158 (type designated); 1925, p. 13.

Type: The Atlantic *Cancer seticornis* Herbst, 1788, type of *Stenorynchus* Lamarck by subsequent designation of Rathbun, 1897.

Description: Carapace triangular, longer than broad, smooth. Rostrum very slender, flattened, longer than the carapace, its lateral margins spinuliferous. Orbits not defined; postorbital spine small. Eyes short, not retractile. Basal article of antenna very slender; flagellum concealed beneath the rostrum. Epistome very large. Ischium of external maxillipeds produced at its anterointernal angle; merus somewhat obcordate, bearing the next article at its external angle. Chelipeds long and slender, with merus, carpus, and palm subcylindrical; fingers much shorter than palm, inner margins dentate. Ambulatory legs extremely long and slender, especially the dactyli. All the legs spinuliferous.

Abdomen in male six-segmented, in female five-segmented. (Rathbun, 1925)

²Use of the name *Stenorynchus* for the genus here treated is contingent upon exercise by the International Commission on Zoological Nomenclature of its plenary powers in validating the generic name *Stenorynchus* Lamarck, 1818, and the selection by Rathbun (1897) of *Cancer seticornis* Herbst, 1788, as its type species, as requested by J. S. Garth and L. B. Holthuis, proposal submitted January 12, 1953.

Range: From Magdalena Bay, west coast of Lower California, and Consag Rock, Gulf of California, Mexico, to Valparaiso, Chile, including the Revilla Gigedo and Galapagos Islands; in the Atlantic from Cape Hatteras, North Carolina, to Rio de Janeiro, Brazil, thence to northwest coast of Africa. Shore to 78 fathoms. Atlantic and Pacific species strictly analogous.

Stenorynchus debilis (Smith)

Plate B, Fig. 7; Plate 9

Leptopodia sagittaria Bell, 1835b, p. 169; 1836, p. 40. Milne Edwards and Lucas, atlas, 1842, pl. 4, figs. 3, 3a-c; 1843, p. 3. Nicolet, 1849, p. 121 (part). A. Milne Edwards, 1878, p. 172 (part). Miers, 1886, p. 3 (part). Cano, 1889, pp. 101, 170. (Not *L. sagittaria* Leach, 1815a, p. 16, pl. 67; not *Cancer sagittarius* Fabricius, 1793, p. 442.)

Leptopodia debilis Smith, 1871, p. 87. Lockington, 1877c, p. 75. Rathbun, 1894, p. 44. Faxon, 1895, p. 5.

Leptopodia sagittaria var. *modesta* A. Milne Edwards, 1878, p. 173; type locality, Chile; type in Paris Museum.

Stenorynchus debilis, Rathbun, 1898, p. 568; 1902b, p. 283; 1910, p. 570; 1923b, p. 633; 1924c, p. 377; 1925, p. 18, pls. 4, 5, text-fig. 4. Boone, 1927, p. 131, fig. 34. Finnegan, 1931, p. 617. Crane, 1937, p. 50. Meredith, 1939, p. 106 (figured). Steinbeck and Ricketts, 1941, p. 465. Garth, 1946, p. 366, pl. 63, fig. 1; 1948, p. 20; 1957, p. 18. Buitendijk, 1950, p. 271.

Type: Male holotype, M.C.Z. No. 3948, length 29.5 mm, width 9.9 mm.

Type locality: Polvon, Bay of Realejo [Corinto], Nicaragua, J. A. McNiel, collector.

Localities subsequently reported, with collectors: Mexico: west coast of Lower California: Magdalena Bay and Cape San Lucas, *Albatross* (Rathbun, 1898); Gulf of California: west coast, W. J. Fisher (Lockington); Patos Anchorage, Fred Baker (Rathbun, 1924c); San Lucas Bay, Gorda Banks, Arena Bay, and Santa Inez Bay, *Zaca* (Crane); Tiburon Island (Steinbeck and Ricketts); Guaymas Bay, Sonora, M. Cardenas (Buitendijk); Bay of Panama: Panama, *Vettor Pisani* (Cano), F. H. Bradley (Smith), *Albatross* (Faxon); Perlas Islands, F. H. Bradley (Smith), *St. George* (Finnegan), *Askoy* (Garth, 1948); Guayabo Chiquito, *Askoy* (Garth, 1948); Colombia: Gorgona Island, *St. George* (Finnegan), *Askoy* (Garth, 1948); Octavia Bay and Utria

Bay [Port Utria], *Askoy* (Garth, 1948); Ecuador: Galapagos Islands, Hopkins Stanford Expedition (Rathbun, 1902b), *Arcturus* (Boone), *St. George* (Finnegan), *Velero III* (Garth, 1946); Chile: Valparaiso, H. Cuming (Bell, 1835b), (Milne Edwards and Lucas).

Atlantic analogue: Stenorynchus seticornis (Herbst).

Diagnosis: Rostrum as long as, or longer than remainder of carapace, its lateral margins spinulose. A small spine located at end of basal article of antenna. Legs exceedingly long and slender.

Description: Male. Carapace naked, or minutely pubescent, and smooth; the branchial regions swollen. Rostrum about twice as long as the posterior portion of the carapace, slender, cylindrical, armed with a row of spines on each side, and sparsely hairy toward the extremity. A strong spine on the basal segment of the antenna and a similar spine on each side just behind the orbit.

Chelipeds equal, slender, reaching nearly to the distal extremity of the carpus of the first ambulatory leg; ischium with a few small spines on the inner side; merus not quite as long as the hand, cylindrical, armed with several spines along the side, and with three stout ones on the inner side at the articulation of the carpus; carpus with two or three small spines on the outer side and two at the distal extremity on the inner side; basal portion of the hand cylindrical and smooth but thickly covered with a minute pubescence; fingers nearly as long as the basal portion of the hand, sparsely hairy, slender, nearly straight horizontally but curved inward laterally at the tips, slightly channeled longitudinally, the prehensile edges approximate, toothed toward the base, and serrate toward the extremity, the serrations of the dactylus fitting accurately those of the propodus.

Ambulatory legs slender, cylindrical, and slightly pubescent; meral segments armed with scattered spines, most of them on the distal two-thirds of the length; carpi with two or three spines about the middle, and four at the distal extremities; propodi armed with small, scattered spines and spinules; dactyli beset with numerous spinules.

First segment of the abdomen nearly as long as broad; second broader and very short; third broadest of all the segments, the lateral margins projecting into angles next the second segment and rapidly converging toward the fourth; fourth narrowing very rapidly to the fifth; fifth segment twice as broad as long, the lateral margins at first converging rapidly and then only slightly toward the sixth; terminal article, composed of the sixth and seventh segments, completely anchylosed, about twice as long as broad, the extremity angular but with the point rounded. (Smith, modified)

Material examined: (See Table 22) 332 specimens from 106 stations, of which 60 were in the Gulf of California. The remaining 46 stations may be grouped as follows: Mexico south of Cape Corrientes, 5; Costa Rica, 15; Panama, 14; Colombia, 6; Ecuador, 2; Revilla Gigedo Islands, 2; Cocos Island, 2. For complete data concerning Galapagos Islands specimens, of which an additional 26 from 12 stations were collected by the *Velero III*, see Garth (1946, p. 367). Patos Island Anchorage, Gulf of California, Mexico, April 23, 1921, 4.5 fathoms, Fred Baker, collector, 1 female (of 2 females identified by M. J. Rathbun) (C.A.S.).

Measurements: For ease in comparing a male and female of like size, both specimens from *Velero III* station 571-36, Gulf of California, the following table is presented. It will be seen that difference in total lengths is compensated for by the greater rostral length of the male. The much smaller dimensions of the female cheliped should also be noted. Measurements are in millimeters.

| | Male | Female |
|-------------------|------|--------|
| Length | 38 | 34 |
| Width | 14 | 15 |
| Length of rostrum | 22 | 18 |
| Cheliped | 64 | 41 |
| Chela | 29 | 18 |
| Dactyl | 11 | 9 |
| Leg 1 | 118 | 105 |
| Leg 2 | 106 | 92 |
| Leg 3 | 84 | 73 |
| Leg 4 | 74 | 65 |

Color in life: Gulf of California specimens: Carapace always marked with narrow vertical and oblique, alternate stripes of dark brown, white and buff. Rostrum and all legs except chelipeds reddish-brown or dull lavender mottled or barred with buff. Merus of chelipeds of adult male pale buff, the palm and fingers olive; merus of chelipeds of female and young like other legs, the palm and fingers bright orange. Carapace coloration of young like that of adult, except that the body stripes are much paler, the dark brown of grown specimens being faint tan. Eggs deep cream. (Crane) (Cf. Garth, 1946, p. 367)

Habitat: Analysis of station data shows that in about 40 per cent of the cases *Stenorynchus debilis* was dredged from sand bottom, associated with shell and rock to a minor extent. In 20 per cent of the cases rock was the dominant substrate, with sand and nullipores occasionally present.

In another 20 per cent the bottom was predominantly mud, with sand frequently present. The final 20 per cent is divided equally between coralline and coral bottom, the latter divided again between dead nullipores and living *Pocillopora*. Crane (1937) records bottoms ranging from muddy or shelly to sandy or rocky with weed.

Depth: Shore to 60 fathoms; exceptionally, as at Gorda Banks, to 78 fathoms.

Size and sex: In view of the small size of the Hancock Galapagos specimens previously reported (Garth, 1946, p. 367), it is gratifying to find that mainland, and particularly Gulf of California, stations yielded some of the largest, if not the largest, specimens of *Stenorynchus debilis* on record. At least half a dozen individuals were noted which exceeded the 27 mm males and 28 mm females recorded by Crane (1937, p. 50) from among a series of 54 individuals from the Gulf of California. The measurements of the male given above exceed those of the type specimen, a 29.5 mm male, as well as those of a 34.6 mm male measured by Rathbun (1925, p. 19). The Hancock series includes young as small as 4 mm in size, some of the smallest having been cracked from *Pocillopora* coral.

Breeding: Females with eggs were found which measured as little as 15 mm in length, although this is to be regarded as exceptional, 20 mm being the customary minimum. February and March were the months in which ovigerous females were encountered, both in the Gulf of California and in the Bay of Panama, with an earlier January date in the Revilla Gigedo Islands and in Colombia. This reflects the dates of visitation by the *Veleo III*, however, rather than the probable later dates of maximum egg bearing.

Remarks: In following the historical treatment accorded the species, we find that Bell, rather than Milne Edwards and Lucas, was the first to record *Stenorynchus* from the Pacific coast, specimens having been obtained by Hugh Cuming at Valparaiso circa 1829. Authors subsequent to Bell continued to refer Pacific specimens to the Atlantic species under the name of *Leptopodia sagittaria* Leach (1815a) [or *Cancer sagittarius* Fabricius (1793), unaware that *Cancer seticornis* Herbst (1788) had priority]. Even after the appearance of the description of Pacific material as *Leptopodia debilis* Smith (1871), A. Milne Edwards continued to regard Atlantic and Pacific material as conspecific, going so far as to propose the name *Leptopodia sagittaria* var. *modesta* (1878) for the form found at Valparaiso.

As recently as Rathbun (1925, p. 18), the definitive character relied upon in separating *Stenorynchus debilis* from *S. seticornis* was the presence of a small supplementary spine on the basal antennal article of the former. Since a figure of the male copulatory appendage of *S. seticornis* has been available from the time of Brocchi (1875, pl. 19, fig. 176), it is surprising that no one has compared with it the corresponding member of *S. debilis*. The male first pleopod of *S. debilis* (Plate B, fig. 7) shows good differentiation from that of the Atlantic species, and may be considered a specific character.

Subfamily OREGONIINAE, new subfamily

Inachinae Alcock, 1895 (part: *Oregonia*) + *Pisinae* Alcock, 1895 (part: *Hyas* and *Chionoecetes*).

Male abdomen terminally broadened, last segment subquadrate or transversely ovate, invaginated into sixth segment, its outer border emarginate or introverted.

Male first pleopod lanceolate, longitudinally grooved, provided with numerous filamentous setae, and having a bulbous base.

In erecting the subfamily on the above two characters no reference is made to orbital configuration, differences in which have led to the previous wide systematic separation between *Oregonia* on the one hand and *Hyas* and *Chionoecetes* on the other. It will be noted that as one proceeds from *Oregonia* to *Chionoecetes*, the exorbital spine tends to be absorbed in the laterally expanded hepatic region, the sides of the carapace to become vertical and delimited from the dorsal surface by a sharply defined ridge. It is actually more difficult to reconcile the orbit of *Oregonia gracilis* with that of *O. bifida* than it is to relate that of *O. bifida* to the remainder of the series.

The pleopods of *Chionoecetes* are not as different from those of *Oregonia* and *Hyas* as would at first appear, due to the fact that the *Chionoecetes* species, with the exception of *C. opilio*, are represented in the accompanying figures (Pl. I, figs. 5-9) by young specimens. Examination of the pleopods of young *C. bairdi*, *C. tanneri*, and *C. angulatus* reveals more filaments than shown, some of which are arranged in supplementary rows. The linear opening is present as a linear groove in the other genera; whether it is open throughout its length or only at the end could not be ascertained. The bulbous base, not shown, is a common character.

In a personal communication, Josephine F. L. Hart (Mrs. C. G. Carl) states that the zoea of *Oregonia gracilis* is very similar to those of *Hyas araneus* and *H. coarctatus*, both of which are quite different from those of *Chorilia longipes* and *Scyra acutifrons* of the Pisinae, species which she has hatched. Full taxonomic weight should be accorded this important developmental consideration.

Distribution circum-Arctic, extending to north temperate waters of both Pacific and Atlantic oceans. That this subfamily formerly enjoyed a more extensive range is indicated by Imaizumi (1952, p. 179), who reviews the genus *Hyas* and reports fossil species from the Helvetian of Austria, the Wakkanai of Japan, and the Sahelian of Oran. These are middle to upper Miocene formations.

KEY TO THE GENERA OF THE SUBFAMILY *Oregoniinae*

- 1a. Carapace considerably longer than broad; rostrum elongate. Cheliped of adult male either longer than walking legs, or very little shorter; ambulatory legs subcylindrical. Male abdomen with sixth segment increasing in width distally.
 - 2a. Carapace subtriangular or suboblong. Postorbital spine remote from eye, affording no concealment. First movable article of antenna not broadened and flattened. *Oregonia*
 - 2b. Carapace lyrate, hepatic lobe prominent. Postorbital tooth closer to eye, cupped, affording partial concealment. First movable article of antenna broadened and flattened. *Hyas*
- 1b. Carapace either broader than long, or very little longer than broad; rostrum short. Cheliped of adult male much shorter than walking legs; ambulatory legs compressed. Male abdomen with sixth segment decreasing in width distally. *Chionoecetes*

Genus OREGONIA Dana

Oregonia Dana, 1851a, pp. 270; 1851b, p. 431; 1852, p. 105; 1853, p. 1421. Rathbun, 1925, p. 70.

Type: Oregonia gracilis Dana, by subsequent designation of Miers (1879c, p. 646).

Description: Carapace subtriangular or suboblong, moderately convex and tuberculate; a large postorbital, but no preorbital spine; rostral spines slender. Antennae visible in dorsal view at sides of rostrum, basal article narrow. Merus of maxillipeds distally truncate, bearing the palpus at its

anteroventral angle. Chelipeds in male much elongated, somewhat enlarged; palm long, compressed and distally widened. Ambulatory legs of moderate length, slender, and decreasing regularly in length. Abdomen composed of seven distinct segments. (Rathbun)

The admission to the genus of a second species, *Oregonia bifurca* Rathbun (1902a), in which the rostral spines are divergent rather than contiguous, called for modification of the original description of Dana (1851a), perpetuated by Holmes (1900) and Schmitt (1921). This was done most acceptably by Rathbun (1925, above), although without mention of the broad terminal male abdominal segments common to both species and to *O. mutsuensis* Yokoya (1928).

The superficiality of the similarity to *Eurypodius* Latreille, mentioned in Dana's description and referred to in subsequent accounts, which conveniently ignores this salient feature of the male abdomen, was exposed by Balss (1929), who removed Latreille's genus from its time-honored position next *Oregonia* in the systematic arrangement and placed it following *Macrocheira* De Haan in the most primitive section of the subfamily Inachinae. The male first pleopod with its filamentous appurtenances suggests that *Oregonia* finds its true relationship with *Hyas* and *Chionoecetes*, with them forming a natural group of circum-Arctic distribution, of which *Oregonia*, with its more open orbits, is the primitive member.

Range: From Bering Sea to Monterey Bay, California. Shallow water to 764 fathoms. Occurs also in Japan.

KEY TO THE PACIFIC AMERICAN SPECIES OF *Oregonia*

- 1a. Rostral horns long and parallel. Postorbital spine remote from eye, lanceolate, outwardly directed. Carapace narrow at hepatic level. Dactyls of ambulatory legs short and stout. . . *gracilis*
- 1b. Rostral horns short and divergent. Postorbital spine close to eye, triangular, forwardly directed. Carapace wider at hepatic level. Dactyls of ambulatory legs long and slender. . . *bifurca*

Oregonia gracilis Dana

Plate I, Fig. 2; Plate 10; Plate 11, Fig. 1

Oregonia gracilis Dana, 1851a, p. 270; 1852, p. 106; atlas, 1855, pl. 3, figs. 2a-c. Stimpson, 1857b, p. 456. Spence Bate, 1866, p. 269. Lockington, 1877c, p. 74. Miers, 1879c, p. 646. S. I. Smith, 1880, p. 209. Newcombe, 1893, p. 21; 1898, p. 76. Rathbun, 1894, p. 59; 1904, p. 171; 1925, p. 71, pls. 24, 25, text-figs. 19, 20. Calman, 1898, p. 260. Walker, 1898, p. 274. Doflein, 1899, p. 183. Holmes,

1900, p. 19. Lenz, 1901, p. 453. Taylor, 1912, pp. 191, 208. Way, 1917, p. 369, fig. 20. Schmitt, 1921, p. 198, text-figs. 122a, 122b. Johnson and Snook, 1927, p. 365, text-fig. 315. G. M. Smith, 1928, pp. 164, 165. Yokoya, 1928, p. 765; 1933, p. 141, p. 210. Hart, 1930, p. 105; 1940, p. 97. MacKay, 1931, p. 187; 1944, p. 149, text-fig. 2. Shen, 1932, p. 48, text-figs. 23, 24, 25. Clemens, 1933, p. 51. Ricketts and Calvin, 1939, p. 249. Stephensen, 1945, p. 218. *Oregonia hirta* Dana, 1851a, p. 270; type locality, Puget Sound; type not extant; 1852, p. 107; atlas, 1855, pl. 3, figs. 3a, 3b. Stimpson, 1857b, p. 546. Spence Bate, 1866, p. 269. Lockington, 1877c, p. 75. Whiteaves, 1878, p. 471.

Oregonia longimana Spence Bate, 1864, p. 663; type locality, Esquimalt Harbor, Vancouver Island; type in British Museum; 1865, p. 487; 1866, p. 267, pl. facing p. 262, fig. 5.

Type: Male cotype, M.C.Z. No. 1232, length 30.2 mm, width 21.2 mm, *vide* Schmitt.

Type locality: "In maris Oregonensis freto Puget." Puget Sound [Washington], collected by U. S. Exploring Expedition, C. Pickering.

Eastern Pacific localities subsequently reported, with collectors: Alaska: (See below). British Columbia: Mouth of Nass River and near Prince Rupert, D. C. G. MacKay (MacKay); Virago Sound, Queen Charlotte Islands, 8-15 fathoms (S. I. Smith); Port Simpson and Queen Charlotte Island, Dr. Dawson (Newcombe); Tasu Harbor, Moresby Island, Queen Charlotte Islands (Hart); Banks Island and Albert [Alert?] Bay, G. W. Taylor (Taylor); west coast of Vancouver Island: Esperanza Inlet, Nootka Sound, Clayoquot Sound, Barkley Sound (Hart); Clayoquot Sound (Newcombe); east coast of Vancouver Island: Departure Bay and Victoria, G. W. Taylor (Taylor); Victoria to Comox (Newcombe); Sidney, G. M. Smith (G. M. Smith); Gonzales Point (Hart); Esquimalt Harbor, type locality of *Oregonia longimana* (Spence Bate); Gulf of Georgia, 15-70 fathoms, J. Richardson (Whiteaves).

Washington: Puget Sound, Columbia University Expedition, Bashford Dean (Calman); Friday Harbor, Brown Island, Canoe Island, Minnesota Reef (Way).

California: Golden Gate, 39-41 fathoms (Schmitt); Monterey Bay, deeper water (Doflein).

For 84 stations from Bristol Bay, Bering Sea, to Heceta Bank, Oregon, and from 5-212 fathoms, collected by the *Albatross* (Rathbun,

1900, p. 19. Lenz, 1901, p. 453. Taylor, 1912, pp. 191, 208. Way, 1917, p. 369, fig. 20. Schmitt, 1921, p. 198, text-figs. 122a, 122b. Johnson and Snook, 1927, p. 365, text-fig. 315. G. M. Smith, 1928, pp. 164, 165. Yokoya, 1928, p. 765; 1933, p. 141, p. 210. Hart, 1930, p. 105; 1940, p. 97. MacKay, 1931, p. 187; 1944, p. 149, text-fig. 2. Shen, 1932, p. 48, text-figs. 23, 24, 25. Clemens, 1933, p. 51. Ricketts and Calvin, 1939, p. 249. Stephensen, 1945, p. 218. *Oregonia hirta* Dana, 1851a, p. 270; type locality, Puget Sound; type not extant; 1852, p. 107; atlas, 1855, pl. 3, figs. 3a, 3b. Stimpson, 1857b, p. 546. Spence Bate, 1866, p. 269. Lockington, 1877c, p. 75. Whiteaves, 1878, p. 471.

Oregonia longimana Spence Bate, 1864, p. 663; type locality, Esquimalt Harbor, Vancouver Island; type in British Museum; 1865, p. 487; 1866, p. 267, pl. facing p. 262, fig. 5.

Type: Male cotype, M.C.Z. No. 1232, length 30.2 mm, width 21.2 mm, *vide* Schmitt.

Type locality: "In maris Oregonensis freto Puget." Puget Sound [Washington], collected by U. S. Exploring Expedition, C. Pickering.

Eastern Pacific localities subsequently reported, with collectors: Alaska: (See below). British Columbia: Mouth of Nass River and near Prince Rupert, D. C. G. MacKay (MacKay); Virago Sound, Queen Charlotte Islands, 8-15 fathoms (S. I. Smith); Port Simpson and Queen Charlotte Island, Dr. Dawson (Newcombe); Tasu Harbor, Moresby Island, Queen Charlotte Islands (Hart); Banks Island and Albert [Alert?] Bay, G. W. Taylor (Taylor); west coast of Vancouver Island: Esperanza Inlet, Nootka Sound, Clayoquot Sound, Barkley Sound (Hart); Clayoquot Sound (Newcombe); east coast of Vancouver Island: Departure Bay and Victoria, G. W. Taylor (Taylor); Victoria to Comox (Newcombe); Sidney, G. M. Smith (G. M. Smith); Gonzales Point (Hart); Esquimalt Harbor, type locality of *Oregonia longimana* (Spence Bate); Gulf of Georgia, 15-70 fathoms, J. Richardson (Whiteaves).

Washington: Puget Sound, Columbia University Expedition, Bashford Dean (Calman); Friday Harbor, Brown Island, Canoe Island, Minnesota Reef (Way).

California: Golden Gate, 39-41 fathoms (Schmitt); Monterey Bay, deeper water (Doflein).

For 84 stations from Bristol Bay, Bering Sea, to Heceta Bank, Oregon, and from 5-212 fathoms, collected by the *Albatross* (Rathbun,

mm, respectively. Ovigerous female from station 1498-42: length 27.5 mm, width 16.5 mm, rostrum 6.5 mm, cheliped 29 mm, chela 11 mm, dactyl 5.5 mm, legs 42, 38.5, 35, and 33.5 mm, respectively.

Color in life: Tan or gray, with dots and small markings of red. (Way) Tan with red chelae. (Hart)

Habitat: Among algae. (Doflein) On *Zostera marina*. (Way) Among eel grass. (Hart) On wharf piling. (Ricketts and Calvin) The dorsum is covered with numerous hooked hairs which permit masking with hydroid polyps, etc., affording the animal marked concealment. (Doflein) Often adorned with sponges, algae, bryozoans, and hydroids. (MacKay) Barnacle-bedecked. (Lenz)

Depth: Shallow water to 212 fathoms. (Rathbun) Specimens examined came from depths of from 3 to 74 fathoms.

Size and sex: The series at hand includes males ranging in size from 13.5 mm to the 60 mm specimen measured above and females ranging from 11.3 to 45 mm. Ovigerous females show great disparity in size, ranging from 11.3 to 44.6 mm. The largest specimen on record is the 65.7 x 39 mm male measured by Rathbun (1925).

Breeding: Some 25 of 40 females taken in late July and 20 of 40 females taken in early August in the San Juan Strait-Puget Sound region were gravid. Rathbun (1925) records ovigerous females from St. George Island, Pribilof Islands, in May and September, from Attu Island and Petrel Bank, Aleutian Islands, in June, from Cordova and Yes Bay, Southeastern Alaska, in June and August, respectively, and from Comox, Vancouver Island, British Columbia, in July.

Remarks: Although writers from Stimpson (1857b) to Whiteaves (1878) followed Dana (1851a) in considering *Oregonia hirta* to be a distinct species, S. I. Smith, writing in 1880, was able to state: "The series of specimens is sufficient to show that the two forms described by Dana are sexual and belong to one species, the *gracilis* being based on the adult male and the *hirta* on the two forms of the female." He also sagaciously included *O. longimana* of Spence Bate in his synonymy, albeit with a question mark. How widely read was Sydney Smith in his day may be judged from the fact that never again was specific rank accorded to either *O. hirta* or *O. longimana*.

The exhaustive series of *Oregonia gracilis* from Alaska, British Columbia, and Washington State (a part of Oregon Territory in the time of Dana) in the collections of the U. S. National Museum (Rathbun, 1925, pp. 72-78) includes but two records from Oregon and one from California. That specimens of this boreal species are included

among Hancock collections is due largely to the activity of Charles Wade and Fred Ziesenne, who visited the Oregon coast in 1942, and Dr. John L. Mohr, who visited the San Juan Islands in 1948 and 1949, preparing the way for later exchanges of specimen material.

The male first pleopod, here described, is figured by Shen (1932, fig. 25a and c).

Oregonia bifurca Rathbun

Plate I, Fig. 1; Plate 11, Fig. 2

Oregonia bifurca Rathbun, 1902a, p. 885; 1904, p. 171, pl. 6, fig. 5; 1925, p. 79, pls. 26-28, text-fig. 21.

Type: Female holotype, U.S.N.M. No. 25287, length 26.5 mm, width 19.6 mm.

Type locality: North of Rat Island, Aleutian Islands, 270 fathoms, *Albatross* station 3785.

Localities subsequently reported, with collectors: Bowers Bank, Bering Sea, 344-764 fathoms, *Albatross* (Rathbun, 1925).

Atlantic analogue: None. A Pacific boreal species.

Diagnosis: Rostrum composed of two short, flattened, divergent spines. Postorbital spine close to eye, triangular, and directed more forward than outward. Carapace subquadrilateral, hepatic narrowing imperceptible. Chelipeds of male little longer than first pair of walking legs, spinulose; fingers nearly as long as palm. Dactyls of ambulatory legs long. A hairy species.

Male first pleopod with tip swollen, little inclined, bearing a row of five long filaments on one side of a line extending backward from the aperture, a row of seven on the other side at the same level; behind these at a higher level 11 more filaments arranged in two rows.

Description: Carapace about three-fourths as wide as long (rostrum included); width between tips of postorbital spines two-thirds of the branchial width. Branchio-hepatic constriction very slight. Surface of carapace covered with tubercles from which proceed long yellow hairs, curved at the tips, making a tolerably thick coating. Rostrum not divided quite to the base; horns slender, divergent, their outer margins almost longitudinal, their length along the inner margin about one-eighth of the entire length of the carapace. Supraocular cave extending laterally not quite so far as in *Oregonia gracilis*. Postocular spine narrow, as in *O. gracilis*, and directed a little more forward than in that species. Inter-antennular spine curved a little more forward than in *O. gracilis*. Eyes a little stouter than in that species. Basal segment of antenna armed

along its outer margin with one stout blunt subterminal spine and three small spines, one of which is at the anterior angle, and along its inner margin with one or two tubercles. Outer maxillipeds as in *O. gracilis*. Lower surface pubescent.

Chelipeds of the female of moderate size, one and a half times as long as carapace, subequal, shaped much as in *Oregonia gracilis*. Inner surface of merus bordered by short blunt spines. Propodus slightly longer than merus, fingers and palm subequal, margins of palm subparallel, fingers fitting close together, denticulate. Ambulatory legs slender, diminishing gradually in length from the first to the fourth pair, the third pair being the length of the female cheliped. Dactyli contained about one and a third times in the propodi. Chelipeds and ambulatory legs covered with long yellow hair, mixed with shorter and finer hair. (Rathbun, 1904)

Material examined: None from Allan Hancock expeditions. Through the courtesy of Dr. F. A. Chace, Jr., curator of marine invertebrates, U. S. National Museum, a male and a female specimen from Bowers Bank, Bering Sea, 426 fathoms, June 4, 1906, *Albatross* station 4771 (U.S.N.M. No. 46488), have been made available for the present study. The photographic illustration is of the male.

Measurements: Male: length 31.8 mm, width 22.7 mm, rostrum 4.8 mm, basal width 4.9 mm, cheliped 62 mm, chela 25.6 mm, dactyl 11.3 mm, height of palm 7.0 mm, legs 59, 56, 51, and 46 mm, respectively. Female: length 29.0 mm, width 20.6 mm, cheliped 37 mm, first walking leg 50 mm.

Color in life: Unknown.

Habitat: Bottom types at *Albatross* stations from which this species was recovered were green mud with Foraminifera, green-brown sand, broken shell, green-brown mud with fine black sand, and gray sand with broken shell.

Depth: 270-764 fathoms.

Breeding: Of 44 females obtained by the *Albatross* at Bowers Bank on June 3-4, 1906, 19 were ovigerous.

Remarks: Although the range of *Oregonia bifurca*, Aleutian Islands and Bering Sea, places it almost beyond the scope of this report, its inclusion is justified from the standpoint of pleopod studies, which relate it undeniably to *O. gracilis* and which prepare the way for a comparative study of Pacific American with the strictly Asiatic members of the genus.

The bathymetric ranges of the two species might be cited as diagnostic, since the range of *Oregonia bifurca*, 270-764 fathoms, and of *O. gracilis*, shallow water to 212 fathoms, are mutually exclusive.

Genus **HYAS** Leach

Hyas Leach, 1814, p. 431. Holmes, 1900, p. 31. Rathbun, 1925, p. 252.

Type: The Atlantic *Cancer araneus* Linnaeus, 1758, by monotypy.

Description: Carapace flattened, more or less tuberculated, but not spiny. Rostrum bifid, flattened, the horns [separated] by a narrow fissure. Orbits shallow and open above, with a fissure above and below. Eyes partially visible from above when retracted. No preocular spine [but a large, triangular postorbital tooth]. Basal antennal [article] much enlarged, the [first movable article] moderately dilated, the [second] narrow. Ambulatory legs subcylindrical and of moderate length. (Holmes)

Chelipeds stout, chelae compressed. (Rathbun)

Abdomen with seven free segments in both sexes.

Range: Eastern Pacific: from Bering Strait and the Aleutian Islands to Puget Sound, Washington; Western Pacific: from East Cape, Siberia, to the Sea of Japan; Siberian, Alaskan, and Canadian Arctic; Western Atlantic south to Cape Hatteras; Eastern Atlantic south to English Channel. Shore to 350 fathoms; exceptionally (Western Atlantic) to 906 fathoms. The distribution of both recent and fossil species is reviewed by Imaizumi (1952, p. 179).

KEY TO THE PACIFIC AMERICAN SPECIES OF *Hyas*

- 1a. Posterior angle of hepatic projection broadly arcuate. Basal antennal article with a blunt tooth at anteroexternal angle *coarctatus alutaceus*
- 1b. Posterior angle of hepatic projection subacute. Basal antennal article with a rounded tubercle at anteroexternal angle *lyratus*

***Hyas lyratus* Dana**

Plate I, Fig. 3; Plate 12

Hyas lyratus Dana, 1851a, p. 268; 1852, p. 86; atlas, 1855, pl. 1, figs.

1a-d. Stimpson, 1857b, p. 450. Lockington, 1877c, p. 64. Newcombe, 1893, p. 20; 1898, p. 76. Rathbun, 1893a, p. 72, pl. 3; 1904, p. 174; 1925, p. 270, pl. 235, text-fig. 90c. Calman, 1898, p. 260. Holmes, 1900, p. 32. Lenz, 1901, p. 454. Taylor, 1912, pp. 191, 209. Way, 1917, p. 371, fig. 26. Johnson and Snook, 1927, p. 372, fig. 325. G. M. Smith, 1928, pp. 164, 165. Hart, 1940, p. 99. MacKay, 1931, p. 187. Clemens, 1933, p. 51. Imaizumi, 1952, p. 181.

Sayas lyratus, Spence Bate, 1866, p. 267.

Hyas lyrata, Miers, 1886, p. 47.

Type: Male holotype, no longer extant, length 31.5 mm, width 20.5 mm.

Type locality: "Ad oras Oregonenses." Actually Puget Sound, then Oregon Territory, C. Pickering, U.S.S. *Vincennes*, collector.

Localities subsequently reported, with collectors: Bering Sea: off Pribilof Islands, 25-121 fathoms, and Bristol Bay, 7.5-33 fathoms, *Albatross* (Rathbun, 1925, 1893a). Aleutian Islands: Chichagoff Harbor, Attu Island, 5-7 fathoms, Kyska [Kiska] Harbor, Kyska Island, 7-14 fathoms, Constantine Harbor, Amchitka Island, 6-10 fathoms, Bay of Islands, Adakh [Adak] Island, 9-16 fathoms, and Captains Harbor or Port Levasheff, Unalaska Island, 25-75 fathoms, W. H. Dall; off Unalaska Island, 59-93 fathoms, off Akutan Island, 45-78 fathoms, and Unimak Pass, 34-91 fathoms, *Albatross* (Rathbun, 1893a); off Kyska Island, Rat Islands, 34-55 fathoms, Petrel Bank, off Semisopochnoi Island, 43-56 fathoms, and off Unimak Island, 41-70 fathoms, *Albatross* (Rathbun, 1925). Alaska Peninsula: north of Peninsula, 15-53 fathoms, Shumagin Islands, 35-110 fathoms, and east of Afognak Island, 51-68 fathoms, *Albatross*; Belkoffsky Bay, 15-25 fathoms, Coal Harbor, Unga Island, 6-9 fathoms, and Chajafka [Shahafka] Cove, St. Paul Harbor, Kodiak Island, W. H. Dall; Kodiak [Kodiak], U. S. Fish Commission (Rathbun, 1893a); 56° N Latitude, 25-62 fathoms (Holmes); Kodiak Island: W. J. Fisher; off Marmot Island, east of Afognak Island, T. H. Bean; Afognak Bay, Afognak Island, 14-19 fathoms, Shelihof Strait, 48-65 fathoms, Alitak Bay, 29 fathoms, Karluk, 31-110 fathoms, and Uyak Bay, 74-99 fathoms, *Albatross* (Rathbun, 1925). Southeastern Alaska: Kachekmak [Kachekmak, not Chugachik] Bay, Cooks Inlet, 20-60 fathoms, Port Etches, 5-18 fathoms, and Sitka Harbor, 15 fathoms, W. H. Dall; Wrangell, W. H. Jones, U.S.N.; Port Wrangell, Steamer Bay, Etolin Island, and Nakat Harbor, H. E. Nichols (Rathbun, 1893a); Berg Bay, Glacier Bay, and Juneau, 50 fathoms, Harriman Alaska Expedition (Rathbun, 1904); Cordova, Bureau of Fisheries; vicinity of Funter Bay, Lynn Canal, 350 fathoms, Chilcoot Inlet, 72-73 fathoms, Dundas Bay, Icy Strait, 6.5-78 fathoms, Stephens Passage, 131-198 fathoms, Bay of Pillars, Kuiu Island, 8 fathoms (in halibut stomach), off Shakan, Sumner Strait, 153-218 fathoms, Kasaan Bay, Prince of Wales Island, 42-123 fathoms, and vicinity of Yes Bay, Behm Canal, 147-205 fathoms, *Albatross* (Rathbun, 1925).

British Columbia: Mouth of Nass River and near Metlakatla, D. C. G. MacKay (MacKay); Otter Bay, Pender Island, Seymour Narrows, *Albatross* (Rathbun, 1925). Vancouver Island: Menzies Bay, Discovery Passage, 6 fathoms, H. E. Nichols, and Victoria, C. F. Newcombe (Rathbun, 1893a); Comox and Clayoquot Sound (Newcombe); Comox, W. Spreadborough (Rathbun, 1925); Nootka Sound (Hart); Departure Bay, Alert Bay, Mayne Island, and Lowe Inlet (Taylor); Sidney, 10-20 fathoms, G.M. Smith (G. M. Smith). Strait of Georgia, J. K. Lord (Spence Bate); Bare Island, between Vancouver Island and mainland, Schauinsland (Lenz).

Washington: San Juan Islands: between Turn Island and San Juan Island, Channel north of Brown Island, off Canoe Island, and northeast of Brown Island, 6-55 fathoms (Way). Port Townsend, U. S. Fish Commission (Rathbun, 1893a); off Squin Bay, 81 fathoms, Kala Point, 14-17 fathoms, Admiralty Inlet, 16-31 fathoms, *Albatross* (Rathbun, 1925). Puget Sound: Bashford Dean, Columbia University Expedition (Calman), Simeahmoo, C. B. R. Kennerly (Rathbun, 1925).

Atlantic analogue: None. A Pacific boreal species.

Diagnosis: Rostral horns moderately long and narrow. Exorbital tooth and hepatic lobe joined in an alate projection having a concave margin. Branchial row of tubercles well defined. Basal antennal article with a large, rounded tubercle at anteroexternal angle. Cheliped of adult male long, hand narrow. Male first pleopod with tip inclined, a short row of five or six and a long row of 11 filaments on either side of a line extended basally from subterminal aperture, which is closed by a seta; line of 11 filaments backed by two additional rows of filaments.

Description: Carapace lyrate and furnished with blunt tubercles. Median region tumid, and generally furnished with two elevations, one near the middle and one behind; postmedian region prominent, pustulate or roughened; cardiac region furnished with a subconical elevation; branchial regions elevated at the middle and crossed by a more or less evident line of rounded tubercles. Rostrum shorter than the width of the interorbital space, the cleft between the horns narrow. A tooth on the anterior margin of the optic peduncle. Basal antennal article with a few small teeth on each margin and a prominent, smooth tubercle at the anteroexternal angle; second [article] dilated and almost entirely visible from above. A small tooth on the first [article] below the articulation of the second. Maxillipeds granulated. Behind the eyes an alate expansion, the anterior and posterior margins generally nearly parallel, outer margin long and a little concave; anterior angle acute; a small

tooth near the base of the convex posterior margin. Behind the alate expansion the side of the carapace quite deeply indented, the margin furnished with a row of small tubercles.

Merus of the chelipeds with a few small tubercles, more prominent at the angles; hands narrow, compressed, smooth or granulated, the upper margin compressed and roughened by small tubercles; fingers nearly smooth.

Abdomen of the male widest at the second and third segments, the sides nearly parallel to the last [segment]; last segment distally truncated and over twice as broad as long. Abdomen of the female broadly elliptical, the [segments] increasing in length from the second to the last. (Holmes, modified)

Material examined: A total of 69 specimens from 15 stations, all from British Columbia and the vicinity of San Juan Islands, Washington. (See Table 24) North of Alaska Peninsula, Bering Sea, 7.25 fathoms, June 2, 1890, *Albatross* station 3233, 1 male and 1 female (U.S.N.M. No. 15906, part), determined by M. J. Rathbun.

Measurements: Largest specimen, male: length 48.7 mm, width 36.8 mm, rostrum 6.8 mm, width 6.4 mm, cheliped 70 mm, chela 29 mm, dactyl 15 mm, ambulatory legs 73, 70, 61, and 59 mm, respectively. Female: length 44.6 mm, width 34.3 mm.

Color in life: Carapace reddish gray; legs banded with stripes of red and gray, not so noticeable in mature specimens. Red is present on the legs of mature specimens, but does not extend to the tips except in the chelipeds. Body much lighter on ventral surface. (Way)

Habitat: Green mud; fine gray sand and broken shell; black sand and gravel. (Rathbun, 1925) Often covered with hydroids, algae, and barnacles. (Way)

Depth: 5-350 fathoms. (Rathbun) Dredged by the *Hydah* in 11-62 fathoms. Occasionally found along shore at low tide in Alaska. (Johnson and Snook)

Size and sex: Males in the present series range from 10.5 to 45 mm, females from 14.0 to 43 mm in length. None of the females are ovigerous. Rathbun (1925) records a male measuring 105 by 80 mm.

Breeding: An ovigerous female was encountered by the *Albatross* at Yes Bay, Behm Canal, southeastern Alaska, and two ovigerous females by Harold G. Coffin at Ship Harbor, Skagit County, Washington, both in late August.

Remarks: The statement by Stimpson (1857b) that the species inhabits deep water off the coast of Oregon, unfortunately repeated by

Miers and by Lockington, stems from Dana's (1851a) use of the phrase "ad oras Oregonenses" in designating the type locality. It was later made abundantly clear by Dana (1852) that his material came from Puget Sound, then part of Oregon Territory but now in the state of Washington.

***Hyas coarctatus alutaceus* Brandt**

Plate I, Fig. 4; Plate 13

Hyas coarctatus Leach var. *alutacea* Brandt, 1851, p. 79.

Hyas coarctatus Stimpson, 1857b, p. 450. Lockington, 1877c, p. 65. Rathbun, 1893a, p. 69; 1904, p. 174; 1919, pp. 9A, 14A. Boone, 1930a, p. 80, pl. 23. Not *H. coarctatus* Leach.

Hyas latifrons Stimpson, 1857c, p. 217; type locality, Bering Sea [Alaska side]; 4♂ and 4♀ cotypes, U.S.N.M. No. 2100; 1907, p. 9, pl. 2. Lockington, 1877c, p. 64. Murdoch, 1885, p. 137. Miers, 1886, p. 47. Birula, 1907, pp. 7, 9.

Hyas coarctatus var. *latifrons*, Braznikov, 1907, p. 43.

Hyas coarctatus alutaceus, Birula, 1910, p. 4, pl. 1, figs. 2-5. Rathbun, 1925, p. 258, pls. 96, 97; 1929, p. 38, text-fig. 52. Sivertsen, 1932, p. 10. Glassell, 1934, p. 454. Van Winkle and Schmitt, 1936, p. 330.

Hyas coarctatus forma *alutacea* Dons, 1915, p. 86, footnote.

Type: Female holotype; in Petrograd [Leningrad] Museum, length 32.8 mm, width 25.4 mm.

Type locality: Bear Island, near the Schantar Islands, Okhotsk Sea, Siberia; A. Th. Middendorff, collector.

Eastern Pacific localities subsequently reported, with collectors: Bering Strait (Lockington). Bering Sea: North Pacific Exploring Expedition (Stimpson, 1857c, type locality of *Hyas latifrons*); off Cape Romanzoff (Stimpson, 1857c); 12 miles east of King Island, 17 fathoms, W. H. Dall; southeast of St. Lawrence Island, 22 fathoms, Norton Sound, 12 fathoms, and between Nunivak Island and St. Matthew Island, G. M. Stoney, U.S.N.; Pribilof Islands, 20-121 fathoms, off Cape Newham, 17.5-21 fathoms, between Pribilof Islands and Bristol Bay, 25.5-57 fathoms, and Bristol Bay, 15-53 fathoms, *Albatross* (Rathbun, 1893a); St. Lawrence Island, R. D. Moore; between Nunivak Island and St. Matthew Island, 37 fathoms, between St. Matthew Island and Pribilof Islands, 55-59 fathoms, and between Nunivak Island and Pribilof Islands, 21-35 fathoms, *Albatross* (Rathbun, 1925); Nuni-

vak Island, Canadian Arctic Expedition (Rathbun, 1919). Alaska, W. J. Fisher (Lockington); Shumagin Islands, Alaska Peninsula, Canadian Arctic Expedition (Rathbun, 1919).

Atlantic analogue: The subspecies *Hyas coarctatus alutaceus* is found off Labrador, Newfoundland, and Cape Breton Island. Elsewhere in the North Atlantic typical *H. coarctatus* occurs.

Diagnosis: Rostral horns short and broad. Exorbital tooth and hepatic lobe presenting a continuous convex surface. Branchial row of tubercles poorly defined. Basal antennal article with a small blunt tooth at anteroexternal angle. Cheliped of adult male short, hand broad. Male first pleopod with tip slender, inclined, a short row of 5 filaments on one side and a long row of 12 filaments, 7 of them backed by another row, on opposite sides of a line projected basally from the subterminal aperture.

Description: Deviates from typical *Hyas coarctatus* through the somewhat more strongly roughened ("chagrinierte") dorsal surface of the cephalothorax, through a somewhat broader posterior part of the body, and through somewhat broader chelae, so that through its body form it approaches somewhat more *Hyas araneus*, particularly younger examples of the latter. (Brandt)

The body is thicker and much broader anteriorly across the postorbital apophyses than [*Hyas coarctatus*]; the angles are all more obtuse. The dorsal surface is marked with fewer tubercles, which are also much larger and more obtuse, most of them being rather swellings than warts. The rostrum is shorter and less acute; and the superior fissure of the orbit is always closed, its margins overlapping. (Stimpson, 1907, of *H. latifrons*, a synonym of *H. c. alutaceus*)

Material examined: Between Pribilof Islands and Bristol Bay, Bering Sea, 25.5 fathoms, June 14, 1890, *Albatross* station 3251, 1 male, 1 female, identified by J. E. Benedict (U.S.N.M. No. 15873, part). Also 26 specimens from nine Arctic Ocean localities, all off Point Barrow, G. E. MacGinitie, collector. (See Table 25)

Measurements: Bering Sea male: length 46.8 mm, branchial width 36.6 mm, hepatic width 28.7 mm, rostrum 4.5 mm, width 7.0 mm, cheliped 52 mm, chela 23.6 mm, dactyl 13.0 mm, height of palm 8.7 mm, ambulatory legs 67, 62, 58, and 55 mm, respectively. Ovigerous female: length 51.0 mm, branchial width 40.0 mm, hepatic width 30.5 mm, cheliped 49 mm. Arctic Ocean male: length 73 mm, branchial width 58 mm, hepatic width 43 mm, rostrum 6.4 mm, width 9.5 mm, cheliped 137 mm, chela 60 mm, dactyl 31 mm, height of palm 20 mm, ambulatory legs 137, 120 (125), 118, and 113 mm, respectively.

Color in life: Dusky brick red above, whitish below. (Stimpson, 1907)

Habitat: Green mud, black mud; fine gray sand, gravel. (Rathbun, 1925)

Depth: 12-121 fathoms; slightly shallower on the Asiatic side.

Breeding: Ovigerous females were encountered by the *Albatross* off the Pribilof Islands and off Kamchatka in June, and by G. E. MacGinitie off Point Barrow in the Arctic Ocean in August, September, and October.

Remarks: The above account is intended to apply only to the subspecies, *Hyas coarctatus alutaceus*, as it alone occurs within the territory under consideration, the American Pacific. For a more complete synonymy and a description of the parent species, *Hyas coarctatus* Leach (1815b, p. 329) of the Atlantic, and of the subspecies *H. c. ursinus* Rathbun (1924a, p. 4), of the Japan Sea, see Rathbun (1925, p. 258).

The discrepancy in the two brief descriptions above, the one by Brandt and the other by Stimpson, concerning the relative amount of tuberculation of the carapace as compared to typical *Hyas coarctatus*, is more apparent than real, since it may be accounted for within the normal range of variation of the subspecies. The figures by Birula (1910) of Brandt's original specimens, a female obtained by Captain Middendorff in the Okhotsk Sea and a carapace found by Wosnessensky at Cape Espenberg, Kotzebue Sound, Arctic Alaska, leave no doubt as to the identity of Stimpson's material with Brandt's.

Specimens obtained by G. E. and Nettie MacGinitie at Point Barrow, Arctic Alaska, in late summer, 1949, are of special interest in view of Murdoch's statement (1885, p. 137) that three large males picked up on the beach near the station at Point Barrow by the International Polar Expedition, when compared with Stimpson's types of *Hyas latifrons*, proved to be indistinguishable from them, and differed from typical *H. coarctatus* from Greenland only in the shape of the rostrum, which is slightly shorter and less acute.

Genus CHIONOECETES Kröyer

Chionoecetes Kröyer, 1838, p. 249. Holmes, 1900, p. 39. Rathbun, 1925, p. 232.

Peloplastus Gerstaecker, 1856, p. 102 (published April, 1857, *vide* Stimpson); type *P. pallasi* Gerstaecker, 1856 (1857) = *Cancer opilio* O. Fabricius, by monotypy.

Type: The circum-boreal *Cancer opilio* O. Fabricius, 1788, type of *Chionoecetes* Kröyer by monotypy.

Description: Carapace broad, depressed, more or less tuberculated or spinose. Rostrum short, flattened and notched, not depressed. Orbits shallow, open above, the short, thick eye peduncles visible from above when retracted. No preorbital spine; postorbital [spine] present. Basal antennal [article] very narrow, with a terminal spine; second and third [articles] not dilated; flagellum short. Ambulatory legs more or less compressed and of moderate length.

Abdomen seven-[segmented] [in both sexes]. (Holmes)

Range: Eastern Pacific: from Bering Strait and the Aleutian Islands to Cortez Bank, opposite the United States-Mexico boundary; Western Pacific: from Kamchatka to off Kinkazan, Japan, and Oki Islands in the Japan Sea. Siberian, Alaskan, and Canadian Arctic. Western Atlantic: from west coast of Greenland to Casco Bay, Maine. Shallow water to 1,625 fathoms.

KEY TO THE SPECIES OF *Chionoecetes*

- 1a. Carapace tuberculate, or with a few spinate tubercles, branchial regions depressed, not concealing lateral margins. Rostrum not sharply inclined. Meri of ambulatory legs broadened
 - 2a. Length and breadth of carapace subequal. Spines of pterygostomian row not increasing in size posteriorly. Seventh segment of male abdomen strongly inserted into sixth *opilio*
 - 2b. Carapace broader than long, lateral margins deeply scalloped. Last 3 or 4 spines of pterygostomian row large. Seventh segment of male abdomen less strongly inserted into sixth than in 2a *bairdi*
- 1b. Carapace spinulose, branchial regions expanded to conceal lateral margins. Rostrum sharply inclined upward. Meri of ambulatory legs **slender**
 - 3a. Interspace between branchial regions deep. Two small subequal spines at curve made by intersection of the two dorsal branchial ridges *tanneri*
 - 3b. Interspace between branchial regions shallow. A large spine at angle made by intersection of the two dorsal branchial ridges *angulatus*

Chionoecetes opilio (O. Fabricius)

Plate I, Fig. 5; Plate 14

Cancer phalangium O. Fabricius, 1780, p. 234. Not *C. phalangium* J. C. Fabricius, 1775, p. 408.

Cancer opilio O. Fabricius, 1788, p. 182, plate.

Chionoecetes opilio, Kröyer, 1838, p. 249. Smith, 1879, p. 41. Murdoch, 1885, p. 137. Rathbun, 1893a, p. 74, pl. 4, figs. 5-7 (part: not British Columbian material; not all Alaskan material); 1904, p. 174; 1919, p. 10A; 1925, p. 233, pls. 84, 85, text-figs. 88, 89. Holmes, 1900, p. 39. Van Winkle and Schmitt, 1936, p. 330. Garth, 1957, p. 31. Not *C. opilio*, Newcombe, 1893, p. 20; 1898, p. 76. Not *C. opilio*, Taylor, 1912, pp. 191, 209.

Chionoecetes behringianus Stimpson, 1857a, p. 84; type locality, off Cape Romanzoff, Alaska, 30 fms.; cotypes U.S.N.M. Nos. 2031, 53041, and M.C.Z. No. 1875; 1857b, p. 449; 1857c, p. 217; 1907, p. 8. Lockington, 1877c, p. 64.

Peloplastus pallasii Gerstaecker, 1856, p. 105, pl. 4 [not 1]; type locality, Asiatic Sea; female holotype in Berlin Museum (published April, 1857, *vide* Stimpson, 1907).

Chionoecetes chilensis Streets, 1870, p. 106; type locality, Chile; type not extant. Rathbun, 1910, p. 572.

Type: Not in Copenhagen Museum; doubtfully extant. (Stephensen, in Rathbun, 1925)

Type locality: Greenland.

Eastern Pacific localities subsequently reported, with collectors (excluding southern records withdrawn in 1924 as Chionoecetes bairdi): Alaska: Bering Strait, Captain Rodgers, North Pacific Exploring Expedition (Stimpson, 1857c); mouth of Port Clarence, 7-12 fathoms, W. H. Dall (Rathbun, 1893a); off Cape Romanzoff, 30 fathoms, Wm. Stimpson, North Pacific Exploring Expedition (Stimpson, 1857a, 1857b, types of *Chionoecetes behringianus*, cotypes labeled "Russian America"), (Lockington, 1877b); northwest of Nunivak Island, 24 and 25.5 fathoms, G. M. Stoney, U.S.N., northwest of Pribilof Islands, 20-52 fathoms, southeast of Pribilof Islands, 51 and 75 fathoms, and between Pribilof Islands and Bristol Bay, 29.5 and 36 fathoms, *Albatross* (Rathbun, 1893a, 1925). Aleutian Islands: Iliuliuk Harbor, Unalaska, 85 fathoms, and north of Unimak Island, 49 and 61 fathoms, *Albatross* (Rathbun, 1893a, 1925). Alaska Peninsula: Off Khoodobine [Kudobin] Islands, 41-53 fathoms, *Albatross* (Rathbun, 1893a, 1925). Specimens from Yakutat, in cod's mouth, and Juneau, 20-50 fathoms (Rath-

bun, 1904), although not listed as such in Rathbun (1925), are believed to be *Chionoecetes bairdi*, as are specimens from Victoria, British Columbia (Newcombe) and Burrard Inlet (north arm), 15 fathoms (Taylor).

Atlantic analogue: The species itself occurs in the North Atlantic, via the Arctic Ocean, as far south as Casco Bay, Maine. A subspecies, *Chionoecetes opilio elongatus* Rathbun, 1924a, occurs in the Sea of Japan and in the Okhotsk Sea.

Diagnosis: Carapace tuberculate, length and breadth subequal, brachial regions not depressed, lateral margins exposed, not deeply scalloped. Meri of ambulatory legs dilated, roughened but not spinulose. Pterygostomian spines numerous and small. Exorbital tooth slightly incurving. Seventh segment of male abdomen strongly inserted into sixth. Male first pleopod with tip reflexed; 24 filaments arranged in two or three rows on convex margin and about a dozen irregularly placed near concave margin in the specimen examined.

Description: Carapace with numerous scattered unequal rugose prominences, blunt and wartlike about the middle, but becoming more acute anteriorly and at the sides. Superior surface covered with a short pubescence. The broad channels above the posterolateral margins nearly smooth, but with their double margins granulated. Inferior anterolateral margin armed with about fourteen small bifid teeth diminishing in size forward. [Legs] everywhere slightly pubescent, with the [meri] scabrous or echinulate above; [chelipeds] muricated along the angles, and everywhere somewhat scabrous on their upper surfaces. Abdomen consisting in both male and female of seven articles, the three nearest the base being strongly granulated. Abdomen of the male one-third the width of the sternal plastron at its penultimate article, the inferolateral angles somewhat produced and tumid. (Stimpson, 1857b, modified, of *C. behringianus*)

Chelipeds one and one-half times as long as the carapace, in the old twice as long; fingers half again as long as palm. First three ambulatory legs about twice as long as carapace, in the old three times as long; last leg much shorter, about as long as cheliped. Varies as to roughness of carapace, amount of hairiness and length and width of legs, especially of merus. (Rathbun, 1925)

Material examined: Off Pribilof Islands, Alaska, 48 fathoms, August 3, 1891, *Albatross* station 3440, 1 male, identified by M. J. Rathbun (U.S.N.M. No. 17075). (Photo) North of Bering Strait, Arctic

Alaska, 30 fathoms, July 3, 1884, Lieut. George M. Stoney, U.S.N., 1 ovigerous female, identified by J. E. Benedict (U.S.N.M. No. 14694). (Photo)

Measurements: Male specimen: length 69.3 mm, width 69.3 mm, rostrum 4.4 mm, width 9.8 mm, cheliped 110 mm, chela 52 mm, dactyl 30.5 mm, height of palm 14.8 mm, ambulatory legs 160, 155, 135, and 100 mm, respectively. Ovigerous female: length 53.8 mm, width 54.5 mm. A male measuring 125.5 x 127.5 mm is recorded from Greenland by Rathbun (1925).

Color in life: Light brick red above, often iridescent, below yellowish white; sides of [legs] shining white. (Stimpson, 1907)

Habitat: Green and black mud; fine gray sand and shell.

Depth: 7-85 fathoms; Sea of Japan (*Chionoecetes opilio elongatus*) to 1,215 fathoms.

Breeding: The single ovigerous female examined was collected in July off Arctic Alaska.

Remarks: The references given above, while including all important synonyms, are complete only insofar as the occurrence of the species itself in the Pacific Ocean and Arctic Alaska is concerned. Numerous records of *Chionoecetes opilio* in the Canadian Arctic and North Atlantic, and of *C. opilio elongatus* Rathbun (1924a) in the western Pacific have been omitted in the interest of brevity.

The description given is that of Stimpson for *Chionoecetes behringianus*, a synonym of *C. opilio*, because it alone of the available descriptions was based upon specimens from the geographical area with which the present work deals, namely, the American Pacific. Sidney Smith (1879, p. 41) states that a comparison of three of the original specimens of *C. behringianus* with specimens from the North Atlantic coast, and with Kröyer's figure and description, proves them to be identical with *C. opilio* of Greenland, the differences in the proportional lengths of the chelipeds and first pair of ambulatory legs being attributable to age and sex.

"The specific name *phalangium*, originally applied to this species, was rejected by Otho Fabricius himself, on the ground, as he expressly states, that he found it preoccupied by *Cancer phalangium* J. C. Fabricius (*Stenorhynchus phalangium* M. Edw.). Having been able to consult O. Fabricius's original description of *Cancer opilio*, I find that it was published in 1788, which settles the question of priority over *C. opilio* J. C. Fabricius (1793), and establishes the specific name *opilio* for this species." (Murdoch, 1885, p. 137)

Chionoectes bairdi Rathbun

Plate I, Figs. 6, 9; Plate 15

Chionoectes opilio, Rathbun, 1893a, p. 74 (part: the British Columbia specimens; not pl. 4, figs. 5-7). Newcombe, 1893, p. 20; 1898, p. 76.

Taylor, 1912, pp. 191, 209. Not *C. opilio* (O. Fabricius).

Chionoectes tanneri, Weymouth, 1910, pl. 7, fig. 19. Way, 1917, p. 372, fig. 28. Queen, 1930, p. 399, fig. 7. Not *C. tanneri* Rathbun.

Chionoectes bairdi Rathbun, 1924a, p. 3; 1925, p. 235, pls. 86, 87. Clemens, 1933, p. 51. Slipp, 1952, p. 235.

Chionoectes bairdi, MacKay, 1931, p. 187.

Type: Male holotype, U.S.N.M. No. 5862, length 73.3 mm, width 81.2 mm.

Type locality: Head of Kingcombe Inlet, British Columbia; H. E. Nichols, collector.

Localities subsequently reported, with collectors (or reported previous to 1924 as *Chionoectes opilio*): Bering Sea: southeast of Pribilof Islands, 75 and 91 fathoms, and northeast of Unimak Island, 49 fathoms, *Albatross* (Rathbun, 1925). Aleutian Islands: Kyska [Kiska] Harbor, Kyska Island, 9-12 fathoms, Bay of Islands, Adakh [Adak] Island, 9-16 fathoms, Nazan Bay, Atka Island, 10-16 fathoms; Unalaska: Captains Bay, beach, Captains Harbor or Port Levashef, 9-80 fathoms, between Pinnacle and Ulakhta or Dutch Harbor, 16 fathoms, Iliuliuk, 10-15 fathoms, all by W. H. Dall, and Iliuliuk Harbor, 85 fathoms, off Aektok [Aiktak] Island, 54 fathoms, and off Unimak Island, 9-70 fathoms, *Albatross* (Rathbun, 1893a); Unalaska Bay, *Albatross* (Rathbun, 1925). Alaska Peninsula: Shumagin Islands, 3-9 fathoms, Chiachi Islands, 20 fathoms, and Chignik Bay, 7-18 fathoms, W. H. Dall (Rathbun, 1893a); Shumagin Islands, 35-110 fathoms, *Albatross* (Rathbun, 1925); Kodiak [Kodiak] Island: Chajafka Cove, 12-14 fathoms, W. H. Dall (Rathbun, 1893a), off Karluk, 31-110 fathoms, and Alitak Bay, 29-41 fathoms; off Sitkalidak Island, 69 fathoms, and Afognak Bay, Afognak Island, 14-19 fathoms, all *Albatross* (Rathbun, 1925). Southeastern Alaska: Kachemak [not Chugachik] Bay, Cooks Inlet, 20-60 fathoms, Port Etches, 12-18 fathoms, Port Mulgrave, Yakutat Bay, 6-40 fathoms, and Sitka Harbor, 15 fathoms, W. H. Dall, and Wrangell, W. H. Jones, U.S.N. (Rathbun, 1893a); Taiya Inlet, Lynn Canal, 247-259 fathoms, Chilkoot Inlet, 45-51 fathoms, Stephens Passage, 198-201 fathoms, Eastern Passage vicinity of Stikine River delta, 70-79 fathoms, Boca de Quadra, 48-57 fathoms,

vicinity of Yes Bay, Behm Canal, 39-45 fathoms, and Kasaan Bay, Prince of Wales Island, 42-47 fathoms, *Albatross*, and 22 miles north-west of Wrangell, J. S. Ligon (Rathbun, 1925).

British Columbia: near Nass Harbour, D. C. G. MacKay (MacKay), Victoria, Vancouver Island, C. G. Newcombe (Newcombe); north arm of Burrard Inlet, 15 fathoms (Taylor).

Washington: Griffin Bay, near Friday Harbor, San Juan Islands, 60 meters (Queen, as *Chionoecetes tanneri*). Georgia Strait, N of Orcas Island, 34-35 fathoms; Hale Passage, Lummi Island, 12-19 fathoms; ENE of Vendovi Island, mouth of Bellingham Bay, 15-17 fathoms; East Sound, Orcas Island, 17-18 fathoms; Lopez Sound, San Juan Islands, 28 fathoms; Mission Bar, 2 miles S of Tulalip Bay, 5-13 fathoms; off Meadow Point, Seattle, 30-100 fathoms; Carr Inlet N of Raft Island, 28-15 fathoms; off Point Jefferson, opposite Seattle, 136-155 fathoms; Port Madison, 43-34 fathoms; the above all taken by the *Onchorhynchus* (Slipp, 1952).

Atlantic analogue: None. An eastern Pacific boreal species having as its western Pacific cognate *Chionoecetes opilio elongatus* Rathbun. (See *Remarks* below)

Diagnosis: Carapace tuberculate and spinate, broader than long, branchial regions depressed, lateral margins exposed, scalloped. Meri of ambulatory legs dilated, spinulous. Pterygostomian spines few, last three or four large. Exorbital tooth strongly incurving. Seventh segment of male abdomen weakly inserted into sixth. Male first pleopod strongly reflexed at tip; about three dozen filaments arranged in two or three rows along convex margin; about eight irregularly placed in the opposite concavity.

Description: Branchial regions more depressed than in *Chionoecetes opilio*, and in consequence the width greater; the width exceeding the length, in *C. opilio* the width subequal to the length. Inclined subtriangular facet of the anterior branchial region steeper, higher and shorter than in *C. opilio*; highest point marked by a spine, instead of a tubercle; no dorsal spines in *C. opilio*, that is, none above those in the submarginal row. In *C. bairdi* the last (posterior) three or four spines of the pterygostomian-branchial row notably enlarged; also the outermost of the prominences in the transverse branchial row spinous or spinulous. The whole animal rougher than in *C. opilio*. Carapace narrower across the orbits, outer orbital teeth bent inward more; median emargination of the front wider and the teeth narrower and with less

arched margins than in *C. opilio*. Lateral margin of the carapace deeply scalloped; this character alone serving to distinguish very young specimens (10 mm and under) from the allied species.

Chelipeds and legs more coarsely and abundantly spinous than in the allied species.

Male abdomen with sides a little more concave, terminal segment with its free edge more arched, the segment less invaginated in the preceding segment. (Rathbun, 1925, modified)

Material examined: 31 specimens from 4 localities in British Columbia and Washington (Puget Sound), through the courtesy of the Provincial Museum at Victoria, the University of Washington at Seattle, and the Pacific Biological Station at Nanaimo. (See Table 26) Also Captains Harbor, Unalaska, 9-16 fathoms, 1871, 1874, W. H. Dall, 1 male, 1 female (U.S.N.M. No. 14675).

Measurements: Male specimen from Vancouver (not largest examined): length 72.3 mm, width 80.5 mm, rostrum 5.0 mm, width 8.6 mm, cheliped 85 mm, chela 46.7 mm, dactyl 32.7 mm, ambulatory legs 150, 135, 125, and 85 mm, respectively. Ovigerous female: length 74 mm, width 81 mm.

Color in life: Yellowish, spines and tubercles tipped with red.

Habitat: Green or gray mud, occasionally with fine sand or broken shell. Burrard and Kingcombe Inlets are fiordlike arms of the sea, where deep water is found close to shore and conditions of quiet prevail, although great variation in tidal levels occurs.

Depth: Shoal water to 259 fathoms. (Rathbun, 1925)

Size and sex: The largest male noted in the Burrard Inlet catch referred to under *Remarks* below measured 108 x 118 mm. It is not as large, however, as the 121 x 139 mm male recorded by Rathbun (1925).

Breeding: Ovigerous females were taken by the *Investigator* at Vancouver in June and by the *Albatross* in the Aleutian Islands in the same month.

Remarks: The writer was fortunate in being able to participate in a demonstration shrimp trawl made by the *Investigator* of the Pacific Biological Station in the north arm of Burrard Inlet near Vancouver, British Columbia, in June, 1949. The heavily loaded cod end of the net literally exploded aboard, filling the ship's after deck and gunwales with shrimp, crabs, and bottom-dwelling fishes. By far the largest and most conspicuous forms were the Brachyura: principally *Cancer magister* and *Chionoecetes bairdi*, the latter present in two well marked size groups which were taken to be year classes. Large specimens were

predominantly males; the few large females, however, were ovigerous. The smaller specimens were evenly divided as to sex, the females without ova.

After discussing the status of *Chionoecetes bairdi* in the Puget Sound region, Slipp (1952, p. 237) concludes: "One may surmise that the general feeling among resident zoologists in the northwest that the named forms of *Chionoecetes* are not specifically distinct is a result of the predominance of specimens of the single species *C. bairdi* in the material collected by ordinary dredging and trawling operations. Except as a result of special collecting at levels well below those of ordinary fishing operations, specimens of *C. tanneri* and *C. angulatus* are evidently seldom encountered and are thus unfamiliar to those examining the catches. This would imply that *C. bairdi* is probably the dominant form not only in the inland passage but also on the continental shelf seaward of the outer coasts."

Chionoecetes bairdi, here treated as a full species, might on zoogeographical grounds be considered a subspecies of *C. opilio*, which occurs in the Bering Sea and is represented in the western Pacific by the subspecies *C. o. elongatus*, with which *C. bairdi* is strictly analogous. However, certain differences apparent in the pleopods of the limited number of specimens examined will have to be reconciled as due to growth, or themselves subject to geographical variation, before this course can be adopted.

***Chionoecetes tanneri* Rathbun**

Plate I, Fig. 8; Plate 16, Fig. 2

Chionoecetes tanneri Rathbun, 1893a, p. 76, pl. 4, figs. 1-4 (part: the southern specimens; northern specimens withdrawn as *C. angulatus* Rathbun, 1924a); 1898, p. 573; 1904, p. 174; 1923b, p. 634; 1925, p. 243, pls. 88, 89, 234. Holmes, 1900, p. 40. Weymouth, 1910, p. 35 (not pl. 7, fig. 19). Schmitt, 1921, p. 210, text-fig. 131. Goodwin, 1952a, p. 179, text-fig. 11; 1952b, p. 395. Not Way, 1917, p. 372, fig. 28. Not Queen, 1930, p. 399, fig. 7. Probably not Newcombe, 1893, p. 19; 1898, p. 76.

Type: Male holotype, U.S.N.M. No. 15860, length 119 mm on median line, width 130 mm.

Type locality: Gulf of the Farallones, California, 29 fathoms, *Albatross* station 3100.

*Localities subsequently reported, with collectors (excluding northern records withdrawn as *Chionoecetes angulatus* in 1924):* Washington: off Sea Lion Rock, 636 fathoms, and off Grays Harbor, 559 fathoms, *Albatross* (Rathbun, 1925).

California: 10 mi. from SE Farallon I., 700-820 fathoms, *N. B. Schofield* (Goodwin, 1952a); Mulberry Seamount, 690-800 fathoms; off San Francisco, 300 fathoms (Goodwin, 1952b); off Halfmoon Bay, 391 fathoms, off Pigeon Point, 5-296 fathoms, Monterey Bay, 198-1062 fathoms, *Albatross* (Rathbun, 1925); off Carmelo Bay, 659 fathoms, off Point Sur, 328 and 475 fathoms, west of Piedras Blancas, 485 fathoms, and west of Point Buchon, 440 fathoms, *Albatross* (Rathbun, 1923b); off Point Conception, 284 fathoms, off San Miguel Island, 264-271 fathoms, off Santa Cruz Island, 447-891 fathoms, off Anacapa Island, 603 fathoms, off Santa Barbara Island, 302-638 fathoms, and off Santa Catalina Island, 334-600 fathoms, *Albatross* (Rathbun, 1925); northwest of San Nicolas Island, 534 and 640 fathoms, and off San Clemente Island, 414 fathoms, *Albatross* (Rathbun, 1923b); off San Clemente Island, 464-776 fathoms, and off San Diego, 67-822 fathoms, *Albatross* (Rathbun, 1925).

Lower California, Mexico: off Los Coronados Islands, 641-666 fathoms, and off Cortez Bank, 984 fathoms, *Albatross* (Rathbun, 1925).

Atlantic analogue: None. An eastern Pacific north temperate species, having as its western Pacific cognate *Chionoecetes japonicus* Rathbun (1932, p. 32).

Diagnosis: Carapace spinous, lateral margins partially concealed by expanded branchial regions; space between branchial regions deep. Rostrum inclined upward. Meri of ambulatory legs little dilated. Two smaller subequal spines at curve made by the two dorsal branchial ridges. Male first pleopod erect, tip acute, linear groove with a marginal row of about 20 filaments; a comb of 9 filaments on opposite side.

Description: Carapace much swollen at the branchial regions; branchial regions distended both vertically and laterally, concealing the lateral margin of the carapace. Between the branchial regions, which nearly meet, a deep, narrow depression widening anteriorly and joining the cervical suture. Carapace covered with spines and spinules instead of tubercles and granules; the transverse row across the branchial regions more prominent than in *Chionoecetes opilio*, and well in advance of the cardiac row; from its outer end a row of spines running obliquely forward toward the orbit. Outer spine of the oblique branchial row as large as outer spine of the transverse row, directly in front of it, and

usually more produced laterally; the two rows therefore joining in a curve, not at an angle. Another row of spines forming the lateral supra-marginal border of the branchial region, and continuing on the pterygostomian region; from this row a short branch running up on the branchial region. An irregular row of small spines crossing the gastric region. Orbits, outer margin of the postorbital teeth and the inferolateral and posterior margins of the carapace armed with spinules. Rostral horns more upturned than in *Chionoecetes opilio* and a little longer and narrower, leaving a wider interspace.

Posterior margin of epistome strongly deflexed in the center and arched at the sides. The external maxillipeds when in place not fitting closely into the buccal cavity, as in *Chionoecetes opilio*; merus with spinous margins.

Ambulatory legs armed with longer and stouter spines than in *Chionoecetes opilio*. In adults more than in young the legs longer in *C. tanneri*, especially the meropodites, which are much narrower, and in the male do not widen at the proximal end as in *C. opilio*. Legs of female shorter than of male, as is the case in *C. opilio*.

Second segment of male abdomen bent downward at lateral extremities in almost a right angle. On the sternum in front of the abdomen a transverse ridge of sharp tubercles. (Rathbun, 1925, modified)

In redefining the species subsequent to the description of *Chionoecetes angulatus*, Rathbun (1925, p. 243) was careful to state that the outer spine of the oblique branchial row is as large as the outer spine of the transverse row, is directly in front of it, and is usually more produced laterally; the two rows therefore join in a curve and not at an angle, as in *C. angulatus*.

Material examined: Off Point Sur, California, 475 fathoms, April 27, 1911, *Albatross* station 5698, 1 male (photographed), 1 female (U.S.N.M. No. 47096).

Measurements: Male specimen: length 31.0 mm, width excluding lateral spines 29.0 mm, rostrum 3.6 mm, width 4.4 mm, cheliped 31.2 mm, chela 14.2 mm, dactyl 9.3 mm, ambulatory legs 71, 73, 69, and 40 mm, respectively. Female: length 31.0 mm, width 29.1 mm.

Color in life: Unknown.

Habitat: Green mud, fine gray sand; rock occasionally present. (Rathbun, 1925)

Depth: 29-1,062 fathoms. (Rathbun, 1925)

Breeding: Ovigerous females were obtained by the *Albatross* off Monterey Bay, off Santa Cruz Island, and off Santa Catalina Island in April, and off San Clemente Island in April and in May.

Remarks: According to Josephine F. L. Hart (Mrs. C. G. Carl) of Victoria (personal communication), there has been considerable confusion in the past regarding the *Chionoecetes* species in the Puget Sound area. The early records of Newcombe (1893), Way (1917), and a later record of Queen (1930) are therefore subject to question, the former two having appeared previous to the 1924 separation by Rathbun of *C. bairdi* from *C. opilio* and of *C. angulatus* from *C. tanneri*, the latter subsequently but without reference to it. In the case of Newcombe's *C. tanneri*, based upon specimens sent him from the Smithsonian Institution, one cannot be certain whether he had the more southerly *C. tanneri* or the more northerly *C. angulatus*, since no locality is given. However, in the case of Way and of Queen, both of whom mention Griffin Bay near Friday Harbor, it may be stated that the specimens were neither *C. tanneri* nor *C. angulatus*, but rather *C. bairdi*, this by reason of the fact that Queen gives a figure clearly recognizable as such. The depth, 60 meters, further supports this view.

Chionoecetes angulatus Rathbun

Plate I, Fig. 7; Plate 16, Fig. 1

Chionoecetes tanneri Rathbun, 1893a, p. 76 (part: the northern specimens). Taylor, 1912, pp. 191, 209.

Chionoecetes angulatus Rathbun, 1924a, p. 4; 1925, p. 247, pls. 90, 91. Clemens, 1933, p. 51.

Type: Male holotype, U.S.N.M. No. 19303, length 73 mm, width 78.6 mm.

Type locality: South of Pribilof Islands, Bering Sea, 1,401 fathoms, *Albatross* station 3604.

Localities subsequently reported, with collectors (or reported previous to 1924 as *C. tanneri*): Bering Sea: off Pribilof Islands, 49-1,625 fathoms, *Albatross* (Rathbun, 1893a); Bowers Bank, 557-764 fathoms, *Albatross* (Rathbun, 1925). Aleutian Islands: north of Islands of Four Mountains, 1,033-1,217 fathoms, *Albatross* (Rathbun, 1893a); north of Unalaska, 987 fathoms, *Albatross* (Rathbun, 1925).

British Columbia: off Queen Charlotte Islands, 876-1,588 fathoms, *Albatross* (Rathbun, 1893a).

Washington: off Grays Harbor, 58 fathoms, *Albatross* (Rathbun, 1893a).

Oregon: northwest of Cape Blanco, 1,064 fathoms, *Albatross* (Rathbun, 1925).

Atlantic analogue: None. A Pacific boreal species.

Diagnosis: Carapace spinulose, lateral margins partially concealed by expanded branchial regions; space between branchial regions shallow. Rostrum inclined upward. Meri of ambulatory legs little dilated. A large spine at angle made by the two dorsal branchial ridges. Male first pleopod erect, tip acute, linear groove with a marginal row of about 17 filaments; a comb of 9 filaments on opposite side.

Description: Carapace more pubescent than in *Chionoecetes tanneri*; the pubescence of *C. tanneri* less dense and more easily rubbed off. Posterior margin of carapace gently arcuate; in *C. tanneri*, a median interruption or small shallow bight. Interbranchial space not so deeply depressed; the urogastric region defined by a groove on either side; in *C. tanneri* the whole region depressed and narrowly compressed. The two dorsal ridges on the branchial region converging in straight lines and meeting in an acute angle marked by a single, though not simple, large spine; in *C. tanneri* the ridges meeting in a curved line marked by two subequal spines. The posterior of these ridges formed of bunches of acute tubercles, except that the outer one or two on each side may be spines or spinous; in *C. tanneri* this ridge composed largely of single spines. Rostral teeth wider, the width at base in half-grown specimens being as great as the length of the inner margin; in old specimens, greater than the length.

Legs more dilated toward the proximal end. (Rathbun, 1925, modified)

Material examined: From off Queen Charlotte Islands, British Columbia, 876 fathoms, August 31, 1888, *Albatross* station 2860, 1 male, 1 female (U.S.N.M. No. 15478, part). The photographic illustration is of the female.

Measurements: Male specimen: length 24.6 mm, width excluding lateral spines 23.3 mm, length of branchial spine 2.0 mm, rostrum 2.0 mm, width 4.0 mm, cheliped 27.3 mm, chela 11.7 mm, dactyl 8.0 mm, ambulatory legs 61, 62, 59, and 44 mm, respectively. Female: length 26.4 mm, width 24.8 mm.

Color in life: Unknown.

Habitat: Green mud, fine black sand; Foraminifera noted. (Rathbun, 1925)

Depth: 49-1,625 fathoms. (Rathbun, 1925)

Size and sex: That males of the species attain a size comparable to individuals of the *Chionoecetes opilio*-*C. bairdi* group is indicated by the measurements given by Rathbun (1925): length along mid-line 134.4 mm, width without spines 151.5 mm, and length of first leg 356.6 mm.

Breeding: Ovigerous females were encountered by the *Albatross* off Oregon in April, off Kamchatka (extralimital) in June, and in the Aleutian Islands in August.

Remarks: It will be noted that our entire knowledge concerning the species is dependent upon the work of the *Albatross*, since she alone of oceanographic vessels plying northerly waters was equipped to probe the great depths required. The overlap in range between *Chionoecetes tanneri* and *C. angulatus* in Oregon and Washington waters suggests again that, as with *C. opilio* and *C. bairdi*, we may be dealing with a single polytypic species. In the latter case it is *C. opilio* that stands as the parent form, giving rise to *C. bairdi* in the eastern and *C. o. elongatus* in the western Pacific. In the former case it is *C. angulatus* that bridges the Aleutian Island gap from British Columbia to Kamchatka that separates the earlier named *C. tanneri* of the eastern Pacific from *C. japonicus* of the western.

Subfamily **OPHTHALMIINAE** Balss

Stenocionopinae Miers, 1879c, p. 652.

Stenocionopoida Alcock, 1895, pp. 161, 166.

Ophthalmiinae Balss, 1929, p. 6 [Name substituted for *Stenocionopinae* Miers to conform with substitution of *Ophthalmias* for *Stenocionops* (Rathbun, 1897, p. 157)].

The orbit consists, if complete, of a supraocular eave and a postocular spine, while the intercalated spine is lacking . . . Longer spinous outgrowths on the supraocular eave and on the postocular spine are for the most part present. The shape of the body is elongate, somewhat truncate in front, often provided behind with a median spine or outgrowth. (Balss)

KEY TO THE NEW WORLD GENERA OF THE SUBFAMILY *Ophthalmiinae*

(Pacific genera are shown in bold-face type and are treated in this volume.)

- 1a. Eyes furnished with orbits completely enclosed, and often outstanding and tubular
 - 2a. Orbits not projecting beyond general outline of carapace.
 *Thersandrus*
 - 2b. Orbits projecting beyond general outline of carapace, and often tubular

- 3a. Rostrum long, greatly advanced beyond orbits; preocular spine twice length of remainder of orbit. Legs filiform. First movable article of antenna cylindrical *Picroceroides*
- 3b. Rostrum short, little if any advanced beyond orbits; preocular spine not long. Legs moderately robust. First movable article of antenna flattened . . . *Pitho*
- 1b. Orbit unprotected below; eyes protected above by a lamellate projection consisting of the supraocular eave and an outgrowth of the hepatic region
- 4a. Basal prolongation of exognath of third maxilliped curving forward and usually lodged in a groove of the ischium of the endognath. Abdomen seven-segmented in both sexes *Tyche*
- 4b. Basal prolongation of exognath of third maxilliped not recurving; merus of endognath strongly arched, brilliantly glistening, and porcellanous. Abdomen of female with segments 4-6 coalesced *Stilbognathus*

Genus PITHO Bell

Pitho Bell, 1835b, p. 172. Rathbun, 1925, p. 355.

Othonia Bell, 1836, p. 55; type: *Pitho sexdentata* Bell, 1835, by subsequent designation of Miers (1879c, p. 665).

Piloronus Gistel, 1848, p. X (name substituted for *Pitho* Bell, believed preoccupied by *Pytho* Fabricius).

Engyzomaria Gistel, 1848, p. X (name substituted for *Othonia*, preoccupied).

Microrynchus Desbonne, 1867, p. 20; type: *M. lherminieri* Desbonne, 1867, by monotypy.

Type: *Pitho sexdentata* Bell, type of *Othonia* Bell=*Pitho* Bell, by subsequent designation of Miers (1879c, p. 665).

Description: Carapace truncate in front; frontal region broad, rostrum very short and formed by two small teeth. Orbits small, tubular, and deep; eyes slender. External antennae short; their basal article lamellate and forming the floor of the orbit; the second article flat, short and broad, especially in its terminal portion; the third article flattened, but smaller; the movable flagellum much reduced. Stiff, straight hairs bordering the external antennae, and appearing in series and in regular tufts on the pterygostomian regions. Carapace suboval, the anterolateral

margins forming a scarcely arched line with the posterolateral margins. External maxillipeds having their merus dilated on the outside and very little notched on the inside for the insertion of the palpus.

Chelipeds of the male terminating in fingers hollowed into a spoon shape and touching only at their extremity. Hands more or less compressed. Ambulatory legs robust and little elongate; their dactyli pointed and furnished below with some denticulations.

Abdomen of the male narrow and composed of seven articles. (A. Milne Edwards, modified)

Range: West coast of North America from Scammon Lagoon, Lower California, and Tepoca Bay, Gulf of California, Mexico, to Manta Bay, Ecuador; Galapagos Islands; east coast of America from Beaufort, North Carolina, to Cape St. Roque, Brazil. Shore to 45 fathoms; exceptionally (in the Atlantic) to 120 fathoms.

KEY TO THE PACIFIC AMERICAN SPECIES OF *Pitho*

- 1a. Five lateral teeth, the second and third united at base, the second and fifth reduced in size. Carapace sparsely and coarsely granulate
 - 2a. Carapace rough and strongly tuberculate. Cheliped of adult male scarcely longer than first walking leg. First free antennal segment very broad. Male first pleopods distally lyre-shaped *picteti*
 - 2b. Carapace nearly smooth and but weakly tuberculate. Cheliped of adult male greatly exceeding first walking leg. First free antennal segment narrower than 2a. Male first pleopods nearly linear *quinquedentata*
- 1b. Six lateral teeth, the second and third not united at base, all teeth of uniform size except last; last tooth smaller and situated at a higher level. Carapace thickly and finely granulate and hairy *sexdentata*

Pitho sexdentata Bell

Plate J, Fig. 3; Plate 17, Fig. 2

Pitho sexdentata Bell, 1835b, p. 172. Rathbun, 1910, p. 573; 1925, p. 367, pl. 130, fig. 1; pl. 250, figs. 5-9. Boone, 1927, p. 152, fig. 47. Sivertsen, 1933, p. 11. Crane, 1937, p. 60; 1947, p. 72. Steinbeck and Ricketts, 1941, p. 466. Garth, 1946, p. 387.

Othonia sex-dentata, Bell, 1836, p. 56, pl. 12, figs. 1, 1a-d. Not White, 1847, p. 9.

Othonia mirabilis, Gerstaecker, 1857, p. 113 (part). Cano, 1889, pp. 102, 182. Not *Cancer mirabilis* Herbst.

Othonia sexdentata, Stimpson, 1860b, p. 192. A. Milne Edwards, 1875, p. 117.

Type: Female, length 19.1 mm, width 16.9 mm; originally in the Museum of the Zoological Society [London], no longer extant.

Type locality: Galapagos Islands, 6 fathoms, sandy mud; Hugh Cuming, collector.

Localities subsequently reported, with collectors: Mexico: Lower California: Cape San Lucas, John Xantus (Stimpson); A. Milne Edwards (Rathbun, 1925). Gulf of California: Santa Inez Point, *Zaca* (Crane, 1937); Coronado[s] Island, Pt. Marcial Reef, and San Gabriel Bay, Espiritu Santo Island, Steinbeck and Ricketts (Steinbeck and Ricketts). Costa Rica: Port Parker, *Zaca* (Crane, 1947). Ecuador: Galapagos Islands: Floreana [Charles] Island, *Vettor Pisani* (Cano); A. Wollebaek (Sivertsen).

Atlantic analogue: *Pitho mirabilis* (Herbst).

Diagnosis: Carapace thickly and finely granulate and pubescent. Six lateral teeth, the second and third not united at base, all teeth of uniform size except last, this tooth smaller and situated at a higher level. First free antennal segment not remarkably broadened. Male first pleopods closely approximated at midpoints, narrowly lyrate distally.

Description: Male: Fronto-orbital distance narrow. Rostral teeth very narrow and sharp or spiniform. Lateral teeth of carapace divided to their bases, acute, margins granulate; the sixth or posterior tooth posterolateral, separated from the fifth tooth by a tubercle and situated above the margin, forming an arcuate line with the other teeth but above their level. Granules and tubercles of carapace more numerous than in *Pitho quinquedentata*; about 50 small granules on the cardiac region and 40 on the mesogastric region; the granules of the postbranchial region large and spinous. One or more hairs curved at tip arising from each tubercle or granule. An uninterrupted row of large transverse tubercles above margin. Orbital teeth acute, the outer one advanced nearly as far as the inner. First movable article of the antenna shaped much as in *P. quinquedentata*. Chelipeds weak; manus compressed, margins tapering toward extremity. (Rathbun, 1925, of a male from Cape San Lucas in the Paris Museum)

Female: Carapace broadly oval, moderately elevated, the surface rough, granulated, and slightly hairy; the lateral margin with six flattened, triangular, falciform teeth, the points acute and directed forwards;

a ridge of prominent granulations over the posterior margin. Rostrum very small, bifid, and with a small sulcus continued backwards from the division. Orbits with a broad, triangular fissure above, the tooth on each side flattened and triangular, the outer one the larger. Eyes not larger than the peduncles; peduncles elongated, slender, projecting forwards and slightly curved inwards.

[Antennules] extremely minute, and placed far back behind the rostrum. Antennae hairy, short, the basilar [article] broad and flat, having a triangular external tooth extending as far forwards as that of the orbit; second [article] flat, cordate, anteriorly emarginate for the insertion of the third [article], also compressed and much smaller than the previous one; the remaining [articles] small and cylindrical. External [maxillipeds] with [exognath] gradually acuminate; the [endognath] with the [ischium] rather broad and rhomboidal; the [merus] triangular with the anterior angles somewhat produced.

Abdomen (in the immature female) oval, consisting of seven nearly equal articulations, obtusely carinated along the center; each of them delicately ciliated at its anterior margin.

[Legs] of moderate length; the [cheliped] (in the female) considerably smaller than the rest, slender, slightly compressed, and smooth; hand with a small obtuse tooth above and one beneath, at the base; the fingers with the margins minutely serrated. The movable finger longer than the other, and curved over its extremity. The remaining pairs of [legs] decreasing in length from the second to the fifth [first to fourth], depressed, and slightly hairy; the [propodus] having a shallow sulcus on each side; the [dactylus] minutely toothed beneath. (Bell, modernized as to terminology)

Material examined: 23 specimens from 11 stations. (See Table 27) From Tiburon Island, Gulf of California, Mexico, via the Revilla Gigedo Islands of Socorro and Clarion, to Bay of Manta, Ecuador. In addition, one young female from Post Office Bay, Charles Island, Galapagos, 4 fathoms, February 6, 1933, *Velero III* station 55-33, not reported in Garth (1946).

Measurements: Largest specimen, male: length 14.3 mm, width including teeth 13.7 mm, without teeth 12.2 mm, rostrum 0.8 mm, width 1.5 mm, cheliped 15.0 mm, chela 7.2 mm, dactyl 3.0 mm, height of palm 2.8 mm, ambulatory legs 13.3, 12.9, 12.3, and 11.1 mm, respectively. Female specimen: length 17.4 mm, width including teeth 16.5 mm.

Color in life: Vividly white on white coral sand. (Steinbeck and Ricketts)

Habitat: Sandy mud. (Bell) On floating weed. (Crane, 1937) On underside of stone at extreme low-tide level. (Crane, 1947) Of the nine stations for which data on bottom type are available, four are sand (one with mud), two coralline, two rock (one with sand), and one mud with sand. Decorated with large grains of sand and bits of weed. (Crane, 1937)

Depth: Shore to 20 fathoms.

Size and sex: Males in the Hancock series are from 5.6 to 14.3 mm, females from 6.2 to 17.4 mm, the former in each case being young. There are no ovigerous females. The largest male recorded measured 19.0 x 19.5 mm, including spines (Sivertsen); the largest female was the 19.1 mm type.

Remarks: This species has been erroneously recorded as the Pacific counterpart of the Atlantic *Pitho aculeata* by Stimpson and of *P. lherminieri* by A. Milne Edwards.

The Ecuadorean localities of Cape San Francisco and Manta Bay are new for the species, unless Cuming's types were collected in this area instead of the Galapagos Islands, as is believed to be the case with others of Bell's species.

Pitho sexdentata was taken in the same dredge hauls with *P. picteti* at Los Frailes and at Maria Magdalena Island, Mexico. Tiburon Island is a range extension north.

***Pitho picteti* (Saussure)**

Plate J, Fig. 1; Plate 17, Fig. 1

- Othonia picteti* Saussure, 1853, p. 357, pl. 13, fig. 2. Stimpson, 1857b, p. 455. A. Milne Edwards, 1875, p. 118. Lockington, 1877c, p. 70. Streets and Kingsley, 1877, p. 104.
- Micippa ovata* Lockington, 1877c, p. 68; type localities: Port [Puerto] Escondido, Mulege Bay, Los Angeles Bay, San José Island, and La Paz, Gulf of California; types not extant.
- Micippa ovata*, var. *laevis* Lockington, 1877c, p. 69; type locality, Gulf of California; types not extant.
- Othonia nicholsi* Rathbun, 1892, p. 257, pl. 35, fig. 3; type locality, Gulf of California; female holotype U.S.N.M. No. 15822.
- Pitho quinquedentata*, Rathbun, 1898, p. 578; 1910, p. 573 (part: the Gulf of California locality). Boone, 1929, p. 563, figs. 1a-1b. (Not *P. quinquedentata* Bell).
- Pitho picteti*, Rathbun, 1923b, p. 635; 1924c, p. 379; 1925, p. 359, pl. 130, figs. 2, 3; pl. 252, fig. 1. Finnegan, 1931, p. 624. Glassell, 1934, p. 454. Crane, 1937, p. 59. Steinbeck and Ricketts, 1941, p. 466.

Type: Male holotype, length 15.7 mm, width 13.5 mm; not in Geneva Museum, as ascertained by correspondence with the director.

Type locality: Mazatlan, Mexico; E. Verreaux, collector.

Localities subsequently reported, with collectors: Mexico: Lower California: L. Diguët, *Albatross* (Rathbun, 1925); Magdalena Bay, C. R. Orcutt, *Hassler* (Rathbun, 1925), *Zaca* (Crane). Gulf of California, Mexico: Off Cape Tepopa, 45 fathoms, *Albatross* (Rathbun, 1892, type of *Othonia nicholsi*); off San Francisco [Island?] (Gulf of California?) (Rathbun, 1925, of specimens in British Museum); Los Angeles Bay, Mulege Bay, Port [Puerto] Escondido, San José Island, and La Paz. W. J. Fisher (Lockington, as *Micippa ovata*); San José Island, California Academy of Sciences (Rathbun, 1924c); El Mogote, Steinbeck and Ricketts (Steinbeck and Ricketts); Gulf of California, southern part, 10 fathoms, *Albatross* (Rathbun, 1898). Nicaragua: Realejo [Corinto], Oersted (Rathbun, 1925). Panama: Taboga Island, St. George (Finnegan); Saboga Island, Perlas Islands, Mrs. S. D. Sturgis (Boone, as *Pitho quinquedentata*).

Atlantic analogue: *Pitho aculeata* (Gibbes).

Diagnosis: Carapace roughly granulate and strongly tuberculate. Five lateral teeth, the second and third united at base, the second and fifth reduced in size. Cheliped of adult male scarcely longer than first walking leg. First free antennal segment very broad. Male first pleopods distally lyre-shaped.

Description: Male: Carapace ovoid, longer than broad, its anterior margin between the external angles of the orbits very wide. Rostrum very short, notched, orbits advanced, forming a projecting angle pointing upwards, notched at their middle above, the notch placed between two triangular spines; a fissure running from the bottom of the notch. Lateral margins of the carapace armed with five spines; the first remote from the external angle of the orbit, the second and third close to each other. Regions of the test very well marked; a furrow at the middle of the anterior part of the carapace; the latter smooth, bearing several tubercles at the summit of its bosses, one placed in front of, another on the hepatic region, two side by side behind the first ones, then three arranged in a triangle on the anterior part of the intestinal [cardiac?] region, one on each side, at the internal angle of the branchial regions; finally several others, very small and dispersed. Inferior margin of the carapace flanged, and near its posterior portion a denticulate transverse line. First article of the external antennae much broadened, bearing an outgrowth at its external angle. Epimeral plates punctate.

Chelipeds: arms cylindrical, very long, smooth, with some small tubercles at the base; carpus [not carapace] bearing a crest on its external surface; hand nearly as long as the carapace, smooth, compressed; its margins sharp-edged; fingers short, leaving a gap between them at the base; the extremity of the fingers toothed at their external margin; the movable finger bearing at its base a sharp tubercle. Legs slender, long, dactyli arched and pointed at their extremities, with stiff hairs at their internal margin; propodi compressed; carpi nearly depressed, channeled on their internal surface.

Abdomen of seven [not five] articles; the penultimate long, and carrying at each side a small tubercle. (Saussure, modernized as to terminology)

Material examined: 84 specimens from 30 stations. (See Table 28) From Scammon Lagoon, west coast of Lower California, and Tepoca Bay, Gulf of California, Mexico, to Taboga Island, Panama. San José Island, Gulf of California, Mexico, California Academy of Sciences, 1921 expedition, 1 male.

Measurements: Male: length 18.7 mm, width including spines 19.0 mm, width without spines 16.0 mm, rostrum 1.4 mm, width 2.6 mm, cheliped 16.8 mm, chela 7.4 mm, dactyl 3.2 mm, height of palm 2.4 mm, ambulatory legs 16.4, 16.0, 15.0, and 13.8 mm, respectively. Largest specimen, male: length 22.1 mm, width including spines 20.1 mm, without spines 18.0 mm. Female: length 21.7 mm, width including spines 19.4 mm, width without spines 17.8 mm.

Color in life: Whitish. (Saussure) Carapace ochraceous buff except for a large patch of dark brown on either side of intestinal region; marginal teeth purplish; orbital teeth white; hairs set in sockets of Beryl green. Cornea light brown, eyestalk ivory. Chelipeds mottled dark yellow-green and white; fingers dark green proximally, warm buff distally. Ambulatory legs with meri cream buff encircled with a yellow-green band; carpi, propodi, and dactyli yellow-green proximally, cream buff distally. Pterygostomian region and outer maxillipeds mottled dark green and white. Abdomen and sternum red-orange and white. (Petersen, of a female from the Gulf of California)

Habitat: Sandy beach with scattered rocks at extreme low tide. (Boone) Under a stone in three feet of water, decorated with large grains of sand and bits of shell and weed. (Crane) Of the 26 recoveries for which data on substratum are available, 7 are from rock (presumably the 7 shore stations), 10 from sand, 4 from sandy mud, and 7 from organic bottom (coral, nullipore, coralline).

Depth: To 45 fathoms. (Rathbun, 1892) Hancock specimens were obtained from shore to 20 fathoms only.

Size and sex: Males in the present series are from 5.5 to 22.1 mm, females from 6.8 to 21.7 mm, ovigerous females from 9.4 to 19.3 mm. A young specimen only 3.6 mm long was cracked from *Pocillopora* coral.

Breeding: Ovigerous females were encountered by Hancock expeditions in the Gulf of California in March, in Costa Rican waters in February, and at Tres Marias Islands, Mexico, and Taboga Island, Panama, in May.

Remarks: Although primarily a Gulf of California species, as attested by the overwhelming number of records from stations north of Mazatlan, the type locality, *Pitho picteti* is appearing with increasing frequency among collections from the Bay of Panama, as shown by records of Boone, Finnegan, and of the *Velero III*. Worthy of note is the extension of range from Magdalena Bay on the Lower California west coast northward to San Ignacio and Scammon Lagoons, the specimens having been obtained by Martin W. Johnson and M. Woodbridge Williams, respectively. Significant also is the taking of *P. picteti* in the same dredge haul with *P. sexdentata* at Tres Marias Islands and at Los Frailes in the southern part of the Gulf of California. In Panamanian waters inhabited by *P. picteti* and *P. quinquedentata*, the two species appear to occur in segregated colonies, the former having been dredged three times at Bahia Honda, the latter twice at Taboga Island.

As compared with *Pitho quinquedentata*, *P. picteti* is generally larger, but with a weakly developed male cheliped which is almost equaled in length by the first walking leg. Its strong tuberculation and rough granulation serve at once to distinguish it from the much smoother *P. quinquedentata* and the finely granulate *P. sexdentata*. The extremely broad first free antennal segment of *P. picteti* is not met with in either of the other species.

The key and diagnostic characters given above depart from the original description with respect to the male cheliped. It is apparent that an occasional male may have the elongated cheliped with the hand nearly as long as the carapace, and that the specimen figured by Saussure and the one described by Lockington as *Micippa ovata* var. *laevis* were of this type. The presence of a transverse line of tubercles above the posterior margin of the carapace serves to distinguish Saussure's specimen from Bell's *Pitho quinquedentata*, with which species the elongated cheliped is here associated. All Hancock expeditions males of *P. picteti*, however, are of the short-handed type figured by Rathbun (1925, pl. 130, figs. 2 and 3), who apparently also was willing to overlook this discrepancy.

***Pitho quinquedentata* Bell**

Plate J, Fig. 2; Plate 18, Fig. 1

Pitho quinquedentata Bell, 1835b, p. 172. Rathbun, 1910, p. 573 (part: not the Gulf of California locality); 1925, p. 361, pl. 250, figs. 1-4, text-fig. 117a. Boone, 1927, p. 151, fig. 46. Garth, 1946, p. 386 (part: not the Isabel Island locality).

Othonia quinque-dentata, Bell, 1836, p. 57, pl. 12, figs. 2-2e. Not White, 1847, p. 9.

Othonia mirabilis, Gerstaecker, 1857, p. 113 (part). Not *Cancer mirabilis* Herbst.

Othonia quinquedentata, A. Milne Edwards, 1875, p. 118; 1878, pl. 24, figs. 3a-c.

?*Othonia aculeata*?, Cano, 1889, pp. 101, 181, pl. 7, fig. 6. Not *Hyas aculeata* Gibbes.

Type: Female holotype, length 12.7 mm, width 10.6 mm; originally in the Museum of the Zoological Society [London], no longer extant.

Type locality: Galapagos Islands, 6 fathoms, sandy mud; Hugh Cuming, collector.

Localities subsequently reported, with collectors: Panama: Bay of Panama (A. Milne Edwards). Ecuador: Galapagos Islands (A. Milne Edwards; Rathbun, 1925). ?Peru: Payta [Paita], *Vettor Pisani* (Cano, 1889, as *Othonia aculeata* Gibbes?).

Atlantic analogue: *Pitho lherminieri* (Schramm).

Diagnosis: Carapace nearly smooth and weakly tuberculate. Five lateral teeth, the second and third united at base, the second and fifth reduced in size. Cheliped of adult male greatly exceeding first walking leg. First free antennal segment of moderate width. Male first pleopods nearly linear.

Description: Carapace of male narrow behind. Front rather wide, inner orbital tooth decidedly more advanced than outer tooth, rostral teeth still more advanced and separated by a V interspace. Lateral teeth five, blunt, the last two very small, the last one hardly more than a tubercle; second tooth nearly as large as third, and not entirely separated from it. First movable segment of antenna rather narrow. Chelipeds with manus compressed, upper edge sharp. (Rathbun, 1925, of a male from the Galapagos Islands in the Paris Museum, in all probability the specimen figured by A. Milne Edwards)

Material examined: 11 specimens from 3 stations, all Panamanian. (See Table 29)

Measurements: Male specimen: length 10.3 mm, width including teeth 9.8 mm, without teeth 8.5 mm, rostrum 0.8 mm, width 1.6 mm, cheliped 13.1 mm, chela 6.4 mm, dactyl 2.6 mm, height of palm 2.1 mm, ambulatory legs 9.5, 9.0, —, and (*ca.*) 6.5 mm, respectively. Female specimen: length 10.3 mm, width 8.9 mm.

Color in life: The general color is brown; the feet with alternate rings of reddish and brown. (Bell)

Habitat: Sandy mud. (Bell) *Velero III* specimens were dredged once from sand and once from rock bottom.

Depth: Shore to 20 fathoms.

Size and sex: Males in the present series are from 6.4 to 10.3 mm, females from 6.5 to 8.3 mm; the ovigerous specimen is 7.2 mm. The largest specimen on record is the 16.7 mm male reported by Rathbun (1925) from the Galapagos Islands.

Breeding: The single ovigerous female was encountered in Panama in January.

Remarks: The remarks of Rathbun (1925, p. 361) on a male from the Galapagos Islands in the Paris Museum are enlightening. If the specimen examined was indeed the same as that figured by A. Milne Edwards, as seems highly probable, then Bell's figure of the female type may be considered no more accurate than his figures have proven to be in the case of species now represented in collections by adequate material. In view of the great strides made in scientific illustration between 1836 and 1875 and the greater reliability which may be placed on A. Milne Edwards's figures, this explanation seems more plausible to the writer than Rathbun's, which was that the differences observable between the two illustrations could be attributed to the accentuation of sexual differences.

Of the characters illustrated by A. Milne Edwards's figured male, the following are exhibited by Hancock expeditions males from Panama: the outer margins of the orbits converge anteriorly; marginal teeth two and three are joined at their bases; teeth two and five are reduced in size; the inner orbital tooth is more advanced than the outer, the front more than either; the tubercles of the carapace are relatively few in number (as compared with *Pitho picteti*) and less upstanding; the chelipeds are much longer than the first pair of walking legs, the chelae swollen and compressed.

Genus **TYCHE** Bell

Tyche Bell, 1835b, p. 172; 1836, p. 57. A. Milne Edwards, 1878, p. 125. Rathbun, 1925, p. 507.

Platyrinchus Desbonne, 1867, p. 3; type: *P. trituberculatus* Desbonne, 1867 = *Tyche emarginata* White, by monotypy.

Type: *Tyche lamellifrons* Bell, by monotypy.

Description: Carapace oblong-oval, flattened, with lamellate extensions in front and behind; front very wide, with four horns, the two lateral forming anterior angles of orbit. Orbits covered by a lamellate prolongation concealing the ocular peduncles nearly to their extremities; no orbital floor below, the ocular peduncles being entirely uncovered. Antennae concealed beneath rostrum; basal segment somewhat enlarged, a small blunt point at its anteroexternal angle; following articles cylindrical. External maxillipeds exhibiting a very remarkable arrangement, not shown in any other genus: external branch or exognath narrow and having at its base a falciform prolongation bent around forward and lodged in a groove of the ischium of the endognath. Merus much extended backward and then inward, cutting deeply the anterior border of the ischium.

Chelipeds little enlarged. Ambulatory legs slender, with very hooked dactyli. (Rathbun, modified, after A. Milne Edwards)

The description given above is emended as follows to include one of the new species here proposed: the ischium of the endognath of the external maxilliped may or may not be grooved, in which latter case the recurving projection of the exognath finds no lodgment therein.

The males of the genus are seven-segmented (Bell); the females possess seven free abdominal segments also. The male first pleopod is bent near the apex, which is sharply or bluntly pointed and lacks supplementary processes, although the end may be split to form a flap which protects the orifice.

Range: Eastern Pacific from Agua Verde Bay, Gulf of California, and Cape San Lucas, Lower California, Mexico, to Salango Island, Ecuador; Clarion and Galapagos Islands. Western Atlantic from Florida Keys to Cape St. Roque [São Roque], Brazil. Shore to 30 fathoms.

KEY TO THE PACIFIC AMERICAN SPECIES OF *Tyche*

- 1a. Rostral horns exceeding preorbital. Length and width of posterior medallion subequal. Ischium of external maxilliped grooved, basal projection of exognath recurving upon it. First

free antennal segment cylindrical. Legs slender. Male first pleopod with a protective flap and row of papillae

2a. Groove of maxilliped extending entire length of ischium; merus not produced externally. No spine at anterolateral angle of basal antennal article. Apertural flap of male first pleopod rounded beneath. *lamellifrons*

2b. Groove of maxilliped occupying basal portion of ischium only; merus produced externally in a thin blade. A spine at anteroexternal angle of basal antennal article. Apertural flap of male first pleopod squarish *clarionensis*, n. sp.

1b. Preorbital horns equaling or exceeding rostral. Width of posterior medallion appreciably exceeding length. Ischium of external maxilliped not grooved, inflated; basal projection of exognath posteriorly directed. First free antennal segment flattened. Legs robust. Protective flap of male first pleopod rudimentary, row of papillae lacking
. *galapagensis*, n. sp.

***Tyche lamellifrons* Bell**

Plate J, Fig. 4; Plate 18, Fig. 2

Tyche lamellifrons Bell, 1835b, p. 173; 1836, p. 58, pl. 12, fig. 3, 3f-j. Stimpson, 1871a, p. 97. A. Milne Edwards, 1878, p. 126. Bouvier, 1895, p. 8. Rathbun, 1898, p. 572; 1910, p. 573; 1925, p. 508, pl. 273, figs. 1-6. Crane, 1937, p. 64. Garth, 1948, p. 30. Buitendijk, 1950, p. 274. Not Garth, 1946, p. 406, pl. 54, figs. 1-6.

Tyche brevipostris [for *brevirostris*] Lockington, 1877c, p. 74; type locality, Port [Puerto] Escondido, Gulf of California, Mexico; female holotype not extant.

Type: Male holotype, length 14.8 mm, width 8.5 mm; not in British Museum, as stated by Rathbun (1925), *vide* I. Gordon (personal communication, March 12, 1956).

Type locality: Panama; Hugh Cuming, collector.

Localities subsequently reported, with collectors: Lower California, Mexico: L. Diguët (Bouvier); Cape San Lucas, J. Xantus (Stimpson). Gulf of California: Santa Inez Bay, 2.5-29 fathoms, *Zaca* (Crane); Port [Puerto] Escondido, W. J. Fisher (Lockington, as *Tyche brevirostris*); San Lorenzo Channel, 7 fathoms, *Albatross* (Rathbun, 1898). Mexican mainland: Acapulco, Guerrero, Exped. Escuela Nacional de Ciencias Biológicas (Buitendijk). Ecuador: Off Esmeraldas, 9-27 meters, *Askoy* (Garth, 1948); not Galapagos Islands, 0-20 fathoms, *Velero III* (Garth, 1946).

Atlantic analogue: Tyche emarginata White.

Diagnosis: Rostral horns slender, exceeding preorbital. Length and width of posterior medallion subequal. External maxilliped slender, ischium grooved throughout length, basal projection of exognath recurving upon it, anteroexternal angle of merus not produced. First free antennal segment cylindrical. Male first pleopod with a rounded protective terminal flap and a row of papillae.

Description: Carapace very wide in front; gastric region swollen, cardiac and branchial regions depressed. Lateral borders straight and nearly parallel at hepatic regions, rounded at branchial regions. Posterior border lamellate. Front with two small, flat horns curved toward each other, extremities bispinose. The superior orbital border extending in the form of a plate over the eye and projecting nearly forward in a strong horn. A deep fissure separating orbit from hepatic margin. Chelipeds of male slender, smooth, shorter than the next pair of legs; fingers touching only at their extremity. Ambulatory legs very slender and cylindrical. (Rathbun, modified, after A. Milne Edwards)

The foregoing description is no longer adequate in view of the necessity for distinguishing the true *Tyche lamellifrons* of the Pacific American mainland from the species newly described from adjacent insular waters. The rostral horns are slender, overreaching the second free antennal segment, and exceeding by a comfortable margin the preorbital horns. The excrescence of the inner margin of each rostral horn is comblike and the two together form an effective mechanism for the anchoring of small bits of *Ulva*. The preorbital horns have the tips broadened and the outer as well as the inner margins arcuate. The posterior margin of the carapace is upturned as well as lamellate. The basal antennal article may bear a small lobe at the anteroexternal angle, but does not bear a spine. The groove of the ischium of the outer maxilliped extends the entire length of the article, and the anteroexternal angle of the merus is squared or rounded off, not extended in a thin blade. The cheliped of the male is little more robust, that of the female no more so, than the walking legs, which are exceedingly long, slender, and hairy. Lastly, the male first pleopod is provided with a flap which is rounded, rather than squared, on its inferior margin, and which scarcely conceals the orifice.

Material examined: 23 specimens from 18 stations. (See Table 30) From Agua Verde Bay, Gulf of California, Mexico, to La Libertad, Ecuador.

Measurements: Largest specimen, a female from the Gulf of California: length 25.9 mm, length posterior to gastric tubercle 14.8 mm, width 16.0 mm, rostrum 3.8 mm, width 4.2 mm, cheliped 16.5 mm, chela 6.8 mm, dactyl 3.3 mm, height of palm 1.8 mm, ambulatory legs 27.0, 19.7, 16.8, and 13.5 mm, respectively. Male specimen: length 18.1 mm, width 10.5 mm.

Color in life: Carapace and chelipeds uniform Sudan brown, hand a tone lighter, fading to very pale finger tips. Eystalk amber; eye buff yellow. Ambulatory legs lighter than carapace; nail of dactyl clear pale amber. Ventral side raw Sienna. (Petersen, of an Isabel Island specimen)

Habitat: Taken on rocky substrate and on sandy bottom four times each, on coral and coralline bottom two times each, and on mud (with sand) once. With *Ulva*, filamentous alga, coralline alga; hydroids, sponges.

Depth: Shore to 15 fathoms. To 29 fathoms. (Crane)

Size and sex: Males in the present series are from 9.9 to 18.1 mm, females from 7.5 to 25.9 mm, young from 5.5 mm.

Breeding: The single ovigerous female was encountered by the *Velero III* at Maria Magdalena Island, Mexico, in May.

Remarks: From the material now available from the west coast of Middle America, including that of the *Askoy* as well as that of the *Velero III*, it is apparent that Bell's species, having Panama as its type locality, is the true analogue of the Atlantic *Tyche emarginata*, and that specimens from the Galapagos Islands, attributed by this writer (Garth, 1946, p. 406) to *T. lamellifrons*, are in reality a distinct and undescribed species. The diagnosis and description of *T. lamellifrons*, as given by Bell, A. Milne Edwards, and Rathbun, therefore, apply as before to Pacific mainland specimens, while the diagnosis and supplementary description of *T. lamellifrons* given by Garth, as well as the published figure (*op. cit.*, pl. 54, figs. 1-6), apply to the Galapagos species instead.

The best comparison between *Tyche lamellifrons* and *T. galapagensis* is provided by a 25.9 mm female of the former from San Lorenzo Channel, Gulf of California, station 498-36, and the type specimen of the latter, a 27.7 mm female from Albemarle Island, Galapagos. In the Gulf of California specimen the rostral horns are long and exceed the pre-orbital, while the length and breadth of the posterior medallion are subequal. The ambulatory legs are much more slender than in the Galapagos species, the cheliped being not noticeably more robust than the walking legs. The maxillipeds are narrow, the ischium deeply grooved, the basal projection of the exognath recurving to lodge itself

in the proximal portion. The merus also recurves in its insertion into the ischium, the inner border of which is spinate. For the corresponding conditions in *T. galapagensis* refer to the description of that species.

The use of the inwardly projecting comb on the rostrum remained a mystery until a specimen from Acapulco, obtained by E. Yale Dawson from among *Ulva*, showed that the stem of the mushroom-shaped plant, after being anchored in the hooked hairs at the base of the rostrum, had been led forward between the rostral horns and under the almost touching projections, being thus firmly held in place.

Tyche clarionensis, new species

Plate J, Fig. 5

Type: Male holotype, A.H.F. No. 344, from off Sulphur Bay, Clarion Island, Mexico, 30 fathoms, June 11, 1934, collected by Allan Hancock Summer Cruise of 1934 at *Velero III* station 303-34. One male and one female, paratypes, same station and date. For additional material, see *Material examined* below.

Measurements: Male holotype: length 20.6 mm, length posterior to gastric tubercle 11.3 mm, width 13.6 mm, rostrum 3.0 mm, width 4.0 mm, cheliped 20.0 mm, chela 9.4 mm, dactyl 4.4 mm, height of palm 3.8 mm, ambulatory legs 26.5, 18.7, 14.5, and 11.3 mm, respectively. Female paratype: length 12.1 mm, width 8.0 mm.

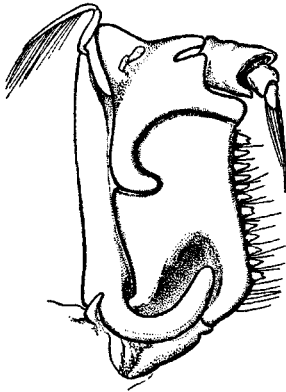
Diagnosis: Rostral horns exceeding preorbital, broadly triangular. Width of posterior medallion appreciably exceeding length. External maxilliped somewhat inflated, groove lodging recurving projection of exognath restricted to basal portion of ischium, anteroexternal angle of merus produced into a thin blade. First free antennal segment cylindrical, a spine at anteroexternal angle of basal article. Male first pleopod with a square-cut flap protecting orifice and a row of papillae on concave margin.

Description: Carapace broadened anteriorly, gastric and cardiac regions elevated, branchial and hepatic regions depressed, the latter two separated from each other by a sharp ridge extending diagonally backward from the gastric prominence and with it delimiting anteriorly a posterior medallion roughly hexagonal in shape. Of the four conspicuous horns comprising the anterior portion of the carapace, the median or rostral pair more advanced than the lateral or preorbital pair, the latter inclined upward as well as outward and lying at a higher level. Rostral horns not large, horizontal, broadly triangular, deeply cleft, and provided with a median protuberance on inner margins. Preorbital spines directed more strongly forward than outward, tips acutely pointed, inner

margins arcuate. Supraocular eave expanded posteriorly to override a corresponding hepatic projection, the two forming a button-hole slit and concealing all but the cornea when viewed from above. A large setose tubercle located on the lateral margin just in advance of, another just posterior to the small sharp tubercle terminating the diagonal ridge. Gastric region high, surmounted by a large median tubercle with a pair of smaller tubercles in advance of it; cardiac region with three small tubercles arranged in a backward-pointing triangle. Hooked hairs present in a double row on each rostral horn, sparsely on each preorbital horn, in a rectangle of four clusters outlining the gastric region, and fringing the posterior medallion. Posterior margin lamellate, crenulate, not bilobed.

Basal antennal article broad, bearing a ridge internally and a small spine at anteroexternal angle. First free antennal segment cylindrical, twice as long as second, second barely reaching end of rostrum, the two segments fringed with coarse hair; flagellum slender. Orbit entirely open beneath, the fringing hairs of the hepatic projection affording a minimum of concealment to the retracted eye.

Outer maxilliped smooth and inflated, hooked projection of exognath lodged in a basal groove of the ischium, completely filling it; merus inserting deeply into outer border of ischium, anteroexternal angle produced into a thin blade, anterointernal margin cut into three distinct lobes; first article of three-segmented palp subquadrate.



5. *Tyche clarionensis* (Velero III Sta. 303-34), right outer maxilliped, x 12.

Cheliped of male more robust than walking legs; merus cylindrical, an outer proximal tubercle; carpus with a tubercle above; manus superiorly compressed, moderately inflated, scarcely tapering distally, palm nearly bare; fingers closing with a narrow gape and provided with numerous denticles, tips pointed, crossing.

Ambulatory legs moderately long and slender, cylindrical, first leg of male exceeding second by length of its propodus and dactylus, remaining legs decreasing in order. Six clusters of hooked hairs along the margin of leg one, three meral, two carpal, and one propodal; a single clavate hair at apex of each condyle. Dactyls strongly curved, dentigerous, tips corneous.

Male abdomen with seven free segments, sides straight and converging, segments two to six with a median setose tubercle, segment seven triangular. Male first pleopod with a fold along convex margin terminating in a square-cut flap concealing orifice; a row of papillae along concave margin.

Material examined: Supplementing the holotype and two paratypes from station 303-34 are 6 specimens from 4 additional Clarion Island stations. (See Table 31)

Remarks: The series of *Tyche* obtained by the *Velero III* during two brief stops at Clarion Island in June, 1934, and March, 1939, consisting of 5 male and 4 female specimens, compares more than favorably with the 3 males, one female, and 2 young taken on four separate Hancock cruises to the Galapagos Islands. Clarion Island specimens were recognized at once as differing from Galapagos Island specimens, but it is only through studies recently completed that it has been possible to differentiate them successfully from Gulf of California-Bay of Panama specimens. Examination of maxillipeds and male first pleopods of all available material, Atlantic as well as Pacific, has revealed important differences which can be correlated with geographic distribution. It is not surprising, therefore, that the most striking of these should occur among Clarion Island and Galapagos specimens, where isolation is extreme and endemism highly developed.

***Tyche galapagensis*, new species**

Plate J, Fig. 6

Tyche lamellifrons, Garth, 1946, p. 406, pl. 54, figs. 1-6. Not *T. lamellifrons* Bell.

Type: Ovigerous female, holotype, Cat. No. 100917, U. S. National Museum, from Albemarle Point, Albemarle Island, Galapagos Islands, shore, February 11, 1933, collected by Allan Hancock Expedition of 1933 at *Velero III* station 69-33.

Measurements: Female holotype: length of carapace 27.7 mm, width 17.9 mm, distance from gastric tubercle to posterior margin 15.5 mm, length of rostrum 4.6 mm, width 3.8 mm, length of cheliped 19.5 mm,

of chela 7.5 mm, of dactyl 3.6 mm, height of palm 2.3 mm, length of ambulatory legs 24.5, 18.5, 16.3, and 13.7 mm, respectively. Male paratype: length 24.0 mm, width 14.8 mm.

Diagnosis: Carapace broad, width greater than length posterior to gastric tubercle. Preorbital horns divergent, equaling or exceeding rostral horns. External maxilliped inflated, basal projection of exognath not recurving over ischium; ischium without a groove. First free antennal segment flattened. Male first pleopod with a terminal triangular opening, protecting flap rudimentary, not extending to tip. **Galapagos only.**

Description: Carapace broad, particularly at hepatic level, gastric and cardiac regions elevated and tuberculate, branchial regions depressed, a strong ridge extending from gastric onto anterior branchial region separating the posterior portion of the roughly hexagonal carapace from the laterally depressed and medially declivitous anterior portion. Frontal region composed of four conspicuous flattened horns, two rostral, two preorbital. Rostral horns small, subparallel, separated to bases, tips broadly rounded, a spinous projection extending inward and upward from the midpoint of each and all but meeting in the midline. Preorbital spines strongly divergent, their blunt tips overreaching the rostral horns although inclined in a plane above them. The posterior projection of the orbit and the hepatic lobe, although separated by a deep notch, together forming a leaflike process concealing the long eyestalk and all but the tip of the cornea from dorsal view. Lateral branchial margins rounded and bearing two or three setose tubercles. Four clusters of stout, hooked hairs forming a square outlining the gastric region, and a double row lining the outer margin of each rostral horn. Longer and softer hairs fringing the inner margin of the preorbital spines and the margins of the carapace posterior to the orbito-hepatic suture. Posterior margin lamellate and faintly trilobed.

Basal antennal article broadened, a low ridge on inner margin, outer margin delimiting the open orbit. First free segment flattened, second cylindrical and half the length of the first, both segments fringed with coarse hair.

External maxillipeds unusually broad, endognath with ischium and merus inflated, strongly convex, and appearing as if coalesced; exognath with basal projection directed posteriorly, rather than recurving onto ischium; ischium without a longitudinal groove. Inner margin of ischium entire, merus inserting deeply into outer margin but not recurving, as in *Tyche lamellifrons* and *T. emarginata*. (It is the configuration of the

maxilliped, more than any other character, which sets the new species apart from the species of *Tyche* heretofore known, requiring a modification of the generic description as given by A. Milne Edwards.)

Male cheliped noticeably stouter than ambulatory legs, merus cylindrical, a proximal tubercle on superior surface; carpus smooth and slightly compressed; manus moderately inflated, compressed, tapering distally, palm smooth, fingers with a narrowly triangular gape at base, denticulate to tips, tips crossing.

Ambulatory legs short and stout in the female, longer and more slender in the male. First leg of male longest of any, including the cheliped, length greater than that of carapace and half again as great as that of the succeeding member; remaining legs diminishing regularly in size. All legs cylindrical, meri and carpi hairy, propodi of all except the first bare, dactyli strongly curved, nondentigerous, and with corneous tips.

Male abdomen with seven free segments, a median setose tubercle on all but the first and last; last segment narrowly triangular. Male sternum flattened, a small tubercle opposite the last abdominal segment. Female abdomen with seven free segments also.

Male first pleopod curved at extremity, terminal opening triangular in shape, protecting flap rudimentary, not extending to tip, the row of papillae characterizing *T. lamellifrons* wanting.

Material examined: Supplementing the holotype is a 24 mm male from Sullivan Bay, James Island, Galapagos Islands, December 12, 1934, *Velero III* station 343-35, from which measurements above were taken. In addition, two males and two young, representing four additional Galapagos collections, all reported in Garth (1946, p. 406) as *Tyche lamellifrons*.

Remarks: In connection with the present study the writer had occasion to reexamine the Galapagos series of *Tyche* previously referred to *T. lamellifrons* Bell (Garth, *op. cit.*). In the vial with an 18 mm male from Post Office Bay, Charles Island, *Velero III* station 167-34, were found two notes representing an exchange of comments between the writer and the late Mary J. Rathbun which took place in 1935:

"*Tyche*, n. sp. (nec *lamellifrons* Bell). Preorbital horns not subparallel but strongly divergent and exceeding rostral [horns] as in the Atlantic species, *emarginata*. Secondary lobes of front almost coalescent. Posterior margin faintly bilobate." (J. S. Garth)

"I think it is *T. lamellifrons*. We have one intermediate in size between yours and the picture [of Bell's type?]. Its 4 anterior horns are intermediate between those other 2." (M. J. Rathbun)

At the time, and for more than a decade subsequently, Rathbun's determination of the Galapagos Islands specimens prevailed. Upon mature consideration, and supported by many more specimens of *Tyche lamellifrons* from the American mainland than the single Gulf of California male (U.S.N.M. No. 21905) available to Miss Rathbun, including specimens from Bell's type locality, the Bay of Panama, the writer is inclined to his former view. Certainly, Rathbun did not consider the totally dissimilar third maxillipeds, that of the new species transcending the limitations of the genus *Tyche* as given by her (1925, p. 507). Additional evidence for separating the Galapagos Islands specimens from those of the mainland and of Clarion Island is furnished by the male first pleopod, the triangular opening of which is unprotected by the flap which in *T. lamellifrons* covers it to the very tip.

It is the maxilliped and pleopod upon which the new species should rest, rather than relative length of rostral to preorbital horns, which is subject to considerable variation, even in the short series of six specimens. The one sizeable male is asymmetrical with respect to the rostrum, the right horn being longer than the left and extending beyond the preorbital. For this reason it was not selected as the type, although this would have been desirable from the standpoint of the pleopod.

The type specimen was figured as *Tyche lamellifrons* (Garth, 1946, pl. 54, figs. 1, 2, 5, 6), figures 3 and 4 of the same plate being of the male paratype from station 343-35.

Subfamily ACANTHONYCHINAE

Acanthonychinae Alcock, 1895, pp. 160, 164, 190. Rathbun, 1925, p. 140. Stephensen, 1945, pp. 99, 218.

Acanthonychidae, Stebbing, 1910, p. 286.

Eyes without true orbits; the eyestalks very short or sometimes even obsolescent, either concealed beneath a forwardly-produced supraocular spine, or sunk in the sides of a huge beaklike rostrum; a postocular spine or process sometimes present, but not excavated for the reception of the retracted eye. Basal antennal article truncate-triangular. External maxillipeds with the merus as broad as the ischium. Dactyli of the ambulatory legs prehensile or sub-chelate; the last three pairs of legs often disproportionately short compared with the [first] pair. (Alcock)

Rathbun (1925) points out that the postocular spine is not cupped (except in *Sphenocarcinus*), that the rostrum may be either simple or two-spined, and that the palp arises from the anterointernal angle of the merus of the maxilliped.

Pleopod 1 medium stout, apex most varying (hammer-shaped ; divided into 3-4 lobes ; etc.). Pleopod 2 short. (Stephensen)

KEY TO THE AMERICAN GENERA OF THE SUBFAMILY

Acanthonychinae (after Balss)

(Pacific genera are shown in bold-face type and are treated in this work)

(Intercalated spine absent in entire group)

1a. Rostrum double

2a. Seven free abdominal segments in both sexes

3a. Antennae visible at sides of rostrum in dorsal view

4a. Postorbital tooth lacking. Rostrum bifurcate for half its length, horns widely divergent

. *Menaethiops*

4b. Postorbital tooth present. Carapace with two lateral expansions, one hepatic, one branchial

5a. Lateral expansions both very broad, leaflike branchial overlapping hepatic dorsally

. *Mimulus*

5b. Lateral expansions narrower, inwardly separated

. *Pugettia*

3b. Antennae not visible at sides of rostrum in dorsal view

6a. Carapace broadly oval. Postorbital tooth small or lacking

. *Taliepus*

6b. Carapace subtriangular or subpentagonal. Postorbital tooth of normal size

7a. Rostrum long, composed of two contiguous spines. Legs not cristate

. *Sphenocarcinus*

7b. Rostrum short, composed of two closely approximated horns with arcuate margins. Legs cristate

. *Leucippa*

2b. Six free abdominal segments in both sexes. Legs subchelate

. *Acanthonyx*

1b. Rostrum single, or secondarily divaricate

8a. Six free abdominal segments in male, five in female

. *Epialtus*

8b. Five free abdominal segments in male

9a. Five free abdominal segments in female

10a. Eyestalks short, immovable. Carapace nodose

. *Mocosoa*

- 10b. Eyestalks longer, movable
- 11a. Some strong tubercles on dorsal surface of carapace. Propodites of ambulatory legs dentigerous **Eupleurodon**
- 11b. Carapace nearly smooth or posteriorly eroded. Propodi of ambulatory legs entire (non-prehensile) **Epialtoides**
- 9b. Four free abdominal segments in female . . . **Esopus**

Genus **MIMULUS** Stimpson

Mimulus Stimpson, 1860b, p. 199. A. Milne Edwards, 1878, p. 144.

Holmes, 1900, p. 23. Rathbun, 1925, p. 182.

Type: Mimulus foliatus Stimpson, by monotypy.

Description: Carapace flattened, more or less pentagonal; anterolateral margin laminate and cut by a narrow fissure into two closely approximate lobes. Rostrum short, bifid, and horizontal. Orbits incomplete below, but furnished above with a preorbital and postorbital spine. Eyes not concealed when retracted. Merus of the external maxillipeds short, the external angle obtuse, the internal angle incised; outer margin of the exognath dilated. Hand of the chelipeds much compressed and subcarinate. Propodi of the ambulatory legs with a setose tooth near the middle of the inferior margin. First pair of ambulatory legs exceeding the others. (Holmes, after Stimpson)

Abdomen seven-segmented in both sexes.

Range: Pacific coast of North America from Unalaska, Alaska, to Point Arguello and Santa Cruz Island, California. Not Mazatlan, Mexico. (A. Milne Edwards) Shore to 70 fathoms.

Contains, in all probability, but one species.

Mimulus foliatus Stimpson

Plate L, Fig. 1; Plate 25, Fig. 3

Mimulus foliatus Stimpson, 1860b, p. 200, pl. 5 (not 3), fig. 1. A. Milne Edwards, 1875, pl. 18, figs. 4-4d; 1878, p. 145. Miers, 1879c, p. 649. Holmes, 1900, p. 23. Rathbun, 1904, p. 173; 1925, p. 182, pl. 60, text-figs. 70, 71. Weymouth, 1910, p. 30, pl. 4, figs. 12, 13. Taylor, 1912, pp. 191, 208. Schmitt, 1921, p. 204, text-figs. 127a, 127b. Johnson and Snook, 1927, p. 368, fig. 320. Clemens, 1933, p. 51. Ricketts and Calvin, 1939, p. 94, pl. 20. Hart, 1940, p. 98.

?*Mimulus acutifrons* A. Milne Edwards, 1867, p. 264, type locality unknown, type in Paris Museum; 1878, p. 145.

Pugettia (Mimulus) foliata, Newcombe, 1893, p. 22; 1898, p. 76.

Pugettia foliata, Rathbun, 1894, p. 72.

Type: Male cotype, without chelipeds or legs, M.C.Z. No. 1244.

Type locality: Off Monterey, California; taken from the stomachs of percoid fishes ("Cabesones"); A. S. Taylor, collector.

Localities subsequently reported, with collectors: Alaska: Off Imagnee Pinnacle, Captains Bay, Unalaska, 8-20 fathoms, W. H. Dall (Rathbun, 1894).

British Columbia: Queen Charlotte Islands: Louscoone Bay and Houston-Stewart Channel near Rose Harbor, Moresby Island (Hart); Vancouver Island: Esperanza Inlet, Nootka and Clayoquot Sounds (Hart); Clayoquot Sound (Newcombe); Ucluelet, Geological Survey of Canada (Rathbun, 1925); Barclay [Barkley?] Sound, *Albatross* (Rathbun, 1894).

California: Mendocino, A. Agassiz (Rathbun, 1925); Monterey Bay, 5-12 fathoms (Weymouth), H. Heath (Rathbun, 1925); Monterey, A. S. Taylor (Stimpson), H. Hemphill (Rathbun, 1894); Pacific Grove, J. C. Brown, T. S. Oldroyd (Rathbun, 1925).

Atlantic analogue: None. A Pacific boreal species.

Diagnosis: Breadth of carapace equaling or exceeding length; lateral expansions leaflike, the posterior overlapping the anterior at lateral fissure. Rostral horns short, narrowly separated. Postorbital tooth small, set off by a fissure from preorbital. Male first pleopod with flared apex, pointed tip and opposing grooved projection of equal length; an intervening lobe.

Description: Carapace flattened and marked with several undulations; median region tumid and bearing two small, obsolescent tubercles, occasionally with two rows of curved setae in front of them. Rostral horns flattened, with convex outer margins, the notch between them narrowly triangular and setose. On the upper side of the rostrum two double rows of curved setae. Preorbital tooth large, triangular, acute; postorbital small and pointing obliquely downwards, and separated by a fissure from the preorbital tooth. The lateral expansions of the carapace a little reflexed, and the margin behind the incision nearly twice the length of that in front. The anterolateral and posterolateral angles wide and the latter somewhat produced. An obsolescent tubercle on the posterior part of the branchial region. Pterygostomian regions with several blunt teeth. Peduncle of antennae about reaching tip of rostrum.

Chelipeds of the male large, the merus rough and cristate on the inner margin; carpus with a lamina on the inner margin; hand oblong, the fingers bent downward and curved inward, somewhat gaping near the base but distally dentate. In the females and young males the chelipeds relatively smaller, the crista on the merus not so prominent, and the fingers contiguous and dentate along the entire inner margin.

First pair of ambulatory legs longer and a little more compressed than the others, the penultimate article subcarinate above.

Abdomen of female elliptical, seven-[segmented]. Abdomen of the male widest at the third segment, narrowing rapidly to the fifth; fifth segment about equal to the sixth; last segment narrow and longer than the preceding one. (Holmes, modified)

Material examined: A total of 115 specimens from 37 stations, including 14 specimens from 4 Pacific Biological Station and 19 specimens from 3 Hopkins Marine Station localities. (See Table 32) From Esperanza Inlet, Vancouver Island, British Columbia, to Point Arguello, California; Santa Rosa and Santa Cruz Islands.

Measurements: Largest specimen, a female in the collection of the Hopkins Marine Station: length 26.5 mm, branchial width 28.0 mm, hepatic width 26.0 mm, rostrum 3.5 mm, width 4.0 mm, cheliped 41 mm, chela 21 mm, dactyl 12 mm, height of palm 9.3 mm, ambulatory legs 40, 28, 25, and 18 mm, respectively. Male specimen: length 23.4 mm, branchial width 26.1 mm, hepatic width 20.0 mm.

Color in life: Dull purplish; legs crossed by light bands. (Holmes) Tan or light reddish with the lateral expansions and marks on the cardiac region lighter, in some cases almost white. (Weymouth) Red or red-brown, with a white V on the carapace and white striped legs. (Hart)

Habitat: Found alongshore with *Pugettia richi*; also dredged from moderate depths. (Weymouth) Among rocks at low tide. (Johnson and Snook) Protected outer coast; rocky shores; low tide horizon, under rock. (Ricketts and Calvin) A 7.2 mm specimen from off Santa Rosa Island, California, station 1282-41, was covered with an encrusting bryozoan identified by R. C. Osburn as *Hippothoa hyalina* (L.).

Depth: Intertidal to 23 fathoms; to 70 fathoms, G. E. MacGinitie, collector, specimen in Hopkins Marine Station collection.

Size and sex: The Hancock series contains males from 7.2 to 23.4 mm, and females from 7.7 to 19.3 mm, ovigerous females 12.4 to 19.3 mm. A 19 mm male from Coos County, Oregon, has a much less crested manus than males of comparable size from south central California.

Breeding: Females with eggs were taken in Mendocino County, California, in June, in Sonoma County in January, February, and March, in Monterey County in February and August, San Luis Obispo County in December, Santa Barbara County in March, and off Santa Cruz Island in December.

Remarks: The southern limit of range of *Mimulus foliatus*, long established as Monterey Bay (with the exception of an unsubstantiated record from Mazatlan of A. Milne Edwards), has been extended southward to Point Arguello by Hancock Foundation collectors, and to Santa Rosa and Santa Cruz Islands by *Velero* dredgings.

Genus PUGETTIA Dana

Pugettia Dana, 1851a, p. 268; 1851b, p. 433; 1852, pp. 84, 116; 1853, p. 1421. Holmes, 1900, p. 24. Stimpson, 1907, p. 24. Schmitt, 1921, p. 205. Rathbun, 1925, p. 167.

Epialtus (Taliepus) A. Milne Edwards, 1878, p. 138 [part: *E. (T.) productus*].

Type: *Pugettia gracilis* Dana, by subsequent designation of Miers (1879c, p. 650).

Description: Carapace suboblong or ovate-oblong, tuberculate or uneven, with two prominent, angular, lateral projections, separated by a concave interspace. Supraorbital cave well developed, advanced to form a preocular tooth; postorbital tooth commonly formed by the anterior angle of the hepatic expansion. Rostrum bifid. Antennae visible at sides of rostrum, basal article rather broad, next two articles flattened. Merus of maxillipeds broad, anterolateral angle dilated, anterointernal angle notched for the insertion of the palpus. Chelipeds of male well developed, merus trigonal, palm dilated and compressed, fingers usually gaping at base. Ambulatory legs subcylindrical, the penultimate article not dilated and compressed.

Abdomen composed of seven segments in both sexes. (Rathbun, 1925)

The genus characterized above includes one species, *Pugettia producta* (Randall), which has been regarded as an *Epialtus, sensu lato*, by authors prior to Rathbun (1925), and as an *Epialtus (Taliepus), sensu stricto*, by A. Milne Edwards (1878). Although of large size, it is here treated under Dana's genus, rather than A. Milne Edwards's group, out of consideration for its depressed carapace, that of *Taliepus nuttalli* and its congeners, *T. dentatus* and *T. marginatus*, being highly

convex. The male first pleopod, which is quite similar to that of *Pugettia quadridens* (De Haan) (cf. Shen, 1932, text-fig. 28c), would appear to support this view.

Range: Eastern Pacific from Attu Island, Aleutian Islands, to Magdalena Bay, Lower California, Mexico; Guadalupe Island; shore to 65 fathoms. Western Pacific south to Hong Kong and including Japan; Indo-Australia. In the Western Pacific to 335 fathoms.

Contains six American species, one of which is new to science.

KEY TO THE AMERICAN SPECIES OF THE GENUS *Pugettia*

- 1a. A smaller secondary spine between postorbital and hepatic spines at a slightly lower level *venetiae*
- 1b. No smaller secondary spine between postorbital and hepatic spines at a slightly lower level
 - 2a. Hepatic projection a transverse spine not joined with postorbital spine by a lateral expansion of the carapace. Legs very long and slender
 - 3a. Postorbital projection an ovate lobe inclined in the adult at a plane perpendicular to the hepatic spine *dalli*
 - 3b. Postorbital projection a slender spine inclined in the same horizontal plane as the hepatic spine. Guadalupe Island only *hubbsi*
 - 2b. Hepatic projection a triangular tooth, joined completely or incompletely with postorbital spine by a lateral expansion of the carapace
 - 4a. Carapace smooth; sides subparallel. No constriction between hepatic and branchial tooth. Legs short and stout *producta*
 - 4b. Carapace tuberculate; sides not subparallel. A constriction between hepatic and branchial tooth. Legs longer than in 4a
 - 5a. Tubercles uneven. Hepatic tooth broadly joined to postorbital, its outer margin trending toward the longitudinal. Legs shorter than in 5b . . . *gracilis*
 - 5b. Tubercles of a size. Hepatic tooth deeply separated from postorbital, its outer margin trending toward the transverse. Legs moderately long and slender *richi*

Pugettia producta (Randall)

Plate L, Fig. 2; Plate 19

Epialtus productus Randall, 1839, p. 110. Gibbes, 1850, p. 173. Dana, 1852, p. 133; 1855, pl. 6, figs. 2a, 2b. Stimpson, 1857b, p. 457; 1857c, p. 219; 1907, p. 26. Lockington, 1877c, p. 77. R. Rathbun, 1884, p. 778, pl. 268. Ortmann, 1893, p. 42. Newcombe, 1893, p. 22; 1898, p. 76. Rathbun, 1894, p. 68; 1904, p. 173. Calman, 1898, p. 260. Doflein, 1899, p. 183. Holmes, 1900, p. 22. Weymouth, 1910, p. 28, pl. 3, fig. 9. Baker, 1912, p. 100. Taylor, 1912, pp. 191, 208. Hilton, 1916, p. 69 (part: not fig. 16). Way, 1917, p. 369, fig. 25. Schmitt, 1921, p. 201, text-fig. 124. Johnson and Snook, 1927, p. 367, fig. 318.

Epialtus (Taliepus) productus, A. Milne Edwards, 1878, p. 138.

Pugettia producta, Rathbun, 1925, p. 167, pls. 56, 57, text-figs. 62, 63; 1926, p. 23. G. M. Smith, 1928, pp. 164, 165. Hart, 1930, p. 106; 1940, p. 97. Glassell, 1935, p. 105. MacGinitie, 1935, p. 713. Ricketts and Calvin, 1939, p. 80, pl. 15. MacKay, 1942, p. 5, fig. 5; 1944, p. 149, text-fig. 2.

Pugettia producta, Clemens, 1933, p. 51.

Type: Female holotype, originally deposited in the Museum of the Philadelphia Academy of Sciences, no longer extant.

Type locality: Upper California, Thomas Nuttall, collector.

Localities subsequently reported, with collectors: West coast of North America, G. Suckley, Pacific Railroad Survey (Rathbun, 1894).

British Columbia: Queen Charlotte Islands: Houston-Stewart Channel near Rose Harbour, Moresby Island (Hart, 1940). Vancouver Island: Beaver Harbor, Queen Charlotte Sound, and Barclay [Barkley?] Sound, *Albatross* (Rathbun, 1894); Esperanza Inlet and Nootka Sound (Hart, 1940); Clayoquot Sound (Newcombe, 1893; Hart, 1940); Ucluelet, Geological Survey of Canada (Rathbun, 1925); Comox, *Albatross*, and W. Spreadborough (Rathbun, 1925); Comox to Victoria (Newcombe, 1893); Departure Bay (Taylor); Denman Island and Gabriola Island, Taylor Bay, *Albatross* (Rathbun, 1925); Brentwood Bay, Gonzales Point, and Parry Bay (Hart, 1930); Sydney, G. M. Smith (Smith); Victoria, C. F. Newcombe (Rathbun, 1894) and Nichols (Rathbun, 1925). Boundary Bay (MacKay, 1944). Order uncertain: Union Bay (Rathbun, 1925).

Washington: San Juan Islands: Sucia Island, *Albatross* (Rathbun, 1925); Friday Harbor (Way). Strait of San Juan de Fuca, D. S. Jordan (Rathbun, 1894). Puget Sound: U. S. Exploring Expedition

(Dana, 1852), G. Suckley (Stimpson, 1857b), Bashford Dean (Calman); Marrowstone Point near Port Townsend, and Dockton, *Albatross* (Rathbun, 1925); Port Ludlow, W. H. Dall (Rathbun, 1894), *Albatross* (Rathbun, 1925); Port Orchard, O. B. Johnson and U. S. Fish Commission (Rathbun, 1894); Oyster Bay, W. L. McAtee (Rathbun, 1925). Mouth of Columbia River, Trowbridge (Stimpson, 1857b).

Oregon: None.

California: "California," G. Schneider (Ortmann), T. B. Wilson, E. Samuels (Rathbun, 1925). Mendocino, A. Agassiz (Ortmann); Tomales Bay, E. Samuels (Stimpson, 1857b); Pt. Reyes, Campbell (Rathbun, 1925); Farallon Islands, Trowbridge, and San Francisco Bay entrance (Stimpson, 1857b); Sausalito, Point Bonita, and Presidio east of Fort Point, 2-3 fathoms, *Albatross* (Schmitt, 1921); San Francisco (Stimpson, 1857c); D. S. Jordan (Rathbun, 1894), North Pacific Exploring Expedition (Stimpson, 1907); Pillar Point, Half-moon Bay, *Albatross* and C. F. Baker (Rathbun, 1925); Santa Cruz, J. S. Kingsley (Rathbun, 1925); Elkhorn Slough (MacGinitie); Monterey Bay, *Albatross* and Harold Heath (Rathbun, 1894, 1925), (Doflein, Weymouth); Monterey, Trowbridge (Stimpson, 1857b), D. S. Jordan, H. Hemphill, A. S. Taylor (Rathbun, 1894); Pacific Grove, J. C. Brown, J. E. Benedict, T. S. Oldroyd (Rathbun, 1925); Santa Barbara, W. G. W. Harford (Lockington), Shoemaker, D. S. Jordan (Rathbun, 1894); Santa Rosa Island, W. G. W. Harford (Lockington); Venice, Portuguese Bend, and Santa Monica Bay, *Anton Dohrn* (Rathbun, 1925); San Pedro, D. S. Jordan (Rathbun, 1894) and E. P. Chace, *Anton Dohrn* (Rathbun, 1925); Laguna Beach (Baker, Hilton); Santa Catalina Island: Catalina Harbor, W. H. Dall, and Avalon Bay, *Anton Dohrn* (Rathbun, 1894, 1925); San Clemente Island, E. A. Mearns, H. N. Lowe, T. L. Casey (Rathbun, 1925); La Jolla, *Albatross* and W. L. Schmitt (Rathbun, 1925); Pt. Loma, *Albatross* (Rathbun, 1894); San Diego, D. S. Jordan, Rosa S. Eigenmann, H. Hemphill (Rathbun, 1894).

Lower California, Mexico: Ensenada (Glassell); [Santa] Rosalia Bay, A. W. Anthony (Rathbun, 1925).

Locality unknown: Krieger (Ortmann).

Fossil: California Pleistocene: Rincon del Potrero, Santa Monica; Nob Hill and Deadman Island, San Pedro (Rathbun, 1926).

Atlantic analogue: None. A Pacific north temperate species.

Diagnosis: Sides of carapace subparallel; no constriction at base of hepatic tooth; hepatic tooth large, rectangular, and broadly but distantly joined with postorbital. Carapace smooth and bare, branchial tooth scarcely projecting laterally. Rostrum small, horns separated by a sinus equal to one horn inverted. A preorbital tooth. Legs short and stout, propodi unarmed. Male first pleopod with a blunt tip and two opposing channeled projections, one on either side of a median cleft; a "tongue" in opening.

Description: Carapace smooth and not distinctly areolated. Rostrum deeply notched, the inner margins of the horns slightly concave, the outer convex. A small, triangular preorbital tooth; postorbital tooth small. Margin between the postorbital and the large tooth at the anterolateral angle concave and transverse. About midway between the anterolateral tooth and the posterior margin of the carapace, a large tooth pointing forwards and outwards; sides of the carapace in front of the posterior teeth nearly parallel; posterior margin with a strong convexity in the middle.

Chelipeds stouter, and except in old males, shorter than the first ambulatory legs; carpus carinate on the outer side; hand long and narrow, palm oblong, subcarinate above, becoming inflated with age; fingers slender, bent downward and curved inward, the inner margins dentate and contiguous throughout their length; in old males becoming more or less gaping at the base.

Ambulatory legs successively decreasing in length posteriorly, penultimate articles subcarinate, dactyls slender, spinulous below, and terminating in sharp, slender claws.

Abdomen of the female subelliptical, the last somite triangular. (Holmes, modified) Abdomen of the male with sixth segment longer than fifth, both segments wider than long. (Rathbun, 1925)

Material examined: 484 specimens from 133 stations. (See Table 33) From Rosario Beach, Skagit County, Washington, to Asunción Point, Lower California, Mexico, and including the islands of Santa Cruz, Santa Barbara, San Nicolas, Santa Catalina, and San Clemente, California, and San Benito, Lower California.

Measurements: The dimensions of the largest male and female in Hancock collections are given in tabular form for purposes of comparison. The male is not the largest on record, a male measuring 107 [not 170] by 93 mm and a female measuring 92 by 78 mm having been recorded by Weymouth (1910, p. 28). Measurements are in millimeters.

| | Male | Ovigerous Female |
|----------------------------------|------|---------------------|
| Length of carapace | 71 | 69 |
| Width at branchial level | 62 | 59 |
| Width at hepatic level | 55 | 52 |
| Length of rostrum | 9 | 8 |
| Width of rostrum | 11 | 11 |
| Length of cheliped | 89 | 65 |
| Length of chela | 42 | 30 |
| Length of dactyl | 25 | 17 |
| Length of ambulatory legs: First | 114 | — |
| Second | 101 | 79 |
| Third | 92 | 73 |
| Fourth | 83 | 68 |

From the above measurements it will be seen that, of two specimens of almost identical carapace measurement, the cheliped and walking legs of the male are appreciably longer than those of the female.

Color in life: Reddish to olive brown mottled with small, round spots of a darker hue. (Holmes) Varies from dark brown to tan, the lighter shades being found in young and apparently recently molted individuals, in which also the dark spots mentioned by Holmes are inconspicuous or absent. Under parts reddish, often a bright brick red, sometimes with light markings on the coxae of the ambulatory legs and on the external maxillipeds. (Weymouth) Dorsal parts dull brownish green, ventral parts light tan; sternum, mouth parts, and chelipeds often marked with bright red; body often mottled with spots of darker color. (Way) Dark brown, greenish brown, or even a bright red on the dorsal surface; ventral side lighter. (MacKay)

Habitat: Wharf piles, floating kelp, and buoys. (Weymouth) Young very common in tidepools clinging to *Fucus* and other brown algae; mature specimens found only in kelp beds. (Baker) Quite plentiful among *Enteromorpha*, but seems to prefer beds of *Zostera*. (MacGinitie) Protected outer coast; rocky shores; low-tide horizon, protected rock and seaweed. Occurs frequently on strands of *Egregia*. (Ricketts and Calvin) Specimens examined had numerous barnacles on carapaces. (MacKay) Infection with *Sacculina* mentioned by Weymouth (1910) and MacGinitie (1935).

Depth: Common to 40 fathoms. (Way) This was the maximum depth from which specimens were recovered at Santa Barbara Island by the *Velero III*. At the great majority of stations, however, collecting was intertidal.

Size and sex: Although the series examined is not as rich in specimens under 8 mm as that of *Taliepus nuttalli*, it is possible to piece together a similar account of post-larval development. The smallest specimens, slightly over 3 mm in length, are constricted about the middle of the carapace, suggesting the young of *Pugettia richi*. 5 mm specimens have attained the characteristic straight-sided appearance of the adults, but are proportionately more slender. By 8 mm sex can be determined with certainty, although the first pleopod of the male is but little longer than the second and extends only half way to the tip of the abdomen. Specimens from 8 to 15 mm possess two gastric tufts of hair which persist in some individuals, especially females, to 35 mm or over. Young of this age also have the margins of the carapace fringed with soft pile, with clusters of clavate hairs at the tips of the rostral, orbital, and lateral marginal spines, which are acutely spinulose. A few clavate hairs at the upper distal extremities of the meral and propodal segments of the walking legs are usually present. As in the young of *Taliepus nuttalli*, the concave inner margins of the rostral horns are fringed with slender, club-tipped hairs which crisscross in a fine network. Unlike that species, the velvet stage seems to be not so much a matter of age as environment, only those specimens taken from Anaheim Slough and inside the breakwater at Corona del Mar, California, showing the downy carapace covered with sediment. Older specimens appear to lose the tufts and marginal hairs, the acute spinules of the marginal prominences wearing down to blunt teeth. The hooked hairs on the rostrum are retained and serve for the attachment of bits of algae which afford concealment.

While the average size of the ovigerous females is about 48 mm, specimens bearing eggs range from 26 to 69 mm. Males taken with the 48 mm females, of like size and presumably sexually mature, lack the tremendously large chelipeds with their widely gaping fingers attributed to the very old in this species (cf. Rathbun, 1925, p. 169). Specimens from Oregon are noticeably larger than those from southern California.

Breeding: Gravid females were found commonly at Coos Bay, Oregon, in June and July, in Sonoma County, northern California, from October to February, and at Dillon Beach, Marin County, in August and November. In southern California, where winter collecting has been the rule, females with ova have been taken from November to February, and in Lower California in January, March, and June.

Remarks: The range of the species has been extended southward from Santa Rosalia Bay to Asunción Point, Lower California, including the

Mexican islands of San Benito. It is absent, however, from Guadalupe Island, where *Taliepus nuttalli* is the abundant large kelp crab. The 118 specimens from 16 Oregon stations and the 74 specimens from 26 California stations north of Tomales Bay supplement knowledge of the species in the Pacific Northwest, no specimens having been listed by Rathbun (1925, p. 170) from this portion of its range.

***Pugettia richi* Dana**

Plate I, Fig. 3; Plate 20, Fig. 1

Pugettia richii Dana, 1851a, p. 268; 1852, p. 118; 1855, pl. 4, figs. 4a-e. Stimpson, 1857b, p. 457. Lockington, 1877c, p. 76. Miers, 1886, p. 40. Newcombe, 1893, p. 21; 1898, p. 76. Rathbun, 1894, p. 71; 1904, p. 173; 1925, p. 176, text-fig. 66; 1926, p. 23. Holmes, 1900, p. 24. Weymouth, 1910, p. 30, pl. 4, fig. 11. Taylor, 1912, pp. 191, 209. Hilton, 1916, p. 92. Nininger, 1918, p. 41, fig. 30. Schmitt, 1921, p. 207, pl. 33, fig. 6, text-fig. 129. Johnson and Snook, 1927, p. 369, figs. 322, 324. ?Queen, 1930, p. 397, fig. 6. Hart, 1940, p. 98; 1953, p. 140.

Pugettia richii, Clemens, 1933, p. 51.

Pugettea [sic] *dalli*, Meredith, 1939, p. 105 (figured). Not *P. dalli* Rathbun.

Type: Male holotype, length 50.8 mm, no longer extant.

Type locality: "In mari juxta Californiam." California, probably San Diego (Stimpson, 1857b, p. 457); William Rich, botanist, U. S. Exploring Expedition, collector.

Localities subsequently reported, with collectors: British Columbia: Goose Island, 52° N latitude (Hart, 1953). Vancouver Island: Esperanza Inlet, Nootka and Clayoquot Sounds (Hart, 1940); Clayoquot and Barclay [Barkley?] Sounds (Newcombe, 1893); Ucluelet, Geological Survey of Canada (Rathbun, 1925); Barclay Sound, *Albatross*, and Victoria, C. F. Newcombe (Rathbun, 1894).

Washington: Friday Harbor, San Juan Islands (Queen); Docton, Puget Sound, *Albatross* (Rathbun, 1925).

Oregon: None.

California: Humboldt Bay, Scripps Institution, and Mendocino, A. Agassiz (Rathbun, 1925); Monterey Bay, *Albatross* (Rathbun, 1894), to 15 fathoms (Weymouth), Harold Heath (Rathbun, 1925); Monterey, H. Hemphill, D. S. Jordan (Rathbun, 1894); Pacific Grove, J. O. Snyder, J. C. Brown, T. S. Oldroyd (Rathbun, 1925); Santa Catalina Island, 50 fathoms, H. N. Lowe; Venice, to 24 fathoms,

Anton Dohrn; near Point del Rey, Santa Monica Bay; San Pedro, E. P. Chace; and Long Beach, H. N. Lowe (all Rathbun, 1925); Laguna Beach (Hilton; Nininger); La Jolla, W. L. Schmitt (Rathbun, 1925); San Diego, H. Hemphill (Lockington); Rosa Smith (Rathbun, 1894); San Diego Bay, 6.5 fathoms, *Albatross* (Rathbun, 1925).

Fossil: California Pleistocene: Nob Hill and Deadman Island, San Pedro; Signal Hill (Los Cerritos); Spanish Bight, San Diego (Rathbun, 1926).

Atlantic analogue: None. A Pacific north temperate species.

Diagnosis: Carapace constricted at base of hepatic tooth; hepatic tooth narrow and incompletely joined to postorbital, its outer margin trending in a transverse direction. Carapace tuberculate, tubercles of a size. Surface of external maxillipeds smooth and devoid of furrows. Legs moderately long, meri and propodi noncarinate, male cheliped massive but uncrested. Male first pleopod with tip thickened and pointed, two strong opposing projections, one on either side of median cleft; an intervening rounded lobule.

Description: Carapace ovate, tuberculated; median region tumid and furnished with four tubercles, the three anterior ones nearly abreast (the anterior one a little in advance of the others); two double rows of curved setae in front of the lateral tubercles, and two similar rows on the rostrum. Cardiac and intestinal regions each furnished with a tubercle; two tubercles on the branchial region, the one situated before the other. Rostrum prominent, the horns divaricate and convex above, the triangular notch between them hairy. Supraorbital tooth acute and directed forward, outward, and upward. Postorbital tooth acute and triangular. Behind the postorbital [tooth] a large, rather slender tooth projecting laterally, the tip curving forwards. At the posterolateral angle of the carapace a prominent, pointed tubercle; in front of it the margin furnished with curved setae. A spine on the subbranchial region below the middle of the space between the posterolateral tubercle and the large, curved tooth. Pterygostomian region with three to six small teeth. Surface of the ischium of the maxillipeds plane, but sometimes bearing a trace of a longitudinal groove; exognath not grooved.

Chelipeds large in the adult males, much shorter and more slender in the females; the merus bearing a few tubercles on the upper side but no carina; the inner side sometimes becoming strongly ridged in adult males, but generally rounded in young males and females; the carpus with two or three cristae becoming more prominent in old males; hands compressed, the upper edge acute; fingers shorter than the palm, and gaping at the base in old males.

Legs subcylindrical and crossed by light-colored bands; merus and propodus not crested. (Holmes, modified)

Material examined: A total of 274 specimens from 99 stations, divided as follows: (See Table 34)

Allan Hancock Foundation material: 237 specimens from 91 stations.

Provincial Museum material: 2 specimens from one station.

Hopkins Marine Station material: 35 specimens from 7 stations.

From S. Bottle Island, Vancouver Island, British Columbia, to San Geronimo Island, Lower California, Mexico.

Measurements: Largest specimen, a male: length 40.6 mm, branchial width 31.4 mm, hepatic width 26.2 mm, rostrum 9.1 mm, basal width 6.9 mm, cheliped 45 mm, chela 19.8 mm, dactyl 10.5 mm, ambulatory legs 51.5, 40, 35.5, and 32 mm, respectively. Ovigerous female: length 29.7 mm, branchial width 21.9 mm, hepatic width 18.7 mm.

Color in life: Red, varying from bright to dark and often closely matching certain of the encrusting corallines. (Weymouth)

Habitat: Found abundantly between tides, usually where there is a growth of algae or coralline. The young are found among the roots of eel-grass and often in the burrows of the pistol [shrimp], *Crangon*. Frequently overgrown with hydroids and coralline. (Weymouth)

Depth: Usually intertidal, but recovered from a maximum depth of 53 fathoms, off Santa Cruz Island, by the *Velero III*.

Size and sex: The largest specimens come from the northern part of the range and so are not represented among Hancock collections. Hart (1940) records from British Columbia a male measuring 44 by 36 mm and a female measuring 33 by 26.5 mm.

Breeding: Egg bearing females were obtained by Weymouth (1910) at Monterey in June, July, and early January. Evidence of both summer and winter breeding was also obtained by Hancock Foundation parties, who found ovigerous females in Marin County in November, in Monterey County in February and in August, in San Luis Obispo County in December, in the Northern Channel Islands in April, October, and December, in Los Angeles County in August, December, and January, and in Lower California in June.

Remarks: Long believed to attain its southern limit of range at San Diego, *Pugettia richi* has been found at half a dozen stations in northern Lower California as a result of collecting done by C. L. Hubbs, E. Yale Dawson, M. Woodbridge Williams, William K. Emerson, and the *Velero IV*, and is now known to extend as far south as San Geronimo Island, Mexico.

***Pugettia gracilis* Dana**

Plate L, Fig. 4; Plate 20, Fig. 2

Pugettia gracilis Dana, 1851a, p. 268; 1852, p. 117; 1855, pl. 4, figs. 3a-c. Stimpson, 1857b, p. 456. Lockington, 1877c, p. 76. Miers, 1879c, p. 650; 1886, p. 40. S. I. Smith, 1880, p. 210. Newcombe, 1893, p. 22; 1898, p. 76. Rathbun, 1894, p. 69; 1904, p. 173; 1925, p. 172, pl. 58, text-figs. 64, 65. Calman, 1898, p. 260. Walker, 1898, p. 274. Holmes, 1900, p. 25. Lenz, 1901, p. 452. Weymouth, 1910, p. 29, pl. 4, fig. 10. Taylor, 1912, pp. 191, 208. Way, 1917, p. 370, pl. 82, fig. 21. Schmitt, 1921, p. 206, pl. 33, fig. 7, text-figs. 128a, 128b. Johnson and Snook, 1927, p. 368, fig. 322. G. M. Smith, 1928, pp. 164, 165. Hart, 1930, p. 106; 1940, p. 97. MacKay, 1931, p. 187; 1944, p. 149, text-fig. 2. Clemens, 1933, p. 51. Ricketts and Calvin, 1939, p. 166.

Pugettia lordii Spence Bate, 1864, p. 662; type locality, Esquimalt Harbor, Vancouver Island, British Columbia; type in British Museum; 1865, p. 486; 1866, p. 265, pl. facing p. 262, fig. 3.

Pugettia quadridens var. *gracilis*, Ortmann, 1893, p. 43.

Type: Male and immature female, cotypes, M.C.Z. No. 1237.

Type locality: "In maris Oregonensis freto 'Puget.'" Puget Sound, [Washington], U. S. Exploring Expedition.

Localities subsequently reported, with collectors: Alaska: Aleutian Islands: Chichagoff Harbor, Attu Island, 5-7 fathoms; Kiska Harbor, Kiska Island, 10 fathoms; Amaknak Island; Nazan Bay, Atka Island; Imagnee Pinnacle, Captains Bay, Unalaska Island, 8-20 fathoms, all by W. H. Dall (Rathbun, 1894); Unalaska Island, S. Applegate, and Dutch Harbor, W. R. Coe (Rathbun, 1894, 1904). Alaska Peninsula: Bellkoffsky Bay, 15-25 fathoms; Popoff Strait, 6 fathoms; Shumagin Islands; Chirikoff Island, all by W. H. Dall (Rathbun, 1894); Fox Island, Kincaid (Rathbun, 1904). Southeastern Alaska: Kodiak Island, W. J. Fisher, *Albatross*, and W. R. Coe (Rathbun, 1894, 1904); Middleton Island, 10-12 fathoms, Port Mulgrave, Yakutat Bay, 6-40 fathoms; Lituya Bay, 6-9 fathoms, all by W. H. Dall (Rathbun, 1894); Virgin Bay, W. R. Coe, and Orca (Rathbun, 1904); Yakutat, Harri-man Expedition (Rathbun, 1904); Alert Bay, Cormorant Island, W. H. Jones (Rathbun, 1894); Sitka, Comdr. L. A. Beardslee and F. Bischoff (Rathbun, 1894, 1904); Ward Cove, Revillagigedo Island, T. H. Streets (Rathbun, 1894). Order uncertain: Mutiny Bay (Lockington). For additional records see Rathbun (1925).

British Columbia: Port Simpson, G. M. Dawson (S. I. Smith); between Metlakatla and Prince Rupert, Kaien Island, Digby Island, and Prince Rupert, D. C. G. MacKay (MacKay, 1931); Fort Rupert [Prince Rupert?], H. I. Smith (Rathbun, 1925). Queen Charlotte Islands: G. M. Dawson (S. I. Smith), (Newcombe, 1893); Tledoo Village, Graham Island, J. G. Swan (Rathbun, 1894); Flamingo Harbor, Louscoone Bay, and Houston-Stewart Channel near Rose Harbor, Moresby Island (Hart, 1940). Vancouver Island: (Lockington); Esperanza Inlet, Nootka Sound, and Clayoquot Sound (Hart, 1940); Clayoquot Sound (Newcombe, 1893); Ucluelet, Geological Survey of Canada (Rathbun, 1925); Barclay [Barkley?] Sound, *Albatross* (Rathbun, 1894); Comox, Nanaimo, and Victoria (Newcombe, 1893); Banks Island, Hope Island, and Departure Bay (Taylor); Gonzales Point and Parry Bay (Hart, 1940); Pender Islands and Denman Island, *Albatross* (Rathbun, 1925); Victoria and Esquimalt Harbor, 8 fathoms, J. K. Lord (Spence Bate, 1866, as *Pugettia lordii*); Sidney, G. M. Smith (G. M. Smith). Bare Island, between Vancouver Island and mainland, Schauinsland (Lenz). Mouth of Fraser River, J. K. Lord (Spence Bate, 1864); Boundary Bay (MacKay, 1944). Order uncertain: Otter Bay, *Albatross* (Rathbun, 1925).

Washington: San Juan Islands: Canoe Island, Turn Island, San Juan Island, and Upright Channel (Way). Strait of San Juan de Fuca, D. S. Jordan, Neah Bay, J. G. Swan, and Port Angeles, U. S. Fish Commission (Rathbun, 1894). Puget Sound: D. S. Jordan (Rathbun, 1894), Bashford Dean (Calman), W. A. Herdman (Walker), J. S. Kingsley (Rathbun, 1925); Port Townsend, *Albatross* (Rathbun, 1894); Kala Point, 14-17 fathoms, Port Townsend Bay, and Kilisut Harbor, *Albatross* (Rathbun, 1925); Port Ludlow, S. Bailey and W. H. Dall, and Port Orchard, O. B. Johnson (Rathbun, 1894).

Oregon: None.

California: Northern California (Holmes); Mendocino, A. Agassiz (Rathbun, 1925); Farallon Islands (Holmes). ?San Luis Obispo (Lockington).

Atlantic analogue: None. A Pacific boreal species.

Diagnosis: Carapace constricted at base of hepatic tooth; hepatic tooth broad and completely joined to postorbital, its outer margin trending in a longitudinal direction. Carapace tuberculate, tubercles uneven. Ischium and exognath of external maxilliped furrowed. Legs short, meri and propodi carinate above; male cheliped massive, manus compressed,

carpus crested. Male first pleopod with thick, acute tip opposed by a single grooved projection; between these two smaller lobes, one on each side of opening.

Description: Carapace lyrate to broadly ovate, tuberculate; four median tubercles, two gastric (the anterior one small), one cardiac and one intestinal; two large branchial tubercles, and one protogastric tubercle. A tuft of setae proceeding from each tubercle; from the protogastric pair two rows of curled setae running forward and inward; upper surface and margins of rostrum, as also the subbranchial regions, setiferous. Lateral projections broad, the anterior one large and winglike, its anteroexternal angle advanced in a tooth, its posterior margin nearly longitudinal; the posterior projection smaller, posterior end spiniform, anterior end lobiform. Postorbital tooth broad, separated from the broad supraocular cave by a narrow fissure. Outer margins of rostral horns subparallel, convex near tips; inner margins concave.

The basal article of the antennae bearing a tooth at the anteroexternal angle; flagellum not reaching end of rostrum. A row of tubercles on pterygostomian region.

Chelipeds large and strong. Merus triangulate, margins cristate; superior crest with three or more teeth; outer surface crossed by a blunt ridge. Carpus with two longitudinal crests; upper surface with an oblique ridge, outer surface uneven. Propodus very broad, compressed, and with a superior crest; inferior margin with a prominent posterior lobe. Fingers in adult males widely gaping; cutting edges dentate; a large tooth near base of dactylus.

Ambulatory legs stout, obscurely tuberculate. (Rathbun, 1925, modified)

Material examined: A total of 167 specimens from 43 stations or localities, divided as follows: (See Table 35)

Allan Hancock Foundation and related material: 150 specimens from 35 stations.

Provincial Museum material: 6 specimens from 3 localities.

Hopkins Marine Station material: 8 specimens from 3 localities.

California Academy of Sciences material: 3 specimens from 2 localities.

From Dutch Harbor, Unalaska, to Monterey Bay, California. Lockington's San Luis Obispo record needs verification.

Measurements: Largest specimen, a male: length 35.5 mm, branchial width 26.5 mm, hepatic width 24.0 mm, rostrum 7.5 mm, basal width 5.0 mm, cheliped 41 mm, chela 21 mm, dactyl 10.5 mm, ambulatory legs

43 (39), 32, 28.5, and 27 mm, respectively. Ovigerous female: length 33.5 mm, branchial width 25.0 mm, hepatic width 21.2 mm, cheliped 34 mm, first ambulatory leg 39 mm.

Color in life: Dorsal surface usually greenish brown, ventral side very much lighter. Those found among algae are a brilliant red. (Way) Greenish brown to reddish. (MacKay)

Habitat: Abundant everywhere in the region [San Juan Islands] in eel grass (*Zostera marina*), on kelp, and on piles under docks. (Way) Among eel grass and *Ulva*, and at Parry Bay among kelp ribbons. (Hart) Bay and estuary; rocky shores; low-tide horizon, rock and seaweed. (Ricketts and Calvin)

Depth: Common to at least 40 fathoms. (Way) Puget Sound and Monterey Bay specimens were dredged at moderate depths; San Juan Channel specimens are from 60-62 fathoms.

Size and sex: Males in the present series are from 15.8 to 35.5 mm, females from 16.4 to 37.4 mm, ovigerous females from 23.0 to 33.5 mm, and young to a minimum of 4.5 mm. The largest male recorded measured 67 x 45 mm (Way); the largest female measured 44 x 30 mm (Walker).

Breeding: Ovigerous females were encountered at Coos Bay, Oregon, in late June, when 14 of 16 specimens were with ova, and in mid-July, at Bodega Bay, California, in March, and at Stewart's Point in November.

Remarks: With no previous records from Oregon and only two valid records from northern California, the 90 specimens from 14 Oregon stations and the 16 specimens from 7 California stations north of San Francisco obtained by Hancock Foundation field parties may be considered as adding considerably to our knowledge of the distribution of the species. Specimens in the collection of the Hopkins Marine Station, Pacific Grove, definitely establish the presence of the species in Monterey Bay, although not intertidally.

Pugettia dalli Rathbun

Plate L, Fig. 6; Plate 21, Fig. 1

Pugettia dalli Rathbun, 1893b, p. 232; 1904, p. 173, pl. 2, figs. 1, 1a; 1925, p. 178, pl. 59, figs. 1-4, text-fig. 67. Holmes, 1900, p. 26. Nininger, 1918, p. 41, figs. 26, 28 (not figs. 25, 27, 29). Schmitt, 1921, p. 208, pl. 33, fig. 5. Johnson and Snook, 1927, p. 369, fig. 322. Not *Pugettia dalli*, Meredith, 1939, p. 105 (figured).

Type: Male holotype, U.S.N.M. No. 17506.

Type locality: Southern California, and most certainly Catalina Harbor, Santa Catalina Island (cf. Rathbun, 1925, p. 178, footnote); W. H. Dall, collector.

Localities subsequently reported, with collectors: California: Off Santa Cruz Island, 30 fathoms, *Albatross* (Rathbun, 1925); Santa Catalina Island, J. G. Cooper, Isthmus Harbor and Avalon Bay, *Anton Dohrn* (Rathbun, 1893b, 1925); between Venice and Rocky Point, and Point Fermin, *Anton Dohrn*; Point Vicente, San Pedro, and San Clemente Island, H. N. Lowe; Point Fermin and off Wilmington, 20 fathoms, *Albatross* (all Rathbun, 1925); Laguna Beach (Nininger); Laguna Beach, W. A. Hilton, La Jolla, Scripps Institution, and San Diego Bay, *Albatross* (Rathbun, 1925); San Diego, C. R. Orcutt, H. Hemphill (Rathbun, 1893b); 5.2 miles off Point Loma Light, 55-58 fathoms, *Albatross* (Rathbun, 1925).

Lower California, Mexico: San Geronimo Island, A. W. Anthony (Rathbun, 1925).

Atlantic analogue: None. A southern California-west coast of Lower California endemic species.

Diagnosis: Carapace densely covered with minute vesicles. Hepatic projection a transverse spine; postorbital projection an ovate lobe directed forward and inclined at a plane perpendicular to it. Branchial spine stout, upturned. Rostral horns slender, divergent. A large lobe on outer margin of basal antennal article; three smaller lobes on each pterygostomial region. Male manus cristate; carpus bicarinate. Male first pleopod with conical tip opposed by two elongate, channeled projections; an intervening, suberect lobe.

Description: A small species. Carapace subtriangular; in its perfect state covered with short cutaneous vesicles forming prominences on the protogastric, mesogastric, cardiac, intestinal, hepatic, and branchial region (3 dorsal). The anterior part of the protogastric region, as well as the rostrum and the anterolateral margin of the branchial region, covered with curled setae. With these coverings removed, a large tubercle seen on the cardiac and intestinal regions and on each protogastric lobe; median gastric tubercles obsolescent; branchial regions not areolate. Lateral margins with two spines, the hepatic one slender, transverse or nearly so, and almost horizontal, the branchial spine stouter and upturned. Postocular tooth thin, obtuse, its upper surface flattened in a smooth oval plate inclined downward from the horizontal at an angle of about 45 degrees. Rostral horns more slender than in *Pugettia richi*, widely divergent. Preocular tooth acuminate. Antennae exceeding rostrum; a large lobe on outer margin of basal article.

Chelipeds strong; merus with a prominent thin and irregular carina on margins; carpus strongly carinate above and on inner margin, outer and upper surfaces irregularly ridged; hand large, compressed, margins thin; palm nearly as broad as long; fingers gaping, a tooth near base of dactyl, and one on pollex toward distal end of gape.

Legs much more slender than in *Pugettia richi* of equal size; first pair about as long as, or longer than the chelipeds; three succeeding pairs short, decreasing regularly in length; margins fringed with club-shaped setae.

Females differing from adult males in having a broader and more ovate carapace, three distinct branchial areolations, when the pubescence is removed, and a much more swollen gastric region. (Rathbun, 1925, modified)

Material examined: 297 specimens from 85 stations. (See Table 36) From San Miguel Island, California, to Thurloe Head (Thurloe Bay), Lower California, Mexico, including all important offshore islands excepting Guadalupe.

Measurements: Largest specimen, a male: length 18.0 mm, branchial width 13.8 mm, hepatic width (including spine) 11.2 mm, rostrum 5.2 mm, basal width 2.9 mm, cheliped 21.6 mm, chela 11.2 mm, dactyl 5.75 mm, ambulatory legs 22.5, 16.0, 12.5, and 12.5 mm, respectively. Ovigerous female: length 14.6 mm, branchial width 10.3 mm, hepatic width 9.1 mm.

Color in life: Unrecorded, but varying with their algal surroundings.

Habitat: Taken at Corona del Mar from eel grass beds, and at Santa Catalina Island from *Eisenia* holdfasts and from clumps of *Lithothrix* and *Liagora*. Dredged specimens frequently had pieces of a calcareous alga attached, and specimens from Santa Cruz Island and South Bay, Cedros Island, supported colonies of a bryozoan identified by R. C. Osburn as *Holoporella brunnea* (Hincks).

Depth: Intertidal to 64 fathoms.

Size and sex: An exceptionally fine series was obtained from kelp holdfasts (*Eisenia*) and from clumps of *Lithothrix* and *Liagora* at White Cove, Santa Catalina Island, station 1378-41. In it were found males of from 4.0 to 8.0 mm, females from 4.5 to 6.5 mm, ovigerous females from 6.0 to 6.5 mm, and young to a minimum of 2.0 mm, the latter but little larger than a megalops present in the same series. Although the dimensions of the 40 individuals were well under the average of specimens living outside the kelp holdfast community, their gradation was so perfect that no essential stage was omitted.

In the smallest of the young, 2 to 3 mm, the rostral spines are relatively longer and less divergent than in older specimens. The hepatic spine is more of a spinule, the branchial spine scarcely apparent. Most remarkable is the postorbital projection, which starts as a spine similar to the hepatic, but typically bifid. As growth progresses it broadens, the edges become serrate, and it begins to tilt downward, gradually assuming the 45 degree angle described by Rathbun, and continuing in older specimens until it is perpendicular to the plane of the hepatic spine, the serrations meanwhile having disappeared. In the very young only its distance from the eye reveals a difference in the orbit from the young of *Pugettia richi*.

Breeding: Ovigerous females have been taken in every month of the year, with April and August favored by the largest number of collections.

Remarks: Previously known from but three of the Channel Islands, Santa Cruz, Santa Catalina, and San Clemente, and from one Lower California locality, San Geronimo Island, *Pugettia dalli* is now known to occur on all eight of the Channel Islands and at nearly a dozen Lower California localities, including the islands of Cedros and San Benito. Specimens from Guadalupe Island, an outlier of the Lower California coast, formerly grouped with *P. dalli*, are now believed to represent a distinct species.

The slenderness of the legs is a reliable means of separating large numbers of *Pugettia dalli* from *P. richi*, just as *P. richi* may be separated from *P. gracilis* in like manner.

***Pugettia hubbsi*, new species**

Plate K, Figs. 1-6; Plate L, Fig. 7

Type: Male holotype, A.H.F. No. 496, and ovigerous female, allotype, A.H.F. No. 496a, from Guadalupe Island, Lower California, Mexico, South Bluff bearing 215° T. 2.8 miles; collected by *Velero IV* in 40 fathoms at station 1922-49. Male and female, paratypes, same locality and date. (For additional specimens see *Material examined*, below.)

Measurements: Male holotype: length 10.5 mm, branchial width 7.3 mm, hepatic width 6.5 mm, rostrum 2.9 mm, basal width 1.8 mm, cheliped 12.0 mm, chela 6.5 mm, dactyl 3.2 mm, height of palm 2.9 mm, legs 13.5, 10.4, 7.8, and 7.3 mm, respectively. Female allotype: length 8.0 mm, branchial width 5.7 mm, hepatic width 5.5 mm.

Diagnosis: Hepatic projection a slender spine curving forward; postorbital projection also a slender spine directed outward as well as forward

and lying in the same plane as the hepatic spine. Branchial spine directed upward and forward. Rostral horns slender, divergent. A denticle on outer margin of basal antennal article; three spinules on each pterygostomial margin. Male manus rimmed; cristae of manus and carpus less pronounced than in *Pugettia dalli*. Male first pleopod similar to that of *P. dalli* but with lateral projections not exceeding length of blunt tip.

Description: Carapace somewhat depressed, a large tubercle on cardiac and on each protogastric lobe, a smaller tubercle on intestinal, genital, anterior gastric, and on each branchial region; tubercles clavately setose. Clusters of curled setae on protogastric and lateral branchial regions, a double row surmounting each rostral spine. Two lateral marginal spines, one hepatic and one branchial. Hepatic spine slender, trending basally in a transverse direction but curving forward until its tip is subparallel with the long axis of the body. Branchial spine a little more robust, tipped with a spinule also curving forward. Postorbital tooth slender, thin, acute, tip bifurcate, directed forward and outward, and lying in the same plane as hepatic tooth. Preorbital tooth long, slender, and incurving. Rostral horns long, slender, divaricate, tips spinulose, incurving. Basal antennal article with an anteroexternal spine and a denticle, rather than a lobe, on outer margin; flagellum long, slender, overreaching tip of rostrum. Pterygostomial region with three spinules. Ischium of third maxilliped without a groove, merus produced at anteroexternal angle; both segments broadened, as is the exognath.

Cheliped of adult male massive; merus with an inner crest and several strong outer basal tubercles; carpus with an inner and an outer crest and two spinules in lieu of an intermediate crest; manus large, moderately compressed, superiorly rimmed, rather than crested, the cristae being noticeably thicker and less translucent than in *Pugettia dalli*; fingers gaping narrowly, a tooth at base of dactyl and another more distally situated on pollex; pollex slightly deflexed, with tip upturned to meet downcurving tip of dactyl.

Ambulatory legs slender, first noticeably longer than second and exceeding cheliped in length; third and fourth shorter and of a size; legs sparsely clothed with clavate setae.

Female differing from the adult male as in the companion species, *Pugettia dalli*; *i. e.*, carapace broader and more ovate; gastric region more swollen. Female abdomen subcircular in outline.

Material examined: Besides the holotype, allotype, and two paratypes from station 1922-49, an additional 40 specimens from 13 Guadalupe Island localities were examined. (See Table 37) These range from

Melpomene Cove, at the south end, to Barracks Beach, at the northeast end of the island, and from shore to 45 fathoms. Seventeen specimens from six stations were collected by C. L. Hubbs.

Remarks: The proposed new species differs from *Pugettia dalli* principally in the shape of the postorbital spine, but also in the less sharply lamelliform cheliped and manus, the reduced lobe on the basal antennal article, and the spinulous, rather than capitate, projections on the pterygostomian region. It may be considered either as approaching more closely to *P. richi*, or as preserving in the adult the transitory appearance of the young of *P. dalli*. It is of interest to note that neither of these species occurs at Guadalupe Island, which is of volcanic origin and oceanic rather than continental in character.

I take pleasure in naming this distinctive small kelp crab for Dr. Carl L. Hubbs of the Scripps Institution of Oceanography, La Jolla, through whose prolific activities the collections of the Allan Hancock Foundation have been enriched on numerous occasions.

***Pugettia venetiae* Rathbun**

Plate L, Fig. 5; Plate 21, Fig. 2

Pugettia venetiae Rathbun, 1924a, p. 2; 1925, p. 180, pl. 59, figs. 5-7, text-figs. 68, 69.

Type: Ovigerous female, holotype, U.S.N.M. No. 50286, length along midline 16.7 mm, rostral horns 4.4 mm, width excluding spines 13.2 mm.

Type locality: Five miles off Newport Beach, California; *Anton Dohrn*.

Localities subsequently reported, with collectors: California: off east end of Santa Catalina Island, 30 fathoms, *Anton Dohrn* (Rathbun, 1925). Lower California, Mexico: Cortez Bank, 10-16 fathoms, *Agassiz*, and off Magdalena Bay, 36 fathoms, *Albatross* (Rathbun, 1925).

Atlantic analogue: None. A southern California-west coast of Lower California endemic species.

Diagnosis: Carapace tuberculate and spinulous dorsally, as well as on subhepatic, subbranchial, and pterygostomian regions. Hepatic spine larger than branchial, a second smaller hepatic spine visible between it and the postorbital at a slightly lower level. Rostral horns long, acute, divergent. Basal antennal article with a terminal and a lateral spine. Legs long and sparsely hairy; merus and carpus of chelipeds with spines in rows. Male first pleopod with two lobate projections opposing thickened, blunt tip; intervening lobule not erect nor pinched.

Description: Carapace lumpy, each lump or boss furnished with one or more tubercles, as follows: four gastric, two of them median, two lateral, a little behind the anterior median tubercle; one cardiac; three intestinal, arranged transversely; four or five branchial. Lateral spines three, one branchial, two hepatic; the branchial and the posterior of the hepatic spines larger, curved, and with slender tips directed forward; the minor hepatic spine a little below the level of the major one and straight. Postorbital spine isolated, a little behind the eye, slender. Supraocular cave less expanded over the eye than in typical *Pugettia*. (Rathbun, 1924a) Preorbital spine also large, directed forward; the antennal spine visible in front of it.

Surface, except of fingers and distal portion of hand, covered with a short, dense pubescence, with occasional tufts of longer, club-shaped setae, most noticeable on the tubercles and other high portions of the carapace and in submarginal rows on ambulatory legs; long, straight hairs bordering the inner margins of the rostral horns, and curled hairs forming an oblique row on each protogastric lobe. Rostrum deeply divided by a wide sinus; outer margins of horns subparallel. Basal antennal article having, besides the anteroexternal spine, one further back on the outer margin, and, in the same line but behind the orbit, another small spine. A small subhepatic spine; also a row on the subbranchial and on the pterygostomial region.

Chelipeds of adult male about as long as carapace. Ischium spined on inner margin; merus on inner, upper and [outer] margins, four of the upper spines being the longest of all; the carpus with two spines on inner margin, a row of four on outer margin, and a few spines above and below; a few spinules on upper surface of palm at proximal end. Upper and lower margins of palm slightly convex; dactylus nearly as long as upper margin of palm; fingers narrow, deflexed, toothed within, a very narrow gape at base, with the teeth smaller there.

Ambulatory legs subcylindrical, slender; propodites thickest at distal end; dactyls with two rows of sharp, prehensile spinules, and a long, light-horn-colored [amber] tip. (Rathbun, 1925, modified)

Material examined: 62 specimens from 26 stations. (See Table 38) From 5 miles off San Pedro breakwater, California, to 8 miles west of Cedros Island, Lower California, Mexico, and including all eight of the Channel Islands, Tanner Bank, Cortez Bank, and Guadalupe Island.

Measurements: Largest specimen, an ovigerous female: length 23.9 mm, branchial width 17.3 mm, hepatic width, including spines, 13.5

mm, rostrum 5.7 mm, basal width 3.5 mm, cheliped 30 mm, chela 14.4 mm, dactyl 5.8 mm (tip broken), ambulatory legs 43, 37.7, 33.3, and 31.4 mm. Male specimen: length 16.2 mm, width 10.7 mm.

Color in life: Rostrum and frontal region dull yellow orange. Gastric, cardiac and intestinal areas vinaceous tawny with a design in white on the cardiac areas. Branchial areas pale gray with a lavender hue. Chelae dull orange yellow. Fingers purplish brown around base, gradually becoming orange red and fading out to white on tips. Ambulatory legs brownish orange faintly banded. Ventral side dull lilac on abdomen and orange on frontal areas. (Petersen)

Habitat: With bottom type recorded at each of the 23 stations from which the species was dredged, *Pugettia venetiae* was found to occur on a sandy substrate in over 50 per cent of the recoveries, with shell also present in 25 per cent of these. Rocky bottom accounted for the remainder, with the exception of one station each of mud and coralline. Specimens were remarkably free from attached organisms of any kind; they are decidedly not "decorators."

Depth: Hancock specimens were dredged in from 5-50 fathoms; once from 64-65 fathoms.

Size and sex: The measured female is considerably larger than was the female holotype, which measured 16.7 mm along the midline. The male is also larger than the 13.2 mm male measured by Rathbun (1925, p. 181), but the chelipeds are unsatisfactory, one lacking and the other having the tip of the pollex missing. All considered, a 12.5 mm male with asymmetrical chelae shows the greatest development. A series of two adults and ten young from off San Nicolas Island, station 1123-40, shows growth stages from 4 mm. In even the smallest the supplementary spine between the postorbital and hepatic spines is present as a spinule at a slightly lower level. The smallest ovigerous female measures 12.5 mm, the largest 23.9 mm.

Breeding: Females with ova were encountered off the northern Channel Islands of Santa Barbara and Anacapa in September and October, respectively, and by C. L. Hubbs at Guadalupe Island, Mexico, in January.

Remarks: The range of the species is extended northward to Santa Rosa Island and westward to San Miguel Island, California, the depth from 36 to 65 fathoms. The extended gap in distribution from Cortez Bank to Magdalena Bay is filled in by stations at Guadalupe and Cedros Islands, Lower California.

The resemblance of this species to *Antilibinia*, mentioned by Rathbun (1925, p. 182), does not hold up under comparison of actual specimen material, in this case the male of *A. smithi* MacLeay referred to by Stebbing (1910, p. 287), borrowed from the British Museum (Natural History) through the kindness of Dr. Isabella Gordon. *Pugettia venetiae* appears much more spinulose throughout and has a subhepatic spine that is lacking in *Antilibinia*. In point of length of rostrum, slenderness of basal antennal article and length of antennal flagellum, elongation of cheliped, slenderness of ambulatory legs, large eye, orientation of post-orbital spine and shape of external maxilliped it suggests rather *Chorilia* of the Pisinae, to which *Pugettia* is related through the scyriiform male first pleopod.

Genus **TALIEPUS** A. Milne Edwards

Epialtus Milne Edwards, 1834, p. 344 (part).

Epialtus (Taliepus) A. Milne Edwards, 1878, p. 138 (part).

Epialtus (Antilibinia) Miers, 1879c, p. 650 (part: the American species).

Taliepus Rathbun, 1925, p. 162.

Type: Epialtus nuttalli Randall, type of *Taliepus* A. Milne Edwards by subsequent designation of Rathbun (1925).

Description: Carapace broadly oval, convex in all directions, smooth, armed laterally with from two to four teeth, mostly small, and following the outline of the carapace. Postocular and preocular tooth small or absent. Rostrum inclined, sides convergent, tip bidentate. Antennae hidden, or partly visible at sides of rostrum; basal article subtriangular.

Chelipeds strong; fingers with tips excavate or spoon-shaped, gaping in the old male. Ambulatory legs stout, subcylindrical; dactyls strongly curved, two rows of spinules beneath. Large species. (Rathbun)

Range: Discontinuous. North Pacific from Santa Barbara, California, to Magdalena Bay, Lower California, Mexico, including Guadalupe Island. South Pacific from Callao, Peru, to Port Otway, Magallanes, Chile, including San Felix Island. Not Brazil (Bell) nor Galapagos Islands (Bell); doubtfully Panama (Rathbun). Shore to 50 fathoms.

It is of interest to note that A. Milne Edwards, who first proposed *Taliepus* as a subgenus of *Epialtus*, failed to include *Taliepus marginatus*, but did include *Epialtus (T.) productus*, a species since transferred to *Pugettia*.

KEY TO THE SPECIES OF THE GENUS *Taliepus*

- 1a. Propodites of ambulatory legs with an inferior distal tooth. Post-orbital tooth wanting; preorbital tooth present. An hepatic tooth in addition to anterolateral tooth. Apex of male first pleopod not flaring. Southern Hemisphere.
- 2a. Three lateral teeth; margin strongly rimmed. Propodal teeth strong in adults. *marginatus*
- 2b. Four lateral teeth; margin not strongly rimmed. Propodal teeth small in adults. *dentatus*
- 1b. Propodites of ambulatory legs lacking inferior distal tooth. A small postorbital tooth; preorbital tooth wanting. A branchial and an anterolateral tooth, but no hepatic tooth between the latter and the orbit. Apex of male first pleopod flaring. Northern Hemisphere. *nuttalli*

***Taliepus nuttalli* (Randall)**

Plate L, Fig. 8; Plate 22

Epialtus nuttalli Randall, 1839, p. 109. Gibbes, 1850, p. 173. Stimpson, 1857b, p. 458. Lockington, 1877c, p. 77. Rathbun, 1898, p. 572; 1904, p. 173; 1923b, p. 634. Holmes, 1900, p. 23. Weymouth, 1910, p. 29. Hilton, 1916, p. 69, fig. 9. Schmitt, 1921, p. 202, text-fig. 125. Johnson and Snook, 1927, p. 367, fig. 319.

Libinia nuttalli, Randall, 1839, pl. 3 [inscribed 1] (error for *Epialtus*).

Epialtus (Taliepus) nuttalli, A. Milne Edwards, 1878, p. 138.

Epialtus (Antilibinia) nuttalli, Rathbun, 1894, p. 69.

Taliepus nuttalli, Rathbun, 1925, p. 162, pls. 50, 51, text-fig. 61. Ricketts and Calvin, 1939, p. 81, fig. 36; 1948, p. 81 (not fig. 36).

Taliepus nuttalli, Meredith, 1939, p. 106 (figured).

Type: Male and female cotypes, Philadelphia Academy No. 598. Male cotype 101.6 by 76.2 mm, *vide* Schmitt.

Type locality: Upper California, Thomas Nuttall, collector.

Localities subsequently reported, with collectors: California: Santa Barbara, D. S. Jordan (Rathbun, 1894); Venice, *Anton Dohrn*, and San Pedro, H. N. Lowe (Rathbun, 1925); Santa Catalina Island (Holmes); Catalina Harbor, W. H. Dall (Rathbun, 1894, 1925); Isthmus Harbor and Avalon Bay, *Anton Dohrn* (Rathbun, 1925); Laguna Beach (Hilton); La Jolla, W. L. Schmitt, and Pt. Loma, *Albatross* (Rathbun, 1925); San Diego, H. Hemphill (Rathbun, 1894); United States-Mexico boundary, E. A. Mearns (Rathbun, 1925).

Mexico: West San Benito Island, *Albatross* (Rathbun, 1923b); Natividad Island, A. W. Anthony (Rathbun, 1925); Ballenas Bay, *Albatross* (Rathbun, 1898); Magdalena Bay, C. R. Orcutt (Rathbun, 1925).

Atlantic analogue: None. A southern California-west coast of Lower California endemic species.

Diagnosis: No preorbital, but a small postorbital tooth. No supplementary tooth on anterior margin between postorbital tooth and anterolateral angle. Propodites of ambulatory legs entire. Male first pleopod flaring at apex; pointed tip opposed by a slender, grooved projection.

Description: Carapace ovate, convex anteroposteriorly and transversely, smooth. No preocular tooth, postocular tooth small. Lateral teeth small, subequal, blunt, the margins between them convergent anteriorly. Rostrum with strongly convergent sides, inclined downward, flattened or slightly concave above, and with an equilaterally triangular notch at the end. Antennae not reaching end of rostrum.

Chelipeds of old male very stout, unarmed, subequal to first leg; fingers gaping moderately for two-thirds of their length, a shallow lobe on the dactyl at middle of gape, extremities of fingers crenate. Legs stouter than in *Pugettia producta*. Fifth segment of male abdomen longer than sixth. (Rathbun, 1925)

Material examined: 62 specimens from 31 stations. (See Table 39) From Venice Breakwater, California, to Entrada Point, outside Magdalena Bay, Lower California, Mexico, including Santa Catalina, Los Coronados, Guadalupe, West San Benito, and Cedros Islands.

Measurements: Largest specimen, a male: length 106 mm, branchial width 92 mm, width between anterolateral teeth 60 mm, rostrum 13 mm, basal width 15 mm, cheliped 160 mm, chela 82.5 mm, dactyl 46 mm, height of palm 48 mm, ambulatory legs 150, 125, 105, and 92 mm, respectively. Right cheliped (measured) larger than left.

Color in life: Dark purplish, besprinkled with testaceous spots becoming large and somewhat ocellate behind, and still larger and brighter on the under side of the body. (Randall) A specimen in the collection of the Allan Hancock Foundation is labeled "deep purple."

Habitat: Protected outer coast; rocky shores; low-tide horizon, protected rock and seaweed. (Ricketts and Calvin) Small specimens from White Cove, Santa Catalina Island, stations 1370-41 and 1378-41, were obtained from *Eisenia* holdfasts, along with numerous amphipods, isopods, and polychaetes.

Depth: Shore to 50 fathoms. Specimens from any considerable depth are very young.

Size and sex: Although less comprehensive in point of localities represented, the Hancock series of *Taliepus nuttalli* contains a greater number of individuals and exhibits more diversity as to size than the material available to Rathbun in 1925. Included are males to 106 mm, the largest on record, and females to 83 mm, together with young as small as 4 mm, from which it is possible to present a fairly complete picture of post-larval growth and development.

In specimens of 8 mm and less the carapace is narrow and pyriform like the young of *Sphenocarcinus*. The slope of the anterolateral and rostral margins is continuous, interrupted only by the eye, which is sessile and relatively larger than in the adult. The rostral horns curve abruptly inward at the tip, and each is surmounted by a sharp spinule. The margins of the rostral sinus are fringed with clavate hairs, those of opposite sides crisscrossing in a delicate network. The spinules of the dactyls of the ambulatory legs are sharp and erect and resemble those of *Podochela veleronis* or *Inachoides laevis*. In freshly preserved specimens the bases of these spines, as well as the tips of the fingers, are pinkish in color. In addition to the dense, short pile of the carapace and appendages, the young have occasional longer hairs on the ambulatory legs.

Sex can be determined in specimens as small as 7 mm, the males first by the narrow abdomen, since at this stage pleopod 1 is but little longer than pleopod 2.

The size at which the dense pile is lost can be placed at between 35 and 47 mm, all but the largest of four specimens within this range being "in velvet." Judging from the ease with which this covering may be removed and the number of scars or bare spots on the tests of medium-sized individuals, its fate is to be scraped off against rocks and boulders. In the old, numerous punctae remain, each with the stub of a papilla at its center.

The size at which the male cheliped enlarges was not determined, specimens of 37, 39, 47, and 61 mm showing little difference with respect to size of chelipeds from females of corresponding dimensions.

Breeding: The single ovigerous female in Hancock collections is an 83 mm individual taken at the north end of Cedros Island, Mexico, in March.

Remarks: Specimens collected by Allan Hancock expeditions prior to 1949 were all from north of the Mexican border. It remained for the *Velero IV* to recover *Taliepus nuttalli* from a succession of well-spaced

Lower California localities: Guadalupe and Cedros Islands, Turtle, San Hipolito, and Magdalena Bays. The latter duplicates Orcutt's record (Rathbun, 1925) and apparently marks the southern limit of range of the species.

Taliepus dentatus (Milne Edwards)

Plate I, Fig. 9; Plate 23

?*Cancer xaiva* Molina, 1782, p. 206.

Epialtus dentatus Milne Edwards, 1834, p. 345. Bell, 1835b, p. 173; 1836, p. 62. Milne Edwards and Lucas, 1843, p. 8. Nicolet, 1849, p. 131. Cunningham, 1871, p. 491. Targioni-Tozzetti, 1872a, p. 390; 1872b, p. 461; 1877, p. 18, pl. 2, figs. 1-4, 6-9, 11. Neumann, 1878, p. 21. Miers, 1881, p. 66. Aurivillius, 1889, p. 42. Cano, 1889, pp. 98-100, 176. Pfeffer, 1890, p. 545. Rathbun, 1898, p. 572; 1910, p. 571. Lenz, 1902, p. 756. Porter, 1903, p. 148. Doflein and Balss, 1912, p. 36.

Inachus mitis Poepig, 1836, p. 141; type locality, shores of Valparaiso, Talcahuano, etc.; type not extant. Nicolet, 1849, p. 125.

Epialtus (Taliepus) dentatus, A. Milne Edwards, 1878, p. 138.

Epialtus (Antilibinia) dentatus, Miers, 1879c, p. 650. Rathbun, 1894, p. 69.

Taliepus dentatus, Rathbun, 1925, p. 165, pls. 54, 55. Porter, 1925, p. 315, fig. 41; 1936b, p. 337; 1941, p. 458. Garth, 1957, p. 24.

Faliepus dentatus, Porter, 1936a, p. 151.

Taliepus dentatus, Porter, 1940a, p. 145; 1940b, p. 311.

Type: Several specimens of both sexes, syntypes, in Paris Museum. Of these the largest male, length 99 mm, width 84 mm, is hereby selected as lectotype, at the request of Dr. J. Forest.

Type locality: Coast of Chile.

Localities subsequently reported, with collectors: Panama: (?) Panama, J. M. Dow (Rathbun, 1894). Peru: "Peru" (Aurivillius); Callao, *Vettor Pisani* (Cano), U. S. Exploring Expedition (Rathbun, 1894). Chile: Pisagua, Kophamel, and Junin, Paessler (Doflein and Balss); Iquique (Lenz; Porter, 1925); Cavancha (Lenz); Cobija, Copenhagen Museum (Rathbun, 1925); Province of Antofagasta, J. Herrera (Porter, 1940a); Bay of Taltal, A. Capdeville (Porter, 1925); Cachuca and Bay of Guayacan (Lenz); Guayacan (Porter, 1925); Coquimbo (Cunningham); Coquimbo and Herradura, F. T. Delfin (Porter, 1903); Valparaiso, H. Cuming (Bell, 1835b); *Magenta* (Targioni-Tozzetti, 1877), *Vettor Pisani* (Cano), U. S. Exploring Expedition (Rathbun,

1894); San Felix Island, C. E. Porter (Rathbun, 1925); Tumbes (Lenz); Talcahuano (Poepig; Lenz; Porter, 1903), Strassenberg (Doflein and Balss), *Hassler* (Rathbun, 1925); Lota, Bay of Arauco (Cunningham); Corral (Porter, 1903); Ancud, Chiloe (Cunningham); Chonos, Chiloe, *Vettor Pisani* (Cano); Port Otway [Puerto Barroso], *Albatross* (Rathbun, 1898); Halt Bay, *Magenta* (Targioni-Tozzetti, 1872a); Trinidad Channel, *Alert* (Miers); Puerto Bueno, *Magenta* (Targioni-Tozzetti, 1872a); west coast of South America, H. E. Ames (Rathbun, 1925).

Atlantic analogue: None. A Pacific austral species.

Diagnosis: A preorbital tooth; postorbital tooth reduced to a tubercle. A supplementary tooth on anterior margin between orbit and anterolateral angle. Inferior distal tooth of propodites of ambulatory legs weak. Four lateral teeth; margin of carapace not strongly rimmed. Apex of male first pleopod not flaring widely, tip pointed; a stout median projection supporting a tonguelike projection arising from within orifice.

Description: Carapace suborbicular, save for the rostrum, very convex in both directions, densely punctate and with four lateral teeth, the first three acute, the last one blunt, tuberculiform; two small, obscure tubercles on anterior part of gastric region. Rostrum with strongly convergent margins, bifid at extremity, notch narrow. Postocular lobule minute, formed by a thickening of the orbital rim, and separated by a sinus from an infraorbital lobule. Antennae not exceeding rostrum.

Chelipeds of old male not longer than first leg; tubercles or stout spines on the upper surface near the proximal end and one or two smaller ones on the lower surface; carpus with a short, stout spine or tooth at the anterointernal angle; manus compressed, little dilated; fingers stout, dentate, narrowly gaping to near the extremity; prehensile teeth strong.

Ambulatory legs shorter than in allied species [see *Remarks* below], especially the dactyli; dactyli with two rows of strong, graduated, horny spinules beneath; propodites with an obscure tubercle or tooth below near distal end.

Fifth segment of male abdomen longer than sixth. (Rathbun, 1925)

Material examined: 70 specimens from 11 Lund University Chile Expedition localities. (See Table 40) From Montemar, north of Valparaiso, to Bahía de Ancud, Chiloe. One ovigerous female and a male first pleopod from a lot of three males and three females (U.S.N.M. No. 21903) collected at Port Otway [Puerto Barroso], Magallanes Territory, Chile, February 9-10, 1888, by the U. S. Fish Commission

Steamer *Albatross*, through the courtesy of Dr. F. A. Chace, Jr., curator of marine invertebrates, U. S. National Museum, with identification by M. J. Rathbun.

Measurements: Largest specimen, male: length 108 mm, branchial width 93 mm, hepatic width 63 mm, rostrum 14.5 mm, basal width 12.7 mm, cheliped 188 mm, chela 91 mm, dactyl 52 mm, height of palm 35 mm, ambulatory legs 160, 125, 105, and 95 mm, respectively. Female, ovigerous: length 87 mm, branchial width 72 mm, hepatic width 50 mm.

Color: Yellow with red dots. (Targioni-Tozzetti) In life, brown. (Lund University Chile Expedition)

Habitat: In rocky crevices in deep water. (Bell) Invariably found under stones in the rock pools at about half-tide. (Cunningham) Among algae and encrusted with serpulids. The masking habit of the species is discussed by Aurivillius (1889).

Depth: Although there is no previous record of depth with any specimen, aside from the statement of Bell under *Habitat* above, Lund University Expedition specimens were taken on two occasions below the intertidal zone, once in 8 and once in 40-55 meters.

Size and sex: Lund University Expedition material contains young to 5.5 mm minimum size, making possible for the first time a comparison of growth and development of this Southern Hemisphere species with the corresponding *Taliepus nuttalli* of the North Pacific. The smallest specimens show a "prehepatic" (or postorbital) spine close to the eye, while the real hepatic spine is first visible in 18 mm specimens. Sex is doubtfully determinable in 9 and 10 mm specimens, but 11 mm specimens are readily distinguishable as male or female. Small to medium sized young show two gastric tufts that develop into the gastric tubercles of 33-34 mm specimens. A female of this size (34 mm) is still "in velvet," while a 64.5 mm female is ovigerous.

Breeding: The large ovigerous female from Montemar, near Valparaiso, cannot be assigned a definite date, as collections were made at the Marine Station in September and October of 1948, and again in June, 1949. A female from Canal Chacao, Chiloe, had already shed its ova when captured in late February, 1949. Two females from SE of Punta Ahui, Bahía de Ancud, were in berry when taken in May, 1949. The February date for the ovigerous female from Port Otway [Puerto Barroso], Magallanes Territory, should be noted.

Remarks: As compared to *Taliepus marginatus* of like size and sex, *T. dentatus* is much more rotund, its ambulatory legs relatively longer, not shorter than in the allied species, as stated by Rathbun in the de-

scription above. The small size of the propodal teeth as compared to those of *T. marginatus*, again a reversal of the situation presented in Rathbun (1925, p. 162, key only; diagnoses and descriptions are correct), is noticeable, as is the fourth marginal tooth, which is postlateral in position.

Although the ranges of the two South Pacific species of *Taliepus* overlap in southern Peru and northern and central Chile, *T. marginatus* finds its southern limit in the vicinity of Talcahuano, whereas *T. dentatus* continues to Magellan Strait, and perhaps to the tip of South America.

The species first made its appearance as an article of food in the markets of Valparaiso and Santiago about 1915, according to Porter (1925).

***Taliepus marginatus* (Bell)**

Plate L, Fig. 10; Plate 24

Epialtus marginatus Bell, 1835b, p. 173; 1836, p. 62, pl. 11, figs. 4, 4i-k; pl. 13. Milne Edwards and Lucas, 1843, p. 8. Heller, 1865, p. 5. Smith, 1869, p. 33. A. Milne Edwards, 1878, p. 138. Miers, 1881, p. 66. Aurivillius, 1889, p. 43. Ortmann, 1893, p. 42. Moreira, 1901, p. 66. Lenz, 1902, p. 756. Rathbun, 1910, p. 534, p. 571, pl. 36, fig. 2.

Epialtus (Antilibinia) emarginatus, Miers, 1879c, p. 650.

Epialtus (Antilibinia) marginatus, Rathbun, 1894, p. 69.

Taliepus marginatus, Rathbun, 1925, p. 164, pls. 52, 53; pl. 220, fig. 2; pl. 221. Boone, 1927, p. 140, fig. 39. Garth, 1946, p. 378; 1957, p. 23.

Type: Female holotype, originally deposited in the Bell Museum, not extant.

Type locality: In place of the original designation, "Ad oras Brasiliae," where the female holotype was purportedly collected by Miller, and for reasons stated under *Remarks* below, the type locality is corrected to Valparaiso, Chile, where a large male specimen was collected by Hugh Cuming (cf. Bell, 1836, p. 63).

Localities subsequently reported, with collectors: Peru: "Peru" (Aurivillius); Independencia Bay and Mollendo, R. E. Coker (Rathbun, 1910). Chile: "Chile," *Novara* (Heller), (A. Milne Edwards), Ackerman (Ortmann); Iquique, Cavanca, and Guaiacan (Lenz); Caldera, Capt. Putnam (Rathbun, 1925); Valparaiso, J. D. Dana (Rathbun, 1894); Talcahuano, *Alert* (Miers, 1881).

Atlantic analogue: None. A Pacific austral species, and the Southern Hemisphere counterpart of *Taliepus nuttalli* (Randall).

Diagnosis: A preorbital, but no postorbital tooth. A supplementary tooth on anterior margin between orbit and anterolateral angle. Three lateral teeth; margin of carapace strongly rimmed. Inferior distal tooth of propodites of ambulatory legs stout. Apex of male first pleopod not flaring widely, tip coarse and blunted, two opposing lobes reduced to folds curling outward; tonguelike projection within orifice lacking, but supporting median projection remaining. (See also *Remarks* below)

Description: Carapace very convex, suborbicular, save for the flat, deflexed rostrum, smooth; lateral border marginate, two teeth anteriorly, an obscure tooth at widest part of carapace and a trace of another behind it. Rostrum subtriangular, tip bifurcate; preorbital tooth present. Eye-stalks globular, sunk in the circular orbits. Chelipeds elongate, very strong in male, two tubercles on upper edge of arm, one tooth at anterointernal angle of wrist, fingers long, gaping. Legs diminishing rapidly in length from first to fourth, a setiferous tooth on under side of propodites increasing in the same order; dactyli bluntly spinulose beneath. (Rathbun, 1910)

Material examined: 8 specimens from 5 stations. (See Table 41) From North Chinchá Island, Peru, to Montemar, N of Valparaiso, Chile.

Measurements: Largest specimen, a Lund University Chile Expedition male: length 87 mm, branchial width 68 mm, hepatic width 48 mm, rostrum 10 mm, basal width 11 mm, cheliped 100 mm, chela 45 mm, ambulatory legs 113, 85, 68, and 55 mm, respectively. The following measurements of a male and ovigerous female of approximately equal size are given in tabular form for purposes of comparison. Neither is as large as the 100 x 80.4 mm male recorded by Rathbun (1925). (Measurements in mm.)

| | Male | Female |
|------------------------------|------|--------|
| Length of carapace | 76 | 65 |
| Width at branchial level | 60 | 52 |
| Width at anterolateral level | 38 | 35 |
| Length of rostrum | 10 | 7 |
| Basal width of rostrum | 10 | 8.5 |
| Length of cheliped | 82 | 60 |
| Length of chela | 36 | 25 |
| Length of dactyl | 20 | 14 |
| Length of leg 1 | 103 | 75 |
| Length of leg 2 | 84 | 61 |
| Length of leg 3 | 70 | 52 |
| Length of leg 4 | 58 | 46 |

Color in life: Color of the adult dark brown; of the young female paler, and reddish. (Bell)

Habitat: In crevices of rocks. (Bell) In fish net near the shore. (Rathbun, 1910) The masking habit of the species is discussed by Auri-villius (1889).

Depth: Shore to 5 fathoms.

Breeding: An ovigerous female measuring 65 mm was taken by the *Velero III* in February at San Juan Bay, Peru. No definite date can be assigned to the two ovigerous females taken at Montemar by the Lund University Chile Expedition, as they were obtained at the Marine Station on various September and October dates, 1948, and one June date, 1949.

Remarks: In keeping with the known distribution of the species, the writer follows A. Milne Edwards (1878, p. 138, footnote), rather than Smith (1869, p. 33) and Moreira (1901, p. 66, footnote), in considering Rio de Janeiro an error of provenience. Bell's initial reference (1836, p. 62) to a Galapagan habitat is also discounted in view of the subsequent assertion (*Ibid.*, p. 63): "found by Mr. Cuming with *Ep. dentatus* at Valparaiso." Certainly, the evidence of all specimen material recovered since Bell indicates that *Taliepus marginatus* is endemic to the coasts of Peru and Chile, and that it occurs neither in the Atlantic, as confirmed by recent correspondence with Dr. A. Lemos de Castro of Brazil, nor in the Galapagos Islands, as confirmed by experience of *Velero III* collectors. Accordingly, its type locality is hereby corrected to Valparaiso, Chile.

From the specimens at hand it is apparent that the last half of the second couplet of the key of Rathbun (1925, p. 162) has been reversed. Thus it is *Taliepus marginatus*, rather than *T. dentatus*, that possesses the strong propodal tooth in the adult, a fact borne out by Rathbun's diagnosis of the latter species (*op. cit.*, p. 165), as well as by Bell (1836, p. 63). The statement concerning the relatively shorter legs of *T. dentatus* is not substantiated by measurement, the female of *T. marginatus* measured above having proportionately shorter legs than a female of *T. dentatus* of like size.

There is reason to believe that the male first pleopod characterized above and illustrated in Plate L, fig. 10, is worn or eroded. In a young male of 76 mm, *Velero III* station 371-35, the apex seems much more like that of *Taliepus dentatus*, Plate L, fig. 9.

Genus **SPHENOCARCINUS** A. Milne Edwards

Sphenocarcinus A. Milne Edwards, 1878, p. 135. Rathbun, 1925, p. 185.
Oxypleurodon Miers, 1886, p. 38; type: *O. stimpsoni* Miers, 1886, by monotypy.

Type: The Atlantic *Sphenocarcinus corrosus* A. Milne Edwards, 1875, by monotypy.

Description: Carapace subpentagonal, broadened behind, tapering gradually in front. Rostrum long and formed of two pointed horns, joined one to another; no preorbital spine [this is not true of *Sphenocarcinus agassizi* Rathbun]. Orbit incomplete below. Basal article of the external antennae narrow, and the movable flagellum inserted underneath the rostrum, entirely hidden by it. Epistome narrow and long. Third article of the external maxillipeds, or merus, dilated a little at its anteroexternal angle, and slightly notched on the inner side for the insertion of the palpus.

Chelipeds slender and symmetrical; the first pair of ambulatory legs much longer than the others. (A. Milne Edwards, modified)

Abdomen in both sexes with seven distinct segments. (Rathbun)

Range: Pacific coast from off Cape Tepoca, Gulf of California, Mexico, to Bahia Honda, Panama; Galapagos Islands. 14-90 fathoms. Atlantic coast from off Cape Lookout, North Carolina, to Barbados. To 100 fathoms. Indo-Pacific Ocean east to Hawaii.

Contains two American species, one Pacific and one Atlantic.

***Sphenocarcinus agassizi* Rathbun**

Plate O, Fig. 1; Plate 25, Fig. 1

Sphenocarcinus agassizi Rathbun, 1893b, p. 231; 1925, p. 188, pl. 63; pl. 223, figs. 1, 2. Faxon, 1895, p. 7, pl. 1, figs. 3, 3a. Crane, 1937, p. 58. Garth, 1946, p. 379, pl. 63, fig. 2.

Type: Male holotype, U.S.N.M. No. 17343, length 35 mm, width 23 mm.

Type locality: Off Cape Tepoca, Gulf of California, Mexico, 14 fathoms, *Albatross* station 3019.

Localities subsequently reported, with collectors: Gulf of California, Mexico: northwest of Guaymas, 71 fathoms, *Albatross* (Rathbun, 1893b); Arena and Gorda Banks, 40-70 fathoms, *Zaca* (Crane). Costa Rica: Cocos Island, Bay of Panama, 66 fathoms, *Albatross* (Faxon). Galapagos Islands, Ecuador: off Daphne Minor and Barrington Islands, 48-80 fathoms, *Velero III* (Garth).

Atlantic analogue: Sphenocarcinus corrosus A. Milne Edwards.

Diagnosis: Carapace unevenly tuberculate, lateral margins conspicuously quadridentate. Rostral horns contiguous, length of rostrum not exceeding postrostral portion of carapace. A blunt preorbital tooth. Chelipeds not appreciably more massive than walking legs. Male first pleopod with a blunt heel, a large opening, and a thickened but pointed tip.

Description: Surface of the body and limbs clothed with a short, close pubescence. Rostral horns long, horizontal, and terminating in blunt points. A more or less broken, longitudinal, rounded ridge running along the median line of the carapace, from the base of the rostrum to the intestinal region, rising into a prominent tubercle on the gastric area. A transverse flattened tubercle on the cardiac region, and two roundish ones on each branchial region. Anterolateral margin of the carapace armed with four prominent tubercles or large teeth, counting the one at the external orbital angle; these teeth increasing in size successively from the first to the last one. Upper margin of the orbit thickened and produced into a blunt preocular tooth. Outer margin of the pterygostomial region furnished with two or three rounded tubercles.

Merus of the chelipeds with two short spines at the proximal end on the superior border and one at the distal extremity; otherwise the limbs unarmed; the fingers of the chela short, gaping slightly at the base, and with blunt tips; no teeth on cutting edges. (Faxon, modified)

Material examined: 10 specimens from 5 stations. (See Table 42) From Puerto Refugio, Angel de la Guarda Island, to Boca de la Trinidad, Gulf of California, Mexico; off Nuez Island, Cocos Island, Costa Rica; and off Medidor Island, Bahia Honda, Panama. In addition to the above, 5 specimens from 2 Galapagos Islands stations (Garth, 1946, p. 379).

Measurements: Largest specimen, a male: length 30.0 mm, width 20.0 mm, rostrum 14.0 mm, basal width 4.0 mm, cheliped 23.7 mm, chela 10.6 mm, dactyl 4.5 mm, ambulatory legs 37, 24.7, 21.5, and 19.5 mm, respectively. Oviparous female: length 23.1 mm, width 16.7 mm, rostrum 7.7 mm, first ambulatory leg 27.6 mm.

Color in life: Olive brown, usually darkest posteriorly. In the adult males the entire cheliped was bright rose red, sometimes speckled with black, while the projecting parts of the ventral surface were similarly colored. Large females occasionally also had a tinge of pink ventrally. Eggs bright scarlet or grenadine orange to mulberry red. (Crane) See also Garth (1946, p. 379).

Habitat: Almost always on muddy bottoms. (Crane) Sand, mud and sand. (Garth) The 7 *Velero III* stations for which information on bottom type is available break down as follows: coralline, 3 stations; rock with sand, sand, mud with shell, and mud with rock, one station each.

Depth: *Velero III* specimens were dredged in from 30-90 fathoms, the latter record depth in the northern part of the Gulf of California.

Size and sex: By referring again to material from off Daphne Minor Island, Galapagos, station 792-38, it is possible to illustrate growth, beginning with a young specimen of 2.3 mm and continuing through stages of 5, 7.5, and 9.5 mm. The 2.3 mm specimen is 1.8 mm wide and its rostrum but 0.4 mm in length. The short horns are acute and widely divided, the three lateral lobes little more than blunt spines, and the enlarged eye gives it much the appearance of a young *Mithrax* at this stage. By 5 mm the inner margins of the rostral horns are beginning to converge and the outer margins curve broadly inward. In the 7.5 and 9.5 mm stages the rostral development continues, along with that of the lateral lobes; but the rostrum is not so lengthy, nor the posterior of the lobes so protuberant, that the triangular or pyramidal shape of the carapace is lost.

A young female specimen from north of San Pedro Nolasco Island, Gulf of California, station 572-36, also 9.5 mm in length, shows much of the anterior portion of the carapace punctate and setose. The rostrum is most heavily pitted, and in each minute depression there grows either a short clavate seta or a tiny vesicle. The punctae are continued down a median ridge onto the anterior gastric region and on the outer hepatic and branchial regions. The actual margins of the anterolateral lobes, as well as the inner branchial and cardiac regions, are smooth and bare.

In the adults, the difference in relative length and width of male and female is accounted for by the relatively longer rostrum of the male. The measurements above also show that the male cheliped does not become massive, and that the first walking leg in the male is considerably longer than the remaining legs.

The largest specimen on record is the 39 by 28 mm male from Bay of Panama (Faxon).

Remarks: For a second time the young of this species were taken on an echinoderm. In the Galapagos Islands it was a holothurian (cf. Garth, 1946, p. 379); in the Gulf of California specimens were removed from the dried test of *Stylocidaris perplexa*, an echinoid.

Sphenocarcinus agassizi is now recorded from the Central American mainland at Bahia Honda, Panama. Its vertical range is extended to 90 fathoms.

Genus **LEUCIPPA** Milne Edwards

Leucippa Milne Edwards, 1833, p. 512; 1834, p. 345. Rathbun, 1925, p. 184.

Type: Leucippa pentagona Milne Edwards, 1834, by monotypy.

Description: Carapace triangular and extending laterally above the base of the legs in the form of a horizontal lamina; orbits incomplete; rostrum broad, horizontal, and concealing the base of the external antennae. Legs provided above with a projecting crest which extends to the origin of the last article. (Milne Edwards, 1833)

Carapace subpentagonal or subtriangular, the length barely exceeding the width; lateral margins dentate or lobed. Rostrum horizontal, wide, lamellate, two-horned. A preorbital and a postorbital tooth present. Eyes small, peduncle very short. Basal article of outer antennae short; next two articles concealed under the rostrum. Epistome of moderate size; merus of outer maxillipeds much dilated outwardly, slightly truncate at the anterior inner angle, a small sharp tooth in front of insertion of palp. Legs short, compressed.

Abdomen with seven segments free in both sexes. (Rathbun)

Range: Atlantic Ocean from Cape St. Roque, Brazil, to Gulf of San Mathias, eastern Patagonia; Pacific Ocean: "Chile," including Strait of Magellan, and west coast of Lower California, Mexico, at Magdalena Bay, 51 fathoms.

Leucippa pentagona Milne Edwards

Plate O, Fig. 2; Plate 25, Fig. 4

Leucippa pentagona Milne Edwards, 1833, p. 517, pl. 18B, figs. 1, 2 (*pantagona* on plate); 1834, p. 347, pl. 15, figs. 9, 10. Milne Edwards and Lucas, 1843, p. 9. Nicolet, 1849, p. 132. Rathbun, 1898, p. 572; 1910, pp. 571, 613; 1925, p. 184, pl. 61; pl. 222, figs. 7-9, text-fig. 72. Moreira, 1901, pp. 66, 139. Doflein and Balss, 1912, p. 36, text-fig. 4. Garth, 1957, p. 26.

Leucippa ensinadae Audouin, in De Haan, 1839, pl. G. See also Holthuis, 1953, p. 41.

Leucippa ensinadae Milne Edwards and Lucas, 1843, p. 9, pl. 5, figs. 3, 3a, 3b; type locality, "l'Ensenade de Ros," Patagonia; type in Paris Museum.

Leucippa laevis Dana, 1851a, p. 273; 1852, p. 135; 1855, pl. 6, figs. 5a-c; type locality, Rio de Janeiro; type not extant.

Leucippa levis, Smith, 1869, p. 33.

Leucippe pentagona, Miers, 1879c, p. 649.

Pugettia species, Miers, 1881, pp. 63, 66.

Pugettia australis Miers, 1881, p. 66; type locality, mouth of Rio de la Plata; type in British Museum.

Leucippe ensenadae, Ortmann, 1893, p. 41.

Type: Female holotype, length 11.25 mm, in Paris Museum.

Type locality: Shores of Chile.

Pacific localities subsequently reported, with collectors: Lower California, Mexico: Magdalena Bay, 51 fathoms, *Albatross* (Rathbun, 1898).

Atlantic analogue: The species occurs in the Atlantic, from Cape St. Roque, Brazil, to Patagonia.

Diagnosis: Rostrum short, bifid, horns closely approximated. Lateral margins lamellate, three rounded lobes in addition to acute postorbital tooth. Chelipeds and legs moderately cristate. Male first pleopod subcylindrical, opening terminal.

Description: Carapace subtriangular, smooth, median region sparingly tumid; rostrum elongate, furcate, horns triangular, acute, and with a triangular interval; lateral margins of carapace very thin, and a little reflexed, four-toothed or angulately undulate, the teeth unequal, posterior tooth arcuate behind, and produced upon the posterolateral surface of the carapace. Pterygostomian region three-toothed, or having a single tooth situated in a large depression. [Legs] naked, [merus] cristate. (Dana, 1852, of *Leucippa laevis*)

Material examined: Magdalena Bay, Lower California, Mexico, 51 fathoms, May 2, 1888, *Albatross* station 2833, 1 young male (U.S.N.M. No. 21902). (Photographed)

Measurements: Young male: length 4.1 mm, width 3.2 mm.

Color in life: Tawny yellow. (Milne Edwards and Lucas, of *Leucippa ensenadae*)

Habitat: On bottom of black sand. (Miers, of *Pugettia australis*) The Magdalena Bay specimen came from a bottom of green mud. (Rathbun)

Depth: 51 fathoms; also reported from 28 fathoms on the Atlantic side.

Remarks: Through the courtesy of Dr. F. A. Chace, Jr., of the U. S. National Museum, the writer has been able to examine the single specimen obtained by the *Albatross* off Lower California. An immature male, slightly over 4 mm long, it constitutes at once the only record for

the species in the Northern Hemisphere and the only recorded occurrence of the species in Pacific waters north of Chile, Atlantic records for *Leucippa pentagona* being confined to southern Brazil and Argentina.

From the limited history of the species in the Pacific, which aside from the Mexican record includes only Milne Edwards's type specimen from Chile, it is not possible to decide whether *Leucippa pentagona* is an Austral species communicating with the Atlantic via the Strait of Magellan, as suggested by the *Hassler* specimen from San Antonio Bay (Rathbun, 1925), or the Pacific member of an analogous species pair. In the former case the Lower California record is distinctly extralimital; in the latter case the Pacific range, Lower California to Chile, would not be exceptional. Should the latter eventuality prove to be the case, the name *L. pentagona* would remain with the Pacific member of the species pair, because of the Chilean type locality.

Genus ACANTHONYX Latreille

Acanthonyx Latreille, 1825, p. 698; 1829, p. 58. Milne Edwards, 1834, p. 342. A. Milne Edwards, 1878, p. 142. Miers, 1879c, p. 650; 1886, p. 42. Alcock, 1895, p. 198. Rathbun, 1901, p. 60; 1925, p. 141.

Peltinia Dana (part), 1851a, p. 272; 1851b, p. 433; 1852, pp. 84, 129; 1853, p. 1422.

Type: The Mediterranean and eastern Atlantic *Maia lunulata* Risso, 1816, by monotypy.

Description: Carapace suboblong, rounded behind, and with the dorsal surface usually depressed, not markedly constricted behind the prominent anterolateral angles, the lateral branchial spines small and not prominent. Preocular spine prominent, acute. Spines of rostrum united at base, acute and but little divergent. Eyes small, mobile, but not completely retractile. Basal antennal [article] narrowing slightly from the base to the unarmed distal extremity; flagellum exposed and visible from above at the side of the rostrum. Merus of the [external] maxillipeds truncated at the distal extremity and but slightly notched at the antero-internal angle, [there] articulated with the next [segment]. Chelipeds in the adult male well developed; palm compressed, but slightly turgid in the middle, and often slightly carinated above; fingers acute, and having between them, when closed, an interspace at the base. Ambulatory legs short, with the [propodal] segment more or less dilated

and compressed and armed with a tooth or lobe on its inferior margin, against which the small acute dactylus closes. Abdomen in the male six-[segmented]. (Miers, 1886)

Range: Pacific coast from Santa Maria Bay, Lower California, Mexico, to Valparaiso, Chile, including Revilla Gigedo and Galapagos Islands; Atlantic coast from Miami, Florida, to Rio de Janeiro, Brazil. Occurs also off West Africa, in the Mediterranean Sea, and in the Indo-Pacific east to Hawaii.

Contains but one American species, which is common to both coasts. Shore to 16 fathoms.

Acanthonyx petiveri Milne Edwards

Plate O, Fig. 3; Plate 25, Fig. 2

Cancer muricatus compressum Petiver, 1712, pl. 20, fig. 8.

Acanthonyx petiverii Milne Edwards, 1834, p. 343. Bell, 1835b, p. 173; 1836, p. 62. De Haan, 1839, pl. G. White, 1847, p. 11. Dana, 1852, p. 128; 1855, pl. 5, figs. 6a-d. Smith, 1869, p. 33. Miers, 1877, p. 654; 1886, p. 42. A. Milne Edwards, 1878, pl. 27, figs. 7, 7a-f. Cano, 1889, pp. 99, 100, 176. Rathbun, 1894, p. 72; 1901, p. 60; 1907, p. 72; 1910, pp. 534, 571, pl. 46, fig. 4; 1925, p. 142, pl. 44; pl. 222, figs. 1-6. Boone, 1927, p. 137, fig. 38. Finnegan, 1931, p. 620. Hult, 1938, p. 11. Garth, 1946, p. 376, pl. 63, fig. 4. Crane, 1947, p. 71. Buitendijk, 1950, p. 271.

Acanthonyx emarginatus Milne Edwards and Lucas, 1843, p. 9, pl. 5, fig. 2; type locality, near Lima, Peru; type in Paris Museum.

Acanthonyx debilis Dana, 1851a, p. 272; 1852, p. 127; 1855, pl. 5, figs. 5a, 5b; type locality, Valparaiso, Chile; type not extant.

Peltinia scutiformis Dana, 1851a, p. 273; 1852, p. 130; 1855, pl. 5, figs. 7a-c; type locality, Rio de Janeiro; type not extant. Smith, 1869, p. 33.

Acanthonyx concamerata Kinahan, 1857, p. 334, pl. 14, fig. 1; type locality, North Chinchas Islands, Peru; type in Royal Dublin Society Museum.

Acanthonyx petiveri, Stimpson, 1871a, p. 97. A. Milne Edwards, 1878, p. 143 and synonymy. Garth, 1957, p. 22.

Pugettia scutiformis, Miers, 1886, p. 40, footnote. Moreira, 1901, pp. 65, 138; 1920, p. 126. Lenz and Strunck, 1914, p. 276, pl. 12, figs. 5-7.

Type: Holotype in Paris Museum. Male, length 18 mm, as verified by J. Forest.

Type locality: The Antilles. "Guadeloupe" on the type specimen.

Pacific localities subsequently reported, with collectors: Mexico: Lower California: Magdalena Bay (Rathbun, 1925); Cape San Lucas, John Xantus (Stimpson); Manzanillo, F. Bonet (Buitendijk). Nicaragua: Corinto, *Zaca* (Crane). Costa Rica: Piedra Blanca, *Zaca* (Crane). Panama: Bay of Panama, *Vettor Pisani* (Cano); Perico Island, *Albatross* (Rathbun, 1907). Ecuador: Galapagos Islands, 5 fathoms, Hugh Cuming (Bell); *St. George* (Finnegan); Hood Island, 15 feet, *Arcturus* (Boone); Academy Bay, Rolf Blomberg (Hult); Hood, Charles, Barrington, Albemarle, and Indefatigable Islands, *Velero III* (Garth). Peru: "Peru" (Miers, 1877); Sechura Bay, 5-6 fathoms, R. E. Coker (Rathbun, 1910); near Lima (Milne Edwards and Lucas, as *Acanthonyx emarginatus*); Callao, *Vettor Pisani* (Cano); North Chinchas Island, 7-10 fathoms (Kinahan, as *Acanthonyx concamerata*), R. E. Coker (Rathbun, 1910), R. C. Murphy (Rathbun, 1925); Paracas Bay, *Hassler* (Rathbun, 1925). Chile: Caldera, *Hassler* (Rathbun, 1925); Valparaiso, U. S. Exploring Expedition (Dana, 1851a, as *Acanthonyx debilis*), *Vettor Pisani* (Cano).

Atlantic analogue: The species itself is considered common to both sides of the Isthmus of Panama, no satisfactory basis having been found for separating the Pacific from the Atlantic form.

Diagnosis: Rostrum short, deflexed, bifid. An elevated preorbital lobe. Hepatic lobe large, rectangular; two setose branchial lobes or teeth. Carapace nearly smooth; five obscure setiferous tubercles: three gastric, one cardiac, one intestinal. Carpus of male cheliped crested, manus enlarged and compressed, fingers denticulate. Ambulatory legs subchelate. Abdomen six-segmented in both sexes; male first pleopod with a thickened tip opposed by a triangular, spinulose lobe.

Description: Carapace elongate, subpentagonal, nearly smooth, a few tufts of hair; lateral margins nearly parallel, tridentate, first tooth large, at anterolateral angle; preorbital tooth present; rostrum short, deflexed, tip bifurcate; each marginal tooth fringed with hair. Antennae visible either side of beak. Orbits in sides of carapace; eyes visible from above. Chelipeds short, considerably enlarged in male; two tubercles on lower outer edge of arm; wrist cristate above; palm longer than narrowly gaping fingers. Legs compressed, decreasing in length from first to fourth; propodi dilated, a blunt tooth on under edge against which the dactylus plays. (Rathbun, 1910)

According to Rathbun (1925, p. 143), different names have been given to this species on the basis of the size of the male cheliped, the

development of the carpal crest, the presence or absence of tubercles on the carapace, and other minor characters of age or sex. (See also *Remarks* below)

Material examined: 173 specimens from 40 stations, divided as follows: (See Table 43)

U. S. National Museum material: 63 specimens from 15 stations, all in Peru and Ecuador, collected by Waldo L. Schmitt.

Hancock expeditions and related material: 111 specimens from 26 stations. From Santa Maria Bay, Lower California, and La Paz Bay, Gulf of California, Mexico, to Vieja Island, Peru, including the Revilla Gigedo Islands. In addition to the above, 38 specimens from 12 Galapagos Islands stations (Garth, 1946, p. 376).

Measurements: Largest specimen, a male: length 34.6 mm, branchial width 24.1 mm, hepatic width 20.3 mm, rostrum 4.4 mm, width 3.7 mm, cheliped 34 mm, chela 19.2 mm, dactyl 10.2 mm, walking legs 44, 35, 29, and 25 mm, respectively. Ovigerous female: length 22.7 mm, branchial width 16.0 mm, hepatic width 15.0 mm.

Color in life: Ranges from bright lettuce green through ochre and brown to deep maroon, depending entirely upon color of surrounding algae. (Crane, 1947, p. 71)

Habitat: From seaweed. (Rathbun, 1910) From marine plant washings. (Garth, 1946) Rocky and sandy shore; coral flats. (Finnegan, 1931) Among elongate algae growing either in tidepools or, rarely, on exposed, surf-beaten rocks. Also occasionally found below low-tide level. (Crane, 1947)

Depth: Specimens not obtained ashore were dredged in from 2 to 16 fathoms.

Size and sex: Males of the U. S. National Museum series, mentioned above, range in size from 8 to 26 mm, females from 8 to 23 mm, ovigerous females from 10.8 to 23 mm. A young specimen, probably female, measures but 2.2 mm and is the smallest specimen examined. It has large, sessile eyes and is constricted behind the hepatic lobes in the manner of *Pugettia*. The two branchial lobes which serve to distinguish the species, while very small, are clearly discernible. The propodal flanges, which develop with age, are not apparent. Males in the Hancock series range from 4.5 to 34.6 mm, females from 5.5 to 21 mm, ovigerous females from 11 to 21 mm. The specimen measured above exceeds the 29.6 mm male reported by Miers (1877) and is considerably larger than the 18.7 mm male specimen measured by Rathbun (1925, p. 143).

Breeding: Ovigerous females were encountered by the *Velero III* in Peru in January, when 5 of 14 females taken at Lobos de Afuera Island were in berry, and by Schmitt in October, when 17 of 20 females taken at Paita were found gravid. Other records for egg bearing females are from San Benedicto Island, Revilla Gigedo Islands, in April by E. Y. Dawson, from Acapulco, Mexico, in February and September, Dawson and Hubbs, collectors, from the southern part of the Gulf of California in December, E. Y. Dawson, collector, and from Nicaragua in January and Costa Rica in February (Crane, 1947, p. 71).

Remarks: The material at hand shows considerable variation, both as to presence or absence of tufts of hair on the carapace and the angle of the hepatic lobe, whether acute or obtuse. In fully two-thirds of the Peruvian specimens the carapace is smooth and bare regardless of age or sex, while the remaining third show the gastric pair of tufted tubercles only. Among specimens from Acapulco, Mexico, one small individual has the full complement of tufts (3 gastric, 1 cardiac, 1 intestinal), while of four ovigerous females two are bare and two have the gastric tufts only. The angle of the hepatic lobe seems to be related to sex, most males having an acutely angled lobe, while most females, in keeping with their more rotund carapace, have an obtusely angled, or arching lobe. Small males (8 mm) resemble the females in this respect, and males of intermediate size may be quite squarish in appearance.

The series examined, while less extensive in range than that seen by Rathbun (1925, p. 143 f.), which included a specimen from Chile, is the most extensive available covering material from Lower California to Peru. The specimen from Santa Maria Bay extends the range northward along the west coast of Lower California. The specimens from Maria Magdalena Island and from Acapulco bridge the gap between Cape San Lucas and Nicaragua, where the species was collected by the *Zaca* (Crane, 1947). The absence of *Acanthonyx petiveri* from the Gulf of California north of La Paz suggests that it is not able to compete with the endemic *Epialtus minimus*, a prolific species occupying a similar ecological niche.

The male first pleopod of an Atlantic specimen from *Velero III* station A46-39 was examined and found to be identical with that of the Pacific form.

Genus **EPIALTUS** Milne Edwards

Epialtus Milne Edwards, 1834, p. 344 (part). Rathbun, 1925, p. 144 (part).

Epialtus (*Epialtus*) A. Milne Edwards, 1878, p. 138 (part: not *E. marginatus*). Miers, 1879c, p. 650.

Type: Epialtus bituberculatus Milne Edwards, 1834, by subsequent designation of Miers (1879c, p. 650).

Description: Carapace broad, subpentagonal or oblong, almost smooth, with two lateral, more or less laminate projections, sometimes very largely developed. Rostrum broad, triangular or oblong, entire or bilobed at tip. Eyes small. Preorbital tooth either present or absent; postorbital small, minute, or wanting. Basal article of antenna triangular; movable part concealed beneath rostrum. Chelipeds of male strong; fingers either gaping or in contact; tips excavate or spoon-shaped. Ambulatory legs subcylindrical, diminishing successively in length from first to fourth; propodites sometimes with an inferior tooth or bunch of setae; dactyli with two rows of spinules beneath. Small species. (Rathbun)

Abdomen of male with six segments, of female with five segments.

The genus *Epialtus* as defined by Rathbun (1925, p. 144) represented an advance over the previous arrangements of A. Milne Edwards and of Miers in that it removed from the genus those American species having seven free abdominal segments in both sexes and placed them either in *Taliepus* or in *Pugettia*. In conformity with the general system proposed for the Oxyrhyncha by Balss (1929, p. 2), in which the number of free abdominal somites becomes a character useful in grouping genera into larger categories, it has been found necessary to further restrict the genus *Epialtus* to those species which, like the type, *E. bituberculatus*, possess six free segments in the male and five in the female. A separate genus, *Epialtoides*, has been erected to receive those species previously referred to *Epialtus* (with the exception of *E. peruvianus*, which has been transferred to *Eupleurodon*) in which the number of free abdominal somites in the male is further reduced to five. *Epialtoides*, therefore, stands in relation to the restricted genus *Epialtus* as does *Acanthonyx* to *Dehaanius* MacLeay.

Range: Eastern Pacific from Lagoon Head, west coast of Lower California, and Puerto Refugio, Angel de la Guarda Island, Gulf of California, to Acapulco, Mexico. Erroneously reported from Chile. Western Atlantic from Indian River, Florida, to Desterro [or Rio de Janeiro], Brazil. ?Bermuda (Verrill). Not South Africa [*Epialtus scutellatus* of Miers (1886) and Stebbing (1910) is a *Dehaanius*, *vide* Barnard (1950, p. 35)]. Shore to 17 fathoms.

KEY TO THE PACIFIC AMERICAN SPECIES OF *Epialtus*, RESTRICTED
(Males with six free abdominal somites)

- 1a. Rostrum elongate, tip bifurcate. Hepatic and branchial lobes subequal; a tuft of hair on propodites of legs. *minimus* ♂
- 1b. Rostrum short, simple, margin entire
 - 2a. Tip of rostrum triangulate above, spiniform below. Upper crest of palm laminiiform. *sulcirostris*
 - 2b. Tip of rostrum truncate or rounded. Margin of hepatic lobes crenulate; propodites of legs tufted.
minimus ♀ (= *crenulatus*)

Atlantic species reported as occurring in the Pacific, but unsupported by authenticated specimens of recent date:

Epialtus bituberculatus Milne Edwards, 1834, p. 345; atlas, 1837, pl. 15 [not 14], fig. 11.

In keeping with the presently recognized range of the species, Indian River, Florida, to Desterro, Brazil, *Epialtus bituberculatus*, type species of the genus, is considered to have its provenience in the Atlantic, rather than in Chile, to which it was attributed by Milne Edwards. Of a specimen in his Charleston cabinet, Gibbes (1850, p. 173) stated: "Brought from Key West by Prof. W. H. Harvey, and agrees perfectly with Milne Edwards's description and figures of individuals said to come from Chili." Specimens from southern California attributed to *E. bituberculatus* by Rathbun (1904, p. 173) were subsequently described as *E. hiltoni* (Rathbun, 1923a, p. 72).

***Epialtus minimus* Lockington**

Plate O, Fig. 5; Plate 26, Fig. 1

Epialtus minimus Lockington, 1877c, p. 77. Streets and Kingsley, 1877, p. 105. Kingsley, 1880, p. 385. Rathbun, 1924c, p. 378; 1925, p. 155, pl. 47, fig. 1; text-fig. 57a-d. Crane, 1937, p. 57, pl. 2, fig. 7.

Epialthus minimus, Steinbeck and Ricketts, 1941, p. 466.

Epialtus crenulatus Rathbun, 1923a, p. 71; type locality, Lower California; ovigerous female holotype, U.S.N.M. No. 18135; 1925, p. 158, text-fig. 53f.

Type: Male and female cotypes, originally in California Academy of Sciences, no longer extant.

Type localities: Puerto Escondido and San José Island, both in the Gulf of California, W. J. Fisher, collector.

Localities subsequently reported, with collectors: Gulf of California, Mexico: Patos Anchorage, 4.5 fathoms, Fred Baker (Rathbun, 1924c); Santa Inez Bay, 0-2.5 fathoms, Zaca (Crane); San Marcos Island, Johnson and Baker (Rathbun, 1925); Coronado[s] Island (Steinbeck and Ricketts, 1941).

Diagnosis: Hepatic and branchial width subequal; anterior margin of hepatic lobe transverse. Male rostrum elongate, tip bifurcate. Gastric region with three tubercles in a backward pointing triangle. Chelipeds of male massive, meri grossly enlarged, tuberculate; fingers gaping in a broad oval. Propodi of ambulatory legs with setiferous projections at midpoints. Male first pleopod a simple cylinder thickened to tip, opening on convex side unprotected, a row of spinules along concave margin.

Description: Rostrum larger than usual for the genus, the emarginated extremities divergent. Transorbital width small. No preorbital or postorbital spine. Anterolateral margin with two triangular teeth, the anterior [pair] much the larger, their front margin at right angles to the carapace . . . Distance from the anterior line of the first teeth to tip of rostrum about equal to the posterior portion of the carapace. First pair of feet [chelipeds] in the male longer than the second [first ambulatories], fingers obtuse and imperfectly spoon-shaped at their tips. Eight posterior legs slender, cylindrical, naked, except terminal segment, this segment fringed below with short setae. Penultimate segment with one or two small spines [compact clusters of hair] on the under side.

Carapace of the largest female stouter and broader than that of the largest male, and in some of the females the manus tuberculated. (Lockington)

The above description, modified in no essential, represents Lockington at his best. Even without the aid of a pencil sketch by J. S. Kingsley of what was in all probability a cotype (Rathbun, 1925, fig. 57a), the species is clearly recognizable.

Material examined: A total of 37 specimens from 18 stations, 15 of which were in the Gulf of California. (See Table 44) From Lagoon Head Anchorage, west coast of Lower California, and Puerto Refugio, Angel de la Guarda Island, Gulf of California, to Acapulco, Mexico. In addition to the above, the writer has on loan from the California Academy of Sciences the male from San Marcos Island figured by Rathbun (1925, pl. 47, fig. 1).

Measurements: Largest specimen, male: length 16.5 mm, hepatic width 12.8 mm, branchial width 12.85 mm, rostrum 4.4 mm, width 2.6 mm, cheliped 16.1 mm, chela 7.0 mm, manus 4.6 mm, dactyl 2.8 mm, height of palm 3.2 mm, walking legs 16.6, 13.4, 11.5, and 9.8 mm.

Color in life: Creamy to ochraceous yellow, the chelipeds and ventral surface sometimes spotted or blotched with brown. (Crane) Uniformly tawny olive except for scattered blotches of white on cardiac and gastric portion of carapace and around joints of ambulatory legs. Ventral side greenish white with a strong lavender tinge; maxillipeds distinctly lavender. Pterygostomial region light tawny olive. (Petersen)

Habitat: Found at low tide under stones and in coral. (Lockington) On sandy bottom with weed and stones. (Crane) Associated with the hatchet clam *Pinna* at Concepción. (Steinbeck and Ricketts) In the 12 instances for which data on bottom type are available, Hancock expeditions specimens were recovered from a substratum of rock in 6 cases, of sand in 2 cases, of coral or coralline in 3 cases, and of algae in one case.

Depth: Shore to 17 fathoms. Extreme tidal fluctuations in the northern part of the Gulf of California expose rich and varied algal fields such as occur at Turner's Island, off the south end of Tiburon Island, and on the reef at Puerto Refugio, Angel de la Guarda Island, to depths of between 18 and 24 feet.

Size and sex: Males of the present series measure 5.5 to 16.5 mm, females 5.3 to 15.8 mm, ovigerous females 10.4 to 15.8 mm. Largest specimen on record is the 21 x 16 mm male from Patos Anchorage (C.A.S.) reported by Rathbun (1924c).

Breeding: Ovigerous females were encountered by the *Velero III* in the Gulf of California in March, by E. Yale Dawson while diving near Guaymas, Sonora, in May, and again at La Paz Bay in November, and by Wm. N. Smith II at Tiburon Island in June. Crane (1937, p. 57) reports 7 of 9 females taken at Santa Inez Bay as carrying eggs in April.

Remarks: Hancock specimens exhibit even greater diversification than the remarkable series illustrated by Crane (*op. cit.*, pl. 2, fig. 7), since the specimens collected by the *Velero III* come from a variety of localities, whereas those of the *Zaca* were all obtained at Santa Inez Bay. In at least two of the specimens examined, an 11.8 mm female from Concepción Bay, station 683-37, and a 7.6 mm female from Agua Verde Bay, station 1104-40, both in the Gulf of California, the configuration of the carapace is clearly that given for *Epialtus crenulatus* (Rathbun, 1925, text-fig. 53f). It will be noted that the characters which separate

E. crenulatus from *E. minimus* are in part to be attributed to sex: length of rostrum with resultant prehepatic length, and size of chelipeds. When those characters not associated with sex are considered (horizontal anterior margin of hepatic lobes, size of hepatic lobe in excess of branchial, and possession of tufts of setae on inferior margins of walking legs), the two agree remarkably well. For this reason, and after examination of photographs of the unique female holotype of *E. crenulatus* (U.S.N.M. No. 18135) provided by Fenner A. Chace, Jr., of the U.S. National Museum, the writer considers *E. crenulatus* Rathbun a synonym of *E. minimus* Lockington. Any remaining doubt should be dispelled by comparing the outline figure of Rathbun with the aforementioned figure of Crane, and particularly with the third specimen from the bottom in the middle row.

While none of the *Zaca* males had a prehepatic length greater than the posthepatic, as shown by Kingsley's figure of a cotype (Rathbun, 1925, text-fig. 57), several of the series at hand have a rostrum proportionately as long as, if not longer than that of the figured specimen. In one of these from Espiritu Santo Island, station 510-36, the tips of the rostrum diverge in a strong Y. Waldo L. Schmitt, who examined this specimen, believed it to represent a new species, but in all other particulars except the rostrum it is typical *Epialtus minimus*. A male specimen without chelipeds from Acapulco, collected by E. Yale Dawson, also has a very long rostrum, slender throughout its length, but without the terminal flare of the Espiritu Santo specimen.

The presence of *Epialtus minimus* outside the Gulf of California, as at Lagoon Head on the west coast of Lower California, at Tenacatita Bay, Jalisco, and at Acapulco, Guerrero, needs confirmation by a series of more nearly typical individuals from these extralimital localities.

***Epialtus sulcirostris* Stimpson**

Plate O, Fig. 6; Plate 26, Fig. 2

Epialtus sulcirostris Stimpson, 1860b, p. 198. A. Milne Edwards, 1878, p. 141, pl. 27, figs. 6-6b. Rathbun, 1923b, p. 634; 1924c, p. 377; 1925, p. 150, pl. 46, fig. 3; pl. 47, fig. 2, text-fig. 53c.

Type: Male cotype in Paris Museum.

Type locality: Cape San Lucas, Lower California, Mexico, John Xantus, collector.

Localities subsequently reported, with collectors: Lower California, Mexico: Santa Maria Bay, with boat dredge, *Albatross* (Rathbun, 1923b); Gulf of California: San Marcos Island, Johnson and Baker (Rathbun, 1924c).

Atlantic analogue: None. A west coast of Lower California-Gulf of California endemic species.

Diagnosis: Rostrum thick, simple, broadly triangular above, spiniform below. A small preorbital but no postorbital tooth. Branchial width exceeding hepatic. Male manus with a laminiform crest. Ambulatory legs slender, bare except for a setose projection at distal fourth of propodus of first pair. Male first pleopod terminally truncate, tip coarse and little projecting.

Description: Carapace widest at the posterior of the two lateral teeth, these teeth rather acute at their tips. Preorbital tooth small but distinct and rather prominent. Rostrum in the outline of its upper side oblong, in length about equaling the distance between the tips of the preorbital teeth, with sides slightly converging to a place near the extremity, running abruptly to a triangular point. In its other characters, the rostrum thick, with its upper and lower surfaces a little concave; the lower surface triangular in shape, narrower than the upper, and separated from it by a deep lateral groove.

Body and ambulatory [legs] smooth and naked. Chelipeds pubescent; carpus acutely carinated externally; hand broad, compressed, with the upper margin acute or crested, crest laminiform, very prominent above the insertion of the dactylus. Ambulatory [legs] slender, with no vestige of a thumb-process on the penult segment, excepting in the first pair. (Stimpson, modified)

Material examined: Hancock expeditions and related material: 4 specimens from 3 stations. (See Table 45) Punta Palmilla, near San José del Cabo, and Cabeza Ballena, Gulf of California, Mexico.

California Academy of Sciences: San Marcos Island, Gulf of California, Mexico, June, 1921, Johnson and Baker, collectors, one male (of two males identified by M. J. Rathbun).

Measurements: Male specimen: length 11.0 mm, branchial width 8.8 mm, hepatic width 7.55 mm, rostrum 1.9 mm, width 2.2 mm, cheliped 10.5 mm, chela 4.6 mm, dactyl 2.3 mm, height of palm 2.3 mm, ambulatory legs *ca.* 12, 10, 9, and 7 mm, respectively (could not be straightened completely for measurement). Female specimen: length 5.9 mm, branchial width 4.65 mm, hepatic width 4.1 mm.

Color in life: Uniform ochre.

Habitat: On *Sargassum liebmanni* J. Agardh, as determined by Dr. E. Yale Dawson.

Depth: Intertidal.

Remarks: The specimen from Cabeza Ballena comes from within sight of Stimpson's type locality, Cape San Lucas. The specimen from San Marcos Island is believed to be the one figured by Rathbun (1925, pl. 46, fig. 3; pl. 47, fig. 2). Although measuring only 11.0 mm, instead of 11.2 mm, it conforms in all particulars, including the loss of the right second ambulatory leg, which is detached in the bottle. Unfortunately, additional damage to the specimen has occurred since the photograph was taken.

Genus **EPIALTOIDES**, new genus

Epialtus Rathbun, 1923a, p. 71 (part); 1925, p. 144 (part); not *Epialtus* Milne Edwards.

Type: *Epialtus hiltoni* Rathbun, 1923.

Description: Similar to *Epialtus*, but with an entirely smooth or posteriorly sculptured carapace; anterior margins of hepatic lobes transverse or curving strongly forward. Preorbital tooth, when present, prominent; postorbital tooth inconspicuous. Chelipeds of male robust, often of a size grossly disproportionate to carapace and walking legs. Ambulatory legs non-prehensile, propodus lacking either an inferior tooth or cluster of setae.

Abdomen with five free segments in both sexes.

With the restriction of the genus *Epialtus* to those species possessing six free abdominal somites in the male sex, it becomes necessary to erect a new genus to accommodate three and possibly four American species, the males of which have but five. Two of these, *Epialtoides hiltoni* and *E. kingsleyi*, were described by Rathbun (1923a) as among "the group of small species of *Epialtus* sometimes combined under the name *E. bituberculatus*," irrespective of the fact that they (along with *E. peruvianus*, here transferred to *Eupleurodon*) possessed one male abdominal somite less. A third, *Epialtus murphyi* Garth (1948, p. 24), is known only from the female sex and is included in *Epialtoides* tentatively until the number of abdominal segments in the male can be ascertained. A fourth species, *Epialtoides paradigmus*, is here described for the first time.

The three Pacific species share the common characters of the oblong, bilobed rostrum and the strong preorbital tooth. The single Atlantic species, *Epialtoides kingsleyi*, has a triangular rostrum and no preorbital tooth; however, it departs no more radically from its congeners than does *Epialtus sulcirostris* from members of the six-segmented group.

Range: Pacific Ocean from Santa Catalina Island, California, to Punta Entrada, Lower California; Guadalupe Island; and Gulf of California from Punta Cholla, Sonora, to Maria Magdalena Island, Mexico; Gorgona Island, Colombia; La Plata Island, Ecuador. Atlantic Ocean: Florida, exact locality unknown. Shore to 13 fathoms.

KEY TO THE PACIFIC AMERICAN SPECIES OF *Epialtoides*
(Males with five free abdominal somites)

- 1a. Posterior third of carapace eroded; anterior margins of hepatic lobes horizontal and minutely dentate *murphyi*
- 1b. Posterior third of carapace smooth; anterior margins of hepatic lobes inclining forward and entire
 - 2a. Hepatic lobes directed strongly outward; male chelipeds massive *paradigmus*
 - 2b. Hepatic lobes directed obliquely forward; male chelipeds of moderate size *hiltoni*

Epialtoides hiltoni (Rathbun), new combination

Plate O, Fig. 7; Plate 26, Fig. 3

Epialtus bituberculatus, Rathbun, 1894, p. 67; 1904, p. 173 (part); 1910, p. 571 (part). Weymouth, 1910, p. 28. Nininger, 1918, p. 39, fig. 15. Schmitt, 1921, p. 203 (the California specimen), not text-fig. 126. (Not *E. bituberculatus* Milne Edwards.)

Epialtus bituberculatus forma *minima*, Hilton, 1916, p. 69, fig. 17. (Not *E. bituberculatus* Milne Edwards; not *E. minimus* Lockington.)

Epialtus hiltoni Rathbun, 1923a, p. 72; 1925, p. 156, pl. 46, figs. 1, 2; text-figs. 53m,n.

Type: Male holotype, U.S.N.M. No. 50599, length 14 mm, hepatic width 12.2 mm, branchial width 12.4 mm.

Type locality: Laguna Beach, California, William A. Hilton, collector.

Localities subsequently recorded, with collectors: California: Catalina Harbor, Santa Catalina Island, W. H. Dall (Rathbun, 1894, as *Epialtus bituberculatus*); Laguna Beach, William A. Hilton (Rathbun, 1925; Hilton, 1916, as *E. bituberculatus* forma *minima*).

Diagnosis: Rostrum oblong, tip bilobed. Hepatic lobe broad, advanced, a tooth on anterior margin; branchial lobe narrow, acute. Pre-orbital tooth outstanding, postorbital tooth inconspicuous. Manus of male elongate, usually with a superior tubercle, fingers short, deflexed. Male first pleopod with convex margin sharply angled below opening, concave margin bordered with setae, tip slender, pointed.

Description: Carapace high in median region; lateral wings broad, ascending; anterior or hepatic lobe much the larger, intervening sinus deep. Posterior margin of hepatic lobe convex, anterior margin transverse, with a lobe or tooth near its middle. Branchial lobe triangular, acute. Rostrum broadly oblong, sides subparallel, extremity bilobed, median sinus broad, shallow. Hand elongate, not widening much until just before the fingers; fingers short and very wide, outer margin acutely carinate. (Rathbun, 1923a)

Chelipeds of moderate size; merus very bluntly angled; carpus and manus with a subacute, outer carina; a tubercle on upper surface of carpus; outer margin of fingers acutely carinate, a large tooth on the dactyl within the narrow gape. Ambulatory legs rather stout; two tubercles on lower margin of proximal half of merus of first leg; propodites without tooth or tufts of hair. Third, fourth, and fifth segments of male abdomen fused. (Rathbun, 1925)

Female similar in all respects to the male except for the less massive cheliped, both merus and manus of which are foreshortened.

In the young the rostrum is deeply emarginate and has a basal swelling, below which a noticeable constriction delimits it from the prominent preorbital lobes. The anterolateral margin has a supplementary inner tooth in addition to the median tooth, and hepatic breadth exceeds branchial. This condition persists in an individual of 7.5 mm. The largest specimens have the rostrum less deeply indented, lack the basal constriction, and have a less prominent preorbital lobe. The inner of the anterior hepatic teeth disappears, as does the tubercle at the mid-point of the superior margin of the manus in the male. In all specimens over 7.5 mm of either sex, the branchial width exceeds the hepatic.

Material examined: 28 specimens from 9 stations. (See Table 46) From one mile northwest of White Cove, Santa Catalina Island, California, to Entrada Point, Magdalena Bay, Lower California, and including Guadalupe, Middle San Benito, and Cedros Islands.

Measurements: Largest specimen, male: length 17.3 mm, hepatic width 14.4 mm, branchial width 15.7 mm, rostrum 3.8 mm, width 3.2 mm, cheliped 21.2 mm, chela 10.3 mm, manus 7.4 mm, dactyl 4.5 mm, height of palm 4.5 mm, walking legs 19.2, 15.0, 13.0, and 11.0 mm. Female: length 10.7 mm, hepatic width 9.2 mm, branchial width 9.6 mm.

Color in life: Unrecorded.

Habitat: Santa Catalina Island specimens were obtained while mask diving for kelp holdfasts, presumably *Eisenia*. The La Jolla specimen, according to Robert J. Menzies, was found in an eel grass holdfast in a

cave. Specimens from Entrada Point, outside Magdalena Bay, and from north of South Bluff, Guadalupe Island, were collected on surf grass (*Phyllospadix*).

Depth: Intertidal to 3 fathoms.

Size and sex: Males in the present series range from 4.0 mm to 17.3 mm, females from 4.6 mm to 10.7 mm, the latter specimen bearing ova.

Breeding: Ovigerous females were obtained at Santa Catalina Island in August and at Cedros Island, Mexico, in October.

Remarks: This distinctive species has not been taken at Laguna Beach since its discovery by Professor Hilton, and may well have been exterminated locally by encroaching civilization. The La Jolla specimen, a gift of R. J. Menzies, furnished the first clue to its habitat, and subsequent examination of beds of eel grass (*Zostera*) or of surf grass (*Phyllospadix*) yielded several times as many specimens as were available to Rathbun in 1925.

In March of 1949 the writer collected a number of small kelp crabs, believed at the time to be *Epialtus minimus*, on surf grass from tidepools on the exposed side of Entrada Point, at the north entrance to Magdalena Bay, which marks the southern limit of range of *Phyllospadix*. It was not until some time afterward that these were identified as *Epialtoides hiltoni*, thereby extending the known range of that species hundreds of miles south of either Laguna or La Jolla, California. In December, 1949, under almost identical circumstances, the collecting of *E. hiltoni* was repeated at Guadalupe Island, and in May, 1950, at Middle San Benito Island, both off the Lower California coast.

The twenty-eight specimens examined are remarkable for the characters which are given above as diagnostic, characters which in other species of *Epialtus*, *sensu lato*, notably *E. minimus*, are subject to considerable variation (see Crane, 1937, pl. 2, fig. 7). The shape of the rostrum, described as oblong although length and width are equal by measurement, is unvarying and the bilobation is clearly indicated. In all adults the branchial width exceeds the hepatic, and in all the lobe on the anterior margin is well developed. One might almost say that uniformity is a characteristic of *Epialtoides hiltoni*, whereas variety is a characteristic of *Epialtus minimus*.

The identification of specimens from southern California by Rathbun (1894, p. 67; 1904, p. 173) with the Atlantic species, *Epialtus bituberculatus* Milne Edwards, unfortunately perpetuated by Weymouth (1910), Nininger (1918), and Schmitt (1921), was only partially rectified by its withdrawal and description as an independent species, *E.*

hiltoni Rathbun (1923a, p. 72). It remained for the present study to disclose that, with one male abdominal somite less, *Epialtoides hiltoni* was not even congeneric with Milne Edwards's species, and, together with *E. kingsleyi* of the Atlantic and the Pacific *E. paradigmus*, n. sp., and probably, *E. murphyi*, should be accorded independent generic treatment as well.

***Epialtoides paradigmus*, new species**

Plate M, Figs. 1-6; Plate O, Fig. 8; Plate 26, Fig. 4

Type: Male holotype, A.H.F. No. 404, and female allotype, A.H.F. No. 404a, from Punta Cholla, Sonora, Mexico, shore, April 13, 1940, collected by Steve A. Glassell. For additional material see Table 47.

Measurements: Male holotype, length 10.8 mm, hepatic width 11.65 mm, branchial width 9.7 mm, length of rostrum 2.3 mm, width 1.75 mm, cheliped 17.8 mm, merus 8.2 mm, manus 10.5 mm, dactylus 3.3 mm, height of palm 3.6 mm, walking legs *ca.* 13.0, 9.1, 8.2, and 5.6 mm, respectively. Female allotype: length 9.0 mm, hepatic width 9.0 mm, branchial width 8.3 mm.

Diagnosis: Rostrum elongate, sides converging, tip emarginate. Pre-orbital tooth obtuse, prominent; postorbital tooth acute, inconspicuous. Anterolateral projections limbed, exceeding branchial in size and span, a ridge extending inward from each branchial lobe. Chelipeds of adult male enlarged out of proportion to carapace and walking legs. A stout tubercle on merus of external maxilliped. Sternal somites deeply separated.

Description: Carapace broader than long, smooth anteriorly and posteriorly, anterolateral projections extending laterally to cover base of chelipeds, almost limbed. Front longer than broad, sharply constricted basally, convex from side to side, sides straight, tapering regularly towards faintly bilobed tip. Orbital margins oblique, straight or slightly sinuous, preorbital tooth obtuse, postorbital tooth small, slender, and seeming to arise from the inner angle of the anterolateral margin. Hepatic lobes inclined strongly outward and but little forward, their anterior margins nearly horizontal and bearing a suggestion of a supplementary lobe, their tips broadly rounded, their posterior margins converging towards the cardiac prominence; carapace widest at hepatic level. Branchial lobes much smaller than the hepatic, more sharply pointed, and separated from them by a broad U-shaped sinus. Posterior margin produced opposite intestinal region. Elevations of carapace more clearly marked posteriorly than anteriorly, intestinal region anteriorly continuous with

domed cardiac region; ridges, extending medially from each branchial lobe and turning abruptly downward to parallel the sinuous posterior margin, having a pinched appearance. Gastric elevation separated from each protogastric by the shallowest of grooves; each hair-tipped protogastric tubercle in turn separated by a faint median depression.

Basal antennal article tapering rapidly from base to summit, longitudinal ridge culminating in a tooth. First two movable articles slender, cylindrical, tip only of flagellum extending beyond rostrum. Ischium of external maxilliped with a linear groove, sides parallel, inner margin hirsute; merus subquadrate, sharply notched at anterointernal angle to receive palpus, a strong tubercle on its midproximal surface.

Chelipeds of adult male massive, grossly disproportionate in size to walking legs and to carapace, except as suggested by anterolateral projections. Merus greatly elongated and swollen medially, tapering proximally and distally, a tooth at base of outer margin and a number of rough tubercles on inner margin. Carpus suborbicular. Manus equaling or exceeding merus in length, smooth except for scattered granules, slightly swollen medially, broadening distally to high point over palm. Dactylus stout, curving strongly downward, meeting pollex along broad outer, opaque ridge, inner margin with a comb of shaggy hairs. Pollex deflexed, recurving, weakly toothed, and similarly hairy. Ambulatory legs slender, only the dactylus of the first overreaching the merus of the cheliped, decreasing regularly in length from first to last, meri only roughened to any extent, those of the first leg with two or three tubercles beneath, propodi laterally compressed, dactyli moderately recurved, provided with two rows of spinules and a stout nail.

Abdomen of male with segments 3-5 fused, widest at base of sixth segment, tip rounded. Sternal somites distinct and well separated. Tip of male first pleopod acute, a rounded flange or heel on opposite side of orifice.

The female allotype differs from the holotype in having a shorter rostrum, a less produced hepatic lobe, more broadly rounded and carrying an accessory lobe on its anterior margin, the chelipeds less strongly developed but more tuberculate, the meri of the walking legs similarly roughened. Female abdomen orbicular and with segments 4-6 fused.

Material examined: Seven specimens from four localities, all in the Gulf of California. (See Table 47) From Punta Cholla, Sonora, to Maria Magdalena Island, Nyarit, Mexico.

Depth: Shore to 13 fathoms.

Size and sex: Males are from 6.4 to 10.8 mm, females from 5.3 to 9.0 mm, an ovigerous female 5.6 mm.

Breeding: The single ovigerous female was collected in late January.

Remarks: The species characterized above was recognized as new from a male specimen collected by the *Velero III* in 1939 at Maria Magdalena Island, Mexico, station 970-39. Consultation with the late Steve A. Glassell revealed that he also had collected the species, having obtained a pair in 1940 at Punta Cholla, Sonora, which he proposed to describe as *Epialtus paradigmus*, using the male as holotype. With characteristic generosity, Glassell made his superior specimen available for illustration by Anker Petersen, and shortly before his untimely death granted full permission to publish. Thus the choice of the name was Glassell's, although description and diagnosis are entirely the author's.

***Epialtoides murphyi* (Garth), new combination**

Plate 26, Fig. 5

Epialtus murphyi Garth, 1948, p. 24, fig. 2a-e.

Type: Female holotype, A.M.N.H. No. 10009.

Type locality: La Plata Island, Ecuador, 5.5 meters, *Askoy* station 80.

Localities subsequently reported, with collectors: Known only from the type locality above, and from Gorgona Island, Colombia, 4-7 meters, *Askoy* station 89 (Garth).

Atlantic analogue: None.

Diagnosis: Rostrum bilobed, preorbital lobe prominent. Hepatic lobe larger than branchial, anterior margins horizontal and minutely dentate. Carapace posteriorly eroded, two tubercles at gastric level. Legs cristate, propodal tuft absent. Hand tuberculate in female; male unknown.

Description: Carapace broad as long, widest at hepatic level, smooth anteriorly, eroded posterior to cardiac and branchial regions. Front produced, length equaling or exceeding width, sides tapering, tip bilobed, thickened, and hollowed beneath. A prominent preorbital lobe and a minute postorbital denticle. Hepatic margins anteriorly horizontal, bearing three or four setose tubercles, laterally broadly rounded. Branchial lobes sharper, culminating in a nonsetose tubercle; branchial width almost equaling or exceeding hepatic width. Regions slightly elevated and obscurely defined except for cardiac and gastric; these rounded, elevated, and together forming a low median ridge occupying about one-third of the carapace. Gastric region bearing a pair of low tubercles in advance of its summit.

Basal article of antenna slender, bearing a thickened ridge internally culminating in a blunt tooth, first two movable segments thickened and compressed. Merus of third maxilliped broader than long, notched internally to receive palpus.

Female chelipeds robust, tuberculate, massive, the chelae elongated and broadened. Merus with three or four low tubercles on outer margin; carpus with several tubercles and a median ridge; manus elongated, crested above, bearing setose tubercles on both its internal and external surfaces; fingers short, stout, convex and toothed exteriorly, the concave inner margins lined with shaggy hairs. Dactyl with rounded superior margin, pollex slightly deflexed, teeth and ridges of both dactyl and pollex outlined in white.

Ambulatory legs cristate; first leg the longest, merus with two sharpened tubercles along its lower anterior border; remaining pairs of legs similar, meri bearing a lamellate ridge most advanced medially and distally, carpi with a similar rounded crest; propodi but slightly thickened medially and without a distal tooth; dactyli of all legs spinulous, dactylus of fourth pair overreaching propodus by the length of its curved yellow nail.

Female abdomen and sternum eroded; female abdomen with five free somites.

Material examined: In addition to the holotype, a female paratype from Gorgona Island, Colombia, (A.H.F. No. 412), a gift of the American Museum of Natural History. The paratype is photographically illustrated.

Measurements: Female holotype: length 6.15 mm, hepatic width 6.15 mm, branchial width 5.8 mm, rostrum 1.1 mm, cheliped 6.9 mm, manus 3.5 mm, dactyl 1.2 mm, height of palm 1.2 mm. Female paratype: length 8.0 mm, hepatic width 8.0 mm, branchial width 8.15 mm.

Color in life: Unrecorded.

Habitat: Presumed to have been collected in association with marine plants, although no notation to this effect was made at time of capture.

Depth: 4-7 meters.

Remarks: Since the male of the species is unknown, its placement in the genus *Epialtoides*, rather than in *Epialtus*, *sensu restr.*, can be only tentative. It is based on a certain superficial resemblance to *Epialtoides hiltoni*, the male of which has five free abdominal segments. The character of the male first pleopod, when available, should furnish an additional clue to the relationship of this distinctive species.

Genus **EUPLEURODON** Stimpson

Eupleurodon Stimpson, 1871a, p. 98. Miers, 1879c, p. 650. Rathbun, 1925, p. 160.

Euplorodon A. Milne Edwards, 1878, p. 141.

Type: *Eupleurodon trifurcatus* Stimpson, by monotypy.

Description: Allied to *Epialtus*, but with a depressed and uneven carapace. Anterolateral angles of the carapace strongly prominent, forming projecting teeth directed forward, almost parallel to the axis of the body. Ambulatory [legs] strongly prehensile, with dentigerous penult [articles]. Size small. (Stimpson) Five free abdominal articles in both sexes.

Range: Cape San Lucas, Lower California, Mexico, and from Manta, Ecuador, to Chincha Islands, Peru; Galapagos Islands. Not found in the Atlantic. Intertidal.

KEY TO THE GENUS *Eupleurodon*

(Based Upon Female Characters in the Absence of Males of Two Species)

- 1a. Hepatic width exceeding branchial, tip of rostrum slightly emarginate, orbital margin arched but not toothed, merus of external maxilliped notched to receive palpus
 - 2a. Orbital margins continuous with anterolateral and concave, hepatic lobes large, directed outward as well as forward.

. *trifurcatus*
 - 2b. Orbital margins convex, anterolateral margins straight, hepatic lobes small, directed forward. Galapagos only.

. *rathbunae*
- 1b. Branchial width equaling or exceeding hepatic, tip of rostrum bilobed, a strong preorbital tooth (lacking in male), merus of external maxilliped entire or nearly so.

. *peruvianus*

Eupleurodon trifurcatus Stimpson

Plate N, Figs. 1-6

Eupleurodon trifurcatus Stimpson, 1871a, p. 98. A. Milne Edwards, 1878, p. 142. Rathbun, 1910, pp. 535, 572 (part: not the Ferrol Bay, Peru, specimen; not pl. 49, fig. 5); 1925, p. 160.

Type: Female holotype, not extant.

Type locality: Cape San Lucas, Lower California, Mexico; John Xantus, collector.

Localities subsequently reported: None. Known only from the type locality.

Atlantic analogue: None.

Diagnosis: Rostrum elongate, flattened, emarginate. Orbital margin arched but not toothed. Hepatic lobes large, curving outward and forward; hepatic width exceeding branchial. Merus of external maxilliped notched.

Description: Carapace with a profound depression in front of the gastric region and one on either side of the cardiac [region], forming with the gastric region a prominent median ridge. Branchial regions depressed, with a tubercle near the posterolateral angle. Teeth and prominences of the carapace generally setose. Rostrum half as long as the post-frontal part of the carapace, and one-third as broad as long, flattened, truncate, and emarginate at the extremity. Tooth of the anterolateral angle half as long as the rostrum and curving forward; the distance between the tips of these teeth equaling the greatest width of the carapace, and one-third greater than the middle width. A small tooth on the lateral margin behind the anterolateral angle. Orbital margin arched but not toothed. [Legs] with an angular or dentated carpus. (Stimpson, 1871a, modified)

Material examined: 3 specimens from 3 stations. (See Table 48) Cabeza Ballena, Gulf of California, and Acapulco, Mexico; Manta, Ecuador.

Measurements: Female specimen: length 7.15 mm, hepatic width 5.3 mm, branchial width 4.35 mm, rostrum 2.2 mm, width 1.1 mm.

Color in life: Unrecorded.

Habitat: At Manta, Ecuador, recovered from a reef over which the surf was breaking with considerable force.

Depth: Shore.

Remarks: As noted in the synonymy above, the female specimen from Ferrol Bay (Chimbote), Peru, earlier referred by Rathbun (1910, pp. 535, 572, pl. 49, fig. 5) to Stimpson's species, was later described as *Eupleurodon peruvianus* Rathbun (1924a). A male specimen from Punta Santa Elena, Ecuador (U.S.N.M. No. 70938), subsequently identified by her as *E. trifurcatus* with a question mark, is here referred to *E. peruvianus* (Rathbun, 1923a). (See *Remarks* under that species.) The female specimen from Manta, Ecuador, although not *E. peruvianus*, also may not be the long lost *E. trifurcatus*, which has Cape San Lucas as its type locality. It can be made to fit Stimpson's description by adopting the interpretation given below, which seems preferable to describing

it as a new species, especially in view of the fact that *E. trifurcatus* and *E. rathbunae* are known from the female sex only. In due time males of these species will be recognized, and relationships, including possible synonymy of the Galapagos form, may be straightened out with the help of sexual characters, including the male pleopod.

The writer departs from his previous concept of the morphology of Stimpson's species, which is expressed in Rathbun's 1925 key and diagnosis: namely, the presence of a small tooth on the lateral margin between the hepatic and branchial lobes. A careful reading of Stimpson's description, above, will reveal that this was not intended. The "tubercle near the posterolateral angle" is shown in Plate N, fig. 1, and lies median to the branchial lobe. The "small tooth on the lateral margin behind the anterolateral angle" is the branchial lobe itself, which is otherwise unaccounted for in Stimpson's description. With this point settled, other slight discrepancies between the Manta specimen and the original description are matters of degree rather than of kind, and are to be accounted for by variations of age, which in this species can be expected to parallel those of *E. peruvianus*.

As compared with the Manta specimen, the specimen from Acapulco, an ovigerous female, differs in the following particulars: the rostrum is shorter, and there is a distinct preorbital lobe. The branchial and hepatic lobes are more slender and forward pointing. The anterior border of the merus of the third maxilliped is convex, rather than concave. It will be noted that in these particulars it approaches more closely *Eupleurodon peruvianus*, and particularly the female figured by Rathbun (1925, pl. 49, figs. 5, 6), although the rostrum is less deeply incised. The female specimen from Cabeza Ballena, which is within sight of Stimpson's type locality, Cape San Lucas, also has the rostrum shorter, with a pronounced preorbital swelling, rather than a lobe. In it the anterior margin of the merus of the third maxilliped is also convex. These specimens were obtained in formalin washings of algae collected by E. Yale Dawson. All legs are detached from the carapaces, and it cannot be stated with certainty that the legs present belong to the specimens described.

***Eupleurodon peruvianus* (Rathbun), new combination**

Plate O, Fig. 9; Plate 26, Fig. 6

Eupleurodon trifurcatus, Rathbun, 1910, pp. 535, 572 (part: the Peruvian specimen), pl. 49, fig. 5. (Not *E. trifurcatus* Stimpson.)

Epialtus peruvianus Rathbun, 1923a, p. 72; 1925, p. 157, text-figs. 53i, 58. Not Finnegan, 1931, p. 620.

Eupleurodon peruvianus Rathbun, 1924a, p. 2; type locality, Ferrol Bay (Chimbote), Peru; ovigerous female holotype, U.S.N.M. No. 40462; 1925, p. 161, pl. 49, figs. 5, 6; text-fig. 60.

Type: Male holotype, U.S.N.M. No. 54208, length 4.8 mm, greatest width 3.5 mm.

Type locality: Chíncha Islands, Peru; R. C. Murphy, collector.

Localities subsequently reported, with collectors: Peru: north end of Ferrol Bay (Chimbote), R. E. Coker (Rathbun, 1924a, female holotype of *Eupleurodon peruvianus*).

Atlantic analogue: None. A Peruvian and Ecuadorean endemic species.

Diagnosis: Male: Hepatic width exceeding branchial; rostrum elongate, faintly bilobate; orbital arch forming an angle with margin of rostrum. Male first pleopod with a hollowed-out thumb process opposing pointed, spinulous tip. Female: Branchial width exceeding hepatic; rostrum foreshortened, tip incised; a prominent preorbital lobe. Merus of external maxilliped entire or slightly notched in both sexes.

Description: Carapace very uneven. Median region separated from hepatic and branchial regions by a deep furrow; a transverse, depressed area across the carapace embracing anterior edge of hepatic lobes; a sharp, median, interorbital sulcus. Hepatic lobe very large, recurved, anterior margin transversely concave, outer angle lobiform, prominent, posterior margin slightly convex; branchial lobe very small, acute, sides concave. Orbital arch swollen, margin forming an angle, not a tooth, with the margin of the rostrum. Rostrum deflexed, thin, oblong, sides parallel to near the tip, there thick, recurved and convergent; tip bilobed, lobes small, sinus wide.

Cheliped of young male shorter than first leg, fingers not gaping. First and second legs similar, stout, merus laminate above, and two- or three-toothed, the tooth at distal end prominent, upstanding; propodus with a strong tooth below, at proximal end. (Rathbun, 1925, p. 157, modified)

Female: Carapace pentagonal; depressions as in *Eupleurodon trifurcatus*. A transverse row of tubercles across the gastric region above the depression, the inner pair larger than the outer pair; a large tubercle near the posterolateral angle; a smaller one in the branchiocardiac furrow; a still smaller tubercle on the mesogastric and the intestinal regions, and three on the cardiac region forming a triangle pointing backwards. Teeth and prominences of carapace setose. Lateral teeth or lobes recurved, blunt at tips; width of carapace at middle of anterolateral lobes greater

than at tip of lobes and appreciably less than width between tips of posterolateral lobes. Rostrum a third as long as the postfrontal part of the carapace and half as broad as long, lateral margins raised, extremity incised for about one-fourth of its length to form two rounded lobes. Eyestalks flattened.

Merus of maxillipeds slightly notched at anterointernal angle [this is not borne out by text-fig. 60]; first article of palp flattened, angular, last two articles small and slender, hidden behind the merus.

Carpus of cheliped nodose, merus and manus nodose at distal articulations; two low tubercles on upper margin of merus; propodal finger strongly deflexed, dentate; fingers stout, the dactylus with a basal tooth and near the tip a few smaller teeth. Dactyli of legs strongly falcate, finely dentate, the digital tooth of the propodus strong and with hairy tip.

A row of five tubercles on first segment of female abdomen. (Rathbun, 1925, p. 161)

Material examined: 24 specimens from 7 stations, divided as follows: (See Table 49)

U. S. National Museum material: 23 specimens from 6 stations representing one Peruvian and two Ecuadorean localities, collected by Waldo L. Schmitt. Also the female holotype of *Eupleurodon peruvianus*.

Hancock expeditions material: A single female specimen from Lobos de Afuera Islands, Peru, *Velero III* station 391-35.

Measurements: Largest specimen, a male: length 9.5 mm, hepatic width 6.45 mm, branchial width 6.45 mm, rostrum 2.7 mm, width 1.5 mm, cheliped —, chela 3.4 mm, dactyl 1.6 mm, first walking leg *ca.* 8.5 mm, fourth walking leg *ca.* 4.5 mm. Ovigerous female: length 7.3 mm, hepatic width 5.25 mm, branchial width 5.45 mm, rostrum 1.8 mm, width 1.0 mm, cheliped —, chela 1.7 mm, dactyl 1.0 mm. (The rigidity of the specimens prevents accurate toto measurements of cheliped or leg lengths.)

Habitat: From rocks between tide lines. (Coker)

Depth: Intertidal.

Breeding: Ovigerous females were encountered at Santa Elena Bay, Ecuador, by W. L. Schmitt in September, and at Ferrol Bay (Chimbote), Peru, by R. E. Coker in March.

Remarks: On the evidence of the specimens now before him, and of those previously studied at the U. S. National Museum, including types, the writer is prepared not only to transfer *Epialtus peruvianus* Rathbun (1923a) to the genus *Eupleurodon*, as suggested in a previous paper (Garth, 1946, p. 378), but to synonymize with it the existing *Eupleuro-*

don peruvianus Rathbun (1924a). It is now apparent that the differences which heretofore caused them to be regarded as two species belonging to different genera are purely sexual in character, *Epialtus peruvianus* being the male, *Eupleurodon peruvianus* the female, of but a single species, and that an *Eupleurodon*.

The evidence consists primarily in a series of 18 individuals from Punta Santa Elena, Ecuador (U.S.N.M. No. 61503), determined by Rathbun as *Eupleurodon peruvianus*, and containing 5 males, 6 females, and 7 young, plus two ovigerous females from Salinas, Ecuador (U.S.N.M. Nos. 61502 and 70939), specimens obtained by Waldo L. Schmitt. In all the males the hepatic width exceeds the branchial, while in two of the five the preorbital lobe is obsolescent and in the remainder nowhere approaches a tooth. This brings the males into line with *Epialtus peruvianus*, which, according to Rathbun (1925, fig. 53i), has its greatest width at the hepatic level and an orbital arch which forms an angle, not a tooth, with the margin of the rostrum. The seven young specimens, not sexed, show a noticeable excess of hepatic width over branchial, the lateral lobes being reduced to mere tubercles in the smallest. This tendency persists in all but the largest of the six females, in which branchial and hepatic width are approximately equal. None of these females is ovigerous, as was the holotype of *Eupleurodon peruvianus* Rathbun (1924a). In the two ovigerous females examined (U.S.N.M. No. 70939 and *Velero III* station 391-35) the branchial width exceeds the hepatic, as required by the description of the female given above. In all females examined, nonovigerous and ovigerous, the preorbital lobe is present and prominent. It is apparent that excess of branchial width over hepatic is a female character attained only at sexual maturity and that the presence of a preorbital lobe is also a female character, its absence in the adult male being associated with the gradual attenuation of the rostrum with age in that sex.

A 9.5 mm male, the largest specimen examined (U.S.N.M. No. 70938), was taken also at Punta Santa Elena, but on the day preceding the series mentioned above. It carries Rathbun's identification as *Eupleurodon trifurcatus* Stimpson, with a question mark, presumably because the hepatic width equals the branchial and there is no preorbital lobe. (Cf. Rathbun, 1925, p. 160, key and diagnosis.) However, when placed with the five males of *Eupleurodon peruvianus* (U.S.N.M. No. 61503) it completes the series, the slight angle of the orbital arch of the smaller

males being absorbed in the greater length of the rostrum of the larger individual. The writer therefore considers it to be of the latter species, rather than *E. trifurcatus*, which has Cape San Lucas, Lower California, as type locality.

Eupleurodon rathbunae Garth

Epialtus peruvianus, Finnegan, 1931, p. 620. (Not *E. peruvianus* Rathbun.)

Eupleurodon rathbunae Garth, 1939, p. 13, pl. 3, figs. 1-5; 1946, p. 377.

Type: Female holotype, U.S.N.M. No. 77366.

Type locality: Gardner Bay, Hood Island, Galapagos Islands, *Velero III* station 27-33.

Localities subsequently reported: Known only from the type locality and from Charles Island, Galapagos, *St. George* Expedition (Finnegan, 1931).

Atlantic analogue: None. A Galapagos endemic species.

Diagnosis: Female: Rostrum of moderate length, medially sulcate, terminally emarginate. Tips of hepatic lobes narrowed and directed forward; hepatic width exceeding branchial. Orbital margins convex, making an obtuse angle with straight anterolateral margins. Merus of external maxilliped notched to receive palpus. Male unknown.

Description: Carapace pentagonal, depressed anteriorly and laterally, a bold cardiogastric ridge and a cross ridge at hepatic level. A single pair of tubercles on gastric region, a small tubercle near the posterolateral lobes, and a cardiac tubercle at a slightly posterior level. Lobes and tubercles clavately setose. Hepatic lobes strongly recurved, outer margins forwardly directed, subparallel, tips rounded; width of carapace at middle of anterior lobes greater than between posterior lobes and greater than distance from tip of anterior lobe to midpoint of posterior margin of carapace. Rostrum more than one-third as long as postfrontal portion of carapace and with an average breadth of one-half its length, lateral margins raised near tip only, extremity faintly bilobed, lobes rounded, a slight median sulcus.

Merus of outer maxilliped notched at anterointernal angle to receive palpus, first article of palp enlarged and flattened, last two articles small and cylindrical, hidden behind merus.

Cheliped with visible portion of merus and carpus nodose, merus with a swelling on superior margin at basal third, carpus with a prominent inner node and one or more superior nodules; propodal finger deflexed, dentate; movable finger with three or four denticles.

First ambulatory leg exceeding cheliped in length, its dactyl as long as the propodus. Dactyls of remaining legs shorter, strongly falcate, finely dentate, digital tooth of propodus strong, blunt, and with a hairy tip.

Abdomen of female with three tubercles on first segment.

Material examined: The female holotype. In addition a camera lucida sketch of the *St. George* Expedition female from Charles Island, Galapagos, in the British Museum.

Measurements: Female holotype: length 7.1 mm, hepatic width 5.3 mm, rostrum 2.1 mm.

Color in life: Unrecorded.

Habitat: From rocky spit; among algae.

Depth: Shore collecting. (Finnegan)

Remarks: Through the courtesy of Dr. Isabella Gordon of the British Museum the writer has before him a camera lucida sketch of the specimen referred by Finnegan (1931, p. 620) to *Epialtus peruvianus*. It differs from the holotype of *Eupleurodon rathbunae* in the following minor particulars: the rostrum is shorter and apparently broader, the orbital margins slightly concave rather than convex, the anterolateral margins more nearly horizontal and less oblique, and the hepatic lobes broader and less forward pointing. The walking leg shows the same strong propodal thumb.

Although a different interpretation is now placed upon the characterization of *Eupleurodon trifurcatus* Stimpson than formerly (see *Remarks* under that species), insufficient information is available to determine whether or not the differences exhibited by the Galapagos specimens now referred to *E. rathbunae* fall within the normal range of variation of Stimpson's species. It is felt that males of the two will finally determine whether or not *E. rathbunae* should be made a synonym of *E. trifurcatus*.

Subfamily PISINAE

Pisinae Alcock, 1895, pp. 165, 200. Balss, 1929, p. 11.

Pisinae, sensu restr., + *Hyasteniinae* Balss, 1929, pp. 11, 14. Stephensen, 1945, p. 218.

Blastidae Stebbing, 1905, p. 25.

Eyes with commencing orbits, one of the most characteristic parts being a large, blunt, usually isolated and cupped postocular tooth or lobe into which the eye is retractile, but never to such an extent as to completely conceal the cornea from dorsal view; also almost always a prominent supraocular eave, the anterior angle sometimes produced forwards

as a spine. Eyestalks short. Basal antennal article broad, at any rate at the base, its anterior angle generally produced to form a tooth or spine. Merus of the external maxillipeds, owing to the expansion of its antero-external angle, broader than the ischium, and carrying the palp at its anterointernal angle. Rostrum [except in *Neodoclea* among New World forms] two-spined. Legs often very long. (Alcock)

Pleopod 1 medium-stout to slender, usually apically somewhat tapering, but apex extremely varying (blunt, acute, filiform, straight, geniculate, etc.). Pleopod 2 short. (Stephenson)

Although the key which follows permits the ready separation of the genera into the two groups recognized by Balss (1929, p. 11) as the Pisinae, *sensu restr.*, and the Hyasteniinae, the former with, the latter without the intercalated orbital spine, it should be pointed out that such an arrangement is not sustained by the male first pleopods. These are of two principal types, the one exemplified by *Scyra*, the other by *Pisoides*. While the Pacific genera exhibiting the scyriiform pleopod (*Chorilia*, *Loxorhynchus*, *Rochinia* (part), *Scyra*, *Libidoclaea*) align themselves with the Hyasteniinae of Balss, those possessing the pisoidiform pleopod (*Herbstia*, *Notolopas*, *Pelia*, *Pisoides*, *Rochinia* (part)), are equally distributed between his Pisinae and his Hyasteniinae. A smaller third group, consisting of the genera *Libinia* and *Neodoclea*, have a male first pleopod similar to that of *Stenocionops* and *Macrocoeloma*. For this reason, plus the fact that the presence or absence of the intercalated spine is subject to geographical variation within the single species *Notolopas lamellatus* Stimpson, the subdivisions of Balss are not adopted here.

From the subfamily as defined by Alcock and Stephenson above, the genera *Hyas* and *Chionoecetes* have been withdrawn because of the resemblance of their male abdomen and filamentous first pleopods to *Oregonia*. The genus *Chorilibinia* Lockington does not appear because its type species is considered to belong in *Stenocionops*. The status of the Asiatic species that have been referred to Lockington's genus is beyond the scope of this paper.

KEY TO THE AMERICAN GENERA OF THE SUBFAMILY *Pisinae* ALCOCK
(Pacific genera are shown in bold-face type and are treated in this work)

- 1a. Intercalated spine present (Pisinae, *sensu restr.*, Balss)
- 2a. Seven free abdominal segments in both sexes
- 3a. Rostrum short. Carapace suborbicular or broadly ovate
- 4a. Propodi of walking legs long, dactyli short . . .
- **Herbstia**

- 4b. Dactyli of walking legs nearly as long as propodi
 *Micropisa*
- 3b. Rostrum longer. Carapace narrower than 3a, distinctly
 longer than broad
 - 5a. Chelipeds more slender than ambulatory legs .
 *Lepteces*
 - 5b. Chelipeds as stout as, or stouter than, ambula-
 tory legs
 - 6a. First pair of walking legs much longer than
 remaining pairs
 - 7a. Carapace oval; antennae concealed by
 rostrum *Chorinus*
 - 7b. Carapace pyriform, four spines in a dia-
 mond on widest portion; antennae visible
 dorsally *Notolopas*
 - 6b. Walking legs diminishing regularly from first
 to last pair *Nibilia*
- 2b. Seven male, five female free abdominal segments
 *Holoplites*
- 1b. Intercalated spine absent (Hyasteniinae of Balss)
 - 8a. Seven free abdominal segments in both sexes
 - 9a. Supraocular eave and postocular process not closely ap-
 proximated
 - 10a. Rostrum double
 - 11a. Rostrum bifid for more than half its length
 - 12a. Rostral spines broad
 - 13a. Rostrum thin, flat, horizontal;
 carapace lumpy . . . *Scyra*
 - 13b. Rostrum thick and deflexed; cara-
 pace hairy . . . *Loxorhynchus*
 - 12b. Rostral spines slender
 - 14a. Two rows of spines on walking
 legs *Oplopisa*
 - 14b. Walking legs without two rows of
 spines
 - 15a. An infero-orbital spine .
 *Trachymaia*
 - 15b. No infero-orbital spine

- 16a. Male chelipeds with palm broad, crested; orbital sinus V-shaped **Chorilia**
- 16b. Male chelipeds slender, elongate; orbital sinus U-shaped . **Rochinia**
- 11b. Rostrum bifid for not more than half its length, or at tip only
- 17a. Supraocular eave produced anteriorly as a spine **Libidoclaea**
- 17b. Supraocular eave not produced anteriorly as a spine
- 18a. Basal antennal article narrow; second free segment not overreaching rostrum **Pelia**
- 18b. Basal antennal article broad, a compound spine at anterocexternal angle; second free segment overreaching rostrum . **Pisoides**
- 10b. Rostrum a simple, triangular spine **Neodoclea**
- 9b. Supraocular eave and postocular process closely approximated
- 19a. Carapace subglobose, spinate; rostrum involute **Libinia**
- 19b. Carapace subtriangular, nodose; rostrum evolute; orbit outward-looking; basal antennal article tapering, not spined **Lissa**
- 8b. Six male, five female free abdominal segments **Leurocyclus**

Genus **SCYRA** Dana

Scyra Dana, 1851a, p. 269; 1852, p. 94. Holmes, 1900, p. 41. Rathbun, 1925, p. 195.

Type: Scyra acutifrons Dana, by monotypy.

Description: Carapace subpyriform, tuberculated, but not spinose. Rostrum composed of two flattened horns. Orbits small, with a fissure above and below, the lower and sometimes the upper one being open.

Preorbital spine present. Basal antennal [article] rather narrow, with a small spine at the anteroexternal angle, the two following [articles] compressed and not concealed by the rostrum. Merus of the maxillipeds distally truncated. Chelipeds in the male well developed, the hand compressed and carinated above; fingers acute. Legs moderately long, subcylindrical, the first pair not greatly exceeding the others in length; dactyls short and acute.

Abdomen seven-[segmented] [in both sexes]. (Holmes)

Range: Eastern Pacific from Kodiak, Alaska, to San Carlos Point, Lower California, Mexico; shore to 62 fathoms. Western Pacific: coast of Japan; shore to 166 fathoms. (Yokoya, 1933)

Scyra acutifrons Dana

Plate P, Fig. 1; Plate 27, Fig. 1

Scyra acutifrons Dana, 1851a, p. 269; 1852, p. 95; 1855, pl. 2, figs. 2a-d. Stimpson, 1857b, p. 455. Lockington, 1877c, p. 69. S. I. Smith, 1880, p. 210. Miers, 1886, p. 62. Rathbun, 1893a, p. 88; 1904, p. 175; 1925, p. 195, pl. 79; pl. 224, figs. 4, 5, text-fig. 79; 1926, p. 24. Newcombe, 1893, p. 21; 1898, p. 76. Calman, 1898, p. 260. Walker, 1898, p. 274. Doflein, 1899, p. 183. Holmes, 1900, p. 41. Weymouth, 1910, p. 33, pl. 6, fig. 17. Taylor, 1912, p. 210. Hilton, 1916, p. 72. Way, 1917, p. 371, fig. 27. Schmitt, 1921, p. 214, text-figs. 134a, 134b. Johnson and Snook, 1927, p. 374, fig. 329. G. M. Smith, 1928, pp. 164, 165. Hart, 1930, p. 106; 1940, p. 99. Clemens, 1933, p. 51. Ricketts and Calvin, 1939, p. 93.

Scyra, sp. undt., Whiteaves, 1878, p. 471. (See S. I. Smith, *loc. cit.*, above.)

Scyra acutifronus [for *acutifrons*], Taylor, 1912, p. 191.

Type: Male, length 27.5 mm, width 18 mm, and female, cotypes, figured by Dana, no longer extant.

Type locality: Oregon, C. Pickering, U. S. Exploring Expedition, collector.

Localities subsequently reported, with collectors: Alaska: Kodiak [Kodiak], W. G. W. Harford (Rathbun, 1893a).

British Columbia: Queen Charlotte Islands: G. M. Dawson (Newcombe); S shore Houston-Stewart Channel, Kunghit Island (Hart, 1940). Banks Island (Taylor). Vancouver Island: "Vancouver Island" (Miers); Esperanza Inlet and Nootka Sound (Hart, 1940); Ucluelet, Geological Survey of Canada, and off Cape Beale, *Albatross*, 24-34 fathoms (Rathbun, 1925); Departure Bay (Taylor); Sidney, 10-20

fathoms, G. M. Smith (G. M. Smith); Victoria, G. M. Dawson (S. I. Smith), R. Middleton (Whiteaves, S. I. Smith), C. F. Newcombe (Newcombe; Rathbun, 1893a); Parry Bay (Hart, 1930).

Washington: Brown Island, San Juan Islands, 20-55 fathoms (Way); off Cape Flattery, 27-40 fathoms, and near Port Townsend, Admiralty Inlet, 15-26 fathoms, *Albatross* (Rathbun, 1925); Puget Sound (Stimpson), D. S. Jordan (Rathbun, 1893a), Bashford Dean (Calman), W. A. Herdman (Walker); Port Orchard, O. B. Johnson, and Dockton, *Albatross* (Rathbun, 1893a, 1925).

California: Humboldt Bay, Scripps Institution; off Farallon Islands, Bureau of Fisheries; and off Santa Cruz, 21 fathoms, *Albatross* (all Rathbun, 1925); Monterey Bay (Doflein; Weymouth), H. Heath (Rathbun, 1925); Monterey, D. S. Jordan, Dr. Canfield (Rathbun, 1893a), H. N. Lowe (Rathbun, 1925); Pacific Grove, J. O. Snyder, J. C. Brown (Rathbun, 1925); off Santa Barbara, 21-26 fathoms, and off Santa Rosa Island, 38-45 fathoms, *Albatross* (Rathbun, 1925); off Venice and off Point Fermin, *Anton Dohrn* (Rathbun, 1925); Laguna Beach (Hilton), W. A. Hilton (Rathbun, 1925); San Diego Bay, 12 fathoms, *Albatross* (Rathbun, 1925); San Diego, H. Hemphill (Lockington); southern California, W. H. Dall (Rathbun, 1893a).

Fossil: California Pleistocene: Deadman Island, San Pedro (Rathbun, 1926).

Atlantic analogue: None. A Pacific north temperate species. A cognate species, *Scyra compressipes* Stimpson, occurs off northern Japan.

Diagnosis: Carapace with entire margins, strong branchial, cardiac, and gastric tubercles. Outer borders of rostral spines arcuate. A lobe on outer margin of basal antennal article and a tooth in line with lateral border of buccal cavity. Merus and carpus of cheliped tuberculate, manus of old males with a large tooth in gape. Male first pleopod with pointed tip opposed by two lobate projections, one on either side of a median longitudinal cleft in which lies a shallow intermediate lobe.

Description: Carapace pyriform and furnished with rounded tubercles. Median region tumid and separated from the cardiac and branchial regions by a conspicuous depression; an acute tubercle near the center of the median region; behind it a larger and more obtuse tubercle. Branchial regions tumid and bearing a large, projecting tubercle; in front of this an elevated prominence usually bearing several small tubercles, often smooth. A large tubercle on the cardiac and a smaller one on the intestinal region. Rostrum short, the horns ovate-lanceolate. Two spines or teeth

on the outer margin of the basal antennal [article] behind the one at the anterior angle. Preorbital spine acute. Pterygostomian regions with several rounded teeth.

Chelipeds of the male large, the merus subcylindrical, somewhat flattened below, and strongly pustulate, especially at the angles; the carpus pustulate and with several ridges on the outer side; hand long, narrow, compressed, the palm below the wide carina often inflated; fingers deflexed and, in old males, gaping at the base and generally with a large tooth near the base of the dactyl.

Legs subcylindrical, more or less pubescent, the propodi sulcate on either side; dactyls considerably shorter than the propodi and furnished with sharp, corneous tips.

The third, fourth, fifth, and sixth abdominal segments in the male of nearly equal length; the seventh longer than broad and rounded at the tip. (Holmes, modified)

Two distinct types are present in the Hancock series. One, which follows Dana's original description, has a raised carapace with gastric region deeply separated from cardiac and branchial regions. The latter are as prominent as in *Microphrys branchialis* and impart a triangular appearance to the carapace. This form is characterized by a broad rostrum, properly designated as ovate-lanceolate, a flat hepatic region continuous with the postocular cup and devoid of a tooth, and massive chelae, cristate, and having a dactylar tooth.

The second type, which Rathbun (1925) refers to as occurring in females of 13 and 14 mm, occurs in both sexes and in individuals of 17 mm which are adult in all respects. The carapace is rounded but not elevated, the regions separated by shallow sulci and covered with dense pile. The narrow rostrum fails to conceal the antennal flagellum from dorsal view and the hepatic swelling is tipped with a sharp spine. The males have an uncrested chela and no tooth or gape between the fingers. California specimens collected ashore or in shallow bays like Monterey were of the latter type, whereas specimens dredged off Redondo Beach, where a submarine canyon permits upwelling from a considerable depth, were of the lumpy type. This would lead one to believe that typical *Scyra acutifrons* is a northern form recurring wherever cold water conditions prevail.

Material examined: A total of 284 specimens from 96 stations, divided as follows: (See Table 50)

Hancock expeditions and related material: 243 specimens from 86 stations.

California Academy of Sciences material: One specimen from one station.

Hopkins Marine Station material: 32 specimens from 5 stations.

Provincial Museum material: 8 specimens from 4 stations.

From Bajo Point, Nootka Island, west coast of Vancouver Island, British Columbia, to San Carlos Point, Lower California, Mexico.

Measurements: Male specimen: length 46.5 mm, width 33.7 mm, rostrum 10.5 mm, width 9.3 mm, cheliped 88 mm, chela 42 mm, dactyl 20.6 mm, ambulatory legs 55, 45, 41, and 37 mm, respectively. Female: length 23.9 mm, width 15.9 mm.

Color in life: Dull, usually gray or tan with more or less red on chelipeds and walking legs. (Way) Dark red carapace, with lighter colored bands on legs. Chelipeds bright red. (Hart, 1930)

Habitat: Shallow water on rock at Parry Bay. (Hart, 1930) Protected outer coast; rocky shores; low-tide horizon, under rock. (Ricketts and Calvin) Usually encrusted with bryozoans. (Way) The carapace of larger specimens is usually covered with an encrustation of sponges, tunicates, barnacles, etc. (Hart, 1940)

Depth: Shore to 50 fathoms. The deeper record of 55 fathoms, San Juan Islands (Way) is substantiated by a single dredging in 60-62 fathoms, San Juan Channel, by the *Hydah*.

Size and sex: Aside from the 46.5 mm male measured above, the Hancock series consists of young from 3.5 mm, males from 6.0 to 22.5 mm, and females from 6.5 to 23.9 mm, ovigerous females from 11.5 to 21.0 mm. Young of 5.5 mm are invariably characterized by an hepatic spine of equal length to the postocular tooth, which has not yet assumed its cup-shaped form and frequently presents a serrate anterior margin. The resemblance to *Pugettia dalli* is remarkable; however, in that species the postocular tooth is always removed from the eye, whereas in *Scyra acutifrons* it is adjacent to it. The young are proportionately more slender than the adults and, with their greater spinulosity, suggest the young of *Mithrax (Mithrax) spinipes*.

Breeding: Ovigerous females were found off southern California in every month but March, July, and September, in northern California in March, and in Washington in July (Way) and August. A female from Santa Rosa Island in April had pre-zoeae in the process of hatching. Weymouth (1910) found egg-bearing females at Monterey in June.

Remarks: The measured specimen, while not as large as the 52.6 mm male of which dimensions are given by Rathbun (1925, p. 196), is so much larger than the balance of the Hancock series as to dwarf them

by comparison. Apparently northern specimens regularly attain a size much greater than southern specimens, none of which are over 24 mm, with an average size for adults of about 17 mm.

The range of the species is extended southward from San Diego, California, to San Carlos Point, Lower California, Mexico.

Genus LOXORHYNCHUS Stimpson

Loxorynchus Stimpson, 1857a, p. 84.

Loxorhynchus, Stimpson, 1857b, p. 451; correction for *Loxorynchus*.

Rathbun, 1925, p. 198.

Type: Loxorhynchus grandis Stimpson, by subsequent designation of Miers (1879c, p. 652).

Description: Carapace pyriform, more or less spinous and pubescent; gastric region extensive, convex; hepatic region small, prominent, armed with at least one stout spine. Rostrum bifid, more or less deflexed; horns divaricate. Orbits imperfect, interrupted above and below by a deep longitudinal sinus, ocular cavity subtubular. Eyes rather short, retractile, not hidden. Preorbital tooth strong; postorbital spine acute, nearly longitudinal, below it a small spine situated external to the basal article of the antenna. Movable part of antenna scarcely concealed by rostrum, flagellum long; immovable article broad, nearly quadrate, armed at external apex with an acute, laterally extended spine. Epistome large, subtrapezoidal. External maxillipeds with inner angle of ischium strongly produced and rounded. Legs subcylindrical, those of the second pair [first walking legs] longer; dactyli short, nonspinulous. Digits of the first pair [chelipeds] of male and female with denticulate margins.

Abdomen 7-segmented [in both sexes]. (Stimpson, 1857b)

Chelipeds of adult male much enlarged, fingers gaping, a large basal tooth on the dactylus. Legs diminishing in length from first to fourth pair. (Rathbun, 1925)

Range: Pacific coast of North America from Point Reyes, California, to Point San Bartolome, Lower California, Mexico. Shore to 110 fathoms.

Contains two species of large size which occupy overlapping, although not identical, ranges.

KEY TO THE SPECIES OF THE GENUS *Loxorhynchus*

- 1a. Carapace covered with many small spines; two spines on hepatic region. Front strongly deflexed. Cheliped of old male shorter than first and second walking legs. Apex of male first pleopod not flaring, tip bilobed *grandis*

- 1b. Carapace covered with a few large tubercles; one spine on hepatic region. Front less strongly deflexed than 1a. Cheliped of old male longer than first walking leg. Apex of male first pleopod flaring, tip blunt, simple *crispatus*

***Loxorhynchus grandis*¹ Stimpson**

Plate P, Fig. 2; Plate 29

- Loxorhynchus grandis* Stimpson, 1857a, p. 85; 1859, p. 49 (3).
Loxorhynchus grandis, Stimpson, 1857b, p. 452, pl. 20 [not 19], fig. 1; pl. 22, fig. 1. Lockington, 1877c, p. 65. Miers, 1879c, p. 652. Holmes, 1900, p. 29. Rathbun, 1904, p. 175; 1908, p. 342, pls. 45, 46, 47, fig. 1; 1923b, p. 634; 1925, p. 198, pls. 64, 65, text-fig. 80; 1926, p. 24, pls. 2, 3; pl. 4, fig. 1. Baker, 1912, p. 100. Hilton, 1916, p. 71, fig. 18. Schmitt, 1921, text-figs. 132a, 132b. Johnson and Snook, 1927, p. 372, figs. 326, 327. Glassell, 1934, p. 454.
Loxorhynchus grandis, Weymouth, 1910, p. 31, pl. 5, fig. 14.
Mithrax rostratus, Boone, 1930b, p. 1, figs. 1a, 1b [not *M. rostratus* Bell].

Type: Female holotype, U.S.N.M. No. 15376, length 141 mm.

Type locality: Near San Francisco, California; Lt. W. P. Trowbridge, collector.

Localities subsequently reported, with collectors: California: Farallon Islands and San Francisco (Holmes); Monterey Bay (Weymouth); Santa Barbara, P. Lorquin (Lockington), *Albatross*, 68 fathoms, and D. S. Jordan (Rathbun, 1925); Santa Catalina Island (Lockington; Holmes), *Albatross* (Rathbun, 1925); China Point, San Clemente Island; San Pedro Bay, H. N. Lowe, and San Pedro Breakwater, *Anton Dohrn* (Rathbun, 1925); Laguna Beach (Baker; Hilton); La Jolla, G. P. Englehardt (Boone, as *Mithrax rostratus*); San Diego Bay, 6.5 fathoms, *Albatross* (Rathbun, 1925); San Diego, C. B. R. Kennerly (Stimpson, 1859), (Holmes).

Lower California, Mexico: Ensenada, E. Gonzalez, and San Martin Island, H. E. Nichols (Rathbun, 1925); Point San Bartolome, C. H. Townsend (Rathbun, 1923b).

¹The writer treats *Loxorhynchus* as masculine, despite the recommendation of the XIV International Congress of Zoology that words ending in *-rhynchus* be treated as neuter, pending action by the International Commission on Zoological Nomenclature on a petition regarding *Stenorynchus*, and on the assurance of Dr. L. B. Holthuis that the Commission will be receptive to further request with regard to similar names in Crustacea for which consistent masculine treatment can be shown.

Fossil: California Pliocene [not Miocene]: Canoas Creek, southeast of Coalinga, Fresno County (Rathbun, 1908); California Pleistocene: Rincon del Potrero, Santa Monica (Rathbun, 1926).

Atlantic analogue: None. A California-Lower California endemic species.

Diagnosis: Carapace covered with many small spines. Two spines on hepatic region. Front strongly deflexed. Cheliped of old male exceeded in length by first and second walking legs. Apex of male first pleopod not flaring, tip divided into two closely approximated lobes, an opposing lobe of nearly equal size located in cleft between them. Size large.

Description: Carapace very broadly ovate, inflated, and covered with small, conical tubercles of nearly equal size. Rostrum a little longer than broad, much deflexed, the horns convex above and below and separated for a little more than half their length. Preorbital spine large, often more or less double pointed; postorbital spine subconical, acute. Thoracic sternum transversely grooved. Carapace covered with short hairs.

Chelipeds in the male large, tuberculated; hand oblong, palm inflated, the edges rounded. Ambulatory legs subcylindrical, sparingly tuberculated, the antepenultimate [segments] grooved above; a small tubercle near the end of the merus.

Abdomen of the male contracted behind the third segment, the three following segments of nearly equal width, the fourth slightly wider at the base; fifth and sixth segments nearly equal and longer than the third or fourth; last [segment] subtriangular, but rounded at the tip.

Abdomen of female broadly elliptical, all the [segments] free; the [segments] increasing in length from the third to the sixth; last [segment] broadly rounded, much broader than long. (Holmes)

A stout spine on the margin of the hepatic region and another equally large just below the margin.

The basal antennal article, besides the anteroexternal spine, with a tubercle on the outer margin and another on the anterior margin at the insertion of the next article. (Rathbun, 1925)

Material examined: 53 specimens from 31 stations. (See Table 51) From Cordell Bank, Marin County, California, to Thurloe Head, Lower California, Mexico.

Measurements: Largest specimen, male: length 190 mm, width 145 mm, rostrum 30 mm, width 20 mm, cheliped *ca.* 220 mm, merus 90 mm, chela 112 mm, dactyl 58 mm, height of palm 39 mm, ambulatory legs *ca.* 290, 240, 225, and 180 mm. Female: length 114 mm, width 86 mm.

Color in life: Exposed parts reddish, inclining to roseate, becoming yellowish white on the sides. Fingers white. (Stimpson)

Habitat: Deeper water, but occasionally taken inshore or brought up by fishermen. (Johnson and Snook) Large carapace shells of this deeper water crab are commonly washed up on the beach [at Laguna]. (Baker)

Depth: To 68 fathoms, *Albatross*. (Rathbun, 1925) Hancock specimens were all obtained in 23 fathoms or less.

Size and sex: While the Hancock series is not sufficiently extensive to present a continuous record of growth and development, there is a wide range, from 6.7 to 190 mm, between the smallest and largest specimen. The young are more slender than the adults, with the rostral, preorbital, and postorbital spines more prominent. The postorbital spine is particularly slender, acute, and equally advanced with the tip of the cornea. The hepatic region is dome-shaped, a tiny papilla surmounted by a cluster of hairs representing each of the two hepatic spines of the adult. Once freed of its accretions of detritus, the young specimen appears almost naked, the carapace being devoid of short pubescence and the longer hairs being fine and inconspicuous. Sex is readily determinable in a 12.7 mm male and a 12.5 mm female. No enlargement of the male cheliped is apparent in specimens of 76 and 92 mm; nor do females to 56 mm show evidence of having borne ova. It is between these and the measured male of 190 mm and female of 114 mm, a size range not covered by the present series of specimens, that secondary sex characters are developed.

The specimen measured by Rathbun (1925, p. 199), with dimensions of 200 by 159 mm, is 10 mm longer than the male measured above, which was not the largest encountered by the *Velero III*. Several larger specimens, kept dry for want of suitable containers, were allowed to deteriorate to powder.

Breeding: No ovigerous females are included in the present series.

Remarks: Although the specimen referred by Boone (1930b) to *Mithrax rostratus* Bell has not been examined, the description and photograph leave no doubt that it is a mature male of Stimpson's species. No *Mithrax* is known to occur at La Jolla, where the specimen was collected by G. P. Englehardt of the Brooklyn Museum, nor is it likely that specimens of 145 mm dimension, if of a species other than commonly encountered, would have been overlooked for these many years by enthusiastic collectors who regularly comb the southern California beaches.

The young specimen obtained by the *N. B. Schofield* in 22 fathoms at Cordell Bank (C.A.S. Locality 31180) represents a northward exten-

sion of range for the species from Farallon Islands and San Francisco, the type locality. Cordell Bank lies on the 38th parallel due west of Pt. Reyes, Marin County, California.

***Loxorhynchus crispatus* Stimpson**

Plate P, Fig. 3; Plate 27, Fig. 2; Plate 28, Fig. 1

Loxorhynchus crispatus Stimpson, 1857b, p. 453, pl. 22, figs. 2-4. Lockington, 1877c, p. 65. Ortmann, 1893, p. 45. Rathbun, 1894, p. 74; 1904, p. 175; 1925, p. 200, pls. 66, 67; 1926, p. 25. Holmes, 1900, p. 30. Weymouth, 1910, p. 32, pl. 5, fig. 15. Hilton, 1916, p. 71, fig. 3. Schmitt, 1921, p. 213, text-figs. 133a, 133b. Johnson and Snook, 1927, p. 374, fig. 328. Ricketts and Calvin, 1939, p. 92, pl. 20.

Type: Male holotype, U.S.N.M. No. 2083, length 87.6 mm, width 58.4 mm.

Type locality: San Miguel Island, California; Lt. W. P. Trowbridge, collector.

Localities subsequently reported, with collectors: California: "California," C. M. Scammon, John Mullan, and Bureau of Fisheries (Rathbun, 1925); Point Reyes (Schmitt); Farallon Islands, 20 fathoms, *Albatross* (Rathbun, 1904, 1925); San Francisco, A. Agassiz (Ortmann), T. G. Cary (Rathbun, 1925); Monterey Bay (Weymouth), H. Heath, 100 feet, and *Albatross*, 46-74 fathoms (Rathbun, 1925); Monterey, D. S. Jordan (Rathbun, 1894); off Point Conception, 31 and 44 fathoms, *Albatross* (Rathbun, 1894, 1925); Santa Barbara, D. S. Jordan (Rathbun, 1894); off San Miguel Island, 26 and 53 fathoms, off Brockway Point, Santa Rosa Island, 38-45 fathoms, off Santa Cruz Island, 36 fathoms, and off San Nicolas Island, 45 fathoms, *Albatross* (Rathbun, 1894, 1925); Santa Catalina Island: H. N. Lowe, Catalina Harbor, *Anton Dohrn*, and off Avalon, *Albatross* (Rathbun, 1925); Santa Monica Bay, 22 fathoms, and between Venice and Rocky Point, *Anton Dohrn* (Rathbun, 1925); off Wilmington, 27 and 47 fathoms, *Albatross* (Rathbun, 1894, 1925); Laguna Beach, A. M. Bean and W. F. Hamilton (Hilton); off San Diego, 36 fathoms, *Albatross* (Rathbun, 1925).

Fossil: California Pleistocene: Long Wharf, Santa Monica; Deadman Island, San Pedro (Rathbun, 1926).

Atlantic analogue: None. A California endemic species.

Diagnosis: Carapace covered with a few large tubercles standing out, with their surrounding pile, as discrete masses. One spine and a domelike

prominence on hepatic region. Front not strongly deflexed. Cheliped of old male exceeding first walking leg. Apex of male first pleopod flaring, tip undivided, rounded, and rimmed; a papillate tongue process arising from within opening.

Description: Carapace rather narrowly triangular, somewhat flattened, not nearly so wide and inflated as in the preceding species [*Loxorhynchus grandis*]. Some of the tubercles much larger than others, the principal ones being located as follows: a tubercle on the cardiac region connected with a tubercle on the intestinal by a prominent ridge; two tubercles on the branchial regions, the anterior somewhat nearer the middle line; a large tubercle on the hepatic region; a tubercle on the anterior and one on the posterior portion of the median region; a tubercle on either side of the anterior median tubercle; a row of small blunt tubercles on the median region extending to each rostral horn. Rostrum longer than broad, not so much depressed as in *L. grandis*, and having more divergent horns, separated for more than half the length of the rostrum. Preorbital spine prominent, subconical.

Chelipeds rather slender; merus with three or four small tubercles on the upper side; carpus with small tubercles; hand slender, slightly wider at the base, margins rounded. Ambulatory legs rather short, the first pair in the female usually longer than the chelipeds, merus grooved above; dactyls shorter and stouter than in *Loxorhynchus grandis*, about one-half the length of the propodi.

Abdomen of the male similar to that of the preceding species, but the last [segment] narrower.

The chelipeds in the male much longer than in the females, and in old specimens becoming enormously lengthened. (Holmes)

Material examined: 117 specimens from 57 stations. (See Table 52) From Cordell Bank, southwest of Baker Head, northern California, to south of Pyramid Cove, San Clemente Island, southern California.

Measurements: Largest specimen, male: length 119 mm, width 88 mm, rostrum 19 mm, width 14 mm, cheliped 300 mm, merus 123 mm, chela 135 mm, dactyl 52 mm, height of palm 30 mm, ambulatory legs *ca.* 207, 154, 132, and 103 mm, respectively. Female: length 105 mm, width 68 mm.

Color in life: Bluish white, the rostrum, spines, and legs bright carmine. (Stimpson, 1857b)

Habitat: Protected outer coast; rocky shores; low-tide horizon, under rock. (Ricketts and Calvin) Generally found so thickly covered with

foreign growths, such as hydroids, seaweeds, bryozoans and sponges, that, in their natural environment, they are scarcely recognizable as crabs at all. (Holmes) A 60 mm specimen carries a rhizocephalan parasite.

Depth: 4-74 fathoms. (Rathbun, 1925) Shore to 110 fathoms, *Velero III* and *IV*.

Size and sex: As the Hancock series contains about three times as many specimens of *Loxorhynchus crispatus* as of *L. grandis*, the record of growth and development is correspondingly more complete. Young specimens of from 5.4 to 14 mm look much alike. The pre- and post-orbital spines are tipped with a translucent spinule and tend to curve forward. The single hepatic spine is sharper than the same spine on *L. grandis*, and there are three similar spines evenly spaced along the lateral margin. The anterior corner of the branchial region is sharply angled, and in the indentation between it and the hepatic swelling the similarly rounded pterygostomian region is exposed. While this young facies persists to 14 mm and larger, it is possible to determine sex in males of 12.5 mm, although the pleopods are only half as long as the abdomen at this stage. Shortly thereafter the large bosses of the carapace become discernible and in specimens of 20 mm and over form a most conspicuous character. As in *L. grandis*, sexual maturity appears to be achieved late, males of 75 mm showing no signs of enlarging chelipeds or females of 58 mm of egg laying.

Breeding: The gap in the series between the specimens just mentioned and the measured male and female, 119 and 105 mm respectively, is bridged by an ovigerous female of 62 mm collected in June or July and an 84 mm female, definitely postovigerous, collected in October.

Remarks: Although the specimen measured above is larger than the largest in the collections of the U. S. National Museum (U.S.N.M. No. 2193), it is not as large as a 133.5 mm male (M.C.Z. No. 2000) of which measurements are given by Rathbun (1925, p. 201). However, the length of the cheliped of the Hancock specimen exceeds by 28 mm the longest cheliped recorded by Rathbun, which belongs to the National Museum specimen. In very old males the length of the cheliped is considerably greater than that of the first pair of walking legs, whereas in *Loxorhynchus grandis* the first two pairs of ambulatory legs exceed the chelipeds.

The southern limit of range of the species appears to have been correctly defined by Rathbun, for *Velero III* collectors found no *Loxorhynchus crispatus* south of San Diego.

Genus **CHORILIA** Dana

Chorilia Dana, 1851a, p. 269; 1852, p. 91. Schmitt, 1921, p. 208. Rathbun, 1925, p. 202.

Type: Chorilia longipes Dana, by monotypy.

Description: Carapace pyriform, inflated, and spiny. Rostrum composed of two long, slender, straight, cylindrical spines, diverging from the base. Basal antennal article large [i. e., long and narrow], furnished distally with a spine; flagellum usually exposed and visible from above at the sides of the rostrum. Preocular spine prominent, acute; postocular acute, deeply cupped on anterior face, and without hairs. Ambulatory legs elongated, subcylindrical, unarmed; first pair usually much the longest. (Schmitt)

Supraocular hood separated by a U-shaped sinus from the postocular cup.

Chelipeds enlarged, manus compressed. (Rathbun)

Abdomen seven-segmented in both sexes.

Range: Eastern Pacific from Shumagin Bank, Alaska, to Cortez Bank, Lower California, Mexico; Western Pacific: Japan. 18-650 fathoms.

Chorilia longipes Dana***Chorilia longipes turgida*** Rathbun

Plate P, Figs. 4, 5; Plate 30

Chorilia longipes Dana, 1851a, p. 269; 1852, p. 91; 1855, pl. 1, figs. 5a-d. Stimpson, 1857b, p. 455. Lockington, 1877c, p. 69. Whiteaves, 1878, p. 470. Rathbun, 1898, p. 572; 1904, p. 174; 1923b, p. 634; 1925, p. 203, pl. 224, figs. 1-3, text-fig. 81. Weymouth, 1910, p. 33, pl. 6, fig. 16. Taylor, 1912, pp. 191, 209. Way, 1917, p. 368, fig. 24. Schmitt, 1921, p. 209, text-fig. 130. Smith, 1928, pp. 164, 165. Clemens, 1933, p. 51. Hart, 1940, p. 99. Goodwin, 1952a, p. 178.

Hyastenus (Chorilia) longipes, Miers, 1879c, p. 658. Holmes, 1900, p. 33.

Hyastenus longipes, Miers, 1886, p. 56. Newcombe, 1893, p. 20; 1898, p. 76. Rathbun, 1893a, p. 85, pl. 7; 1894, p. 62, pl. 1, fig. 5.

?*Hyastenus* sp., Rathbun, 1893a, p. 87.

Chorilia longipes turgida Rathbun, 1924a, p. 3; 1925, p. 203, pl. 225, text-fig. 82; type locality, off San Diego, 359 fathoms; male holotype U.S.N.M. No. 15500, length 56 mm, width 50 mm.

?*Chorilia* sp., Rathbun, 1926, p. 25, pl. 1, fig. 2 [fossil].

Type: Female holotype, not extant, length 40.2 mm, width 21.2 mm.

Type locality: Oregon. [This designation referred to Oregon Territory, which included the present state of Washington and part of British Columbia as well.]

Localities subsequently reported, with collectors: Of typical *Chorilia longipes*: Alaska: off Shumagin Bank, 138 fathoms, *Albatross* (Rathbun, 1925); off Sitkalidak Island, Kodiak, 69 fathoms, *Albatross* (Rathbun, 1893a); Chilkoot Inlet, 45-51 fathoms; Stephens Passage, 131-188 fathoms; Kasaan Bay, Prince of Wales Island, 89-123 fathoms; junction of Clarence Strait and Behm Canal, 206-248 fathoms; Naha Bay, Behm Canal, 41-240 fathoms; Yes Bay, Behm Canal, 45-205 fathoms; Boca de Quadra, 149-181 fathoms; all *Albatross* (all Rathbun, 1925).

British Columbia: Queen Charlotte Islands: 9.5 miles S of Marble Island, and Tasu Harbor, Moresby Island (Hart); McLaughlin's Bay, Campbell Island, 10-30 fathoms, J. Richardson (Whiteaves, Newcombe); Banks Island (Taylor). Queen Charlotte Sound, 25-338 fathoms, *Albatross* (Rathbun, 1893a); Halibut Bank, Gulf [Strait] of Georgia, 18-44 fathoms, *Albatross* (Rathbun, 1925); Vancouver Island: Clayoquot and Nootka Sounds (Hart); Departure Bay, 10-20 fathoms, and Lowe Inlet (Taylor); off Nanaimo, 89-97 fathoms, *Albatross* (Rathbun, 1925); Sidney, 10-20 fathoms, G. M. Smith (Smith); south shore, 56-152 fathoms, *Albatross* (Rathbun, 1893a).

Washington: Friday Harbor, San Juan Islands (Way); off Cape Flattery, 27-77 fathoms, and Admiralty Inlet, 40 fathoms, *Albatross* (Rathbun, 1893a); Strait of [San Juan de] Fuca, 97-114 fathoms, *Albatross* (Rathbun, 1925).

Oregon: Off Columbia River, 68 fathoms; off Alseya [Alsea] River, 42 fathoms; off Heceta Bank, 46 fathoms; all *Albatross* (all Rathbun, 1893a); off Cape Kiwanda, 50 fathoms, *Albatross* (Rathbun, 1925).

California: Between Shelter Cove and Big Flat, 155-285 fathoms, N. B. Schofield (Goodwin); off Point Arena, 75 fathoms, *Albatross* (Rathbun, 1893a); south of Farralones [Farallon Islands], 68 fathoms, *Albatross* (Rathbun, 1925); off Pigeon Point, 296 fathoms; off Point Año Nuevo, 62 fathoms; Monterey Bay, 46-495 fathoms; off Point Sur, 298 fathoms; off San Miguel Island, 267 fathoms; off Santa Rosa Island, 52 fathoms; all *Albatross* (all Rathbun, 1893a).

Of *Chorilia longipes turgida* (including specimens earlier described as typical *C. longipes*): California: Monterey Bay, 65-406 fathoms, and off Point Carmel, 162 fathoms, *Albatross* (Rathbun, 1925); off San Simeon Bay, 160 fathoms, *Albatross* (Rathbun, 1893a); west of Point

Buchon, 440 fathoms, off Point Conception, 145 fathoms; and off San Nicolas Island, 32-451 fathoms, *Albatross* (Rathbun, 1923b); off San Miguel Island, 264-376 fathoms, off Anacapa Island, 388-603 fathoms, and off Santa Barbara Island, 178-638 fathoms, *Albatross* (Rathbun, 1893a); off Santa Rosa Island, 243-265 fathoms, off Santa Cruz Island, 197-510 fathoms, and off Santa Catalina Island, 478-600 fathoms, *Albatross*, and San Clemente Island, Scripps Institution (Rathbun, 1925); northwest of San Clemente Island, 414 fathoms, *Albatross* (Rathbun, 1898); between Santa Catalina Island and San Diego, 464 fathoms, and vicinity of San Diego, 36-650 fathoms, *Albatross* (Rathbun, 1893a).

Fossil: ?California Pleistocene: Deadman Island, San Pedro (Rathbun, 1926).

Atlantic analogue: None. A Pacific boreal species of which two geographical races, *Chorilia longipes japonica* (Miers, 1879a) and *C. l. turgida*, are recognized as occurring in temperate waters of the western and eastern Pacific, respectively.

Diagnosis: Carapace multituberculate or spinate, largest spine on branchial region; a blunt ridge or, in *Chorilia longipes turgida*, a spine on hepatic region. Rostral spines slender, subparallel or divaricate; an acute preorbital spine. Two spines on external margin of basal antennal article. Cheliped of male massive; palm inflated and compressed, two larger teeth in gape. Male first pleopod with two subterminal lobes, one rounded, the other acute, opposing thickened but pointed tip.

Description: Of typical *Chorilia longipes*: Carapace covered with numerous tubercles and some short, unequal spines; largest spine at widest part of carapace on margin of branchial region. Other important spines two median gastric, forming a rhomb with two smaller lateral spines or tubercles. A blunt ridge or tubercle on hepatic region. Cardiac region at its narrowest more than half its greatest width. Two median cardiac tubercles, one larger intestinal tubercle. Rostrum about half (it may be more or less than half) as long as remainder of carapace; horns gradually tapering, acuminate. A slender preocular spine. Two spines on outer margin of basal antennal segment; followed posteriorly by a triangular tooth situated just outside the segment. Merus of outer maxillipeds with concave surface and prominent outer angle; ischium with a broad and deep longitudinal sulcus.

Chelipeds massive; merus prismatic, rough with granules, and with tubercles and spines arranged in rows. Carpus similarly rough, inner margin lamellate, the lamella bearing a backward-pointing lobe at proximal end. Manus compressed, upper edge thin. Fingers narrow, gaping in

their basal half or two-thirds; dactylus as long or nearly as long as upper margin of palm, with a subbasal tooth; immovable finger with a basal tooth; distal ends of fingers meeting, their edges crenulate.

Legs of the first pair exceeding cheliped little or not at all; other pairs considerably shorter and themselves diminishing successively in length. Merus of each terminating in a short, sharp point above; dactyli slender and curved. (Rathbun, 1925)

Compared to typical *Chorilia longipes*, the carapace of *C. l. turgida* is much rougher, more spinous, the tubercles replaced by short, sharp spines; the hepatic margin bears a spine instead of a tubercle or blunt ridge; the width of the carapace increases notably in proportion to the length, the branchial regions are inflated and approach nearer the median line, the distance between them being not more than half the greatest width of the cardiac region; the movable segments of the antennal peduncle are longer and more slender. (Rathbun, 1924a)

Material examined: Of typical *Chorilia longipes*: 20 specimens from 13 stations. (See Table 53) From off McKay Point, British Columbia, to SE end of Santa Catalina Island, California. Of *C. l. turgida*: 152 specimens from 43 stations. (See Table 54) From San Miguel Island, Channel Islands, California, to Cortez Bank, Lower California, Mexico. While the preponderance of southern California specimens have been referred to *C. l. turgida*, select specimens from as far south as 12 miles SW of Newport Beach might with propriety have been referred to typical *C. longipes*, the northern form.

Measurements: Of *Chorilia longipes*: male: length 50.4 mm, width at branchial spines 30.2 mm, rostrum 18.6 mm, width 5.0 mm, cheliped 71 mm, chela 35 mm, dactyl 17.2 mm, height of palm 6.3 mm, ambulatory legs ca. 84, 68, 62, and 54 mm, respectively. Of *C. l. turgida*: male: length 70.8 mm, width 52 mm, rostrum 18.4 mm, basal width 6.9 mm, cheliped 123 mm, chela 61.5 mm, dactyl 32.5 mm, height of palm 17.5 mm, ambulatory legs 120 (est.), 105, 90, and 80 mm, respectively. Oviparous female: length 54 mm, width 40 mm.

Color in life: Usually white, but occasionally bright flesh pink, the color persisting for years in alcohol.

Habitat: Specimens from off Santa Catalina Island were most frequently recovered by the dredge with smooth, round boulders, by which many were crushed. Occurring in the same hauls were *Paralithodes rathbuni* (Benedict); *Munida* and *Munidopsis*, galatheid shrimps; *Psolus*, a sessile holothurian; and a siliceous sponge.

Depth: 18-650 fathoms. (Rathbun) Depths over 300 fathoms are from Monterey Bay south. Hancock specimens were obtained in depths of from 35-380 fathoms. One shore record is believed to be in error, as the species is not known to occur intertidally.

Size and sex: In young *Chorilia longipes turgida* of from 5.0 to 10.0 mm the rostral horns are long and slender and occupy about one-third of the carapace length. The width is slightly over half the length, giving the young a more slender appearance than the adults. The postorbital spine is slender, acute, inclined toward the horizontal, and well separated from the preorbital, as in *Rochinia*, the cup-shaped postocular process of the adult being assumed by a gradual curving around the eye, accompanied by a broadening of the spine in adolescent specimens. Sex may be readily determined in 10 mm specimens, and females of 13 mm were found to be ovigerous; however, females of 33 and 54 mm produce a vastly greater number of eggs. The tremendous development of the male cheliped and the sharp crests of the palms occur in specimens approaching the size of the 70.8 mm male measured above.

Breeding: Ovigerous females were found by the *Velero III* in the vicinity of the southern Channel Islands (Santa Catalina and San Clemente) in September, November, and December, and by the *Albatross* from Monterey Bay to San Diego, California, in March, April, and May. (Rathbun, 1925)

Remarks: In deeper dredging operations among the Channel Islands, off the coast of southern California, the *Velero III* has amassed a series of *Chorilia longipes* second only to that of the *Albatross*, and exceeding that of the *Albatross* in representation of *C. l. turgida*, the southern form. In enumerating specimens taken south of Monterey Bay, Rathbun (1925, p. 207) mentions 2 males from off Santa Rosa Island, 2 males and 4 females from off San Miguel Island, and a few from among many specimens taken off San Diego as being either typical of the northern form, or intermediate between *C. longipes* and *C. l. turgida*. From among *Velero III* collections, which are exclusively southern Californian, the following localities yielded one or more specimens of the northern form: off Redondo Beach, 70-240 fathoms; south of Santa Barbara Island, 240-275 fathoms; southeast of Santa Catalina Island, 132-148 fathoms; San Pedro Channel, 12 miles southwest of Newport, 225-250 fathoms; east of White Cove, Santa Catalina Island, 121-260 fathoms. Some or all of these locations are subject to upwelling of cold water from greater depths. A similar situation is found with respect to *Scyra acutifrons*, which also presents a northern and a southern facies (see *Remarks* under that species).

An occasional hairy specimen, including a 27 mm male and a 14.5 mm female, was found. Smaller individuals of *Chorilia longipes* (23 mm and under) had numerous vesicles on rostrum, antennae, eyestalks, legs, and on the low portions of the posterior part of the carapace, a feature reminiscent of *Rochinia vesicularis*.

It should be noted that the figure used by Rathbun (1893a) and by Schmitt (1921) to illustrate *Chorilia longipes* is that of *C. longipes turgida*, and that the description of Holmes (1900) is a composite of the northern and southern forms.

Genus PELIA Bell

Pelia Bell, 1835b, p. 170; 1836, p. 44. A. Milne Edwards, 1875, p. 71.

Rathbun, 1925, p. 275.

Type: Pelia pulchella Bell, by monotypy.

Description: Carapace pyriform, swollen, devoid of tubercles, and covered with a sparse down. Rostrum well developed, formed of two rostral horns, united at their base, divergent near their extremity. Superior orbital margin smooth and without a spine. Basal antennal article long, slender, and forming only an incomplete flooring to the orbit; jutting out beyond the orbital margin and appearing at the sides of the rostrum. Movable flagellum greatly developed. Eye retractile into a hollow fossette at the base of a tubercle limiting the hepatic region in front. Merus of the external maxillipeds notched at its anterointernal angle to receive the palp.

Chelipeds rather long, but feeble [in females and young males]; fingers terminating in a sharp extremity, finely denticulate and in contact at their terminal portion; pollex bearing near its base a large tooth, corresponding to an excavation of the cutting edge of the dactyl. Arm bearing a more or less pronounced crest above.

First pair of ambulatory legs much longer than the others; the fifth very small; the merus much compressed and bearing a projecting ridge above. Last article devoid of denticulations below.

Abdomen of the male narrow and composed of seven articles. (A. Milne Edwards, modified)

Range: Eastern Pacific from Santa Cruz Island, California, to Zorritos Light, Peru; Galapagos Islands (Bell). Western Atlantic from Buzzards Bay and Vineyard Sound, Massachusetts, to Gulf of San Matias, Patagonia; Atlantic range interrupted between St. Thomas, West Indies, and Cape St. Roque, Brazil. Shore to 55 fathoms; possibly to 70 fathoms.

KEY TO THE PACIFIC SPECIES OF *Pelia*

- 1a. Rostrum of moderate length, or not more than one-third of the remaining carapace length. Only the tip of basal antennal article exposed dorsally
- 2a. Carapace narrow, width from two-thirds to three-fourths total length. Rostral horns from one-third to one-fourth length of remainder of carapace. Basal antennal article elongate, succeeding two articles slender, the second falling short of tip of rostrum. Digital tooth of male cheliped molariform. Male first pleopod slender, not bent to tip *tumida*
- 2b. Carapace broader, width from three-fourths to four-fifths total length. Rostral horns from one-fourth to one-eighth length of remainder of carapace. Basal antennal article broad, succeeding two articles wide as one rostral horn, the second reaching or exceeding tip of rostrum. Digital tooth of male cheliped a simple tubercle. Male first pleopod broad, bent sharply before tip *pacifica*
- 1b. Rostrum long, or nearly half of the remaining carapace length. Almost the entire basal antennal article exposed dorsally. Galapagos only? *pulchella*

Pelia pulchella Bell

Pelia pulchella Bell, 1835b, p. 170; 1836, p. 45, pl. 9, figs. 2, 2d-f. A. Milne Edwards, 1875, p. 72. Rathbun, 1910, p. 572; 1925, p. 284, pl. 241, figs. 1-4. Boone, 1927, p. 142, fig. 40. Garth, 1946, p. 380.

Type: Male holotype, length 8.5 mm, width 5.3 mm, originally deposited in the Museum of the Zoological Society (London), no longer extant.

Type locality: Galapagos Islands, 6 fathoms, sandy mud; Hugh Cuming, collector.

Localities subsequently reported, with collectors: None.

Diagnosis: Carapace narrow, width from four-sevenths to five-eighths total length. Rostral horns long, nearly half the length of remainder of carapace. Basal article of antenna almost wholly exposed in dorsal view, second movable article falling short of tip of rostrum. Presence of digital tooth of male cheliped not ascertainable. Nature of male first pleopod unknown.

Description: Carapace pyriform, gibbous, rounded, polished, somewhat hairy; the regions elevated, particularly the gastric and cardiac, the latter forming a rounded tubercle; lateral margins entire. Rostrum straight, much produced, nearly half as long as the rest of the carapace, bifid at the extremity, with a slight groove continued backwards from the bifurcation. [Antennules] inserted at the base of the rostrum; [antennae] placed at the sides of the rostrum, the basal [article] reaching to about half its length, almost wholly exposed above, slightly tapering towards its extremity, extremity bearing a small external tooth; the movable portion setaceous, extending a little beyond the apex of the rostrum, the second and third [articles] cylindrical, and much larger than the terminal portion. External [maxillipeds] with the [exognath] semifusiform; the [ischium] of the [endognath] elongate, rhomboid; the [merus] an irregular four-sided figure, the margins entire.

[Chelipeds] longer than the body, the arm three-sided, having a toothed carina above and two carinae beneath, the outer minutely serrated; the hands slightly compressed, smooth; the fingers, when closed, in contact throughout their whole length, the half towards the apex being serrated, and a tubercle of the immovable finger received into a corresponding excavation in the movable one. [Ambulatory legs] compressed, carinated and hairy above, the [first] pair longer than the [cheliped], the rest becoming gradually shorter.

Abdomen in the male seven-segmented, the [segments] becoming gradually smaller from the third to the last. (Bell, modernized as to terminology)

Material examined: None.

Measurements: Male holotype, length 4 lines (10.16 mm), width 2.5 lines (6.35 mm).

Habitat: Sandy mud. [Note: *Pelia* elsewhere is sponge-covered.]

Depth: 6 fathoms. [Note: *Pelia pacifica* of the mainland is intertidal.]

Remarks: While Bell's description gives at least two apparently valid criteria, rostral length and exposed basal antennal article, on which to separate *Pelia pulchella* of the Galapagos from either *P. tumida* or *P. pacifica* of the mainland, Bell's figures leave some room for doubt as to the first of these. His figure 2 shows the antennal flagellum extending barely to the tip of the rostrum, but his figure 2d depicts the flagellum as exceeding the rostrum in length, while the second movable article falls short of it. This resembles the situation found in *P. tumida*, which *P. pulchella* further resembles with respect to narrowness of body and elon-

gation of the cheliped. A single mature *Pelia* from the Galapagos Islands, where none has been collected since the holotype, would settle the question of rostral length, as well as that regarding the presence and nature of the digital tooth, the tubercle mentioned by Bell being on the pollex, as well as providing the essential first pleopod for comparison with the mainland species. Lacking such a specimen, it seems best to treat *P. pulchella* as distinct from either *P. tumida* or *P. pacifica* for the present.

***Pelia tumida* (Lockington)**

Plate Q, Fig. 1; Plate 31, Fig. 2

Pisoides? *tumidus* Lockington, 1877a, p. 30; 1877c, p. 67.

Microphrys tenuidus [error for *tumidus*], Miers, 1886, p. 83.

Pelia pacifica, Rathbun, 1893a, p. 90; 1898, p. 573; 1904, p. 174 (part); 1910, p. 572 (part). Not *P. pacifica* A. Milne Edwards.

Pelia, sp., Rathbun, 1893a, p. 90.

Pelia tumida, Holmes, 1900, p. 35. Rathbun, 1904, p. 174; 1925, p. 281, pl. 99, figs. 2, 3. Hilton, 1916, p. 72. Schmitt, 1921, p. 211, pl. 34, figs. 5, 6. Johnson and Snook, 1927, p. 369, figs. 321, 323.

Pelia clausa Rathbun, 1907, p. 72; type locality, "Southern California," really Catalina Harbor; male holotype, U.S.N.M. No. 16203. Hilton, 1916, p. 72. Nininger, 1918, p. 41, fig. 21. Schmitt, 1921, p. 211, pl. 34, figs. 1-4.

Type: Male holotype, length 16.5 mm, width 11.4 mm, originally in the California Academy of Sciences, no longer extant.

Type locality: Near San Diego, between tides; H. Hemphill, collector.

Localities subsequently reported, with collectors: California: Venice breakwater and between Venice and San Pedro, *Anton Dohrn*, Point Vicente, San Pedro, and Long Beach, H. N. Lowe, Reef Point, and vicinity of San Pedro, E. P. Chace (Rathbun, 1925). Santa Catalina Island: (Holmes); Catalina Harbor, 30-40 fathoms, W. H. Dall (Rathbun, 1893a, as *Pelia pacifica*); beach, W. H. Dall (Rathbun, 1907, as *Pelia clausa*); Avalon Bay, *Anton Dohrn*, and off Santa Catalina Island, 50 fathoms, H. N. Lowe; San Clemente Island, H. N. Lowe (Rathbun, 1925). Laguna Beach, W. A. Hilton (Hilton; Nininger as *Pelia clausa*); La Jolla, Scripps Institution, and San Diego County, C. R. Orcutt (Rathbun, 1925); San Diego, 10 fathoms, H. Hemphill, also C. R. Orcutt and Rosa Smith (Rathbun, 1893a, as *Pelia pacifica*); *Hassler* (Rathbun, 1925).

Lower California, Mexico: San Bartolome Bay and Magdalena Bay, 3 fathoms, W. J. Fisher? (Lockington, 1877c); west of Magdalena Bay, 36 fathoms, *Albatross* (Rathbun, 1893a, as *Pelia*, sp.); Magdalena Bay, 12 fathoms, *Albatross* (Rathbun, 1898, as *Pelia pacifica*), C. R. Orcutt (Rathbun, 1925).

Gulf of California, Mexico: off Adair Bay, 17 fathoms, *Albatross* (Rathbun, 1893a, as *Pelia pacifica*).

Atlantic analogue: None.

Diagnosis: Carapace narrow, width from two-thirds to three-fourths total length. Rostral horns with outer margins parallel or divergent, length from one-third to one-fourth remainder of carapace. Basal antennal article elongate; second movable article falling short of tip of rostrum. Gape between fingers of adult male of moderate width, digital tooth molariform. Male first pleopod slender, gradually narrowing to tip, not bent below aperture; aperture normally closed.

Description: Carapace pyriform, rounded, tumid, covered with pubescence, but entirely devoid of spines. Median [gastric] region rounded, smooth, much elevated, and furnished with a small rounded tubercle at the summit; branchial regions inflated; cardiac region with a small rounded elevation. Rostrum depressed, nearly one-half the length of the carapace and bifurcated for about half its length, the horns narrow, divergent, and slightly upturned at the tip. No preorbital tooth; postorbital small. Anterolateral margin entire. Basal antennal [article] considerably longer than wide and devoid of teeth with the exception of the one at the anteroexternal angle, plainly visible from above; tip of the peduncle reaching just beyond the apex of the notch between the rostral horns, not nearly reaching the tip of the rostrum as in *Pelia pacifica*; flagellum rather long. Merus of the maxillipeds distally truncated.

Chelipeds unarmed; merus not nearly reaching the tip of the rostrum; hand oblong, inflated, the edges obtuse and parallel; fingers widely gaping, a tubercle on the inner margin of the dactyl near the base.

Ambulatory legs compressed, pubescent, the margins furnished with a thick fringe of stiff setae; dactyls sharply curved at their sharp, corneous tips. (Holmes, from a male specimen of Lockington's from Magdalena Bay)

In the undeveloped males (the *Pelia clausa* form) the chelipeds are weak as in the adult females, the chelae small, the palms tapering distally, the fingers meeting except for a very slight gape in the basal third or fourth. (Rathbun, 1925)

Remarkable spinulation is shown by a 4.8 mm young from Redondo Beach, California, with a bifid spine at the outer extremity of the basal antennal article and spinules along both anterior and posterior leg margins, and by a 3.6 mm young from Guadalupe Island, Mexico, in which the spinules extend to the base of the rostrum, the basal antennal article, the postocular cup, and the anterolateral margins, as well as to the chelipeds and walking legs. This condition, which does not persist in the adult, is contrary to the description of Holmes given above.

Material examined: 222 specimens from 62 stations. (See Table 55) From Santa Cruz Island, California, and Rocky Point, Gulf of California, Mexico, to Petatlan Bay, Guerrero, Mexico.

Measurements: Male specimen: length 21.2 mm, width 14.5 mm, rostrum 5.9 mm, width 2.4 mm, cheliped 22.2 mm, chela 11.3 mm, dactyl 5.2 mm, height of palm 4.7 mm, ambulatory legs 28.2, 19.3, 16.2, and 12.6 mm, respectively. Female specimen: length 20.5 mm, width 13.0 mm.

Color in life: Carapace cadmium orange. Chelae white, lightly mottled with brown; fingers brown at base, gradually blending into orange and fading to white on tips. Merus of ambulatory legs strong cadmium orange; carpus, propodus, and dactylus white with a few markings of brown. Ventral side grayish white. (Petersen, of a Gulf of California specimen)

Habitat: These sluggish creatures live under stones at low tide and usually have their legs closely folded to them. (Nininger) When turned upon its back, will remain motionless with its legs upcurved and is almost indistinguishable from the surroundings. (Johnson and Snook) Almost all specimens are sponge covered, the sponge being either soft fibrous and covering the entire dorsal portion of the carapace and the enlarged meral segments of the legs, or hard and disposed in discrete clumps, as if planted by the crustacean.

Two specimens from Lower California and the Gulf of California are hosts of rhizocephalan parasites. It is thought that there may be some connection between susceptibility to parasitism in this species and the occurrence of a definitely recognizable form in the male (*Pelia clausa*) in which the secondary sex character of the enlarged chelipeds fails to develop. More observation is needed to establish this as a fact.

Depth: Shore to 55 fathoms; possibly to 70 fathoms (Gulf of California).

Size and sex: From the Hancock series it is apparent that *Pelia tumida* attains its maximum size in the colder waters off southern California, where males up to 21 mm were encountered. In the Gulf of

California, males were under 14 mm in length. These will be treated as distinct populations in the account of growth and development to follow:

Among southern California-Lower California specimens, regarded as typical, males from 7.0 to 21.2 mm and females from 6.9 to 20.5 mm, with young to as small as 4.8 mm, were found. Ovigerous females range from 9.5 to 20.5 mm. There is considerable difference as to the size at which the male chela ceases to resemble the female and becomes high, compressed, with fingers agape. In general, it seems to be attained between 10.3 and 15 mm, some specimens of 11 mm exhibiting this feature while others considerably larger (*Pelia clausa* of Rathbun) do not.

Gulf of California males range from 7.5 to 13.8 mm, females from 7.0 to 14.7 mm, the 7.0 mm specimen being ovigerous. Young to 3.5 mm are present, with sex clearly determinable in females of 4.7 and 5.0 mm. A 13.8 mm male had undeveloped chelae, while one of 13.7 mm had the chelae fully matured. Individuals with rostral horns diverging, usually old males, but in one case a female, were observed more frequently in the Gulf than elsewhere. It is remarkable that in the Gulf there occur ovigerous females smaller than the first recognizable developing females in the southern California population.

Breeding: Ovigerous females were encountered by *Velero III* collectors in the Gulf of California in January, off the Mexican mainland in March, by C. L. Hubbs and party in Lower California in February, and by Hancock Foundation collectors in southern California waters in January, and again in June, July, and August.

***Pelia pacifica* A. Milne Edwards**

Plate Q, Figs. 2-4; Plate 31, Fig. 3

Pelia pacifica A. Milne Edwards, 1875, p. 73, pl. 16, figs. 3-3c. Holmes, 1900, p. 36 (part). Rathbun, 1904, p. 174 (part); 1907, p. 72 (part); 1910, p. 572 (part); 1925, p. 283, pl. 98, fig. 1; pl. 99, fig. 1. Crane, 1947, p. 71. Not *P. pacifica* Rathbun, 1893a, p. 90; 1898, p. 573.

Type: Male holotype, length 9 mm, width 7 mm, in Paris Museum; obtained through S. I. Smith, Yale University, according to A. Milne Edwards.

Type locality: Bay of Panama, F. H. Bradley, collector.

Localities subsequently reported, with collectors: Mexico: Manzanillo, Colima, C. R. Orcutt (Rathbun, 1925); Acapulco, Guerrero, Zaca (Crane). Not Magdalena Bay, Lower California, *Albatross*

(Rathbun, 1898, 1907; Holmes?), the specimens so recorded being later attributed to *Pelia tumida* (Rathbun, 1925).

Nicaragua: Corinto, *Zaca* (Crane).

Costa Rica: Jasper Island and Uvita, *Zaca* (Crane).

Panama: Perico Island, *Albatross* (Rathbun, 1907); "Panama," Sternbergh (Rathbun, 1925); Bahia Honda, *Zaca* (Crane).

Atlantic analogue: *Pelia mutica* (Gibbes). (See *Remarks* below)

Diagnosis: Carapace relatively broad, width from three-fourths to four-fifths total length. Rostral horns with outer margins convergent, length from one-fourth to one-eighth remainder of carapace. Basal antennal article broad; second movable article reaching or exceeding tip of rostrum. Gape between fingers of adult male very wide, digital tooth simple. Male first pleopod broad nearly to tip, sharply bent below aperture, the thickened lip of aperture finely setose.

Description: Carapace shorter and more triangular than in [*Pelia tumida*], the rostrum much shorter, not more than one-fourth as long as remainder of carapace in the old male, its outer margins converging anteriorly, thus carrying out the triangular form of the carapace. Very little of the basal antennal article visible from above; its outer angle tipped with a spine.

Chelipeds in the well-developed male stouter than in [*Pelia tumida*], and about as long as the first pair of ambulatory legs; palm wider, varying from 0.72 in the smaller specimen to 0.81 of its superior length in the old; a little narrowed distally and slightly constricted near the fixed finger; fingers widely gaping for from half [in the young] to two-thirds of their length in the old, slender, the basal tooth of the dactylus comparatively insignificant, the fixed finger arched very markedly downward in the basal half, thus increasing the gape. (Rathbun, 1925)

Material examined: 34 specimens from 15 stations. (See Table 56) From Acapulco, Guerrero, Mexico, to 9.5 miles southwest of Zorrillos Light, Peru.

Measurements: Male specimen from Changamé, Panama: length 9.1 mm, width 6.2 mm, rostrum 1.6 mm, width 1.0 mm, cheliped 9.0 mm, chela 4.3 mm, dactyl 2.1 mm, height of palm 1.8 mm, ambulatory legs ca. 11.2, 7.0, 5.0, and 4.5 mm, respectively. Ovigerous female from Panama: length 6.6 mm, width 4.9 mm.

Color in life: Bluish gray above, pile ochraceous yellow. Merus and manus of chelipeds translucent buff peppered with black; carpus and chelae flame scarlet. Underparts buffy green. Eggs orange. (Crane, of

specimens from Uvita, Costa Rica) Dark red. (Crane, of specimens from Corinto, Nicaragua)

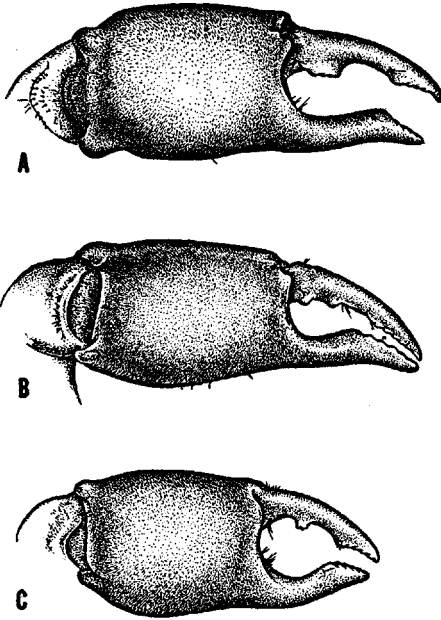
Habitat: On under sides of sponge- and algae-grown stones; in tide-pools; in *Pocillopora* coral. Well covered with hydroids, sponges, algae, and sand grains. (Crane) As in the preceding species, susceptibility to parasites is shown, a female specimen from Ecuador being host to a rhizocephalan.

Depth: Customarily recovered intertidally, but on occasion, as at Manta Bay and La Libertad, Ecuador, dredged in 1-2 fathoms.

Size and sex: Males in the present series range in size from 5.4 to 9.6 mm, females from 5.2 to 7.5 mm, ovigerous females the same, and young from 4.0 mm.

Breeding: Eggs in January-March. (Crane) Ovigerous females were obtained by *Velero III* collectors at Manta and La Libertad, Ecuador, in January, and at Zorritos Light, Peru, in February, and by *Velero IV* collectors at Acapulco, Mexico, in February. An egg-bearing female was collected by Elinor D. Robson at Bellavista, Panama, in February or March.

Remarks: The two males from Playa Blanca, Costa Rica, *Velero III* station 465-35, have a small rostrum, the tips of which converge, a short, wide basal antennal article, and the first two movable antennal segments are as wide as one of the rostral horns and are contained within its length. The teeth of the dactyl of the chela (see text-fig. 6B) are two in number and simple, not molariform, as is the single digital tooth of *Pelia tumida* (see text-fig. 6A). The two males from Changamé, Panama, Elinor Robson, collector, have the elongate hand and bicuspid digital tooth of *P. tumida*, but in body proportion, length of rostrum, and other particulars belong in the *P. pacifica* series. A female specimen from Port Utria, Colombia, *Velero III* station 239a-34, has a rostrum only about one-eighth the length of the carapace. The series from Zorritos Light, northern Peru, station 847-38, consists of an 8 mm male of undoubted maturity and five ovigerous females. The male clearly shows the narrow fingers and correspondingly wide gape, and the digital tooth is again simple (see text-fig. 6C). The male first pleopod, however, is atypical (see Plate Q, fig. 4).



6. Chelae of *Pelia* males. A. *P. tumida* (Velero III Sta. 1230-41), x 4. B. *P. pacifica* (Velero III Sta. 465-35, Playa Blanca, Costa Rica), x 12.5. C. *P. pacifica* (Velero III Sta. 847-38, Zorritos, Peru), x 9.

A character omitted in A. Milne Edwards's figure, which is oversimplified, is a tiny white papilla on the eyestalk, which is visible in dorsal view. This is not, however, a specific character, being shared by *Pelia tumida* and perhaps by other members of the genus.

The confusion which has existed regarding the Pacific species of *Pelia*, quite apart from the identity of *P. pulchella*, discussed elsewhere, is only partially clarified by the synonymy given above. This arose from two independent circumstances, the first of which was the unfortunate grouping by Rathbun (1893a) of material from San Diego and Santa Catalina Island, California, with A. Milne Edwards's Panamanian species, rather than with Lockington's San Diego species; and her subsequent (1907) erection of a new species, *P. clausa*, for southern California material, after coming into possession of specimens from Perico Point, Panama, which she correctly assigned to *P. pacifica*. The second concerns specimens from Magdalena Bay, Lower California, *Albatross* stations 2831 and 2989, also referred by Rathbun (1898, 1907) to *P. pacifica*. These, along with the southern California specimens previously mentioned, were not correctly placed as *P. tumida* until 1925.

In order to preclude similar difficulty with respect to material from Ecuador, the writer has elected to include specimens earlier determined for him by Rathbun as *Pelia tumida*, in his series of material examined of *P. pacifica*, which has for its range the Bay of Panama in its broadest sense. The pleopods of the males from La Libertad tend to support this view. Similarly, for zoogeographical reasons, he prefers to consider *P. pacifica*, rather than *P. tumida*, the Pacific analogue of the Atlantic *P. mutica* (Gibbes).

Genus PISOIDES Milne Edwards and Lucas

Pisoides Milne Edwards and Lucas, 1843, p. 10. Dana, 1852, p. 79.

A. Milne Edwards, 1875, p. 74. Rathbun, 1925, p. 284.

Type: Pisoides tuberculosus Milne Edwards and Lucas = *Hyas edwardsi* Bell, by monotypy.

Description: Carapace much longer than wide, trianguliform, slightly swollen. Gastric and genital regions very apparent and separated from each other, as well as from the branchial regions, by rather deeply marked furrows. Rostrum, directed a little obliquely downward, equal in width to the buccal cavity; armed with two spines, very elongate and divergent at their extremity. Eyes imperfectly retractile; orbital cavity almost entirely filled by the base of the short, medially constricted ocular peduncle. Orbit presenting a notch on its superior margin and not armed with a tooth above its internal angle, as in *Pisa*; below, this cavity very incomplete, but with a small spine near the base of the antenna; finally, the external orbital angle occupied by a large and very sharp tooth. Basal article of the antennae a little longer than wide, and adorned with a small tubercle advancing between the movable flagellum and the orbit; the first movable article, much longer than the preceding, wide, very compressed; the second article, a little shorter, reaching the extremity of the rostrum or surpassing it. Antennules and mouth parts disposed like those of *Pisa*. Epistome nearly linear. Sternal plastron as long as wide.

Chelipeds in both sexes short, composed of rather robust articles, and terminating in slender, elongate, slightly curved fingers finely denticulate on the inner side. Legs diminishing progressively in length from the first pair; first pair much longer than the cheliped; merus and carpus broad and compressed; propodus cylindrical, the dactylus short, very crescentic, and non-denticulate.

Abdomen in both sexes composed of seven segments. (Milne Edwards and Lucas, modified)

Range: West coast of South America from San Nicolas Bay, Peru, to Strait of Magellan. Galapagos Islands. (Bell) Panama. (A. Milne Edwards) Japan. (Balss, 1929) Shore-30 fathoms.

***Pisoides edwardsi* (Bell)**

Plate Q, Fig. 5; Plate 31, Fig. 4

Hyas edwardsii Bell, 1835b, p. 171; 1836, p. 49, pl. 9, fig. 5 p-r.

Pisoides tuberculosus Milne Edwards and Lucas, 1843, p. 11, pl. 5, figs. 1, 1a-d; type locality, coast of Chile; type in Paris Museum, male cotype in Mus. Acad. Nat. Sci. Philadelphia. Nicolet, 1849, p. 134. A. Milne Edwards, 1875, p. 75, pl. 16, fig. 5-5b. Lenz, 1902, p. 757. Porter, 1903, p. 147. Rathbun, 1910, pp. 572, 616.

Pisoides edwardsii, Dana, 1852, p. 87; 1855, pl. 1, figs. 2a, 2b. Miers, 1881, p. 63. Cano, 1889, pp. 98, 99, 100, 179. Pfeffer, 1890, p. 545. Rathbun, 1910, pp. 572, 613; 1925, p. 285, pl. 236. Boone, 1927, p. 143, fig. 41. Garth, 1946, p. 380.

Pisoides edwardsi, Miers, 1881, p. 66. Porter, 1936b, p. 337. Garth, 1957, p. 29.

Pisoides edwardsii, Cano, 1888, pp. 163, 166.

Pisoides edwardsi, Porter, 1936a, p. 152.

Type: Male holotype, length 19.1 mm, width 14.8 mm, not extant.

Type locality: Valparaiso and the Galapagos Islands, H. Cuming, collector. In view of the fact that all subsequent records, with the exception of a doubtfully correct record of A. Milne Edwards from Panama, have been from Chile, the type locality is hereby restricted to Valparaiso, Chile.

Localities subsequently reported, with collectors: Panama: (A. Milne Edwards, as *Pisoides tuberculosus*, without reference to a specimen from that locality). Chile: Guérin collection (Rathbun, 1925, specimen thought to be a cotype of *P. tuberculosus*); Iquique, L. Plate (Lenz); Coquimbo, *Vettor Pisani* (Cano, 1889); Bay of Guaiacan, L. Plate (Lenz); Herradura, F. T. Delfin (Porter, 1903); Bay of Valparaiso (Nicolet); Tumbes and Talcahuano, L. Plate (Lenz); Bahía de Concepción, near Talcahuano (Porter, 1936a); Ancoud [Ancud], *Vettor Pisani* (Cano, 1889); Calbuco, L. Plate (Lenz); Porto [Puerto] Lagunas, *Vettor Pisani* (Cano, 1889); Trinidad Channel, 30 fathoms, and Port Rosario, Strait of Magellan, 2-30 fathoms, *Alert* (Miers); Strait of Magellan, *Caracciolo* (Cano, 1888).

Atlantic analogue: None. A Pacific austral species. A related species, *Pisoides ortmanni* Balss (1924), has been described from Japan.

Diagnosis: Carapace with tubercles of median and branchial regions obscured by villosity. Rostrum flattened, horns divergent. Basal antennal article subquadrate, a spinulous tubercle at anteroexternal angle and a similar tubercle just outside base; succeeding two articles broadened. A sharp postorbital, but no preorbital spine. A stout spine at distal end of merus of cheliped and walking legs. Male first pleopod broad and flattened nearly to tip, a row of spinules on concave margin.

Description: [Rostrum] flattened, with the horns evenly and slightly divergent and setigerous within. [Basal article] of the antenna subquadrate, with the outer angle projecting. [First movable article] fully twice as long as the [second], both flattened and ciliate on the outer side, the [second] being ciliate on both margins. [Anteroexternal] angle of [basal article] set with minute spinules or hairs, a prominence at posterior angle raggedly but minutely denticulate. Branchial regions tumid, with two or three faint tubercles of small size. Cardiac region a broad prominence with a rounded surface, a small tubercle on either side a little posteriorly. [Gastric] region prominent with a low posterior tubercle, another oblong one anteriorly equally distinct. Outer orbital [spine] acute. Intestinal region with a small tubercle, but all tubercles concealed mostly by the villosity of the surface, and seen only on its removal. External maxillipeds pubescent, outer margin of the palpus with a re-entering angle a short distance from its upper extremity. Legs with a fringe of rather short hairs on opposite (upper and lower) margins. (Dana)

Carapace entirely covered with small rounded pits serving for the insertion of the hairs; branchial, gastric, and genital regions ornamented with prominent tubercles. Chelipeds having the anterior margin of the merus armed on its upper part with a strong spine; first pair of walking legs remarkable for their strongly compressed merus, with their superior margin crested; merus of the following legs broad, flattened, and rounded above; a very pronounced spine at their external margin, especially in the first pair of legs; carpus short, broad; the propodus elongate and cylindrical. Abdomen in both sexes entirely smooth. (Milne Edwards and Lucas, modified, of *Pisoides tuberculosus*) For a description of one of the original type specimens of *P. tuberculosus* in the Museum of the Philadelphia Academy of Natural Science, see Rathbun (1925, p. 286).

Material examined: Hancock expeditions material: Five specimens from three stations, all in Peru. Lund University Chile Expedition material: 16 specimens from 11 stations, all in Chile. (See Table 57) From San Nicolas Bay, Peru, to Paso Tenaun, south of Punta Tenaun, island of Chiloe, Chile.

Measurements: Largest specimen, male from Canal Chacao, Chile: length 23.7 mm. Ovigerous female, Peru: length 21.6 mm, width 15.7 mm, rostrum 4.0 mm, width 2.6 mm, cheliped 17.3 mm, chela 6.7 mm, dactyl 3.5 mm, ambulatory legs 21.5, 18.1, 15.0, and 13.3 mm, respectively.

Color in life: Carapace and chelipeds yellow tinged with reddish. (Milne Edwards and Lucas) Reddish brown; the hands red. (Bell, probably from preserved specimens) "Gray or gray-brown with red claws." "Claws brilliant red." (Field notes of Dahl and Brattström, of Chilean specimens)

Habitat: Among seaweed (?). (Lenz) Sandy bottom; sand and rock bottom. (Miers) Hancock expeditions specimens were collected on rocky shore; the dredged specimen was recovered from mud bottom. Lund University specimens were covered with a variety of epizooites, including sponges, hydroids, and (?) ascidians.

Depth: Shore to 70 meters.

Size and sex: Males in the small Hancock series measure 9.0 and 14.5 mm, females 15.5 to 21.6 mm, the latter ovigerous. Males in the larger Lund University series measure 9.9 to 23.7 mm, females 10 to 22 mm, the latter post-ovigerous.

Breeding: Ovigerous females were encountered by Hancock expeditions in Peru in February and a post-ovigerous female by Lund University collectors in Canal Chacao, Chiloe, in late February.

Remarks: The Hancock series lacks a male comparable in size to the 30 x 14.6 mm specimen from the Guérin collection in the Museum of the Academy of Natural Sciences of Philadelphia (Rathbun, 1925, p. 286). The 14.5 mm male, however, yielded a first pleopod (Plate Q, fig. 5) closely resembling that of *Pelia*. When one considers that the basal antennal article of *Pelia pacifica* is broad as compared to that of *Pelia tumida*, and that the peduncle (first two movable articles) is wider than in that species and extends to the tip of the rostrum also, it is apparent that characters other than those given by Rathbun (1925, p. 194) must be used in any key separating *Pisoides* from *Pelia*. In addition to its larger size, *Pisoides* is tuberculate and spinate, particularly at the extremities of the meral segments of the cheliped and legs, and usually lacks the peculiar interlocking arrangement of the fingers of the adult male in *Pelia*. However, the male specimen from S of Punta Nagle, Golfo de Quetalmahué, Canal Chacao, has claws with a gape like those of *Pelia*.

Although the specimens at hand, because of their small size, do not add to the descriptive features of the species as set forth by Milne Ed-

wards and Lucas and by Dana above, they do contribute materially to an understanding of the present distribution. It is significant that *Pisoides edwardsi* was not encountered north of the bays of San Juan and San Nicolas, which are in the southern part of Peru, nor was it taken by R. E. Coker (Rathbun, 1910), whose territory was essentially the same as that covered by the *Velero III*. Collectors subsequent to Cuming have failed to find it in the Galapagos Islands (Garth, 1946), and extensive collecting in the Panama Bight since the time of A. Milne Edwards has been negative as regards the species. Southern Peru, then, rather than the Galapagos or Panama, should be considered as defining the northern limit of range of the species.

Genus ROCHINIA A. Milne Edwards

Amathia Roux, 1828, p. 8 of livr. 1, and/or p. 1 of text accompanying pl. 3. Not p. [5]; type: the Mediterranean *A. rissoana* Roux, 1828, by monotypy. Milne Edwards, 1834, p. 285. Not *Amathia* Lamouroux, 1812.

Pisa (Amathia) De Haan, 1839, pp. 78, 84.

Rochinia A. Milne Edwards, 1875, p. 86, footnote; type: *R. gracilipes* A. Milne Edwards, by monotypy. Rathbun, 1925, p. 204.

Scyramathia A. Milne Edwards, 1880, p. 356; type: *S. carpenteri* Norman by subsequent designation of Rathbun (1925). Alcock, 1895, p. 201. A. Milne Edwards and Bouvier, 1923, p. 379.

Anamathia Smith, 1885, p. 493; name substituted for *Amathia* Roux, preoccupied.

Rachinia Alcock, 1895, p. 165.

Type: The south Atlantic *Rochinia gracilipes* A. Milne Edwards, 1875, by monotypy.

Description: Carapace pyriform or elongate-triangular, armed either with tubercles or with long spines. Hepatic and branchial spines always prominent and very conspicuous. Rostrum consisting of two spines, usually long and slender. Eyes small, and retractile against a sharp postocular process commonly but little cupped; a supraocular eave terminating either in a forwardly directed tooth or in an upturned spine. Basal antennal article not very broad, sharply truncated; the mobile portion of the antennae freely exposed on either side of the rostrum.

Merus of the external maxillipeds as broad as the ischium, slightly expanded at the anteroexternal angle, and bearing the palp at the antero-internal angle.

Chelipeds in the adult male enlarged [i. e., elongated], with the palms broadened and compressed. First pair of ambulatory legs markedly the longest.

Abdomen in both sexes consisting of seven distinct segments. (Alcock, modified, of *Scyramathia*).

Range: Eastern Pacific: from 5 miles south of San Benito Islands, Lower California, to Gorda Banks, Gulf of California, Mexico; Galapagos Islands; western Atlantic: from off Nantucket Shoals, Massachusetts, to Cape Horn. Occurs also in the eastern Atlantic, Mediterranean, Indian and western Pacific oceans as far north and east as Japan. 40-633 fathoms.

Remarks: Evidence that the genus formed by uniting *Anamathia*, *Rochinia*, and *Scyramathia*, as above, may be diphyletic is to be found in the male first pleopods. Those of *Rochinia gracilis* (Atlantic), *R. cornuta*, and *R. occidentalis* (see Plate Q, figs. 6, 7) resemble that of *Pisoides*, while that of *Rochinia vesicularis* (see Plate P, fig. 6) resembles those of *Scyra* and *Chorilia* (= *Hyastenus*). Unfortunately, their separation cannot be accomplished along the lines suggested by their earlier synthesis, for the pleopods of both *Rochinia rissoana* (type of *Anamathia*) and of *Rochinia carpenteri* (type of *Scyramathia*), as shown by camera lucida drawings provided by Dr. Isabella Gordon of specimens in the Norman collection (British Museum), are of the first or pisiform type. Rather, it will be necessary to examine the male pleopod of each of the *Rochinia* species on a world-wide basis in order to determine which of them should be united with *R. vesicularis* in an independent genus, a task that lies beyond the scope of the present work. Thus in due time, the superficial resemblance of *Scyramathia* to *Hyastenus* noted by Sars (1885, p. 6) and to *Pugettia*, which has a scyriiform pleopod although belonging in another subfamily, noted by Alcock (1895, p. 202) will have received structural confirmation.

KEY TO THE PACIFIC AMERICAN SPECIES OF *Rochinia*

- 1a. Median tubercles 3; gastric 3. Rostrum longer than one-half remainder of carapace. Pleopod pisiform . . . *cornuta*
- 1b. Median tubercles 4; gastric 4. Rostrum shorter than one-half remainder of carapace
 - 2a. Two spines on basal antennal article; an oblique row of 3 spines from the anterior median gastric spine to the marginal branchial spine. Pleopod scyriiform . . . *vesicularis*
 - 2b. One spine on basal antennal article; an oblique row of 5 spines from the anterior median gastric spine to the marginal branchial spine. Pleopod pisiform . . . *occidentalis*

Rochinia vesicularis (Rathbun)

Plate P, Fig. 6; Plate 31, Fig. 1

Scyramathia vesicularis Rathbun, 1907, p. 73, pl. 5, fig. 7; pl. 8, figs. 1, 1a.

Rochinia vesicularis, Rathbun, 1925, p. 221, pl. 230. Crane, 1937, p. 58, pl. 3, figs. 8, 9.

Type: Male holotype, U.S.N.M. No. 32860, length 20.7 mm, width 11.5 mm.

Type locality: Southeast of Hood Island, Galapagos Islands, 300 fathoms, *Albatross* station 4642.

Localities subsequently reported, with collectors: Gulf of California, Mexico: Gorda Banks, 40-100 fathoms, *Zaca* (Crane).

Atlantic analogue: None.

Diagnosis: Four median and four gastric spines. Rostral horns slender, from one-third to two-fifths length of remainder of carapace. Two spines on basal antennal article and a spine posterior to these on orbital margin. Walking legs with a distal meral spine. Male first pleopod much like that of *Scyra*: a stout, pointed tip opposed by two lobate projections with concavities approximated, an erect spinate lobe between them directly above orifice.

Description: Body and legs everywhere covered with a pubescence formed of spherical vesicles; a few long, slender hairs on the gastric region, the lateral margins, and the rostrum. Carapace armed with eighteen short, stout, and pointed spines, four on the gastric region, one on the cardiac, one on the intestinal region, four on each branchial region, one on each hepatic region, and one above each eye; in addition, the post-ocular lobe narrow, curved, and acute. Rostrum composed of two slender, divergent horns, two-fifths the length of the rest of the carapace. Eyes visible even when retracted against the postocular lobe. The narrow basal antennal article having an anteroexternal spine, and two spines further back on the outer margin; flagella situated outside the rostrum. Ischium and merus of outer maxillipeds with a concave surface.

Chelipeds of male just as long as the carapace and rostrum and little stouter than the other legs; arm with four short spines above, increasing distally; wrist with three or four similar spines; palm with sides parallel, one and one-half times as long as the fingers, fingers meeting when closed.

Merus of all the ambulatory legs with a spine or tooth at the distal end. First pair one and one-half times as long as carapace and rostrum.

In the female the rostrum shorter, one-third length of remainder of carapace; the cheliped equaling length of carapace and half the rostrum; the fingers relatively longer than in the male; first pair of ambulatories one and one-fifth times as long as carapace and rostrum. (Rathbun, 1907, modified)

In an amended description Rathbun (1925) increased the number of carapace spines to twenty, the extra pair being on the branchial region, and removed the posterior of three spines in line from the basal antennal article, as in the diagnosis above. The edges of the fingers are crenulate.

Material examined: 5 specimens from 3 stations. (See Table 58) From 5 miles south of San Benito Islands to San Jaime Bank, off Cape San Lucas, Lower California, Mexico.

Measurements: Largest specimen, male: length including rostral spines 19.6 mm, width including branchial spines 13.3 mm, rostrum 5.2 mm, narrowest width 2.3 mm, cheliped 19.2 mm, chela 9.0 mm, dactyl 4.4 mm, ambulatory legs 27, 23, 20, and 19 mm, respectively. Female: length 11.1 mm, width 7.1 mm.

Color in life: Not recorded.

Habitat: Rocky bottom. (Crane) The three stations from which Hancock expeditions specimens were recovered had bottoms of rock, sand, and coralline.

Depth: 40 fathoms (Crane) to 300 fathoms. *Velero* specimens are from 52-97 fathoms only.

Size and sex: It is thought that all known specimens, including the 20.7 mm holotype, are young, since specimens of related species attain the following dimensions: *Rochinia crassa* (Atlantic) 95 mm, *R. histrix* (Atlantic) 41.5 mm, *R. cornuta* (Pacific) 50.2 mm, and *R. occidentalis* (Pacific) 57 mm.

Breeding: Ovigerous females of the species are unknown.

Remarks: Although *Rochinia vesicularis* was originally described from the Galapagos Islands, there can be no doubt that specimens taken off Lower California by the *Velero III* and *IV* and in the Gulf of California by the *Zaca* are this species. The male from San Benito Islands, station 1119-40, was compared with the type in the collection of the U. S. National Museum and agrees in every particular.

The 18.6 mm male from San Jaime Bank, station 618-37, has the requisite number of carapace spines, but some have been broken off at their bases. In addition to the 20 dorsal spines, there are 4 pairs of lateral spines, 3 of which are subbranchial, 1 subhepatic.

Rochinia cornuta (Rathbun)

Plate Q, Fig. 6

Anamathia cornuta Rathbun, 1898, p. 571, pl. 41, fig. 2.*Scyramathia cornuta*, Rathbun, 1907, p. 73.*Rochinia cornuta*, Rathbun, 1925, p. 217, pl. 227, fig. 2.

Type: Ovigerous female, holotype, U.S.N.M. No. 21572, length 50.2 mm, width 20.2 mm.

Type locality: Northeast of Indefatigable Island, Galapagos Islands, 392 fathoms, *Albatross* station 2818.

Localities subsequently recorded, with collectors: Off Hood Island, Galapagos Islands, 633 fathoms, *Albatross* station 4641 (Rathbun, 1907).

Atlantic analogue: None. A Galapagos endemic species.

Diagnosis: Three median and three gastric tubercles; two long paired marginal spines. Rostral horns long, divergent, length equal to half or more than half remainder of carapace. One spine on outer margin of basal antennal article. A blunt distal meral spine on ambulatory legs. Male first pleopod as in *Pisoides*: tip bluntly pointed, no lobate projections, but a compressed, spinulous shoulder on opposite side of subterminal aperture.

Description: Surface closely covered with tuberculiform cutaneous vesicles, a few curved hairs among them. Tubercles and spines of the carapace as follows: gastric region with three short [spines], one median, the lateral in advance of the median; cardiac and intestinal regions each with one, short and conical; branchial region with two short, the posterior smaller and nearer the median line; hepatic and branchial regions each with a long, slender marginal spine directed outward, upward, and forward. Rostral horns very long and slender, nearly equaling or exceeding one-half the entire length of the carapace, and extending nearly to the base of the rostrum; slender, widely divergent, slightly arched. Pre-orbital spine short, slender, not reaching the base of the rostral horns; postorbital tooth rounded. Basal article of antenna with a short tooth or spine at the anterolateral angle. Pterygostomial ridge with three or four tubercles. A blunt rounded tooth at the angle of the buccal cavity.

Chelipeds slender. Merus triangulate; outer face with a low blunt ridge; upper margin with a sharp terminal spine, and a broad subacute tooth near the proximal end. Carpus with a superior longitudinal uneven crest, and a tubercle on the outer surface near the distal end. Propodus compressed, with a thin upper edge; dactylus more than one-half the

superior length of the propodus. Fingers with a narrow gape along their basal third; prehensile edges crenate.

Meri of ambulatory legs with a short spine; spine decreasing in size and acuteness from the first to the fourth pair, there becoming a blunt lobiform prominence. (Rathbun, 1898, modified)

Material examined: The type series, from northeast of Indefatigable Island, Galapagos, Lat. $0^{\circ} 29' S$, Long. $89^{\circ} 54' 30'' W$, 392 fathoms, April 15, 1888, *Albatross* station 2818, 5 males and 2 females, including the ovigerous holotype, U.S.N.M. No. 21572. None from among Hancock collections.

Measurements: Ovigerous female, holotype: length 50.2 mm, width exclusive of spines 20.2 mm, rostrum 26.5 mm, length of branchial spine 9.0 mm. Male: length 35.9 mm, width exclusive of spines 14.5 mm, rostrum 17.8 mm, length of branchial spine 6.2 mm.

Color in life: Unknown.

Habitat: Sand; *Globigerina* ooze. (Rathbun)

Depth: 392-633 fathoms.

Remarks: Through the courtesy of Dr. F. A. Chace, Jr., curator of marine invertebrates, U. S. National Museum, a male paratype was made available for dissection. Although crushed, the specimen yielded the pleopod from which the accompanying sketch (Plate Q, fig. 6) was made. The dissimilarity of this pleopod to that of *Rochinia vesicularis* suggests that the genus *Rochinia*, as presently constituted, may be diphyletic, including species which are related to *Scyra* and *Chorilia* on the one hand, and to *Pisoides* and *Pelia* on the other.

***Rochinia occidentalis* (Faxon)**

Plate Q, Fig. 7

Anamathia occidentalis Faxon, 1893, p. 150; 1895, p. 8, pl. 1, figs. 2, 2a.

Rochinia occidentalis, Rathbun, 1925, p. 220, pl. 228; pl. 229, fig. 5.

Type: Male holotype, M.C.Z. No. 4479, length without rostral horns 45 mm, width 38 mm, rostral horns 12 mm.

Type locality: Off the Galapagos Islands, Lat. $1^{\circ} 03' S$, Long. $89^{\circ} 28' W$, 385 fathoms, *Albatross* station 3404.

Localities subsequently reported: Known only from the type locality, above.

Atlantic analogue: None. A Galapagos endemic species.

Diagnosis: Four median and four gastric spines. Rostral horns awl-shaped, divergent, rostrum over one-fourth carapace length. Branchial spine largest, over half as long as rostral horn. One spine on outer mar-

gin of basal antennal article. Male first pleopod with a short, acute tip; aperture delimited by fleshy folds that have a tendency to curl outward, the more prominent fold obtusely angled.

Description: Carapace pyriform, strongly arched when viewed in profile, its surface clothed with tuberculiform cutaneous vesicles and with delicate setae hooked at their tips. The spines and tubercles of the carapace arranged as follows: four on the gastric region, two of these in the median line and one on each side; the posterior median having the form of a blunt tubercle, from this a blunt low keel running back to the cardiac region; one in the middle of the cardiac region; one [tubercle] on the intestinal region; one on each hepatic region; five on each branchial region. Of the branchial spines the one near the middle projecting upward and forward, and the longest spine on the carapace, being one-half as long as the rostral horns; behind and inside of this a short, rather blunt spine in a transverse line with its fellow and the cardiac spine; the three remaining branchial spines arranged in a triangle on the anterior part of the branchial area; those nearest the median line on the branchial areas short and blunt—tubercles rather than spines. In addition to these prominent spines and tubercles of the carapace, four or five small tubercles on the outer border of the pterygostomian region. The rostrum produced into two divergent, awl-shaped horns, more than one-fourth the length of the remaining portion of the carapace. The preocular spines well developed and acute, the postocular processes obtuse. The basal segment of the antenna projecting at the anteroexternal angle in the form of a short, blunt spine or tubercle. The anteroexternal angle of the buccal area projecting, but not forming a dentiform process.

The chelipeds twice as long as the carapace, minus the rostral horns, and but little more robust than the ambulatory [legs]; the carpus with two low ridges on the outer face; the chela a little longer than the merus, the basal part cylindrical, the distal part gradually widening to the base of the fingers. The fingers slightly curved, less than one-half as long as the basal portion, smooth, prehensile edges regularly dentate, closing throughout their length.

The first ambulatory legs exceeding the chelipeds by the length of the [dactylus]. The other pairs successively shorter, the last pair being shorter than the chelipeds. The merus of all the legs with a small tubercular projection at the distal end above, most prominent on the anterior pair; otherwise the legs unarmed, but closely invested with minute papillae, like the carapace.

The abdomen seven- [segmented]. (Faxon, 1895, modified)

Material examined: Through the courtesy of Dr. Elisabeth Deichmann of the Museum of Comparative Zoology, Harvard, it has been possible to obtain on loan the right first pleopod of the unique male holotype.

Measurements: Male holotype: length without rostral horns 45 mm, width 38 mm, length of rostral horns 12 mm, length of branchial spine 7 mm. (Faxon)

Color in life: Unknown.

Remarks: The similarity of the male first pleopod (see Plate Q, fig. 7) to that of *Rochinia rissoana* (Roux), type of the genus, is striking. The writer is indebted to Dr. Isabella Gordon of the British Museum (Natural History) for a camera lucida sketch of the male first pleopod of the latter species, made from a specimen in the Norman collection.

Genus **LIBIDOCLAEA** Milne Edwards and Lucas

Libidoclaea Milne Edwards and Lucas, 1843, p. 6. Rathbun, 1925, p. 223.

Type: *Libidoclaea granaria* Milne Edwards and Lucas, by monotypy.

Description: Carapace pyriform, convex above, and laterally rounded due to expansion of branchial regions; gastric region distinct, elongate; genital region small and triangular, invaded posteriorly by the branchial regions, separated from one another by a deep depression; cardiac and intestinal regions indistinct and very oblique; hepatic regions rudimentary. Surface covered with fine granulations and spinous tubercles, the longest occupying the branchial, cardiac, and intestinal regions. Rostrum elongate, narrow, and notched at extremity. Orbits divided above and below by a groove; a strong preorbital spine. Eyes short, stout, and retractile. Basal antennal article well developed, a strong tooth near middle of external margin. Buccal cavity closed by third maxillipeds. Sternal plastron broader than long, anterior portion oblique. Chelipeds elongate, robust, not surpassing next pair of legs; fingers elongate, slender, and internally denticulate. Ambulatory legs slender, diminishing progressively in length; dactyli slender, elongate, and slightly curved.

Abdomen of the male [and of the female] composed of seven segments. (After Milne Edwards and Lucas)

Range: From Valparaiso, Chile, to Gulf of San Matias, Argentina. 10-1050 fathoms.

Libidoclaea granaria Milne Edwards and Lucas

Plate P, Fig. 7; Plate 32, Fig. 1

Libidoclaea granaria Milne Edwards and Lucas, 1842, atlas, pl. 3, fig. 1; pl. 4, figs. 1, 1a, 1b; 1843, p. 8. Nicolet, 1849, p. 129. Miers, 1886, p. 72. Rathbun, 1910, p. 572; 1925, p. 224, pls. 76-78; pl. 231, figs. 1, 2, 4-6. Garth, 1957, p. 27.

Libidoclea coccinea Dana, 1851a, p. 268; type locality, off Eastern Patagonia; type not extant; 1852, p. 88; 1855, pl. 1, figs. 3a-d.

Libinia coccinea, Miers, 1886, p. 73. Rathbun, 1898, p. 574.

Libinia gracilipes Miers, 1886, p. 74, pl. 9, figs. 2-2c; type locality, off Chiloe, 45 fathoms, *Challenger* station 304; male holotype in British Museum. Pfeffer, 1890, p. 545. Murray, 1895, p. 1140.

Libidoclea granaria, Porter, 1936a, p. 152.

Libidoclea granaria, Porter, 1936b, p. 337.

Type: Male holotype, length 67 mm, width 56 mm, in Paris Museum.

Type locality: Environs of Valparaiso, Chile. A. d'Orbigny, collector.

Localities subsequently reported, with collectors: Chile: Chiloe, 45 fathoms, *Challenger* (Miers, 1886; Murray); Porto [Puerto] San Pedro, depth not given, *Hassler* (Rathbun, 1925); Bahía de Concepción, near Talcahuano (Porter, 1936a). The remaining localities are Atlantic.

Diagnosis: Not more than two lateral marginal spines, the branchial always the stronger. Chelipeds of old males massive, but not exceeding length of first ambulatory legs. Rostrum bifurcate for less than half its length. Branchial spine less than half as long as width of branchial region. Apex of male first pleopod flaring, tip bluntly pointed; opening expansive, protected above by a suberect lobe.

Description: Spines and tubercles of carapace very unequal; the principal spines proportionally much longer in the young than in the old. Gastric tubercles seven, three median, the middle one sometimes almost disappearing, and two on each side in a longitudinal line; a long cardiac spine, a longer intestinal spine, a still longer spine on the lateral margin at the widest part of the carapace and opposite the narrow anterior border of the cardiac region. Hepatic margin produced in a spine. A curved line of tubercles following the innermost margin of the branchial region; among the larger tubercles of this region a triangle of three near the gastric region prominent; a still larger spine lying above the postero-lateral margin and in a line with the cardiac spine; from it a row of

spines curving downward and then forward and continued on the sub-branchial and the pterygostomian regions, ending in a flat triangular spine at the angle of the buccal cavity. Rostrum inclined downward; horns short, moderately spreading. Supraocular eave narrow, armed with a sharp, ascending spine, and divided from the postocular cup by a narrow fissure; this cup in lateral view showing a rounded lobe. This in turn separated by a broad, curved sinus from the basal segment of the antennae. The segment anteriorly narrowed and its outer margin occupied by two stout curved spines. A well developed tubercle behind the orbital sinus. Merus of the outer maxillipeds a little longer than wide, its antero-external angle broadly rounded.

Chelipeds and legs very long, the chelipeds not so long as the first pair of ambulatory legs even in the fully developed male, there stouter than the legs. Their surface rough with fine sharp granules, invisible to the naked eye, but evident to the touch when the appendage is rubbed from the distal end toward the carapace. Palms of old male compressed, a little narrower at proximal end than elsewhere; fingers about two-thirds as long as upper margin of palm, gaping at base and armed with low teeth on their prehensile edges.

A smooth longitudinal depression on the upper surface of the carpus of the ambulatory legs. (Rathbun, 1925, modified)

Material examined: Lund University Chile Expedition material: four specimens from two stations, both Chilean. U. S. National Museum material: two specimens from a single *Albatross* station, Argentina. (See Table 59)

Measurements: Male: length including rostral but not intestinal spines 35.9 mm, width without branchial spines 29.7 mm, rostrum 6.2 mm, narrowest width 2.9 mm, cheliped 41 mm, chela 19.8 mm, dactyl 10.3 mm, height of palm 3.6 mm, ambulatory legs 65, 58, 50, and 45 mm, respectively. Female: length 34.1 mm, width without branchial spines 28.5 mm.

Color in life: Scarlet. (Dana) "Red-brown." (Field notes of Dahl and Brattström)

Habitat: Specimens from off Gulf of San Matias, Patagonia, were dredged by the *Albatross* in fine dark sand. An old male from Porto [Puerto] San Pedro, *Hassler*, was encrusted with barnacles.

Depth: 30-52 fathoms. Lund University Chile Expedition specimens, however, were collected in 30-55 meters, suggesting a shallower minimum depth for the species.

Size and sex: Large individuals recorded to date are males of 60.4 mm (Dana), 67 mm (Milne Edwards and Lucas), and 90.5 mm (Rathbun, 1925). Of the latter specimen (M.C.Z. No. 1870) Rathbun writes: "The dorsal spines of the carapace are reduced to tubercles; even those of the margins are short and conical. The rostrum is much wider at the base than its length and does not widen at the tip as in the young. The inner margins of the orbits converge anteriorly, and the width of the body, exclusive of spines, in relation to its total length, is greater than in smaller specimens." Males in the Lund University Chile Expedition series range from 25.7 to 50.0 mm, females from 25.3 to 32.2 mm, the latter an ovigerous specimen.

Breeding: A single ovigerous female was obtained by the Lund University Chile Expedition in Seno Reloncaví, Chiloe, in December.

Remarks: Lund University Chile Expedition material bears out the segregation of *Libidoclaea granaria* from *L. g. smithi* on the basis of depth, *L. granaria* being the shallow water form.

***Libidoclaea granaria smithi* (Miers), new combination**

Plate P, Fig. 8; Plate 32, Fig. 2

Libinia smithii Miers, 1886, p. 73, pl. 9, figs. 1-1c. Pfeffer, 1890, p. 545. Rathbun, 1898, p. 574.

Libinia hahni A. Milne Edwards, 1891, p. 5, pl. 1, figs. 1-6 (♀); type localities, Beagle Channel, in sight of Loupataya, 198 meters, and near Murray Narrows, 280 meters; female holotype in Paris Museum. Lenz, 1902, p. 757.

Libidoclaea smithii, Rathbun, 1925, p. 226, pls. 74, 75; pl. 231, fig. 3.

Libidoclaea smithi, Garth, 1957, p. 28.

Type: Male holotype, length 26 mm, width 25 mm, rostrum 13.5 mm, in British Museum.

Type locality: Off Chiloe, 45 fathoms, *Challenger* station 304.

Localities subsequently reported, with collectors: Chile: Calbuco, 10-15 fathoms, L. Plate (Lenz, as *Libinia hahni*); off Chonos Archipelago, 1050 fathoms, off Port Otway [Puerto Barroso], 61 fathoms, between Wellington Island and mainland, 194 fathoms, off Esperanza Island, 122 fathoms, and Strait of Magellan, 369 fathoms, *Albatross* (Rathbun, 1898); Beagle Channel in sight of Loupataya, 198 meters, and near Murray Narrows, 280 meters, Scientific Mission to Cape Horn (A. Milne Edwards, as *Libinia hahni*).

Diagnosis: Rostrum bifurcate for half its length. Branchial spine half as long as width of branchial region. Other carapace spines proportionately longer than in typical *Libidoclaea granaria*.

Description: Differs from *Libidoclaea granaria* [the typical form] in the greater length of the rostrum and of certain spines of the carapace. Rostrum in the largest male nearly half as long as the postrostral portion of the carapace not counting the posterior spine, the horns occupying half the length of the rostrum and diverging widely. Spine at the lateral angle of the carapace the longest and equaling in length the width of the branchial region. Four elongate median spines, namely, the intestinal, cardiac, anterior, and posterior gastric; the hepatic spine; two branchial spines (paired); preocular spine (paired). Tubercles of the carapace fewer and lower than in [typical] *L. granaria* of similar size. In the females examined the rostral horns less divergent than in the males, but the long spines of the carapace very little if any shorter than in the male. In the young only six spines noticeably longer than in *L. granaria* of the same size, viz., the two rostral, cardiac, intestinal and lateral branchial (paired). (Rathbun, 1925, modified)

Material examined: Lund University Chile Expedition material: five specimens from five stations, all Chilean. U. S. National Museum material: two specimens from a single *Albatross* station, also Chilean. (See Table 60)

Measurements: Female: length without intestinal spine 30.7 mm, width without branchial spines 21.5 mm, rostrum 7.7 mm, narrowest width 2.2 mm, cheliped 28.7 mm, chela 13.5 mm, dactyl 6.7 mm, height of palm 2.3 mm, ambulatory legs 50, 44, 40, and 37 mm, respectively. Male: length 23.8 mm, width without branchial spines 15.7 mm, length of branchial spine 7.0 mm.

Color in life: Red-brown. (Dahl and Brattström, field notes)

Habitat: *Albatross* specimens were recovered from green and blue mud. (Rathbun, 1898)

Depth: 61-1050 fathoms, with the exception of specimens obtained by Plate at Calbuco in 10-15 fathoms, and attributed by Lenz to *Libinia hahni*, a synonym of *Libidoclaea smithi*. Lund University Chile Expedition specimens were dredged in 60-300 meters, indicating a lesser minimum depth for this, the deep water form.

Size and sex: Lund University Chile Expedition specimens range in size from young of 4.4 and 5.0 mm and a male of 9.7 mm to females of from 26 to 34 mm. An ovigerous female (U.S.N.M. No. 21920) measures 51.8 mm in length.

Breeding: The egg-bearing female above was obtained by the *Albatross* in the Strait of Magellan in February, which is mid-summer in the Southern Hemisphere.

Remarks: The characters formerly used to differentiate *Libidoclaea smithi* as a full species are here used to distinguish it as a subspecies of *L. granaria*. It will be noted that they are differences of degree, rather than of kind, having reference to relative lengths of spines of carapace and rostrum, rather than to the different placement of any of them. Retention of *smithi* as a subspecific designation is based upon evidence that, Lenz's apparently contradictory record notwithstanding, its distribution can be correlated with lower temperature and greater depth than temperatures and depths appropriate to typical *Libidoclaea granaria*. A comparative situation exists in the Northern Hemisphere with respect to *Chorilia longipes* and *C. longipes turgida*, the latter being the deep water form. There is no apparent difference between the male first pleopods of *Libidoclaea granaria* and of *L. granaria smithi*. (See Pl. P, figs. 7 and 8.)

Genus NOTOLOPAS Stimpson

Notolopas Stimpson, 1871a, p. 96. Miers, 1886, p. 64. Rathbun, 1925, p. 287.

Type: *Notolopas lamellatus* Stimpson, by monotypy.

Description: Carapace subpyriform, moderately convex, and rounded posteriorly; the posterior margin more or less distinctly carinated, the dorsal surface bearing a few spines. The orbits having a single hiatus, or a hiatus and a notch in the superior margin, and a wider hiatus below, and bearing a preocular spine or tooth. Rostrum well developed, with the spines coalescent at the base and afterwards divergent. Eyes short, retractile. Antennae with the basal [article] considerably enlarged with a spine or tooth at the anteroexternal angle, and often another on the exterior margin; the following [articles] slender and not concealed by the rostral spines. The merus of the external maxillipeds distally truncated, with the anteroexternal angle rounded, a little, if at all, produced, and the anterointernal angle very slightly emarginate.

The chelipeds in the adult male slender; palm somewhat elongated and slightly compressed; fingers with but a small intermarginal hiatus. The ambulatory legs very slender, with the [segments] subcylindrical, the first pair considerably the longest; the dactyli slightly curved and nearly as long as the [propodi].

Abdomen (in the male) distinctly seven-[segmented]. (Miers)

Range: From Rocky Point, Sonora, Mexico, to La Libertad, Ecuador; Atlantic ocean from Beaufort, North Carolina, to Bahia, Brazil. Shore to 55 fathoms.

KEY TO THE PACIFIC AMERICAN SPECIES OF *Notolopas*

- 1a. Posterior portion of carapace with upturned margin; cardiac region depressed. Merus of outer maxilliped subquadrate. Tip of male first pleopod conical *lamellatus*
- 1b. Posterior portion of carapace without upturned border; cardiac region elevated, dome-shaped. Merus of outer maxilliped subtriangular. Tip of male first pleopod triangular *mexicanus*

Notolopas lamellatus Stimpson

Plate Q, Fig. 8; Plate 33, Fig. 1

Notolopas lamellatus Stimpson, 1871a, p. 97. A. Milne Edwards, 1875, p. 71. Miers, 1886, pp. 64, 65, pl. 8, fig. 1c. Rathbun, 1910, p. 572; 1925, p. 287, pl. 81; pl. 238, fig. 1, text-fig. 95. Garth, 1948, p. 26.

Pelia orbiculata Finnegan, 1931, p. 621, text-fig. 4; type locality, Balboa, Panama; female [not male] holotype in British Museum.

Type: Cotypes, including a measured male, length 16 mm, width 8.9 mm, originally in the collections of the Smithsonian Institution, no longer extant.

Type localities: Panama, Captain J. M. Dow, and Manzanillo, Mexico, J. Xantus, collector.

Localities subsequently reported, with collectors: Nicaragua: Corinto and Carbon [Cardón] Island, Corinto, J. A. McNeil (Rathbun, 1925). Costa Rica: Puntarenas, P. Biolley (Rathbun, 1925). Panama: Taboga Island and Panama City, J. Zetek (Rathbun, 1925); "Panama," Hassler (Rathbun, 1925); Balboa, *St. George* (Finnegan, as *Pelia orbiculata*); Piñas Bay and Guayabo Chiquito, *Askoy* (Garth). Colombia: Ardita Bay and Málaga Bay, *Askoy* (Garth).

Atlantic analogue: The species itself is said by Rathbun (1925) to occur in the Atlantic, on the strength of an ovigerous female from off Beaufort, North Carolina.

Diagnosis: Posterior margin of carapace sharply rimmed, a stout median spine. Cardiac region depressed. Rostrum long, horns widely diverging. Basal antennal article with a strong lobe on outer margin. Merus of external maxilliped subquadrate. Tip of male first pleopod acute, subconical, well separated from opposing fold bearing the aperture.

Description: Posterior half of dorsum flattened, enclosed by a ridge which posteriorly becomes a broad concave lamella projecting over the posterior margin; four equidistant spines on this margin, two median, the gastric spine at the highest point of the carapace, the other two branchial, above the widest part of the carapace. Cardiac region a rounded nodule. Two small protogastric spines. Rostrum bifurcate for half its length, horns tapering, acute, widely divergent. A short but well marked supraocular spine. Basal antennal article much widened, especially posteriorly, there forming a strong lobe on the margin; tooth at anteroexternal angle a little more advanced than that at anterointernal angle. A small lobe behind outer margin of basal article and in transverse line with antennal glands. Anterointernal outline of merus of external maxilliped oblique, slightly notched.

Chelipeds of largest male examined, which may not have reached its full development, just as long as next leg, palm slightly narrowed distally, gape of fingers slight.

Abdomen of male widened a little at end of sixth segment. (Rathbun, 1925)

Male abdominal appendages of the first pair somewhat flattened, reaching to the last segment of the abdomen, and tapering very little toward the extremity; extremity truncate and expanded, with a fold on the outer and a small slender hook on the inner side. (Stimpson, 1871a, p. 96)

Although considerable variation is present among the extensive series of *Notolopas lamellatus* examined, lots from given localities show such remarkable uniformity with respect to certain important characters as to suggest that the variation has a geographical basis. Gulf of California specimens, especially those from the north, are large (19.3 mm ♀) as compared with those from Ecuador (13.0 mm ♂). They show a long rostrum with widely divergent horns, a strong preorbital but no intermediate orbital spine, a postocular cup basally broadened, and strong protogastric spines. The same type, but more generally without the preorbital spine, occurs as far south as Costa Rica commonly, and sporadically to Ecuador, where individuals are of larger size than the prevailing local form. The Ecuadorean specimens, as exemplified by a splendid series from La Libertad, station 209-34, have a well developed intermediate spine between the preorbital spine and the postocular cup. The carapace is widest basally, instead of medially, and if supernumerary spines are present, they tend to be the intestinal and (rarely; an ovigerous female from station 9-33) the cardiac. This form occurs occasionally as far north as Guatemala.

Material examined: 87 specimens from 21 stations. (See Table 61) From Rocky Point, Sonora, Mexico, to Santa Elena Bay, Ecuador. In addition to the above, 10 specimens from 4 *Askoy* expedition stations (Garth, 1948), and 9 specimens from five Costa Rican and Panamanian localities in the collections of the U. S. National Museum.

Measurements: Largest specimen, a female: length 19.3 mm, width exclusive of lateral spines 9.7 mm, rostrum 5.8 mm, width 2.2 mm, cheliped 12 mm, ambulatory legs 14, 10.6, 10.2, and 9.6 mm, respectively. Largest male, length 18.4 mm, width 10.5 mm, rostrum 5.6 mm, width 2.4 mm, cheliped 20.5 mm, chela 9.7 mm, dactyl 3.3 mm, ambulatory legs 20.6, 13.5, 12.2, and — mm, respectively.

Color in life: Unrecorded.

Habitat: Gray sand, green sandy mud. (Garth) Excluding the two shore stations, which were rock and sandstone, dredge stations from which the species was recovered show a primary breakdown into sand 58 per cent, mud 33 per cent, and rock 8 per cent. The sand was often combined with rock, shell, or mud; the mud similarly contained sand, shell, or rock. None were taken on coral or coralline bottom.

A specimen from Tangola-Tangola Bay, Oaxaca, Mexico, station 259-34, carries a rhizocephalan parasite.

Depth: Shore to 20 fathoms; exceptionally to 55 fathoms.

Size and sex: In the Gulf of California males of from 9.5 to 18.4 mm, females from 9.0 to 19.3 mm, and ovigerous females from 14.3 to 15.5 mm were found. In Ecuador males ranged from 5.8 to 13.0 mm, females from 7.5 to 10.5 mm, ovigerous females 9.0 mm, and young from 3.5 mm. In the intervening territory, Mexico to Panama, males were from 6.5 to 17.8 mm, females from 6.8 to 14.4 mm, ovigerous females from 8.5 to 10.0 mm, and young from 4.0 mm.

Breeding: Ovigerous females were encountered by the *Velero III* in the Gulf of California in February and March, off Guatemala in January and March, and off Ecuador in mid-January.

Remarks: It will be seen from the paragraph on variation above that the character which has heretofore been relied upon to separate genera from one another, namely, the small spine intercalated between the pre-orbital tooth and the postocular cup, is subject in *Notolopas lamellatus* to intraspecific variation. The writer considers this primary evidence against the division of the Pisinae of Alcock into the Pisinae *sensu restr.* and Hyasteniinae of Balss (1929) on the strength of this character. Ideally, the key to genera should make allowance for those specimens of *Notolopas* in which the spine is absent or but weakly developed.

Notolopas mexicanus Garth

Plate Q, Fig. 9; Plate 33, Fig. 2

Notolopas mexicanus Garth, 1940, p. 61, pl. 14, figs. 1-4.

Type: Male holotype, U.S.N.M. No. 91081, length 7.5 mm, width 5.2 mm.

Type locality: South and west of White Friars, Guerrero, Mexico, 25 fathoms, *Velero III* station 264-34.

Localities subsequently recorded: Known only from the type locality.

Atlantic analogue: *Notolopas brasiliensis* Miers.

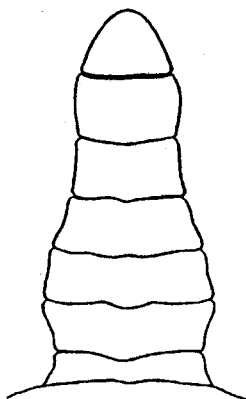
Diagnosis: Posterior margin of carapace smoothly rounded, no carina or posterior marginal spine. Cardiac region high, domed. Rostrum short, horns little diverging. Basal antennal article with a shallow lobe on outer margin. Merus of external maxilliped subtriangular. Tip of male first pleopod triangular, acuminate, setiferous, and sharply bent at an angle of 90°; tip opposed by a smaller, thinly rimmed lobe in which aperture is situated.

Description: Carapace subpyriform, convex, and posteriorly rounded. Regions elevated, separated by deep, naked sulci and surmounted by well-defined tracts of curved setae with the two epigastric most isolated. Rostrum short, horns divergent and papillate, each bearing two rows of curved setae, tips incurving. Supraocular spine slender and curving forward; postocular cup broad, exteriorly flattened; a minute tooth between pre- and postocular projections. Four equidistant setose tubercles, one gastric, two branchial, and one intestinal, forming a diamond on carapace; cardiac area dome-shaped, well separated from branchial swellings. Intestinal area projecting slightly below the general level of the posterior border; no lamellate posterior carina. Basal antennal article wide, concave, edge thin, a blunt spine at anteroexternal angle, a shallow lobe near base, and a tubercle opposite green-gland opening; first movable segment slender, spinulose, reaching nearly to tip of rostrum and visible in dorsal view; flagellum overreaching rostrum by twice its length. Merus of third maxilliped produced at both internal and external distal angles until almost triangular; ischium with internal margin spinulose. Two compressed lobes on pterygostomian ridge. A pair of deep sternal indentations opposite coxae of chelipeds.

Chelipeds of male stouter than legs, merus and propodus of approximately equal length. Merus with four evenly spaced tubercles along inferior margin, the proximal being largest. Manus moderately compressed, fingers gaping slightly at base, regularly toothed, tips crossing.

Ambulatory legs diminishing regularly in length, cylindrical, pubescent; dactyli almost as long as propodi, tips curved.

Sternal trough extending past tip of abdomen, incompletely filled by it. Male abdomen (see text-fig. 7) with seven free somites. (Garth, 1940, revised)



7. *Notolopas mexicanus*, male holotype (U.S.N.M. No. 91081), abdomen, x 15.

Chelipeds of female shorter and more slender than those of male, otherwise resembling them; fingers not crossing at tips.

In the female specimen the four tubercles in a diamond on the carapace of the male represented by four spinulose granules, the two branchial tending to become obsolete.

Material examined: In addition to the male holotype, an ovigerous female from Tenacatita Bay, Jalisco, Mexico, lagoon, February 15, 1935, station 487-35.

Measurements: Male holotype: length 7.5 mm, width 5.2 mm, exorbital width 3.2 mm, rostrum 1.1 mm, width 1.1 mm, cheliped 11.1 mm, chela 3.9 mm, height of palm 1.0 mm. Ovigerous female: length 6.5 mm, width 4.6 mm, rostrum 0.9 mm, width 0.7 mm, cheliped 5.7 mm, chela 2.5 mm, dactyl 1.0 mm, first ambulatory leg 6.0 mm.

Color in life: Unknown.

Habitat: Rock with gorgonids. (Garth) The female specimen from Tenacatita Bay was collected in a lagoon in association with *Pinna*, the hatchet clam.

Depth: Shoal water to 25 fathoms.

Breeding: The single ovigerous female was collected in February.

Remarks: The additional material extends the range of the species from the type locality, near Acapulco, Guerrero, north to Tenacatita Bay, Jalisco, Mexico.

Genus HERBSTIA Milne Edwards

Herbstia Milne Edwards, 1834, p. 301. A. Milne Edwards, 1875, p. 75.

Holmes, 1900, p. 36. Rathbun, 1925, p. 293.

Rhodia Bell, 1835b, p. 169; type: *R. pyriformis* Bell, 1836, by monotypy.

Herbstiella Stimpson, 1871a, p. 93; type: *Herbstia depressa* Stimpson, 1860, by original designation.

Fisheria Lockington, 1877c, p. 72; type: *F. depressa* Lockington, 1877 = *Herbstiella camptacantha* Stimpson (not *Herbstia depressa* Stimpson), by monotypy.

Type: The Mediterranean *Cancer condyliatus* Fabricius, 1787, type of *Herbstia* Milne Edwards by monotypy.

Description: Carapace broadly triangular or subpyriform, tuberculated or spinose. Rostrum short, the horns acute, vertically compressed, and dilated at the base. Orbits shallow, with or without a preorbital spine. Eyes short and not entirely concealed when retracted. Basal antennal [article] moderately dilated and armed with an anteroexternal spine, the distal portion not entirely covered by the rostrum. Merus of maxillipeds distally truncated and not produced at the outer angle.* Ambulatory legs rather slender, subcylindrical, and of moderate length; dactyls nearly straight, acute.

Abdomen in the male seven-[segmented]. (Holmes)

Range: Eastern Pacific from Monterey Bay, California, to Santa Elena Bay, Ecuador; Guadalupe, Clarion, Cocos, and Galapagos Islands. Western Atlantic: St. Thomas, Barbados, and Curaçao. Eastern Atlantic: African west coast and Mediterranean. Shore to 50 fathoms.

KEY TO THE PACIFIC AMERICAN SPECIES OF *Herbstia*

- 1a. Ambulatory legs spinulose. Orbit with one or more teeth. Carapace not strongly produced posteriorly. Male first pleopod without a notch
- 2a. Only one supraorbital tooth between pre- and postocular teeth. Male first pleopod with a setiferous fold in concave margin

*An exception will be noted in *Herbstia edwardsi* Bell.

- 3a. Three outer marginal teeth on basal antennal article, including anteroexternal tooth. Only one tooth in gape of male manus *camptacantha*
- 3b. Only two outer marginal teeth on basal antennal article, including anteroexternal tooth. Two teeth in gape of male manus. Galapagos only *edwardsi*
- 2b. Two supraorbital teeth between pre- and postocular teeth. Male first pleopod lacking setiferous fold, although opening may be concealed in a loose flap
- 4a. First movable antennal article not reaching tip of rostrum. Palm with proximal spinules above. Flap of male first pleopod projecting, triangular . . . *parvifrons*
- 4b. First movable article of antenna reaching or exceeding tip of rostrum. Palm entirely smooth. Flap of male first pleopod not projecting, opening concealed within *tumida*
- 1b. Ambulatory legs without spines. Orbit non-dentate. Carapace strongly produced posteriorly. Male first pleopod notched at level of spermiducal opening
- 5a. Four prominent spines on lateral margin of carapace. Palm of adult male with a spinulose crest. Rostrum longer than in 5b. Galapagos only *pyriformis*
- 5b. Numerous scattered small spines on lateral margin of carapace. Palm of adult male with spinulose crest obsolescent. Rostrum shorter than in 5a *pubescens*

***Herbstia camptacantha* (Stimpson)**

Plate S, Fig. 1; Plate 34, Fig. 1

Herbstia parvifrons, Stimpson, 1860b, p. 185. (Not *H. parvifrons* Randall)

Herbstiella camptacantha Stimpson, 1871a, p. 94.

Herbstia camptacantha, A. Milne Edwards, 1875, p. 78, pl. 18, fig. 3-3e. Rathbun, 1924c, p. 378; 1925, p. 294, pl. 105, figs. 1, 2; pl. 240, figs. 9-13.

Mithrax armatus?, Lockington, 1877c, p. 70. (Not *M. armatus* Sausure)

Fisheria depressa Lockington, 1877c, p. 72; type localities, Port Escondido and San José Island, Gulf of California; types not extant.

Herbstia (Herbstiella) depressa, Miers, 1879c, p. 655.

Herbstia (Herbstiella) camptacantha, Miers, 1886, p. 49. Holmes, 1900, p. 37 (part: not the California or Magdalena Bay specimens).

Microphrys depressa, Miers, 1886, p. 83.

Mithrax (Mithrax) sonorensis Rathbun, 1933, p. 338, pl. 24; type locality, San Pedro Bay, Sonora, Mexico; female holotype, U.S.N.M. No. 67865.

Mithrax sonorensis, Steinbeck and Ricketts, 1941, p. 467.

Type: Male cotype from Acapulco, M.C.Z. No. 991, length 17.1 mm, width 14.5 mm. The male cotype from Cape San Lucas, originally in the collections of the Smithsonian Institution, is no longer extant.

Type localities: Cape St. [San] Lucas, Lower California, John Xantus, collector, and Acapulco, Mexico, Alexander Agassiz, collector.

Localities subsequently reported, with collectors: Gulf of California: San Pedro Bay, Sonora, and Concepción Bay, Lower California, S. A. Glassell (Rathbun, 1933, as *Mithrax sonorensis*); Patos Anchorage, 4.5 fathoms, Fred Baker, California Academy of Sciences (Rathbun, 1924c); Port [Puerto] Escondido and San José Island, W. J. Fisher (Lockington, as *Fisheria depressa*); Coronado[s] Island, J. Steinbeck and E. F. Ricketts (Steinbeck and Ricketts, as *Mithrax sonorensis*). Central Mexico: Mazatlan, Hy. Edwards (Lockington, as *Mithrax armatus?*). Note: All California and west coast of Lower California specimens are treated under *Herbstia parvifrons* Randall.

Atlantic analogue: None. A Gulf of California-west coast of Mexico endemic species.

Diagnosis: Basal antennal article narrow; three outer marginal spines including anteroexternal spine. First movable article of antenna falling short of tip of rostrum; anteroexternal antennal spine directed forward rather than outward. Male first pleopod tapering, tip acute, slightly recurving, a setiferous fold on concave margin.

Description: Carapace slightly convex, and the surface very regularly and conspicuously punctate. The cervical suture deep and well marked, the sulci separating the branchial from the cardiac regions very shallow, and no sulcus whatever between the branchial and the rather flattened intestinal region. Twenty small tubercles on the carapace, not including the marginal spines; there are of these tubercles five on the gastric region, four arranged in a transverse line across the middle, the two on either side being approximated; three on the cardiac region, two on the intestinal, and five on each branchial region. Margin of the carapace on each side behind the orbit with fourteen spines; five on the anterolateral and nine on the posterolateral margin. Posterior spines very

small, blunt, or tuberculiform; but the anterior ones larger, and, like the spines on the legs, abruptly bent at the tip, having a truncated appearance, with the sharp apex pointing forward. A similar spine and two smaller ones on the subhepatic region; the oblique ridge separating the pterygostomian from the subhepatic region armed with five spines, the anterior three being small and toothlike. Horns of the rostrum rather large and divergent, forming considerably more than half the length of the rostrum, and with their tips as well as those of the antennal spines bent inward. All of the spines much more acute in young specimens than in adults.

Chelipeds long, the merus armed with numerous (about 13) blunt spines on the outer side; the carpus tuberculated above; the large and compressed hand perfectly smooth, and unarmed above and below; the fingers less than half as long as the palm, and gaping; and the dactylus bearing a strong truncated tooth at the middle. Merus of the ambulatory [legs] armed with seven to ten spines along the upper edge, and two or three below near the extremity; the carpus slightly tuberculated, and the [propodus] unarmed.

The adult male specimens entirely naked, but young and female specimens frequently pubescent. (Stimpson, 1871a, modified)

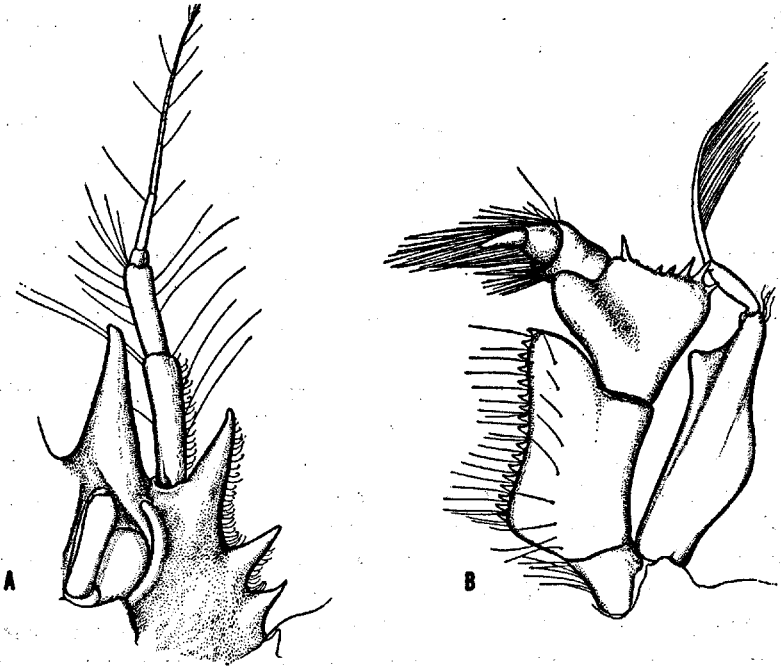
Supplementary description (based on a 21.6 mm male from San Esteban Island): Basal antennal article armed with three strong marginal spines including the anteroexternal; this spine larger and more anteriorly directed than the other two; first free antennal segment reaching nearly to tip of rostrum. (See text-fig. 8A)

Merus of external maxilliped slightly concave from side to side, anterointernal angle produced as a narrow, rounded lobe with a smooth margin, anteroexternal angle a broad, rounded lobe with a spinulous margin; an isolated, erect spinule just external to insertion of palpus. (See text-fig. 8B)

Male abdomen with seven free somites; widest at middle of somite three, narrowing gradually to base of somite six, then flaring slightly; somite seven triangular, tip rounded. Male first pleopod cylindrical, tapering, tip acute, recurving, a setiferous fold on concave margin. (See Plate S, fig. 1)

Carpus of cheliped spinulous, not smooth as shown by A. Milne Edwards (1875, pl. 18, fig. 3). In spite of its large size, the specimen shows only an incipient digital tooth.

Material examined: 42 specimens from 17 stations, of which 12 are in the Gulf of California. (See Table 62) From Patos Island to San Gabriel Bay, Espiritu Santo Island, in the Gulf of California; Isabel Island, Nayarit, Acapulco, Guerrero, and Tangola-Tangola Bay, Oaxaca, Mexico.



8. *Herbstia camptacantha* (Velero III Sta. 1083-40). A. Lower orbit, x 9. B. Outer maxilliped, x 9.

Measurements: Largest specimen, male: length 21.6 mm, width 17.8 mm, rostrum 2.7 mm, width 2.7 mm, cheliped 29.5 mm, chela 13.9 mm, dactyl 5.0 mm, ambulatory legs 31.6, 29.9, 24.7, and 22.4 mm, respectively. Female specimen: length 14.3 mm, width 11.4 mm.

Color in life: Not recorded. In spirits bright red, the smooth manus, under side of legs, and buccal apparatus especially bright. (Lockington, of *Fisheria depressa*)

Habitat: The twelve stations for which data on substratum are available are equally divided between rock and [*Pocillopora*] coral.

Depth: Shore or from coral heads in shallow water. To 4.5 fathoms. (Rathbun, 1924c)

Size and sex: The present series contains males of from 7.0 to 21.6 mm, females of from 5.6 to 14.1 mm, ovigerous females from 9.9 to 14.3 mm. Since there are no males between 14.1 and 21.6 mm, and the 14.1 mm male fails to show the digital tooth, the size at which this secondary sex character is attained cannot be stated.

Breeding: Seven of eight females encountered by the *Velero III* at Isabel Island, Mexico, in March were ovigerous.

Remarks: With the exception of the cotype from Acapulco (M.C.Z. No. 991) and a young female from Patos Anchorage (Calif. Acad. Sci.), Rathbun (1925, p. 295) was obliged to rely on citations of non-extant specimens for most of the locality records given for this species. To make matters more difficult, these were recorded by Lockington under different names, and one must look to a third party, S. J. Holmes, who saw Lockington's types, for assurance that one is dealing in each case with the same organism. Even Holmes was misled into including southern California and west coast of Lower California material under Stimpson's species; these are now separated from Gulf of California and Mexican specimens and listed under *Herbstia parvifrons* Randall.

Early in his studies of the Hancock collections the writer had occasion to compare specimens from both the Gulf of California, station 604-36, and southern Mexico, station 261-34, with the female holotype of *Mithrax (Mithrax) sonorensis*, U.S.N.M. No. 67865. At a much later date their agreement with the original description of *Herbstia camptacantha* was noted and the identity of the two strongly suspected. The elongated propodal segments of the ambulatory legs are characteristic of *Herbstia*, rather than of *Mithrax*. A study of the male first pleopod of *Mithrax sonorensis* clearly shows it to be pisine, rather than mithracine, in character. *M. (Mithrax) sonorensis* Rathbun is therefore considered a synonym of *Herbstia camptacantha* (Stimpson).

The Hancock expeditions series confirms Lockington's Gulf of California localities for the species and extends the range southward from Acapulco, Guerrero, to Tangola-Tangola, Oaxaca, Mexico.

Herbstia edwardsi Bell

Plate 8, Fig. 2

Herbstia edwardsii Bell, 1835b, p. 170; 1836, p. 46, pl. 9, fig. 3, 3g-i. A. Milne Edwards, 1875, p. 80. Rathbun, 1910, p. 573; 1925, p. 300, pl. 105, figs. 3, 4; pl. 240, figs. 1-4. Boone, 1927, p. 145, fig. 42. Finnegan, 1931, p. 623. Sivertsen, 1933, p. 11. Hult, 1938, p. 11. Garth, 1946, p. 381, pl. 65, figs. 1, 2.

Herbstiella edwardsii, Stimpson, 1871a, p. 93.

Herbstia (Herbstiella) edwardsii, Miers, 1886, p. 49.

Type: Male, length 14.8 mm, width 12.7 mm, and female, cotypes, originally deposited in the Museum of the Zoological Society [London], and the Bell Museum, respectively, no longer extant.

Type locality: Galapagos Islands, 6 fathoms, coral sand; Hugh Cuming, collector.

Localities subsequently reported, with collectors: Galapagos Islands: James Island, *Hassler* (Rathbun, 1925); Hood Island, *Arcturus* (Boone); Albemarle Island, *St. George* (Finnegan); Charles Island, *Wollebaek* (Sivertsen); Indefatigable Island, *Rolf Blomberg* (Hult); the above localities plus Duncan, Tower, South Seymour, and Barrington Islands, *Velero III* (Garth).

Atlantic analogue: None. A Galapagos endemic species.

Diagnosis: Basal antennal article with two outer marginal spines including anteroexternal spine; first movable article of antenna reaching nearly to tip of rostrum. Movable finger of male with two teeth in gape; palm smooth. Chelipeds of adult male exceeding ambulatory legs in length, ambulatory legs spinulose. Male first pleopod with tip slender and recurving as in *Herbstia camptacantha*, but with setiferous fold more strongly protuberant.

Description: Carapace broadly rounded posteriorly, narrowing slightly anterior to cervical groove, surface punctate, regions distinct but not elevated, tuberculate, and obscurely pubescent. Rostrum small, composed of two depressed, triangular teeth separated by a narrow V reaching nearly to their bases. Orbits lying considerably laterad of rostral horns, external antennal spine and entire antennal flagellum exposed in intervening hiatus. Preorbital spine blunt, suberect, prominent, interorbital spine truncate, dentiform, exorbital spine acute and internally excavate to provide lodgment for the retracted cornea.

Six or seven prominent lateral marginal spines, the first and largest hepatic; of the remaining five or six the last postbranchial; numerous

lesser granules between these and also on the dorsal branchial surface. A transverse row of four small tubercles at protogastric level, a single low metagastric tubercle, a pair of cardiac tubercles, and a pair each of inner meso- and inner metabranchial tubercles; besides these paired intestinal tubercles and a row of lesser postlateral granules. Intestinal region not protruding appreciably beyond posterior margin of carapace.

Basal antennal article broadened anteriorly as well as posteriorly, anteroexternal spine acute and incurving, lateral marginal spine smaller, rounded. First two movable articles of antenna flattened, second overreaching rostrum. A spine external to the base of the immovable article and a group of three spines at pterygostomian level. External maxilliped remarkably broadened and flattened, ischium not grooved, merus with both internal and external angles broadly produced and almost no indentation for insertion of palpus.

Chelipeds of male massive, devoid of pubescence, and porcellanous in texture. Merus cylindrical, unarmed except for a few proximal tubercles; carpus shallowly sulcate above; manus smooth, greatly elongated, and swollen internally; dactylus occupying about one-third of total length, bearing one molariform and one simple tooth in gape, a tooth of the pollex interposing between them, tips incurving, crenulate, excavate, and setiferous.

Ambulatory legs much shorter than cheliped in male, sparsely setose; meri shortening abruptly from first to last, broadening distally, anterior borders spinulose; carpi deeply sulcate; propodi of relatively equal length, cylindrical; dactyli longer than in related species, spiniform beneath, tips curving.

Male abdomen seven-segmented, otherwise unremarkable. Male first pleopod with tip slightly recurving, a setiferous fold occupying the shallow concavity and concealing the opening. (See Plate S, fig. 2)

Female with cheliped little if any longer than first ambulatory leg; manus not greatly elongated; fingers distally denticulate, proximally gaping slightly, gape without enlarged tooth or teeth. Meri of ambulatory legs of the first two pairs less attenuated than in male.

Material examined: 180 specimens from 29 Galapagos stations. (See Garth, 1946, p. 381)

Measurements: Male specimen: length 13.0 mm, width 10.8 mm, rostrum 1.3 mm, width 1.4 mm, cheliped 22.3 mm, chela 12.0 mm, dactyl 4.3 mm, height of palm 2.7 mm, ambulatory legs 17.5, 15.0, 14.0, and 11.5 mm, respectively. Largest male: length 15.7 mm, width 13.0 mm. Largest female: length 15.4 mm, width 12.3 mm.

Color in life: Carapace light bluish gray. Chelae dusky dark brown, fingers white. (Petersen)

Habitat: Rocky shore; occasionally obtained from coral.

Depth: Intertidal. To six fathoms. (Bell)

Size and sex: Males are from 3.6 to 15.7 mm, females from 5.1 to 15.4 mm, ovigerous females from 7.4 to 14.5 mm.

Breeding: Ovigerous females were encountered by the *Velero III* in December, January, and February. Young to 1.5 mm are present.

Remarks: The similarity of this species and *Herbstia camptacantha* Stimpson, noted by Hult (1938) in connection with a 13 mm male having three external antennal spines instead of the two customary for *H. edwardsi*, is borne out by pleopod studies which show them to be more closely related than are any two mainland species and indicate the probable origin of the Galapagos form.

Herbstia pubescens Stimpson

Plate S, Fig. 7; Plate 34, Fig. 3

Herbstia pubescens Stimpson, 1871a, p. 92. A. Milne Edwards, 1875, p. 76. Miers, 1886, p. 49. Rathbun, 1925, p. 302. Garth, 1948, p. 27.

Type: Female holotype, length 21.6 mm, width 17 mm, originally in the collections of the Smithsonian Institution, no longer extant.

Type locality: Manzanillo, Mexico; John Xantus, collector.

Localities subsequently reported, with collectors: Panama: Guayabo Chiquito; Colombia: Gorgona Island; Ecuador: La Plata Island; all by the *Askoy* (Garth).

Atlantic analogue: None. A Panamic species with Galapagan affinities.

Diagnosis: Rostrum short. Ambulatory legs without spines. Lateral marginal spinules numerous. A transverse ridge on genital region. Spinules on superior border of palm lacking in females and young males, obsolescent in adult males. Male first pleopod notched at level of spermiducal opening.

Description: Carapace subpyriform, depressed, regions indicated, medially tuberculate, laterally spinulose, posteriorly produced, and covered with short pubescence. Rostrum short, horns broadly triangular, basal width of each exceeding length, tips curving slightly inward, median interspace equal to one horn inverted. Inner superior margins of orbits but little convergent anteriorly, a sharp preorbital spine; outer orbital spine, together with the broadly arching interorbital tooth, forming a

shallow cup into which the reniform cornea partially retracts. Gastric region worn smooth of pubescence, bearing two low tubercles along its midline, and separated from the moderately elevate and nontuberculate cardiac region by a short, transverse, tuberculate ridge at the genital level. Intestinal region prolonged posteriorly into a blunt triangular spine or tubercle. Hepatic regions small, tumid, hirsute, bearing one spinule at the level of the exorbital spine and three smaller spinules at the subhepatic level. Branchial regions hairy, delimited anteriorly from the hepatic and medially from the cardiogastric regions by shallow sulci but confluent posteriorly with the intestinal region, an almost imperceptible tubercle at the anterointernal angle of each. Of the scattered marginal spinules three most prominent: an acute anterolateral, a midlateral, and a blunt postlateral, inside of the latter a smaller spinule, not marginal. A postlateral branchial fold above the rimmed posterior margin of the carapace.

Basal antennal article narrowing anteriorly to half its basal width, the acute anteroexternal spine completely exposed in dorsal view, the posteroexternal spine serving to define the orbit; first two free segments narrowly cylindrical, the first falling short of the tip of the rostrum; flagellum long.

Ischium of external maxilliped with inner margin serrate; merus triangular, outer angle rounded, scarcely produced, inner angle a short, truncate blade, between these a slight notch to receive the palpus; first segment of palp tomentose, broadening distally, second segment cylindrical, third segment tapering to extremity, all segments hairy.

Cheliped of male with merus trigonal, inner margin irregularly spinulous, outer margin with four larger spines, a diagonal row of sharp tubercles across inferior surface; carpus crowded with sharp spinules; manus inflated, smooth and bare, about five compound spinules in a single row on superior proximal margin; fingers slender, incurving, gaping slightly in basal two-fifths, tips crenulate, internally excavate and setigerous, a low, truncate, digital tooth. Ambulatory legs long and slender, all segments pubescent, the meri alone bearing an anterior row of stout setae in lieu of spines; first leg noticeably longest, the remaining pairs decreasing regularly in size; meri narrow, but little broadened medially, carpi slightly grooved, propodi greatly elongated, dactyli short, tips only incurving.

Male abdomen with seven free segments, widest opposite third, diminishing in width towards the triangular seventh, the tip of seventh rounded. Male first pleopod conspicuously notched at level of aperture,

apertural flap bearing numerous setae, a longitudinal row of setae on side opposite opening, tip cylindrical, tapering distally, and terminating bluntly. (See Plate S, fig. 7)

Material examined: 11 specimens from 8 *Velero III* stations. (See Table 63) From Playa Blanca, Costa Rica, to Octavia Bay, Colombia. In addition to the above, 6 specimens from 3 *Askoy* stations (Garth, 1948).

Measurements: Male: length 14.0 mm, width without spinules 10.6 mm, rostrum 1.2 mm, width 2.3 mm, cheliped 18 mm, chela 8.6 mm, dactyl 3.8 mm, height of palm 3.2 mm, ambulatory legs 21.4, 19.1 (abnormally shortened), 20.0, and 17.2 mm, respectively. Ovigerous female: length 13.0 mm, width 9.5 mm.

Color in life: Unknown.

Habitat: *Pocillopora* coral in six of seven instances. This was also the experience of the *Askoy* Expedition. (Garth)

Depth: 4.5-10 m. (Garth) Hancock expeditions specimens were encountered in shoal water to a maximum of 3.5 fathoms.

Size and sex: The present series contains males of from 7.5 to 14.0 mm, females of 7.7 and 13.0 mm, the latter ovigerous. The largest specimen examined was a 14.6 mm female, also ovigerous, obtained by the *Askoy*.

Breeding: Females with ova were encountered by the *Velero III* in Panama in early February and by the *Askoy* in Colombia in late April.

Remarks: The present series of specimens, including those of the *Askoy* Expedition, establish the range of Stimpson's species as the southern portion of the Panamic province, or from Playa Blanca, Costa Rica, to La Plata Island, Ecuador. Collecting off northern Mexico, pursued by the *Velero III* with equal intensity, has failed to reveal the presence of *Herbstia pubescens* in northerly latitudes, as would be expected from the Manzanillo type locality.

Herbstia pyriformis (Bell)

Plate S, Fig. 8

Rhodia pyriformis Bell, 1835b, p. 170; 1836, p. 44, pl. 9, fig. 1, 1a-c.
Herbstia pyriformis, Stimpson, 1871a, p. 93. A. Milne Edwards, 1875, p. 77. Miers, 1886, pp. 49, 50. Rathbun, 1910, p. 573; 1925, p. 301, pl. 104, figs. 2, 3; pl. 240, figs. 5-8. Boone, 1927, p. 147, fig. 43. Garth, 1946, p. 383, pl. 63, fig. 3.

Type: Male holotype, length 16.9 mm, width 12.7 mm, originally deposited in the Museum of the Zoological Society [London], no longer extant.

Type locality: Galapagos Islands, 6 fathoms, sandy mud; Hugh Cuming, collector.

Localities subsequently reported, with collectors: Galapagos Islands: James Island, *Hasler* (Rathbun, 1925); Hood, Albemarle, Charles, and James Islands, *Velero III* (Garth).

Atlantic analogue: None. A Galapagos endemic species.

Diagnosis: Carapace posteriorly produced, four prominent spines on lateral margin. Palm of adult male with a double crest of spines; ambulatory legs exceeding chelipeds in length, non-spinulous. Apex of male first pleopod notched as in *Herbstia pubescens*, but with a straighter keel beneath; both keel and lobe above setigerous.

Description: Carapace pyriform, moderately depressed, regions slightly raised above general level, surface evenly covered with soft, short pubescence. Rostrum composed of two stout horns equal in length to their combined basal width, their spinulous tips incurving, separated by a broad median notch reaching half way to their bases, and each surmounted by a low ridge bearing, in addition to the usual double row of curled setae, an inner row of short, stiff hairs. Slope of rostrum broken by the acute preorbital spine; outer margin of spine continuing without interruption to the broad, transverse interorbital tooth; this tooth forming with the acute exorbital a vestibule for the retraction of the reniform cornea. Anteroexternal spine and antennal flagellum, also tip of outer basal antennal spine, visible beyond cornea when retracted.

Anterolateral margins with four equidistant conical spines or sharpened granules, the first and largest hepatic, the remaining three branchial. Below the hepatic spine three pterygostomian spinules, between the first and second branchial spines several spinulous granules at a slightly lower level. Gastric and cardiac regions broadly rounded and set off from adjacent branchial regions by shallow sulci and from each other by a low, transverse, genital ridge. Intestinal region projecting conspicuously beyond posterior margin, slightly acuminate, and tipped with a small, sharp granule.

Basal antennal article twice as broad basally as medially, the lateral extension forming the floor of the orbit and bearing the second of two lateral marginal spines, the first or anteroexternal the longer and more forwardly directed. Merus of external maxillipeds triangular, anteroexternal angle subrectangular, anterointernal angle acute; merus notched to receive palpus.

Cheliped of male only slightly more robust than walking legs; merus with three rows of compound spinules, two inferior and one superior,

the latter composed of four larger spines and additional secondary spinules; carpus somewhat inflated, bearing roughly a dozen spinules, the two superodistal most prominent; manus with a double row of spinules above, palm smooth but hairy; fingers long, slender, incurving, finely dentate, and closing without a gape.

Ambulatory legs exceeding cheliped in length, slender, cylindrical, and hairy; meri little broadened medially, devoid of marginal spines except for a single spine at superodistal angle, and each marked with three transverse bands of red; carpi imperceptibly grooved; propodi long, straight, cylindrical; dactyli short, the amber nails only curved.

Male sternum and abdomen together forming an almost plane and sparsely hairy surface; abdomen consisting of seven separate segments, widest at base of third segment, terminal segment narrowly rounded. Male first pleopod prominently notched at level of aperture, a setiferous lobe above notch and a keel below; tip acuminate, inclined at a slight angle, an irregular row of setae along concave margin. (See Plate S, fig. 8)

Female similar to male except for a slight foreshortening of the appendages, most apparent in the meral and propodal segments, giving a more compact and robust appearance.

Material examined: 14 specimens from 7 Galapagos stations. (See Garth, 1946, p. 383)

Measurements: Male: length 21.4 mm, width 15.6 mm, rostrum 2.4 mm, width 2.6 mm, cheliped 23.0 mm, chela 10.8 mm, dactyl 5.1 mm, height of palm 3.5 mm, ambulatory legs 28.5, 30.0, 27.5, and 24.5 mm, respectively. Largest specimen, female: length 25.8 mm, width 19.4 mm.

Color in life: Carapace light ochre red with Van Dyke red markings; marginal spines and a triangular spot on intestinal region white. Chelipeds light vinaceous fawn with bands of vivid Van Dyke red on merus. Ambulatory legs similarly marked; nails yellow.

Size and sex: Males examined are from 7.3 to 21.4 mm, females from 6.9 to 25.8 mm. None of the females is ovigerous.

Habitat: From rocky shore in six of seven instances; the seventh recovery was from coral inside the submerged crater of Onslow Island.

Depth: Intertidal to one fathom.

Remarks: Now that *Herbstia pubescens* of the Bay of Panama has been rediscovered, an interesting comparison with that species is possible. In *H. pyriformis* the intestinal region projects beyond the normal posterior margin as a dome surmounted by an erect tubercle, whereas in

H. pubescens there protrudes only a triangular spine, directed posteriorly instead of dorsally. The rostrum of *H. pyriformis* is more elongate, the length of each horn exceeding its basal width, although not the width of the two combined. The granules of the lateral margin are four in number, but of the many in *H. pubescens* it is the same four, one hepatic and three branchial, which show greatest development. More important differences may be noted in the double crest of spines on the manus of *H. pyriformis* which extends the length of the superior border, and the hirsute palm, that of *H. pubescens* being entirely smooth and bare. The greater pubescence of *H. pyriformis* is particularly noticeable ventrally, where it extends to the sternum and abdomen, which in *H. pubescens* are almost bare. The male first pleopods are remarkably alike. A similar resemblance exists between *H. camptacantha* of the Gulf of California and *H. edwardsi*, also of the Galapagos Islands. There can be little doubt but that each Galapagos species has been derived from the corresponding mainland species, and that but comparatively recently.

Herbstia tumida (Stimpson)

Plate R, Figs. 1-5; Plate S, Figs. 3, 4, 6; Plate 34, Fig. 4

Herbstiella tumida Stimpson, 1871a, p. 95.

Herbstia tumida, A. Milne Edwards, 1875, p. 79. Rathbun, 1925, p. 299, pl. 105, figs. 5, 6. Finnegan, 1931, p. 623. Crane, 1947, p. 72. Garth, 1948, p. 27.

Herbstia (Herbstiella) tumida, Miers, 1886, p. 49.

?*Herbstia tumida*, Crane, 1937, p. 59.

Type: Female holotype, length ca. 12.7 mm, originally in the collections of the Smithsonian Institution, no longer extant.

Type locality: Manzanillo, Mexico; John Xantus, collector.

Localities subsequently reported, with collectors: Gulf of California, Mexico: American Museum of Natural History (Rathbun); Arena Bank, 2.5 fathoms, *Zaca* (Crane, 1937). Panama: Bahía Honda, *Zaca* (Crane, 1947); Isla Saboga, Perlas Islands, 4 meters, and Guayabo Chiquito, 8-10 meters, *Askoy* (Garth). Colombia: Gorgona Island, *St. George* (Finnegan); same locality, 4-6.5 meters, *Askoy* (Garth).

Atlantic analogue: *Herbstia depressa* Stimpson.

Diagnosis: Basal antennal article short and broad, only two outer marginal teeth, including the anteroexternal. First movable article of antenna reaching or exceeding tip of rostrum; anteroexternal spine di-

rected outward. Ambulatory legs spinulous. Tip of male first pleopod slender, recurving, a loose fold beneath concealing the spermiducal aperture.

Description: Carapace broadly rounded, superficially glabrous, microscopically finely pubescent, regions elevated, moderately convex, and separated by sulci with the cervical groove most prominent. Frontal horns short, acute, tips incurving, separated by a narrow V-shaped sinus extending half way to the base of the rostrum. Basal antennal article exposed dorsally to show insertion of flagellum. Orbits with a rectangular preorbital tooth followed by two blunt teeth separated from the concave exorbital tooth by a deep V. Gastric shield elevated, bearing a large tubercle with anterior to it four smaller tubercles in a transverse line, only the median pair conspicuous. Cardiac region convex, rounded, surmounted by a prominent tubercle with a faint tubercle on either side, laterad of the cardiac region two small metabranchial tubercles. Hepatic region restricted in size, scarcely inflated, a sharp spinule near the post-orbital spine and three smaller spinules at the subhepatic level. Branchial regions each with five small tubercles disposed as follows: one anterolateral, two epibranchial, one mesobranchial, and the aforementioned metabranchial. Anterolateral margins with a scattering of spinules, four more prominent than the others, the first and last being the two mentioned by Stimpson, spinules continued on posterolateral margin. Intestinal region confluent with branchial, bearing a pair of distinct tubercles.

Basal antennal article very broad, anteroexternal spine acute, directed obliquely outward as well as forward, second spine also acute, much smaller than first, crowded towards its base, and directed even more laterally. First two free segments flattened slightly, the first equaling or exceeding the tips of the rostrum, the flagellum long and filiform.

Inner and outer borders of endognath of external maxilliped subparallel; ischium with inner margin denticulate; merus with outer angle rectangular, slightly rounded, internal angle produced as a blade, a similar extension on the compact and inflated first segment of the three-segmented palp.

Outer border of merus of male cheliped with six serrate spines increasing in size and sharpness distally; carpus with a proximal spinule; manus smooth and bare, little inflated, fingers slender, incurving, meeting without gape, edges crenulate, internally excavate, a few setae present within.

Ambulatory legs hairy and, except for elongate propodal segments, of moderate length; meri considerably widened at midpoint, laterally

compressed for overriding one another, bearing stout spines on their anterior borders, ranging in number from ten on the first to five on the fourth, a distal inferior spine on the first only, inferior spines on the balance reduced to granules; carpi doubly grooved; propodi elongate and narrowly cylindrical, dactyli short only in proportion to propodi, tips corneous, strongly curving.

Male abdomen with seven free segments, broadest between second and third segments, tapering gradually from third to last segment, tip narrowly rounded.

Tip of male first pleopod tapering to extremity, arching to protect a soft flap of tissue concealing the irregular opening of the sperm duct. (See Plate S, figs. 3, 4, 6)

Cheliped of adult male more massive than ambulatory legs; merus trigonal, armed with six stout spines along superior border and a seventh at distal end; carpus smooth; manus smooth, inflated, dactylus occupying two-fifths of its superior length, curving strongly to meet pollex at crenulate tip, a strong, molariform tooth in gape, simple tooth of pollex advancing into distal hiatus, inner margins excavate and sparsely setose.

Notes on two males from Cocos Island, Costa Rica, stations 773-38 and 778-38: As compared to *Herbstia tumida* from the adjacent mainland, the insular specimens differ in the following minor points: The first of two interorbital spines is scarcely apparent. There are but six instead of eight anterior marginal spines on the merus of the cheliped, and the external meral spine is lacking. The outer pair of the four anterior gastric spines is more prominent. The spinulosity is more apparent throughout, but particularly on the posterior margins of the ambulatory legs. There is a slight difference in the male first pleopod. Although some endemism is to be expected in insular localities, the differences noted are so slight as to be unworthy of so much as subspecific recognition, particularly when some of them at least may be attributed to the small size of the specimens (5.8 mm) and to the depth from which they were recovered (30-50 fathoms). Plate R is of a Cocos Island specimen.

Material examined: 31 specimens from 12 *Velero III* stations. (See Table 64) From Port Culebra, Costa Rica, to Santa Elena Bay, Ecuador; Clarion and Cocos Islands. In addition to the above, 12 specimens from 3 *Askoy* stations. (Garth, 1948, p. 27)

Measurements: Male: length 8.9 mm, width 7.1 mm, rostrum 0.8 mm, width 1.1 mm, cheliped 9.5 mm, chela 4.8 mm, dactyl 1.9 mm, height of palm 1.2 mm, ambulatory legs *ca.* 11.5, 10.8, 10.0, and 8.0 mm, respectively. Female: length 8.6 mm, width 7.0 mm.

Color in life: No notes on color are available for this species.

Habitat: On under side of stone at extreme low tide level. (Crane, 1947) Of the 11 instances in which data on bottom type are available *Velero III* specimens were recovered 8 times from *Pocillopora* coral, as against one time each from sand with shell, sand with rock, and rock. *Askoy* expedition specimens were also from living coral.

Depth: Shore to 15 fathoms; exceptionally, as at Cocos Island, 31 to 50 fathoms.

Size and sex: Males in the present series range from 5.6 to 9.0 mm, females from 7.0 to 8.6 mm, ovigerous females from 7.1 to 8.3 mm. An ovigerous female from Clarion Island is larger than any from the mainland, measuring 10.8 mm. Young to 3 mm are to be found, those of 3.8 mm and over being determinable as to sex.

Breeding: Ovigerous females were encountered by the *Velero III* in February off Panama and by the *Askoy* in April off Colombia.

Remarks: Admitting Rathbun's determination of a very young specimen from La Playa, which she herself questioned, as *Herbstia tumida*, the range of the species is extended to Ecuador.

***Herbstia parvifrons* Randall**

Plate 8, Fig. 5; Plate 34, Fig. 2

Herbstia parvifrons Randall, 1839, p. 107. Gibbes, 1850, p. 170. Stimpson, 1857b, p. 451. Lockington, 1877c, p. 65. Holmes, 1900, p. 38. Nininger, 1918, p. 41, figs. 19, 20. Schmitt, 1921, p. 215, text-fig. 135. Rathbun, 1925, p. 296, pl. 106, text-fig. 99.

Herbstia (Herbstiella) parviformis [for *parvifrons*], Miers, 1886, p. 49.

Herbstia (Herbstiella) camptacantha, Rathbun, 1893a, p. 79. Holmes, 1900, p. 37. [Not *H. camptacantha* (Stimpson).]

Rhodia parvifrons, Rathbun, 1900, p. 511; 1904, p. 175 (part: not the Acapulco locality). Weymouth, 1910, p. 34, pl. 7, fig. 18.

Herbstia parvifrons, Hilton, 1916, p. 72.

Type: Female holotype, length "scarcely 1 inch" (25.4 mm), in Museum Philadelphia Academy of Science.

Type locality: Western America; T. Nuttall, collector.

Localities subsequently reported, with collectors: California: South of Point Pinos Lighthouse, Monterey Bay (Weymouth); San Pedro and Long Beach, H. N. Lowe (Rathbun, 1925); Laguna Beach, W. A. Hilton (Hilton, Nininger); Santa Catalina Island: Catalina Harbor, 30-40 fathoms, W. H. Dall (Rathbun, 1893a, as *Herbstia camptacantha*), Catalina and Isthmus Harbors, Anton Dohrn (Rathbun, 1925);

San Diego County, C. R. Orcutt (Rathbun, 1893a, as *Herbstia camptacantha*); San Clemente Island, H. N. Lowe (Rathbun, 1925); southern California, W. H. Dall (Rathbun, 1893a, as *Herbstia camptacantha*). Lower California, Mexico: Off Magdalena Bay, 34-36 fathoms, *Albatross* (Rathbun, 1893a, as *Herbstia camptacantha*). (See *Remarks* below.)

Atlantic analogue: None. A southern California-west coast of Lower California endemic species.

Diagnosis: Basal antennal article with only two outer marginal teeth including anteroexternal tooth. Two interorbital teeth. First movable article of antenna short, not reaching tip of rostrum. Movable finger of male with one tooth in gape; palm with proximal spinules. Ambulatory legs spinulose. Male first pleopod with a trianguliform subterminal flange protecting opening and spiraling toward pointed tip.

Description: Carapace ovate, punctate, flattened above, tuberculate, and hairy; gastric region with four inconspicuous tubercles in a transverse row in front and a median rounded tubercle on the posterior portion; three or four small tubercles on the cardiac region, and about five on each branchial region; two tubercles in a transverse line on the intestinal area; *intestinal area projecting slightly beyond posterior marginal level*. Rostral horns very short, one-ninth to one-tenth the length of the carapace. Spine at anteroexternal angle of basal antennal article prominent, on margin behind it *one spine, with a second spine posterior to it, but lying external to the article*. Preocular spine present, acute; *two small spines or teeth on the margin of the orbit between the preocular and postocular spines, below the latter a spine on the inferior orbital margin*; beside the postocular tooth the anterolateral margin furnished with about five spines, and several smaller ones *above these and on the posterior margin*. (Schmitt, modified as indicated by italics)

Three prominent subhepatic spines and a row of five or six pterygostomian spinules. First two movable articles of antenna short, cylindrical; first article not much more advanced than anteroexternal spine and falling considerably short of rostrum. Merus of external maxilliped broadly produced at internal angle; outer angle spinulose margined.

Cheliped of adult male more robust than walking legs and exceeding first in length. Merus with five larger spines on superior inner margin and numerous smaller spines external to these; carpus with ten or eleven spinules; manus with five or six blunt spines on superproximal border, otherwise smooth and bare; dactyl with a low denticulate ridge in gape, fingers meeting along distal halves, edges denticulate.

Ambulatory legs elongate, hairy; meri with from seven to nine spinules on anterior and not exceeding three on posterior margins; carpi with but a single, distal spinule; propodi long, cylindrical, unarmed; dactyli spinulous beneath, amber tips recurving.

Male abdomen seven-segmented, narrowing from base of third to middle of sixth segment, seventh segment narrowly rounded. Male first pleopod with a sail-shaped projection, the distal edge of which spirals toward the sharply pointed tip. (See Plate S, fig. 5)

Cheliped of female shorter than first walking leg; manus with superior proximal row of spines as in male, but with narrower gape and less prominent digital tooth or ridge.

Material examined: 30 specimens from 21 stations. (See Table 65) From Monterey Bay, California, to Asunción Point, Lower California, Mexico, including the offshore islands of Santa Cruz, Santa Catalina, and Guadalupe.

Measurements: Largest specimen, a soft-shelled male: length 33.0 mm, width excluding spines 30.0 mm, rostrum 4.2 mm, width 4.6 mm, cheliped 54 mm, chela 26 mm, dactyl 10 mm, ambulatory legs 48, 44, 41, and 37 mm, respectively. Largest female: length 19.5 mm, width 17.1 mm.

Color in life: Carapace light tan mottled with dark brown; ambulatory legs barred with reddish brown; chelipeds, with the exception of light finger tips, a still more pronounced red. (Weymouth)

Habitat: Under stones at medium low tide. (Nininger) From a large tide pool. (Weymouth) With the exception of one specimen dredged (see below), all Hancock specimens were obtained from rocky shore between tides.

Depth: Intertidal, but occasionally obtained at depth, as at White Cove, 9-11 fathoms, *Velero IV*, and Catalina Harbor, 30-40 fathoms, W. H. Dall, and off Magdalena Bay, 34-36 fathoms, *Albatross* (Rathbun, 1893a).

Size and sex: Males in the present series are from 5.0 to 33.0 mm, females from 6.5 to 19.5 mm, the single ovigerous specimen being 18.5 mm in length.

Breeding: An egg-bearing female was encountered by the *Velero IV* at Guadalupe Island, Mexico, in December.

Remarks: The involved synonymy of this species and *Herbstia camptacantha* becomes simplified at once with the application of geographical criteria. Accepting the range Monterey Bay, California, to Magdalena Bay, Lower California, as delimiting the distribution of *H. parvisfrons*,

all specimens of *Herbstia*, under whatever name originally recorded, coming from southern California and northern Lower California, are probably of this species. Similarly, all specimens of *Herbstia* from the Gulf of California not belonging to the Panamic species *H. tumida*, which occurs in the extreme southern end of the Gulf, are *H. camptacantha*. Specimens collected in recent years by the *Velero III* and *Velero IV* support this geographical separation, and there should be no hesitation in applying it to specimens collected in the time of Stimpson or Lockington, even if these be no longer extant.

Genus NEODOCLEA Buitendijk

Neodoclea Buitendijk, 1950, p. 271.

Type: Neodoclea boneti Buitendijk, by original designation and by monotypy.

Description: Carapace circular, convex; armed on the anterolateral margin as well as on the dorsal surface with tubercles or, in young specimens, with spines. Rostrum exceedingly short, hardly breaking the general outline of the carapace and formed by a single spine. Eyes very small. Pterygostomial region longitudinally grooved; this groove surrounded by long hairs. Meri of the external maxillipeds less broad than the ischium and tapering at the distal end. Body as well as legs tomentose. (Buitendijk)

Abdomen with seven free segments in both sexes.

Range: Eastern Pacific from Macapule, Sinaloa, Mexico, to San José, Guatemala. 5-11 fathoms. Contains but one species.

Neodoclea boneti Buitendijk

Plate T, Fig. 1; Plate 35

Neodoclea boneti Buitendijk, 1950, p. 271, pl. 10, figs. 1, 2.

Type: Male and female, syntypes, in Rijksmuseum van Natuurlijke Historie, Leiden. Of these the figured male, R.M.N.H. No. 7604, length 37 [not 41] mm, is hereby selected as lectotype, at the request of Dr. L. B. Holthuis.

Atlantic analogue: None. A tropical Eastern Pacific species with Indo-Pacific affinities.

Diagnosis: Rostral horns united into a single beak projecting no further forward than the orbits. Anterolateral margin with three stout spines. Pterygostomial region longitudinally channeled. Merus of ex-

ternal maxilliped narrower than ischium and tapering distally. Male cheliped no more robust than walking legs. Tip of male first pleopod falciform, grooved, and opposed by an erect, setiferous blade or keel.

Description: Carapace circular, covered as well as the legs, with the exception of the fingers and the dactyli, with a short close tomentum and some tubercles. On the branchial region three tubercles, placed on an oblique line, the foremost very small and scarcely visible through the fur, the second better developed and the third much stronger and sharper; the gastric region bearing two tubercles, the foremost small again and scarcely visible, the second better developed; the cardiac region bearing a tubercle of about the same height. Anterolateral margin armed with three tubercles, the anterior [one] small, the others much better developed, more spinelike.

Rostrum exceedingly short and hardly breaking the general outline of the front, formed by a single rather broad spine. Eyes small; the upper outer- and lower innerorbital angle tuberculiform, the latter formed by the basal antennal article. The next two antennal articles swollen and the proximal of the two broadened distally. The flagellum rather long and slender. Pterygostomian region longitudinally grooved, the upper outer angle of this groove marked by a strong spine. Both inner and outer margin fringed by long hairs; those on the inner margin implanted on the exognath and on the outer part of the merus and the ischium of the outer maxillipeds. The form of the merus of the outer maxilliped rather obscured by these hairs; but when denuded, the merus less broad than the ischium and tapering distally.

Chelipeds slender, about as long as the equally slender walking legs of the last pair; the other walking legs missing [in the lectotype].

Abdomen seven-segmented.

In the two young specimens all the protuberances of the cephalothorax are exceedingly long and spinelike; the branchial region bears two of these spines, while anteriorly of the two gastric spines a third but lower one can be observed. (Buitendijk, modified)

Female resembling male in all particulars; cheliped even more feeble. Female abdomen with a strong spine on segment 2, a lesser spine on segment 3, and a low tubercle on each succeeding segment except the last.

Material examined: In addition to the male lectotype in the Leiden Museum, the following specimens from Allan Hancock expeditions: Chacahua Bay, Oaxaca, Mexico, 5-10 fathoms, January 9, 1938, *Velero III* station 765-38, one male; off San José Light, Guatemala, 7-11 fathoms, January 11, 1938, *Velero III* station 770-38, two males, one ovigerous female (paratype), and five young.

Measurements: Male lectotype: length 37 [not 41] mm, width without spines 39 mm, with spines 44 mm, rostrum 2.0 mm, width 6.0 mm, cheliped 41 mm, last walking leg (only one still attached) 46 mm. Ovigerous female, paratype: length 26.6 mm, width without spines 26.4 mm, with spines 36.6 mm, rostrum 1.0 mm, width 2.0 mm, cheliped 20.3 mm, chela 8.2 mm, dactyl 4.1 mm, ambulatory legs 32.4, 37.6, 34.7, and — mm, respectively.

Color in life: Unknown.

Habitat: Black sand, shell, and mud; nullipores.

Depth: 5-11 fathoms.

Size and sex: The Hancock series includes males of 10.0 and 10.8 mm, the 26.6 mm ovigerous female paratype, and young to as small as 4.0 mm.

Breeding: The single ovigerous female was encountered by the *Velero III* off Guatemala in early January.

Remarks: The writer is indebted to Miss A. M. Buitendijk of the Royal Netherlands Museum for the privilege of examining a male specimen from Macapule, Sinaloa, one of a pair sent her for identification by Dr. F. Bonet of the National School of Biological Sciences in Mexico City, and for the suggestion that it might be related to the Old World genus *Doclea*. With this specimen and information it was possible to combine the small series of immature males and one mature female in the collections of the Allan Hancock Foundation and to establish a New World genus differing from *Doclea* in the following particulars:

1. The rostrum is short and simple; in *Doclea* it may be short, but is always double.

2. The outer angle of the buccal cavity is unarmed; in *Doclea* it is marked by a spine or tubercle.

3. The merus of the outer maxilliped is narrower than the ischium and tapers distally; in *Doclea* it is broader than the ischium and the anterior angle is often produced.

4. The form of the male first pleopod (see Plate T, fig. 1) resembles that of *Libinia*; it is strikingly different from that of *Doclea canalifera* Stimpson, of which specimens from Japan (U.S.N.M. No. 26271) identified by M. J. Rathbun were examined by the writer.

Because of the importance attached to the last mentioned character, it was decided that the new species and type of the new genus should rest upon the mature male specimen, herein designated as lectotype, and that the description should be prepared by Miss Buitendijk, who in Leiden had available for comparison a number of *Doclea* species from the Sunda Islands region.

Genus **LIBINIA** Leach

Libinia Leach, 1815a, p. 129. Milne Edwards, 1834, p. 298. Rathbun, 1892, p. 235 (part: not *L. macdonaldi* or *L. spinimana*); 1925, p. 310.

Type: The Atlantic *Libinia emarginata* Leach, 1815, by monotypy.

Description: Carapace convex; tuberculous or spinous; triangular-orbiculate and evenly rounded behind the frontal region. Preocular spine usually distinct. Rostrum emarginate or bifid at the apex. Orbits small, nearly circular, with a superior fissure closed or nearly so, and a closed fissure or an open sinus below. Basal antennal segment moderately enlarged. Merus of external maxillipeds truncate at distal end. Chelipeds well developed; palm elongate; fingers evenly denticulate on inner margins. Ambulatory legs well developed, sometimes elongate, diminishing in length from first to fourth pair; segments subcylindrical, usually unarmed. (Rathbun, 1925)

Abdomen composed of seven articles in the two sexes. (Milne Edwards)

Range: Pacific Ocean from Playa Maria Bay to Magdalena Bay, Lower California, and from near mouth of Colorado River to San Ignacio Bay, Gulf of California, Mexico; vicinity of Paita, Peru. Shore to 51 fathoms. Atlantic Ocean from Windsor, Nova Scotia, to Gulf of San Matias, Patagonia; questionably from Bermuda; Gaboon, West Africa. In the Atlantic to 68 fathoms.

KEY TO THE PACIFIC AMERICAN SPECIES OF *Libinia*

- 1a. Rostral horns strongly divergent. Two large teeth on basal antennal article. Lateral margin strongly rimmed. Merus of cheliped armed with spines and tubercles. Male first pleopod stout, keel not equally advanced with tip. Southern Hemisphere *rostrata*
- 1b. Rostral horns not divergent. Only one tooth on basal antennal article. Lateral margin not strongly rimmed. Merus of cheliped unarmed. Male first pleopod slender, keel equally advanced with tip in old specimens. Northern Hemisphere
 - 2a. Rostrum short, ascending. Median spines 8; hepatic spines 2. Tip of male abdomen triangular *setosa*
 - 2b. Rostrum longer, horizontal. Median spines 6; one hepatic spine. Tip of male abdomen rounded *mexicana*

Atlantic species reported as occurring in the Pacific, but unsupported by records within the last century:

- L. emarginata* Leach, "NW coast of America," (Randall, 1839, p. 106, as *L. affinis*); San Francisco, March, 1854, T. G. Cary, Jr. (Rathbun, 1925, p. 317).
L. dubia Milne Edwards, "Chile" [really Cuba, *fide* Rathbun], (Streets, 1870, p. 105, as *L. subspinosa*).
L. spinosa Milne Edwards, Chile (Milne Edwards and Lucas, 1843, p. 6; Nicolet, 1849, p. 128). (See also Garth, 1957, p. 31.)

Since there is uniform agreement among specialists as to the identity of the specimens involved with the Atlantic species listed above, the writer prefers to treat these cases as errors of provenience, rather than to countenance the dislocations which their inclusion in the Pacific fauna, even on an extralimital basis, would imply. *Libinia? verrucosa*, Mazatlan (Lockington, 1877c, p. 64) is a *nomen nudum*.

Libinia setosa Lockington

Plate T, Figs. 2, 3; Plate 36

- Libinia canaliculata?* Lockington, 1877c, p. 67. (Not *L. canaliculata* Say)
Libinia affinis? Lockington, 1877c, p. 67. (Not *L. affinis* Randall)
Libinia setosa Lockington, 1877c, p. 68. Rathbun, 1892, p. 238, pl. 28; 1898, p. 574; 1923b, p. 635; 1924c, p. 378; 1925, p. 327, pl. 243.
Libinia semixonale Streets, 1877, p. 103; type locality, Lower California; male holotype, U.S.N.M. No. 2300.
 ?*Libinia setosa*, Miers, 1886, p. 73.

Type: Female holotype, length 52 mm, width 39 mm, one of two females originally in the collections of the California Academy of Sciences but no longer extant. In view of these circumstances, a male specimen from Santa Maria Bay, Lower California, Mexico, collected August 11 and 12, 1932, by the *Zaca*, Loc. 27594, and belonging to the California Academy of Sciences, is hereby designated neotype.

Type locality: San Bartolomé Bay, Lower California, Mexico; W. J. Fisher, collector.

Localities subsequently reported, with collectors: Lower California, Mexico: Playa Maria Bay, A. W. Anthony (Rathbun, 1925); Abrejos Point, G. D. Hanna, California Academy of Sciences (Rathbun, 1924c); off Abrejos Point, 5.5 fathoms, *Albatross* (Rathbun, 1898); Santa Maria Bay, *Albatross* (Rathbun, 1923b); Magdalena Bay, 12-51 fath-

oms, *Albatross* (Rathbun, 1898), *Hassler*, and C. R. Orcutt (Rathbun, 1925). "Lower California," T. H. Streets (Streets, as *Libinia semizonale*).

Atlantic analogue: None. A west coast of Lower California species.

Diagnosis: Carapace with 8 median and 2 hepatic spines. Rostrum short, ascending, channeled beneath. Only one tooth on basal antennal article. Manus of adult male not noticeably compressed, fingers gaping narrowly. Tip of male abdomen triangular. Male first pleopod channeled to tip; keel of similar length, recurved, and setose.

Description: Carapace broadly pyriform, its width less than the post-frontal length. Rostrum ascending, not widened at the extremity, emarginate, forming two shallow teeth shorter in old than in young; rostrum arched from side to side, bordered with a fringe of hair, and forming with the rather rigid, similarly fringed antennae, an expiratory channel.

Median spines eight, four gastric, one genital, two cardiac, and one intestinal; a single spine on each side of the anterior gastric spine; two marginal spines, one branchial, the other subhepatic; four dorsal branchial spines, two forming a slightly curved line with the marginal spine and the posterior cardiac spine, and the other two in line with the genital spine. A prominent preocular spine. Two hepatic spines, one above the other; a subbranchial spine, below the epimeral suture. A small spine or two on either side above the postlateral margin. Two stout pterygostomian spines, the posterior one very blunt; a spine at antero-external angle of basal antennal segment; a spine just behind the outer margin of that segment.

Chelipeds of old male much longer than ambulatory legs, stout, finely granulate; palm not widening much toward fingers; dactylus two-thirds as long as upper margin of palm; fingers gaping in basal half. Legs stout and rather short. (Rathbun, 1925)

Abdomen [of male] composed of seven segments; on the center of the first segment a rather prominent tubercle; the terminal segment somewhat triangular, with a rounded apex. (Streets, modified, of *Libinia semizonale*).

Male first pleopod channeled to tip, overlapping edges forming a tubular extension of spermiducal canal; keel erect, narrowly triangular, and, like tip, recurved and setigerous. In a 20.9 mm young male from station 1031-40 the keel is not attenuated, nor are the sides of the grooved tip overlapping. (See Plate T, figs. 2, 3)

In the young, 18 mm or less in length, eleven spines are very long and the rest small. The long spines are three median (penultimate gas-

tric, anterior cardiac, and intestinal), and four branchial (paired) forming two transverse lines on the carapace; posterior gastric spine wanting. (Rathbun, 1925)

Material examined: Hancock expeditions material: 14 specimens from 7 stations. (See Table 66) From San Juanico Bay to Marcy Channel, Magdalena Bay, Lower California. California Academy of Sciences material: San Bartolomé Bay, Lower California, Mexico, December 16, 1916, "surface haul with lampara net (?)," *Albatross*, 1 female; Santa Maria Bay, Lower California, Mexico, August 11 and 12, 1932, *Zaca*, 1 large male (the neotype), 1 ovigerous female.

Measurements: Male neotype: length 68 mm, width 55 mm, rostrum 7.8 mm, width 8.0 mm, cheliped 122 mm, chela 58 mm, dactyl 25 mm, height of palm 12.7 mm, ambulatory legs 91, 68, 59, and 49 mm, respectively. Ovigerous female, length 42 mm, width 31 mm.

Color in life: Not recorded.

Habitat: Green mud; fine gray sand. (Rathbun, 1925) Hancock specimens were dredged from sand bottom in all but one instance.

Depth: 5 to 25 fathoms (*Velero III*); to 51 fathoms (*Albatross*).

Size and sex: Excluding the specimens from the California Academy of Sciences measured above, and a 55 mm female obtained by the *Velero IV* very recently, Hancock collections have consisted entirely of young males of from 6.4 to 21 mm and young females of from 12.0 to 26.8 mm. The largest specimen on record is the 95 mm male from Playa Maria Bay (U.S.N.M. No. 19523) collected by A. W. Anthony. (Rathbun, 1925)

Breeding: The single ovigerous female examined was encountered by the *Zaca* at Santa Maria Bay, Lower California, in August.

Remarks: Lest there be any question concerning the priority of Lockington's name over that of Streets, the following is quoted: "His *Libinia setosa* is a valid species and has since been redescribed in 'Bulletin No. 7' of the National Museum by Dr. Streets as *L. semizonale*. Mr. Lockington's name, however, will hold." (Streets and Kingsley, 1877, p. 108)

Of historical interest also, in view of the more recent emphasis placed upon geographical distribution, is this quotation from Lockington's original description: "I have never seen a specimen of *L. canaliculata*, nor Randall's specimen of *L. affinis*, but it is unusual to find an Atlantic species existing unaltered at such a point as San Bartolomé Bay, remote both from the Isthmus of Panama and from Behring's Straits, and for this reason I should not be surprised if it should prove distinct."

Libinia mexicana Rathbun

Plate T, Figs. 4, 5; Plate 37, Fig. 1

Libinia mexicana Rathbun, 1892, p. 242, pl. 31, fig. 3; 1925, p. 328, pl. 244, fig. 1.

Type: Young male, holotype, U.S.N.M. No. 16072, length 13.5 mm, width 7.5 mm.

Type locality: Off Shoal Point, near the mouth of the Colorado River, Gulf of California, Mexico, 10.5 fathoms, *Albatross* station 3029.

Localities subsequently reported: None. Known only from the type locality and unique specimen above.

Atlantic analogue: None. A Gulf of California endemic species having as its cognate on the Pacific coast of Lower California the foregoing *Libinia setosa* Lockington.

Diagnosis: Carapace with 6 median and 1 hepatic spine. Rostrum longer than in *Libinia setosa*, horizontal, channeled beneath. Only one tooth on basal antennal article. Manus of adult male compressed, fingers gaping broadly at base. Tip of male abdomen rounded. Male first pleopod channeled to tip; keel upstanding.

Description: Since the original description is based upon an immature (13 mm) male specimen, a complete description of a 65 mm male from San Felipe, Gulf of California, is given. It will be found possible to compare the Gulf of California species point by point by referring to the description of its west coast of Lower California cognate, *Libinia setosa*, as given by Rathbun (1925, p. 327).

Carapace narrowly pyriform, its width less than its postfrontal length by the distance from the anterior gastric spine or tubercle to the base of the rostrum. Rostrum horizontal, considerably longer than broad, tubular, sides subparallel, tip emarginate, the two shallow teeth fringed with hair, and forming with the coarse and hairy antenna an effective excurrent channel.

Median spines six, two gastric, one genital, two cardiac, and one intestinal; a single spine on either side of anterior gastric spine. Two marginal spines, one branchial, the other subhepatic; four dorsal branchial spines, the posterior two forming a slightly curved horizontal line with the anterior cardiac spine, the anterior two with the genital spine. A prominent preocular spine. A single hepatic spine; a subbranchial spine below the epimeral suture. Two stout pterygostomian spines, the anterior acute, the posterior blunt; a blunt spine at anteroexternal angle of basal segment, a small spine just behind the outer margin of that segment.

Chelipeds considerably longer than ambulatory legs, stout, finely granulate; palm widening appreciably towards fingers; dactyls two-thirds as long as upper margin of palm; fingers gaping widely in basal half. Legs stout and rather short; the dactyli, however, long, as in the related species.

Male abdomen with seven free segments, widest opposite segment three, narrowing abruptly; sides remaining subparallel to base of terminal segment, this segment broadly rounded. Male first pleopod with a slender, curving, grooved tip, sides of channel overlapping, keel arising from a broad base set well back, narrowing toward tip, sparsely and minutely spinulose. (See Plate T, figs. 4, 5)

The 59 mm female from San Felipe resembles the male as regards shape and tuberculation of the carapace, except that the intestinal tubercle is wanting. There is a supplementary anterior branchial tubercle lacking in the male. In the absence of pile, deeply eroded pits are revealed outlining the gastric, cardiac, and intestinal regions and delimiting them laterally from the hepatic and branchial. The rostrum is broken and the antennae are missing, so that it is not possible to compare its length to that of the male. The chelipeds are no more stout than the walking legs; the chelae, however, are of proportionate size and not filiform, as in *Libinia rostrata*. The abdomen, which consists of seven separate segments, is ovoid in shape.

The principal differences from *Libinia setosa*, then, will be found in the more slender carapace and longer rostrum of *L. mexicana*, the reduction in the number of median spines from eight to six by the elimination of two of the gastric spines, the possession of but one instead of two hepatic spines, a longitudinally more compressed cheliped with a wider gape between the fingers in the male (a character which may be expected to vary greatly with the maturity of the individual), and a rounded terminal abdominal segment, that of *L. setosa* being triangular.

Material examined: 11 specimens from 6 stations, all in the Gulf of California. (See Table 67) From Rocky Point, Sonora, to San Ignacio Bay, Sinaloa, Mexico.

Measurements: Largest specimen, the male from San Felipe: length 65.6 mm, width 48.7 mm, rostrum 10.0 mm, width 5.0 mm, cheliped 96.7 mm, chela 43 mm, dactyl 17.3 mm, height of palm 10.8 mm, ambulatory legs 97, 64, 60, and 50 mm, respectively. Female from San Felipe: length 59.6 mm, width 45.6 mm, cheliped 56 mm. (Note: Because of the rigidity of these specimens, measurements of cheliped and

legs were taken segmentally, with somewhat larger totals than are to be expected when legs are flexible and can be measured along a continuous inferior margin.)

Color in life: Carapace dark bluish green. Chelipeds and ambulatory legs lighter and over all small black spots, evenly placed. Ventral surface deep olive buff. Eyes black. (Petersen)

Habitat: Fine gray sand, broken shell. (Rathbun, 1925) *Velero III* specimens were obtained three times on sand bottom, once on sand with shell, and once on mud with sand.

Depth: 8 to 35 fathoms. Depth was not given on the San Felipe specimens, which may have been obtained at extreme low tide.

Size and sex: Apart from the large male and female measured above, the present series consists of males from 11.5 to 27.3 mm and of females from 16.0 to 19.1 mm.

Breeding: The 59.6 mm female from San Felipe is ovigerous. Unfortunately its date of capture can be given only as fall of 1946 to March of 1947.

Remarks: The large pair described above were brought to the Allan Hancock Foundation by Dr. Carl L. Hubbs. Permission to retain and describe them was graciously given by Dr. Alden Noble, for whom they were collected by Johnny Rodriguez, a fisherman, at San Felipe in the upper part of the Gulf of California. They are the only adult specimens known.

Libinia mexicana is an example of a Gulf of California endemic species clearly delimited from its west coast of Lower California cognate, yet closer to it than to any other species of the genus.

***Libinia rostrata* Bell**

Plate T, Fig. 6; Plate 37, Fig. 2

Libinia rostrata Bell, 1835b, p. 169; 1836, p. 42, pl. 8, fig. 3. White, 1847, p. 4. Miers, 1886, p. 73. Rathbun, 1910, p. 572; 1925, p. 329, part (not the Atlantic specimens), pl. 242 (not pl. 122, fig. 2).

Type: Male holotype, length 67.7 mm, width 57.2 mm, originally deposited in the Museum of the Zoological Society [London], no longer extant. In view of this fact a male specimen, U.S.N.M. No. 100916, from Paita, Peru, October, 1926, W. L. Schmitt, collector, is hereby designated neotype.

Type locality: Peru, 5 fathoms, soft mud; Hugh Cuming, collector.

Localities subsequently reported, with collectors: None. Specimens from Atlantic Panama and Brazil referred to this species by Rathbun (1925, p. 330) are believed instead to represent a distinct species.

Atlantic analogue: Libinia rostrata var. *bellicosa* Oliveira (1944, p. 87), to which the Atlantic Panamanian and Brazilian specimens mentioned above should in all probability be referred.

Diagnosis: Rostral horns strongly divergent. Spine at postlateral angle directed outward, longest of any. Two teeth on basal antennal article. Three lateral submarginal spines, a fourth commencing a flattened ridge extending to posterior margin. Merus of male cheliped armed with spines and tubercles; manus with three teeth in gape. Male first pleopod with tip grooved and sharply bent, a blunt keel on opposite side.

Description: Carapace subglobose, regions elevated, well delimited from one another, and covered with numerous spines, tubercles, and tracts of curled setae. Rostrum horizontal, composed of two elongate spines diverging widely toward extremities, width between tips equal to one and one-half times basal width of rostrum. A strong preorbital spine lying in a plane inclined to that of the rostrum, tip slightly recurving. Orbit with a single closed fissure above, exorbital protuberance a cup into which the small eye retracts completely. Principal spines and tubercles of dorsal surface disposed as follows: a transverse row of three (not five) tubercles on anterior gastric region, posterior to these a cluster of three on mesogastric region, the median largest and crowded forward; a low tubercle on genital region; a large boss on cardiac region; an upstanding spine on intestinal region above posterior margin; a single inner hepatic tubercle almost in line with anterior gastric tubercles; an inner epibranchial tubercle similarly placed with respect to cardiac tubercles; two diagonal lines of branchial spines, the inner row composed of two, the outer of three spines, the spine at lateral angle of carapace the longest and horizontally directed. Three strong pterygostomial spines, plus a fourth subbranchial spine basally confluent with a thickened ridge extending continuously to posterior margin.

Basal antennal article broad at base, slightly concave from side to side, and bearing two blunt spines on outer margin. Ischium of outer maxilliped with a longitudinal groove; merus subcordiform, expanded externally, notched internally to receive palpus, and inserting deeply and narrowly into outer distal portion of ischium.

Cheliped of male neotype less than twice the length of carapace without rostrum; merus stout, two prominent superior spines, the more proximal of which is directed outward, the more distal inward, an outer row of three low tubercles, and a superior row of two in line with inwardly directed spine; carpus tuberculate; manus granulate, superior and inferior borders subparallel, fingers touching at tips, gaping widely at base, two

tubercles on dactylus and between these one on pollex, distal half of fingers denticulate.

Ambulatory legs cylindrical, the first nearly as long as the cheliped, the remainder diminishing regularly in length; meri granulate but not tuberculate; carpi longitudinally sulcate; dactyli stout, incurving.

Male abdomen with seven free segments, a stout tubercle at middle of segment one, a lesser tubercle on succeeding segments, widest opposite segments two and three, sides of segments four to six subparallel, sides converging from middle of segment six, tip triangular.

Male first pleopod coarse, tip acute, bent sharply, grooved, a blunt but well developed keel on opposite side, tip and keel minutely spinulose. (See Plate T, fig. 6)

Female similar to male as regards general shape and tuberculation of carapace. Rostrum shorter at base, horns equally or more strongly divergent. Lateral marginal ridge less prominent than in male; hooked hairs more abundant and conspicuous. Chelipeds weak, especially chelae, which are almost filiform. Dactyli long and slender, crenulate, gaping narrowly, the three teeth of adult male lacking. Abdomen orbicular, a tubercle on narrow first segment.

A young male of 40 mm agrees with the female in lacking the digital teeth of the cheliped.

Material examined: 4 specimens from 2 lots, all U. S. National Museum material: Paita, Peru, October 8, 1926, W. L. Schmitt, collector, Walter Rathbone Bacon Fellowship, donor, 1 male, 1 female (U.S.N.M. No. 76573); Paita, Peru, October, 1926, W. L. Schmitt, collector, Walter Rathbone Bacon Fellowship, donor, 1 male (U.S.N.M. No. 70999), 1 male neotype (U.S.N.M. No. 100916).

Measurements: For critical comparison measurements of a male and female of approximately equal size are given in tabular form:

| | Male Neotype | Female |
|--|--------------|--------|
| Length of carapace | 64.5 | 60 |
| Width, exclusive of postlateral spines | 52 | 48 |
| Length of rostrum | 13 | 12 |
| Basal width of rostrum | 8 | 7 |
| Length of cheliped | 97 | 54 |
| Length of chela | 46.7 | 25 |
| Length of dactyl | 18.4 | 9 |
| Height of palm | 10.8 | — |
| Length of leg 1 | 86 | 54 |
| Length of leg 2 | 66 | 50 |
| Length of leg 3 | 59 | 46 |
| Length of leg 4 | 49 | 41 |

Color in life: Unrecorded. Bell (1836) notes the color of the hair as light brown, that of the body itself paler; these notations were presumably made from the preserved specimen.

Habitat: Soft mud. (Bell)

Depth: With no indication of depth given, it is assumed that the specimens obtained by Schmitt were collected intertidally. 5 fathoms. (Bell)

Remarks: One of the best crustacean finds resulting from the circumnavigation of South America in 1926 by Waldo L. Schmitt under the auspices of the Walter Rathbone Bacon Scholarship Fund of the Smithsonian Institution was the rediscovery of Bell's lost species, *Libinia rostrata*. Originally described from among specimens collected by Hugh Cuming on the west coast of South America, the species was known only from Bell's brief description and what proves to be not too accurate illustration, the unique type having meanwhile disintegrated. It was probably not without hesitation that Rathbun (1925, p. 330) referred to Bell's species a specimen from Brazil in the Philadelphia Academy of Sciences and one from Atlantic Panama in the collections of the U. S. National Museum (U.S.N.M. No. 56536). Although the writer has not examined these specimens, they are believed, in view of the discontinuity of habitat, to represent a new form, possibly that described by Oliveira (1944, p. 87) as *Libinia rostrata* var. *bellicosa*, which in the writer's view should be accorded full specific rank. Certainly Rathbun subsequently recognized in Schmitt's west coast South American material the true *L. rostrata*, for the determination of the Peruvian specimens redescribed above is hers.

Genus LISSA Leach

Lissa Leach, 1815a, p. 69. Rathbun, 1901, p. 64; 1925, p. 331.

Lissula Rafinesque, 1818, p. 272; name substituted for *Lissa* Leach.

Type: The Mediterranean *Inachus chiragra* Fabricius, 1798 = *Cancer chiragra* Herbst, by monotypy.

Description: Carapace very convex; surface very uneven; mesogastric region especially elevated, sides of gastric and branchial regions steep. Preocular spine or tooth present. Horns of rostrum flattened, contiguous, truncate, outer extremities of anterior margin forming a small lateral lobe. Orbit with a superior and an inferior closed fissure; eyes when retracted fitting into cup-shaped inconspicuous postorbital lobe. Basal article of antennae much enlarged, entire, distal margin of outer portion

united with front margin of carapace. Ischium of outer maxillipeds inwardly strongly advanced; merus subtriangular, dilated outwardly; a very shallow sinus at articulation of palpus.

Chelipeds with palm compressed, sometimes carinated; fingers gaping at base in the male. Ambulatory legs of moderate length, decreasing rapidly in size from the first to last, either cristate or nodose; dactyli unarmed. (Rathbun, 1901)

Abdomen with seven free segments in both sexes.

Range: From Santa Maria Bay, west coast of Lower California, and Puerto Refugio, Angel de la Guarda Island, Gulf of California, Mexico, to Santa Elena Bay, Ecuador; Revilla Gigedo Islands; Galapagos Islands. Western Atlantic from Bahama Banks to Cape Frio, Brazil. Mediterranean. Shore to 50 fathoms; possibly to 70 fathoms.

KEY TO THE PACIFIC AMERICAN SPECIES OF *Lissa*

- 1a. Branchial ridges compressed; posterior margin biconcave. Carpi of walking legs single crested. Tip of male first pleopod triangular, gonopore centered *aurivilliusi*
- 1b. Branchial ridges bilobate; posterior margin sinuous. Carpi of walking legs double crested. Tip of male first pleopod lobate, gonopore eccentric *tuberosa*

Lissa tuberosa Rathbun

Plate T, Fig. 7; Plate 33, Fig. 3

Lissa tuberosa Rathbun, 1898, p. 574, pl. 41, fig. 3; 1925, p. 333, pl. 246, fig. 1, text-fig. 107. Crane, 1937, p. 59. Garth, 1948, p. 28.

Type: Male holotype, U.S.N.M. No. 21574, length 16.9 mm, width 15.8 mm.

Type locality: Southern part of the Gulf of California, Mexico, 8 fathoms, *Albatross* station 2824.

Localities subsequently reported, with collectors: Mexico: Southern part of the Gulf of California, 7-10 fathoms, *Albatross*. (Rathbun, 1898); Gorda Banks, 20-30 fathoms, *Zaca* (Crane). Colombia: Utria Bay [Port Utria], 8 feet, from coral, *Askoy* (Garth).

Atlantic analogue: *Lissa brasiliensis* Rathbun.

Diagnosis: An inflated branchial ridge divided into two lobes between gastric prominence and lateral angle. Posterior margin sinuous, median projection rounded. First three pairs of ambulatory legs with double-crested carpi. Male first pleopod terminating in a sharply bent lobe, the spermiducal opening eccentrically located therein.

Description: Surface covered with a dense, short, vascular pubescence. Carapace with two median tuberculated prominences, gastric higher than cardiac, continued along median line to posterior margin. Ridge running obliquely backward from gastric prominence almost entirely occupied by two protuberances, one at its middle and one at posterolateral angle of carapace; carapace presenting a rounded or obliquely truncate outline. Sinus of posterolateral margin more shallow than in *Lissa bicarinata*. Margin of hepatic region with a tubercle; of branchial region with several tubercles and a blunt tooth at middle. Hepatic region nearly vertical. Front with a shallow median emargination, from this the margin sloping obliquely backward or almost transverse; outer corners with a slight tooth, most produced in the young. Preorbital tooth subacute or obtuse.

Chelipeds heavy in male; ischium with tooth on inner margin; merus with tridentate crest on superior margin; carpus with surface uneven, tubercle at inner angle. Hands broad, compressed, widening distally, inner surface tuberculate; lower margin of propodus with a sinus near its middle; dactylus with acute upper margin; fingers gaping for basal half. Chelipeds of female much smaller. Legs cristate; crest of merus with a thin triangular tooth at distal end; carpus with two triangular crests side by side, divergent, forming a cup; propodus with a triangular superior crest, a tubercle on anterior and posterior surfaces, and with swellings at articulation with dactylus. (Rathbun, 1925, modified)

Male abdomen with segments 3-5 fused; segments two and three strongly tuberculate; greatest width opposite segment three, least width at base of segment six; segment seven narrowly triangular. Male first pleopod cylindrical, gradually tapering and curving toward tip; tip consisting of a fleshy lobe sharply bent back and having the opening of the sperm duct at one end, rather than in the middle. (See Plate T, fig. 7)

Material examined: 33 specimens from 25 stations, of which 10 are in the Gulf of California. (See Table 68) From Redondo Point Light, Magdalena Bay, Lower California, and Tortuga Island, Gulf of California, Mexico, to Octavia Bay, Colombia, including the Revilla Gigedo Islands.

Measurements: Male specimen: length 12.3 mm, width 11.3 mm, rostrum 2.2 mm, width 2.5 mm, cheliped 11.2 mm, chela 4.9 mm, dactyl 2.2 mm, height of palm 2.1 mm, ambulatory legs 8.2, 7.5, 6.5, and 5.8 mm, respectively. Largest specimen, female: length 14.8 mm, width 15.3 mm. (Note reversal of length-breadth proportion in the two sexes.)

Color in life: Carapace and legs uniformly deep olive buff. A large patch of bright madder brown on anterior branchial and hepatic regions. Eyes brilliant flame scarlet. Chelae and propodi of ambulatory legs lightly shaded with red orange, proximal portion of ambulatory legs light Russian blue. Abdomen and sternum pale mallow pink. Pterygostomial region and maxillipeds madder brown. (Petersen)

Habitat: Broken shell, broken coral, *Albatross*. (Rathbun) Sand bottom, *Zaca*. (Crane) From coral, *Askoy*. (Garth) The 28 *Velero* stations for which data on bottom type are available give a primary breakdown as follows: rock 6, sand 9, mud 3, organic (coral, nullipore, and coralline) 10. A secondary breakdown shows shell present with the sand in 2 cases, shell or nullipore present with the rock in 3 cases, and shell or sand present with the mud in all cases. The only bottom on which *Lissa tuberosa* does not occur would appear to be unadulterated mud. Two specimens from Panama carry a rhizocephalan parasite. Living Bryozoa are frequently recorded as encrusting organisms.

Depth: Shore to 47 fathoms.

Size and sex: The series includes males from 5.3 to 12.3 mm, females from 5.8 to 14.8 mm, ovigerous females from 5.8 to 14.5 mm. As in the case of *Lissa aurivilliusi*, specimens from the Gulf of California are larger than average, the 14.8 mm female being from the Gulf, whereas the largest from the Bay of Panama is 13.5 mm. None are as large as the 16.9 x 15.8 mm male holotype.

Breeding: Ovigerous females were encountered off Lower California in March, in the Gulf of California in February and March, off the Mexican mainland in March, in the Revilla Gigedo Islands in June, off Panama in February, and off Colombia in January. The 5.8 mm specimen from Cocos Island, Costa Rica, is unusually small to be gravid and carries a correspondingly small number of large-sized eggs. The smallest ovigerous female from a mainland station measures 9.3 mm.

Remarks: With the exception of the single specimen taken by the *Askoy* at Utria Bay, Colombia (Garth, 1948), *Lissa tuberosa* has been unknown outside of the Gulf of California. As a result of the work of the *Velero III* and *Velero IV*, the range of the species has been extended northward to include Magdalena Bay, Lower California, and Tortuga Island, Gulf of California; westward to include Clarion Island of the Revilla Gigedo Islands; and southward to Octavia Bay, Colombia. It is not known to occur in the Galapagos archipelago.

***Lissa aurivilliusi* Rathbun**

Plate T, Fig. 8; Plate 33, Fig. 4

Lissa aurivilliusi Rathbun, 1898, p. 575, pl. 41, fig. 4; 1902b, p. 284; 1910, p. 573; 1925, p. 333, pl. 246, fig. 2. Boone, 1927, p. 148, fig. 44. Crane, 1937, p. 59. Garth, 1946, p. 384, pl. 65, figs. 3, 4.

Type: Male holotype, U.S.N.M. No. 21575, length 12.5 mm, width 13 mm.

Type locality: Off Cape San Lucas, Lower California, Mexico, 31 fathoms, *Albatross* station 2829.

Localities subsequently reported, with collectors: Mexico: Lower California: Magdalena Bay, 12 fathoms, *Albatross* (Rathbun, 1898); Gulf of California: Arena Bank, 35 fathoms, *Zaca* (Crane). Galapagos Islands: Tagus Cove, Albemarle Island, reef, Hopkins-Stanford Expedition (Rathbun, 1902b); Charles, Indefatigable, James, Albemarle, and Hood Islands, 3-70 fathoms, *Velero III* (Garth).

Atlantic analogue: *Lissa bicarinata* Aurivillius.

Diagnosis: A compressed branchial ridge extending without interruption from gastric prominence to postlateral angle. Posterior margin biconcave, median projection angular. First three pairs of ambulatory legs with single-crested carpi. Male first pleopod terminating in a triangle in which the opening of the sperm duct is centered.

Description: Surface everywhere microscopically punctate and short-pubescent, hooked hairs confined to well-defined tracts, two rostral, two protogastric, and two hepatic. Carapace with two prominent median elevations, the smaller cardiac, the larger gastric; from the latter a low, compressed, granulate ridge extending obliquely to the postlateral angle. Rostrum deflexed, broad at base, flaring toward extremities, each tipped with a tubercle; median emargination shallow. Preorbital tooth acute, incurving; postorbital cup sufficient only to conceal the fully retracted eye; two closed fissures trending obliquely inward, one superior and one inferior. Anterolateral margins with an acute tooth at hepatic level and another at branchial level, forming, together with the lateral angle of the carapace and the postlateral tubercle terminating the diagonal ridge, a tridentate projection affording concealment of the ambulatory legs in a manner reminiscent of certain Parthenopidae. Posterior margin a doubly concave arc interrupted by the acute median projection.

Basal antennal article broad, granulate, outer portion forming floor of orbit, inner portion giving rise to the minute flagellum, reaching not more than half way to the tip of the rostrum. External maxillipeds pre-

senting a plane surface, inner margins closely approximated; merus triangular, angles rounded, anterior margin broadly arcuate, no visible notch for insertion of palpus.

Chelipeds of male massive; ischium with inner margin compressed; merus trigonal, inner margin compressed, outer margin tridentate; carpus roughened, largest tubercle at inner angle; manus high, compressed, margins subparallel, a double row of granules on inner surface; dactylus ridged, fingers denticulate throughout, gaping slightly at bases. Chelipeds of female much smaller, proportionate to walking legs, which they resemble.

Ambulatory legs strongly cristate; merus with a superior crest culminating in a tooth; carpus with a single triangular crest; propodus with a similar crest and a superior and inferior tubercle; dactylus as long as propodus, curving, nail amber.

Male abdomen set flush with concave surface of sternal plastron; plastron outlined by a row of tubercles continuous with the two tubercles of segment three; segment two with a low median tubercle, segments three to five fused, segment six becoming broader distally, segment seven longer than broad, tip narrowly rounded.

Male first pleopod becoming increasingly curved and sclerotized toward tip; tip appearing in terminal view as a triangle having the opening of the sperm duct centered, protected by a shallow cave. (See Plate T, fig. 8)

A number of specimens in the present series, including the male described, show a remarkable attenuation of the branchial ridges. This character is associated with age and occurs in specimens as large as the type (12.5 mm) or larger. Although first observed in Ecuadorean specimens, it does not appear to be a geographical development, since specimens taken in the Gulf of California in later years show this peculiarity also.

Material examined: 62 specimens from 23 stations. (See Table 69) These range from Santa Maria Bay, Lower California, and Puerto Refugio, Angel de la Guarda Island, Gulf of California, Mexico, to Santa Elena Bay, Ecuador, and are distributed as follows: Mexico 9, Costa Rica 4, Panama 6, Colombia 1, and Ecuador 3 stations. In addition to the above, 18 specimens from 12 Galapagos stations (Garth, 1946).

Measurements: Male specimen: length 13.7 mm, width 17.3 mm, rostrum 3.7 mm, width 2.8 mm, cheliped 12.7 mm, chela 6.3 mm, dactyl

2.7 mm, height of palm 2.6 mm, ambulatory legs 8.8, 7.6, 6.7, and 4.9 mm, respectively. Largest specimen, a female: length 15.4 mm, width 20.0 mm, cheliped 10.5 mm.

Color in life: Dorsal surface of carapace dull yellow orange with numerous indistinct darker small spots. Chelipeds as carapace, finger tips white. Ambulatory legs white with but little color. Ventral side pale gray with light touches of dull orange. (Petersen, of a Gulf of California specimen)

Habitat: Fine gray sand; rock, *Albatross*. (Rathbun) Sandy bottom with weed, *Zaca*. (Crane) Rock, frequently covered with red algae, and accompanied by sand or shell, *Velero III* (Garth, of Galapagos specimens). For the 21 mainland stations for which data on bottom type are available, the primary breakdown is as follows: sand 9, rock 7, mud 3, organic (coral and nullipore) 2. A secondary breakdown shows shell and nullipore frequently present with the sand, and sand and nullipore sometimes present with the rock. As in the case of *Lissa tuberosa*, *L. auri-villiusi* appears to occur in mud only when diluted with sand or shell.

Specimens from Costa Rica, invariably females, show parasitism by *Sacculina* or other rhizocephalan parasite. Bryozoa are recorded as encrusting forms on Gulf of California and Galapagos Islands specimens.

Depth: Mainland specimens from 2 to 35 fathoms; Galapagos specimens to 70 fathoms.

Size and sex: The Hancock series from the mainland contains males of from 5.8 to 13.7 mm and females of from 4.5 to 12.2 mm (ovigerous females from 7.7 to 12.2 mm). Three Gulf of California females, non-ovigerous, run from 12.8 to 15.4 mm. These represent a giant race and should not be compared with those taken outside the Gulf. Unfortunately there are no comparable males.

Breeding: Ovigerous females were taken by the *Velero III* off southern Mexico in March and off Panama and Ecuador in February.

Remarks: The range of the species is extended northward to Hughes Point, Lower California, and to Puerto Refugio, Angel de la Guardia Island, in the Gulf of California, and southward to La Libertad, Ecuador. With the inclusion of the Galapagos Islands specimens, previously reported (Rathbun, 1902b; Garth, 1946), the limits broadly define the Panamic province.

Genus **LEUROCYCLUS** Rathbun

Salacia Milne Edwards and Lucas, 1843, p. 12.

Leurocyclus Rathbun, 1897, p. 164 (name substituted for *Salacia*, pre-occupied); 1925, p. 230.

Type: Salacia tuberculosa Milne Edwards and Lucas, type of *Salacia* Milne Edwards and Lucas, by monotypy.

Description: Carapace broader than long, depressed, and dilated posterolaterally. Regions delimited by deep furrows; surface granulate and tuberculate. Rostrum trianguliform, very short and narrow. Orbits oval, directed forward and upward; a superior marginal notch and a larger inferior hiatus. Eyes short and retractile. Basal antennal article quadrate, as broad as long, terminating externally in a tubercle; flagellum completely exposed at side of rostrum. Buccal cavity much broader than long. Epistome rudimentary. Ischium of external maxillipeds broad, inner margin denticulate; merus cordiform, anteriorly notched. Sternal plastron broader than long, depressed, anteriorly trianguliform. Chelipeds short, granulate; hand greatly swollen; fingers elongate and internally denticulate. Ambulatory legs very long, spiny; merus [in the type species] noticeably swollen; propodus compressed; dactylus elongate, compressed, and slightly curved. (Milne Edwards and Lucas)

Sixth and seventh segments in male abdomen fused; in female, fifth, sixth, and seventh fused. (Rathbun, 1925)

Range: From Chile [exact locality unknown] to Rio de Janeiro, Brazil.

Contains two species, only one of which occurs in the Pacific.

Leurocyclus tuberculatus (Milne Edwards and Lucas)

Cf. Plate T, Fig. 9

Salacia tuberculosa Milne Edwards and Lucas, 1842, pl. 2; 1843, p. 13.

A. Milne Edwards and Bouvier, 1923, p. 387, pl. 12, fig. 5.

Salacia sp.? Brito Capello, 1871, p. 263, pl. 3, figs. 3, 3a, 3b.

Leurocyclus tuberculatus, Rathbun, 1925, p. 230, pl. 232, figs. 6-11; pl. 233. Garth, 1957, p. 28.

Type: Male holotype, length 52 mm, width 55 mm, in Paris Museum.

Type locality: Unknown; thought to be Chile.

Localities subsequently reported, with collectors: Pacific Ocean: Chile, E. Verreaux (Brito Capello). Atlantic Ocean: Rio de Janeiro, Brazil, M. Jobert (A. Milne Edwards and Bouvier).

Atlantic analogue: The species itself occurs in the South Atlantic.

Diagnosis: Carapace depressed, tuberculate, regions well delineated. Palms inflated; ambulatory legs shorter than in the companion species, *Leurocyclus gracilipes*; meri enlarged, superior basal spines inconspicuous; propodi of last three pairs densely pubescent. Male first pleopod not examined.

Description: Carapace decorated above with tubercles and with fine granulations. Hairs of a clear fawn color, short and not very close-set, visible in the furrows separating the regions. Rostrum finely granulated above for its entire length, as is the superior and internal margin of the orbital cavities. Chelipeds having their merus decorated with several longitudinal rows of projecting granules, sometimes even taking the form of more or less spiny tubercles; their carpus more finely granulate and with a rounded crest; the manus greatly swollen and with fine granulations mixed here and there with some spiny tubercles; the fingers elongate, smooth, slightly curved, and finely serrated. Basis and ischium of ambulatory legs granulate, with the superior margin of the ischium armed with a very pronounced spine; merus entirely covered above with projecting granulations, among them very pronounced spines, especially in the first and second pairs; below, these same articles nearly smooth, especially in the third and fourth pair of legs. Carpus with several granulations on its external surface, and the other parts entirely smooth; the propodus decorated on its external surface with several longitudinal lines of fine granulations; finally, the dactylus strongly channeled and a little flattened; a slight swelling apparent near the base of the clear brown nail. Sternal plastron very finely granulate. (Milne Edwards and Lucas, modified)

Material examined: None. Through the courtesy of Dr. F. A. Chace, Jr., of the U. S. National Museum, a pair of the companion species, *Leurocyclus gracilipes* (A. Milne Edwards and Bouvier), from off Rio de la Plata, Argentina (U.S.N.M. No. 21907), has been made available to the writer. A sketch of the pleopod of this species is reproduced (Plate T, fig. 9) in lieu of that of *L. tuberculosus*.

Measurements: Largest specimen recorded, a male from Chile: length 60 mm, width 71 mm. (Brito Capello)

Color: Yellowish white. (Milne Edwards and Lucas)

Depth: Not recorded. The companion species, *Leurocyclus gracilipes*, occurs in the Atlantic in 10.5-30 fathoms.

Remarks: Verification of Chile as the probable type locality is found in the two Verreaux specimens reported by Brito Capello. Otherwise

the Pacific occurrence of *Leurocyclus tuberculosus* might be doubted in view of the two Jobert specimens from Rio de Janeiro, reported by A. Milne Edwards and Bouvier. The figure of Brito Capello leaves no doubt but that the hairy propodi of the last three pairs of ambulatory legs, mentioned by Bouvier as distinguishing the Jobert specimens from the type of Milne Edwards and Lucas, are present in Chilean as well as Brazilian examples. If the two are to be separated, it must be on some other character, perhaps the male first pleopod. Unfortunately, specimens are not available on this side of the Atlantic for such a study.

Subfamily MAJINAE

Maiinae Alcock, 1895, pp. 161, 166, and 236 (part: the Maioida).

Majinae, sensu restr., Balss, 1929, pp. 16, 20.

Orbit formed (1) by a supraocular hood, the posteroexternal angle of which is often produced as a spine, (2) by a sharp postocular tooth, and (3) by a spine intercalated between the two. Basal antennal [article] broad, but not specially produced to form a floor to the orbit; usually armed at both its anterior angles with a strong spine. (Alcock)

Pleopod 1 like that in the preceding subfamily [Pisinae Alcock]. Pleopod 2 short. (Stephensen)

The subfamily Majinae, as conceived by Alcock, contained three subdivisions termed by him alliances: the Maioida, the Stenocionopoida, and the Periceroida. The Stenocionopoida were withdrawn by Balss (1929) as a separate subfamily, renamed the Ophthalmiinae to conform with the substitution by Rathbun (1897) of *Ophthalmias* for *Stenocionops*. At the same time, the Maioida were established as the restricted subfamily Majinae, while the Periceroida were divided into two subfamilies, the Mithracinae and the Macrocoelominae. The Majinae, *sens. restr.*, and the Ophthalmiinae are here recognized as Balss conceived them; however, the Mithracinae in its limited sense and the Macrocoelominae as such are not, for reasons explained elsewhere. Instead, the Periceroida of Alcock are retained as a natural group, and to them is applied the name Mithracinae, rather than the confusing Stenocionopinae, also avoided by Balss, *Stenocionops* having been substituted by Rathbun (1897) for *Pericera*. Thus the present number of subfamilies recognized, as well as their basic composition, is the same as that of alliances recognized by Alcock, plus or minus a few genera transferred from one to another.

The Majinae, *sens. restr.*, are represented in the western Atlantic only by ?*Temnonotus* and in the eastern Pacific by *Maiopsis* and an

island endemic species of the Old World genus *Paramithrax*. They are more primitive than the Mithracinae both in configuration of orbit and structure of male first pleopods. *Maiopsis* shares with *Oregonia* and *Hyas* of the Oregoniinae a broadened terminal male abdominal segment.

KEY TO THE AMERICAN GENERA OF THE RESTRICTED SUBFAMILY
Majinae BALSS

(Pacific genera are shown in bold-face type and are treated in this work)
(Intercalated spine present; basal antennal article not forming floor of orbit)

- 1a. Cardiac lobe not delimited by a deep trench
 2a. Carapace broadly ovate-triangular. Basal antennal article very broad, three-spined. Rostral horns each with an accessory spine **Maiopsis**
 2b. Carapace oblong-triangular. Basal antennal article of moderate width, two-spined. Rostral horns simple **Paramithrax**
 1b. Cardiac lobe delimited laterally and posteriorly by a deep trench *Temnonotus*

Genus MAIOPSIS Faxon

Maiopsis Faxon, 1893, p. 150; 1895, p. 11. Rathbun, 1925, p. 337.

Type: Maiopsis panamensis Faxon, by monotypy.

Description: Carapace subtriangular, as broad as long, spinose; rostrum produced anteriorly into two divergent horns with an accessory spine upon their outer margins; interorbital space broad. Eyes small, eyestalks slender, retractile within the orbits. Orbits large, with a forward aspect, incomplete below, the upper margin prominent, with two deep fissures, and supraocular spines. Epistome short. Basal segment of antennae very broad, with three prominent spines upon its anterior margin; flagellum of the antennae widely separated from the cavity of the orbit by a broad process of the basal segment. Merus of outer maxillipeds notched at the anterointernal angle. Legs of moderate length; carpus of chelipeds elongated, not carinated; chela elongated and slender, fingers canaliculate within, but not spoon-shaped at their tips, their prehensile edges meeting throughout most of their length, not distinctly toothed; ambulatory legs spinose.

Male abdomen seven-[segmented], terminal segment short and broad. (Faxon)

Female abdomen seven-segmented also.

Range: Eastern tropical Pacific: Clarion Island, Mexico, Bay of Panama, and Ecuador. 48-182 fathoms. The genus contains but one species.

Maiopsis panamensis Faxon

Plate U, Figs. 3, 3a; Plate 38, Figs. 1, 2; Plate 39, Fig. 1

Maiopsis panamensis Faxon, 1893, p. 151; 1895, p. 13, pl. 2. Rathbun, 1925, p. 338, pl. 247.

Type: Male holotype, M.C.Z. No. 4480, length to base of rostrum 112 mm, rostrum 22 mm, width 113.5 mm.

Type locality: Bay of Panama, 182 fathoms, *Albatross* station 3355.

Localities subsequently reported, with collectors: Known only from the type locality above.

Atlantic analogue: None. A Panamic species.

Diagnosis: Carapace extremely spiny, three spines at distal end of meri. Two deep supraorbital fissures and an interorbital spine. Basal antennal article very broad, three spines on anterior margin. Male seventh abdominal somite broader than long, truncate terminally. Male first pleopod long, slender, cylindrical, tapering toward apex, grooved along concave border, and twisted so that the groove distally reaches the convex border, where its ridges enclose the subterminal aperture, protected also proximally by a minute flap; a single row of inconspicuous setae on concave margin between aperture and needle-sharp tip.

Description: Dorsal surface of carapace thickly set with spines of various sizes and scattered hooked setae. The largest spines distributed as follows: five on the gastric region, one on the genital, one on the cardiac, four on the intestinal, and about seven on each branchial region. Margin of carapace armed with twelve prominent spines, three of them on the hepatic region. [Chelipeds and] legs covered with numerous spiny tubercles; the meri armed with three or more prominent spines at the distal end. Chela long and slender, the tubercles of the hand smaller than on the other parts of the legs; fingers nearly smooth; a deep pit at base of movable finger.

Sternum ornamented with small tubercles along each side of the abdomen. First abdominal segment furnished with a bidentate tubercle. (Faxon, 1893)

Female with principal spines of carapace distributed as in male except on intestinal region; this region with but one prominent spine, the median intestinal, instead of four. Seven spines of each branchial region arranged

in two diagonal rows of three spines each, plus a single spine in advance of either row. Median of three basal antennal spines double, giving a four-spined appearance to anterior margin of article. Merus of third maxilliped broader than ischium, notched to receive palpus; anteroexternal angle broadly arcuate, anterointernal angle produced as a thin, sharp blade, margins of both external and internal projections spinulose.

Female chelipeds with coxa, basis, and ischium of nearly normal size, merus and carpus much reduced in diameter, propodus and dactylus almost filiform. Sharp granulations of merus and carpus not extending onto smooth or microscopically punctate manus.

Female sternum with tubercles fewer in number than in male and mostly concealed by rounded abdomen. Female abdomen seven-segmented; first segment with two tubercles side by side, second segment with similar tubercles more closely approximated.

Material examined: Manta, Ecuador, October 25, 1895, R. Paessler, 1 male specimen (Hamburg Museum). Sulphur Bay, Clarion Island, Mexico, March 16, 1939, 48-60 fathoms, *Velero III* station 918-39, 1 female specimen.

Measurements: Male specimen: length including rostrum 147 mm, width including spines 145 mm, without spines 131 mm, rostrum 25 mm, width 25 mm, cheliped 230 mm, chela 105 mm, dactyl 41 mm, legs 271, 240, 219, and 190 mm, respectively. Female specimen: length including rostrum 72 mm, width including spines 69 mm, without spines 60 mm, rostrum 10 mm, width 13 mm, cheliped 62 mm, chela 28 mm, dactyl 11.4 mm, legs 82, 75, 71, and 60 mm, respectively.

Color in life: Unknown.

Habitat: Black gravel, shell. (Rathbun) The Clarion Island specimen was dredged on a bottom of shell and coralline.

Depth: 48-182 fathoms.

Remarks: The specimens recorded above are the first to be reported since the holotype and extend the range of the species from the Bay of Panama north to Clarion Island, outpost of the Revilla Gigedo Islands, Mexico, and south to Manta, Ecuador. The discovery by Dr. A. Panning among Hamburg Museum collections of a large male incorrectly identified as *Maja squinado* (Herbst) is most fortunate, since it permits the figuring of the male first pleopod for the species and genus. Collected by Captain Paessler in 1895, this specimen is almost as old as the holotype in the Museum of Comparative Zoology, which now cannot be located, according to Dr. E. Deichmann.

Genus **PARAMITHRAX** Milne Edwards

Paramithrax Milne Edwards, 1834, p. 324 (part: §A). Miers, 1879, p. 655 (part: subgenus *Paramithrax*, restricted). Rathbun, 1918, p. 17; 1925, p. 338.

Type: The Australian and New Zealandian *Paramithrax peroni* Milne Edwards, 1834, by subsequent designation of Miers (1879c, p. 656).

Description: Carapace oblong-triangular, usually spinous above. Rostrum composed of two spines divergent from their base. Orbits large, deep, oval, with a forward aspect, incomplete below, upper margin prominent, with two deep fissures and long spines. The eyes concealed when retracted; stalks rather long, slender, curved, cornea small. Postorbital spine conical, usually remote from orbit . . . Basal article of antenna much enlarged, armed with spines; movable portion arising within orbital margin and separated from the cavity of the orbit by a narrow process of the basal article. Anterior margin of buccal cavity straight or nearly so. Merus of outer maxillipeds notched at anterointernal angle. Chelipeds strong; fingers pointed. Ambulatory legs cylindrical; dactyls unarmed. (Rathbun, 1925)

Abdomen seven-segmented in both sexes.

Range: Western South Pacific, especially Australia, New Zealand, and outlying islands. Approaches the American continent only at Juan Fernandez Island, Chile.

Paramithrax baeckstroemi Balss

Plate U, Fig. 2; Plate 41, Fig. 2

Paramithrax peroni, Lenz, 1902, p. 756. Not *P. peronii* Milne Edwards, 1834.

Paramithrax peronii, Rathbun, 1910, p. 573. Not *P. peronii* Milne Edwards, 1834.

Paramithrax bäckströmi Balss, 1924, p. 336, text-fig. 3. Rathbun, 1925, p. 339, pl. 123, text-fig. 108.

Paramithrax baeckstroemi, Garth, 1957, p. 30.

Type: Male holotype, length 20.8 mm, width without spines 12.8 mm, with spines 14 mm.

Type locality: Masatierra Island, Juan Fernandez Islands; K. Bäckström, collector; type and cotypes in Museum of Natural History, Gothenburg, *vide* Dr. Karl Lang.

Localities subsequently reported, with collectors: Juan Fernandez Island, L. H. Plate (Lenz, as *Paramithrax peroni*), Hassler Expedition (Rathbun, 1925). The early records from Halt Bay and Porto Buono [Puerto Bueno], Chile, *Magenta* (Targioni-Tozzetti, 1872a, 1872b, as *Paramithrax peronii?*), are believed instead to represent *Eurypodius latreillei* Guérin.

Atlantic analogue: None. An eastern Pacific representative of a western Pacific genus.

Diagnosis: Differing from *Paramithrax peroni* in the following particulars, according to Balss: rostral spines diverging more strongly, a serrate crista adorning the carpus of the cheliped, but two branchial spines [three, including the anterior branchial] instead of four, and a large intestinal spine. Aperture of the male first pleopod located in a saclike outgrowth protected by a fleshy flap and concealed by a half-twist near the apex. Several rows of setae present, the most prominent extending to the slender, pointed tip.

Description: Carapace covered with curled hairs, finely granulate and armed with a few spines; of the median spines, two mesogastric, one intestinal; two pairs of submedian spines, one pair cardiac, the other on the posterior margin. Supraocular eave provided with a strong anterior and a small posterior spine, followed by a longer spine half as long as the postorbital spine; the latter with a lobe or tooth on its outer margin and denticulate on inner margin. Two marginal hepatic spines, subequal, directed outward; followed by a small branchial spine, and at the widest part of the carapace by a strong spine; another similar spine above posterolateral margin. Rostral horns very divergent, acuminate. Basal article of antenna with a large, flat, falciform tooth or lobe at outer angle and a small, sharp tooth at inner angle; inner margin denticulate. Flagellum extending for half its length beyond rostrum. Two sharp spines on the eye, one anterior, on the edge of the cornea, the other superior, overlapping cornea. Merus of outer maxillipeds subquadrate, with the inner, distal angle deeply notched, a tooth at outer angle of notch; palpus long and stout.

Merus and carpus of chelipeds ornamented with flat lobes or teeth; about six of these forming a superior border on the merus; and five smaller lobes marking the lower-outer border; inner and outer surfaces unevenly granulate. On the carpus three or four lobes forming a continuous crest above; only one below; inner and outer surfaces uneven, the outer having two large tubercles. Upper carina of palm sharp, distally wanting. Fingers crenulate within, moderately gaping, no large basal

tooth. Ambulatory legs slender, covered with curled hair; distal articulations of merus acute, in first pair spiniform. (Rathbun, 1925, modified)

Material examined: Juan Fernandez Island, Chile, *Hasler*, 1872, M.C.Z. No. 2048, 2 males, 1 female. Also *Paramithrax peroni*, New Zealand, L. R. Richardson, 1 pair.

Measurements: Male holotype: median length 16.3 mm, length to tip of horns 20.8 mm, width without spines *ca.* 12.8 mm, with spines 14.0 mm. Ovigerous female: length to tip of horns 12.3 mm. Male specimen, M.C.Z. No. 2048: median length 16.1 mm, length to tip of horns 20.2 mm, width without spines 13.2 mm, with spines 14.8 mm, rostrum 4.8 mm, basal width 3.7 mm, cheliped 20.4 mm, chela 11.7 mm, dactyl 5.6 mm, height of palm 4.7 mm, walking legs 21.6, 19.8, 16.6, and 14.6 mm, respectively. Mature, non-ovigerous female: length 13.9 mm, width including spines 10.3 mm, without spines 9.5 mm.

Color in life: Unknown.

Habitat: Not specified.

Depth: Not given.

Remarks: Through the kindness of Professor L. R. Richardson of Victoria College, Wellington, specimens of *Paramithrax peroni* were made available for study. These serve to confirm the differences noted by Rathbun (1925, p. 240) between New Zealand and Juan Fernandez specimens, including the absence in *Paramithrax peroni* of the preorbital spine, the absence in *P. baekstroemi* of the second of the four branchial spines, and the more elaborate ornamentation of the carpus of the cheliped in the latter species. In addition to these points, and to such considerations as the disparity in size of mature specimens and the remoteness of their habitats, we have now the distinctness of their gonopods, here illustrated (Plate U, figs. 1, 1a; 2, 2a), as a basis for treating them as separate species.

Subfamily MITHRACINAE

Majinae Alcock, 1895, pp. 161, 166, and 236 (part: the Periceroida).
Mithracinae Balss + *Macrocoelominae* Balss, 1929, pp. 16, 20.

Carapace broadened anteriorly by the outstanding, often tubular, orbits; the orbits formed (1) by an arched supraocular hood, or semi-tubular horn, (2) by a hollowed postocular process, and (3) by a remarkable broadening, or by a prolongation, of the anterior part of the basal antennal article, affording complete concealment to the retracted eye. Rostrum often more or less deflexed. (Alcock)

Pleopod 1 like that in the [Pisinae Alcock]. Pleopod 2 short. (Stephensen)

While the key that follows permits the further division of the Mithracinae thus broadly conceived into the Mithracinae, *sens. restr.*, and the Macrocoelominae of Balss (1929, p. 16 ff.), this refinement is not adopted here for reasons set forth in the introduction and again discussed for the subfamily Pisinae. The presence of the intercalated spine, on which Balss based the separation of the Mithracinae from the Macrocoelominae, is difficult to demonstrate in *Hemus*, *Thoe*, and *Teleophrys* because of coalescence. The genus *Microphrys*, placed by Balss in the Macrocoelominae, has an intercalated spine and must on this account be considered as belonging to the restricted mithracine group. Furthermore, it shares with *Ala* [= *Anaptychus*], said by Balss to have been derived from the Hyasteniinae, a typically mithracine male first pleopod. Finally, *Stenocionops* and *Macrocoeloma* themselves stand close in structure of pleopod to *Libinia* and *Neodoclea* of the Hyasteniinae (here considered a subgroup of the Pisinae) and may be related to them through *Coelocerus*, an Atlantic genus not seen by Balss, nor yet studied by the present writer.

KEY TO THE AMERICAN GENERA OF THE SUBFAMILY *Mithracinae*

(Pacific genera are shown in bold-face type and are treated in this work)
(Basal antennal article forming floor of orbit; intercalated spine present or absent)

- 1a. Intercalated spine present; orbits sometimes projecting beyond general outline of carapace, but never tubular
 (Mithracinae, *sensu restr.*, Balss)
- 2a. Orbits not projecting laterally beyond general outline of carapace. Carapace subtriangular. Legs cristate
- 3a. Merus of ambulatory legs with a thin, lamellate, posterior expansion. No preorbital tooth
 - 4a. Carapace very high on median line. Basal article of antenna broader than long **Hemus**
 - 4b. Carapace not noticeably high on median line, lobulate. Basal article of antenna no broader than long **Thoe**
- 3b. Merus without posterior (or inferior) expansion, but cristate above. A preorbital tooth present
 **Teleophrys**

- 2b. Orbits projecting laterally somewhat beyond the general outline of the carapace
- 5a. Rostrum small. Carapace ovate, usually broader than long
- 6a. Lateral margins of carapace laminiform, coarsely dentate. Chelipeds and legs cristate above. Orbital margin not incised, bearing a preocular spine and a postocular tooth . . . Ala [= *Anaptychus*]
- 6b. Lateral margins armed with four, or three, spines or lobes behind orbit. Legs spinous. Orbital margin spinous or tuberculous . . . *Mithrax*
- 5b. Rostrum of good size, usually with two strong horns. Carapace broadly pyriform. Basal antennal article armed with a prominent spine at anteroexternal angle . . . *Microphrys*
- 1b. Intercalated spine absent; orbits tubular . . .
 (Macrocoelominae Balss)
- 7a. Lateral margin of carapace armed with a series of strong spines. Basal antennal article very broad
- 8a. Basal antennal article quadridentate. Postocular tooth large, quadrangular, armed with two teeth or spines . . . *Coelocerus*
- 8b. Basal antennal article with fewer than four spines or teeth. Postocular tooth of moderate size, triangular, armed with only one spine . . . *Stenocionops*
- 7b. Lateral margin of carapace not armed with a series of strong spines, but with a spine, usually strong, at the lateral angle of the carapace
- 9a. Orbits strongly projecting. Rostral horns short. Carapace broad . . . *Macrocoeloma*
- 9b. Orbits little projecting. Rostral horns long and slender. Carapace narrow . . . *Leptopisa*

Genus ALA Lockington

- Anaptychus* Stimpson, 1860b, p. 183; type: *A. cornutus* Stimpson, 1860, by monotypy. A. Milne Edwards, 1875, p. 66. Rathbun, 1925, p. 377. Not *Anaptychus* Opper, 1856.
- Ala* Lockington, 1877c, p. 65; type: *A. spinosa* Lockington, 1877, by monotypy. Balss, 1929, p. 16.

Anaptychoides Strand, 1928, p. 40 (name substituted for *Anaptychus* Stimpson, preoccupied).

Type: Ala spinosa Lockington, 1877 = *Anaptychus cornutus* Stimpson, by monotypy.

Description: Carapace broader than long, not very convex. Lateral margins advanced in the form of toothed lamellae above the base of the legs. Front formed of two pointed horns. Orbit provided above with a projecting tooth. Eyes small and lodged in cavities entirely separated below by the basal article of the external antennae; the latter wide and provided in front and on the outside with a strong spine advanced nearly as much as the rostral horns. Movable flagellum exposed. Merus of external maxillipeds broader than long; its anteroexternal angle projecting; its internal angle notched for the insertion of the palp. Exognath broad and provided on the inside with a triangular sharp tooth lodged between [the second and third article] of the endognath. Ambulatory legs short and heavy. (After A. Milne Edwards)

Abdomen seven-segmented.

Range: West coast of America from Cholla Bay, Gulf of California, to Port Utria, Colombia. Shore to 12 fathoms.

Contains only one species.

Ala cornuta (Stimpson), new combination

Plate V, Figs. 1, 2; Plate 39, Fig. 2

Anaptychus cornutus Stimpson, 1860b, p. 184, pl. 2, figs. 1, 1a, 1b. A. Milne Edwards, 1875, p. 67, pl. 19, figs. 1, 1a, 1b. Streets and Kingsley, 1877, p. 105. Kingsley, 1879a, p. 146. Rathbun, 1924c, p. 379; 1925, p. 378, pl. 134, figs. 4, 5; pl. 254, fig. 1; text-fig. 122. Steinbeck and Ricketts, 1941, p. 467. Crane, 1947, p. 72. Garth, 1948, p. 28.

Ala spinosa Lockington, 1877c, p. 66; type locality, La Paz, San José Island, and Port [Puerto] Escondido, Gulf of California; types not extant.

Mithrax trigonopus Cano, 1889, p. 183, pl. 7, fig. 8; type locality, Panama; type originally in Naples Museum, believed not extant.

Anaptychus cornutus, Bouvier, 1895, p. 8.

Mithrax trigonopus, Rathbun, 1910, p. 575.

Type: Male holotype, length 25.4 mm, width 31.5 mm, not extant; ovigerous female, paratype, M.C.Z. No. 331.

Type locality: Pinacate Bay, near Guaymas, Sonora, Mexico; Capt. C. M. P. Stone, collector.

Localities subsequently reported, with collectors: Mexico: Lower California: L. Diguët (Bouvier); Gulf of California: Tepoca Bay, Fred Baker, California Academy of Sciences Expedition (Rathbun, 1924c); Concepción Bay and Pt. Marcial Reef, Steinbeck and Ricketts (Steinbeck and Ricketts); Port [Puerto] Escondido, San José Island, and La Paz, W. J. Fisher (Lockington, as *Ala spinosa*); Mexico south of Cape Corrientes: Chamela Bay and Sihuatenejo, *Zaca* (Crane); Manzanillo, C. R. Orcutt (Rathbun, 1925). Costa Rica: Port Parker, Port [Puerto] Culebra, Piedra Blanca, Jasper Island, Ballenas Bay, and Uvita, *Zaca* (Crane). Panama: *Vettor Pisani* (Cano, as *Mitrax trigonopus*); Bahía Honda, *Zaca* (Crane); Pearl [Perlas] Islands, S. W. Garman (Rathbun, 1925). Colombia: Utria Bay [Port Utria], *Askoy* (Garth).

Atlantic analogue: None. Confined to the Panamic province.

Diagnosis: Carapace broader than long; rostrum from one-fourth to one-fifth as long as remainder of carapace. Rostral and antennal spines acute, subequal. Chelipeds crested and tuberculate; walking legs cristate and dentate. Male first pleopod with apex swollen at base, tip pointed, two triangular lateral flanges.

Description: Carapace devoid of granulations, but a certain number of projections [i. e., nine or ten gastric] on the gastric, cardiac, and branchial regions. Several hairs, short and arranged in little tufts, covering these projections. Frontal region broad and formed: first, by the two pointed rostral horns, extending parallel to each other, and united at their base; measured from the orbit, about one-fifth the length of the carapace; second, by the preorbital horns, shorter and situated at a level superior to the preceding. External orbital angle small and dentiform. Lamellate expansion of the lateral margins irregularly scalloped. A first triangular tooth occupying the hepatic region, separated by a deep rounded notch from the lamellate prolongation of the branchial regions; the latter bearing in front a strong flattened tooth, the point bent a little forwards, then several not very deep indentations. Posterior margin surmounted by a marginal crest, separated from the lamellate branchial expansion by a notch; several tufts of hair occurring along this margin.

Chelipeds slender and a little longer than the first pair of ambulatory legs; arm bearing a toothed crest above, and a spine at its extremity; forearm provided with cristiform projections; hand smooth, except for several very fine granulations; fingers scarcely gaping, provided with fine denticulations and tapering. Ambulatory legs short; their first articles having a prismatic triangular shape, the projecting edges being cut into

pointed teeth or into spines. Stiff, short hairs almost entirely concealing these indentations. (A. Milne Edwards, modified)

The male first pleopod is decidedly mithracine, resembling in particular that of *Mithrax (Mithrax) tuberculatus* in having a bulbous base, a pointed tip, and two triangular lateral projections, in one of which the aperture is situated. (See Plate V, figs. 1, 2)

Specimens from Secas Islands, Panama, differ uniformly from those of other localities, both north and south, in that laminiform processes of the carapace are lacking. In their place are blunt spiniform teeth well separated at their bases. A small but distinct tridentate lobe in the posterolateral region constitutes the only approach to a crest in the entire armature.

Material examined: 120 specimens from 31 stations. (See Table 70) From the southeast end of Cholla Bay, Sonora, Mexico, Bruce W. Halstead, collector, to Bahia Honda, Panama. In addition to the above, two females from Tepoca Bay, Gulf of California, Mexico, April 25, 1921, Fred Baker, collector, California Academy of Sciences, determined by M. J. Rathbun; also one male from Utria Bay [Port Utria], Colombia, *Askoy Expedition*. (Garth, 1948)

Measurements: Male: length 29.6 mm, width 33.8 mm, rostrum 5.0 mm, width 4.4 mm, cheliped 29.2 mm, chela 13.2 mm, dactyl 6.0 mm, height of palm 4.3 mm, ambulatory legs 29.0, 25.0, 22.5, and 19.0 mm, respectively. Female: length 33.0 mm, width 40.0 mm.

Color in life: Olive green overgrown with white bryozoans, green and purple sponges and algae. Eggs purplish black. (Crane, of a specimen from Chamela Bay, Mexico)

Habitat: Under side of stones at extreme low-tide level, in tidepools and in *Pocillopora* coral. (Crane) Associated with the hatchet clam *Pinna*. (Steinbeck and Ricketts) Typically covered with calcareous algae, sponges, hydroids, bryozoans, serpulids, barnacles and sand grains. (Crane) *Velero III* specimens were collected 18 times on rocky shore, cracked 5 times from *Pocillopora* coral, and dredged three times on bottoms of sand, sandy mud, or coralline.

Depth: Shore to a maximum of 12 fathoms.

Size and sex: Males from the Gulf of California are from 12.1 to 29.6 mm, females from 12.5 to 33.0 mm, ovigerous females from 23.0 to 33.0 mm. Males from the Bay of Panama (including Costa Rica) are from 7.0 to 21.6 mm, females from 6.4 to 16.6 mm, and ovigerous females from 12.5 to 15.3 mm. Thus it will be seen that females of a size that in the Gulf of California would be immature are breeding in the Bay of Panama.

Breeding: Egg-bearing females in August or September in the Gulf of California. (Lockington) Eggs in November in Mexico and in January-March in Costa Rica. (Crane) Ovigerous females were encountered by the *Velero III* in Costa Rica in February, in Panama in March, and in the Gulf of California in May, and at Tiburon Island in June by William Neil Smith, II.

Remarks: Because of the existence of a paratype in the M.C.Z., a neotype is not proposed for the species. Station 1092-40, Bahia Catalina, outside Guaymas, is nearest to the type locality, Pinacate Bay.

Genus MITHRAX Desmarest

Mithrax Desmarest, 1823, p. 263. Milne Edwards, 1837, p. 83, pl. 27.

A. Milne Edwards, 1875, p. 91. Rathbun, 1925, p. 379.

Trachonites Desmarest, 1823, p. 263; type: *Cancer aculeatus* Herbst, 1790 = *Mithrax pilosus* Rathbun.

Mithraculus White, 1847, p. 7; type: *M. coronatus* White, 1847 (not *Cancer coronatus* Herbst) = *Mithrax (Mithraculus) sculptus* (Lamarck).

Nemausa A. Milne Edwards, 1875, p. 80; type: *N. spinipes* (Bell), 1836, by subsequent designation of Miers (1879c, p. 666).

Type: The Atlantic *Cancer aculeatus* Herbst, 1790, a species now recognized as *Mithrax pilosus* Rathbun, 1892, type of *Mithrax* Desmarest by subsequent designation of Milne Edwards (1837).

Description: Carapace convex and little elongate, narrowing noticeably in front. Front formed of two small, often pointed rostral horns, with other preorbital or antennary spines or projections at the side. Orbital margins generally more or less spinous or tuberculate. Basal article of the external antennae wide, bearing in front two or three strong spines; second article inserted outside of the orbit, at the base of the rostrum. Merus of the external maxillipeds broad and dilated on the outside; exognath broad. Sternal plastron nearly circular.

Chelipeds long and strong, especially in the male; chelae deeply hollowed into a spoon shape, and the fingers leaving between them, when closed, a considerable space. Ambulatory legs robust, armed with spines, and ending in hooked digits often armed with several spinules on their inferior surface.

Abdomen of the male formed of seven free articles. (A. Milne Edwards, modified)

Anterolateral margin bearing usually four, sometimes three, spines or lobes behind the orbit; posterolateral margin sometimes having a spine or tubercle. Rostral horns either pointed or truncate. (Rathbun)

Range: Eastern Pacific from San Diego, California (locality supposed correct), and Puerto Refugio, Angel de la Guarda Island, Gulf of California, Mexico, to Guayaquil, Ecuador (extralimital), possibly to Valparaiso, Chile (*Mithrax*, sp. indet.), including Revilla Gigedo and Galapagos Islands. Western Atlantic from Cape Hatteras, North Carolina, to Ilha Victoria, São Paulo, Brazil; Bermuda. Shore-160 fathoms.

The writer departs from the time-honored synonymy for this characteristically American genus, customarily attributed to Latreille (1817, p. 23), on the advice of Dr. L. B. Holthuis, who points out in a personal communication that the use by that author of the article in the phrase "Les *Mithrax* Leach" makes of it a vernacular name, while the fact that the name is plural, as indicated by the article, makes it unavailable nomenclatorially. The first valid use of the name, then, was that of Desmarest (1823); the earliest type designation that of Milne Edwards (1837, pl. 27), the title of whose work expressly states that it is accompanied by engraved plates representing the types of all the genera.

The same difficulty with vernacular names is encountered in any attempt at a formal synonymy of the subdivisions of the genus. Thus the "*Mithrax transversaux*" plus the *Nemausa* of A. Milne Edwards (1875) form the subgenus *Mithrax* as presently constituted, while his "*Mithrax déprimés ou Mithracules*" (exclusive of *Teleophrys*) comprise the subgenus *Mithraculus* as here recognized.

KEY TO THE PACIFIC SPECIES OF *Mithrax*

- 1a. Carapace roughened to a greater or lesser extent by tubercles or spinules, branchial sulci wanting. Intermediate orbital teeth pointed or subtruncate, conspicuous . . . (Subgenus *Mithrax*)
 - 2a. Rostral horns acute and elongate
 - 3a. A proximal tubercle on outer surface of manus. Four blunt anterolateral spines, with only the hepatic having an auxiliary spine at base. Rostral horns of moderate length. Male first pleopod with three subterminal folds, tip acute. Size large *armatus*
 - 3b. Outer surface of manus without a proximal tubercle. Carapace with a lateral angle. Five lateral spines, the last postlateral; hepatic and first branchial spines simple. Rostral horns long. Male first pleopod with truncate tip. Size small *spinipes*

- 2b. Rostral horns subtruncate or tuberculiform
- 4a. Carapace not paved with close-set granules, occasionally some of the areolations granulate. Male first pleopod without tubular extension, tip pointed
- 5a. Only three or four anterolateral spines or tubercles, some occasionally with accessory spines or tubercles
- 6a. Three spines on basal segment of antenna. Four anterolateral protuberances, the last simple and acute, the others subdivided into two or three spines each.* Male first pleopod with a single subterminal fold . . . *sinensis*
- 6b. Two blunt teeth on basal segment of antenna. Areolations of carapace granulate; two lobes and one (or two) spine(s) on anterolateral margin. Male first pleopod with two subterminal flanges . . . *tuberculatus*
- 5b. Six or more anterolateral spines or spinules. Rostral lobes truncate. Chelipeds and ambulatory legs elongate. Antennae long and slender. Male first pleopod with a subterminal swelling. Size small . . . *pygmaeus*
- 4b. Carapace paved with close-set granules. Lateral margins of carapace with lumpy projections. Wrist tuberculate above. Male first pleopod with a tubular extension. Size large. Galapagos only . . . *belli*
- 1b. Carapace smooth and bearing oblique branchial sulci, either strongly or weakly indicated. Intermediate orbital teeth tuberculiform, inconspicuous . . . (Subgenus *Mithraculus*)
- 7a. Three anterolateral marginal lobes. Inner edge of cheliped laminate to middle of manus. Carapace narrower than 7b. Male first pleopod with a sheath extending beyond terminal opening. Galapagos only . . . *nodosus*
- 7b. Two lobes and a spine on anterolateral margin. Inner edge of wrist only laminate, lamina faintly bilobed. Carapace wider than long by nearly half. Male first pleopod with two rounded flanges . . . *denticulatus*

*In *Mithrax (Mithrax) sinensis clarionensis* into five spines each.

Species not treated because of insufficient data:

Mithrax (Mithrax) rostratus Bell (1835b, p. 171; 1836, p. 51, pl. 10, figs. 1, 1a, 1b); type locality unknown; not collected since original description. Not *Mithrax rostratus* Boone (1930b, p. 1, figs. 1a, 1b), which is *Loxorhynchus grandis* Stimpson.

Mithrax, species indeterminable, Rathbun (1925, p. 421); Valparaiso Bay, Chile, 25 fathoms, C. E. Porter; specimen returned to sender.

Subgenus *Mithrax* Desmarest

Mithrax (Mithrax) Rathbun, 1925, p. 383.

Description: Carapace without conspicuous, smooth, oblique, branchial sulci. Rostral horns usually as long as wide, sometimes elongate and spiniform. Minor teeth or tubercles of orbit plainly marked, though small. (Rathbun)

The majority of west coast species belong in this, the more typical division of the genus.

Mithrax (Mithrax) tuberculatus Stimpson

Plate V, Fig. 3; Plate 40, Fig. 1

Mithrax tuberculatus Stimpson, 1860b, p. 189. A. Milne Edwards, 1875, p. 96, pl. 20, figs. 5, 5a, 5b. Miers, 1886, p. 86. Coventry, 1944, p. 543. Not *M. tuberculatus*, Aurivillius, 1889, p. 57.

Mithrax (Mithrax) tuberculatus, Rathbun, 1925, p. 418, pl. 151, figs. 1, 2. Crane, 1937, p. 60.

Type: 13 males and 13 females, cotypes, M.C.Z. No. 1228; 2 males and 1 female, cotypes, U.S.N.M. No. 23178. Measured male cotype, length 34.8 mm, width 42.4 mm.

Type locality: Cape St. [San] Lucas, Lower California, Mexico; John Xantus, collector.

Localities subsequently reported, with collectors: Mexico: Arena Bank, Gulf of California, Zaca (Crane); Mazatlan (A. Milne Edwards); Maria Madre Island, Tres Marias Islands, *Pioneer* (Coventry). Panama: Capt. Field (Rathbun).

Atlantic analogue: *Mithrax (Mithrax) hispidus* (Herbst).

Diagnosis: Rostral horns short and truncate, edges granulate. Two lobes and a spine (or often two spines) on anterolateral margin. Areolations of carapace granulate. Basal antennal article with two blunt teeth. Two or three tubercles on inner margin of merus of cheliped. Male first pleopod with pointed tip and two divergent subterminal flanges.

Description: Carapace naked, tuberculated; tubercles more or less prominently granulated, most so in the young. Margin armed on each side with a strong unguiform spine or tooth curved forward. Between this lateral spine and the orbit two large, well-rounded tubercles, their distance from each other about equaling their diameter; the posterior one larger and more prominent. On each side of the lateral spine (before and behind it) a smaller marginal spine or sharp tooth. Front narrow; horns of the rostrum short, blunt, scarcely more prominent than the anterior tooth of the basal article of the antennae. This [article] triangular, narrowing before, and armed on the under side of the orbit with another, a lateral tooth, very small. A small tooth, posterior to this, scarcely belonging to the antennal [article]. Pterygostomial ridge or margin tuberculated. Merus of the external maxillipeds with a right-angled notch at the inner apex for the insertion of the palpus.

Chelipeds naked; merus tuberculated; carpus sparsely granulated; hand smooth; fingers scarcely gaping, and unarmed within, except for a tooth on the dactylus in old specimens. Ambulatory [legs] thick, sub-cylindrical, nearly naked, short-spinose or granulated above, tomentose below. (Stimpson, modified)

Of the dorsal tubercles two pairs behind the rostral horns, followed by a transverse row of five; about seven large tubercles on the branchial region, and two side by side on the intestinal region. Small, low tubercles on the cardiac and mesogastric regions, and single granules on the posterior and posterolateral margins. (Rathbun)

The presence of an accessory spine in front of the last anterolateral spine is a variable character within the species. This may be small, as noted by Crane (1937, p. 61), or of equal size with the lateral spine, as noted in a majority of *Velero III* specimens. In general, specimens from the Gulf of California, near the type locality, Cape San Lucas, have the accessory spine reduced or wanting, while specimens from the Bay of Panama show it well developed. Two or three specimens in the present series are asymmetrical with respect to this spine, having it on one side but not the other.

Material examined: 17 specimens from 13 stations. (See Table 71) From Perico Point of Carmen Island, and Puerto Escondido, Gulf of California, Mexico, to La Libertad, Ecuador.

Measurements: Largest specimen, male: length 26.7 mm, width including spines 32.2 mm, without spines 29.0 mm, rostrum 2.2 mm, width 3.9 mm, cheliped 46 mm, chela 24.6 mm, dactyl 13.0 mm, height of palm 10.0 mm, ambulatory legs 35, 32.5, 28, and 25 mm, respectively.

Ovigerous female: length 23.4 mm, width including spines 26.8 mm, without spines 24.0 mm.

Color in life: Crimson to maroon, mottled ventrally with a varying amount of white. Chelipeds either pale cream except for crimson dactyls or mottled crimson and white, or entirely crimson. Color deepest in male. (Crane)

Habitat: Coral (*Pocillopora ligulata*). (Crane) Of the 13 Hancock expeditions stations, 7 were coral, 3 rocky substratum, 2 sandy bottom, and one coralline. Serpulids and bryozoans were observed attached to both *Zaca* and *Velero* specimens.

Depth: Shore to 25 fathoms.

Size and sex: The series includes males from 12.3 to 26.7 mm, females from 14.1 to 23.4 mm, ovigerous females from 17.0 to 23.4 mm, and an 8.5 mm young.

Breeding: Ovigerous females were encountered by the *Zaca* in the Gulf of California in May (Crane) and by the *Velero III* off Panama and Colombia in January.

Remarks: The range of the species is extended northward from Arena Bank to Perico Point, Carmen Island, in the Gulf of California, and southward from Panama to La Libertad, Ecuador. These localities define in the littoral the limits of the Panamic province.

This species may be distinguished from *Mithrax (Mithrax) sinensis* by the tuberculate rather than subacute hepatic and anterior branchial prominences, by the two blunt teeth rather than three spines on the basal antennal article, and by the stout and tuberculate meri of the chelipeds, rather than the slender and spinulous meri of *M. (M.) sinensis*.

Mithrax (Mithrax) armatus Saussure

Plate V, Fig. 4; Plate 40, Fig. 2

Mithrax armatus Saussure, 1853, p. 355, pl. 13, fig. 1. Stimpson, 1857b, p. 456. A. Milne Edwards, 1875, p. 101. Miers, 1886, p. 86.

Mithrax (Mithrax) armatus, Rathbun, 1925, p. 399, pl. 262, fig. 6.

Mithrax (Mithrax) orcutti Rathbun, 1925, p. 397, pls. 140, 141; type locality, Puerto Angel, Oaxaca, Mexico; female holotype, U.S.N.M. No. 47110.

Mithrax orcutti, Crane, 1947, p. 73.

Type: Female holotype, length 47.3 mm, width 42.8 mm; not in Geneva Museum.

Type locality: Mazatlan, Mexico; J. Verreaux, collector.

Localities subsequently reported, with collectors: Mexico: T. B. Wilson (Rathbun); Mazatlan, Sinaloa, A. Agassiz (Rathbun); Puerto Angel, Oaxaca, C. R. Orcutt (Rathbun, holotype of *Mithrax (Mithrax) orcutti*). Nicaragua: Corinto, Zaca (Crane). Panama, Capt. Field (Rathbun). [All the foregoing as *Mithrax (Mithrax) orcutti* Rathbun.]

Atlantic analogue: *Mithrax (Mithrax) hemphilli* Rathbun.

Diagnosis: Rostral horns of moderate length, tips acute, incurving. Four blunt anterolateral spines, the first or hepatic with an auxiliary spine at its base. A tubercle near the proximal end of the outer surface of the manus. Propodites of ambulatory legs without spines. Tip of male pleopod pointed, three subterminal folds. A large species.

Description: Carapace, including spines, a little longer than wide; granules and tubercles numerous, high and very unequal. Spines of the dorsum arranged as follows: one on each epigastric lobe; a transverse row of four on protogastric lobes; three median mesogastric; one urogastric; a line of three on the cardiac region forming a transverse curve concave forward; behind these, one on median line; from seven to eight on branchial region; four on intestinal region forming a transverse curve concave to posterior margin; posterior marginal spines of the intestinal region prominent and not continuous with the spines at the extremity of the curved row above. Rostral horns moderately long, the tips curving inward and acutely pointed. Orbital teeth or spines blunt pointed, the one at the outer base of the preorbital spines minute or obsolescent. Of the four anterolateral spines, also blunt, only the first having a secondary spine on its anterior base; at the middle of each of the succeeding sinuses a small and insignificant spine or tubercle. The first or hepatic spine on a lower level than the others. The fourth spine, at the lateral angle of the carapace, rather far forward; between it and the large posterolateral spine a smaller, slenderer spine. On the subbranchial and subhepatic regions a row of seven or eight spines extending forward from the lateral angle of the carapace to the angle of the buccal cavity. On the basal antennal segment, the spine at the anteroexternal angle the largest and rather near the margin; a smaller spine on the orbital margin and one at the base of the next segment; this last spine at the end of a tuberculated ridge bordering on the antennular fossa.

Chelipeds of male stout, longer than first ambulatory leg; merus with two rows of long spines above and numerous tubercles elsewhere; carpus armed with high, granulated knobs; hands smooth except for a large tubercle on outer surface near proximal end and in the middle of its

height; sometimes also a granule adjacent in the same horizontal line. Legs stout; merus armed above with seven or eight spines in two rows and at the distal end a single spine between those rows, below one or two small spines; four or five spines on carpus; propodus unarmed. (Rathbun, modified to eliminate comparative references to *Mithrax* (*Mithrax*) *hemphilli*)

Material examined: Six specimens from 3 stations. (See Table 72) From Los Frailes, peninsular side of the Gulf of California, to Salinas Bay, Costa Rica, and including topotypical material from Mazatlan, Mexico.

Measurements: Comparative dimensions of a male and female from the type locality, in all probability a mated pair, are given in tabular form: (Measurements in mm)

| | Ovigerous | |
|---------------------------------|-----------|--------|
| | Male | Female |
| Carapace length | 53.7 | 56 |
| Carapace width including spines | 53.4 | 55 |
| Carapace width excluding spines | 48 | 50 |
| Rostral length | 8.8 | 8.5 |
| Rostral width | 6.0 | 5.8 |
| Cheliped | 56 | 56 |
| Chela | 26 | 25 |
| Dactyl | 12.4 | 11.7 |
| Height of palm | 7.6 | 7.0 |
| First ambulatory leg | 55 | 57 |
| Second | 50 | 51 |
| Third | 46 | 49 |
| Fourth | 41 | (41) |

Color in life: Clinging to ochre weed, matching it perfectly in color. (Crane) Color in preservative: Crimson, mixed with white; outer surface of chelipeds crimson with small white dots; abdomen crimson and white, mottled. (Rathbun)

Habitat: In tidepools. (Crane) The Mazatlan specimens were collected from a harbor jetty, the Los Frailes specimens from an exposed reef.

Depth: Intertidal.

Size and sex: The small series contains young of 11.4 and 15.9 mm, males of 38 and 53.7 mm, and an ovigerous female of 56 mm.

Breeding: The single ovigerous female was collected at Mazatlan in December.