STUDIES ON THE FAUNA OF CURAÇAO AND OTHER
CARIBBEAN ISLANDS: No. 177

THE TAXONOMY AND ZOOGEOGRAPHY OF THE HADZIID AMPHIPODA,

with emphasis on the West Indian taxa

by

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II GENERAL PART

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ABSTRACT

The origin of the Antillean inland water fauna is discussed. It is assumed that the West Indian islands have been populated along three different lines: by dispersal, by divergence (fragmentation) and by stranding of marine elements during regression periods. – The phylogeny of the hadziid amphipods appears to correspond with the Regression Model. – The members of hadziid group are enumerated, the differences between the genera are tabulated and keyed. – The type-species of the genus *Hadzia*, *H. fragilis*, is re-examined. – *Hadzia taveresi* is transferred to the new genus *Metahadzia*. – The genus *Metaniphargus* is re-surrected; its type-species *M. curasavicus* is re-described after topotypes and divided into two subspecies. Of *M. nicholsoni*, *M. beattyi*, and *M. jamaicae* descriptive notes, based on typical or topotypical material, are provided. Four new taxa of *Metaniphargus* are described from Aruba, Curaçao, St. Martin, Anguilla, and Puerto Rico. – A new genus, *Saliweckelia*, with two new species, is described from anchihaline localities in Curaçao and Bonaire.

I. INTRODUCTION

The present paper treats a group of blind amphipods from hypogean and interstitial habitats in tropical and warm-temperate regions. Members of this group were almost simultaneously discovered for the first time in the Mediterranean region by S. KARAMAN, 1932, and in Curaçao (Netherlands Antilles) bij STEPHENSEN, 1933a.

The group of genera is usually (STOCK & NIJSSEN, 1965) classified with the Gammaridae, but during the Third international Colloquium on *Gammarus* and *Niphargus* (Schlitz, 1975), BOUSFIELD (1977) proposed to rise them to family status, as the family Hadziidae, in the superfamily Melitoidea. Although BOUSFIELD's ideas are still controversial I see no harm in calling the group of genera in question the hadziid group, since this name got a certain tradition through the papers of, for instance, S. KARAMAN and RUFFO.

Provisionally, the contents of the hadziid group are accepted as they are listed by BOUSFIELD (1977, table V), with the exception of the genus *Metacrangonyx* Chevreux, 1909, that I cannot possibly associate with a hadziid.

The genus *Quadrivisio* Stebbing, 1907, is removed in BOUSFIELD's conception from the hadziids and placed in the melitids. For this reason, *Quadrivisio*, though well represented in my collections from various Antillean islands, is not treated in this paper.

Although the present work is chiefly limited to the Caribbean taxa, it proved to be necessary to re-examine some of the Mediterranean species as well, in order to assure an accurate classification of the New World taxa. The taxa from continental areas in North and Central America will not be dealt with here, since a revision of their status is being undertaken by Dr. J. R. HOLSINGER.

The taxonomic studies led to a number of correlations with palaeogeographic conditions in the West Indies. The two prevailing biogeographic models used for the explanation of the actual distribution of animals on the Caribbean Islands, did in my opinion not entirely do justice to the facts derived from Crustacea living in inland waters. In a next section a third model is worked out which takes the historical evolution of the area into consideration. It is assumed that the population or colonization of the islands in the Caribbean took place along ways fitting one of these three different models, depending on the organism and depending on the palaeogeographic history of the island.

METHODS. – The samples brought together by the author, were collected as follows:

In wells, a "phreatobiological net" (BOU, 1975: 616, fig. 2C) was used, a net with a diameter of 30 cm for normally dug wells, a smaller one (Ø 12 cm) for drill holes.

In caves, a handnet was used.

For sampling interstitial waters in banks of coral rubble, a "pump and corer" (BOU, 1975: 612, fig. 2A) proved to be very effective.

The specimens were initially preserved in formalin 4%, but transferred as soon as possible to aethyl-alcohol 70%. For study, the specimens were placed in lactophenol. Dissected appendages were mounted in Reyne's modification of Faure's medium.

Unless otherwise stated, measurements of (parts of) appendages have been made after a single, dissected and mounted, male appendage. Variability counts always are based on 10 specimens (5 ♀, 5 ♂).

The temperatures of the wells on Curaçao and Aruba are not recorded in the lists of localities, since they show very little variation. The temperatures observed range from 26.7° to 31.1°C, mostly between 28° and 29°C.

The chlorinities of a number of my own samples have been determined according to the ASTM (American Society for Testing and Materials) method D512 by Mr. H. BONVIE of the Laboratory of Shell Curaçao N.V. (the samples 73–1 to 74–27). The remaining samples were tested with the aid of an E.E.L. electric chlorinimeter.

For the samples collected by Dr. P. WAGENAAR HUMMELINCK on the various West Indian islands, the reader is referred to his "Description of the localities' (1940b, 1953) and "Marine localities" (1977).

ACKNOWLEDGEMENTS. – The author's older fieldwork (1973–75) in Curaçao, Aruba, Bonaire, and St. Croix was supported by two grants (WR 87–79 and 87–114) from the Netherlands Foundation for the Advancement of Tropical Research (WOTRO), the Hague. Recent (1976) fieldwork in Bonaire and the Windward Islands of the Netherlands Antilles was benefited by a grant from the "Treub Maatschappij", Utrecht.

Thanks are due to Mr. C. Bou, of Albi, France, who provided the pump and corer developed by him, which proved to be a valuable tool for collecting groundwater animals.

The staff members of the Caribbean Marine Biological Institute (Curaçao) and of the West Indies Laboratory, Fairleigh Dickinson University, St. Croix, offered hospitality and greatly appreciated assistance during the fieldwork phase.

Special thanks are due to Dr. P. Wagenaar Hummelinck, Utrecht, who kindly placed his most interesting Antillean amphipod collection at my disposal. A number of years ago, part of this collection was sent to Dr. S. Ruffo, Verona, who – after being informed about my plans – kindly refrained from a further study and returned the material.

Assistance during the fieldwork was received from several persons: on Curaçao in particular by the late Ir. Pieters Kwiers, Dienst Landbouw, and Mr. S. E. Fraai, Kantoor 3e District; on Statia by Mr. J. H. Smid; on Bonaire by Mr. J. Herrera; on St. Croix by Mr. D. Holt.

ABBREVIATIONS. – The following abbreviations for appendages have been used in the text: A1, A2 = first and second antennae; Gn. 1, Gn. 2 = first and second gnathopods; Mx. 1, Mx. 2 = first and second maxillae; P3 to P7 = pereiopods 3 to 7; Ur. 1 to 3 = uropods 1 to 3.

For the collections in which material is preserved, the following abbreviations are used: NMC = National Museums of Canada (Ottawa); RMNH = Rijksmuseum van Natuurlijke Historie (Leiden); USNM = National Museum of Natural History (Washington); ZMA = Zoölogisch Museum (Amsterdam); ZMC = Zoologiske Museum (Copenhagen).

II. GENERAL PART

1. ORIGIN OF THE ANTILLEAN INLAND WATER FAUNA

Two biogeographical models prevail to explain the actual distribution patterns found on the Caribbean islands. The most currently accepted one is the Dispersal Model, that got ample attention through DARLINGTON's well-known books (1957, 1965), as well as through CROIZAT's writings (1958, 1964, 1976).

As ROSEN (1976) recently ably pointed out, the Vicariance Model, long considered unrealistic, finds considerable support from new ideas in the field of plate tectonics.

According to the Dispersal Model, the Caribbean islands got their flora and fauna by chance dispersal, over or through the sea, from nearby islands or continents. As far as the inland water fauna is concerned, this mode of dispersal has a high degree of probability in a number of limnic crustaceans having marine larvae, like *Atya, Jonga, Micratya, Potimirim, Macrobrachium, Palaemon, Sesarma*.... Several of these are widely distributed and show little tendency towards endemism. CHACE & HOBBS (1969: 28–29) presume that members of such genera reached the Antillean islands fairly recently, in Pleistocene or Recent times. Passive transport, e.g. of crayfish hiding in wood logs, of salt-tolerant adults is not excluded as a possibility by CHACE & HOBBS.

Although there certainly are numerous freshwater species for which Dispersal-Model-colonization sounds probable, I cannot accept this as the only possible or realistic way of explaining the actual distribution of animals in the inland waters of the Antilles.

Certainly ROSEN's Vicariance Model (1976) should be carefully tested. He made it more plausible than ever that the Antillean island chain has originated from an ancient (Mesozoic) Proto-Antillean archipelago situated in the position of the present-day Central America. This chain lagged behind when the Southern American and North American plates drifted westward. The position of certain decoupling faults, trenches and submarine ridges forms interesting evidence for this theory (ROSEN, 1976, figs. 8–12). On the back of the fragmentating Central American / Proto-Antillean landmasses, a Mesozoic fauna was carried to their actual position, the Antillean arc. This biogeographic model is called the Fragmentation or Vicariance Model. Essentially, it involves a monophyletic group of island populations, descending from ancestors or relatives on the North and/or South American plates. As far as the inland water fauna of the Caribbean islands is concerned, the distribution of the flatworm genus *Dugesia* may conform to this model (BALL, 1971). Land-bridges of any sort are not necessary as an explanation for this type of distribution. BALL stressed rightly that "a continuous land (or water) connection at any given point in time is not essential. It is only necessary that refugia should persist while various connections are made or broken".

Again, like is the case with the Dispersal Model, I reject the idea that the Vicariance Model would be the only way of origin of the Antillean fauna. The main reason for my doubts is, that most (if not all) islands of the Calcareous Antilles, and perhaps of the Greater Antilles too,1) have been entirely submerged in the earlier half of the Tertiary2). It is clear that during the period that the islands

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1) The Greater Antilles: the islands from Cuba to Puerto Rico. The Lesser Antilles (from the Virgin Islands to Trinidad and from there westward to Aruba) are subdivided (WEYL, 1966) into the Volcanic and the Calcareous Antilles. The Volcanic Antilles comprise the arc running mostly from North to South, from Saba to Grenada. The two East-West running chains (Barbuda to Vieques and Blanquilla to Aruba) form the calcareous Antilles. In the present discussion, Trinidad, Tobago and Margarita, lying on the Venezuelan shelf and having a clearly South American fauna, are not considered.

2) Possible exceptions are parts of Puerto Rico and some of the smaller Virgin Islands (thus excluding St. Croix) that might have been dry land already during the Upper Eocene, and of Hispaniola for which a landbridge during the Palaeocene via the Rosalind and Pedro Banks, with Central America is supposed (vide WEYL, 1966, figs. 118–121).

were below sea-level, the entire terrestrial and limnic flora and fauna must have been destroyed.

Thus, a number of the original islands evolving from the fragmenting "Proto-Antilles" (= Mesozoic Central America), have been submerged during longer periods. During the immersion period, coral limestones were deposited on the volcanic socle. Lateron during the Tertiary period, notably in the Late Oligocene and Miocene, regressions took place, during which the coral limestones were uplifted above sea-level. These limestones are still visible in the actual islands as a calcareous cover of impressive magnitude on the volcanic base, from which the chain derives its collective name, Calcareous Antilles.

During the various regressions, several marine littoral species "stranded", were uplifted, and got adapted to mixohaline or limnic conditions. This way of origin of certain inhabitants of the inland waters may be called the Regression Model.

The evolution of the Thermosbaenacea, Microparasellidae, *Typhlocirolana*, *Troglomysis*, *Spaeleomysis*, *Typhlatya*, subterranean Cyathurid isopods, etc. (see FRYER, 1965; STOCK, 1976a, 1977a,b) in several parts of the former Tethys Sea took presumably place along the lines of the Regression Model.

At any rate, it is clear that for islands immerged during the earlier part of the Tertiary, only two possible ways of re-colonization remained after they broke through the sea surface again: by transportation over sea (Dispersal Model) or by stranding and adaptation of originally marine forms (Regression Model).

It appears to me that a great many of the West Indian islands must have known immersion and emersion phases. Geological evidence for two islands (Curaçao in the southern Antillean chain and St. Croix in the northern chain) is summarized by STOCK, 1976a. In agreement herewith is that Tertiary marine (Tethyan) relicts (uplifted according to the Regression Model) are found in several West Indian islands as well as in circum-Caribbean areas having the same type of geological history (the northern parts of Guatemala, Yucatán and other parts of México, Texas). In the Antilles, these relicts have been found up to now on the Calcareous Antilles and the Greater Antilles only, thus on islands having considerable accumulations of uplifted coral limestones. The Volcanic Antilles have not yielded any Tethyan relicts so far.

One can think of several reasons to explain why the Volcanic Antilles are devoid of an old, Tertiairy or Tethyan, inland water fauna. The main reason is no doubt that during periods of climatic changes[1], and more in particular during periods of drought, the fauna has to retreat into places, like the groundwater, cave waters, springs, etc., where the conditions are more stable, both as to permanency of water supply and as to temperature. It is clear that karstic groundwaters are of more common occurrence on limestone islands than on volcanic ones.

In addition, the Volcanic Antilles rise to much higher altitudes than the calcareous ones (altitudes of over 1000 m are commonly recorded). This has a double effect, one ecological, and one historical, both working against the establishment of Tethys elements in the inland waters. The ecological effect is, that in virtue of their considerable altitude, these islands catch more rainwater during the wet season. The rain is drained through steep, torrent-like streams that (not only here but in all parts of the world) are renowed for their faunistic poverty[2]. During past periods of decreased precipitation, these torrents presumably carried no water at all, like during the present-day dry season. This factor also contributed to the extinction of pre-Quarternary aquatic relicts.

The historical factor is, that due to their great altitudes, the Volcanic Antilles probably never disappeared entirely below sea-level (the absence of limestone deposits of any importance forms an indication in this direction). Having been above sea-level all the time, it is quite well possible that certain faunal elements on these islands originated from the Mesozoic Proto-Antilles (Vicariance Model). The presence of these elements might have prevented, through competition, the colonization of the Volcanic Antilles by Tertiairy (Tethyan) elements.

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[1] MÜLLER (1973) considers these oscillations the major factor in explaining the distribution of vertebrates in the neotropical realm.

[2] Fine descriptions of such streams on the (volcanic) island of St. Vincent can be found in the papers of HARRISON & RANKIN (1975, 1976a, 1976b).

Apparently, volcanism being still active even in Recent times, the plant and animal life on the Volcanic Antilles must have suffered repeatedly from cataclystic events, resulting in destruction of the biota and extinction of those elements that did not find a refugium. I imagine that the destructive effects on the smaller islands must have been more drastic, due to the absence of sizable refugia, than on the larger ones. At any rate, I attribute the obvious rareness or absence of relicts on the Volcanic Antilles to elimination by periods of drought and to active volcanism. Instead these islands have a rather varied fauna of Pleistocene or Recent origin, e.g. consisting of numerous decapod crustaceans (CHACE & HOBBS, 1969: 28). These are distributed in a uniform way throughout the island (see examples in CHASE & HOBBS, 1969: 39 for Dominica), instead of showing a relict-like, patchy type of distribution.

The Greater Antilles may form a mixed type, showing characters of both the Volcanic Antilles (great altitudes, fast torrents, no submersion) and of the Calcareous Antilles (karstic limestone plateaus, formed during immersion periods, lower altitudes). This being true, the Greater Antilles can be expected to have faunal elements dating back to a Mesozoic origin (Vicariance Model), furthermore uplifted marine descendants (Regression Model), and over-sea immigrants (Dispersal Model). Since the Volcanic Antillian and the Calcareous Antillian chains have faunal elements of only two of these three sources, it is to be expected that the fauna of the Greater Antilles is not only richer in species, but more in particular is more varied on generic (and higher) levels. For several crustacean groups I am familiar with, this is undoubtedly true.

For instance, the hadziids, the group which form the subject of the present paper, are absent from the Volcanic Antilles, represented by 2 non-endemic genera in the Calcareous Antilles, whereas Puerto Rico has 2 genera (1 endemic), just as Cuba (both endemic). The Central and North American mainlands, as far as these were immerged during the Tethys period, are still richer in (endemic) genera.

In general, it can be said that the West Indian islands form a unique test area for zoogeographic models. By their varied geomorphology and palaeogeography, as well as by the virtue of the large numbers of isolated islands, this archipelago ranks among the most interesting in the world, even when compared with such "pets' as the Galápagos Islands.

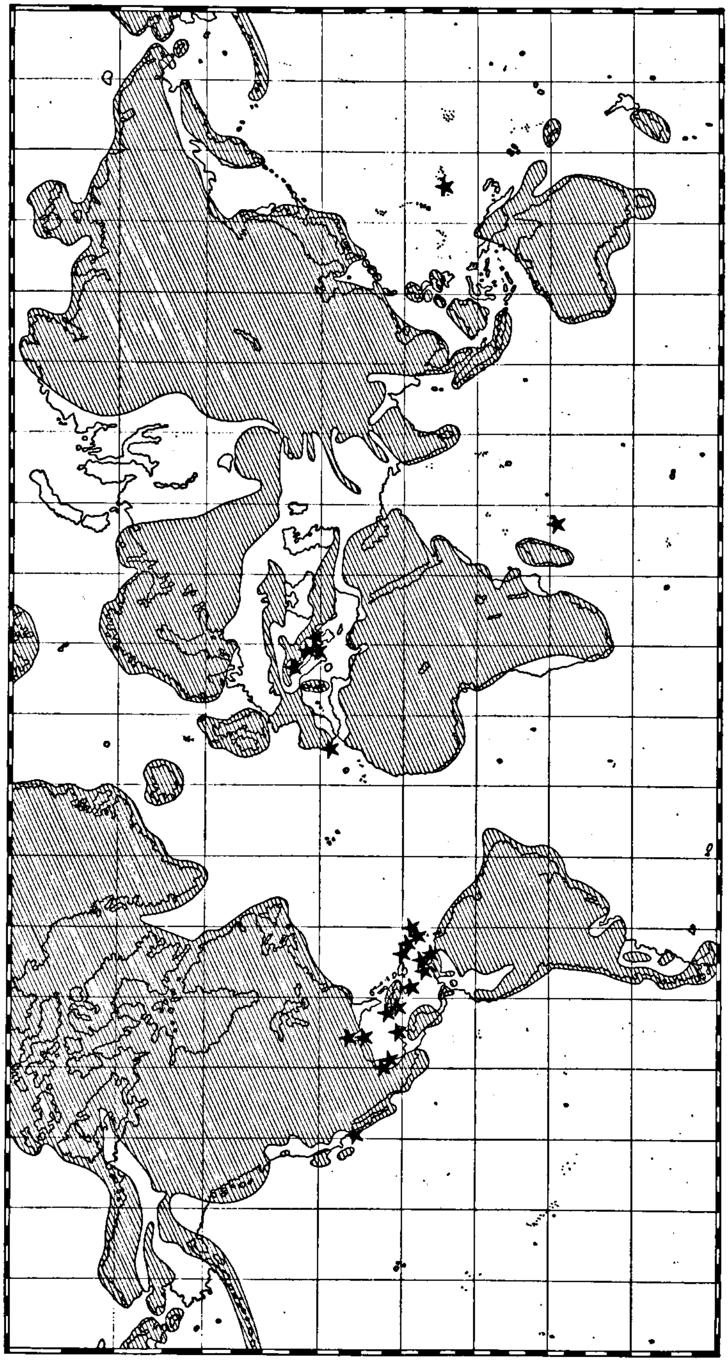
Since the hypogean, Tethyan relicts have almost no means of interinsular dispersal, and almost no chance of accidental introduction through interference of man, they are more fit than terrestrial vertebrate or invertebrate taxa for zoogeographical and evolutionary deductions.

2. THE EVOLUTION OF HADZIID AMPHIPODS

Apparently, hadziid amphipods form an old stock, which was widely distributed in the former Tethys Sea. The present-day distribution is still limited to the area once covered by Tethyan waters (Fig. 1), with a marked concentration of species and records on the northern Mediterranean belt and in the West Indies (see also HOLSINGER, 1974b). As is often the case in such Tertiairy distribution patterns of limnic animals, several taxa occur in México and Texas (HOLSINGER, 1973), areas that were immerged by Tethyan waters in the late Cretaceous, may be up to the late Oligocene or early Miocene. At present, there are only 3 species (belonging to 3 monotypic genera) known from the Indo-Pacific, viz. *Psammoniphargus* from Réunion, *Liagoceradocus* from the Caroline Islands, and *Dulzura* from California. It seems fair to expect that more directive search in the vast Indo-Pacific area will reveal several additional discoveries.

The members of the hadziid group known to-day occur chiefly in anchihaline habitats, or in freshwater habitats that originated from post-Miocene sea-level regressions. Only two purely marine genera have been described so far, viz. *Dulzura* and *Liagoceradocus*.

The oldest West Indian members of the group are supposed to have been originally inhabitants of coastal habitats, presumably macroporous interstitia, in the former Tethys Sea. They "stranded" when the Antillean arc arose above sea-level. The animals were "uplifted" in subsequent geological regression periods and adapted themselves, from the originally marine elements living in macropo-



rous interstitia, to mixohaline or limnic forms living in continental waters, such as cave waters, subterranean aquifers, hyporhaeic conditions, etc. All known forms are eye-less, pointing to a long interstitial or hypogean evolutionary history[1]. Many forms have retained a marked euryhalinity[2].

The fact that ten islands of the Calcareous Antilles are now known to harbour no less than 14 species and subspecies of hadziids (more species than known from the entire rest of the world), make this group of amphipods a most interesting subject of zoogeographic and speciation studies.

It is presumed that these 14 taxa have originated from one or more marine ancestors during various periods of uplifting which caused the islands to break through the sea-surface in the late Oligocene and/or Miocene. This implies that the geological age of several West Indian hadziids is set.

Every island with hadziids discovered so far, has its own taxon, or even several taxa (Fig. 2). This is not surprising since the majority of Antillean islands arose individually above sea-level and never had contact with other land masses ever since.

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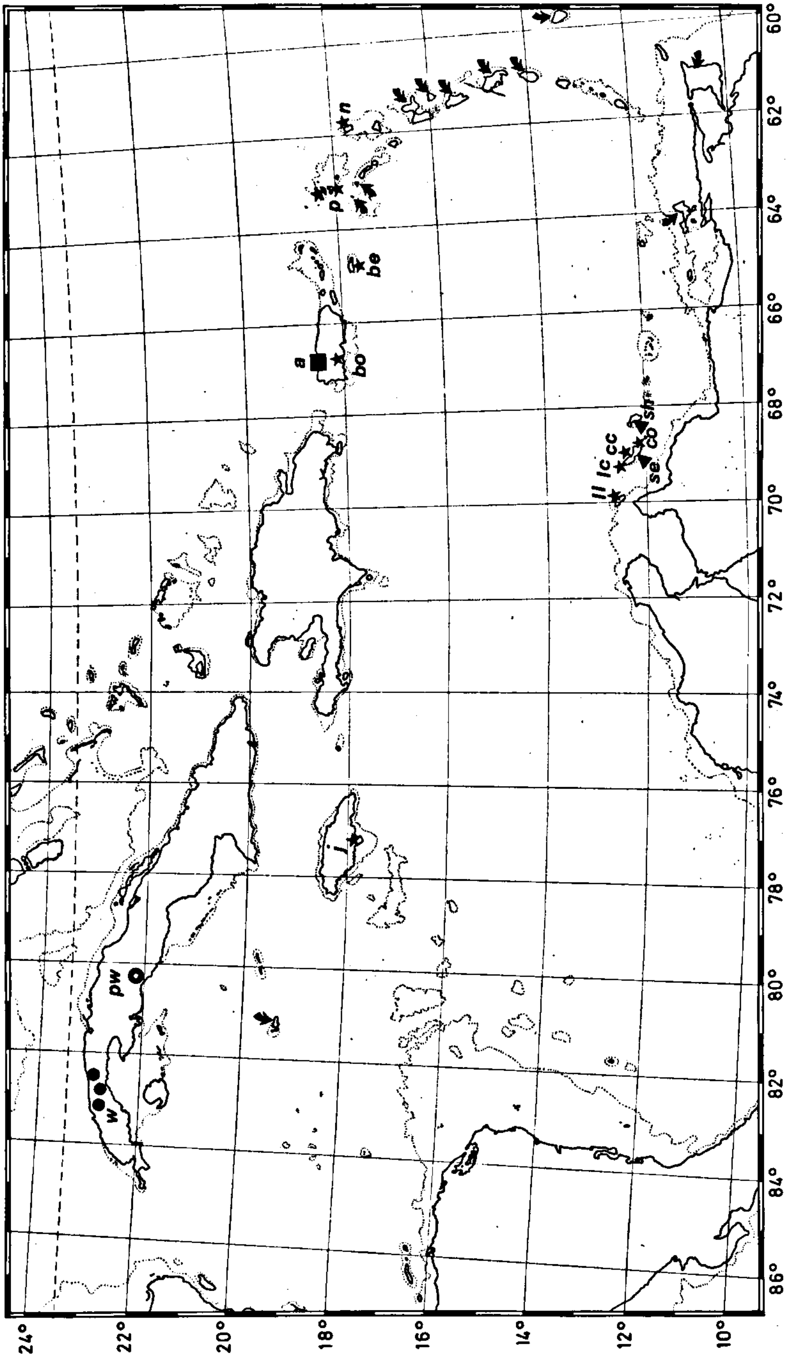
1) Since on the Calcareous Antillean islands on which these hadziids occur, arid or semi-arid conditions prevail, surface waters of any importance (except for salty lagoons) are lacking actually. There are indications, for instance the presence of abundant dripstone formations in inactive caves, that the climate was not always as dry as nowadays. If there are or have been epigean hadziids, no one has been discovered so far or all are extinct.

2) It should be noted that the groundwater, especially in the more arid islands, is never entirely fresh but contains a relatively high amount of ions, partly blown in by the trade winds, partly dissolved from the bottom.

Fig. 1. – THE DISTRIBUTION OF LAND (hatched) AND SEA-WATER (open) DURING THE OLIGOCENE (based on DE LATTIN, 1967, fig. 42). – For orientation purposes the present day land-masses are shown as well. The asterisks denote the actual distribution of the members of the hadziid-group (localities which are too crowded are not all shown individually). – Notice that all records lie within the area of the former Tethys Sea. Several localities that are now situated in continental areas (e.g. Texas, northern México, Yucatán, western Cuba, southern Portugal, southern Italy, the Dalmatian coastal stretch of the Balcans) were under sea-level during the Tethys period. This supports the idea that the animals "stranded" during post-Tethys upliftings or marine regressions.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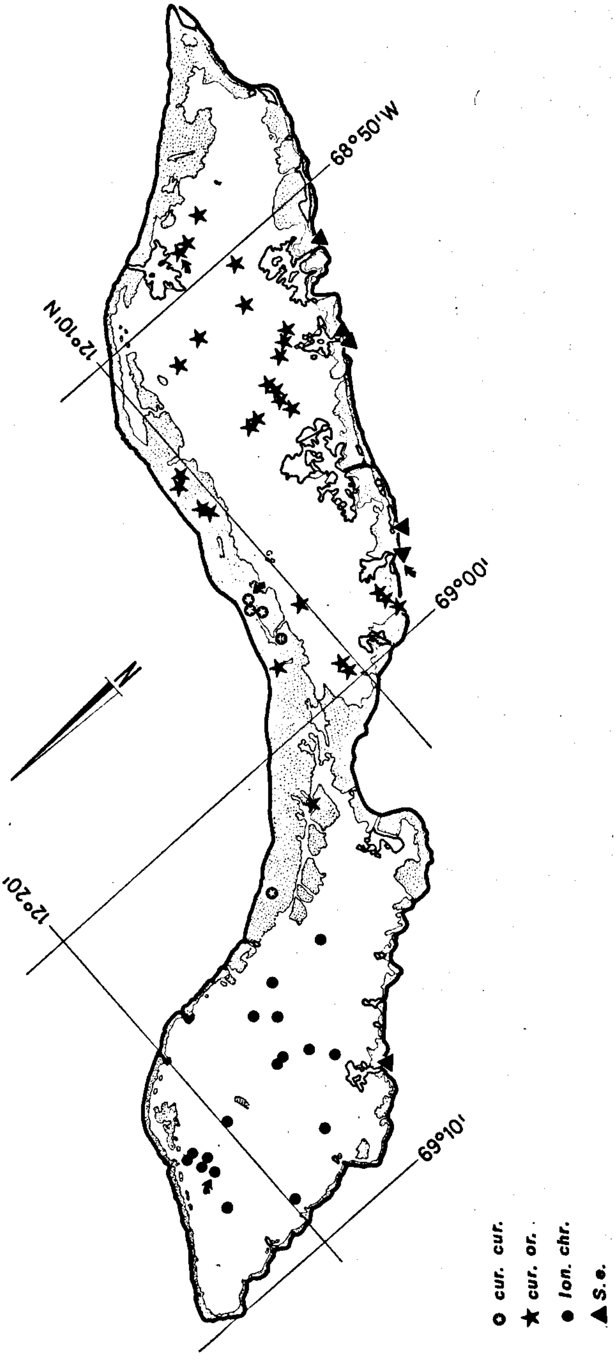
The only known exception on the endemism just mentioned form the islands of St. Martin and Anguilla, which have identical hadziids. This case, however, can also easily be understood: both islands lie on a shallow submarine plateau, of less than 20 fathoms deep, called the "Anguilla Bank". During the time of the greatest Pleistocene glaciations, when the sea-level was much lower (perhaps up to 100 m under the actual level), Anguilla and St. Martin formed one, much larger island, which included also Dog Island, the Prickly Pear group, Tintamarre, La Fourche, and St.-Barthélemy (e.g. WESTERMANN, 1957: 140, fig. 1).

The 8 other islands known to harbour hadziids (Aruba, Curaçao, Bonaire, Barbuda, St. Croix, Puerto Rico, Jamaica, and Cuba) are all separated from each other by deep to very deep waters, excluding any contact between them even during periods of the strongest sea-level regressions.

As a general rule, taxa on neighbouring islands are more similar to each other. So, the taxon from Aruba is closely related to the taxon found on the half of Curaçao facing Aruba, whereas the taxon from hypersaline waters on Curaçao has its close relative in similar waters

Fig. 2. – MAP OF THE ANTILLEAN ARC AND DISTRIBUTION OF HADZIID AMPHIPODS. – The dotted lines indicate the 200 m isobath. Note that all islands separated by deep water (> 200 m) have different taxa, whereas St. Martin and Anguilla, separated by shallow waters only, have identical taxa. – Arrows indicate islands on which (some) sampling has been done, without yielding hadziid amphipods so far. Most of these islands are of volcanic nature.
Closed dots (*w*): *Weckelia caeca* (Weckel, 1907) (inc. *Neoweckelia cubanica* Dancau, 1973) from Cuba.
Open dot (*pw*): *Paraweckelia silvai* Shoemaker, 1959, from Cuba.
Square (*a*): *Alloweckelia gurneei* Holsinger & Peck, 1968, from northern Puerto Rico.
Triangles: genus *Saliweckelia* (*se* = *S. emarginata* n. sp. from southern Curaçao; *sh* = *S. holsingeri* n. sp. from Bonaire).
Asterisks: genus *Metaniphargus* (*be* = *M. beattyi* Shoemaker, 1942, from St. Croix; *bo* = *M. bousfieldi* n. sp. from southern Puerto Rico; *cc* = *M. curasavicus curasavicus* Stephensen, 1933, from northern central Curaçao; *co* = *M. curasavicus orientis* n. ssp., from eastern Curaçao; *j* = *M. jamaicae* (Holsinger, 1974) from Jamaica; *lc* = *M. longipes christophorensis* n. ssp. from western Curaçao; *ll* = *M. longipes* n. sp. *longipes* from Aruba; *n* = *M. nicholsoni* Shoemaker, 1959, from Barbuda; *p* = *M. palpator* n. sp. from St. Martin and Anguilla).
Not all localities for each species are shown individually.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of the next island, Bonaire. The taxa from the north-eastern corner of the Antillean arc (Puerto Rico, St. Martin plus Anguilla, Barbuda) are mutually closely related, although distinct. A notable exception forms the taxon from St. Croix, which has no known close relatives. The taxon on Jamaica is not only geographically about 900 km remote from the closest congeneric taxon, but is also morphologically isolated.

The most widely distributed genus in the West Indies is *Metaniphargus*, which ranges from the Leeward Group (Aruba to Bonaire), via the Windward Group (Barbuda to St. Croix) to Puerto Rico and Jamaica. In addition two islands of the Greater Antilles, Puerto Rico and Cuba, have endemic genera (*Weckelia, Paraweckelia,* and *Alloweckelia*), whereas two islands of the Leeward Group, Curaçao and Bonaire, share the endemic genus *Saliweckelia.*

A number of islands, good examples being Aruba, Curaçao and Bonaire, originally were made up of two islets which got fused only in the Quarternary period. Their complex palaeographical history is reflected in the presence of four different hadziid taxa on a small island (472 km^2) like Curaçao. This high number is no doubt positively influenced by that fact that Curaçao is the best explored for hadziids, more than 150 sampling stations all over the island having been checked. Thus the ranges of the four Curasavican taxa are rather well-documented.

According to DE BUISONJÉ (1974: 249) Curaçao was formed in late

Fig. 3. – DISTRIBUTION OF HADZIID AMPHIPODS ON CURAÇAO: the four recorded forms are *Metaniphargus curasavicus curasavicus* (open stars), *M. c. orientis* (solid stars), *M. longipes christophorensis* (solid dots), and *Saliweckelia emarginata* triangles). The type-locality of each taxon is marked with an arrow. Localities lying very close to each other are not all shown individually.
The basic map is based on DE BUISONJÉ's survey (1974, maps 1 and 2). Dotted areas indicate Recent, Subrecent, Quarternary or Pleistocene marine deposits, thus immerged by sea-water in the near past.
Curaçao was divided by a marine belt at the level of the narrow central "waist" of the island, into two isolated islands each which its own *Metaniphargus*. A third member of *Metaniphargus* is restricted to running waters on the north side of island, in an area innundated in the near past. *Saliweckelia emarginata* occurs in near-coast, anchihaline conditions on the south side of Curaçao.

Miocene and perhaps Pliocene times, as reefs around shoals or islands of a size much smaller than the present island. During the regional tectonic uplift ever larger areas emerged. WEYL (1966: 280) presumed that during the Pleistocene marine transgression the entire island, but for the mountainous north-western part, was submerged again. DE BUISONJÉ (1974: 249) believes that during the old Pleistocene two nuclei remained above sea-level, viz. the north-western and south-eastern parts of the present-day island (a situation which was already accepted by BAKER, 1924, and WAGENAAR HUMMELINCK, 1940a). In between these two islets, an inundated shallow plateau was present (at the place where the actual island shows its "narrow waist") that emerged again during slow regressions in the Quarternary or Upper Pleistocene. Deposits of Recent, Subrecent and Quarternary age (dotted in Fig. 3) show that the central part of the island was submerged until very recently. In agreement herewith is, that each of the two primordial parts of the island have a different species of *Metaniphargus*. A third taxon of *Metaniphargus* is present on the north coast of the island, in the part that was up to recently innundated.

The fourth taxon from Curaçao, *Saliweckelia emarginata*, has a distribution similar to the thermosbaenacean *Halosbaena acanthura* (see STOCK, 1976a: 69, fig. 56): it occurs merely in Quarternary or Neogene limestone deposits (Recent or Subrecent coral shingle in the terminology of DE BUISONJÉ, 1974, maps 1 and 2) on the south coast of the island. The obvious halophily of the species and its present-day distribution (in anchihaline localities), make it likely that *Saliweckelia* is the most recent invader of the inland waters. *Saliweckelia* (with 2 known species) has a sexually modified 3rd male pleopod, and a similar pleopod is found in *Metaniphargus cur. curasavicus*, which inhabits a region in Curaçao that was under sea-level in the late Pleistocene. It is tempting to assume that species having such a modified 3rd male pleopod are of more recent marine descent than species without sexual dimorphism in the pleopods. If this assumption is correct, the subspecies from eastern Curaçao (*Metaniphargus curasavicus orientis*), likewise having a transformed 3rd pleopod in male, should be of relatively recent marine origin as well. Although no real proof for this assumption could be found, support for the idea is found in WEYL's conception (1966: 280) that the entire area occupied nowadays by *M. c. curasavicus* and *M. c. orientis* was submerged during the Pleistocene. However, DE BUISONJÉ's more recent (1974) geological work does not appear to bear out this idea.

According to DE BUISONJÉ (1974, maps 3 and 4), the islands of Aruba and Bonaire also are built up of 2 smaller islets, merging in the Quarternary period. In the case of Aruba, the two island nuclei are of very different size, the south-eastern one being the much smaller fragment. I have examined several samples from Aruba, but none from the smaller nucleus, which happens to be for the greater part private ground.

In Bonaire, an intensive sampling program was carried out in the last two years. This island (or, if one wants, the two primordial nuclei) seems to be devoid of hadziid amphipods in the inland wells, springs or cave-waters (in anchihaline, often hyperhaline, localities, an endemic *Saliweckelia* has been discovered). Bonaire harbours, however, an interesting hypogean crustacean fauna, with species of *Angeliera* and *Microcharon* (Isopoda), *Ingolfiella* (Amphipoda), and shrimps of the *Typhlatya*-group. On these findings, I shall come back in separate publications (STOCK, 1976b, 1977a,b).

So, for the moment Curaçao is the only island for which I have been able to integrate the geological history and the biogeographic data.

3. THE SYSTEMATICS OF HADZIIDS IN THE LEEWARD ISLANDS OF THE NETHERLANDS ANTILLES

Metaniphargus material from the three islands forming the Leeward group of the Netherlands Antilles (Aruba, Bonaire, and Curaçao) has been recorded in STEPHENSEN's papers of 1933a, 1933b and 1948.

In his 1933a paper STEPHENSEN described the new genus and species *Metaniphargus curasavicus*, after 4 specimens collected at "Bak Ariba (Hato), Curaçao". In subsequent publications the indication "Bak Ariba" sometimes has been misunderstood as a locality name.

In fact it is a Papiamento expression meaning "upper trough", a cemented basin or trough used to collect the water of a spring. This "bak" is situated in the "Hofje van Hato" (vegetable garden of Hato), and is fed by a spring called "Boca Spelonk", which is captured in a ruined stone structure; the overflow runs through a pipe underground for a couple of yards before reaching the "bak". From the "bak" itself and from the spring or "boca", numerous specimens have been collected during later visits. From these topotypic samples, the taxon *curasavicus* will be redescribed.

In his two subsequent papers, STEPHENSEN records *M. curasavicus* from a salt-pond in Bonaire (1933b: 441; 1948: 5), from a number of Curaçao localities (all situated in a small sector in the centre of the island, the plain of Hato), and from 3 localities in Aruba (1948: 5). In 1948, STEPHENSEN corrected some errors in the original description and synonymized *M. beattyi* Shoemaker, 1942, from St. Croix with *M. curasavicus.*

I have re-examined STEPHENSEN's material (preserved in the Rijksmuseum van Natuurlijke Historie, Leiden, the Zoologisk Museum, Copenhagen, and the Zoölogisch Museum, Amsterdam), and found it to comprise a mixture of two genera and three species. Through a sheer coincidence, STEPHENSEN's Curaçao material is monospecific, although three more taxa are common in Curaçao; the Aruba material is a different species of *Metaniphargus*, the Bonaire material is a different genus (the presence of *Metaniphargus* has not been demonstrated in the numerous subsequent samples from Bonaire). None of these taxa is identical with *M. beattyi,* as re-examination of the type material of the latter (preserved in the U.S. National Museum) proved.

III. TAXONOMIC PART

1. COMPOSITION OF THE HADZIID GROUP

For the moment, I adopt BOUSFIELD's concept (1977, table V) of the hadziids, with one exception: I see no sufficient reason to include *Metacrangonyx* Chevreux, 1909. The remaining genera are (in chronological order):

- *Hadzia* S. Karaman, 1932. Type species *H. fragilis* S. Karaman, 1932. Other taxa *H. gjorgjevici* S. Karaman, 1932, *H. gj.* natio *crispata* G. Karaman, 1969. Distribution: coastal groundwater, cave waters, wells, etc. in Jugoslavia.
- *Metaniphargus* Stephensen, 1933a. Type species *M. curasavicus* Stephensen, 1933a. Other taxa: *M. curasavicus orientis* n. ssp., *M. nicholsoni* Shoemaker, 1959, *M. palpator* n. sp., *M. bousfieldi* n. sp., *M. longipes* n. sp. *longipes*, *M. longipes christophorensis* n. ssp., *M. beattyi* Shoemaker, 1942, *M. jamaicae* (Holsinger, 1974). Distribution: brackish inland subterranean waters in the Caribbean islands.
- *Weckelia* Shoemaker, 1942. Type species *W. caeca* (Weckel, 1907) (incl. *Neoweckelia cubanica* Dancau, 1973) (cf. HOLSINGER, in press). Distribution: cave waters in Cuba.
- *Psammoniphargus* Ruffo, 1956. Type species *P. pauliani* Ruffo, 1956. Distribution: interstitial, Réunion Island.
- *Paraweckelia* Shoemaker, 1959. Type species *P. silvai* Shoemaker, 1959. Distribution: cave waters, Cuba.

– *Liagoceradocus* J. L. Barnard, 1965. Type species *L. pusillus* J. L. Barnard, 1965. Distribution: in marine algae, Ifaluk Atoll, Caroline Islands.
– *Alloweckelia* Holsinger & Peck, 1968. Type species *A. gurneei* Holsinger & Peck, 1968. Distribution: cave waters, Puerto Rico.
– *Dulzura* J. L. Barnard, 1969. Type species *D. sal* J. L. Barnard, 1969. Distribution: marine, California.
– *Mexiweckelia* Holsinger & Minckley, 1971. Type species *M. colei* Holsinger & Minckley, 1971. Other taxa provisionally (pending a revision now in press by HOLSINGER) attributed to this genus: *M. particeps* Holsinger & Minckley, 1971, *M. mitchelli* Holsinger, 1973, *M. texensis* Holsinger, 1973. Distribution: springs, cave waters, wells in northern México and Texas.
– *Metahadzia* n. gen. Type species *M. tavaresi* (Mateus & Mateus, 1972). Distribution: wells, southern Portugal. Probably belonging to this genus: *Hadzia minuta* Ruffo, 1947.
– *Saliweckelia* n. gen. Type species *S. emarginata* n. sp. Other taxon: *S. holsingeri* n. sp. Distribution: macroporous, marine and hyperhaline, interstitia in Curaçao and Bonaire.

These genera can be distinguished with the aid of Tables 1a and 1b, or with that of the following key.

ARTIFICIAL KEY TO THE GENERA

1a) Mandible palp 3-segmented 5
b) Mandible palp absent or reduced to a 1-segmented vestige . 2

2a) Fourth coxal plate with distinct posterior emargination . . 3
b) Fourth coxal plate without emargination 4

3a) Exopodite of 3rd uropod 1-segmented; 3rd uropod of magniramus-type . . . . *Weckelia*
b) Exopodite of 3rd uropod 2-segmented; 3rd uropod of parviramus-type . . . . *Psammoniphargus*

4a) Carpus of 1st gnathopod triangular; merus normal. Accessory flagellum of 1st antenna 1-segmented. . . . . *Mexiweckelia*
b) Carpus of 1st gnathopod very elongated; merus produced. Accessory flagellum of 1st antenna 3-segmented . . . . Unnamed new genus from México

5a) Exopodite of 3rd uropod 1-segmented. 6
b) Exopodite of 3rd uropod 2-segmented. 7

6a) Accessory flagellum of 1st antenna 4-segmented. Seven setae on inner lobe of 1st maxilla. Coxal gills not stalked . . . . *Paraweckelia*
b) Accessory flagellum of 1st antenna 2-segmented. About 20 setae on inner lobe of 1st maxilla. Coxal gills stalked. . . . . *Alloweckelia*

7a) Fourth coxal plate with distinct posterior emargination . . . . *Saliweckelia*
b) Fourth coxal plate not emarginated. 8

8a) Uropod 1 without subbasal spine. Pleonites partially fused. . . . . *Liagoceradocus*
b) Uropod 1 with subbasal spine. Pleonites well-articulated. . 9

9a) Mandible palp segment 2 as long as segment 1. Carpus of 2nd gnathopod with posterior lamellar expansion. . . . . *Hadzia*
b) Mandible palp segment 2 > 1. Carpus of 2nd gnathopod without posterior lobe 10

10a) Lateral margin of telson with 1 or more spines. Uropod 3 of variiramus- or parviramus-type 11
Lateral margin of telson without spines. Uropod 3 of magniramus-type . . . . *Metahadzia*

11a) Peduncle segment 3 of 1st antenna very short. Inner lobe of 1st maxilla with c. 9 setae. . . . . *Dulzura*
b) Peduncle segment 3 of 1st antenna longer. Inner lobe of 1st maxilla with at least 15 setae . . . . *Metaniphargus*

TABLE 1a

SALIENT DIFFERENCES BETWEEN THE GENERA OF THE HADZIID GROUP CEPHALIC APPENDAGES

	A1 ped.	A1 acc. flag.	Md., molar seta	Md., palp	No. setae inner lobe Mx. 1	Oblique row of setae on inner lobe Mx. 2	Inner lobes labium
Hadzia	segm. 3 short	1- or 2-segm.	right	3-segm., 1 = 2, D-setae present	< 10	present	indistinct
Metaniphargus	segm. 3 longer	2-segm.	right	3-segm., 2 > 1, D-setae present	> 15	present	indistinct
Weckelia	segm. 2 narrow, very long	3- or 4-segm.	right	1-segm. (reduced)	12–13	present	present
Psammoniphargus	as *Weckelia*?	2-segm.	?	1-segm. (reduced)	6	absent	absent
Paraweckelia	segm. 2 and 3 elongated	4-segm.	?	3-segm., 2 > 1, D-setae not differentiated	7	absent	present
Liagoceradocus	segm. 2 and 3 elongated	2-segm.	?	3-segm., D-setae present	?	?	absent
Alloweckelia	segm. 2 and 3 very elongated	2-segm.	right, often also left	3-segm., 2 > 1, small, D-setae hardly differentiated	c. 20	present	indistinct
Dulzura	segm. 3 short	2-segm.	?	3-segm., 2 > 1, D-setae present	c. 9	present	absent

Table 1a (continued)

	A1 ped.	A1 acc. flag.	Md., molar seta	Md., palp	No. setae inner lobe Mx 1	Oblique row of setae on inner lobe Mx. 2	Inner lobes labium
Mexiweckelia	segm. 2 and 3 short	1-segm.	right	absent	7	present	vestigial
Metahadzia	segm. 2 not very elongated	2-segm.	right	3-segm., 2 > 1, D-setae not differentiated	c. 12	present	absent
Saliweckelia	segm. 2 narrow, long	2-segm.	right	3-segm., 2 > 1, D-setae present	c. 11	present	absent

TABLE 1b

SALIENT DIFFERENCES BETWEEN THE GENERA OF THE HADZIID GROUP
NON-CEPHALIC APPENDAGES

	Gn. 1, carpus	Gn. 2, carpus	Gn. 2, propodus	4th coxal plate (emargination)	coxal gills	basis P7 (post. lobe)	Ur. 1 (subbasal spine)	Ur. 2	Ur. 3	telson, spines on lat. margin
Hadzia	triangular	with lobe	sex. dimorph	absent	not distinctly stalked	protruding	present	not sex. dimorph	magniramus, exop. 2-segm.	absent
Metaniphargus	elongately trapezoidal	without lobe	sex. dimorph	absent	stalked	usually not protruding	present	not sex. dimorph	variiramus, exop. 2-segm.	present
Weckelia	elongately triangular	without lobe	weakly sex. dimorph	present	not stalked	protruding	present	not sex. dimorph	magniramus, exop. 1-segm.	absent
Psammoniphargus	trapezoidal	without lobe	strongly sex. dimorph	present	?	slightly protruding	present	not sex. dimorph	parviramus, exop. 2-segm.	present
Paraweckelia	elongately trapezoidal	triangular, no lobe	no sex. dimorph.	present	not stalked	overhanging	present	not sex. dimorph	magniramus, exop. 1-segm.	absent
Liagoceradocus	elongately trapezoidal	with lobe	?	absent	?	not protruding	absent	?	magniramus, exop. 2-segm.	present

Alloweckelia	triangular	without lobe	sex. dim. weak	present	stalk not very distinct	overhanging	present	not sex. dimorph	variiramus, exop. 1-segm.	absent
Dulzura	elongately trapezoidal	without lobe	sex. dimorph	very weak	?	not protruding	present	?	parviramus, exop. 2-segm.	present
Mexiweckelia	triangular	with lobe	sex. dimorph	absent	stalked	overhanging	absent?	not sex. dimorph	magniramus, exop. 1-segm.	present
Metahadzia	trapezoidal	without lobe	sex. dimorph	almost absent	stalked	produced	present	sex. dimorph	magniramus, exop. 2-segm.	absent
Saliweckelia	trapezoidal, elongated, setose	without lobe	sex. dimorph	present	not stalked	overhanging	present	not sex. dimorph	magniramus, exop. 2-segm.	absent

2. THE HADZIA-COMPLEX

(a group of genera at some time synonymized with or not separated from *Hadzia*)

STOCK & NIJSSEN, 1965, expressed as their opinion that *Hadzia* and *Metaniphargus* were synonymous, an opinion that alternatively has been supported (e.g. by HOLSINGER) or rejected (e.g. by BOUSFIELD and by BARNARD).

Having re-examined the type-species for both genera, as well as some species of uncertain status (notably *Hadzia tavaresi* Mateus & Mateus), I arrived at the conclusion that *Hadzia* and *Metaniphargus* are closely related but separable entities, and that the species *taveresi* should be placed in a new genus, called *Metahadzia*.

Liagoceradocus Barnard, 1965, from Micronesia, is close to *Hadzia* in the shape of the third uropods, and of the first and in particular the second gnathopods. However, the description is too little detailed to judge about its status. More knowledge about the mandible palp, the pleopods, the coxal gills is necessary to allocate *Liagoceradocus* properly. If the pleosome segments are really fused, as BARNARD's figure 15 shows, *Liagoceradocus* must be considered a distinct genus. Another special character of *Liagoceradocus* is the absence of a ventroproximal spine on uropod 1.

The three genera forming the *Hadzia*-complex can be separated with the aid of the following KEY:

1a) Coxal gills without clearly demarcated stalk. Carpus of gnathopod 1 triangular, posterior margin rounded. Carpus of gnathopod 2 with lamellar expansion, setae not marginal. Mandibular palp segments 1 and 2 subequal. Third peduncle segment of antenna 1 short, not much longer than the first flagellum segment. (Mandible palp segment 3 with row of D-setae; pleopods 2 and 3 not sexually dimorph; telson lobes without lateral spines; uropod 3 of magniramus-type; uropod 2 not sexually dimorph). . . . . .genus *Hadzia* s. str. (Mediterranean)

b) Coxal gills with clearly demarcated basal stalk. Carpus of gnathopod 1 trapezoidal, posterior margin straight. Carpus of gnathopod 2 without expansion, setae marginal. Mandibular palp segment 2 much longer than 1. Third peduncle segment of antenna 1 elongated, much longer than the first flagellar segment 2

2a) Telson lobes without lateral spines. Uropod 3 of magniramus-type (inner ramus about as long as the outer ramus). Uropod 2 sexually dimorph. Mandibular palp segment 3 devoid of a clearly demarcated row of D-setae. . . Genus *Metahadzia* nov. (Lusitanian)

b) Telson lobes with lateral spines. Uropod 3 of variiramus-type (inner ramus shorter, usually much shorter, than the outer ramus). Uropod 2 not sexually dimorph. Mandibular palp segment 3 with row of D-setae. . . . . Genus *Metaniphargus* Stephenson, 1933 (West Indian)

Genus **Hadzia** S. Karaman, 1932, s. str.

DIAGNOSIS. – A1 very long, but 3rd peduncle segment short; accessory flagellum 1- or 2-segmented. Mandible palp 3-segmented, segments 1 and 2 subequal; segment 2 without, or with distal setation only; segment 3 has a small number of D-setae and 3 E-setae. Molar seta present in right mandible. Inner lobes of labium only vaguely indicated. Left and right maxilla 1 asymmetrical. Second maxilla with oblique row of setae on inner lobe. Gnathopod 1 of hadziid type (propodus rectangular, palm transverse), smaller than gnathopod 2; carpus triangular, posterior margin curved, short. Gnathopod 2 sexually dimorph in the shape and armature of the palm and the length of the dactylus; carpus with posterior, swollen lobe; setation not marginal but implanted at the base of the lobe. Fourth coxal plate without posterior excavation. Coxal gills with short, inconspicuously stalked basal portion. Oöstegites linear, narrow. Rami of third pleopod not sexually dimorph. Uropods not sexually dimorph. Third uropod of magniramus-type; endopodite armed with spines and plumose setae. Telson completely cleft; provided with distal and medial spines, devoid of lateral spines.

TYPE-SPECIES. – By present selection: *Hadzia fragilis* S. Karaman, 1932. Other taxa: *H. gjorgjevici* S. Karaman, 1932, and *H.g.* natio *crispata* G. Karaman, 1969.

Hadzia taveresi Mateus & Mateus, 1972, is made the type of a new genus *Metahadzia* (vide infra).

Hadzia minuta Ruffo, 1947, was described from a single female specimen. In a later paper (RUFFO, 1957: 51) also males and an ovigerous female are recorded. In the original description, the mouth-parts are dismissed as "corresponding to the description of Karaman for the other two species of the genus". Dimorphism in the 3rd pleopod or in the 2nd uropod, if any, is not recorded. The coxal gills are not described. In the 1957 paper, RUFFO stated that the male does not differ notably from the female. If this latter statement is correct (i.e., that there is no sexual dimorphism in the gnathopods), the taxon *minuta* is hard to place in any of the described hadziid genera which all have a clear sexual dimorphism, at least in gnathopod 2, sometimes in other appendages as well. Judging from the rather great length of peduncle segment 3 of A1, and from the absence of a posterior lobe in the carpus of Gn. 2, *minuta* is perhaps provisionally placed best in the genus *Metahadzia*, pending a detailed re-examination.

DISTRIBUTION. – Subterranean waters (fresh and brackish) in Yugoslavia (see RUFFO & KRAPP-SCHICKEL, 1969, fig. 1).

Hadzia fragilis S. Karaman, 1932

(Fig. 4)

Hadzia fragilis S. KARAMAN, 1932: 214–220, figs. 19, 19A, 20, 21, 22; S. KARAMAN, 1943: 205, fig. 36; G. S. KARAMAN, 1967: 1; G. S. KARAMAN, 1969: 167–169, figs. 1–10 (figs. 7–10, labelled "*Hadzia gjorgj. gjorgjevici*" belong in reality to *H. fragilis*) (refs.); SKETI, 1969: 148, fig. 2 (labium illustrated); RUFFO & KRAPP-SCHICKEL, 1969: 686–688, fig. 1; MATEUS, 1974: 10–11, fig. 1.

MATERIAL. – Šipun cave, Cavtat, YUGOSLAVIA, May 29, 1970; leg & don. G. S. Karaman, 1♂, 8♀ ZMA.
– Same locality, April 1953; 1 fragmentary specimen ZMA.

REMARKS. – This species is described and illustrated in detail in various papers by S. and G. KARAMAN (see synonymy). A number of characters, either not illustrated in these papers, or important for a better understanding of the generic classification, are illustrated in the present article. The material used for this study was kindly put at my disposal by Dr. G. S. KARAMAN of Titograd.

The first antenna has a short 3rd peduncle segment (fig. 21a in S. KARAMAN, 1932; Fig. 4a in the present paper): it is hardly longer than the first flagellum segment. The accessory flagellum may have

2 articles (S. KARAMAN, 1932, fig. 20f; G. KARAMAN, 1969, fig. 3), but as G. KARAMAN, 1969: 167 noticed already, the apical segment may be indistinctly articulated (Fig. 4b in present paper).

The mandible palp has a very elongated basal segment (fig. 5 in G. KARAMAN, 1969; Fig. 4d in present paper); article 2 bears a limited number (1 to 3) of distal setae only (no midventral setae); article 3 bears a limited number (5 to 7) of widely spaced ventral spines and 3 longer distal setae.

The masticatory part of the mandible resembles that of *Metahadzia taveresi* (vide MATEUS & MATEUS, 1972, fig. 7b) in that the element adjacent to the molar process is flag-like or brush-like (in the West Indian relatives, there is a row of cilia in this place). Molar process of right mandible with a long molar seta.

The carpus of the first gnathopod (♂♀) has a rounded posterior margin (Fig. 4e) which is shorter than the posterior margin of the propodus.

The carpus of the second gnathopod (♂♀) has, as S. KARAMAN (1932: 214) called it, "a strong leaf-like enlargement", being a thin posterior lobe, provided with numerous rugosities, but devoid of setae. The setae are implanted along the base line of the lobe (Fig. 4f; figs. 19b and 20c in S. KARAMAN, 1932; fig. 36 in S. KARAMAN, 1943).

The coxal gills, never described before, are surprisingly enough devoid of a long, narrow stalk (Fig. 4g); the basal portion is narrow, it is true, but it is hardly longer than wide, and therefore clearly different from the situation found in the West Indian *Metaniphargus* species.

The fourth coxal plate (Fig. 4h) has a rounded anterior, and an almost straight posterior margin.

The 3rd male pleopod (Fig. 4i) has normally hook-shaped retinacula. A strong spine at the base of outer ramus is characteristic. The basal articles of outer and inner rami are devoid of special swellings and devoid of rugosities.

The uropods do not show sexual dimorphism.

Genus **Metahadzia** nov.

DIAGNOSIS. – Similar to *Hadzia*, but for the following characters: Third peduncle segment of A1 long. Accessory flagellum 2-segmented. First segment of mandible palp much shorter than the second; second segment unarmed; third segment with an unarmed ventral margin (3 E- and 3 D-setae are crowded near the tip of the article). Posterior margin of carpus of Gn. 1 straight, almost as long as the propodus. Carpus of Gn. 2 without swollen lobe; setation marginal. Coxal gills with short, but dinstincly demarcated stalk. Uropod 2 sexually dimorph (peduncle in ♂ with strong distal process).

TYPE-SPECIES. – *Hadzia tavaresi* Mateus & Mateus, 1972. Presumably belonging in this genus *Hadzia minuta* Ruffo, 1947 (in which the mandible palp and uropod 2♂ are unknown).

DISTRIBUTION. – Subterranean waters in southern Italy and southern Portugal.

Since *tavaresi* is in certain respects intermediate between *Hadzia* and *Metanipharגus*, the name *Metahadzia* is proposed.

Metahadzia tavaresi (Mateus & Mateus, 1972)

(Figs. 5–6)

Hadzia tavaresi MATEUS & MATEUS, 1972: 13–28, figs. 2–16; A. MATEUS, 1974: 10–13, fig. 1.

MATERIAL. – Wells at Tavira, Algarve, PORTUGAL, April 9, 1971; leg. et don. A. Mateus, 4♀, 1♂ (topotypes) ZMA.
– Shallow well with ruined water-wheel, just outside the town limits of Portimão, Algarve, 700 m NNE of the railway Portimão – Lagos, on W-side of road N 124, July 30, 1976; 670 mg Cl′/l, 162 mg Ca^{++}/l, 23 mg Mg^{++}/l; 1♀, 1♂ ZMA.
– Deep well, 200 m NNE of the aforementioned, on W-side of road N 124, July 30, 1976; 158 mg Cl′/l, 124 mg Ca^{++}/l, 10 mg Mg^{++}/l; many specimens ZMA.

REMARKS. – The original description being very detailed, only a few notes on the morphology of the species are necessary. Two remarks concern corrections of the original description: (1) The illustration ot the first uropod in fig. 2 of MATEUS & MATEUS appears to be confused with the third uropod (cf. Fig. 2e in the present paper). (2) The illustration (fig. 3) and description (p. 15) of the telson suggest that it bears lateral spines and no medial spines. As already stressed by MATEUS, 1974: 13, *H. tavaresi*, like all other European species, has no lateral spines on the telson (cf. Fig. 6e in the present paper).

The remaining remarks concern minor additions to the original description.

The right mandible (Fig. 5b) has a molar process with triangular teeth (spiniform in the left mandible); a molar seta is present (absent in the left mandible). The mandible palp (Fig. 5b) has a basal segment that is shorter than the second; both segments are unarmed. The distal palp segment is the longest; it bears 3 longer terminal setae (so-called E- setae) and 3 shorter subterminal setae (presumably the rudiments of a D-row); there is no ventral row of D-setae any more.

The palmar angle of the 2nd gnathopod in ♂ (Fig. 6a) is marked by 2 long setae and 1 long spine; the palm bears 2 rows of bicuspidate spines, the proximal two being larger than the others. The 2nd gnathopod of the ♀ (Fig. 5c) has a rather elongated carpus, the posterior margin of which bears 6 or 7 groups of setae; the propodus has an oblique palm which is excavated in the middle; the palmar angle is armed with 2 long setae and 1 spine; 6 more spines (all bicuspidate) are borne on the palm; 2 of these spines are much stronger than the others.

The coxal gills have a short, but well-demarcated basal stalk (Figs. 6c, d). Coxal plate 4 has a rounded frontal, and a slightly concave caudal margin (Fig. 6d).

The third leg is as illustrated (Fig. 6b).

The third male pleopod (Fig. 5d) has 3 hook-shaped retinacula; the rami are not transformed.

The first uropod (Fig. 5e) bears a strong ventral spine; the rami are subequal and bear several, often strong, spines. The sexually dimorph second uropod is correctly described and illustrated by MATEUS & MATEUS (their fig. 16a).

In the telson lobes (Fig. 6e) the lateral margin is more strongly convex than the medial one. There are 4 terminal spines, 1, 2 or 3 medial spines, and no lateral spines. The 2 sensory setae are implanted at a considerable distance from the tip of the lobe.

AFFINITIES. – By the magniramous-type third uropod and by the absence of lateral armature on the telson, the present species resembles the other European *Hadzia*'s. However, the mandible palp is quite distinctive. Additional characters in the A1, in the Ur. 2♂, and Gn. 2 (absence of carpus lobe), support the distinction of *tavaresi* on a separate level.

Genus **Metaniphargus** Stephensen, 1933

DIAGNOSIS. – A1 long; peduncle segments slender. Accessory flagellum 2-segmented. Mandible palp 3-segmented, segment 1 much shorter than segment 2; segment 2 with distal and ventral setae; segment 3 with row of D-setae and 3 to 4 E-setae. Molar seta present in right mandible. Inner lobes on labium only vaguely indicated. Left and right Mx. 1 asymmetrical. Mx. 2 with oblique row of setae on inner lobe. Gn. 1 with elongated carpus, the straight posterior margin of which is longer than the propodus. Gn. 2 sexually dimorph in shape and generally also in armature, of the propodus; carpus elongately triangular, without posterior lobe; setation on carpus marginal. Fourth coxal plate without posterior excavation. Coxal gills with a long, narrow, well-demarcated basal stalk. Oöstegites long, narrow. Rami of pleopod 3 usually slightly, but sometimes strongly, sexually dimorph. No sexual dimorphism in the 2nd uropod. Third uropod of variiramus-type; endopodite armed with spines and (usually naked) setae. Telson completely cleft; provided with distal and lateral spines, sometimes also with medial spines.

TYPE-SPECIES (by monotypy). – *M. curasavicus* Stephensen, 1933a.

SPECIES-GROUPS WITHIN *Metaniphargus*

Although *Metaniphargus* is homogeneous to such an extent that STEPHENSEN (1948) considered all populations known to him (from

Aruba, Curaçao, Bonaire, and St. Croix) identical, it is possible now to distinguish a number of groupings, that agree in morphology and to a certain extent, also in geographic distribution. Since members of *Metaniphargus* are known at present from only 8 out of the hundreds of West Indian islands, it seems premature to philosophize at length about the level of the groupings. These may be subgenera or polytypic species; for the moment I prefer to call them just species-groups. The same holds true for the taxa from different islands, which may be treated as species or subspecies. Provisionally, I have attributed specific status to them, except for certain taxa from Aruba and Curaçao from which islands so many records are known, that a detailed knowledge of their microdistribution permits the use of a subspecific classification-system.

I distinguish the following SPECIES-GROUPS:

(1) the *curasavicus*-group (*c. curasavicus* and *c. orientis*), restricted to Curaçao and characterized by the following characters:
- carpus Gn. 2 (♀) not very long, triangular
- palm Gn. 2 (♀) setiferous
- peduncle of uropod 2 (♀, ♂) without row of spinules
- pleopod 3 (♂) with complex lobes
- endopodite of Ur. 3 (♀, ♂) without plumose setae

(2) the *nicholsoni*-group (*nicholsoni, palpator, bousfieldi, l. longipes, l. christophorensis*) from Aruba, the adjacent part of Curaçao, and a number of islands in the northeastern part of the Antillean arc.
- carpus of Gn. 2 (♀) very elongate
- palm of Gn. 2 (♀) setiferous
- peduncle of uropod 2 (♀, ♂) with row of spinules
- pleopod 3 (♂) without or almost without lobes
- endopodite of uropod 3 (♀, ♂) without plumose setae

(3) the *beattyi*-group (*beattyi*) from St. Croix
- carpus of Gn. 2 (♀) triangular
- palm of Gn. 2 (♀) spiniferous
- peduncle of uropod 2 (♀, ♂) with row of spinules
- pleopod 3 (♂) with small lobe only
- endopodite of uropod 3 (♀, ♂) without plumose setae

(4) the *jamaicae*-group (*jamaicae*) from Jamaica
- carpus of Gn 2 (♀) very elongate
- palm of Gn. 2 (♀) setiferous
- peduncle of uropod 2 (♀, ♂) with row of spinules
- pleopod 3 (♂) almost without lobes
- endopodite of uropod 3 (♀, ♂) with plumose setae

The difference between the various groups can be expressed as follows in a dichotomous KEY:

1a) Pleopod 2 with strong sexual dimorphism. Peduncle of uropod 2 without row of spinules. . . . . *curasavicus*-group
b) Pleopod 2 without or with weak sexual dimorphism. Peduncle of uropod 2 with row of spinules 2

2a) Uropod 3, endopodite as long as segment 1 of exopodite, provided with plumose setae . . . . *jamaicae*-group
b) Uropod 3, endopodite shorter than segment 1 of exopodite, devoid of plumose setae. 3

3a) Palmar edge of Gn. 2 ♀ with spines . . . . . *beattyi*-group
b) Palmar edge of Gn. 2 ♀ with setae . . . . . *nicholsoni*-group

THE **curasavicus** – GROUP

This group is chiefly characterized by the strongly developed outgrowth on the median side of the first exopodite article in the 3rd male pleopod. It has but one species (divided into two subspecies).

Metaniphargus curasavicus Stephensen, 1933

This species is only known from Curaçao. It falls apart in two subspecies, without morphological intermediates and with touching but separated ranges. The nominal subspecies occurs in running waters (springs) on the north coast of central Curaçao (an area submerged under sea-water during the Pleistocene), the other subspecies is from stagnant subterranean waters on central-eastern and eastern Curaçao (presumably not submerged).

KEY to the subspecies of *M. curasavicus*:

1a) Second exopodite segment of uropod 3 not or not much longer than the distal spines on the first segment . . . . *M. c. curasavicus*

b) Second exopodite segment of uropod 3 about twice as long as the distal spines on the first segment . . . . . *M. c. orientis*

Metaniphargus curasavicus curasavicus Stephensen, 1933

(Figs. 7–15)

Metaniphargus curasavicus STEPHENSEN, 1933a: 426–430, figs. 6–8; STEPHENSEN, 1948: 4–5 (pro parte, only the Curaçao records).
Non *Metaniphargus curasavicus*. – STEPHENSEN, 1933b: 441 (= *Saliweckelia emarginata*).

MATERIAL. – All from the North coast of central CURAÇAO:
(1) Topotypes, from Hofje van Hato, just east of Curaçao airport: "Bak Ariba" and "Boca Spelonk di Bak Ariba" (approx. geogr. position 12°11′04″ N 68°56′50″ W), Hummelinck Sta. *71*, Oct. 13, 1936; chlorinity 310 mg/l, temp. 30°C, pH 7.4; 200+ specimens (of these 19 are in ZMC, the remaining ones in ZMA).
Same locality:
Hummelinck Sta. *71a*, Aug. 29, 1949; chlor. 705 mg/l, pH 7.1; 23 spec. ZMA.
Sta. *71b*, Dec. 23, 1963; chlor. 345 mg/l; 60+ spec. ZMA.
Sta. *71c*, Feb. 27, 1970; chlor. estimated at 400–600 mg/l; 100+ spec. ZMA.
Stock Sta. *C73–7*, Nov. 29, 1973; chlor. 475 mg/l; 200+ spec.
About 100 specimens from Sta. *71* have been studied by STEPHENSEN, 1948.

(2) Other springs around Curaçao airport:
– Boca di Leon (= Boca di Leeuw), Hofje van Hato (12°11′10″ N 68°56′54″ W), Hummelinck Sta. *72*, Oct. 13, 1936; chlor. 210 mg/l, pH 7.6; 29 spec. ZMA.
Sta. *72a*, Aug. 29, 1949; chlor. 305 mg/l, pH 7.1; 200 spec. ZMA.
Sta. *72b*, Dec. 23, 1963; chlor. 210 mg/l; 500+ spec. ZMA.
Stock Sta. *C73–9*, Nov. 29, 1973; chlor. 416 mg/l; 100+ spec.
Seventeen specimens from Sta. *72* have been studied by STEPHENSEN, 1948.
– Bron Cajoeda, spring on the S.-side of the Franklin D. Roosevelt Road, behind house nr. 541A, Hummelinck Sta. *74*, Oct. 1, 1938; chlor. 320 mg/l, pH 8.3; 2 spec. ZMA, studied by STEPHENSEN, 1948.
Sta. *74b*, Sep. 26, 1948; chlor. estim. at 700–1000 mg/l; 1 spec. ZMA.
Sta. *74c*, Aug. 27, 1955; chlor. 490 mg/l; 2 spec. ZMA.
Stock Sta. *C73–10*, 1 Dec. 1973; chlor. 832 mg/l, 64 spec.
– Bron Wandongo, spring on the S.-side of Fr. D. Roosevelt Road, in front of Marine Luchtvaart Dienst, Hummelinck Sta. *76*, Oct. 6, 1936; chlor. 230 mg/l, pH. 7.2; 10 spec. ZMA.
Sta. *76Aa*, Oct. 11, 1936; chlor. 240 mg/l; pH 7.3; 10 spec. ZMA.
Sta. *76Ca*, Dec. 15, 1967; chlor. 150 mg/l; 50+ spec. ZMA.
Sta. *76D*, Aug. 27, 1955; chlor. 250 mg/l, temp. 28.5°C; 2♂ ZMA.
Sta. *76Da*, Oct. 15, 1967; chlor. about 150 mg/l; about 50 spec. ZMA.
All specimens from Sta. *76*, and 5 from Sta. *76Aa* have been studied by STEPHENSEN, 1948.

(3) Various springs of San Pedro (12°15′33″ N 69°02′34″ W), about 13 km in direct line WNW of the type locality.

Hummelinck Sta. *79*, Bron San Pedro, S; Sta. *80*, Bron San Pedro, N; Sta. *395*, Bron in hofje San Pedro, all from various dates: Oct. 22, 1936, chlor. 360–460 mg/l; Dec. 13, 1948, 405 mg/l; Feb. 13, 1949, 405 mg/l; Feb. 20, 1949, 405 mg/l; March 11, 1949, 405 mg/l; March 27, 1949, 635 mg/l, May 1, 1949, 1070 mg/l; May 8, 1949, 1600 mg/l.

Stock Sta. *C73–20* and *C75–0*.

The material includes many specimens from Sta. *79* and *80* (both taken on Oct. 22, 1936), studied by STEPHENSEN, 1948 (now in ZMC and ZMA). All together more than 6000 specimens ZMC, ZMA, RMNH.

DESCRIPTION OF TOPOTYPES. – Body length (♂♀) 3–4 mm. White (unpigmented), no eyes. Eggs: diameter 0.49 × 0.35 mm, greenish.

The appendages of males and females are very similar to each other, except for the second gnathopod and third pleopod, and, of course, the presence of oöstegites in female.

First antenna (Fig. 7b) about 2.3 mm long, much shorter than the body. Peduncle segments 1, 2, and 3 of 341, 300, and 157 μm long (thus 1 longer than 2). Flagellum of adults 17- to 20-segmented; all segments, except for the most proximal 2 or 3, with a slender aesthete (Fig. 7b). Accessory flagellum (Fig. 7c) 2-segmented.

Second antenna (Fig. 7d) about 1.5 mm long, much shorter than the first. Peduncle segments 4 and 5 are relatively short (4–5 times as long as wide), and have a length of 287 and 277 μm, respectively, thus are distinctly shorter than peduncle segments 1 and 2 of the first antenna. Flagellum of about 10 segments, 644 μm long.

The upper lip (Fig. 7e) is of the usual shape. The mandibles have a 3-segmented palp (Fig. 7f) consisting of an unarmed basal segment, a second segment with usually 3 setae, and a distal segment with a ventral row of 6 to 9 regular setae and 3 longer distal setae. The masticatory part of the mandibles are asymmetrical (Figs. 8a, b). The right mandible possesses a long seta on the pars molaris, lacking in the left one. The pars incisiva has 3 distal teeth in the right appendage, 4 marginal teeth in the left one. The lacinia mobilis is bifid, each branch armed with 3 to 5 small teeth in the right mandible, but consists of only one cusp armed with 3 strong teeth in the left mandible. Two of the elements implanted between the lacinia mobilis and the pars molaris are strongly transformed in the right mandible, all elements are ordinarily setiform in the left one.

The lower lip (Fig. 8c) is partially cleft; inner lobes are rudimentary.

The first maxilla (Fig. 8d) has a plate-shaped inner lobe, armed with some 17 plumose setae; the more slender outer lobe bears 11 terminal spines, the inner margin of which is denticulated (the medialmost spine bears 10–15 denticles, the lateralmost spines bear 2 or 3 denticles). The palp is 2-segmented; the small proximal segment is naked, it is squarish and small in the right appendage, rectangular and slightly larger in the left one; the second palp segment is distally armed with 6 or 7 heavy spines and 1 seta in the right appendage, with 5 or 6 slender spines and 1 or 2 setae in the left appendage (Figs. 8d, e).

The second maxilla (Fig. 9c) consists of two lobes; the inner lobe bears 1 marginal row of setae plus an additional row running obliquely over the surface; the outer lobe bears likewise 2 rows of elements, both (sub)terminal, one row consisting of "normal" setae, the other of about 10 slightly sigmoid elements.

The maxilliped is as illustrated (Figs. 9a, b). The lateral margin of the outer lobe is devoid of setae.

The first gnathopod (Fig. 10a) is similar in both sexes. The coxal plate bears some setules along its anterior and ventral margins. Merus and ischium bear a strong, curved, posteriorly directed seta. The carpus is longer than the propodus and bears some 4 groups of setae on its posterior margin. The propodus is rectangular; four (two longer and two shorter) bicuspidate spines mark the palmar angle (Fig. 10b).

The second gnathopod is sexually dimorph. In ♂ (Fig. 10c), the carpus is shorter than the propodus; the propodus has a long, oblique palmar margin, armed with 2 parallel rows of spinules of a size (Fig. 10d); the palmar angle is marked by 2 spiniform and 2 setiform elements. The ♂ claw is slender; the inner margin of the claw bears numerous denticles. In ♀ (Fig. 11a) the carpus and propodus are about equally long. The palmar margin and the claw are shorter; the palmar margin is devoid of spines, but bears some setules. The claw bears some 4 or 5 denticles along its inner margin.

Pedunculate coxal gills are present on legs 2 to 6. Brood plates are narrow, armed with long setae (Fig. 12a) and present on legs 2 to 5 of the female.

The third pereiopod (Fig. 11b) resembles the fourth (Fig. 11c). The coxal plate of the latter is roundedly rectangular, devoid of a posterior incision.

The fifth pereiopod (Fig. 12b) has a tapering basis, the posterior margin of which is crenulated bearing some 6 or 7 setules, the anterior margin bears the same number of stiff setules. Merus, carpus and propodus are relatively robust and bear strong spines. The claw (Fig. 12c) is slender but not excessively so.

The distal segments of the 6th pereiopod are not very slender either (Figs. 12e, f).

The basis of the 7th pereiopod (Fig. 12g) is devoid of a posteriorly overhanging lobe. The long segments and the claw (Fig. 12h) are not very elongate or slender.

The pleopods have each 2 retinacula (Figs. 13a, e), exceptionally 3 retinacula occur. The peduncle of pleopod 1 is 366 μm, the outer ramus is 421 μm long, the inner ramus 445 μm. In pleopod 2, these measurements are 345, 410, and 445 μm, respectively, and in pleopod 3 they are 320, 359, and 410 μm. Pleopod 3 is sexually dimorphic. In males (Fig. 13b) proximal article of the inner ramus is slightly and regularly swollen at the lateral side; the proximal article of the outer ramus bears a strong mediodistal swelling (Figs. 13c, d). This swelling is always about as wide as the width of the untransformed article, provided with rugosities, but its shape may vary. The number of setae on the lateral margin of the swollen article is variable. In females, pleopod 3 is not transformed.

The epimeral plates are posteriorly produced into a minute point (Fig. 7g). Plate 1 bears no or 1 posterior setule; plate 2 bears 0 or 1 posterior setule and 0 or 1 ventral spine; plate 3 bears 0, 1 or 2 posterior setules and 1 ventral spine.

The first uropod (Fig. 15b) bears several strong spines on its pedunculus. The exopodite is slightly shorter than the endopodite; the latter is armed with 2 spines along its dorsal margin and 5 terminal and subterminal spines.

The 2nd uropod (Fig. 15c) is shorter than the first; the (shorter) exopodite bears 4 strong dorsal spines and 3 terminal spines; the (longer) endopodite bears 3 dorsal, 1 ventral, and 5 terminal and subterminal spines.

The 3rd uropod (Figs. 14a–f) is relatively robust. The endopodite usually is about as long às the pedunculus; its armature varies to some extent, but usually consists of 3 spines implanted in marginal or subterminal position, and a short setule placed immediately below the pointed tip of the endopodite. In some specimens, this pointed tip is absent (Fig. 14f) and the setule might be proportionally longer. The first exopodite article has a lateral armature consisting of 3 groups of spines, and a medial armature of 3 groups of spines and a plumose seta; terminally, this article bears 7 to 11 long spines and one or a few plumose setae. The 2nd exopodite article is small, in most specimens it is shorter than the distal spines of article 1, only rarely it is slightly overreaching these, the 2nd article is tapering, pointed, and usually armed with 3 (rarely 2) setules.

Urosomite 1 bears a dorsal setule, urosomite 2 bears 1 lateral spine on either side, urosomite 3 is unarmed (Fig. 15a).

The telson (Figs. 13f, g) is entirely cleft; the lateral margin of each lobe is convex, the median margin is straight. Each lobe bears a subbasal seta and 2 minute, subdistal sensory setules. The distal armature consists of numerous (5 to 8) very long spines, which are implanted on either side of the pointed distal tip of the telson; on the part of the telson mediad of the tip more spines are usually implanted than laterad of the tip.

VARIANT POPULATIONS. – The typical population (from the "bak ariba" – Boca Spelonk complex) is rather uniform and differs from all other *Metaniphargus* populations known to me by a combination of characters: (1) the very spinose telson, with both lateral and medial armature; (2) the very short distal article of the exopodite in uropod 3; (3) the short endopodite of uropod 3 being as long as the peduncle; (4) the robust posterior pereiopods with a relatively short propodus and short claw; (5) the large swelling on the exopodite of the 3rd male pleopod; (6) the uniform and small size of the spines on the palm of gnathopod 2, ♂; (7) the short first and second antennae (in A2 articles 4 and 5 are shorter than the 1st and 2nd articles of A1 and are only 4 to 5 times as long as wide); (8) the presence of long spines on the dorsal margin of the endopodite of uropod 1.

A certain percentage of the populations from Wandongo and San

Pedro differs from the typical population in characters (2), (3) and (4). The 3rd uropod sometimes has a longer distal exopodite article (Fig. 14c), but this elongation of the distal article seems to be restricted to large (senile?) males. On the other hand, in both males and females, the endopodite of uropod 3 is relatively longer and more slender, distinctly longer than the pedunculus, and often armed with more spines or setae than in the typical form (Figs. 14c, d). In some specimens, especially in older males, the propodus of the posterior pereiopods is somewhat more slender than in the typical form. In all remaining features, the Wandongo and San Pedro animals agree with the types. I am uncertain what status I must attribute to these animals. Material from the type locality is uniform in all respects, and the other samples recorded agree with the topotypes, except for the two westernmost populations, Wandongo and San Pedro, where typical animals live mixed with, and are (in San Pedro) in the minority with respect to, atypical animals. Provisionally, pending an experimental approach, I consider all these populations the same species.

SEX RATIO. – In the type locality, 40.8% of the population consisted of females, 59.2% of males (based on a count of 125 specimens collected in November 1973).

DISTRIBUTION. – The nominate form of *M. curasavicus* has a limited distribution on Curaçao only (all other records are based on confusion with other taxa). It occurs in a number of natural springs originating from the terraces on the Hato plain, on the north coast of the narrow central "waist" of the island. The entire range of *M. c. curasavicus* is only about 13 km.

To the east and south, the present taxon is replaced by *M. c. orientis*, to the west by *M. longipes christophorensis*.

ECOLOGY. – This subspecies is only known from springs (running subterranean waters reaching the surface). In stagnant subterranean waters, within its range, such as wells or pools in caves, *M. c. curasavicus* has never been found. In fact, such localities have only once yielded a member of *Metaniphargus*, viz. *M. c. orientis* on HUMMELINCK's Station 393 (vide infra).

In an arid area like Curaçao, the springs never contain entirely fresh water, but oligo- and mesohaline waters. The Hato springs as well as the San Pedro springs are situated at altitudes of 20 to 30 m above sea-level, and certainly cannot be classified as anchihaline¹). The only truely anchihaline locality within the range of *M. c. cura-*

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¹) According to HOLTHUIS' (1973: 3) definition, anchihaline species inhabit waters without surface connection with the sea, containing salt or brackish waters, which fluctuate with the tides.

savicus, the subterranean lake in the Sjingot cave, has – notwithstanding intensive sampling – never yielded any *Metaniphargus*.

M. c. curasavicus may be termed a euryhaline species recorded from 210 to 1600 mg Cl/l.

Metaniphargus curassavicus Stephensen, 1933 **orientis** n. ssp.

(Figs. 16–18)

MATERIAL. – All from CURAÇAO:

– Deep well with windmill, Oostpunt estate, just E of the Klein St. Joris country house (12°06′39″ N 68°49′03″ W), Stock Sta. *75–5*, Nov. 11, 1975; chlorinity 1250 mg/l; 1♂ (holotype), 1♀ (allotype), and more than 300 paratypes, ZMA Amph. 107.000 a-b.

Other records, arranged from East to West (all in ZMA):

– Well on Oostpunt (Oranjeberg) estate, 12 m deep (12°05′53″ N 68°48′44″ W), Stock Sta. *74–45*, March 17, 1974; chlor. 660–700 mg/l; 14 specimens.

– Well on Oostpunt estate, 16 m deep, 400–500 m SSE of the Klein St. Joris country house (12°06′24″ N 68°48′59″ W), Sta. *74–46*, March 14, 1976; chlor. 700–720 mg/l; 2 spec.

– Well along the road to Santa Barbara, Montañe Rey, 12 m deep (12°05′46″ N 68°50′21″ W), Sta. *74–55*, April 4, 1974; chlor. 185–190 mg/l; 1♂.

– Deep well on estate Coral Patín (12°07′51″ N 68°51′00″ W), Sta. *74–27*, Jan. 28, 1974; chlor. 297 mg/l; 100+ spec.

– Well of 14 m deep, Montañe Rey, lot L 49 (12°06′19″ N 68°51′07″ W), Sta. *74–54*, April 4, 1974; chlor. 250–400 mg/l; 1♂.

– Well with windmill at plot Ronde Klip no. 24, just E of the northern boundary of the Vetter estate, 19 m deep (12°08′42″ N 68°51′17″ W), Sta. *76–1*, June 11, 1976; chlor. 390 mg/l; 48 spec.

– Well of over 19 m deep, estate Brakke Put, E-side of Caracasbaaiweg (12°05′58″ N 68°52′15″ W), Sta. *74–29*, Feb. 28, 1974; chlor. 90–100 mg/l; 2 juveniles.

– Well of 16 m deep on N-side of Caracasbaaiweg (12°06′12″ N 68°52′26″ W), Sta. *74–47*, March 21, 1974; chlor. 240 mg/l; 100+ spec.

– Well on the junction of the road to Montaña and to Caracas Bay, just opposite Zuurzak country house, abt. 8 m deep (12°06′30″ N 68°52′41″ W), Sta. *74–28*, Feb. 28, 1974; chlor. 240–300 mg/l; 100+ spec.

– Well with windmill on estate Klein Kwartier, 20 m deep (12°07′17″ N 68°53′02″ W), Sta. *74–38*, March 15, 1974; chlor. 210 mg/l; 8 spec.

– Well in the vegetable garden of Noordkant country house, 6½ m deep (12°10′20″ N 68°53′15″ W), Sta. *74–62*, April 9, 1974; chlor. 400–430 mg/l; 25 spec.

– Well on estate Klein Kwartier, 25 m deep (12°07′17″ N 68°53′22″ W), Sta. *74–40*, March 15, 1974; chlor. 180 mg/l; 2♀.

– Well in quarry of Noordkant estate, abt. 8 m deep (12°10′31″ N 68°53′23″ W), Sta. *74–61*, April 9, 1974; chlor. 2800 mg/l; 200+ spec.

– Well on estate Klein Kwartier, 11½ m deep (12°07′19″ N 68°53′25″ W), Sta. *74–42*; March 15, 1974; chlor. 130–200 mg/l; 16 spec.

– Well in botanical gardens of Cas Corá (12°07′57″ N 68°53′36″ W), Sta. *74–43*, March 15, 1974; chlor. 200–210 mg/l; 4 spec.

– Well on estate Klein Kwartier, 22 m deep (12°07′07″ N 68°53′52″ W), Sta. *74–39*, March 15, 1974; chlor. 200–210 mg/l; 4 spec.

– Well 1450 m W of Noordkant country house, with electric pump, depth 5 m (12°10′32″ N 68°54′15″ W), Sta. *74–59*, April 9, 1974; chlor. 660 mg/l; 24 spec.

– Well just west of *74–59*, estate Noordkant (12°10′32″ N 68°54′16″ W), Sta. *74–60*, April 9, 1974; chlor. 240–300 mg/l; 100+ spec.

– Old ruined well on Noordkant estate (12°10′32″ N 68°54′21″ W), Sta. *75–6*, Nov. 13, 1975; chlor. 140 mg/l; 100+ spec.

– Well with mill on boundary of estates Mahuma and Weltevreden, just N of pumping station L.W.V., 8 m deep (12°10′18″ N 68°57′36″ W), Sta. *74–34*, March 7, 1974; chlor. 200–270 mg/l; 6 spec.

– Well with mill on estate Blauw (12°08′38″ N 68°58′44″ W), Sta. *73–13*, Dec. 7, 1973; chlor. 891 mg/l; 18 spec.

– Well with mill on estate Blauw, just N of country house (12°08′37″ N 68°58′52″ W), Sta. *73–12*, Dec. 7, 1973; chlor. 653 mg/l; 1 spec.

– Subterranean pool in cave and N-end of Blauw Bay beach, in semi-darkness (12°08′19″ N 68°59′05″ W), Sta. *73–6*, Nov. 27, 1973; water subjected to the tides, chlor. 8910 mg/l; 100+ spec.

– Beach at the entrance of Blauw Bay cave, pumped from gravel (vide *73–6*), Sta. *73–17*, Dec. 28, 1973; chlor. 17820 mg/l; 2 spec.

– Well in dusky cave W of Hato airport, 8½ m deep, 280 m from the sea (approx. position provided by collector in litt. 12°11′47″ N 68°58′28″ W), Hummelinck Sta. *393*, March 7, 1949; cavern water with tidal movements, chlor. 2500 mg/l, temp. 26°C, pH 8.1; 13 spec.

– Well on estate Mount Pleasant (= Malpais), depth 16 m (12°10′22″ N 68°59′36″ W), Stock Sta. *74–49*, March 25, 1974; chlor. 280–300 mg/l; 200+ spec.

– Well with mill on estate Mount Pleasant, depth 14 m (12°10′24″ N 68°59′41″ W), Sta. *74–50*, March 25, 1973; chlor.?; 11 spec.

– Well in garden of estate Dusu, just N of Pos'i Wanga, depth 10½ m (12°13′10″ N 69°01′34″ W), Sta. *76–39*, June 17, 1976; chlor. 710 mg/l; many specimens.

DIFFERENTIAL DESCRIPTION. – Body length of both sexes 3.0–3.5 mm, rarely up to 4.0 mm. The first antenna (Fig. 16a) is slightly more slender than in *c. curasavicus*; the three peduncle segments are 366 µm, 366 µm, and 171 µm long (in another male: 377, 379, and 206 µm); thus peduncle segments 1 and 2 are equal in length; the flagellum has 16 to 20 segments. The second antenna (Fig. 16b) is more slender than in *c. curasavicus*; peduncle segment 4 is 5½–7½ and segment 5 is 6–8 times as long as wide; in absolute size these articles are 385 µm and 365 µm long (in another ♂: 383 and 340 µm), thus subequal to the articles 1 and 2 of the first antenna. The flagellum has 10 to 12 segments and is 0.75 mm long.

The gnathopods resemble those of *c. curasavicus* (Fig. 16c).

The merus of the 4th pereiopod (Fig. 16d) is more than 3 times as long as wide, thus slenderer than in *c. curasavicus* where it is 2.6 times as long as wide.

In the 5th to 7th pereiopods (Figs. 17a–d, 18a), the propodus and especially the claw are markedly more slender. The anterior margin of the basis tends to have fewer spinules than in *c. curasavicus*.

The third male pleopod (Fig. 18b) is similar to that of the nominate subspecies.

The shape of the epimeres is as in *c. curasavicus*; the spine on the ventral margin of epimeres 2 and 3 is usually absent.

Uropod 1 (Fig. 17e) differs in lacking dorsomarginal spines on the endopodite (exceptionally, 1 small spine is present). The spines on uropod 2 (Fig. 17f) are less robust. Uropod 3 (Fig. 17g) has a tall, fingershaped distal exopodite article, which overreaches the distal spines of the first exopodite article by about twice their length. The endopodite of uropod 3 is narrowly pointed; it bears several medial spines, and is always longer than the pedunculus.

The telson (Figs. 18c–f), though variable in armature, is apically pointed; laterad of the apex one finds 1 or 2 spines, mediad of it 2 to 4 spines. The total number of spines varies between 3 and 6 and is usually lower than in *c. curasavicus*; moreover, a greater part of the medial margin of the telson is devoid of armature in comparison to the nominate form.

REMARKS. – The present form is easily distinguished from *M. c. curasavicus* by the longer 2nd exopod segment of uropod 3, by the more slender posterior pereiopods, the subequal peduncle segments 1 and 2 of the first antenna, the longer peduncle segments 4 and 5 of the 2nd antenna, and by the absence of a dorsomarginal spine on the endopod of uropod 1.

I have decided to consider this form as a subspecies of *curasavicus*, because it resembles that taxon in the development of a large lobe on the proximal exopod article of the 3rd male pleopod, in the armature of the 2nd male gnathopod, and in the general configuration of the telson. It is geographically separated from *curasavicus* s. str.: the present form is widely distributed in stagnant groundwater of the eastern and central part of Curaçao, but is absent from running springs on the north coast terraces in the narrow "waist" of Curaçao where *curasavicus* s. str. occurs.

ECOLOGY. – This subspecies tolerates a wide chlorinity range: it has been found from 130 to 17820 mg Cl/l. Large samples have been collected both at very low chlorinities (140 mg/l) and at high chlorinities (8910 mg/l). The subspecies consequently appears to be distributed in subterranean waters irrespective of the salinity. It should be termed euryhaline (and certainly not anchihaline, since in all but three localities, no tidal effect is present). It has so far only been found in stagnant groundwaters (pools in caves, deep wells).

"Key" samples for the distribution of this subspecies are STOCK's sample 76–39 (westernmost record) and HUMMELINCK's sample 393 (on the lowest north coast terrace, in the general area of *M. curasavicus* s. str., but, in contrast to the latter, in stagnant cave waters).

The proposed specific name, *orientis*, alludes to the distribution on the eastern half of Curaçao. In western Curaçao, ssp. *orientis* is replaced by *M. longipes christophorensis*.

THE **nicholsoni** – GROUP

This group is characterized by having a combination of a very elongated carpus in the 2nd gnathopod and an endopodite of uropod 3 lacking plumose setae.

The group contains 5 taxa (4 species and 1 subspecies), which mutually differ by relatively minor characters only.

KEY TO THE SPECIES AND SUBSPECIES OF THE *nicholsoni*-GROUP

1a) Distoposterior corner of basis of P5 to P7 produced and overhanging. Distal article of exopodite of uropod 3 not much longer than the distal spines on the proximal article. . *M. nicholsoni*
 b) This segment of P5–P7 neither produced nor overhanging. Distal article of exopodite of uropod 3 much longer than the spines 2

2a) Third segment of mandible palp very elongate and narrow; D-setae of a size . . . . *M. palpator*
 b) Third segment of mandible palp less elongate, less narrow; D-setae decreasing in length 3

3a) Palmar angle spines (in Gn. 2 ♂) twice as long as the palmar margin spines . . . . *M. longipes longipes*
b) Less difference in size between the palmar angle and palmar margin spines 4

4a) Peduncle segment 2 of A1 very slender and narrow. Carpus of Gn. 2 ♂ with about 10 groups of setae on the posterior margin . . . . *M. bousfieldi*
b) Peduncle segment 2 of A1 not so slender and narrow. Carpus of Gn. 2 ♂ with about 5 groups of setae on the posteroir margin . . . . *M. longipes christophorensis*

Metaniphargus nicholsoni Shoemaker, 1959

(Figs. 19–22)

Metaniphargus nicholsoni SHOEMAKER, 1959: 276–279, figs. 2, 3a–p.
"*Metaniphargus*, new species", SCHMITT, 1959: 422 (descr. of locality).

MATERIAL. – All from BARBUDA:
– Dark Cave, Highlands, large pool (dark), Hummelinck Sta. *671*, July 6, 1955; chlor. 930 mg/l, temp. 23°C; 16 spec. (topotypes) ZMA.
– Pycrust Well, Highlands, Hummelinck Sta. *669*, July 6, 1955; chlorinity 1700 mg/l, temperature 27°C; 100+ specimens ZMA.

DESCRIPTION. – A larger species: specimens from the type-locality are 5 to 7 mm long; those from Sta. *669* are slightly smaller (4–5½ mm). Some small comparative additions to the original description suffice.

The first antenna (Fig. 19a) resembles that of *M. beattyi*, except for the relative length of peduncle article 2 (which is shorter than article 1) and the relative length of the more slender accessory flagellum. The peduncle segments are 702, 629, and 305 μm long in a female; 534, 497, and 268 μm in a male.

The second antenna (Fig. 19b) is slender; in the ♀, peduncle segment 4 is 572 μm long, segment 5 is 554 μm, and the 10- or 11-segmented flagellum 847 μm.

The masticatory part of the mandibles, the lips, and the first and second, maxillae are similar to the corresponding parts in *M. c. curasavicus*. The mandible palp (Fig. 22a) has a slightly sigmoid terminal article and is ventrally armed with a row of about 16 spines, decreasing in length in distal direction; the terminal armature consists of 4 longer setae.

The maxilliped is almost identical to that of *M. c. curasavicus*, except for the presence, on the lateral side of the basipodal endite, ot 1 short seta.

The first gnathopod (Figs. 20a, b) is identical in both sexes. It is characterized by an elongately rectangular coxal plate, and a very elongated carpus, the posterior margin of which caries 8 or 9 groups of setae.

The second gnathopod of the male (Fig. 21a) bears about 12 groups of setae on the posterior margin of the carpus. The propodus is elongately ovate. The palm (Fig. 21b) is armed with 2 strong palmar angle spines, and along the palmar margin with 2 rows of spines, mostly much smaller than the angle spines, except for the two medial spines that are as strongly developed as the angle spines.

In the second gnathopod of the female (Fig. 21c) the great elongation of the carpus is noteworthy; the posterior carpal margin is armed with about 14 groups of setae. The propodus is very elongated, and the claw proportionately short. The palm (Fig. 21d) bears two angle spines; the remainder of the palmar margin is armed with a few setae only.

The third and fourth pereiopods have more elongated coxal plates (Fig. 21e) than *M. c. curasavicus*, but are otherwise resembling it.

The pereiopods 5 to 7 are slender. Their most striking character is the overhanging lobe formed by the posterior margin of the basis (Figs. 19c, d, e).

The high number of spinules on the anterior and posterior margins of the basis is also noteworthy. The number of spine groups on the anterior margin of the propodus may vary from 5 (see figure 3c in SHOEMAKER, 1959) to 3 (see Fig. 20c in the present paper).

The basal exopodite and endopodite articles of pleopod 3 (♂) do neither show any swelling (Fig. 22b) nor other transformations like fields of spinules.

The first and second uropods (Figs. 20d, e) are more slender and less spinose than in *M. c. curasavicus.*

The third uropod (Fig. 22e) has a relatively wide first exopodite article and a rather short 2nd one (not much overreaching the distal spines of article 1). The endopodite reaches beyond the half of exopodite article 1.

The telson halves (Figs. 22c, d) are tapering, more or less triangular in outline. The lateral margin bears 1 or 2 shortish spines, the distal margin 1 or 2, and the straight medial margin bears 1 spine, implanted at a considerable distance from the tip. Subbasal setae (1 or 2) present.

Remarks. – A well-characterized species (great size; armature and shape of gnathopods 1 and 2; shape and armature of the basis of P5 to P7; construction of the uropods; and armature and shape of the telson halves). It is only known from the island of Barbuda.

Ecology. – The type-locality, Dark Cave, is apparently brackish. Hummelinck's Sta. 671 has a chlorinity of 930 mg/l. Martin-Kaye (1956, table 31) records a total salinity of 2.018 p.p.m. for the same locality. The cavern water of the Pycrust Well is distinctly mesohaline, 1700 mg Cl′/l.

Metaniphargus palpator n. sp.

(Figs. 23–26)

Material. – From St. Martin and Anguilla (ZMA):
St. Martin.
– Devil's Hole Cave puddle in dusky shaft of Airmouse Cave, on E-side of Simson Bay, now Pelican Key Estate (approx. 18°01′39″ N 69°05′42″ W), Hummelinck Sta. *681a*, Oct. 14, 1963; possibly in connection with cavern water and subjected to tidal movements, chlorinity 10370 mg/l; 1♂ (holotype), 1♀ (allotype), 62 paratypes, ZMA Amph. 107.015–016.
Same locality, Hummelinck Sta. *681*, July 26, 1955, chlor. 8100 mg/l; 106 specimens.
Devil's Hole, June 8, 1959; 14 spec. H. E. Coomans and H. J. Koelers coll.
Stock Sta. *76–63*, Devil's Hole, June 23, 1976; chlor. 8250 mg/l; 3♀, 1♂.
[The Devil's Hole cave has at least 2 waterbodies: one larger, which contains *Stygiomysis*, and a very small one (a puddle often not larger than a tea-cup and sometimes without free water) in the 3rd little shaft from the right, which harbours *Metaniphargus* in varying numbers and only rarely *Stygiomysis*.]
Anguilla.
– Forest Point Saltwell, near southern shore (approx. 18°12′15″ N 63°02′16″ W), Hummelinck Sta. *543*, June 18, 1949; 3½ m deep, limestone with some clayish mud, chlor. 4070 mg/l, pH 7.6; 6♀.
– The Fountain (approx. 18°15′15″ N 63°02′00″ W), Hummelinck Sta. *056* and *056A*, July 1–2, 1973; dark limestone cave, chlor. 780–790 mg/l; 1st pool 100 spec., 2nd pool 34 spec.

DESCRIPTION OF TOPOTYPES. – A large species: body length of adult specimens 5–7½ mm.

The first antenna (Fig. 23a) is very elongated, about as long as the body, flagellum of 40–45 segments; peduncle segments 1, 2, and 3 have lengths of 719, 798, and 369 μm, respectively (thus, article 2 is the longest). Accessory flagellum (Fig. 23b) narrow, slender, 2-segmented, about as long as or longer than flagellum segment 1. Flagellum segments 1 to 11 without aesthetes, remaining segments provided with an aesthete.

Second antenna (Fig. 23c) distinctly less than half as long as the first. Flagellum about 16-segmented, about as long as the peduncle; peduncle segments 4 and 5 with lengths of 642 and 541 μm, respectively.

Labrum and labium as in *M. curasavicus*. Mandible with 4 teeth on the right pars incisciva, 5 on the left. Palp characteristic (Fig. 23d): basal segment not very short, unarmed; second segment much shorter than the third; third segment very slender (7 to 8 times as long as its greatest diameter), ventral margin straight (forming an obtuse angle in other species); the D-setae are subequal in length; there are 3 or 4 E-setae.

Remaining mouth-parts as in *M. curasavicus*. Maxilliped as in *M. nicholsoni*.

First gnathopod (Figs. 23e, f) chiefly characterized by its rather elongate, rectangular, carpus, the posterior margin of which bears 5 groups of setae.

Second gnathopod with elongated carpus and propodus (♂♀) (Figs. 24a, c). The carpus bears about 9 groups of setae on the posterior margin in female, about 8 groups in male. In male the palm is very oblique and occupies about half the length of the propodus; the palmar angle spines are very strong; the palmar margin bears 2 rows of about 7 spines each, these spines being much smaller than the angle spines (Fig. 24b). In female, the palm is also very oblique, but shorter than in male; the palmar angle is armed with 2 rather strong spines; the palmar margin bears setae and setules only (Fig. 24d).

The 3rd and 4th pereiopods are rather slender (Figs. 25a, b).

Fifth pereiopod (Fig. 25c) shorter than the 6th and 7th pereiopods

(Figs. 25e, 26a). Claws of P5–P7 very slender (Figs. 25d, f, 26b). Basis without posterodistal, overhanging lobe.

Third pleopod (Fig. 26c) of the male without internal swelling on the first exopodite article; both exo- and endopodite without rugosities on the margins. Two retinacula.

Epimeral plates 2 and 3 (Fig. 24e) with pointed posteroinferior corners.

First uropod (Fig. 26d): peduncle with strong subbasal spine; rami slender, subequal, both rami with mediodorsal spines. Second uropod (Fig. 26e): peduncle with dorsodistal spine row; exopodite shorter than endopodite, both rami with spines along the dorsal margin. Third uropod (Fig. 26f) slender; exopodite spines rather short; 2nd exopodite article about twice as long as the terminal spines on article 1; endopodite pointed, of variable length (ranging from 47 to 55% of the length of the first exopodite article) but usually slightly more than half as long as exopodite article 1.

Telson (Fig. 24f) with convex, unarmed lateral margin and straight, unarmed medial margin; distal margin with 3, but usually 4, short spines.

THE ANGUILLA POPULATIONS. – Although an important number of specimens (134) have been recorded in The Fountain cave, all are females (partly ovigerous) or juveniles. Thus the male of this population remains unknown. It should be noted that in *Hadzia fragilis* males are also very rare or absent (SKET, 1969: 148). The females are very similar in their characteristic features (mandible palp, lengths peduncle segments of A1, uropods 1–3, telson, shape gnathopods, slenderness of P5–P7 claws) to the St. Martin population.

Differences of minor importance between the populations of The Fountain (Anguilla) and of the Devil's Hole (St. Martin) are found in the following appendages: the A1 flagellum, which has more segments in The Fountain population (up to 57); in the accessory flagellum, which is slender but shorter than flagellum article 1; in the presence of 4 to 5 E-setae in the mandible palp.

From a second locality on Anguilla, called Forest Point Saltwell, 6 small specimens, likewise all females, are available. These specimens resemble the Devil's Hole material in having only 3 E-setae on the mandible palp, and in having the accessory flagellum of A1 longer than the first flagellum segment. These specimens differ from the type material in having less (up to 25) articles in the A1 flagellum, in having less deep anterior coxal plates, and in having a relatively short endopodite in Ur 3 (44% of the length of the first exopodite article).

AFFINITIES. – The slender carpus in gnathopods 1 and especially 2 distinguishes the present species from all taxa except *M. longipes*, *M. nicholsoni*, *M. bousfieldi*, and *M. jamaicae.*

M. longipes differs as follows: (1) 3rd palp segment $\leqslant$ 5 times as long as its maximum width; (2) the proximal D-setae of the palp are much longer than the distal ones; (3) article 2 of the A1 peduncle is not longer than article 1; (4) the male pleopod is sexually dimorph; (5) the first uropod lacks spines along the dorsal margin of the exopodite; (6) the palmar angle spines of Gn. 2 ♂ are smaller.

M. nicholsoni differs as follows: (1) the ventral margin of palp article 3 is less straight; (2) exopodite article 2 of uropod 3 is not much longer than the distal spines on article 1; (3) the carpus of Gn. 1 and Gn. 2 (♂♀) bears more numerous groups of setae; (4) the palm of Gn. 2♀ is shorter; (5) the palmar angle spines of Gn. 2♂ are smaller, the palmar margin spines are larger; (6) the P5–P7 claws are much shorter; (7) the basis of P5–P7 has an overhanging posterodistal lobe; (8) the telson has spines on the medial margin; (9) the exopodite of uropod 1 lacks mediodorsal spines; (10) the 2nd peduncle segment of A1 is shorter than segment 1; (11) the flagellum of A1 has much fewer (< 30) segments.

Between *M. palpator* and *M. jamaicae* exist several differences, such as the mutual lengths of the rami of uropod 3, the setation of the claws in P5 to P7, the armature of the telson, etc.

For the differences with *M. bousfieldi*, see under that species.

DISTRIBUTION AND ECOLOGY. – Assuming that the populations from St. Martin and from Anguilla are identical (the females are very similar, but for the Anguilla population no males are known), this is the only monotypical *Metaniphargus* known from more than one island. This is not so surprising as it seems, however, since St. Martin and Anguilla lie on the same shallow submarine plateau.

Up to now *Metaniphargus palpator* has been found in one well and in waterbodies of two different caves. The present author has intensively sampled a great number of wells on St. Martin, but never found *M. palpator* outside the type-locality, the Devil's Hole cave. It is assumed, therefore, that cavern waters are the typical habitat for this species, an assumption that is in agreement with the fairly large size of the animals.

The proposed specific name, *palpator*, alludes to the very slender 3rd palp article of the new species.

Metaniphargus bousfieldi n. sp.

(Figs. 27–30)

MATERIAL. – All from PUERTO RICO:
– Guánica Forest Cave, Guánica, small pool, June 12–14, 1974; on bait, S. & J. Peck coll., Nat. Mus. Canada, Ottawa, 1♂ (holotype) and 100+ paratypes (mostly in fragmentary condition); 15 paratypes ZMA Amph. 107.003.
– Guánica Shelters Cave, Guánica Forest, June 11, 1974; S. & J. Peck coll., 5 spec. NMC.
Same locality, same data; 50 spec. USNM, 20 spec. ZMA, 14 spec. NMC.
– Guánica Forest, Cueva de Murciélagos, June 12–14, 1974; S. &. J. Peck coll., 3 spec. NMC.

DESCRIPTION. – Total body length 5–6 mm. First antennae about as long as, or longer than, the body, slender (Fig. 27a); peduncle segment 2 clearly longer than segment 1 (lengths of segments 1 to 3: 641, 665, and 268 µm, respectively). Flagellum long, 30- to 35-segmented; proximal 13 segments without aesthete. Accessory flagellum (Fig. 27b) 2-segmented, markedly shorter than flagellum segment 1.

Second antenna (Fig. 27c) half as long as the first; peduncle segments 4 and 5 narrow and slender, 613 and 537 µm long, respectively, flagellum 10- to 13-segmented.

Mandible palp (Fig. 28a) with rather long basal segment; segment 2 with 3 ventral setae; segment 3 with an angular ventral margin; a row of some 14 D-setae is present, decreasing in length in distal direction; 4 E-setae. Pars incisiva as in *M. longipes*.

Remaining mouth-parts without particulars, similar to those of *M. c. curasavicus*. Maxilliped as in *M. c. curasavicus* (lateral side of basipodal endite devoid of setae).

First gnathopod (Fig. 27d) with a rather elongated coxal plate, the ventral margin of which bears only 2 setules. Carpus rather elongate, with about 5 groups of setae along its posterior margin.

Second gnathopod of the male (Fig. 28b) with elongated carpus, the posterior margin of which is armed with 9 groups of setae. Propodus elongately ovate; palm (Fig. 28c) with 2 long angle spines; palmar margin with 2 rows of spines, larger and smaller ones intermixed. In female, the carpus is very elongate, and armed with 11 groups of setae (Fig. 28d). The palm is shorter than in male, and (apart from the 2 strong angle spines) armed with stiff setae only (Fig. 28e). The coxal plate of the second gnathopod (Fig. 29a) is slightly more elongated than in other species of the *nicholsoni*-group; the ventral margin bears 2 setae only.

In the 3rd and 4th pereiopods (Fig. 27e) the scarce armature of the merus is noteworthy: in P3 the anterior margin of the merus bears only 1 seta (Fig. 28f) in P4 even none; the posterior margin in P3 and P4 bears 1 group of setae (the distal group excluded in both cases).

The basis of pereiopods 5 to 7 (Figs. 29b, d) is more elongated and slenderer than in several relatives. The posterodistal corner of the basis is neither expanded nor overhanging. The propodus is relatively slender, the terminal claw is not extremely elongated.

The third male pleopod (Fig. 29f) has 2 retinacula. The first exopodite article has a rugose, slightly swollen medial margin.

Epimeral plates 2 and 3 (Fig. 30a) with 1 spine on the inferior margin, and 1 setule on the posterior one. Posteroventral corner slightly pointed.

Uropod 1 (Fig. 30b) peduncle and rami with rather numerous spines; the distal ones on the rami are particularly long. Dorsal margin of both rami with 1 or 2 spines. Uropod 2 (Fig. 30c) with distal spines row on the peduncle; spines on the rami long.

Uropod 3 (Fig. 30d) with slender rami. Exopodite article 1 with rather short spines; inner margin moreover with plumose setae; article 2 fingershaped, much longer than the distal spines of article 1. Endopodite pointed, almost half as long as exopodite article 1; armed with 3 to 5 spines on the medial margin, 1 or 2 spines on the lateral margin.

Telson lobes (Fig. 29g) feebly tapering, truncated distally; with 1 lateroterminal and 2 or 3 terminal spines.

REMARKS. – The species clearly belongs to the *nicholsoni*-group. It differs from *M. nicholsoni* in the non-overhanging basis of P5–P7; in having less than 10 spinules on the posterior margin of the basis of P5–P7; in having fewer groups of setae on the posterior margin of the carpus of P1 and P2; in the absence of medial spines on the telson lobes.

It differs from *M. palpator* in having an angular bend in the ventral margin of mandible palp article 3; in the decreasing length of the D-setae on the same palp article; in the shorter accessory flagellum of A1; in the armature (of smaller and larger spines intermixed) of the palm of P2 ♂.

Surprisingly, the present Puerto Rican species is morphologically closest to *M. longipes* and its subspecies from the N.A. Leeward group. Differences from *M. longipes longipes* are found in the more elongated first segment of the mandible palp; in the armature of the palm of P2 ♂ (vide supra under *M. palpator*); a shorter 2nd exopodite article in Ur. 3; in a shorter claw in P5–P7; in the absence of a medial spine on the telson lobes. Perhaps the resemblance to *M. longipes christophorensis* is the greatest. Differences are found in the lower number of flagellum articles in A1; a longer 2nd peduncle segment of A1; a shorter 2nd exopodite article in Ur. 3; a longer first mandible palp segment; and in more groups of setae on the posterior carpal margin of P2 ♂.

It is with great pleasure that I dedicate this species to Dr. ED BOUSFIELD, of Ottawa, Canada, who has provisionally studied the present material and, after having established that a new species was concerned, turned over the specimens to me to be incorporated in my revision of the West Indian hadziids.

Metaniphargus longipes n. sp.

For the moment, this species appears to be composed of two subspecies, the nominate one from Aruba, and the ssp. *christophorensis* from the western part (facing Aruba) of the next island, Curaçao.

On the basis of the morphological similarity and the geographical proximity, the taxa *longipes* and *christophorensis* are considered subspecies. Factual proof about interfertility or sterility lacks entirely.

From the other members of the *nicholsoni*-group, *M. longipes* differs in several ways:

From *M. nicholsoni* in lacking an overhanging posterodistal lobe in the basis of P5 to P7; in having fewer spinules on the posterior margin of the basis of P5 to P7; in having fewer groups of setae on the posterior margin of the carpus of P1 ♀, P2 ♀ and P2 ♂, in having a slight sexual dimorphism in the 3rd male pleopod (none whatsoever in *nicholsoni*); in having fewer D-setae on article 3 of the mandible palp; in having a longer 2nd exopodite article in uropod 3, etc.

From *M. palpator* and *M. bousfieldi* it differs in the characters mentioned under the descriptions of these species (vide supra).

On Curaçao, this species occurs (though spatially separated) together with members of the *M. curasavicus*-group. From these, it differs chiefly by having only a slight swelling on the first exopodite article of the third male pleopod. Additional differences are the shorter and less numerous telson spines and the more slender posterior pereiopods.

M. beattyi is rather similar to *M. longipes* in most characters, but differs fundamentally in its "masculine" type of second gnathopod in the female (palm with spines instead of setae, long claw). Additional differences are found in the A1 (peduncle segment 2 > 1), in uropod 3 (shorter 2nd exopodite article), and in the less elongated, more triangular, carpus in Gn. 2 (♀♂).

Metaniphargus longipes longipes n. ssp.

(Figs. 31–34)

Metaniphargus curasavicus, part., STEPHENSEN, 1948: 5 (the Aruban records only).

MATERIAL. – All from ARUBA:

– Springs of Rooi Prins (right bank of a temporary rain gully, just upstream of a small cascade) (12°29′48″ N 69°54′57″ W), Stock Sta. *A–38*, March 13, 1974; under stones, and in gravel and sand, chlorinity 1450–1500 mg/l, temperature 28°C; 1♂ holotype, 1♀ allotype, 126 paratypes, ZMA Amph. 107.008a–c.

Same locality:

Hummelinck Sta. *104*, Jan. 9, 1937; chlor. 1300 mg/l, temp. 29°C, pH 7.9; 18 spec. ZMA.

Sta. *104b*, Aug. 12, 1955; chlor. 1780 mg/l, temp. 30½°C; 48 spec. ZMA.

Sta. *104Ab*, Aug. 12, 1955; chlor. 1780 mg /l, temp. 31°C; 1 spec. ZMA.
Sta. *104C*, Aug. 12, 1955; puddle, chlor. abt. 3000 mg /l?; 1 juvenile ZMA.
Of these, 12 specimens from Sta. 104 have been identified by STEPHENSEN, 1948, as *M. curasavicus*.

– Pos Grandi, Rooi Lamoenchi (= Lamunchi), Hummelinck Sta. *94*, Feb. 12, 1937; chlor. 960 mg/l, temp. 28–31°C, pH 7.8; several hundred spec., identified by STEPHENSEN, 1948, as *M. curasavicus*, now in ZMC, ZMA, and RMNH.

– Pos West of Rooi Lamoenchi, Hummelinck Sta. *95*, Feb. 11, 1937; chlor. 720 mg/l, temp. 28–30°C, pH 7.8–8.0; 105 spec. ZMA, identified by STEPHENSEN, 1948, as *M. curasavicus*.

– Mangel Corá Well, artificial tunnel on Lower Terrace, Lago, Hummelinck Sta. *632*, May 2, 1955; chlor. 1340 mg/l, temp. 29.5°C; 61 spec. ZMA.

– Deep well with windmill on the left side of the road from Mahuma to Hooiberg (12°30′38″ N 69°59′50″ W), Stock Sta. *A–33*, March 12, 1974; chlor. 700–720 mg/l, temp. 27.3°C; about 100 spec. ZMA.

– Covered well with windmill, 7 m deep, near footballfields of Pos Grandi (12°27′25″ N 69°56′58″ W), Stock Sta. *A–39*, March 12, 1974; chlor.?, temp. 28.8°C; 8 spec. ZMA.

– Well with windmill at Jara, near Pos Grandi, 6 m deep (12°27′37″ N 69°57′04″ W), Stock Sta. *A–40*, March 12, 1974; chlor. 1430–1500 mg/l, 16 spec. ZMA.

– Deep well with old mill, 18 m deep, S of the road from Noord to Salinja near Sabana Libre (12°33′44″ N 70°01′13″ W), Stock Sta. *A–43*, March 12, 1974; chlor. 1500–1670 mg/l, temp. 29.1°C; 21 spec. ZMA.

DESCRIPTION OF PARATYPES. – The body length of adult males and females varies between 3.5 and 4.5 mm.

The first antenna (Fig. 31a) is very long, from somewhat shorter to somewhat longer than the length of the body. The peduncle segments are 436, 430 and 199 μm long. The accessory flagellum is 2-segmented. The main flagellum may have up to 35 segments. In the largest specimens (from Sta A-39) the A1 reaches a length of 5 mm.

The second antenna (Fig. 31b) has very slender peduncle segments 4 and 5 which are 424 and 432 μm long, and 6 to 8 times as long as wide. The flagellum is 11- to 12-segmented.

The mandible has 1 tooth more in the pars incisiva than *M. curasavicus* (Figs. 31c, d). The palp (Fig. 31e) has an elongate distal segment, provided with a ventral row of 9 to 11 spines, decreasing in length from proximal to distal, and with 4 longer distal and subdistal setae.

Lower lip (Fig. 31f) without inner lobes.

The first maxilla resembles that of *M. curasavicus*, except in that the right palp (Fig. 31g) has 5 heavy teeth.

The second maxilla is as in *M. curasavicus*.

The maxilliped resembles that of *M. nicholsoni*, in that it bears a lateral setule on the basal part of the outer lobe.

Gnathopod 1 (Fig. 31h) similar to that of *M. curasavicus*.

Gnathopod 2 of the male (Fig. 32d) with a very slender propodus. The length of the claw is somewhat variable, but usually it reaches beyond the palmar angle spines. There is a great difference in size between the two palmar angle spines and the spines of the two rows on the palm (Fig. 32e).

The second gnathopod of the female (Fig. 32b) resembles that of *M. curasavicus*, but has more numerous groups of setae on the posterior margin of the carpus. Palmar angle spines (Fig. 32c) slightly smaller in size.

Oöstegites as illustrated (Fig. 33a); coxal gills stalked (Figs. 32a, f).

The distal articles of the third and fourth (Fig. 32f) pereiopods are more slender than in *M. curasavicus*.

The fifth, sixth, and seventh pereiopods (Figs. 33b, f) are characterized by the great elongation of the carpus, but in particular of the propodus and the claw (Figs. 33d, e, g).

The epimeral plates resemble those of *M. curasavicus*.

The 3rd pleopod of the male (Figs. 34a, b, c) has a slightly swollen medial side of the first exopodite article. The first endopodite article has a regularly curved lateral margin. The number of setae on the outer margin of the first exopodite article is variable (2 to 4).

The first uropod resembles that of *M. nicholsoni* (rami slender, exopodite with terminal armature only, endopodite with 1 dorsomarginal spine).

The second uropod (Fig. 34d) has fewer, and less robust, spines as compared to *M. curasavicus*.

The third uropod (Fig. 34e) is characterized by the relatively short spines on the lateral margin of the exopodite, and by the slender, elongated, finger-shaped 2nd exopodite article, that is at least 3 times longer than the distal spines on the first exopodite article. The endopodite is narrowly pointed, more than half as long as the first exopodite article.

The telson is variable in shape and armature (Figs. 34f, g, h). The lateral margin of each telson lobe is curved, the medial margin is straight. The medial margin bears 0, 1 or 2 spines in its distal part. In addition there are 1 (rarely 2) distal spines and 1 or 2 lateral spines. Sometimes, the telson bears 1 dorsal spine. The telson spines are short in comparison to those of *M. curasavicus*. Two sensory setae are usually, but not always, present. In the basal portion, the telson carries 0 to 4 setae.

VARIANT POPULATIONS. – In the type-locality, the animals are found in upwelling water in sand and gravel of the bed of a temporary rain gully, in a kind of interstitial habitat. Specimens from more "spacious" habitats (subterranean tunnels, deep wells, i.e. the Pos Grandi wells and the Mangel Corá tunnel) are larger in size and have more slender antennae, but are otherwise indistinguishable (the A1 of such a specimen has, for instance, peduncle segments of 557, 604, and 338 µm long, and a flagellum of 3.9 mm long).

In a population from Sta. A-43, the male pleopod (Fig. 34c) is practically devoid of any swelling; the telson (Fig. 34g) has very few (2 or 3) distal spines, and the A1 and Ur. 3 are slightly shorter than in the types.

For the moment, I consider these "forms" as one and the same species. The material recorded by STEPHENSEN from Aruba under the name of *M. curasavicus*, consists in reality of *M. longipes longipes*. It is the only taxon of *Metaniphargus* recorded so far from Aruba. This may seem surprising, since the geological history of Aruba is more or less similar to that of Curaçao (where 3 taxa occur), in that the island is supposed to be composed of several smaller islands grown together (personal communication of Dr. P. H. DE BUISONJÉ). On the other hand, the number of samples from Aruba available for study was considerably smaller than that from Curaçao, so it may be wise not to jump to conclusions before the island is more intensively sampled.

ECOLOGY. – Both in running (springs) and in stagnant (wells, tunnels) subterranean waters. These waters have, on a very arid island like Aruba, a rather high natural ion content (chlorinities between 700 and 3000 mg/l), but since most localities are at a certain altitude (up to 20 m above sea-level) and devoid of tidal influence, they cannot be called anchihaline.

Metaniphargus longipes christophorensis n. ssp.

(Figs. 35–37)

MATERIAL. – All from western CURAÇAO:

– Pos Sjimarrón, source in bed of intermittent stream on the N.E. flank of the Christoffel Mountain (= Ceru Christoffel) (approx. 12°20′58″ N 69°06′52″ W), Stock Sta. *75–4*, Nov. 9, 1975, just under some small cascades, water upwelling from the gravel bed, altitude 40–50 m, accompanying fauna Polychaeta, Oligochaeta, *Cyathura* (Isop.), insect larvae; chlorinity 3100 mg/l; 1♂ (holotype), 1♀ (allotype), 100$^+$ paratypes; ZMA Amph. 107.002 a–b.

– Sta. *74–52*, same locality, April 2, 1974; chlor. 2500 mg/l; 200$^+$ spec. ZMA.

Other localities, arranged from east to west (all ZMA, Stock coll.):

– Government well "Colonia 26", open well without mill, depth 15 m (12°15′22″ N 69°04′15″ W), Sta. *74–69*, April 11, 1974; chlor. 220 mg/l; 19 spec.

– Well in former gardens ("hoffie") of Dokterstuin country house, depth 12 m (12°16′47″ N 69°04′16″ W), Sta. *74–72*, April 11, 1974; chlor. 820–1000 mg/l; 6 spec.

– Government well "Barber 138" (Pos di Jonchi), depth 12 m, no mill, partly overgrown (12°17′47″ N 69°04′34″ W), Sta. *74–71*, April 11, 1974; chlor. 330 mg/l; 7 spec.

– Deep well of Baha Hundu (= Behundu) on Barber estate (12°17′24″ N 69°04′59″ W), Sta. *74–24*, Jan. 24, 1974; chlor. 1129 mg/l; 60 spec.

– Government well in S.W. corner of Leliënberg estate, depth 15 m, sand, covered (12°17′55″ N 69°05′43″ W), Sta. *74–67*, April 11, 1974; chlor. 138–170 mg/l; 5 spec.

– Well on N.-side of road Santa Cruz-Barber, on the S.E.-side of Flip estate, left of house no. 10 (12°18′05″ N 69°05′53″ W), Sta. *74–26*, Jan. 24, 1974; chlor. 475 mg/l; 49 spec.

– Government well S. of road Soto-Rio Magdalena, 130 m W. of Rio Magdalena country house, depth 8 m, covered (12°17′25″ N 69°06′08″ W), Sta. *74–70*, April 11, 1974; chlor. 190–200 mg/l; 30 spec.

– Well on Savonet estate, N. of country house, depth 9 m, with mill, open (12°21′22″ N 69°06′10″W), Sta. *74–36*, March 7, 1974; chlor. 290–300 mg/l; 51 spec.

– Well with mill just E. of Savonet country house, depth 11 m (12°21′11″ N 69°06′12″ W), Sta. *74–35*, March 7, 1974; chlor. 1600–1710 mg/l; about 140 spec.

– Source in bed of intermittent river, Rooi Kalki, about 900 m WSW. of Savonet country house (est. 12°20′58″ N 69°06′32″ W), Sta. *74–53*, April 2, 1974; water upwelling from gravel in the dry bed, chlor. 1250–1300 mg/l; 200$^+$ spec.

– Source in bed of intermittent river, Rooi Berú (= Beroerd), Savonet, about 600 m WSW. of Savonet country house, near ruined dam (est. 12°21′04″ N 69°06′33″ W), Sta. *74–51*, April 2, 1974; upwelling water from gravel in dry bed, chlor. 1319 mg/l; 50$^+$ spec.

– Well just N of Pos Sorsaca-complex, San Hironimo estate, square well with gasoline pump (12°19′53″ N 69°06′33″ W), Sta. *74–63*, April 10, 1974; chlor. 500–600 mg/l; 7 spec.

– Government well in village of Soto, near the Police appartments, square, partly covered, without mill, 12 m deep (12°16′52″ N 69°06′38″ W), Sta. *74–66*, April 11, 1974; chlor. 360–400 mg/l; 1♀.

– Well in village of Westpunt, just S of Restaurant Jan Christian, open, depth

about 7 m, ruined mill (12°21′22″ N 69°07′42″ W), Sta. *74–74*, April 17, 1974; chlor. ?; 4 spec.
– Key-hole well (pos'i pia) on Santa Cruz estate (12°18′22″ N 69°07′50″ W), Sta. *74–25*, Jan. 25, 1974; chlor. 297 mg/l; 1♂.
– Well E of road Lagún-Westpunt, near entrance of Jeremi country house, open, ruined mill, depth 14 m (12°19′57″ N 69°08′44″ W), Sta. *74–73*, April 17, 1974; chlor. 1240 mg/l; 4 spec.

DESCRIPTION. – Length of adult specimens (♂♀): 3–4½ mm. In general similar to the nominate subspecies, but different in the following characters:

The first antenna (Fig. 35a) has peduncle segments of 390, 364, and 184 μm, respectively; the flagellum has fewer segments (maximum observed 26, usually 20 to 22); the entire appendage is much shorter than the body.

The second antenna (Fig. 35b) is slender; peduncle segments 4 and 5 are 531 and 476 μm long. The flagellum consists of 9 to 12 segments.

The masticatory parts of the left and right mandibles are as illustrated (Figs. 35c, d) and do not differ much from the nominate subspecies. The mandible palp (Fig. 35e) is also rather similar; the shortness of segments 2 and 3 is characteristic in comparison with most other species.

The first and second maxillae, the lips, the maxilliped, and the first gnathopod are as in the nominate subspecies.

The second gnathopod (♂) (Fig. 35f) shows some differences: the propodus is slightly less slender. The spines on the palm (Fig. 35g) are heavier; the greatest palmar spines are as large as the smallest palmar angle spine. The number of spines in each of the 2 rows of palmar spines may vary between 5 and 9. The finger is shorter than in the nominate form. The 2nd ♀ gnathopod is almost as in the nominate subspecies, but may have fewer groups of setae on the carpus.

Pereiopods 3 and 4 without salient differences.

Pereiopods 5, 6, and 7 (Figs. 36a, d, 37a) has a relatively shorter carpus and a shorter claw (Figs. 36c, 37b).

The epimeres 2 and 3 (Fig. 37c) and the pleopods 1 and 2 resemble those of *l. longipes*. The 3rd male pleopod (Figs. 36f, g): exopodite with a slight medial swelling on article 1, endopodite article 1 regularly curved laterally.

Uropods 1 and 2 resemble those of *M. nicholsoni* and *M. l. longipes*. Uropod 3 (Figs. 37d, e) rather similar to that of *l. longipes*, although the endopodite is slightly shorter ($< \frac{1}{2}$ the first exopodite article).

The telson is distinctive in that it never bears medial spines, and (although its shape is variable) it usually presents the truncated distal end as shown in Figs. 37f, g. Variant shapes are shown in Figs. 37h, i. The number of telson spines varies from 2 to 4; subbasal setae are usually absent, rarely 1 setae is present.

VARIABILITY. – The endopodite of uropod 3 may vary from 1/3 to 1/2 the length of the first exopodite article. The claw of the 2nd ♂ gnathopod varies in length: usually it is shorter than in *l. longipes*, but sometimes (e.g. in the population from Sta. 74–35) it is as long as in *l. longipes*. The carpus of Gn. 2♀ usually bears 5 to 6 groups of setae, but sometimes up to 8. The variations in the telson are already recorded in the description.

DISTINCTION. – From the other Curaçao taxa, the present one is at once distinguished by the poor development of the lobe on article 1 of the exopodite of the 3rd male pleopod. Also the telson (with a low number of spines, of which none on the medial margin) is characteristic.

In the poorly developed outgrowth on the 3rd male pleopod, the present taxon agrees strikingly with *M. longipes* from Aruba. Other points of agreement are the shape of the uropods 1, 2, and 3, the low number of telson spines, the slender posterior pereiopods, the armature of the maxilliped, the structure of the mandibles, etc. On these morphological grounds, I have decided to consider the taxon from western Curaçao a subspecies of the Aruban form (western Curaçao faces Aruba, the distance between the islands is about 70 km, but the islands are separated by a straits with a depth of 1000–2000 m).

The differences between the Curaçao and Aruba populations of *M. longipes* are mostly a matter of degree: the A1 is much shorter than the body (Curaçao) versus shorter than to as long as the body (Aruba); the A1 flagellum has up to 26 articles (Curaçao) versus up to 35 (Aruba); the shape, but especially the armature of P2 ♂ offers some distinctions (the most obvious of which is the larger size of the palmar spines in the Curaçao populations); the dactylus of the posterior pereiopod is shorter in the Curaçao populations; and the telson is devoid of medial spines in Curaçao.

DISTRIBUTION. – All records are from the western part of Curaçao, the slopes of the Christoffel mountain system and nearby localities.

The proposed subspecific name alludes to the Ceru Christoffel area.

THE **beattyi** – GROUP

This group consists of one species only, *M. beattyi* Shoemaker, 1942, which is endemic to St. Croix (Virgin Islands). It is chiefly characterized by the "masculine" type of armature of the palm of gnathopod 2 (♀), consisting of spines instead of setae.

Metaniphargus beattyi Shoemaker, 1942

(Figs. 38–42)

Metaniphargus beattyi SCHOEMAKER, 1942: 24–27, fig. 9.

MATERIAL. – All from ST. CROIX, U.S. Virgin Islands.
– Deep well near Frederiksted, slightly brackish spring water, 1937; leg. H. A. Beatty, 1♂ (holotype) USNM 80027.
Same data as holotype; 20 paratypes of both sexes, USNM 155051–155054.
– Deep well at Christiansted, March 1935; leg. H. A. Beatty, 4♀♀ USNM 155055, 4♀♀ ZMA Amph. 104.912.
– Deep well (over 160′) on Estate Solitude, in Mr. Roebuck's meadow (17°45′22″ N 64°38′04″ W), Nov. 21, 1975; chlorinity 540–580 mg/l; leg. J. H. Stock & D. Holt, 4 fragmentary specimens ZMA.

ADDITIONAL NOTES. – Slightly larger than *M. curasavicus*, viz. 4.5–5 mm long (♂♀). The first and second antennae (cf. SHOEMAKER, fig. 9a; present paper Figs. 38a, b) are much more slender than in *M. curasavicus*. The peduncle segments in A1 of a male are 535, 583, and 294 μm long, respectively; thus article 2 is longer than 1. The accessory flagellum is 2-segmented, shorter than the first flagellum segment. Peduncle segments 4 and 5 of A2 measure 533 and 518 μm, respectively; the 13-segmented flagellum is 984 μm long.

The mandible palp (Fig. 38c) has a short, unarmed basal segment; segment 2 bears a few (usually 3) setae; segment 3 bears a comb-like row of D-setae, about 10 in number, gradually decreasing in length from proximal to distal, the proximal one longer than the diameter of the segment; 4 long E-setae. Masticatory part of mandible similar to that of *M. curasavicus.*

First maxilla: inner lobe with 13–15 setae; for the rest similar to the corresponding appendage of *M. curasavicus.*

Second maxilla and maxilliped: as in *M. curasavicus.*

Oöstegites in the female dissected are linear, non-setiferous (= not in reproductive phase).

First gnathopod: Setae on carpus longer than in *M. curasavicus.* Armature of palm see Fig. 39b.

Second gnathopod sexually dimorph but much less so than in the other species of the genus. In the male (Fig. 39c), the palmar margin is about 1.5 times as long as the posterior propodal margin; in the female (Fig. 39d), this ratio is 1.0 to 1.1. The palmar angle is marked by two very strong spines, and 2 setae that are slightly longer and heavier than the other setae. The palmar margin in male bears about 8 spines, vaguely arranged in 2 rows, which are $\frac{3}{4}$ to $\frac{1}{2}$ as long as the angle spines. In the female there are 4 to 6 small spines, which are markedly less than half as long as the angle spines and a few setae.

The carpus of both the male and female second gnathopod is not very elongated, more or less triangular (Figs. 42c, d).

The 3rd and 4th pereiopods (Figs. 40a, b) have a slightly wider coxal plate than in *M. curasavicus,* but are otherwise rather similar.

The 5th pereiopod is much shorter and more feebly built than pereiopods 6 and 7 (cf. Figs. 41a and 41c, d, e, which are drawn to the same scale). These pereiopods do not differ much from those of *M. curasavicus.*

The 3rd male pleopod (Fig. 38d) has the proximal article of both rami with a slight, regularly curved, rugose swelling; there are 2 retinacula.

The epimeres 2 and 3 are as figured (Fig. 40c).

The uropods 1, 2, and 3 are less slender in ♀ than in ♂. In comparison with *M. curasavicus,* the 1st and 2nd uropods (Figs. 40d, e) bear shorter spines.

The 3rd uropod (Figs. 41g, h) has a longish, finger-shaped 2nd exopodite article, which is at least twice as long as the distal spines on article 1. The spines on the inner and outer margin of the 1st exopodite article are shorter than in *M. curasavicus*. The endopodite is longer, more than half as long as the 1st exopodite article.

The characteristic telson (Figs. 42a, b) consists of two completely separated lobes, each with a curved, unarmed, lateral margin; a truncated distal margin armed with 2 to 4 short spines; and a straight unarmed medial margin.

REMARKS. – The differences (length and slenderness of A1 and A2; armature Md. palp; spiny palmar margin in P2 ♀; pleopod 3♂; shorter spination of uropods 1–3; greater length of exopodite article 2 and of endopodite in Ur. 3; shape and armature of telson) from *M. curasavicus* are so clear, that I find no justification for STEPHENSEN's (1948) opinion that *beattyi* would be a synonym of it (some forms confused by STEPHENSEN with *M. curasavicus*, in particular *M. l. longipes*, resemble *M. beattyi* more strongly, but show likewise sufficient differences, especially in P2 ♀, and are surely distinct).

THE **jamaicae** – GROUP

In this group, so far only one species can be lodged, *M. jamaicae* (Holsinger, 1974), endemic to Jamaica.

The group is at once distinguished from the other species-groups of *Metaniphargus* by the great development of the endopodite of uropod 3 (♂♀).

Metaniphargus jamaicae (Holsinger, 1974)

(Figs. 43–45)

Metaniphargus jamaicae HOLSINGER, 1974a: 648–653, figs. 1–4; PECK, 1975: 309, 312.
"Troglobitic amphipods", PECK & KUKAL, 1976: 66, fig. 11 (descr. of site).

MATERIAL. – Jackson Cave (near Portland Point), Clarendon, JAMAICA, in different

parts of the cave, between August 2 and August 15, 1974; coll. by Dr. S. Peck of Ottawa, 42 specimens (topotypes).
Many females carry eggs. The material has been divided between the Smithsonian Institution, the National Museums of Canada, and the Zoölogisch Museum, Amsterdam.

REMARKS. – The female of this species has been described in detail by HOLSINGER (1974); the male was not known up to now. A number of illustrations of the male appendages, as far as they are different from those of the female, ar incorporated in the present paper. They have been made after the largest male available, with a length of 7 to 8 mm. Certain females may attain a considerably larger size (up to 12 mm).

The first antenna has a flagellum of 45 segments. In the second antenna, the flagellum has 16 segments.

The mandible palp (Fig. 44a) has a short, unarmed first segment; segment 2 bears a variable number of ventral setae, ranging from 1 to 4; segment 3 is the longest; its ventral margin bears a row D-setae, the length of which diminishes from proximal to distal; there are 3 longer and 1 shorter E-setae.

The first maxilla is asymmetrical (Figs. 43a, b): the right palp has a short basal segment and a widened second segment, armed distally with 7 strong spines and a setule; the left palp has a longer basal segment and a narrow second segment, distally armed with 2 slender spines and 6 setiform elements.

The first gnathopod (Fig. 44b) has a very elongated, almost rectangular, carpus, with a straight posterior margin. The propodus is distinctly shorter than the carpus. The palmar angle spines are distally bifurcated (Fig. 44b, detail).

The second gnathopod (Fig. 43c) shows the usual sexual dimorphism. Its carpus is slightly less linear than in female; it bears 8 groups of setae on its posterior margin. The propodus is also less linear; the palm occupies almost half of the length of the propodus. There are two very strong palmar angle spines (Fig. 43d) and 3 midpalmar spines, in addition to the usual setae. The claw is dinstinctly longer than in female.

The coxal gills (Figs. 43c, e) have a very clearly marked basal stalk; the gill itself is wider on the anterior legs, narrower on the posterior ones.

The posteroventral corner of the basopodites of pereiopods 5 to 7 is produced into a distinct lobe bearing a setule implanted in a notch (Figs. 45a, b). The claws of P5–P7 are remarkable in that they carry (1) a plumose subbasal seta and (2) several, often paired, setae on the outer margin of their distal part (fig. 44c).

The 3rd pleopod (♂♀) has a tall, rounded, distal projection on the outer side of the peduncle. The proximal article of the endopodite in male bears a low but distinct lateral swelling, which is absent in female (Figs. 44d, e).

The telson lobes (Fig. 45c) bear 2 median, 2 distal, and 1 lateral spines; moreover a pair of sensory setae and a medio-subbasal setule are present.

TAXONOMIC POSITION. – HOLSINGER attributed this species to the genus *Hadzia* s.l., following the suggestion made in a paper by STOCK & NIJSSEN, 1965, that *Hadzia* and *Metaniphargus* are synomymous. In the present paper, I have endeavoured to reinstate *Metaniphargus*; as presently defined, the taxon *jamaicae* fits better in *Metaniphargus* than in *Hadzia,* although the great development of the endopodite of uropod 3 is almost *Hadzia*-like. In *Hadzia,* however, the rami of uropod 3 are equal or almost equal, whereas in *Metaniphargus* the inner ramus is shorter, usually much shorter than the outer one. In its remaining characters (stalked coxal gills, short first mandible palp segment, no lamellar expansion on the carpus of Gn. 2, elongate carpus in Gn. 1), *jamaicae* is clearly more similar to *Metaniphargus* than to *Hadzia.*

3. Genus **Alloweckelia** Holsinger & Peck, 1968

This genus resembles in several details the configuration found in *Metaniphargus* (2-segmented accessory flagellum in A1; inner plate of Mx. 1 with numerous setae; Mx. 2 with oblique row of setae on inner plate; Md. palp present etc.) but it differs clearly in other respects (a non-elongated P1 carpus; Ur. 3 of magniramus-type, exopodite 1-segmented; coxal plate of P4 posteriorly emarginated). The 2nd female gnathopod bears a row of spines on the palm, like in *Metaniphargus beattyi*, but unlike the other species of *Metaniphargus*. Pleopodal dimorphism is not recorded for *Alloweckelia*.

Other characters of *Alloweckelia* point to a relationship with *Hadzia* (imperfectly stalked coxal gills, magniramus Ur. 3; non-elongated P1 carpus; distinctly produced posterodistal lobes on the basis of P5–P7) and with *Saliweckelia* (magniramus Ur. 3; emarginated basis of P4). At any rate, it is clear to me that *Alloweckelia* belongs to the Hadziid-group and should not (as was suggested in informal discussions during the Schlitz amphipod symposium) be removed to a different grouping.

Alloweckelia gurneei Holsinger & Peck, 1968

(Fig. 46)

HOLSINGER & PECK, 1968: 253–257, figs. 1–3; PECK, 1974: 21 (site description on p. 16–17).

MATERIAL. – Cueva del Río Angeles (tributary to Río Camuy Cave), Bayabey, PUERTO RICO, perched pool near Norman's Lake, 2 m deep, 3 × 1 ft., Feb. 2, 1975; B. & P. Peck coll., 2♀ (ovigerous), 1♀, 1 juvenile (topotypes), ZMA.

REMARKS. – The species has been extensively described by HOLSINGER & PECK likewise from the Río Camuy Cave system. I have nothing to add, except for a figure of the coxal gill, which is about of a same type as in *Hadzia* (i.e., with a poorly developed basal stalk), and for a figure of the fully developed, setiferous oöstegite (Fig. 46). In comparison to the original material in which ovigerous females were rare (7.5%), in the present (though much smaller) sample 2 of the 3 females were carrying eggs. This hardly can be a question of reproduction season, since both samples were collected in the early months of the year (Jan. 5, and Feb. 2).

4. Genus **Paraweckelia** Shoemaker, 1959

This monotypic genus (type-species *P. silvai* Shoemaker, 1959) is known from the Cueva Grande (Caguanes Caves), Punta Caguanes

(Las Villas Province), Cuba. It was also recorded by BOTOSANEANU, 1973: 211, 213.

HOLSINGER (in press) expresses *en passant* tentatively the opinion that *Paraweckelia* and *Alloweckelia* might be synonymous. Personally, I find the differences between the two (in the accessory flagellum, in the setation of Mx. 1, in the presence or absence of an oblique row of setae on the inner lobe of Mx. 2, in the labium, in the carpus of Gn. 1, in the coxal gills) sufficient to maintain a generic distinction (cf. Tables IA and IB).

I have not examined material of *P. silvai*.

5. Genus **Weckelia** Shoemaker, 1942

This genus is exclusively known from Cuba, where its type species was recorded by WECKEL, 1907, as *Gammarus caecus*, from Cueva de Modesta, near Cañas (Prov. La Habana). SHOEMAKER (1942) re-examined the type material, and concluded rightly that the species could not possibly belong to *Gammarus* and that a new genus, that he called *Weckelia*, was necessary for the reception of the species. Although SHOEMAKER's re-description was very detailed, the 3rd uropod remained unknown, since it was missing in all of the type-specimens.

DANCĂU, 1973, recently described a second species of *Weckelia*, *W. cubanica*, which he attributed to a new subgenus, *Neoweckelia*. The only diagnostic character in which *Neoweckelia* differs from *Weckelia*, is the accessory flagellum of A1, that is 4-segmented in *Weckelia*, 3-segmented in *Neoweckelia*.

As HOLSINGER (in press) pointed out, the type-localities of *Weckelia caeca* and *W.* (*Neoweckelia*) *cubanica* lie only 25 km apart. The number of segments in the accessory flagellum, though not very variable in hadziid amphipods, is not entirely constant either. In *Hadzia* for instance, the number of articles can be 1 or 2 (see data in present paper for *H. fragilis*). In conclusion, I do completely concur with HOLSINGER's opinion that *Weckelia* and *Neoweckelia* are synonymous, and that *cubanica* is a junior synonym of *caeca*.

This leads to the following list of references for the type and unique species of *Weckelia*:

Gammarus caeca WECKEL, 1907: 47, fig. 12.
Weckelia caeca; SHOEMAKER, 1942: 12–16, figs. 3–4; BOTOSANEANU, 1973: 211; HOLSINGER, in press.
Weckelia (Neoweckelia) cubanica DANCĂU, 1973: 223–229, figs. 1–4; BOTOSANEANU 1973: 211.

I have not examined any material of this species.

6. **Saliweckelia** n. gen.

DIAGNOSIS. – Hadziid group of the Gammaridae. Blind. First antenna with ventrodistal spine on peduncle segment 1; segment 2 long and narrow; accessory flagellum 2-segmented. Mandible palp well-developed, 3-segmented; segment 1 short, segment 2 the longest; segment 3 with long row of D-elements. Pars molaris of right mandible with a long seta, of left mandible without. Lower lip without inner lobes. First maxilla: asymmetrical, inner lobe with 10–11 setae. Second maxilla with oblique row of setae on inner lobe. Coxal gills unstalked. Gnathopod 1 with numerous transverse rows of long setae on the lateral surface of the elongated carpus. Gnathopod 2 (♀) with 5 to 15 transverse rows of long setae on the medial surface of the propodus, in ♂ the setae are fewer and shorter. Fourth coxal plate with a large posterior excavation. Third pleopod (♂) with anchor-shaped retinacula; exopodite article 1 with a proximomedial swelling; endopodite article 1 with a conspicuous, reversed, lateral swelling. Third pleopod (♀) not transformed. First uropod with basoventral peduncle spine; distolateral peduncle spine enlarged (half as long as the exopodite); one of subdistal exopodite spines sexually dimorph. Third uropod with 2-segment exopodite; endopodite longer than first exopodite segment (magniramus-type).

AFFINITIES. – The new genus is related to *Weckelia*, *Paraweckelia*, *Alloweckelia*, and *Psammoniphargus*, in having a posteriorly excavated 4th coxal plate. From *Weckelia* it differs (1) in the third uropod (exopodite 1-segmented in *Weckelia*), (2) in the accessory flagellum of the first antenna (3- to 4-segmented in *Weckelia*), (3) in the mandible palp (reduced to a 1-segmented bud in *Weckelia*), and (4) in the lower lip (with inner lobes in *Weckelia*).

From *Paraweckelia* in the characters (1), (2), and (4) mentioned above for *Weckelia*; moreover, *Paraweckelia* lacks sexual dimorphism in the second gnathopod, and lacks an oblique row of setae on the inner lobe of maxilla 2.

Saliweckelia resembles *Weckelia* and *Paraweckelia* in having unstalked coxal gills.

From *Alloweckelia*, the new genus differs by having a 2-segmented exopod in uropod 1, by having an elongated and very setose carpus in gnathopod 1, by having a better developed mandible palp, etc.

Psammoniphargus has a 3rd uropod of the parviramus-type, a reduced mandible palp, no oblique row of setae on the inner of maxilla 2, etc.

Although *Hadzia* s. str. has a non-excavated 4th coxal plate, it resembles *Saliweckelia* in certain other characters, such as the long endopodite and the 2-segmented exopodite in the 3rd uropod and the indistinctly stalked coxal gills. But *Hadzia* differs in other details, such as a triangular, non-setose carpus in gnathopod 1, a different mutual length of the mandible palp articles, a "normal" first uropod, the presence of a carpal lobe in gnathopod 2, etc.

The remaining hadziid genera differ more distinctly from *Saliweckelia* by one or more of the following characters: stalked gills; reduced mandible palp; 1-segmented exopodite in uropod 3; parviramustype uropod 3; non-emarginated 4th coxal plate.

TYPE-SPECIES. – *Saliweckelia emarginata* n. sp. Other species *S. holsingeri* n. sp.

The generic name alludes to the resemblance to the *Weckelia*-group of genera, and to the hypersaline habitat of the type-species (from Latin *sal* = salt).

Saliweckelia emarginata n. sp.

(Figs. 47–53)

MATERIAL. – All from CURAÇAO.

– Piscadera Bay, in supralittoral coral rubble about 3 m from the high water mark, in front of the guest house of the Caribbean Marine Biological Institute (12°07′33″ N 68°58′02″ W), Stock Sta. *73–2*, Nov. 17, 1973; chlorinity 33858 mg/l; 1♂ (holotype), 1♀ (allotype), 82 paratypes, collected with a phreatic pump, ZMA Amph. 107.001 a–b.

Other samples (all ZMA):

- South shore of Lagoon Zakitó, along the north side of the John F. Kennedy Boulevard (12°07′02″ N 68°57′33″ W), Stock Sta. *73–3*, Nov. 20, 1973; phreatic pump in muddy coral rubble with plant-débris, chlor. 35640 mg/l; 68 specimens.
- South side of the J. F. Kennedy Boulevard, small pools in coral rubble (12°07′07″ N 68°57′42″ W), Sta. *75–3*, Nov. 8, 1975; chlor. 2010 mg/l (after rainfall); 15 spec.
- About same locality as *75–3*, Sta. *73–4*, Nov. 20, 1973; chlor. 31482 mg/l; 5 spec.
- Barbara Beach, inside of coral rubble wall on the shore, in small pool (12°04′05″ N 68°51′01″ W), Sta. *75–1*, Nov. 6, 1975; chlor. 19000 mg/l; 4 spec.
- Lagoon Jan Thiel, seepage through coral rubble wall separating the hypersaline lagoon from the sea (12°05′05″–12°05′02″ N 68°53′11″–68°53′10″ W), Hummelinck Sta. *1619*, Oct. 29, 1967; Stock *75–7* and *75–8*, Nov. 16, 1975; chlor. 19600–20900 mg/l; about 90 spec.
- E.-side Lagoon Jan Thiel, carstic source in rocky coast (12°05′04″ N 68°53′07″ W), Sta. *75–9*, Nov. 16, 1975; Cl 19700 mg/l, Ca 422 mg/l, Mg 1260 mg/l (!), Na 13100 mg/l, K 675 mg/l, SO_4 3375 mg/l; 29 spec.
- Santa Martha Bay, pumped from muddy coral rubble at boat landing of the (former) Coral Cliff Hotel (12°16′21″ N 69°07′32″ W), Sta. *73–15*, Dec. 16, 1973; chlor. 28512 mg/l; 3 spec.

DESCRIPTION. – Colour whitish to pale salmon. Eye round, pale greenish in live specimens; completely disappearing in preserved material. Size 3.4–4.3 mm (♀ ov. and ♂).

Eggs pale greenish, maximum observed 7 per ♀; eggs ovate (490–568 µm long, 396–416 µm wide).

Head with rounded lateral lobes (Fig. 47e).

Body smooth; urosomites 1 and 2 with 1 lateral spine on either side.

Epimeral plates 1 and 2 with rectangular posterior corner, plate 3 with acute posterior corner (Fig. 47g); lower margin of plates 2 and 3 with 2–3 spines, posterior margin with 3 or 4 spinules.

First antenna (Fig. 47a) about 5/7 of the body length.

Peduncle segments 1 to 3 are 538, 592, and 225 µm long in ♀, 478, 527, and 186 µm in ♂. Hence, article 2 is the longest; this article is at the same time much narrower than article 1. Article 1 with a characteristic distoventral spine. Flagellum of 18 to 27 segments, all except for the 2 to 4 basal ones, with a short aethete (Fig. 47c). Accessory flagellum (Fig. 47b) 2-segmented, as long as the first flagellum article.

Second antenna (Fig. 47d) about 2/3 as long as the first. Peduncle slender; gland cone pointed, slender. Flagellum 11- to 20-segmented.

Labrum (Fig. 47f) of usual construction.

Mandible (Figs. 48a, b). Right molar process with, left without plumose seta. Incisor process right with 4 teeth, left with 5. Lacinia mobilis right with 2 plates, each armed with several (abt. 6) small teeth; left with 1 plate, armed with 5 stronger teeth. The 4 masticatory setae of the right side are transformed (flattened), the 6 setae of the left side are ordinarily plumose. The palp (Fig. 48c) has a short, unarmed basal segment, an elongated 2nd segment, armed with a few short setae; and a slender 3rd segment, armed with a row of ventral spines, and with 4 distal setae.

Labium (Fig. 49a) with short lateral horns; deeply cleft, inner plates not significant.

Maxilla 1 (Fig. 49b): inner lobe trapezoidal, with 10 or 11 plumose setae and numerous cilia; outer lobe with 9 curved distal teeth, the 6 innermost teeth are pectinated (with 5 to 11 pectinations), the 3 lateralmost teeth each bear 1 inner denticle.

Palp asymmetrical: right palp with short basal segment (Fig. 49b), left palp with longer one (Fig. 49c); right palp with 7 robust distal spines and 1 plumose seta; left palp with 6 slender distal spines and 3 setae.

The 2nd mxailla (Fig. 49d) possesses an oblique row of setae on the inner lobe.

The maxilliped is as illustrated (Fig. 48d).

The first gnathopod (Fig. 50a) has a rectangular coxal plate; the carpus is about rectangular, elongated, longer that the propodus; it carries abt. 15 transverse rows of long setae on its lateral surface, 2 to 3 such rows on its medial surface. The propodus (Fig. 50b) is rectangular, palm transverse; palmar angle with 3 graduated spines; palmar edge with 1 spine, 3 longer and some smaller setae.

Unstalked coxal gills are present on legs 2 to 6 (Fig. 51c).

Oöstegites (Fig. 52a) narrow, present on legs 2 to 5.

The coxal plate of the 2nd gnathopod (Fig. 51c) is slightly widened distally. The carpus is elongately triangular, and armed along its posterior margin with abt. 10 groups of setae. Propodus sexually dimorph (Figs 51a, b). Both in ♀ and in ♂ it is elongately ovate. The palmar angle in ♀ is marked by 1 spine, the palmar edge is armed with longer and shorter setae. In ♂, the palmar angle is marked by a spine, the palmar edge is provided with 2 rows of 10 to 12 long spines, which are of about the same size as the angle spine. The medial surface of the propodus in ♀ bears about 14 transverse rows of long setae; in ♂ these setae are reduced, both in length, in number of rows (abt. 6), and in number of setae per row.

The 3rd and 4th coxal plates (Figs. 52b, 51d) do not carry a long ventral seta as in plates 1 and 2. Plate 4 has a strong posterior excavation. The other segments of P3 and P4 are similar.

The 5th, 6th, and 7th pereiopods (Figs. 52c, d, e) have a rounded slightly overhanging, posterodistal lobe on the basis; claw slender.

The 3rd pleopods are sexually dimorph (Figs. 49e, 53a). In ♂, the retinacula are anchor-shaped (Fig. 53e), in ♀ they are hook-shaped (Fig. 53d). The basal exopodite article in ♂ bears, medioproximally, a distinct though small swelling. The basal endopodite article in ♂ has its lateral margin modified by an invagination and a recurved, very prominent, lobe. Numerous scale-like spinules ornament the proximal exo- and endopodite articles in ♂ (Figs. 53a, b). In ♀ (Fig. 49e) neither swellings or lobes, nor spinules are found.

The retinacula on the remaining pleopods are normally hooked (Fig. 53c); usually each pleopod peduncle bears 2 retinacula on its mediodistal end; occasionally there may be 3.

The first uropod (Fig. 50c) has a proximoventral peduncular spine and 2 rows of dorsal peduncular spines. At the base of the exopod, a very robust, curved spine arises (present in both sexes). The exopodite is shorter than the endopodite. The exopodite bears several dorsal spines, and a group of 4 (sub)distal spines, of which 1 is transformed in a fan-like way in ♂.

The second uropod (Fig. 50d) is short; the rami bear several (3–5) dorsal spines.

The third uropod (Fig. 50e) has a 2-segmented exopodite, and a 1-segmented endopodite overreaching the first exopodite article. Lateral margin of basal exopodite article armed with spines only; medial margin with groups consisting of a spine and 1 or 2 plumose setae. Distal exopodite article elongately finger-shaped. Endopodite distally pointed; lateral margin with groups consisting of 1 spine and 1 setule; median margin with spines and plumose setae.

Telson (Fig. 53f) cleft to the base; lateral margin unarmed; distal margin with 2–3 long spines; medial margin with 2–3 spines.

SEX RATIO. – In the Piscadera Bay samples the ratio between males and females is about 1 : 2.

HABITAT. – This species is found in the interstices in coral rubble, especially at places where seepage of seawater causes a resurgence. In one place (Sta. 75–9) it was found in a carstic (perhaps anchialine) source with aberrent ionic composition (surplus of Mg). In almost all localities, the water is of a hyperhaline nature.

The specific name, *emarginata*, refers to the excavated posterior margin of the 4th coxal plate.

Saliweckelia holsingeri n. sp.

(Fig. 54)

Metaniphargus curasavicus (non Stephensen, 1933). – STEPHENSEN, 1948: 5 (pro parte, only the Bonaire record).

MATERIAL. – All from BONAIRE:

– Slagbaai (12°16′01″ N 68°24′41″ W), S-side of Boca, resurgence of sea-water on the land-side of a coral rubble wall, muddy gravel and coral débris, Stock Sta. *76–17*, June 14, 1976; chlorinity 21,800 mg/l, temperature 27.2°C; 1♂ (holotype) and 19 juveniles (paratypes), ZMA Amph. 107.006 a–b.

– Pekelmeer, N. of Oranjepan, seepage of sea-water through wall of coral-rag, Hummelinck Sta. *1084*, Sep. 7, 1930; chlor. 25,000–27,000 mg/l, temp. 30°C; 8 spec. (paratypes, some in poor condition); this material has been recorded by STEPHENSEN, 1948, as *Metaniphargus curasavicus* (ZMC).

– Pekelmeer, recently dug canal S. of Blauwe Pan, Hummelinck Sta. *1649*, Oct. 30, 1968; est. chlor. 50,000–80,000 mg/l; 1♀ (allotype), ZMA.

DESCRIPTION. – Smaller than the preceding species (body length, without antennae, 2.5–3 mm).

The morphology of the appendages is very similar to that of *S. emarginata*, with the following exceptions:

In the first antenna of the ♂ holotype, the peduncle segments 1 to 3 have a length of 337, 418, and 140 μm, respectively. The flagellum has 22 articles; the accessory flagellum (Fig. 54d) is slightly longer than the first flagellar article.

The second antenna has only 9 segments in its flagellum.

The first gnathopod resembles that of *S. emarginata* but has only 7 to 8 transverse rows of setae on the carpus.

The second gnathopod offers the most distinctive characters for the new species. In the male (Fig. 54b), the palmar angle spine is about twice as long as the palmar margin spines; the number of transverse rows of setae on the medial surface of the propodus is restricted to 3; the palmar edge bears a row of 5 to 6 short spines only. In the female (Fig. 54a), the carpus is slightly more elongated than in the opposite sex. The propodus bears a restricted number of transverse rows of setae: there are about 5 rows, each with a limited number (1 to 4) of long setae. Except for the strong palmar angle spine, the palmar edge is armed with setiform elements only. The claw is shorter than in the male.

The third and fourth pereiopods resemble those of S. *emarginata.* The fourth coxal plate (Fig. 54e) shows a distinct posterior emargination.

The basis of pereiopods 5 (Fig. 54g) to 7 differs from the corresponding parts in S. *emarginata* in having fewer (5 to 6) spines on the anterior margin.

The epimeral plates 2 and 3 (Fig. 54h) have a posteroventral corner that is more acutely produced than in S. *emarginata.*

The third male pleopods resemble strongly those of S. *emarginata.* The endopodite (Fig. 54f) bears a strong, reversed, lateral lobe on article 1; the shape of the tip of the lobe is slightly more globular than in S. *emarginata.* The patches of spinules on endopodite and exopodite, and the anchor-shape of the retinacula are similar to those in the other species.

The third uropod is lacking in most specimens examined. In two specimens having retained this appendage, the endopodite (Fig. 54c) has a truncated tip (pointed in *emarginata*), armed with 2 spines and 1 setule (with 1 setule only in *emarginata*).

The telson is closely similar to that of S. *emarginata.*

REMARKS. – Although I was able to examine 29 specimens of the present species, the material was rather insufficient for description, since all specimens were more or less mutilated, having lost the 3rd uropods and the distal segments of the posterior pereiopods. More material from Bonaire would be most welcome.

The differences in the propodal armature of the 2nd gnathopod

(♂♀) between the material from Curaçao (= *S. emarginata*) and that from Bonaire are so conspicuous, that it was thought justified to consider the latter specifically distinct from the former. The habitat of both species are very similar: waters circulating in the macroporous interstitia of the walls of coral rubble built up between the sea and hypersaline lagoons.

I re-examined STEPHENSEN's (1948) specimens from Bonaire, recorded as *Metaniphargus curasavicus*; they proved to be *Saliweckelia holsingeri*. Extensive sampling (over 50 stations) in subterranean waters of Bonaire never revealed any *Metaniphargus*, so that this genus must be deleted from the faunal lists of Bonaire.

The specific name is proposed in honour of Dr. JOHN R. HOLSINGER, Old Dominion University, Norfolk, Virginia, in recognition of his various fine contributions to the knowledge of subterranean amphipods from the New World.

REFERENCES

BAKER, H. B., 1924. Land and freshwater molluscs of the Dutch Leeward Islands. *Occ. Pap. Mus. Zool. Michigan 152*: 1–159.

BALL, I. R., 1971. Systematic and biogeographical relationships of some Dugesia species (Tricladida, Paludicola) from Central and South America. *Amer. Mus. Novit. 2472*: 1–25.

BARNARD, J. L., 1965. Marine Amphipoda of atolls in Micronesia. *Proc. U.S. natn. Mus. 117* (3516): 459–552.

BARNARD, J. L., 1969. Gammaridean Amphipoda of the rocky intertidal of California: Monterey Bay to La Jolla. *Bull. U.S. natn. Mus. 258*: i–x, 1–230.

BOTOSANEANU, L., 1973. Observations sur la faune aquatique souterraine de Cuba. *Int. J. Speleol. 5*: 209–218.

BOUSFIELD, E. L., 1977. A new look at the systematics of gammaroidean amphipods of the world. *Crustaceana, Suppl. 4*.

BOU, C., 1975. Les méthodes de récolte dans les eaux souterraines interstitielles. *Annls. Spéléol. 29* (4): 611–619.

BUISONJÉ, P. H. DE, 1974. *Neogene and Quarternary geology of Aruba, Curaçao and Bonaire*. Uitg. Natuurwet. Studiekring Suriname en Ned. Ant. *78*; 293 pp. maps 1–4.

CHACE, F. A., Jr. & HOBBS, H. H., Jr., 1969. The freshwater and terrestrial decapod crustaceans of the West Indies with special reference to Dominica. *Bull. U.S. natn. Mus. 292*: 1–258.

DANCĂU, D., 1973. Contribution à la connaissance des Amphipodes souterrains de Cuba. *Rés. Expéd. biospéol. Cubano-Roumain.* Cuba, *1*: 223–229.

HARRISON, A. D. & RANKIN, J. J. 1975. Forest litter and stream fauna on a tropical island, St. Vincent, West Indies. *Verh. int. Verein Limnol. 19*: 1736–1745.

HARRISON, A. D. & RANKIN, J. J., 1976a. Hydrobiological studies of eastern Lesser Antillean islands, 1. St. Vincent: freshwater habitats and water chemistry. *Arch. Hydrobiol., Suppl. 50*: 96–144.

HARRISON, A. D. & RANKIN, J. J., 1976b. Hydrobiological studies of eastern Lesser Antillean islands, 2. St. Vincent: freshwater fauna – its distribution, tropical river zonation and biogeography. *Arch. Hydrobiol., Suppl. 50*: 275–311.

HOLSINGER, J. R., 1973. Two new species of the subterranean amphipod genus Mexiweckelia (Gammaridae) from Mexico and Texas, with notes on the origin and distribution of the genus. *Bull. Ass. Mexican Cave Stud. 5*: 1–12.

HOLSINGER, J. R., 1974a. A new cavernicolous amphipod crustacean of the genus Hadzia (Gammaridae) from Jamaica, with notes on the distribution and taxonomic status of the genus. *Ann. Spéléol. 29* (4): 647–655.

HOLSINGER, J. R., 1974b. Zoogeography of the subterranean amphipod crustaceans (Gammaridae, Hadzia group) of the greater Caribbean region. *Virginia J. Sci. 25* (2): 64.

HOLSINGER, J. R., in press. Some observations on the taxonomy of the Cuban subterranean amphipod genus Weckelia (Gammaridae). *Rés. Expéd. biospéléol. Cubano-Roumain.* Cuba, *2*.

HOLSINGER, J. R. & MINCKLEY, W. L., 1971. A new genus and two new species of subterranean amphipod crustaceans (Gammaridae) from northern Mexico. *Proc. biol. Soc. Washington 83* (37): 425–444.

HOLSINGER, J. R. & PECK, S. B., 1968. A new genus and species of subterranean amphipod (Gammaridae) from Puerto Rico, with notes on its ecology, evolution and relationship to other Caribbean amphipods. *Crustaceana 15* (3): 249–262.

HOLTHUIS, L. B., 1973. Caridean shrimps found in land-locked pools at four Indo-West Pacific localities (Sinai Peninsula, Funafuti Atoll, Maui and Hawaii Islands), with the description of one new genus and four new species. *Zool. Verhand. Leiden 128*: 1–48.

HUMMELINCK, see WAGENAAR HUMMELINCK.

KARAMAN, G. S., 1967. Ueber die Gattung Salentinella Ruffo in Jugoslavien. *Poljoprivreda Šumarstvo, Titograd, 13* (3): 1–16.

KARAMAN, G. S., 1969. Die Gattung Hadzia Kar. in Jugoslavien. *Acta Mus. Maced. Sci. nat. 11* (9): 163–177.

KARAMAN, S., 1932. Beitrag zur Kenntnis der Süsswasser Amphipoden, 5. Amphipoden unterirdischer Gewässer. *Prirodoslovne Razprave 1*: 179–232.

KARAMAN, S., 1943. Die unterirdischen Amphipoden Südserbiens. *Srpska Akad. Nauk, Posebna Izd. 135* (Prir. matem. Spisi *34* (4)): 161–312.

LATTIN, G. DE, 1967. *Grundriss der Zoogeographie*: 1–602 (Fischer, Jena).

MARTIN-KAYE, P. H. A., 1956. *The water resources of Antigua and Barbuda, B.W.I.*: 1–109, 2 maps. (B.G. Lithogr. Co., La Penitence, Brit. Guyana).

MATEUS, A., 1974. Sur la phylogénie du genre Hadzia (Crustacea Amphipoda). *Publ. Inst. Zool. Augusto Nobre 128*: 9–33.

MATEUS, A. & OLIVEIRA MATEUS, E. DE, 1972. Une nouvelle espèce d'Hadzia (Crustacea Amphipoda) du Portugal. *Publ. Inst. Zool. Augusto Nobre 117*: 9–30.

MÜLLER, P., 1973. The dispersal centres of terrestrial vertebrates in the neotropical realm. *Biogeographica 2*: 1–244.

PECK, S. B., 1974. The invertebrate fauna of tropical American caves, 2. Puerto Rico, an ecological and zoogeographic analysis. *Biotropica 6* (1): 14–31.

PECK, S. B., 1975. The invertebrate fauna of tropical American caves, 3. Jamaica, an introduction. *Int. J. Speleol. 7* (4): 303–326.

PECK, S. B. & KUKAL, O., 1976. Jamaican caves and caving. *Canad. Caver 7* (2): 47–77, 1 map.

ROSEN, D. E., 1976. A vicariance model of Caribbean biogeography. *Syst. Zool. 24* (4): 431–464.

RUFFO, S., 1947. Hadzia minuta n. sp. (Hadziidae) e Salentinella gracillima n. gen. n. sp. (Gammaridae) nuovi Anfipodi troglobi dell'Italia meridionale. *Stud. speol. faun. Ital. merid. 4*. In: *Boll. Soc. Natural. Napoli 56, Suppl.*: 178–188.

RUFFO, S., 1956. Psammoniphargus pauliani n.g. n.sp. nouveau gammaride des eaux interstitielles de l'Ile de la Réunion. *Mém. Inst. sci. Madagascar* (*A*) *11*: 89–95.

RUFFO, S., 1957. L'attuali conoscenze sulla fauna cavernicola della regione pugliese. *Mem. Biogeogr. Adriatica 3*: 1–143.

RUFFO, S. & KRAPP-SCHICKEL, G., 1969. Hydrobiologie der Randhöhlen, 2. Troglobionte Amphipoden aus Karstsiphonen von Istrien. *Int. Revue ges. Hydrobiol. 54* (5): 685–696.

SCHMITT, W. L., 1959. Narrative of the 1958 Smithsonian-Bredin Caribbean Expedition. *Ann. Rep. Bd. Regents Smithson. Inst. 1958* (*Publ. 4354*): 419–430, pls. I–X.

SHOEMAKER, C. R., 1942. Notes on some American fresh-water amphipod crustaceans, and descriptions of a new genus and two new species. *Smithson. misc. Coll. 101* (9): 1–31.

SHOEMAKER, C. R., 1959. Three new cave amphipods from the West Indies. *J. Wash. Acad. Sci., 49* (8): 273–283.

SKET, B., 1969. Ueber die Verbreitung einiger Malacostraca (Hadzia, Salentinella, Neogammarus, Jaera) längs der Jugoslawischen Adria-Küste. *Bull. sci.* (*A*) *14* (5–6): 147–148.

STEPHENSEN, K., 1933a. Fresh- and brackish-water Amphipoda from Bonaire, Curaçao and Aruba. *Zool. Jahrb.* (*Syst.*) *64*: 415–436.

STEPHENSEN, K., 1933b. Amphipoda from the marine salines of Bonaire and Curaçao. *Zool. Jahrb.* (*Syst.*) *64*: 437–446.

STEPHENSEN, K., 1948. Amphipods from Curaçao, Bonaire, Aruba and Margarita. *Stud. Fauna Curaçao 3*: 1–20.

STOCK, J. H., 1976a. A new genus and two new species of the crustacean order Thermosbaenacea from the West Indies. *Bijdr. Dierk. 46* (1): 47–70.

STOCK, J. H., 1976b. A new member of the crustacean suborder Ingolfiellidea from Bonaire. *Stud. Fauna Curaçao 50*: 56–75.

STOCK, J. H., 1977 a. Microparasellidae (Isopoda, Asellota) from Bonaire, with notes on the origin of the group. *Stud. Fauna Curaçao 51*: 69–91.

STOCK, J. H., 1977 b. The zoogeography of the crustacean suborder Ingolfiellidea, with descriptions of new West Indian taxa. *Stud. Fauna Curaçao 55*: 131–146.

STOCK, J. H. & NIJSSEN, H., 1965. Eriopisa longiramus n. sp., a new subterranean amphipod from a Red Sea island. *Bull. Sea Fish. Res. Stat. Haifa 38*: 28–39.

WAGENAAR HUMMELINCK, P., 1940a. Studies on the fauna of Curaçao, Aruba, Bonaire and the Venezuelan islands. 1: General information. 3: Zoogeographical remarks. *Stud. Fauna Curaçao 1*: 1–57 and 109–130.

WAGENAAR HUMMELINCK, P., 1940b. Description of the localities. *Stud. Fauna Curaçao 2*: 1–42.

WAGENAAR HUMMELINCK, P., 1953. Description of new localities. *Stud. Fauna Curaçao 4*: 1–108.

WAGENAAR HUMMELINCK, P., 1977. Marine localities. *Stud. Fauna Curaçao 51*: 1–68.

WESTERMANN, J. H., 1957. De geologische geschiedenis der drie Bovenwindse eilanden St. Martin, Saba en St. Eustatius. *West-Indische Gids 37*: 127–168; also Uitg. Natuurwet. Werkgroep Ned. Ant. *7*.

WEYL, R., 1966. *Geologie der Antillen*. Beitr. region. Geol. Erde *4*, Bornträger, Berlin; viii + 410 pp.

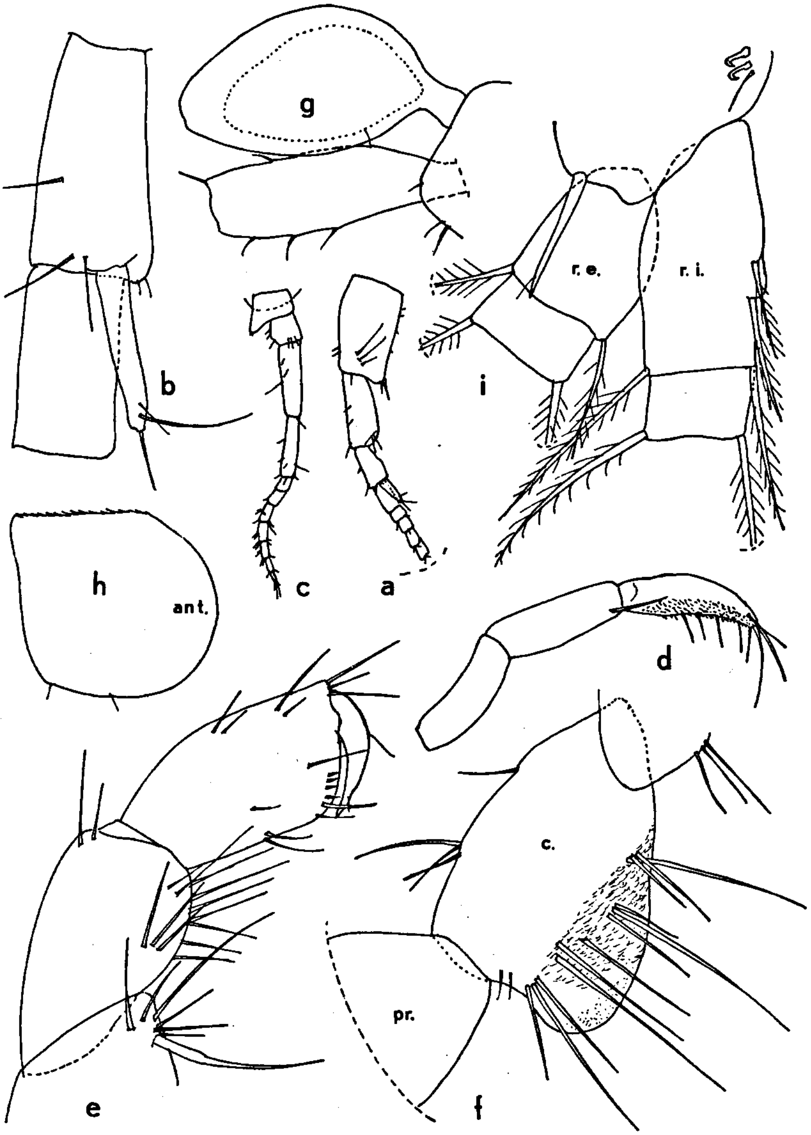

Fig. 4. – *Hadzia fragilis* S. Karaman, 1932, from Cavtat, YUGOSLAVIA.
a, first antenna, ♀ (scale G); b, accessory flagellum, ♀ (B); c, second antenna, ♀ (J); d, mandible palp, ♀ (D); e, first gnathopod, ♂ (details of armature omitted) (D); f, carpus of second gnathopod, ♂ (D); g, basal articles of third pereiopod, with coxal gill, ♂ (A); h, coxal plate of fourth pereiopod, ♀ (F); i, detail of third pleopod, ♂ (B). (r.i. = endopodite; r.e. = exopodite; ant. = anterior margin; c. = carpus; pr. = propodus).

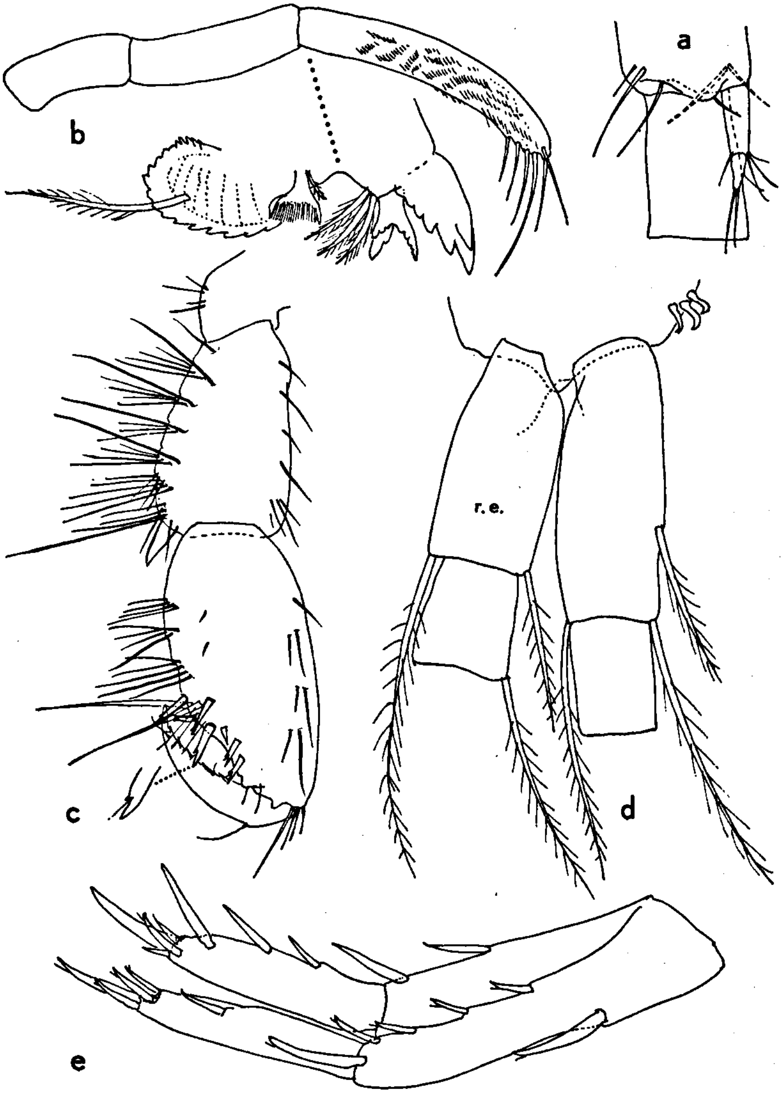

Fig. 5. – *Metahadzia tavaresi* (Mateus & Mateus, 1972), from PORTUGAL, topotypes. a, accessory flagellum, ♂ (scale D); b, right mandible with palp, ♂ (D); c, second gnathopod, ♀ (A); d, detail of third pleopod, ♂ (B); e, first uropod, ♂ (A). (r.e. = exopodite).

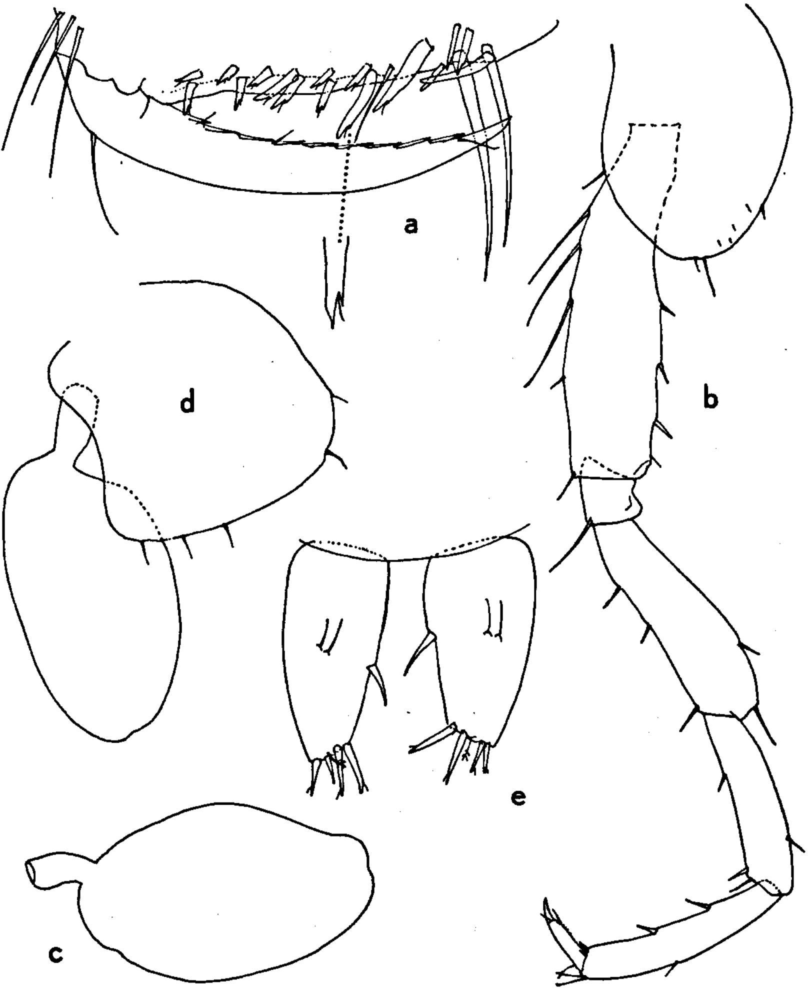

Fig. 6. – *Metahadzia tavaresi* (Mateus & Mateus, 1972), topotypes.
a, palm of second gnathopod, ♂ (scale D); b, third pereiopod, ♂ (F); c, coxal gill of third pereiopod, ♂ (F); d, coxal plate and coxal gill of fourth pereiopod, ♂ (F); e, telson, ♂ (A).

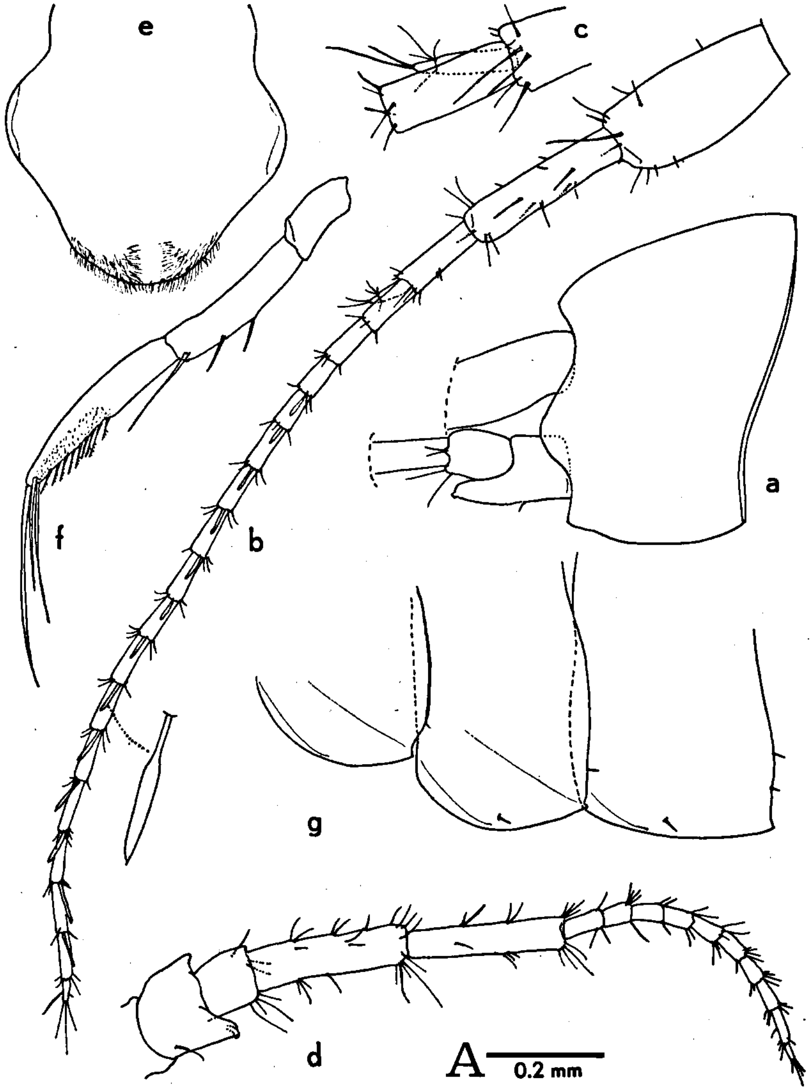

Fig. 7. – *Metaniphargus c. curasavicus* Stephensen, 1933, from CURAÇAO, topotypes. a, head of ♀, from the left (scale A); b, first antenna, ♂ (A); c, accessory flagellum, ♂ (B); d, second antenna, ♂ (A); e, upper lip, ♂ (B); f, mandible palp, ♂ (B); g, epimeral plates 1 to 3, from the left, ♂ (A).

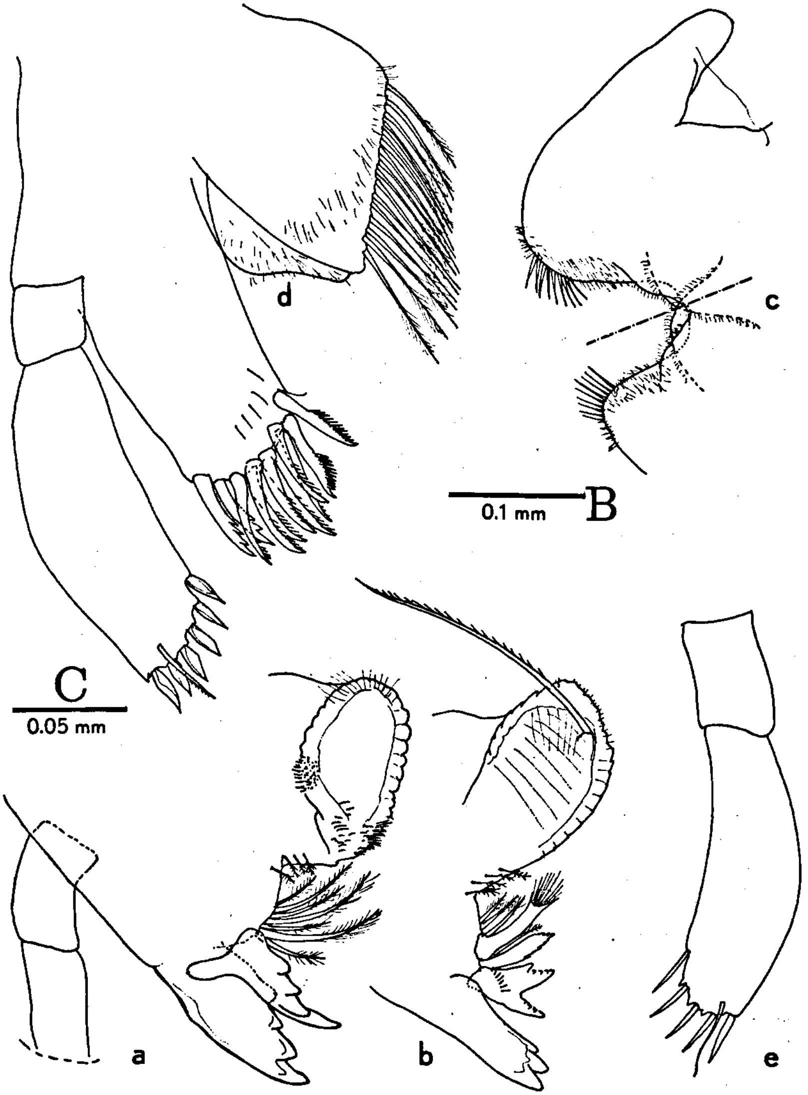

Fig. 8. – *Metanipharguș c. curasavicus* Stephensen, 1933, topotypes.
a, left mandible (palp omitted), ♂ (scale C); b, right mandible (palp omitted), ♂ (C); c, lower lip, ♂ (B); d, right first maxilla, ♂ (C); e, palp of left first maxilla, ♂ (C).

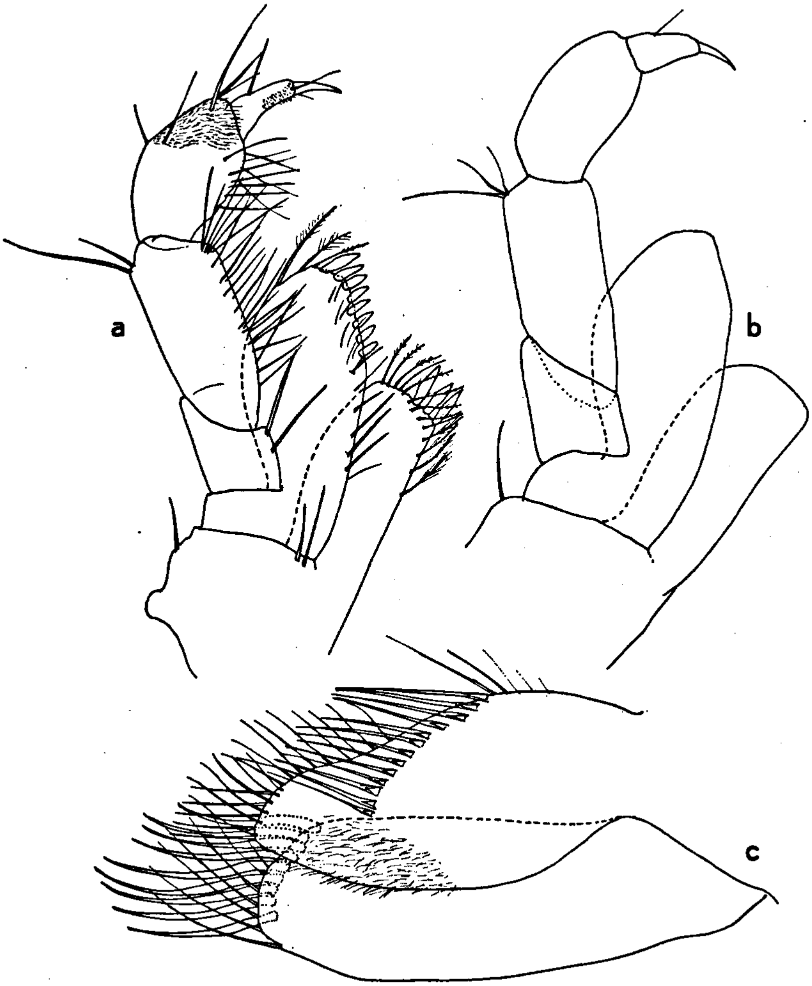

Fig. 9. – *Metaniphargus c. curasavicus* Stephensen, 1933, topotypes.
a, maxilliped, ♂ (scale B); b, maxilliped, ♀ (setation omitted) (B); c, second maxilla, ♂ (C).

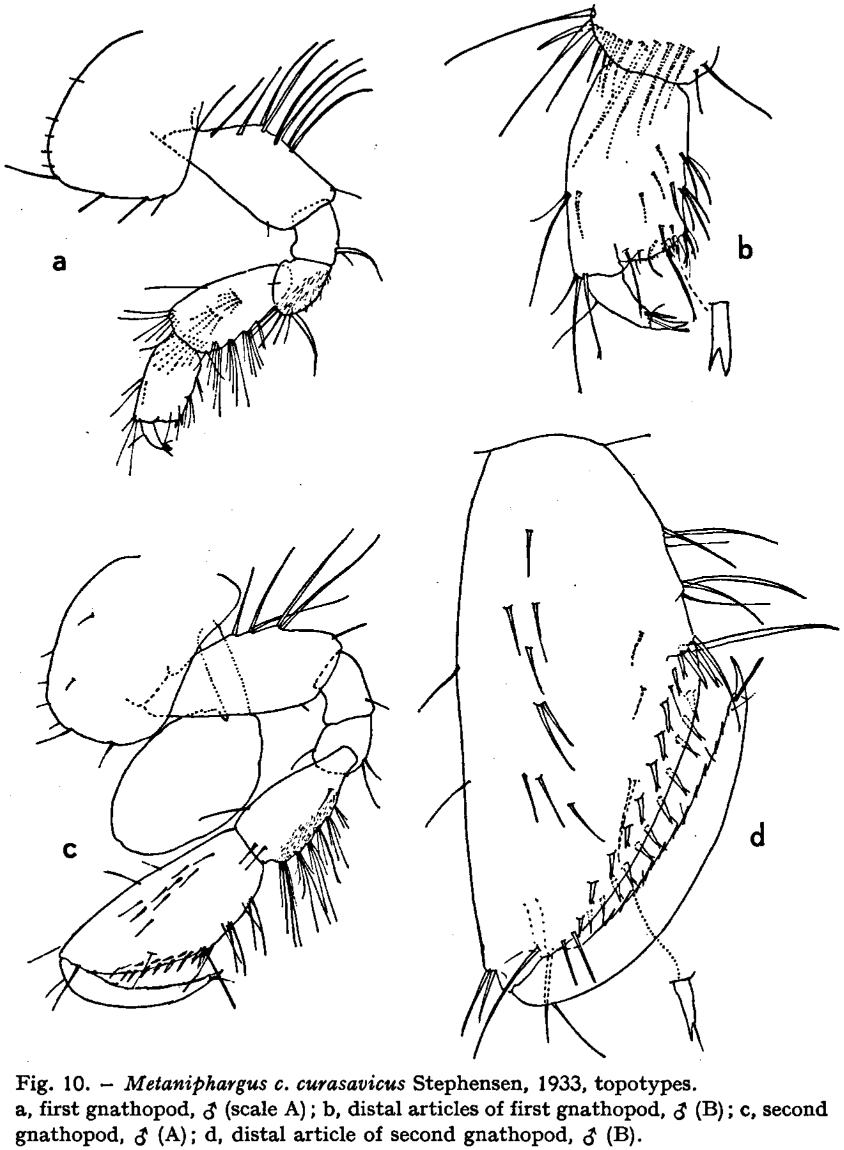

Fig. 10. – *Metaniphargus c. curasavicus* Stephensen, 1933, topotypes.
a, first gnathopod, ♂ (scale A); b, distal articles of first gnathopod, ♂ (B); c, second gnathopod, ♂ (A); d, distal article of second gnathopod, ♂ (B).

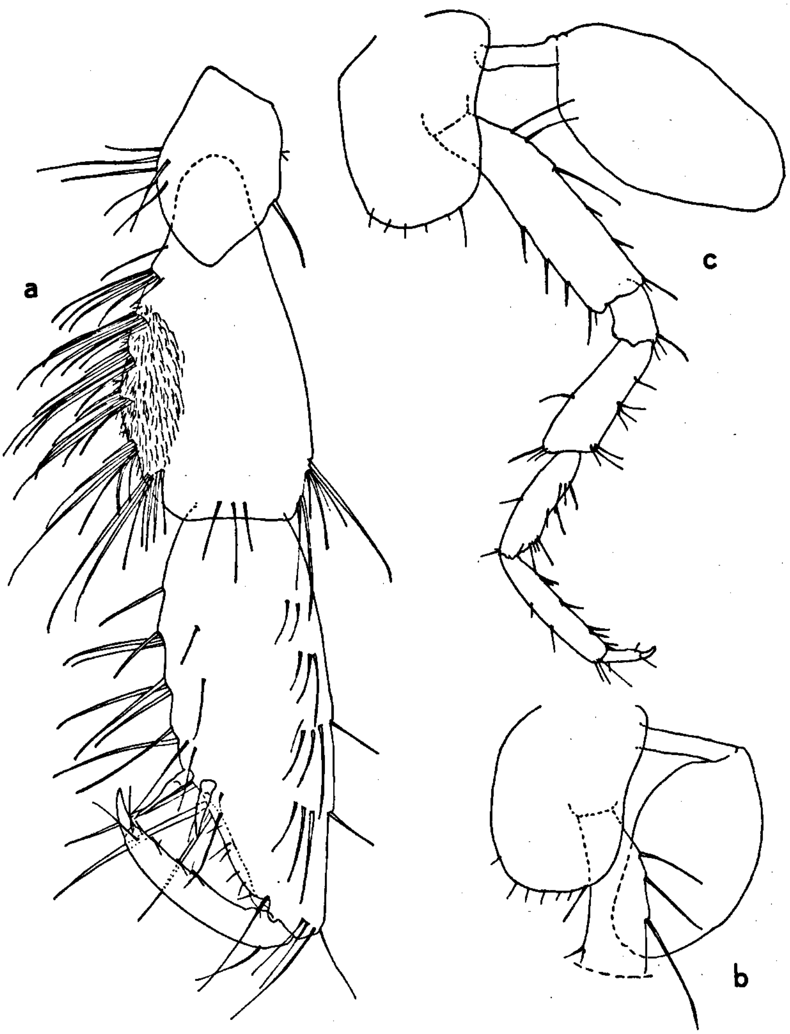

Fig. 11. – *Metaniphargus c. curasavicus* Stephensen, 1933, topotypes.
a, distal articles of second gnathopod, ♀ (scale B); b, basal articles of third pereiopod, ♂ (A); c, fourth pereiopod, ♂ (A).

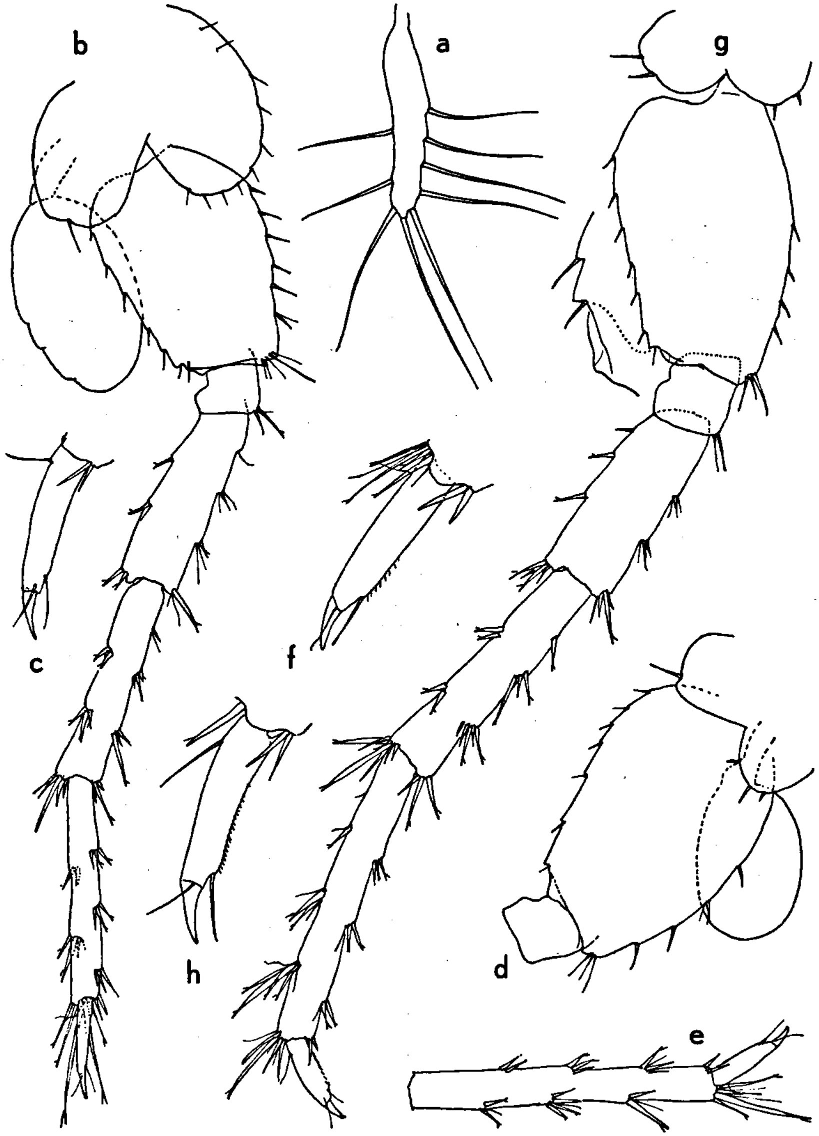

Fig. 12. – *Metaniphargus c. curasavicus* Stephensen, 1933, topotypes.
a, brood plate from second gnathopod, ♀ (scale A); b, fifth pereiopod, ♂ (A); c, claw of fifth pereiopod, ♂ (B); d, basal articles of sixth pereiopod, ♂ (A); e, distal articles of sixth pereiopod, ♂ (A); f, claw of sixth pereiopod, ♂ (B); g, seventh pereiopod, ♂ (A); h, claw of seventh pereiopod, ♂ (B).

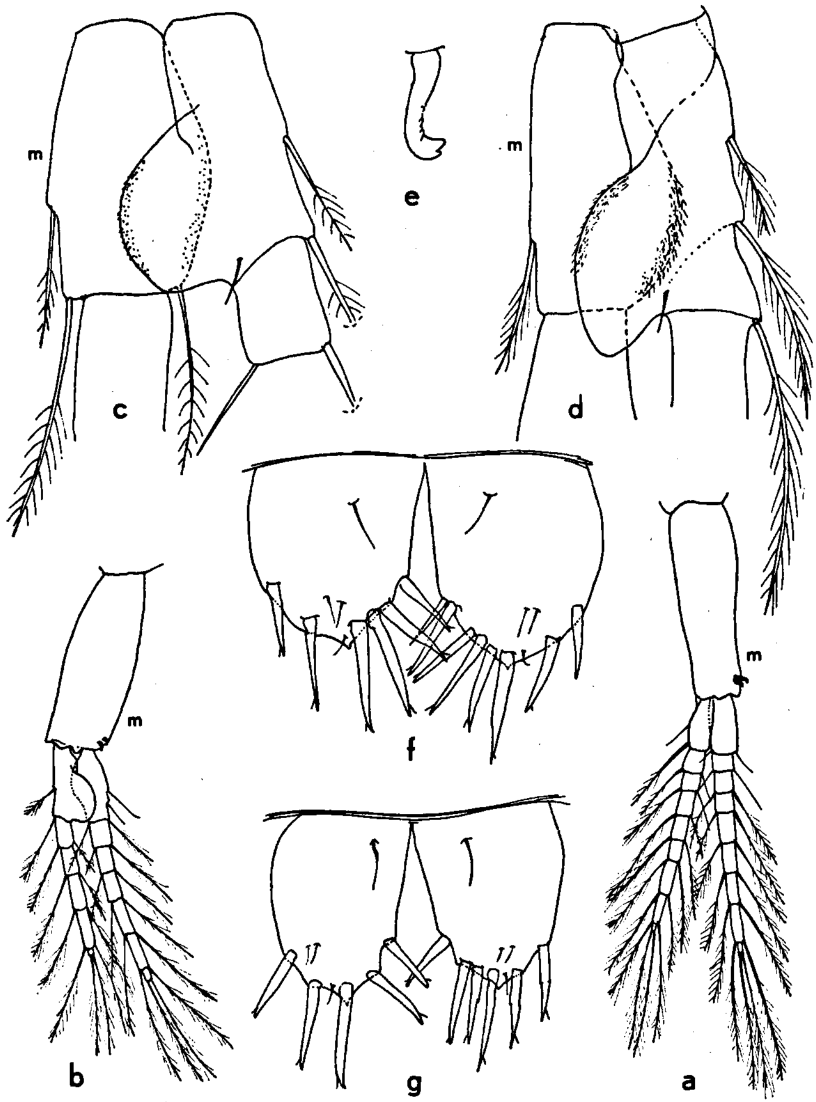

Fig. 13. – *Metaniphargus c. curasavicus* Stephensen, 1933, topotypes.
a, first pleopod, ♂ (scale A); b, third pleopod, ♂ (A); c, d, third pleopod, ♂ (detail) (C); e, retinaculum of second pleopod, ♀ (free-hand sketch); f, telson, ♀ (B); g, telson, ♂ (B). (m = medial side of the appendage).

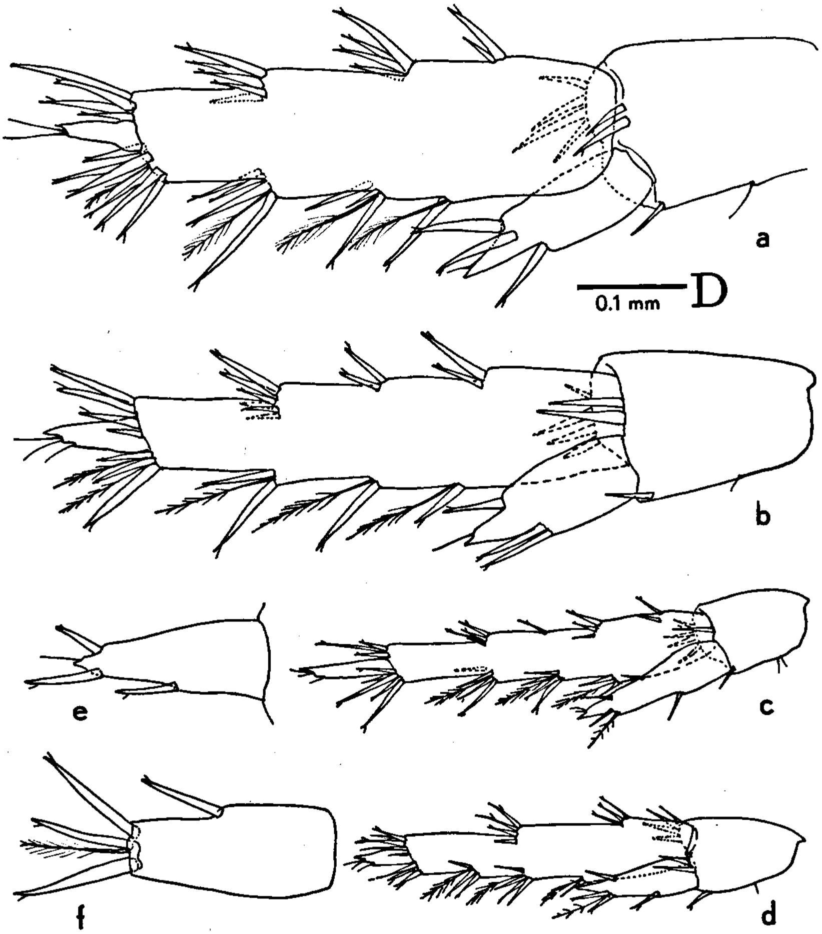

Fig. 14. – *Metaniphargus c. curasavicus* Stephensen 1933, from the type locality, Hato (a, b, e, f) and from San Pedro (c, d).
a, third uropod, ♂ (scale B); b, same of large ♂ (D); c, d, third uropod, ♂, variant population (A); e, f, left and right endopodite of third uropod, of a single ♀ (B).

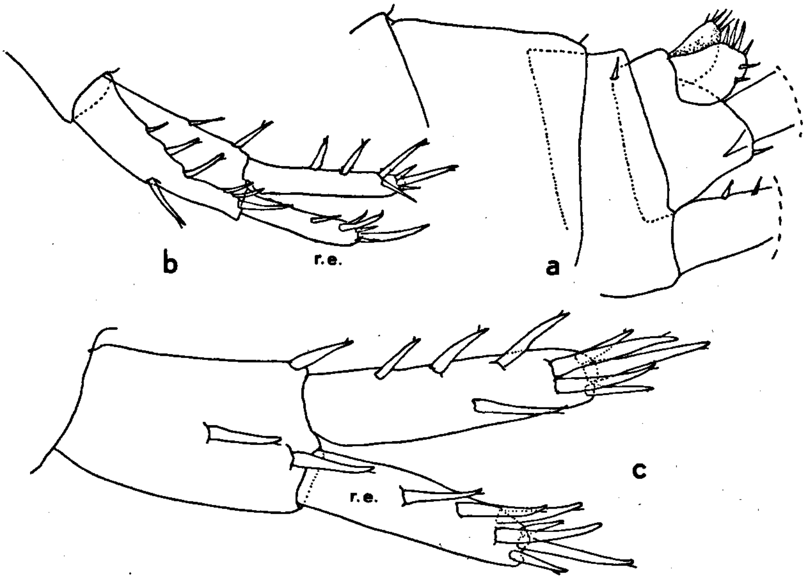

Fig. 15. – *Metaniphargus c. curasavicus* Stephensen, 1933, topotypes.
a, urosomites, ♂, from the left (scale A); b, first uropod, ♂ (A); c, second uropod, ♂ (B). (r.e. = exopodite).

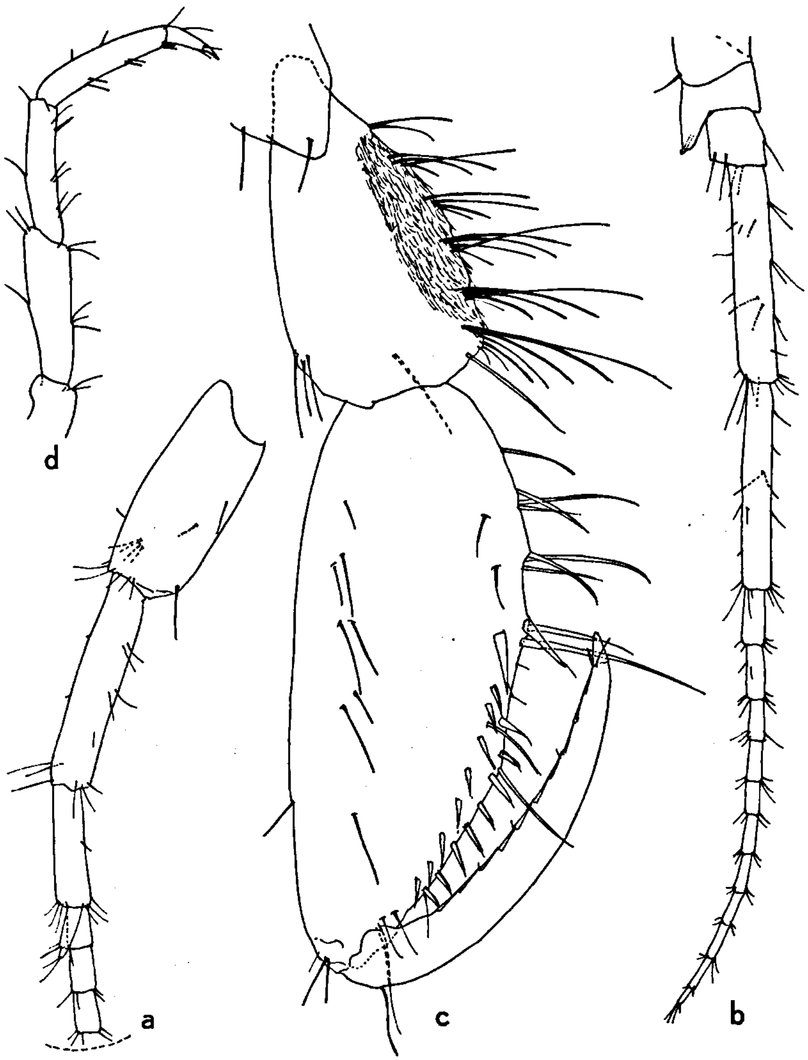

Fig. 16. – *Metaniphargus curasavicus orientis* n. ssp., from Curaçao, ♂ paratype. a, first antenna (distal part of flagellum omitted) (scale A); b, second antenna (A); c, distal articles of second gnathopod (B); d, fourth pereiopod (A).

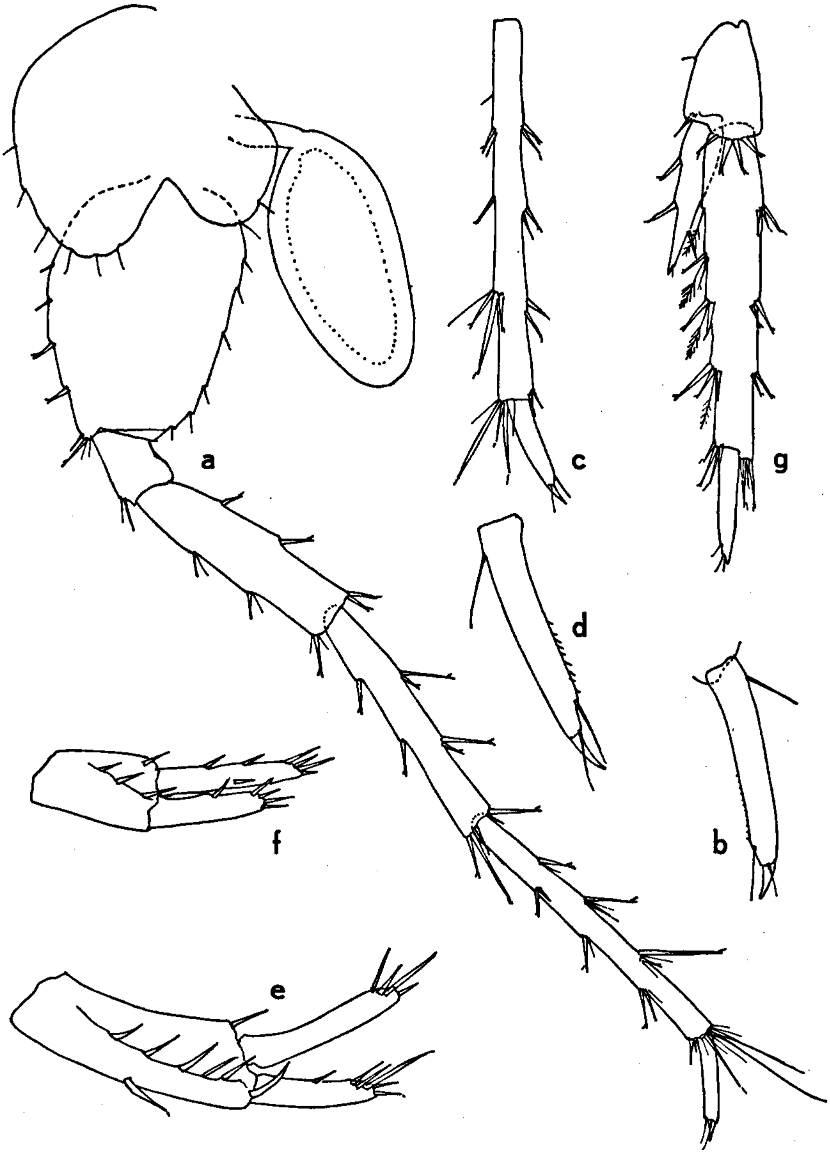

Fig. 17. – *Metanipharqus curasavicus orientis* n. ssp., paratypes.
a, fifth pereiopod, ♂ (scale A); b, claw of fifth pereiopod, ♂ (B); c, distal articles of sixth pereiopod, ♀ (A); d, claw of sixth pereiopod, ♀ (B); e, first uropod, ♀ (A); f, second uropod ♀ (A); g, third uropod, ♂ (A).

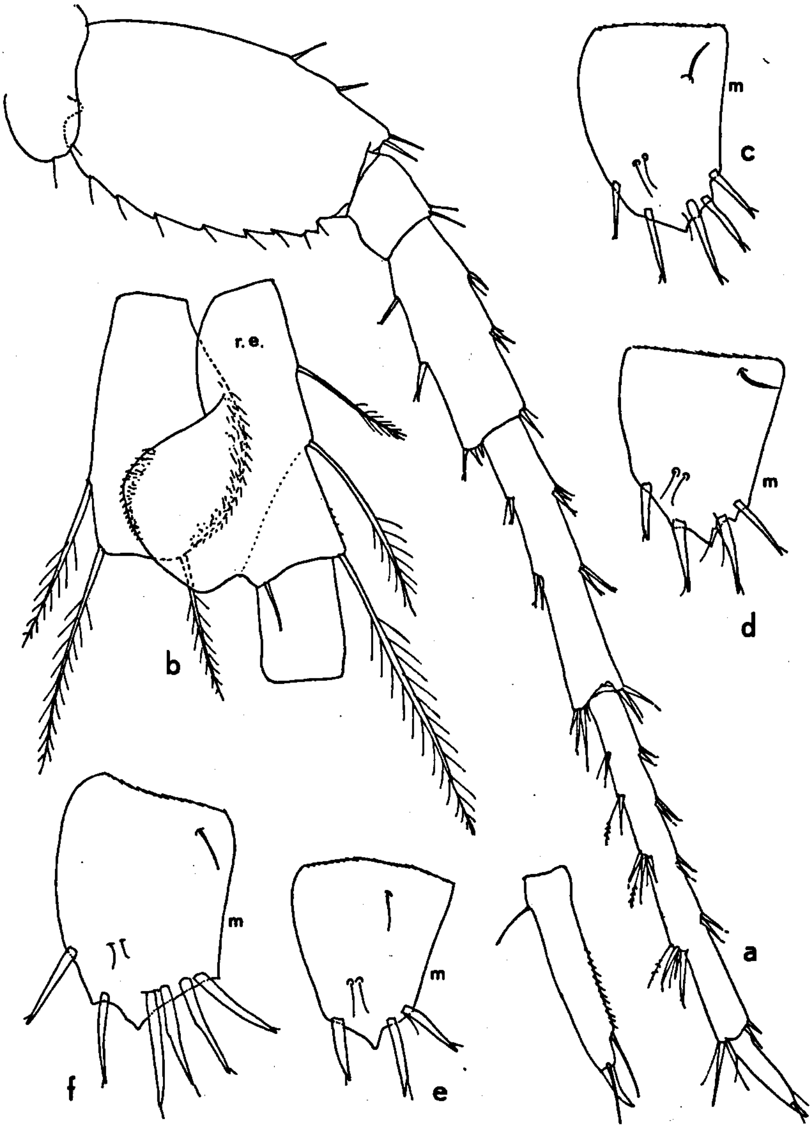

Fig. 18. – *Metaniphargus curasavicus orientis* n. ssp.; a–e: paratypes; f: Mount Pleasant Estate, Curaçao. a, seventh pereiopod, ♀ (scale A); b, detail of third pleopod, ♂ (C); c, left telson half, ♂ (B); d, e, f, left telson half, ♀ (B). (m = medial side of appendage; r.e. = exopodite).

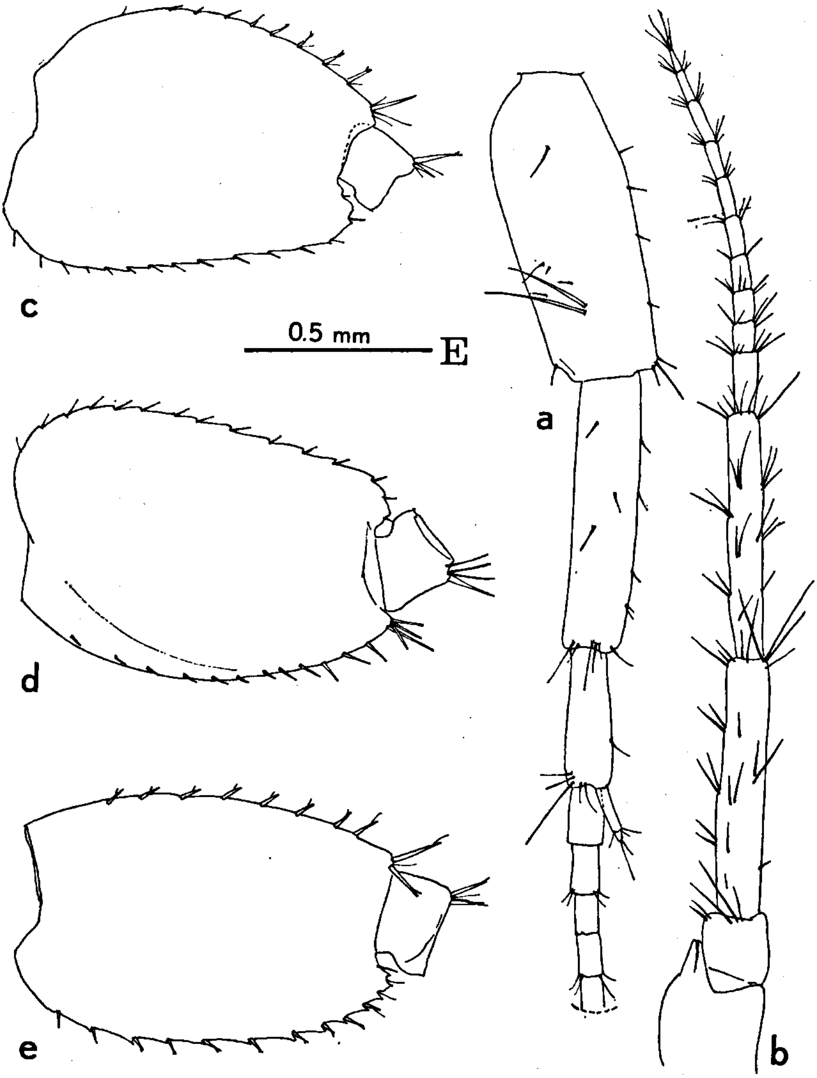

Fig. 19. – *Metaniphargus nicholsoni* Shoemaker, 1959, from BARBUDA, topotypes. a, first antenna, ♀ (scale I); b, second antenna, ♀ (I); c, basis of fifth pereiopod, ♀ (E); d, basis of sixth pereiopod, ♀ (E); e, basis of seventh pereiopod, ♀ (E).

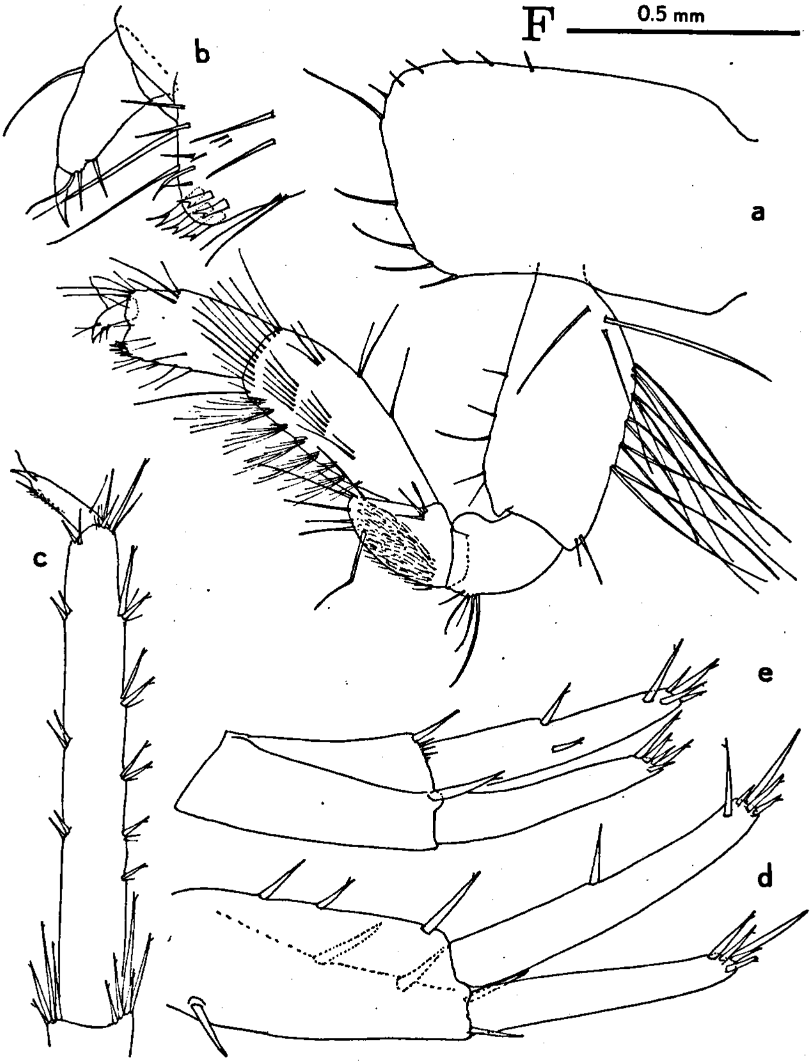

Fig. 20. – *Metaniphargus nicholsoni* Shoemaker, 1959, topotypes.
a, first gnathopod, ♀ (scale A); b, palm of first gnathopod, ♀ (C); c, distal segments of seventh pereiopod, ♀ (F); d, first uropod, ♀ (A); e, second uropod, ♀ (A).

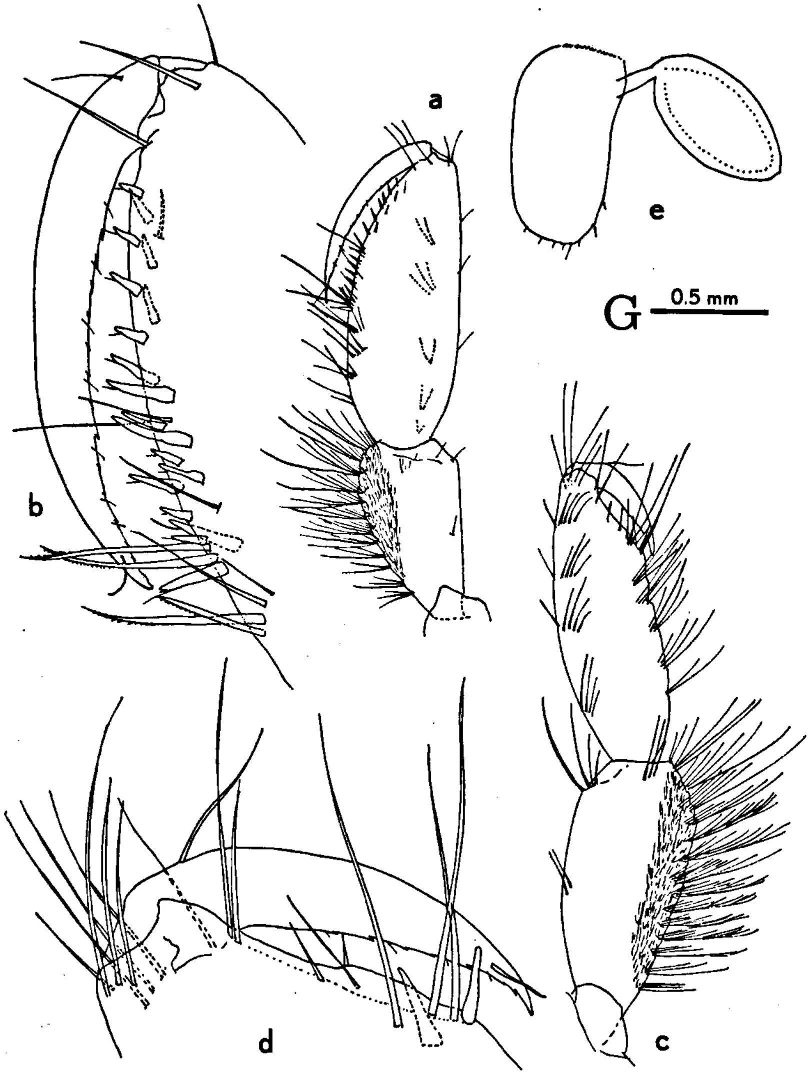

Fig. 21. – *Metaniphargus nicholsoni* Shoemaker, 1959, topotypes.
a, second gnathopod, ♂ (scale F); b, palm of second gnathopod, ♂ (B); c, second gnathopod, ♀ (A); d, palm of second gnathopod, ♀ (C); e, coxal plate and coxal gill of fourth pereiopod, ♀ (G).

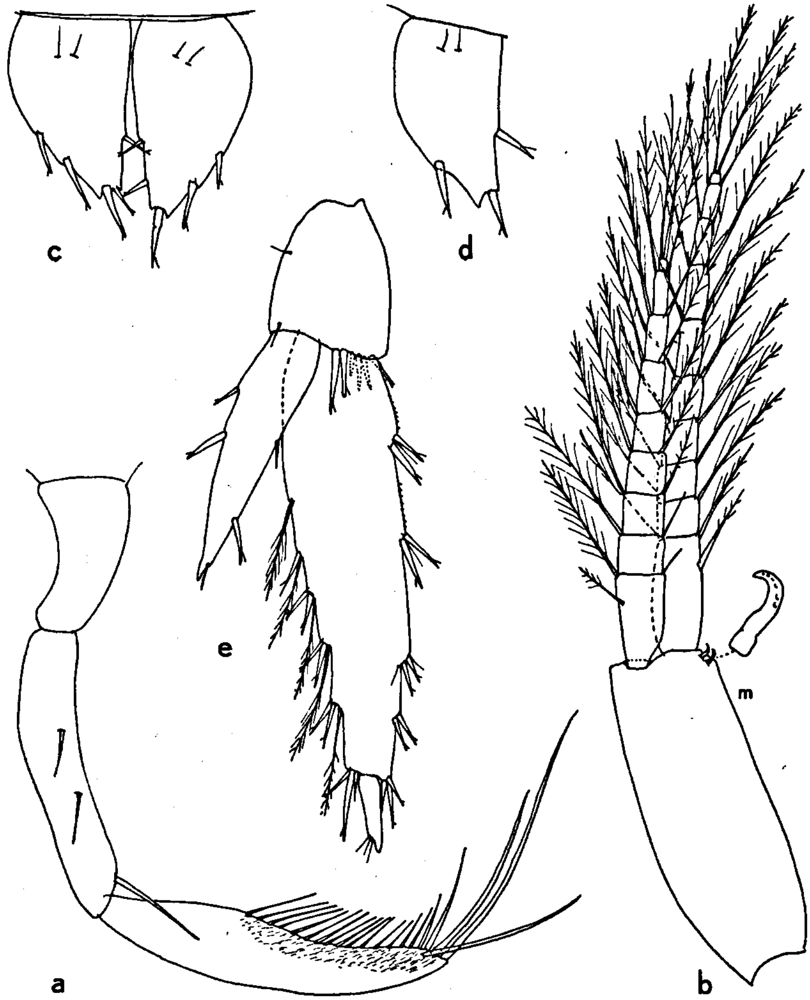

Fig. 22. – *Metaniphargus nicholsoni* Shoemaker, 1959, topotypes.
a, mandible palp, ♀ (scale B); b, third pleopod, ♂ (A) (m = medial side); c, telson, ♀ (A); d, left telson half, ♂ (A); e, third uropod, ♂ (A).

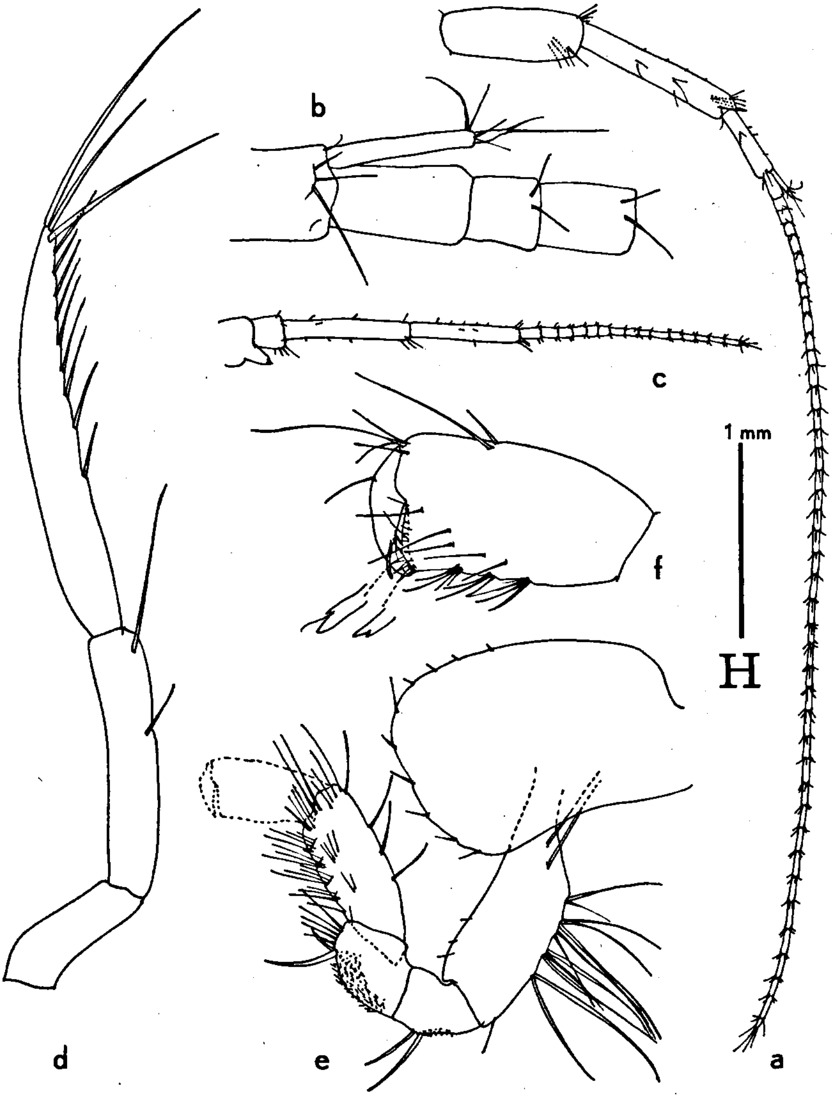

Fig. 23. – *Metaniphargus palpator* n. sp., from St. Martin, paratype, ♂.
a, first antenna (scale H); b, accessory flagellum (D); c, second antenna (H); d, mandible palp (B); e, first gnathopod (F); f, propodus of first gnathopod (D).

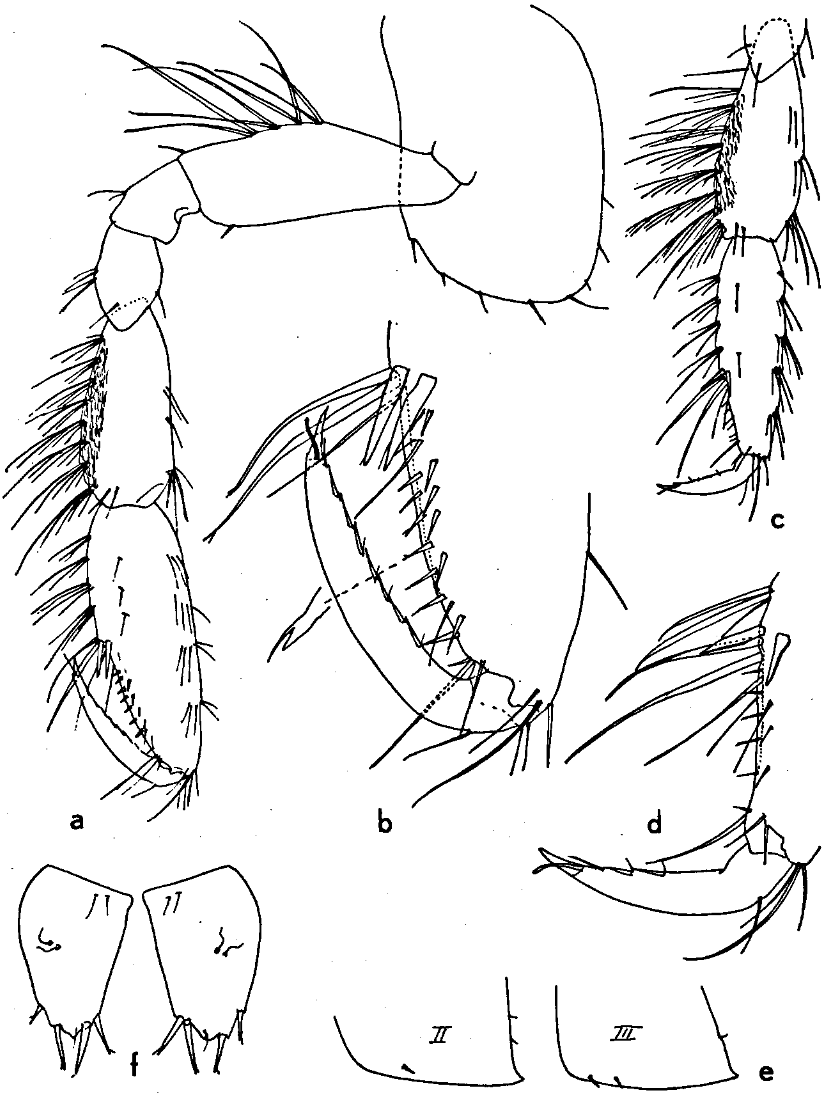

Fig. 24. – *Metaniphargus palpator* n. sp., paratypes.
a, second gnathopod, ♂ (scale F); b, palm of second gnathopod, ♂ (D); c, second gnathopod, ♀ (F); d, palm of second gnathopod, ♀ (D); e, epimeral plates II and III, ♂ (G); f, telson, ♂ (A).

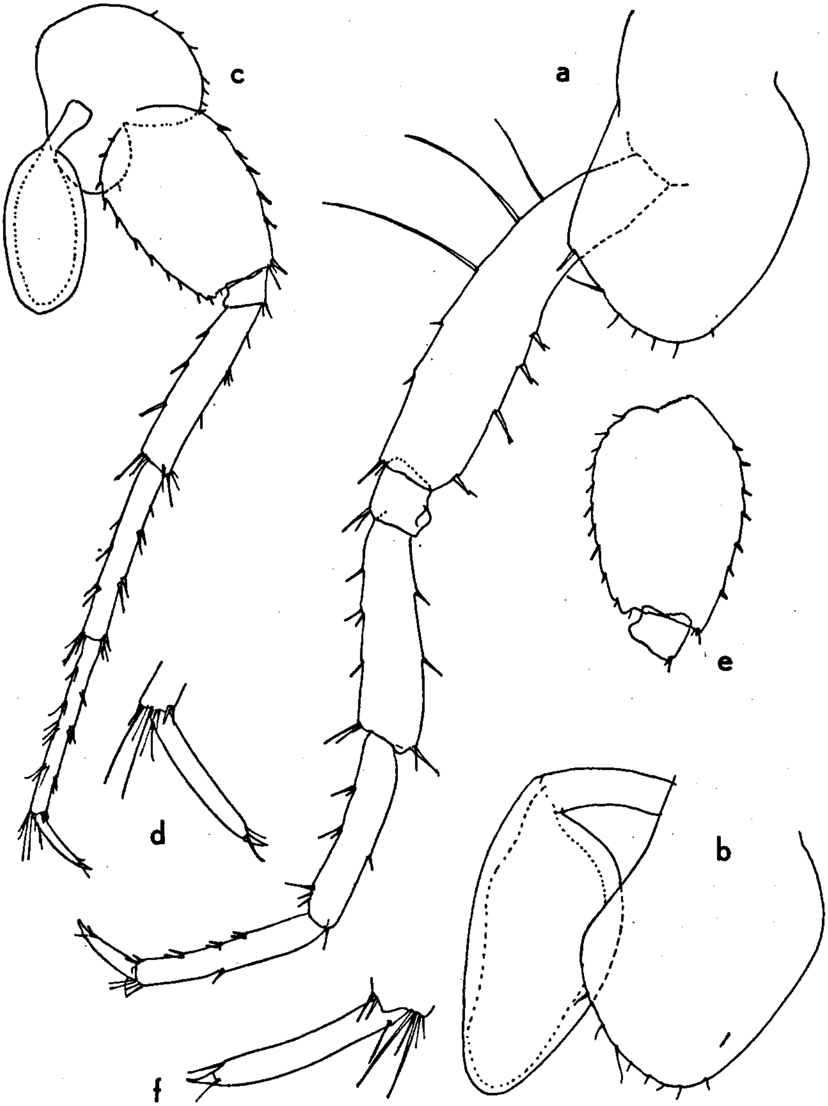

Fig. 25. – *Metaniphargus palpator* n. sp., paratype, ♂.
a, fourth pereiopod (scale F); b, coxal plate and coxal gill of third pereiopod (F); c, fifth pereiopod (G); d, claw of fifth pereiopod (A); e, basis of sixth pereiopod (G); f, claw of sixth pereiopod (A).

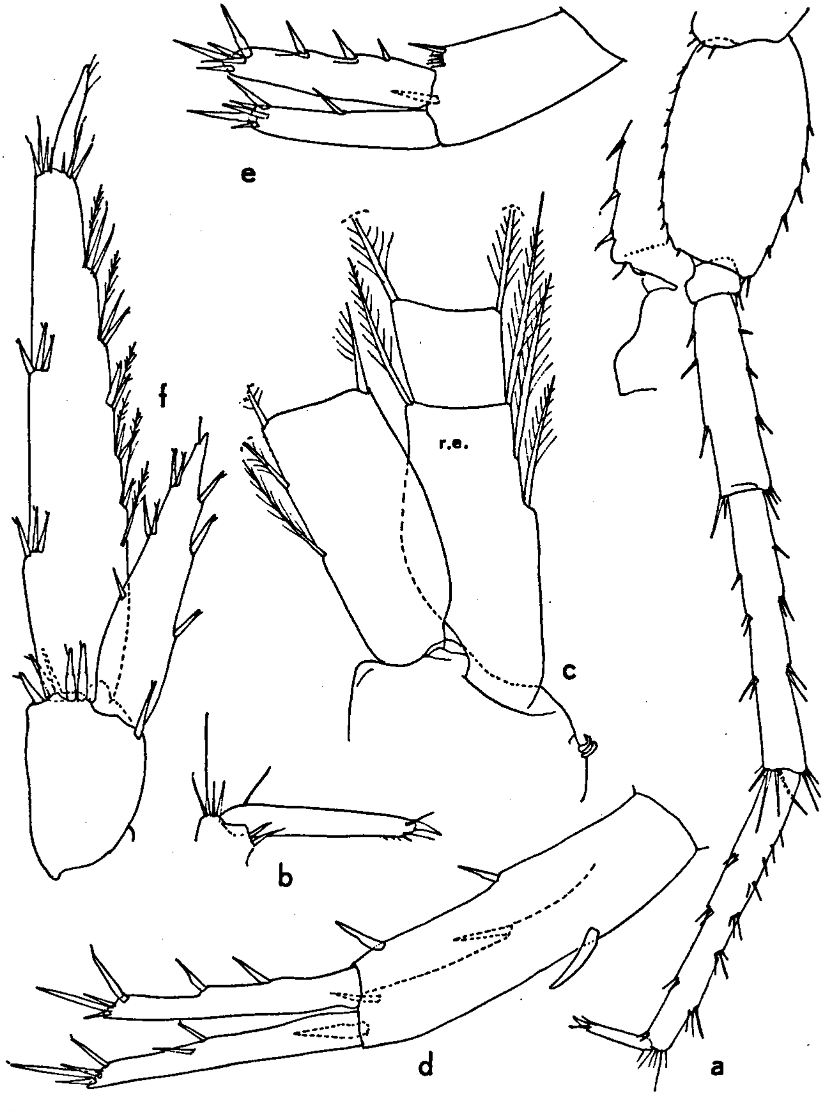

Fig. 26. – *Metaniphargus palpator* n. sp., paratype, ♂.
a, seventh pereiopod (scale G), posterior lobe of basis more strongly enlarged (scale A); b, claw of seventh pereiopod (A); c, third pleopod (B) (r.e. = exopodite); d, first uropod (F); e, second uropod (F); f, third uropod (F).

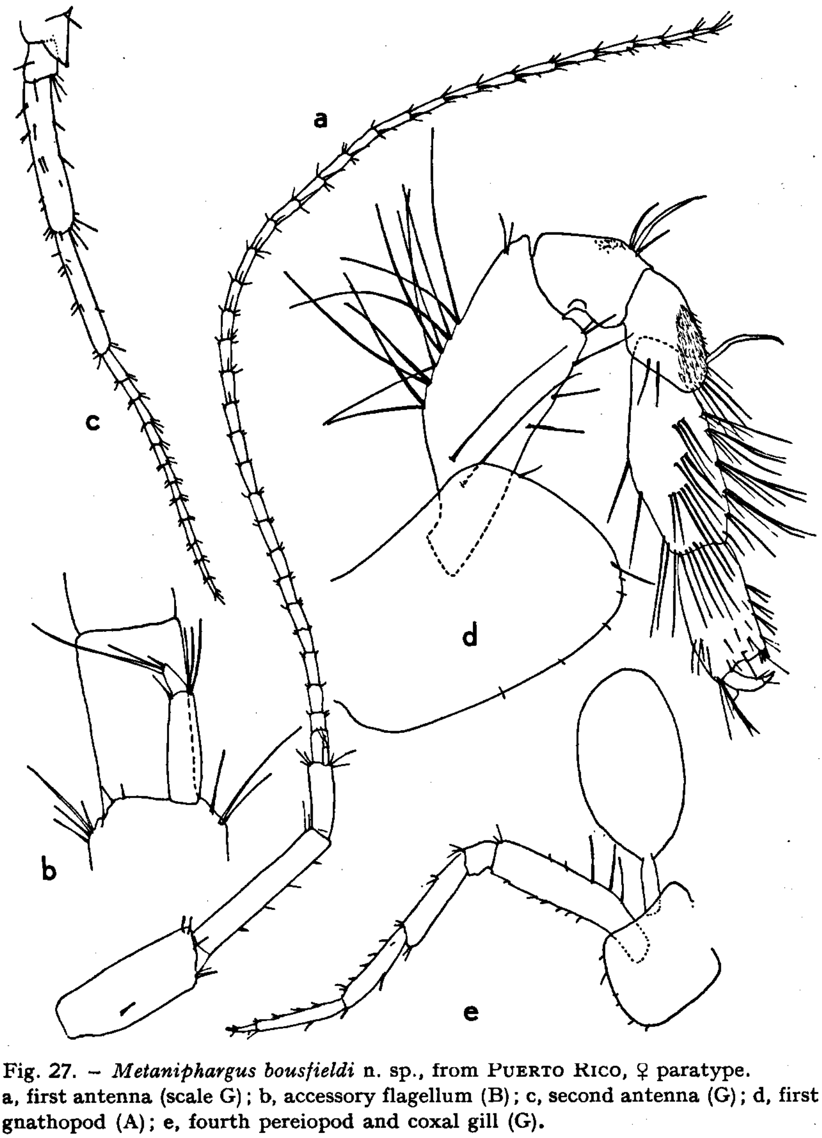

Fig. 27. – *Metaniphargus bousfieldi* n. sp., from Puerto Rico, ♀ paratype. a, first antenna (scale G); b, accessory flagellum (B); c, second antenna (G); d, first gnathopod (A); e, fourth pereiopod and coxal gill (G).

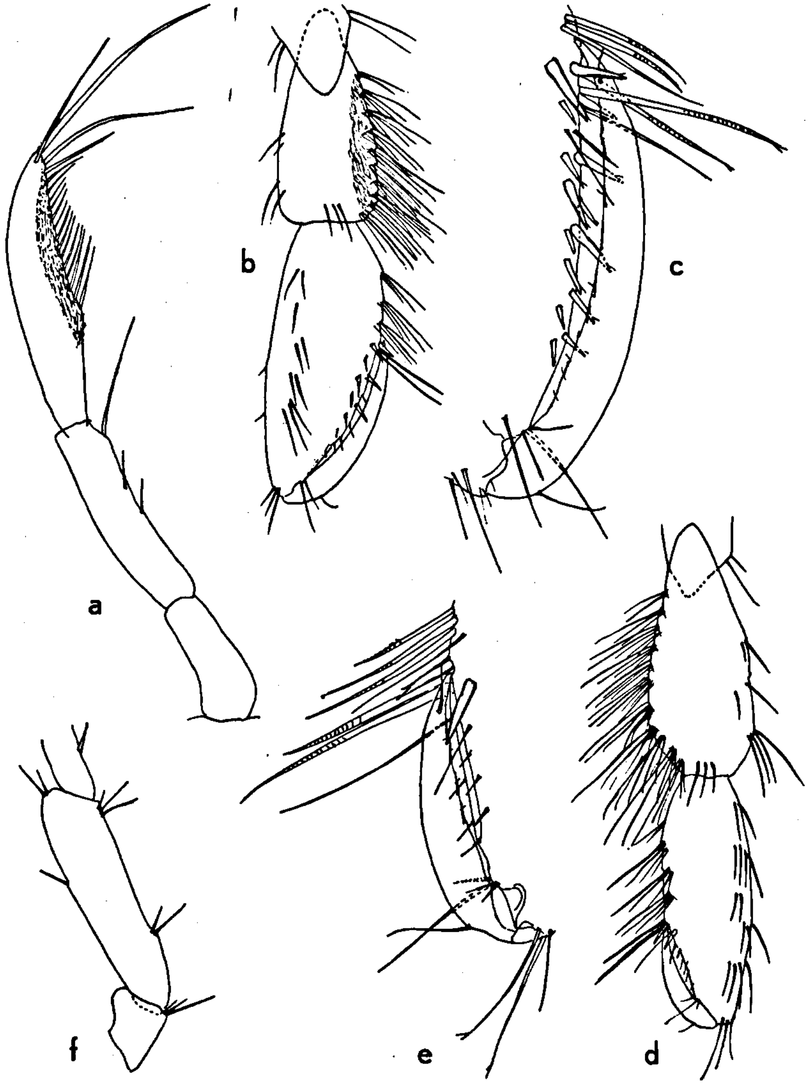

Fig. 28. – *Metaniphargus bousfieldi* n. sp., paratypes.
a, mandible palp, ♀ (scale D); b, distal articles of second gnathopod, ♂ (A); c, palm of second gnathopod, ♂ (B); d, distal article of second gnathopod, ♀ (A); e, palm of second gnathopod, ♀ (B); f, merus of third pereiopod, ♀ (F).

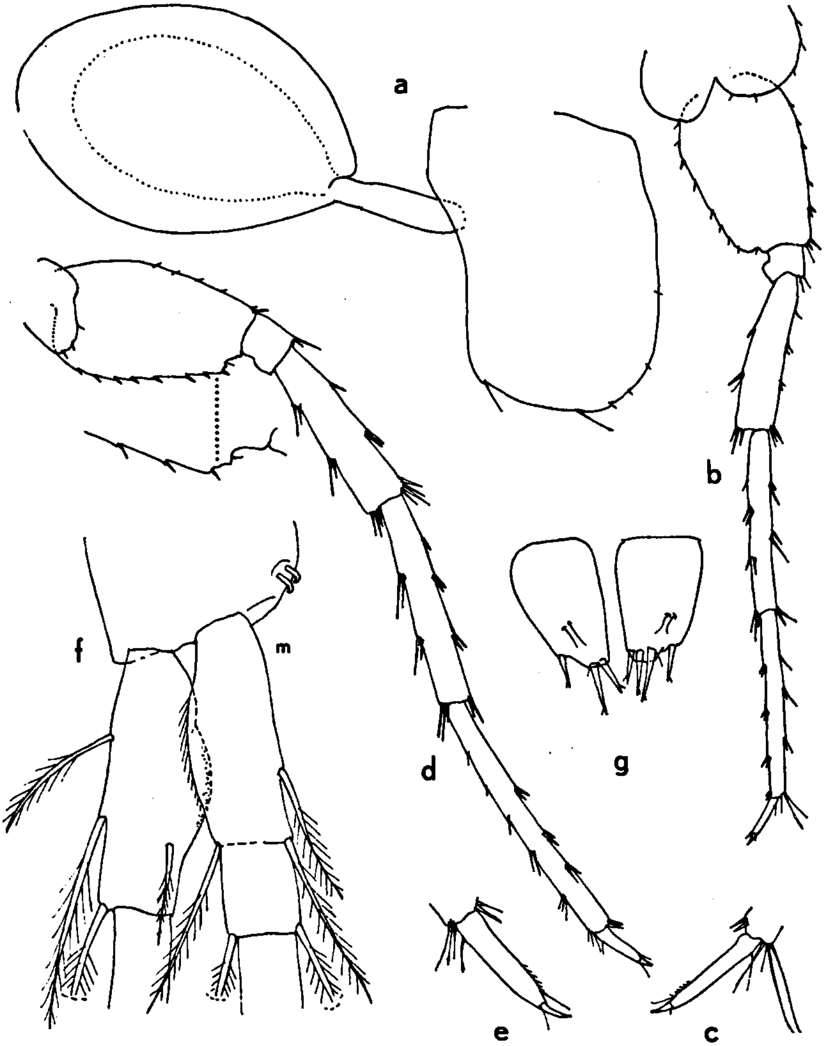

Fig. 29. – *Metaniphargus bousfieldi* n. sp., paratypes.
a, coxal plate and coxal gill of second gnathopod, ♀ (scale A); b, fifth pereiopod, ♀ (G); c, claw of fifth pereiopod, ♀ (A); d, seventh pereiopod, ♀ (G), with posterior margin of basis more strongly enlarged (A); e, claw of seventh pereiopod, ♀ (A); f, detail of third pleopod, ♂ (B) (m = median side of the appendage); g, telson, ♂ (A).

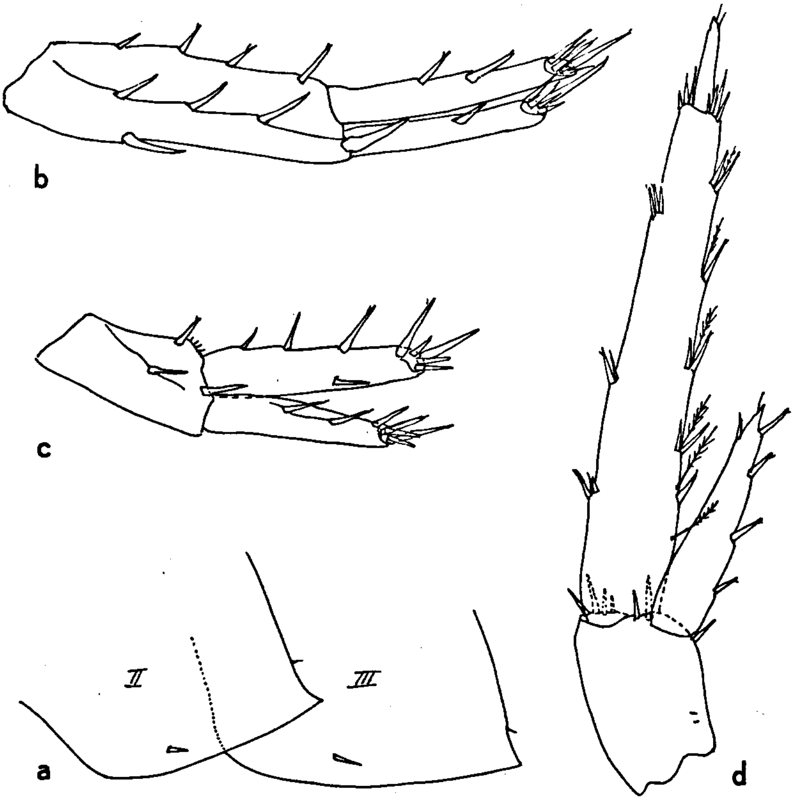

Fig. 30. – *Metaniphargus bousfieldi* n. sp., paratypes.
a, epimeral plates II and III, ♂ (scale F); b, first uropod, ♂ (A); c, second uropod, ♂ (A); d, third uropod, ♀ (F).

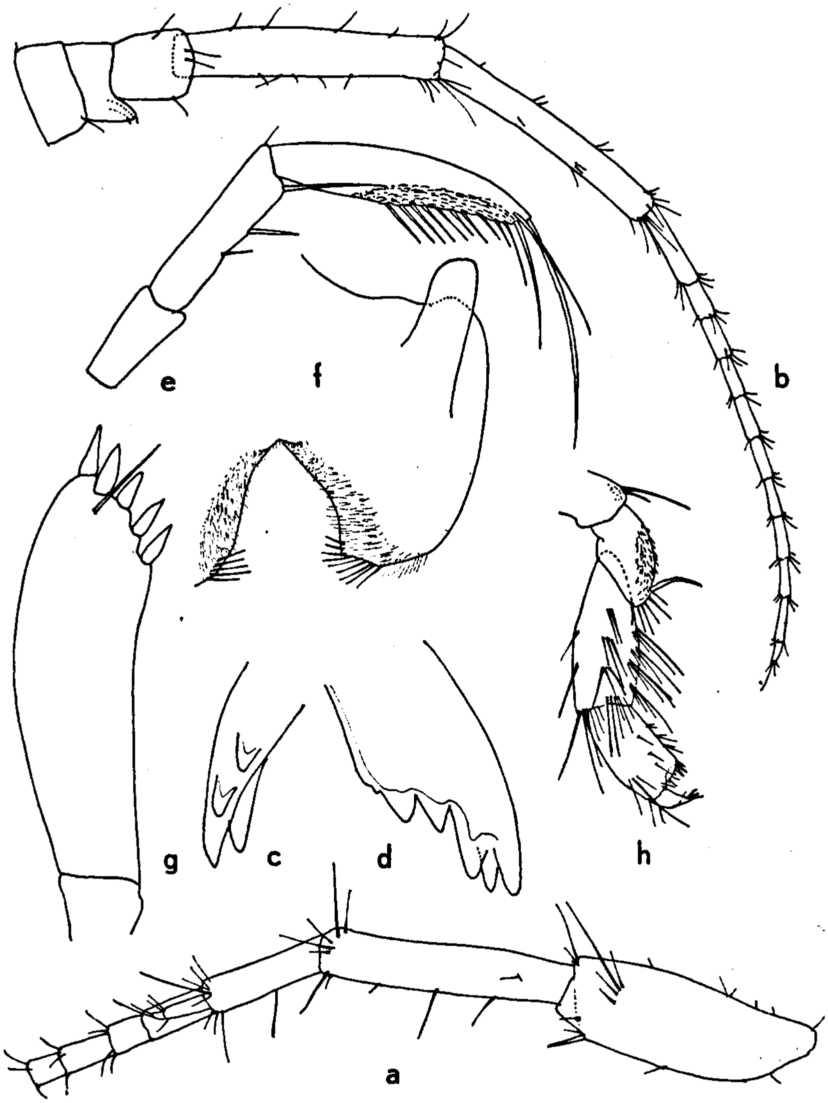

Fig. 31. – *Metaniphargus longipes longipes* n. ssp., from ARUBA, paratypes. a, proximal part of first antenna, ♀ (scale A); b, second antenna, ♂ (A); c, pars incisiva of right mandible, ♂ (M); d, same of left mandible, ♂ (M); e, mandible palp, ♂ (B); f, lower lip, ♂ (B); g, right palp of first maxilla, ♂ (C); h, first gnathopod, ♂ (A).

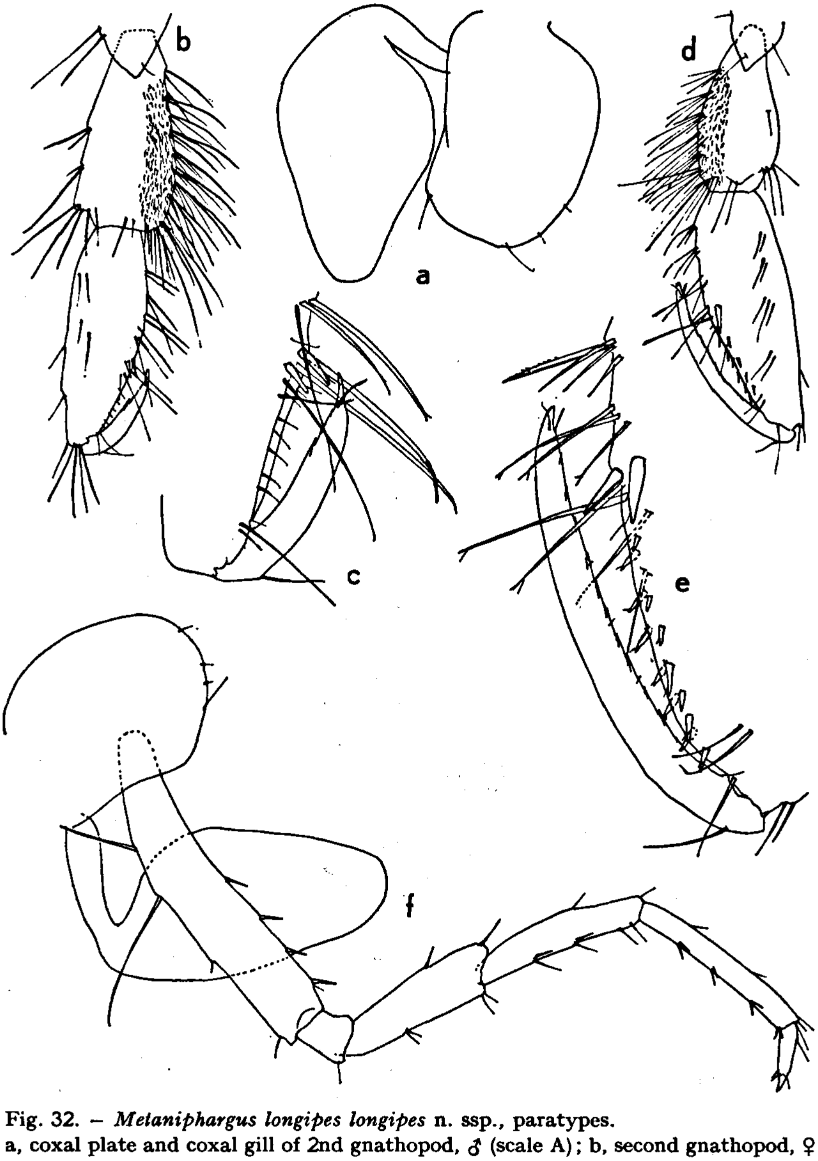

Fig. 32. – *Metaniphargus longipes longipes* n. ssp., paratypes.
a, coxal plate and coxal gill of 2nd gnathopod, ♂ (scale A); b, second gnathopod, ♀ (A); c, palm of 2nd gnathopod, ♀ (B); d, second gnathopod, ♂ (A); e, palm of 2nd gnathopod, ♂ (B); f, fourth pereiopod, ♂ (A).

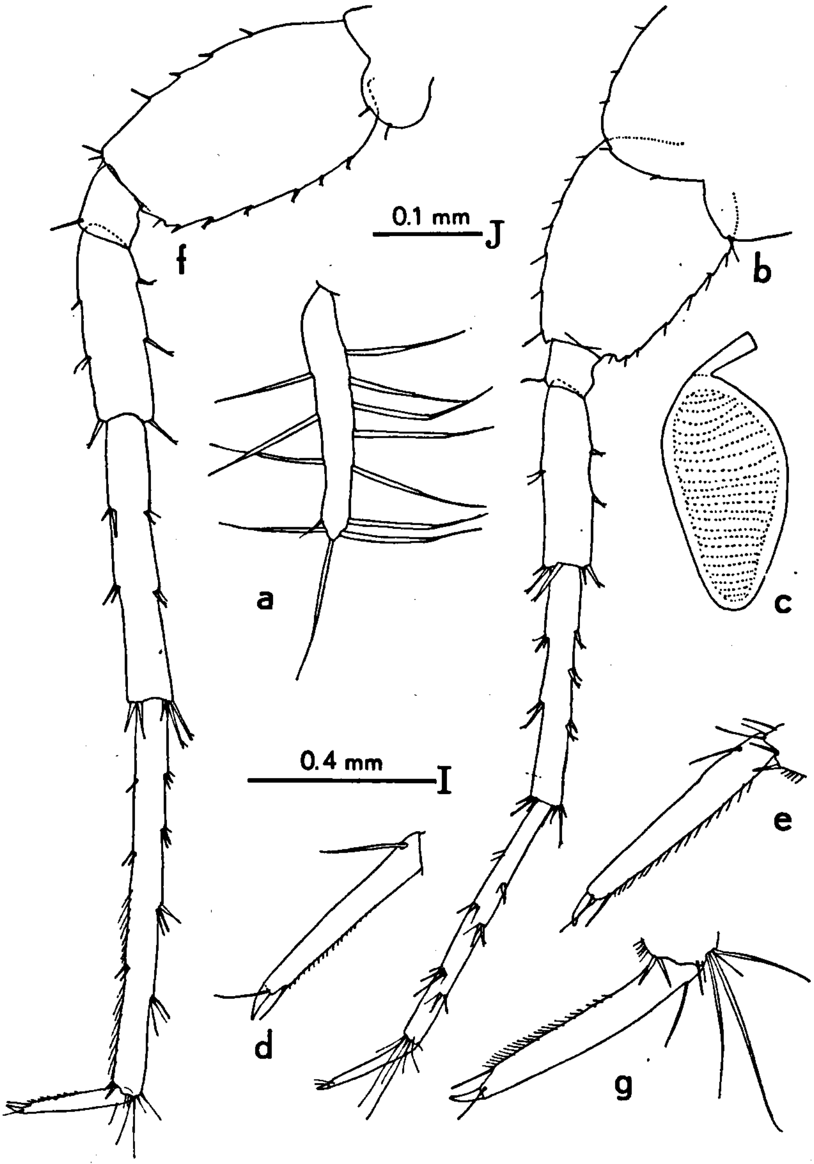

Fig. 33. – *Metaniphargus longipes longipes* n. ssp., paratypes.
a, oöstegite from 2nd gnathopod, ♀ (scale I); b, fifth pereiopod, ♂ (I); c, coxal gill of same (I); d, claw of fifth pereiopod, ♀ (J); e, claw of sixth pereiopod, ♂ (J); f, seventh pereiopod, ♂ (I); g, claw of seventh pereiopod, ♂ (J).

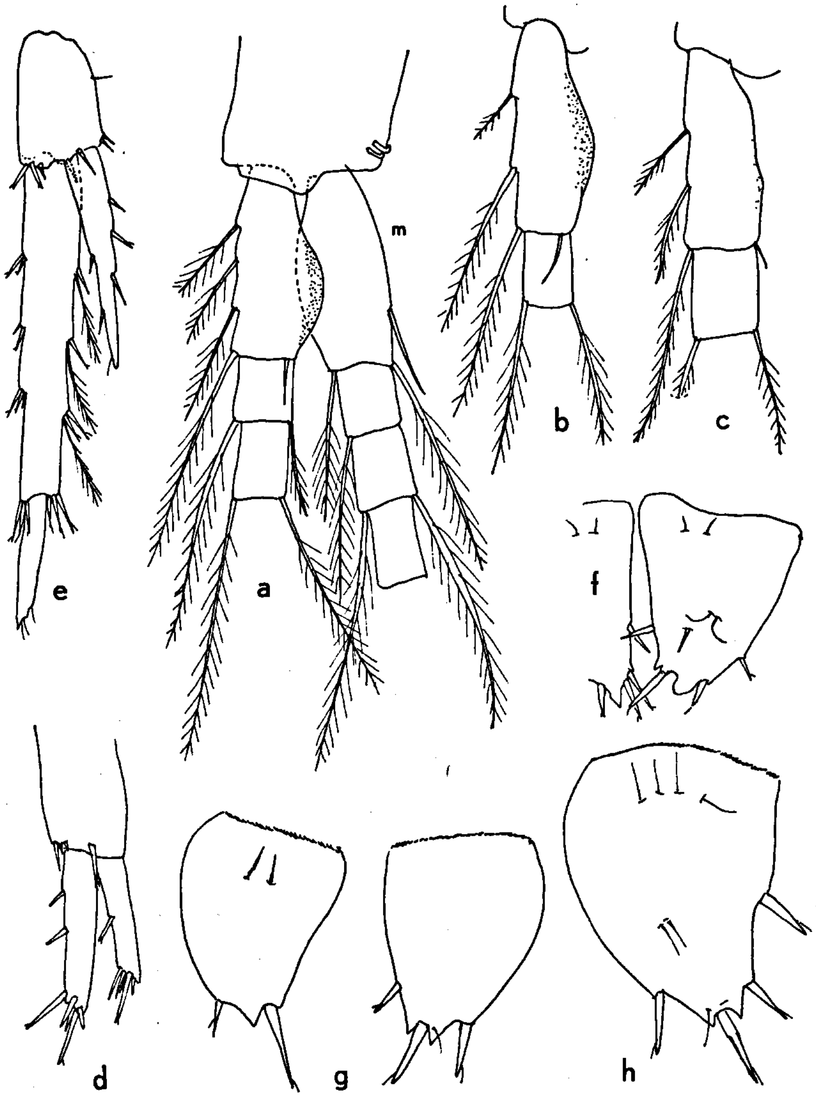

Fig. 34. – *Metaniphargus longipes longipes* n. ssp., paratypes, except for c and g (from Stock Sta. A–43) and h (from Hummelinck Sta. 632).
a, third male pleopod (scale B) (m = median side of the appendage); b, c, outer ramus of third male pleopods (B); d, second uropod, ♂ (A); e, third uropod, ♂ (A); f, telson, ♂ (B); g, contralateral halfs of the telson of a male (B); h, telson, ♂ (B).

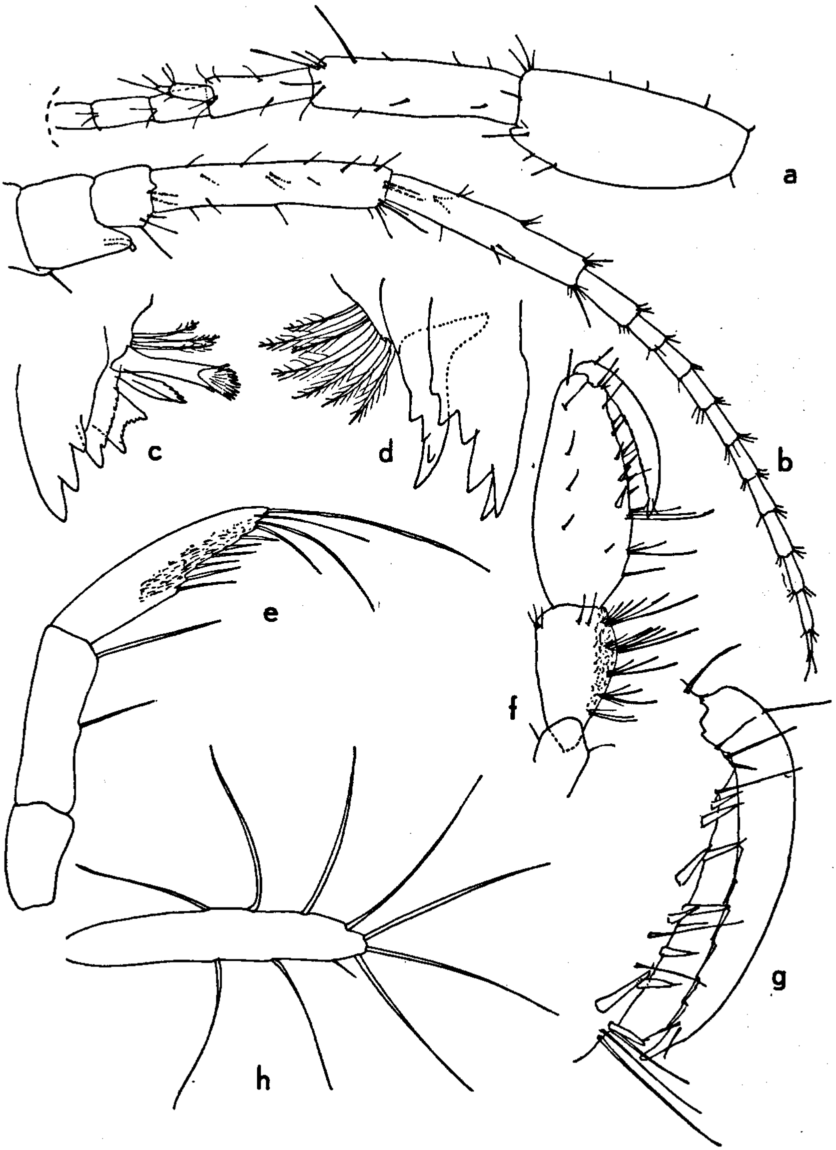

Fig. 35. – *Metaniphargus longipes christophorensis* n. ssp., from CURAÇAO, paratypes.
a, first antenna, basal part, ♂ (scale A); b, second antenna, ♂ (A); c, masticatory part of right mandible, ♀ (C); d, same of left mandible, ♀ (C); e, mandible palp, ♀ (B); f, second gnathopod, ♂ (A); g, palm of second gnathopod, ♂ (B); h, oöstegite from second gnathopod, ♀ (A).

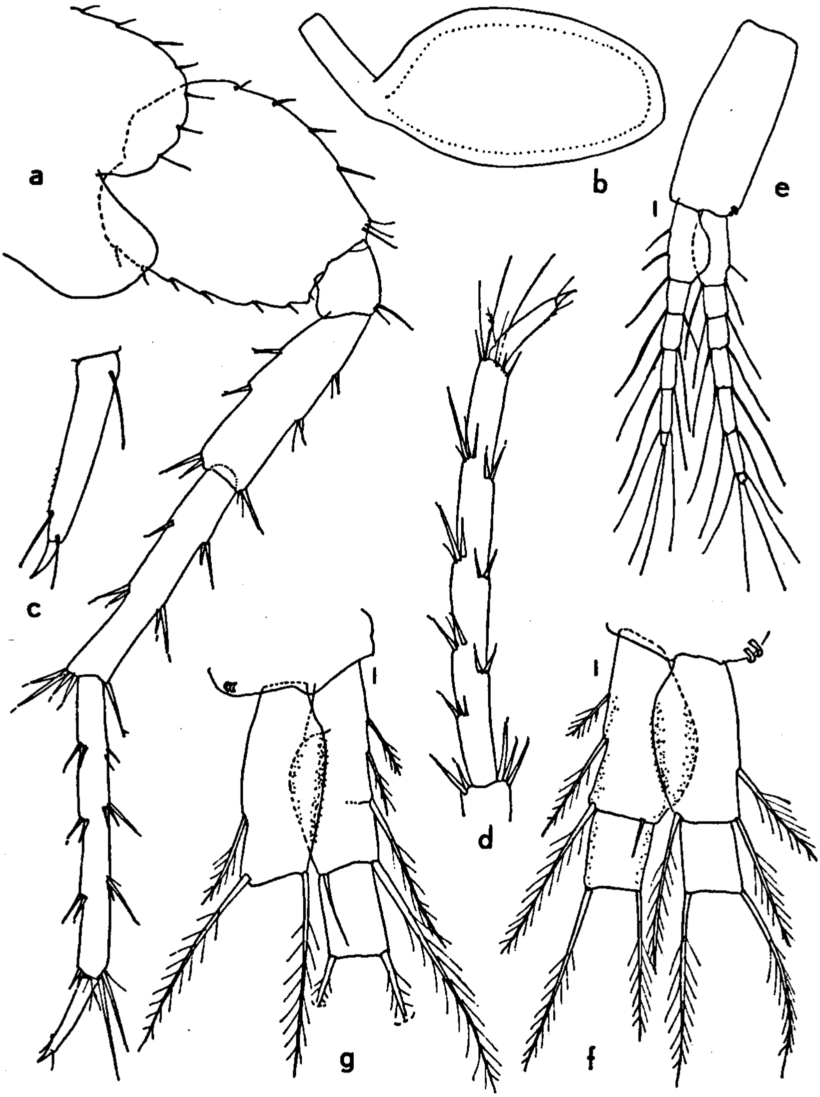

Fig. 36. – *Metaniphargus longipes christophorensis* n. ssp., a–f, paratypes ♂; g, ♂ from Sta. 74–36.
a, fifth pereiopod (scale A); b, coxal gill of fifth pereiopod (A); c, claw of fifth pereiopod (B); d, distal segments of sixth pereiopod (A); e, third pleopod, plumosity of the setae omitted (A); f, g, detail of third pleopod (B). (l = lateral side of the appendage).

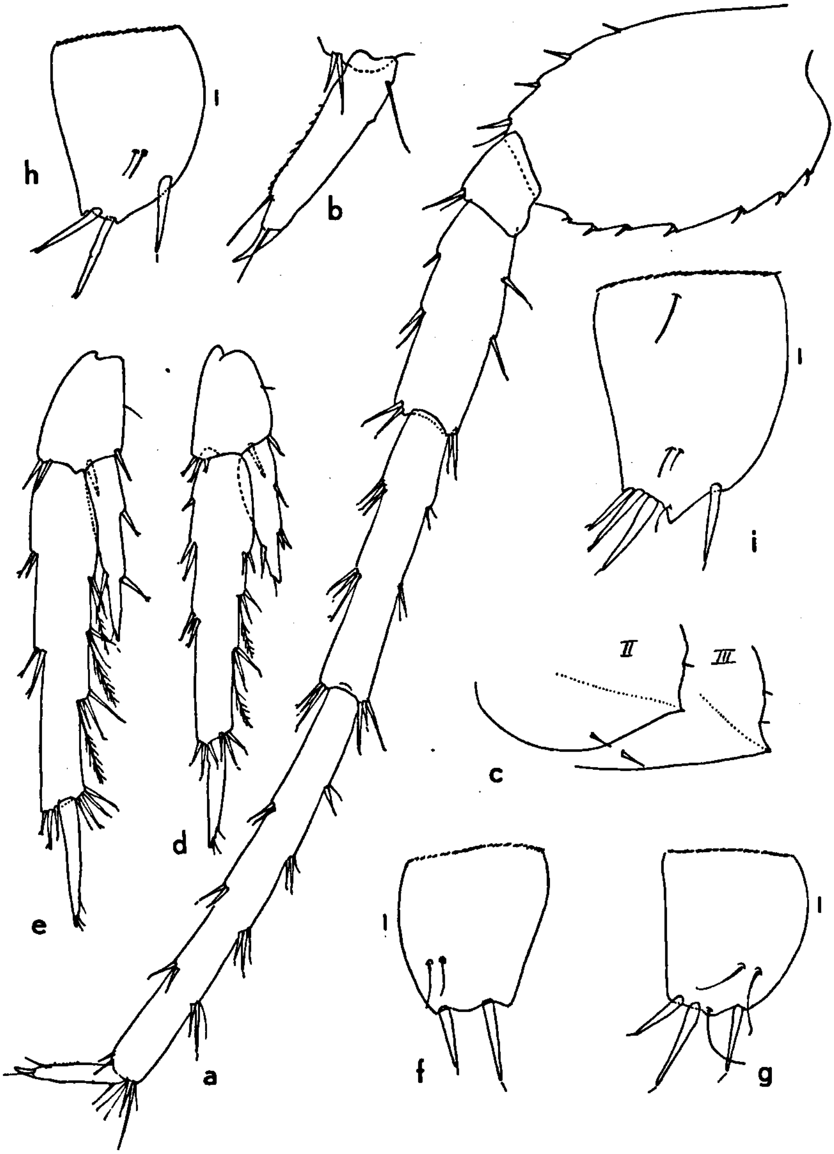

Fig. 37. – *Metaniphargus longipes christophorensis* n. ssp., a–d, f–g, paratype ♂; e, ♂ from Sta. 74–35; h–i, ♂ from Sta. 74–71.
a, seventh pereiopod (scale A); b, claw of seventh pereiopod (B); c, epimeres II and III (A); d, e, third uropod (A); f–i, telson halves (B) (l = lateral side of the telson).

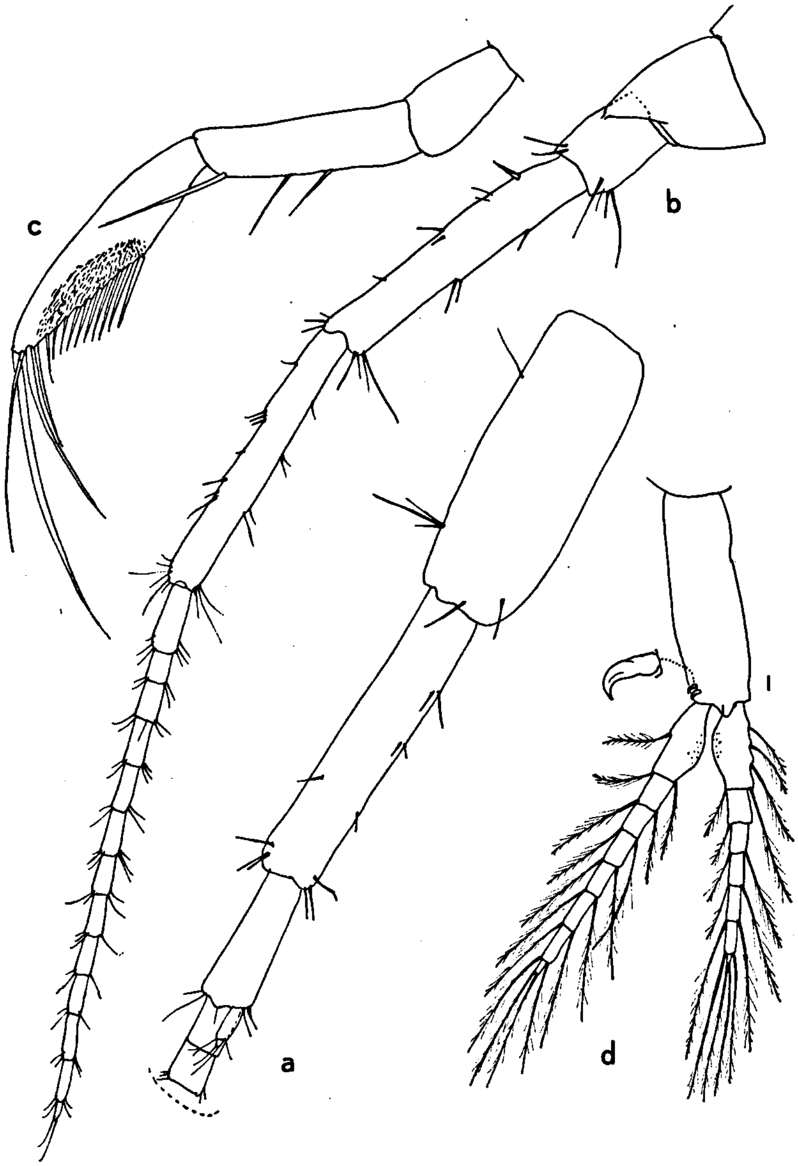

Fig. 38. – ***Metaniphargus beattyi*** Shoemaker, 1942, from St. Croix, paratypes. a, basal portion of first antenna, ♂ (scale A); b, second antenna, ♂ (A); c, mandible palp, ♂ (B); d, third pleopod, ♂ (F) (l = lateral side of the appendage).

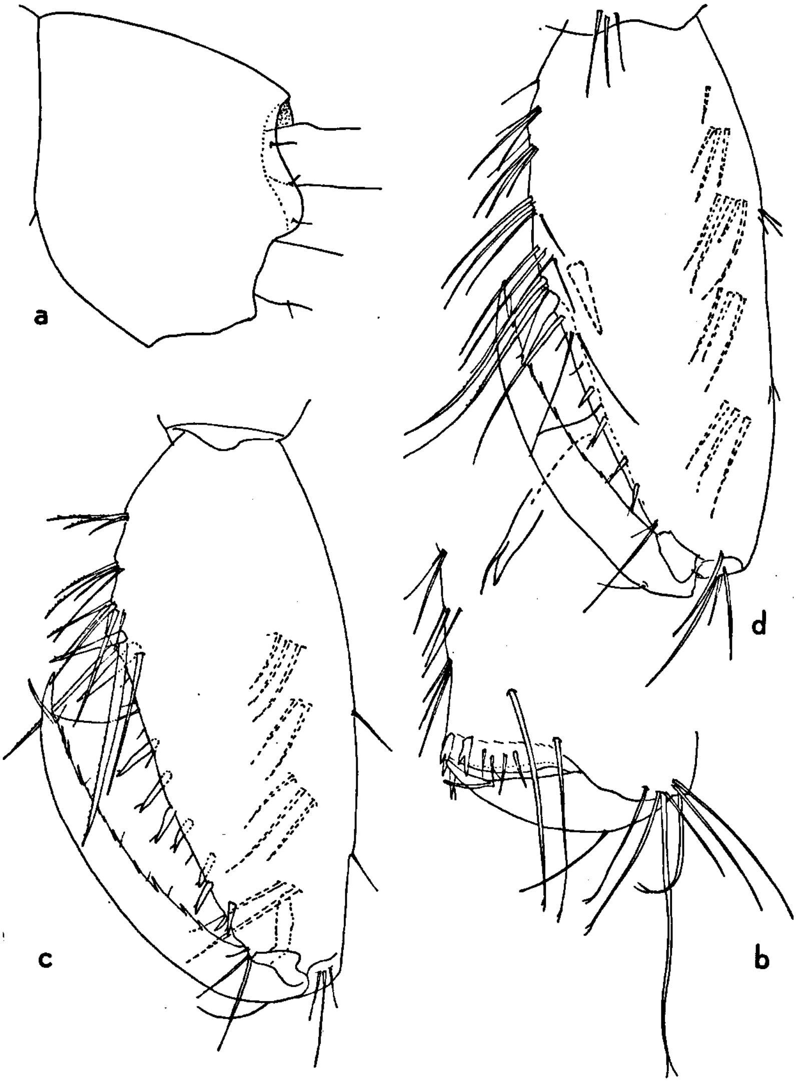

Fig. 39. – *Metaniphargus beattyi* Shoemaker, 1942, paratypes.
a, head, ♂, from the right (scale F); b, palm of first gnathopod, ♂ (C); c, propodus of second gnathopod, ♂ (D); d, propodus of second gnathopod, ♀ (D).

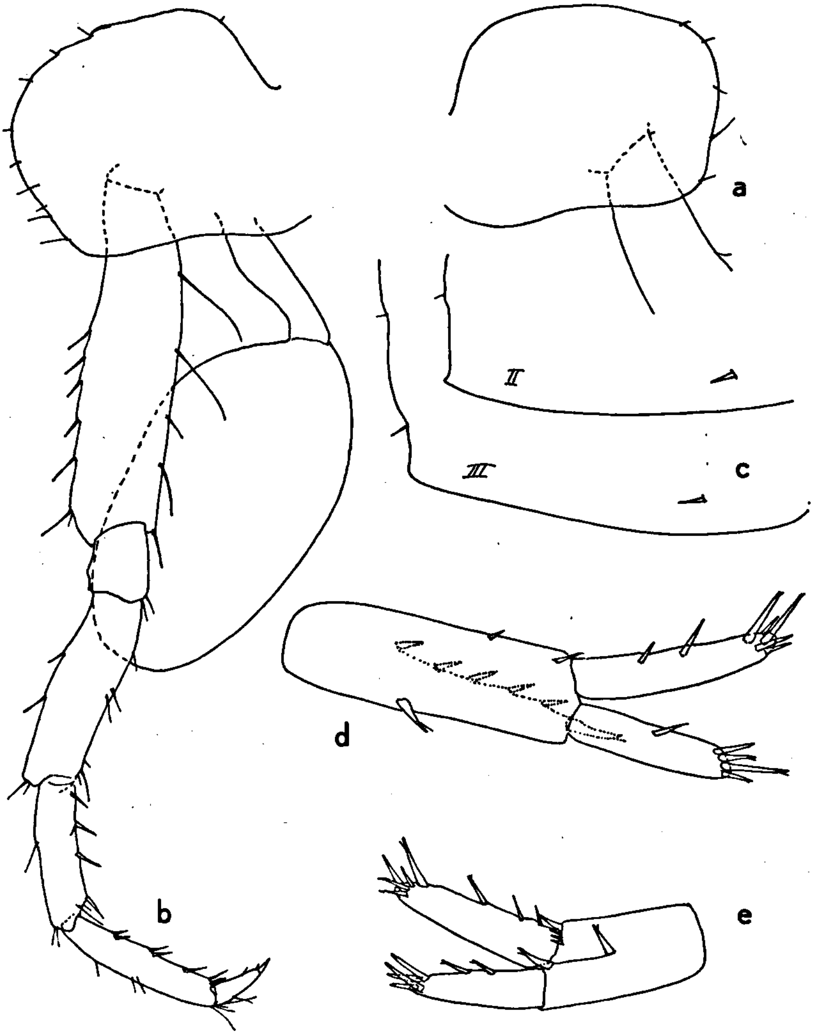

Fig. 40. – *Metaniphargus beattyi* Shoemaker, 1942, paratypes.
a, coxal plate of third pereiopod, ♀ (scale F); b, fourth pereiopod, ♀ (F); c, epimeral plates II and III, ♂ (D); d, first uropod, ♀ (F); e, second uropod, ♀ (F).

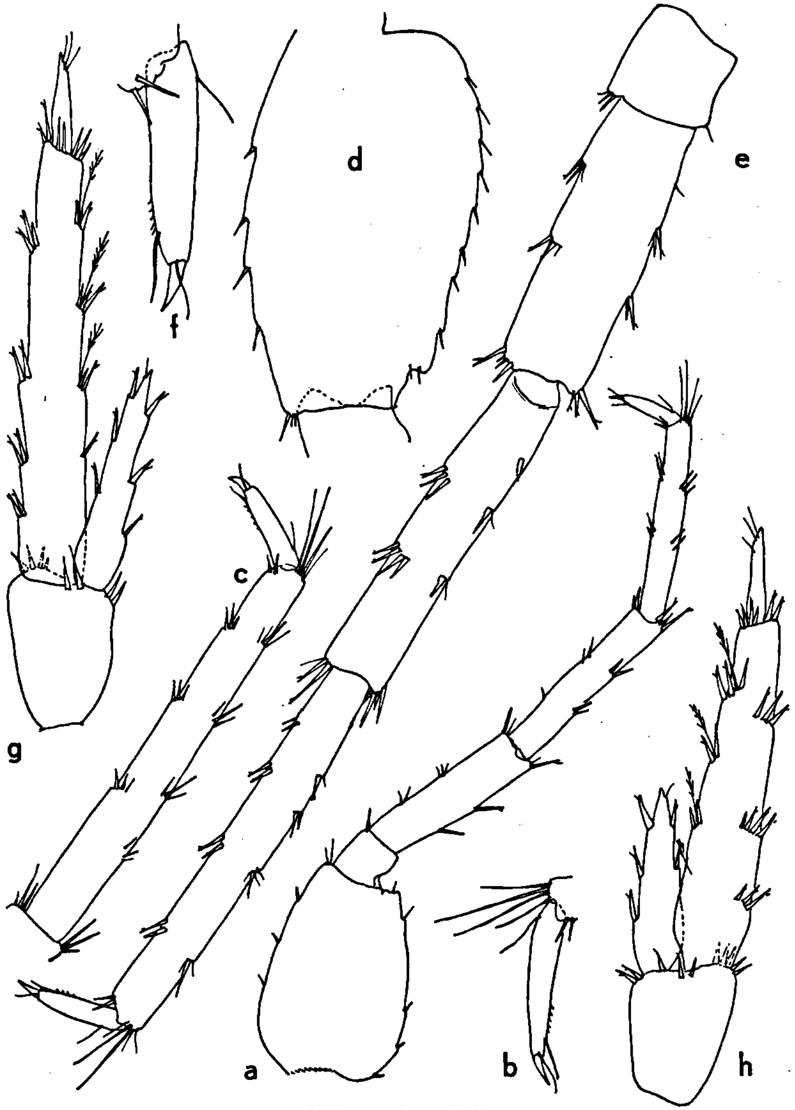

Fig. 41. – *Metaniphargus beattyi* Shoemaker, 1942, paratypes.
a, fifth pereiopod, ♂ (scale F) ; b, claw of fifth pereiopod, ♂ (D) ; c, distal articles of sixth pereiopod, ♀ (F) ; d, basis of seventh pereiopod, ♀ (F) ; e, remaining articles of same (F) ; f, claw of seventh pereiopod, ♀ (D) ; g, third uropod, ♂ (F) ; h, third uropod, ♀ (F).

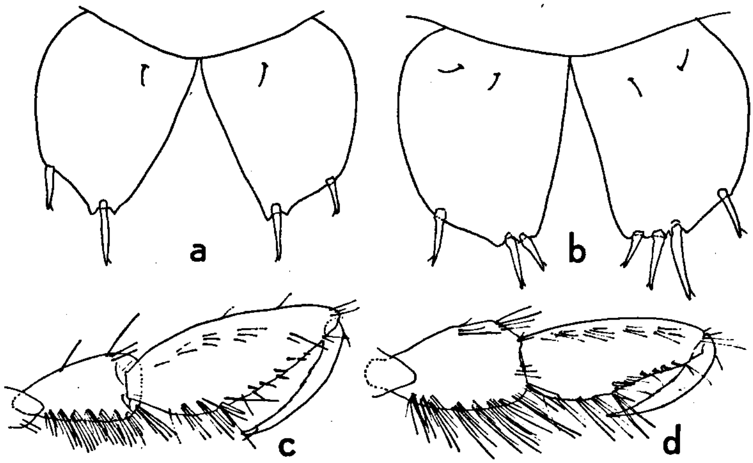

Fig. 42. – *Metaniphargus beattyi* Shoemaker, 1942, paratypes.
a, telson, ♂ (scale J); b, telson, ♀ (J); c, distal articles of second gnathopod, ♂ (E); d, same of ♀ (E).

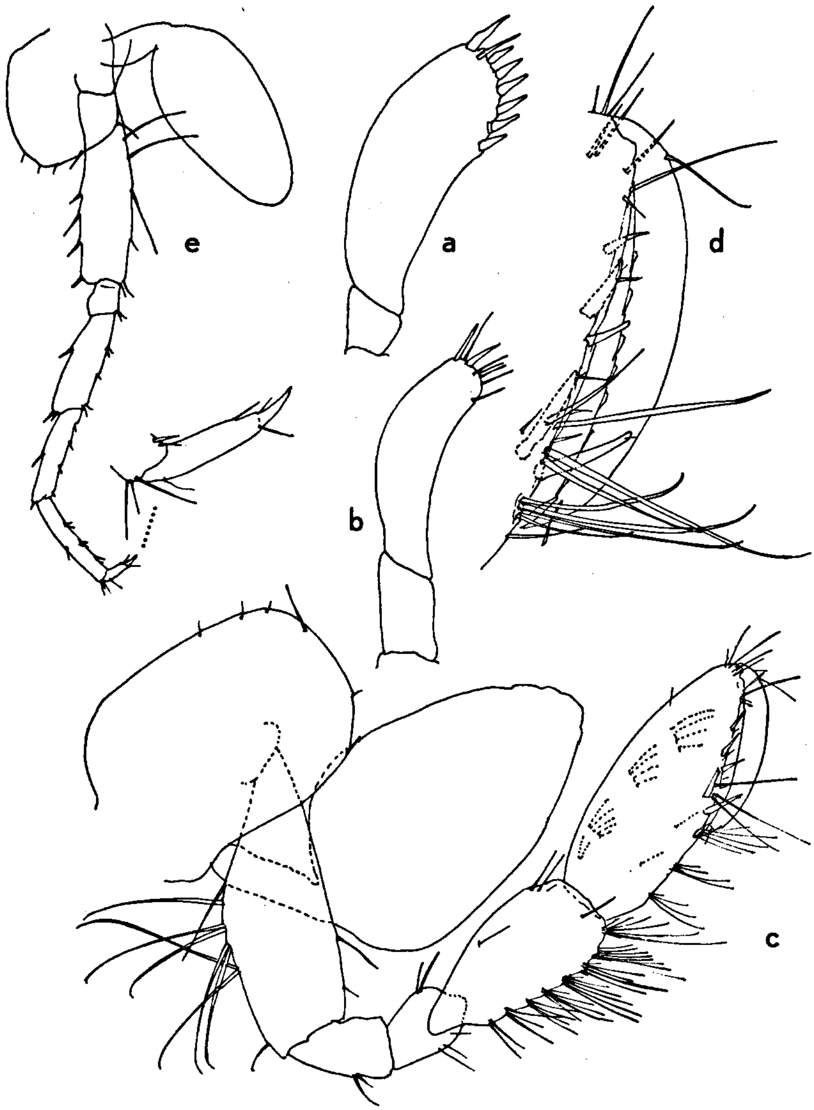

Fig. 43. – *Metaniphargus jamaicae* (Holsinger, 1974), from JAMAICA, topotype, ♂. a, palp of right first maxilla (scale D); b, palp of left first maxilla (D); c, second gnathopod (F); d, palm of second gnathopod (D); e, fourth pereiopod (G), claw more strongly enlarged.

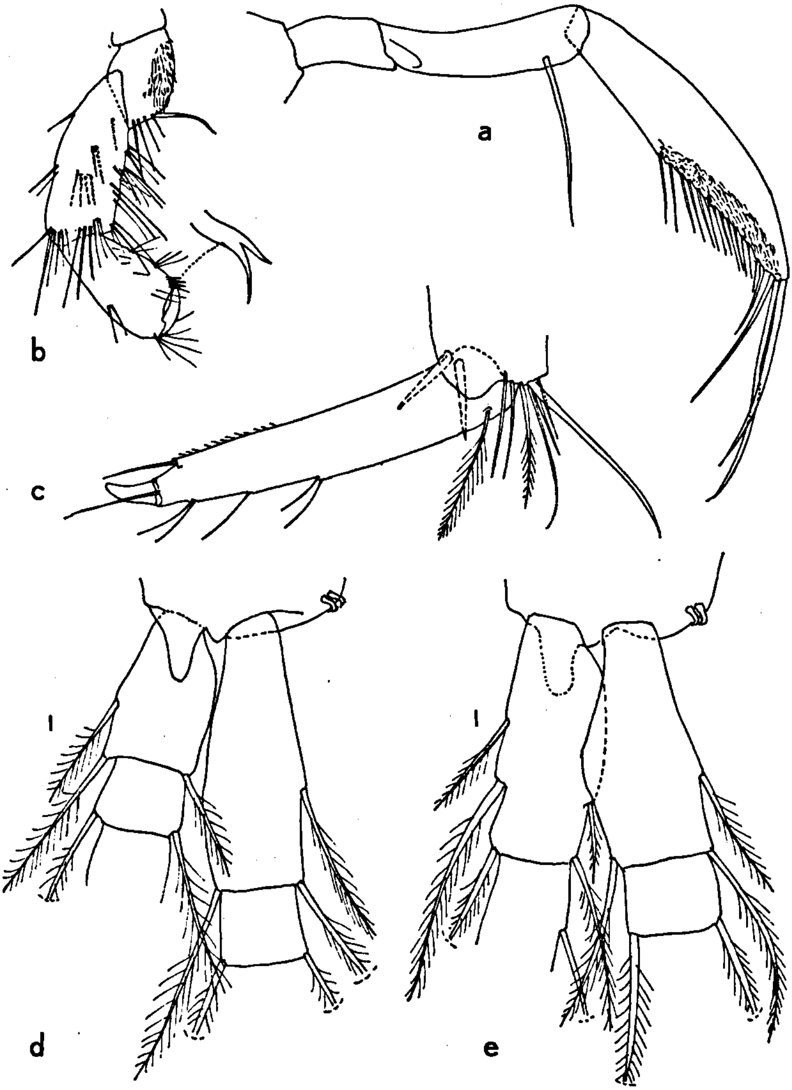

Fig. 44. – *Metaniphargus jamaicae* (Holsinger, 1974), topotypes.
a, mandible palp, ♂ (scale D); b, distal part of first gnathopod, ♂ (F); c, claw of seventh pereiopod, ♂ (D); d, detail of third pleopod, ♀ (D); e, detail of third pleopod, ♂ (D). (l = lateral side of the appendage.)

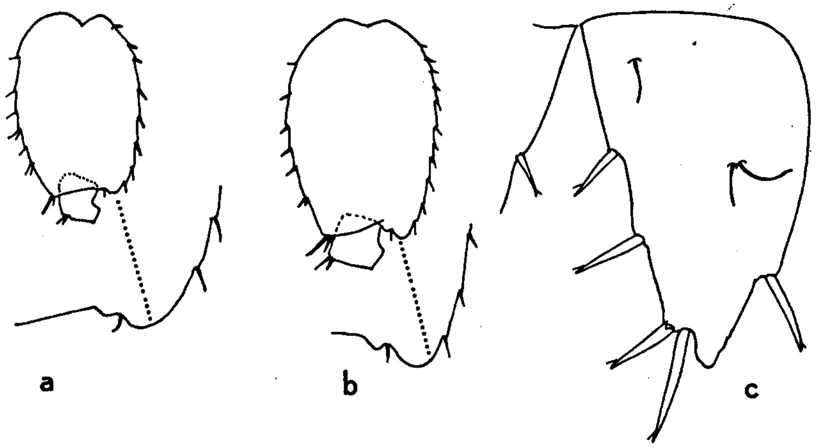

Fig. 45. – *Metaniphargus jamaicae* (Holsinger, 1974), topotype, ♂.
a, basis of fifth pereiopod (scale G); b, basis of sixth pereiopod (G); c, telson (D).

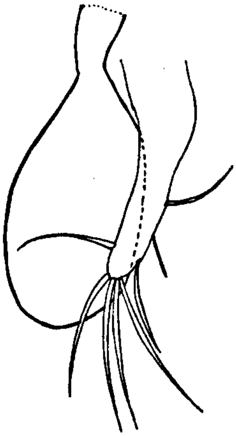

Fig. 46. – *Alloweckelia gurneei* Holsinger & Peck, 1968, from Puerto Rico, topotype, ♀. Coxal gill and oöstegite of 5th pereiopod (scale F).

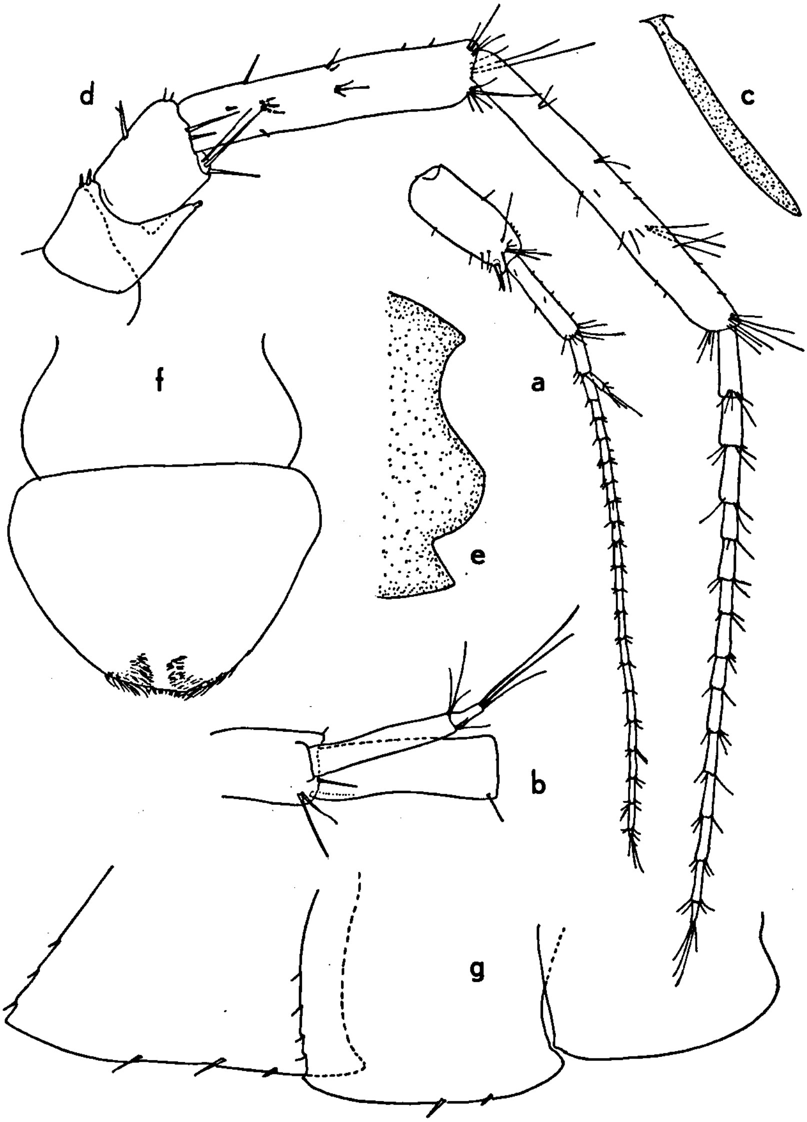

Fig. 47. – *Saliweckelia emarginata* n. gen., n. sp., from CURAÇAO, paratypes. a, first antenna, ♀ (scale G); b, accessory flagellum, ♀ (B); c, aesthete, ♀ (free-hand sketch); d, second antenna, ♀ (A); e, head, from the right, ♀ (A); f, labrum, ♀ (B); g, epimeres I–III, from the right, ♂ (A).

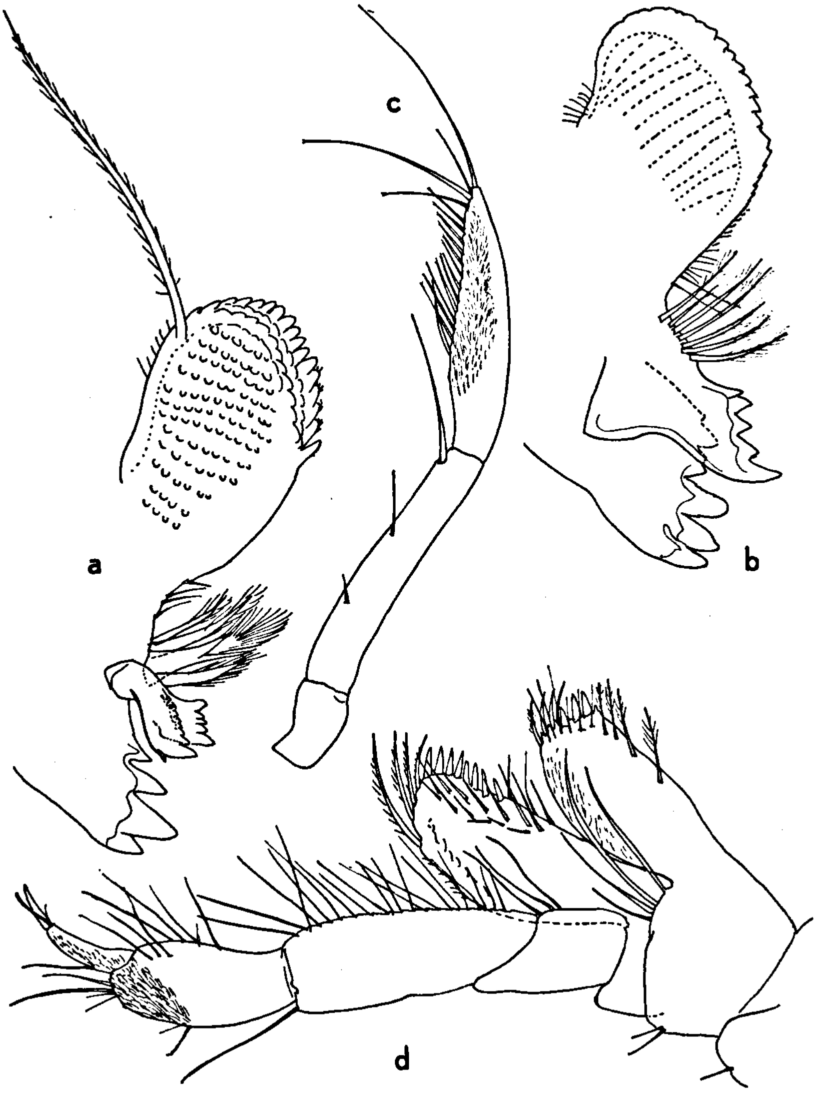

Fig. 48. – *Saliweckelia emarginata* n. gen., n. sp., paratypes.
a, masticatory part of right mandible, ♀ (scale C); b, same of left mandible, ♀ (C); c, mandible palp, ♂ (B); d, maxilliped, ♂ (B).

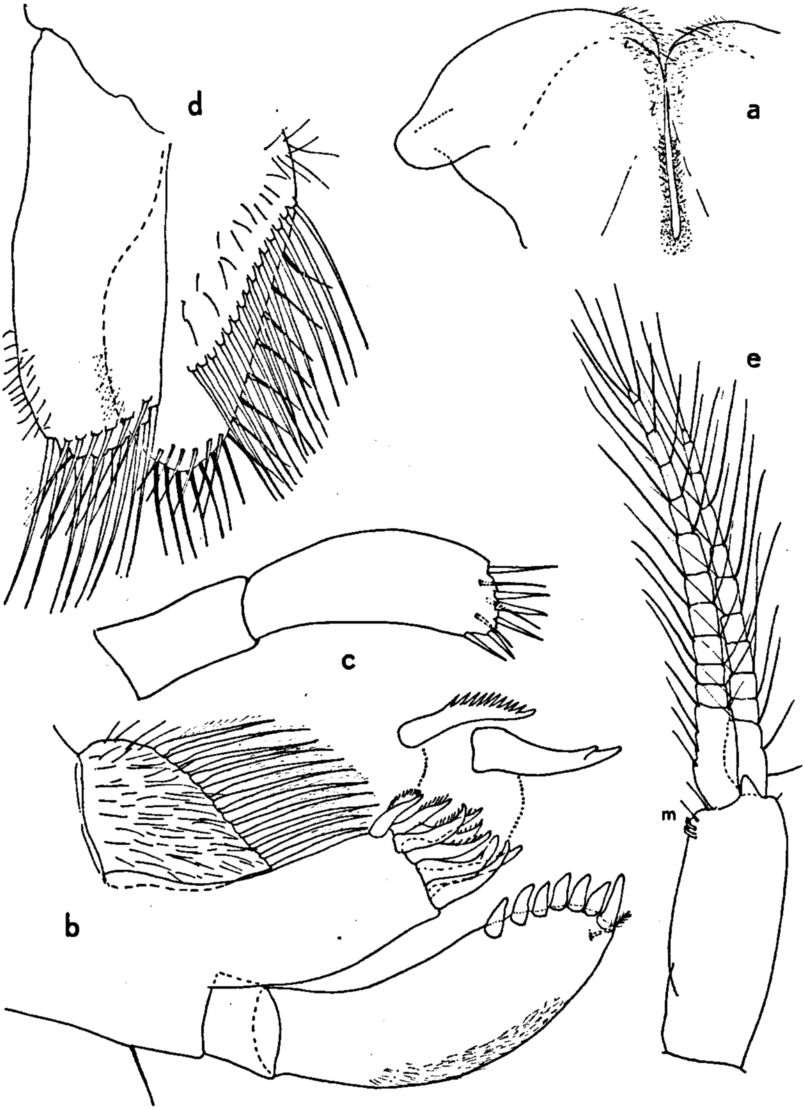

Fig. 49. – *Saliweckelia emarginata* n. gen., n. sp., paratypes.
a, labium, ♀ (scale B); b, right first maxilla, ♂ (C), with two of the spines of the outer lobe more strongly enlarged (to scale E); c, palp of left first maxilla, ♂ (C); d, second maxilla, ♂ (C); e, third pleopod, ♀ (plumosity of the setae omitted) (A). (m = medial side of the appendage).

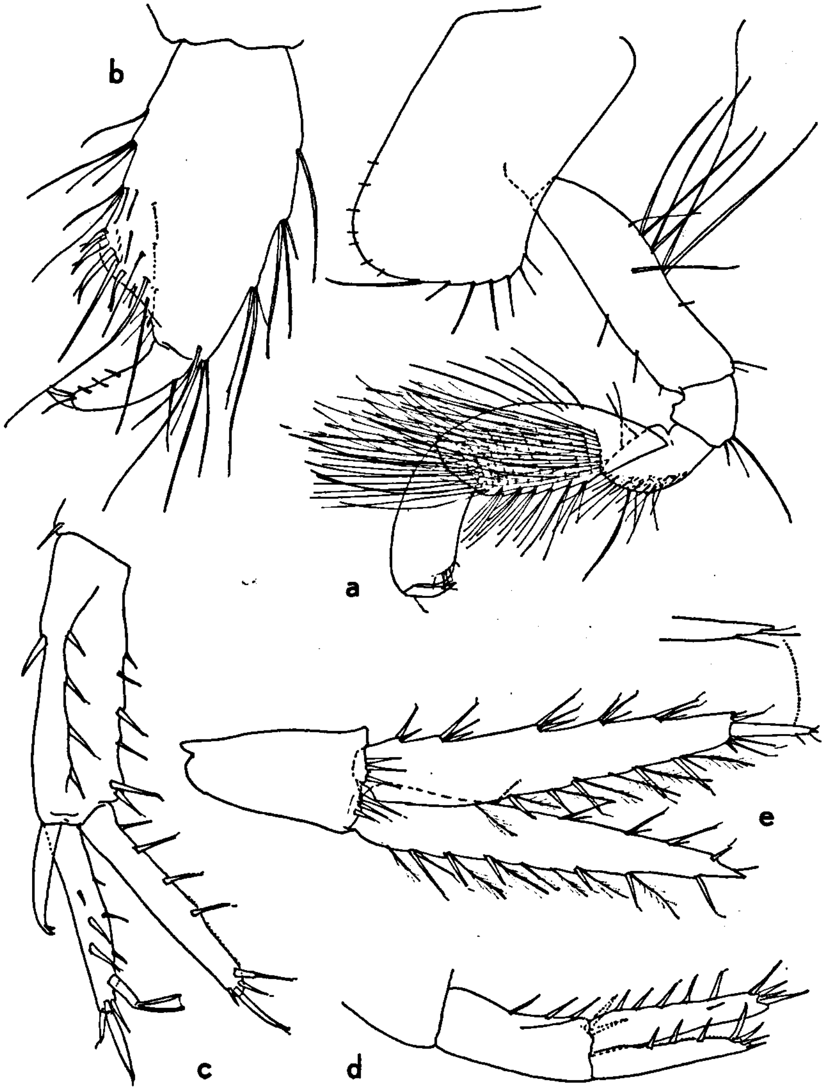

Fig. 50. – *Saliweckelia emarginata* n. gen., n. sp., paratypes.
a, first gnathopod, ♀ (scale A); b, distal segments of first gnathopod, ♀ (B); c, first uropod, ♂ (A); d, second uropod, ♂ (A); e, third uropod, ♂ (A), with the distal exopodite article more strongly enlarged (to scale B).

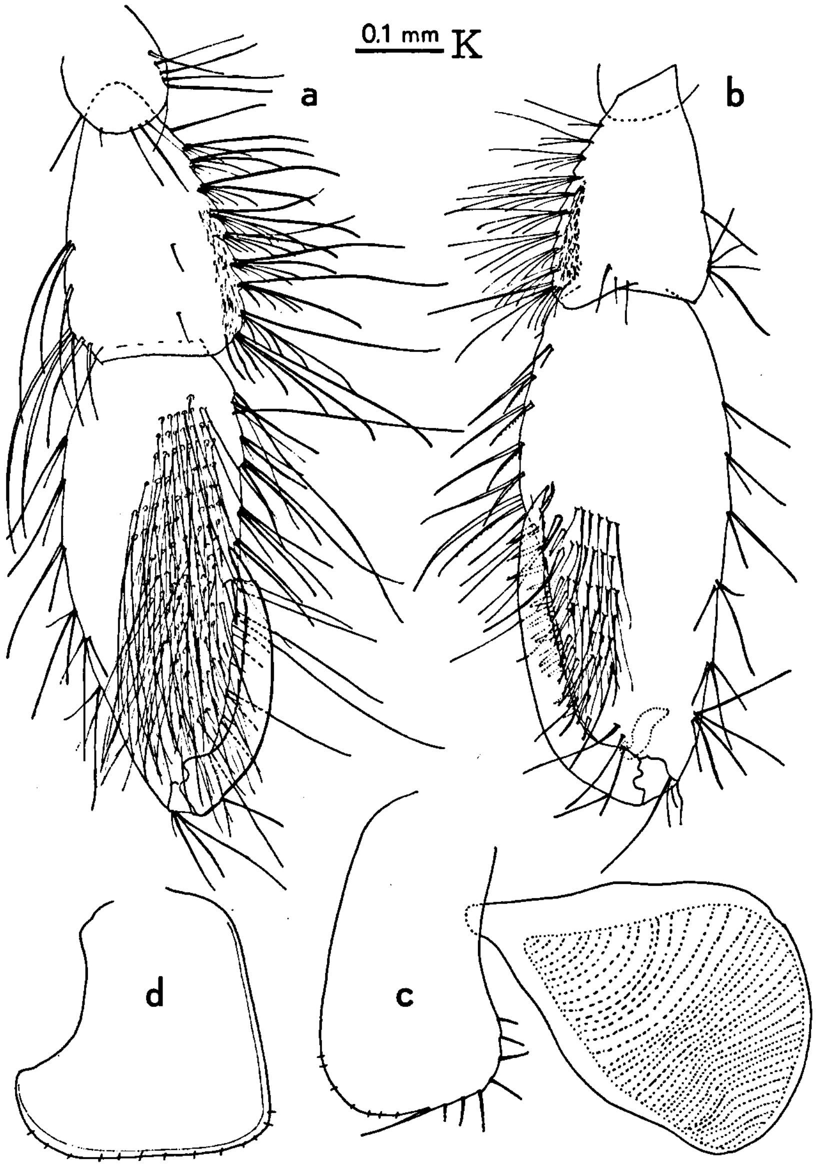

Fig. 51. – *Saliweckelia emarginata* n. gen., n. sp., paratypes.
a, second gnathopod, ♀ (scale K); b, second gnathopod, ♂ (K); c, coxal plate and coxal gill of second gnathopod, ♀ (I); d, coxal plate of pereiopod 4 (E).

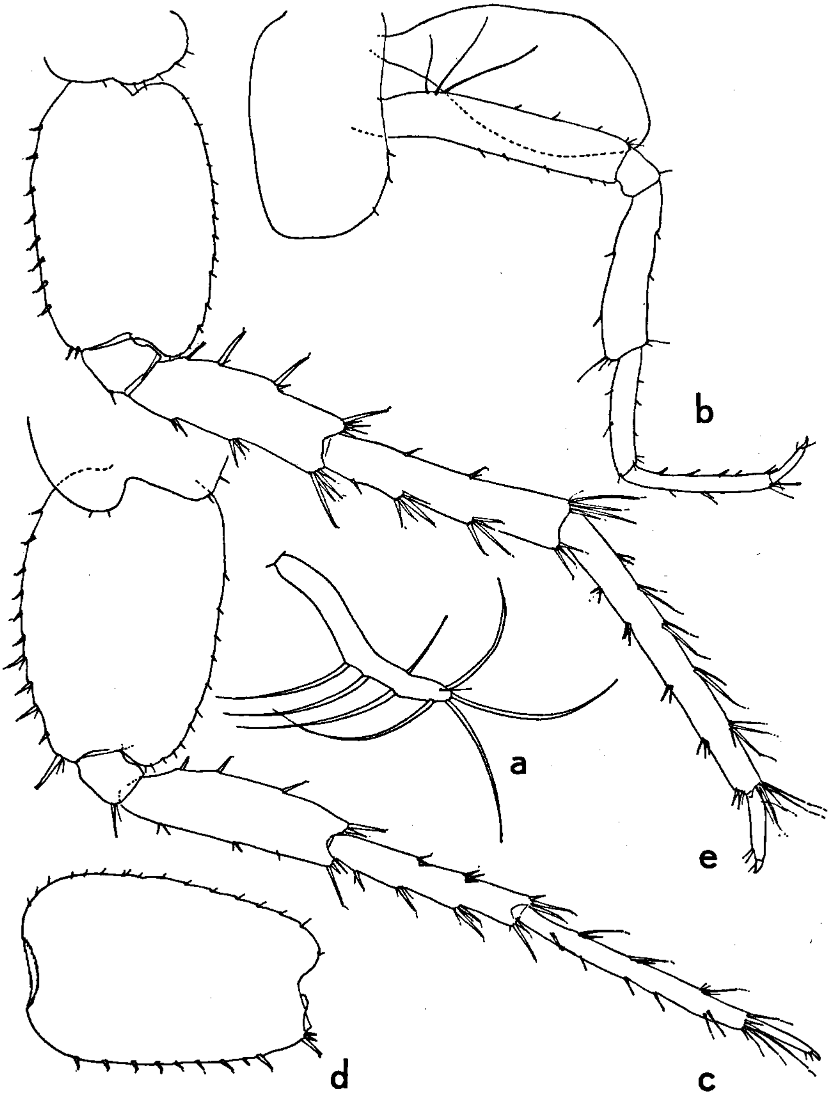

Fig. 52. – *Saliweckelia emarginata* n. gen., n. sp., paratypes.
a, oöstegite from second gnathopod, ♀ (scale I); b, third pereiopod, ♀ (E); c, fifth pereiopod, ♀ (E); d, basis of sixth pereiopod, ♀ (E); e, seventh pereiopod, ♀ (E).

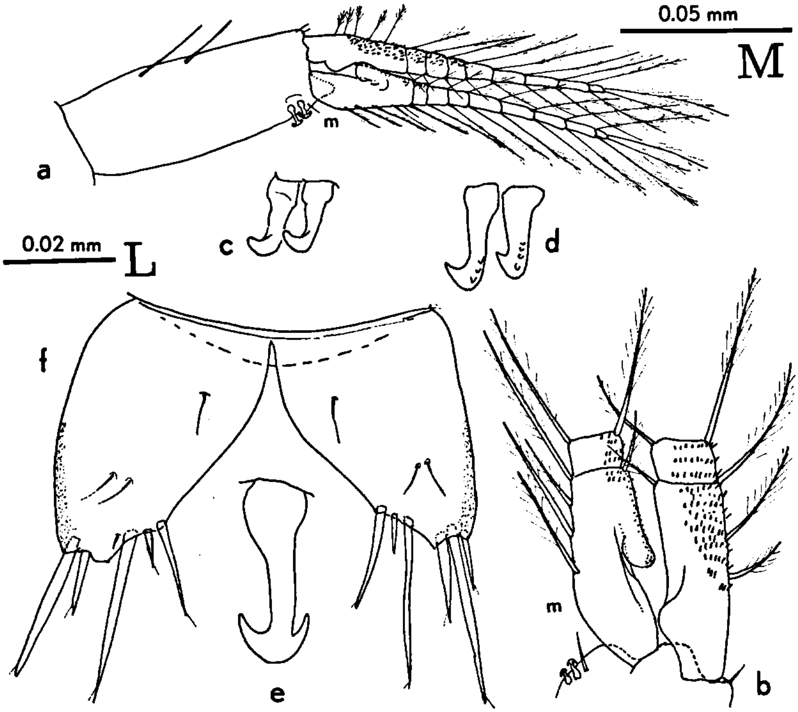

Fig. 53. – *Saliweckelia emarginata* n. gen., n. sp., paratypes.
a, third pleopod, ♂ (scale A); b, same, detail (B); c, retinacula of first pleopod, ♂ (L); d, retinacula of third pleopod, ♀ (L); e, retinaculum of third pleopod, ♂ (L); f, telson, ♀ (B). (m = medial side of the appendage).

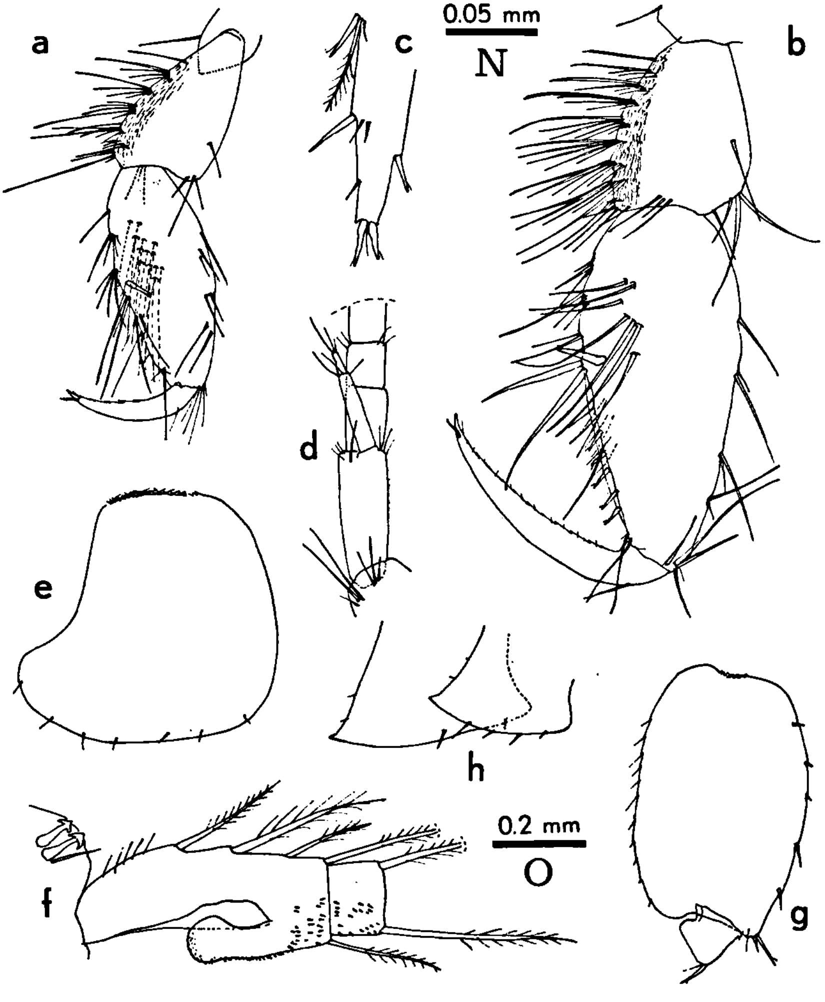

Fig. 54. – *Saliweckelia holsingeri* n. sp., from Bonaire, ♂ holotype, ♀ paratype. a, second gnathopod, ♀ (scale K); b, second gnathopod, ♂ (K); c, distal end of endo-) podite of 3rd uropod, ♂ (J); d, accessory flagellum of first antenna, ♂ (K); e, fourth coxal plate, ♀ (K); f, proximal endopodite segments of third pelopod, ♂ (N); g, basis of fifth pereiopod, ♂ (I); h, second and third epimeral plates, ♀ (O).