Bijdragen tot de Dierkunde, 52 (2): 207-227 — 1982

AMSTERDAM EXPEDITIONS TO THE WEST INDIAN ISLANDS, REPORT 20 *)

THE GENUS *HETEROCYPRIS* (CRUSTACEA, OSTRACODA) IN THE WEST INDIES
PART I. TAXONOMIC CHARACTERS

by

NICO W. BROODBAKKER
Institute of Taxonomic Zoology, University of Amsterdam,
P.O. Box 20125, 1000 HC Amsterdam, The Netherlands

ABSTRACT

A redescription is provided of *Heterocypris margaritae* Margalef, 1961 (= *H. similis* Klie, 1933). *H. antillensis* n. sp., a species closely related to *H. margaritae*, is described. Taxonomic remarks are made on *H. punctata* Keyser, 1975, a species from Florida, which also inhabits part of the Caribbean islands and is related to both other species.

Descriptions of chaetotaxy were made according to the system of Broodbakker & Danielopol (1982) and form an example of the use of this system.

Carapace length seems to be a very variable character in this genus and must be used as a taxonomic character with great caution. The structure of the hemipenis seems to be a very valuable taxonomic character, as are the furca and maxillular palp and to a lesser degree the male maxilla. The form of the carapace seems to be quite characteristic of each species, but is more difficult to define and compare when material for comparison is not at hand and other characters are not provided.

RÉSUMÉ

Une redescription est présentée pour *Heterocypris margaritae* Margalef, 1961 (= *H. similis* Klie, 1933). On décrit *H. antillensis* n. sp., espèce étroitement apparentée à *H. margaritae*. Des observations taxonomiques sont faites à propos de *H. punctata* Keyser, 1975, espèce de la Floride et d'une partie des îles des Caraïbes, et qui est apparentée aux deux autres.

La chétotaxie a été décrite suivant le système de Broodbakker & Danielopol (1982); ceci représente un exemple d'utilisation de ce système.

La longueur de la carapace semble être un caractère fort variable dans le cadre de ce genre, devant être utilisé avec beaucoup de prudence en tant que caractère taxonomique. Par contre, la structure du hémipenis s'avère être un caractère taxonomique de grande valeur, ce qui est valable aussi pour la furca et pour le palpe maxillulaire, et, à un moindre degré, pour la maxille du mâle. La forme de la carapace semble être bien caractéristique pour chaque espèce; cependant, cette forme se prête plus difficilement à une définition et aux comparaisons, en l'absence d'un matériel de comparaison et quand d'autres caractères ne sont pas fournis.

*) Report 19 is published in the same issue of this journal.

INTRODUCTION

Not much is known about the distribution of freshwater ostracods in the West Indies. Only a few papers have been published, mostly based on samples of Dr. P. Wagenaar Hummelinck, especially from Aruba, Bonaire and Curaçao (Klie, 1933; Triebel, 1961, 1962), on samples from Margarita by Margalef (1961) and on samples from Trinidad by Van den Bold (1958).

In the period 1973-1982 the Amsterdam Expeditions have explored some 36 islands and island groups of the Antillean chain, part of the mainland of Venezuela and part of the Bahamas, for the presence of stygobionts (Stock, 1979). Many samples contained ostracods. In the expectation that part of these ostracods would also be stygobiont species, these samples were studied. However, nearly all samples proved to contain only epigean species (species normally dwelling in surface waters), except for some samples from Haiti and possibly Venezuela.

For this reason we decided to start a description of the epigean species found in subterranean habitats, to compare them with samples from epigean habitats, to reveal their ecological peculiarities in wells, if any, and to find out if they are temporal or permanent immigrants of these wells. Other aims are to answer the question whether microevolution and speciation has taken place in wells and other groundwater habitats and where the origin of the ostracod fauna in the West Indies is to be found.

We were fortunate receiving about 600 samples containing ostracods from mostly epigean habitats,

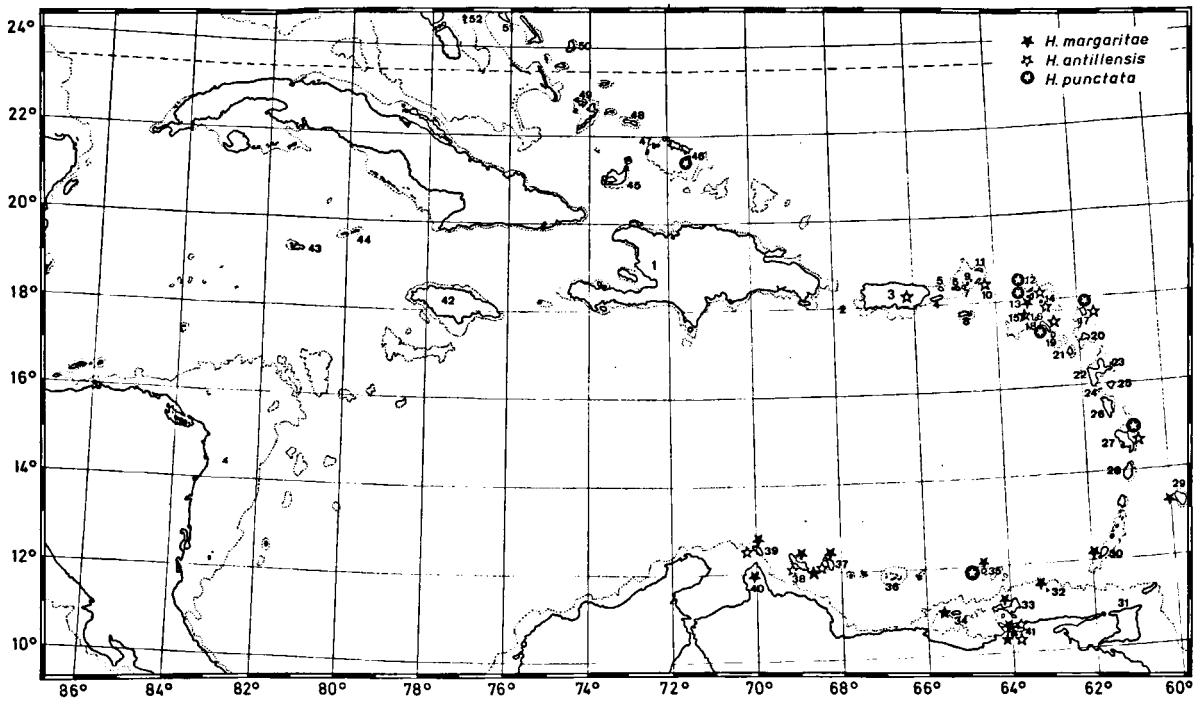

Fig. 1. Map of the Caribbean, showing (dotted) the 200 m line being the edge of the continental shelf. The numbers of the islands correspond with those in table I. The distribution of *Heterocypris margaritae* Margalef, 1961, *H. antillensis* n. sp. and *H. punctata* Keyser, 1975 is indicated.

sampled by Dr. P. Wagenaar Hummelinck from 1936-1973 in the West Indies. This collection made it possible to make a better comparison between epigean and groundwater habitats and to investigate the distribution of the species on the islands.

The taxonomic system of Alm (1915) as adapted by Maddocks (1969), will be used to divide the order of Cypridacea in families and subfamilies. According to this system, most of the species present in the West Indies belong to the subfamilies of Cypridinae and Cyclocypridinae and most of them to the genera *Heterocypris, Hemicypris, Cypris, Chlamydotheca, Strandesia, Stenocypris, Cypretta, Cypridopsis* (all Cypridinae) and *Physocypria* (Cyclocypridinae). Species of the Darwinulidae and of the subfamily Candoninae were encountered much less, the Darwinulidae mostly in springs and the Candoninae in wells. Even in subterranean habitats where real stygobiont taxa like Thermosbaenacea, *Metaniphargus, Ingolfiella, Bogidiella* or Harpacticoidea were encountered, no specialized subterranean ostracod species were present (except for some samples from Haiti).

The present paper will deal with the three species of the genus *Heterocypris* that are present in the West Indies. An overall view of the presently known distribution of these species is provided in table I and fig. 1. Lists of stations with the number of specimens found, mean carapace length and some other information will be provided in part II of this paper. For further details about the different stations the reader is referred to Stock (1979) and Wagenaar Hummelinck (1940 a-b, 1953 & 1981) abbreviated in the sequel as S and WH, respectively.

TAXONOMIC PART

Family CYPRIDIDAE Baird, 1845
Subfamily CYPRIDINAE Baird, 1845

Genus **Heterocypris** Claus, 1893

The genus *Heterocypris* was established on the basis of *Heterocypris incongruens* (Rahmdohr,

TABLE I

Antillean islands investigated during the Amsterdam Expeditions to the West Indian Islands, 1973-1982 and the expeditions of Dr. P. Wagenaar Hummelinck, 1936-1973. (Island numbers are also indicated in fig. 1.) Only fresh- and brackish water samples are indicated.

	Samples from Amsterdam Expeditions (S = Stock)					Samples taken by Dr. Wagenaar Hummelinck (WH)			
Island or island group (V = predominantly volcanic, C = predominantly calcareous)	No. of nonmarine samples	No. of samples containing ostracods	Samples containing *Heterocypris* *marg.*	*antil.*	*punct.*	No. of samples containing ostracods	Samples containing *Heterocypris* *marg.*	*antil.*	*punct.*
1. Haiti (C/V) 1978-1979	58	31	—	—	—	—			
2. Mona (C)	3	1	—	—	—	—			
3. Puerto Rico (C/V)	20	2	—	—	—	4	—	1	—
4. Vieques (C)	8	3	—	—	—	—			
5. Culebra (C)	13	5	—	—	—	—			
6. St. Thomas (C)	2	1	—	—	—	1	—	—	—
7. St. John (C)	9	4	—	—	—	—			
8. St. Croix (C)	7	1	—	—	—	1	—	—	—
9. Tortola (incl. Beef Isl. and Frenchman's Cay)	22	11	—	—	—	—			
10. Virgin Gorda (C)	15	8	—	1	—	—			
11. Anegada (C)	14	8	—	—	—	—			
12. Anguilla (C)	16	9	—	—	—	3	—	—	—
13. St. Martin (C/V)	40	13	—	3	—	19	1	5	6
14. St. Barths (V)	15	5	—	1	—	—			
15. Saba (V)	3	—	—	—	—	2	—	—	—
16. St. Eustatius (V)	15	4	—	—	—	7	—	—	—
17. Barbuda (C)	16	2	—	1	—	11	—	7	2
18. St. Kitts (V)	—					2	—	—	1
19. Nevis (V)	—					3	—	—	—
20. Antigua (C/V)	15	6	—	—	—	1	—	—	—
21. Montserrat (V)	—					3	—	—	—
22. Guadeloupe (C/V)	14	2	—	—	—	1	—	—	—
23. La Désirade (C)	—					3	—	—	—
24. Îles des Saintes (C)	—					2	—	—	—
25. Marie Galante (C)	—					10	—	—	—
26. Dominica (V)	1	—				—			
27. Martinique (V)	4	2	—	—	—	4	—	1	1
28. St. Lucia (V)	1	1	—	—	—	—			
29. Barbados (C)	30	9	—	—	—	10	1	—	—
30. Grenada (V)	—					3	1	—	—
31. Trinidad (C)	—					6	—	—	—
32. Los Testigos (V/C)	3	2	—	—	—	1	1	—	—
33. Margarita (V/C)	16	8	6	—	—	9	2	—	—
34. Tortuga & Tortugillo (C)	5	3	1	—	—	—			
35. La Blanquilla (C/V)	5	5	3	—	1	3	—	—	—
36. Los Roques (C/V)	4	3	—	—	—	—			
37. Bonaire & Klein Bonaire (C)	81	41	7	3	—	40	10	11	—
38. Curaçao & Klein Curaçao (C/V)	74	15	—	—	—	42	1	14	—
39. Aruba (C)	48	15	3	3	—	22	6	6	—
40. Paraguana (Venezuela) (C)	10	3	2	—	—	3	1	—	—
41. Araya (Venezuela) (C/V)	—					3	1	2	—
42. Jamaica (C)	26	11	—	—	—	2	—	—	—
43. Grand Cayman (C)	14	11	—	—	—	4	—	—	—
44. Cayman Brac (C)	15	9	—	—	—	—			
45. Inagua (C)	11	7	—	—	—	—			
46. South Caicos (C)	5	4	—	—	2	—			
47. Providenciales (C)	11	6	—	—	—	—			
48. Mayaguana (C)	23	12	—	—	—	—			
49. Crooked Island (C)	18	17	—	—	—	—			
50. San Salvador (C)	8	8	—	—	—	—			
51. Eleuthera (C)	26	10	—	—	—	—			
52. New Providence (C)	8	3	—	—	—	—			

marg. = *margaritae*, *antil.* = *antillensis*, *punct.* = *punctata*. Part of the samples of Haiti and Puerto Rico have not yet been studied.

1808) and its morphological and taxonomic characters have been adequately discussed by Pürper & Würdig-Maciel (1974), Malz (1976), Victor & Fernando (1981) and Battish (1981). There was some confusion about the genera *Cyprinotus, Hemicypris* and *Heterocypris,* but most of the recent papers have adopted these three genera with the characteristics as provided by Pürper & Würdig-Maciel (1974) in their comparative generic table.

Of the other two genera mentioned, only the genus *Hemicypris* was encountered in the West Indies. This genus will be dealt with in a next paper.

The description of the chaetotaxy of the limbs will be made according to the system of Broodbakker & Danielopol (1982), which is presented in the same issue of this journal.

Heterocypris margaritae Margalef, 1961
Figs. 1-5, 10B-C.

Heterocypris similis Klie, 1933: 372-374, figs. 6-11.
Heterocypris margaritae Margalef, 1961: 104-106, figs. 13-14.

Material. — Syntypes: ZMA Ost. 150.723, WH 63b, Klein Bonaire, Tanki (Pos) Calbas, 12°09'20"N 68°18'14"W, 9-VI, 17-X and 27-XI-1930.
Topotypes: ZMA Ost. 150.721, WH 63e, 20-VIII-1955, 25 ♂♂ and 25 ♀♀ dissected, used for redescription and measurements. Furthermore about hundred undissected specimens.

This station is proposed to be the restricted type-locality, since Klie (1933) did not indicate a type-locality. The other stations where this species was encountered will be listed in part II of this paper.

This species was first described by Klie (1933) from Bonaire, Klein Bonaire and Aruba. Klie described it under the name of *Heterocypris similis,* which name was already used by Wierzejski (1893) for another *Heterocypris* species from Argentina (redescribed by Ramirez, 1967). The carapace of the latter species is larger (1.5 mm length), it has a different shape and it has longer anterior and posterior setae on its furca. According to the drawings of Ramirez (1967) the hemipenis is very similar to that of *H. margaritae.*

Klie compared his species with *H. affinis* Klie, 1929, and *H. hyalinus* Klie, 1929, from Paraguay, which are rather differently shaped, more elongated, and also have different copulatory organs. *H. margaritae* looks more like *H. communis* Klie, 1940, which has about the same shape and size and also the same type of male copulatory organ, and comparable female genital lobes.

The various *Cyprinotus* species described by Furtos (1936) from Yucatan do not agree with this species, neither does *H. margaritae* conform with any of the North American species of this genus in the key of Tressler (1959). *Heterocypris panningi* Brehm, 1934, from Chili, is much more rounded.

H. margaritae was next described by Margalef (1961) from the island of Margarita. Margalef found the species in several pools and ditches and named it after the island. Margalef's specific epithet is the valid name for this species.

Known geographical distribution. — Venezuela (districts Coro and Araya, Isla de Margarita, Los Testigos, La Blanquilla, Tortugillo), (Klein) Bonaire, Curaçao, Aruba, Grenada, Barbados and St. Martin (all in the Lesser Antilles).

Description

Carapace (fig. 2):

In dorsal view greatest width at about the middle, being about 0.4 times the length. Left valve somewhat wider and overlapping the right valve. In lateral view (figs. 2A-B, E) greatest height just behind the middle of the carapace. The height is about half the length of the carapace. Both valves regularly arched, dorsal margin passing smoothly into the posterior and anterior margins. Anteriorly the bend is slightly stronger. Ventral margin nearly straight.

The carapace is very soft and whitish transparent. Surface smooth with sparse hairs and densely punctated. Hinge adont. Muscle scars typical of Cypridinae.

Left valve: Marginal pore canals distinct at the anterior and anteroventral margin, simple and straight. Inner lamella moderate, anteriorly somewhat broader than posteriorly. Flange anteroventrally more conspicuous. Selvage not pronounced.

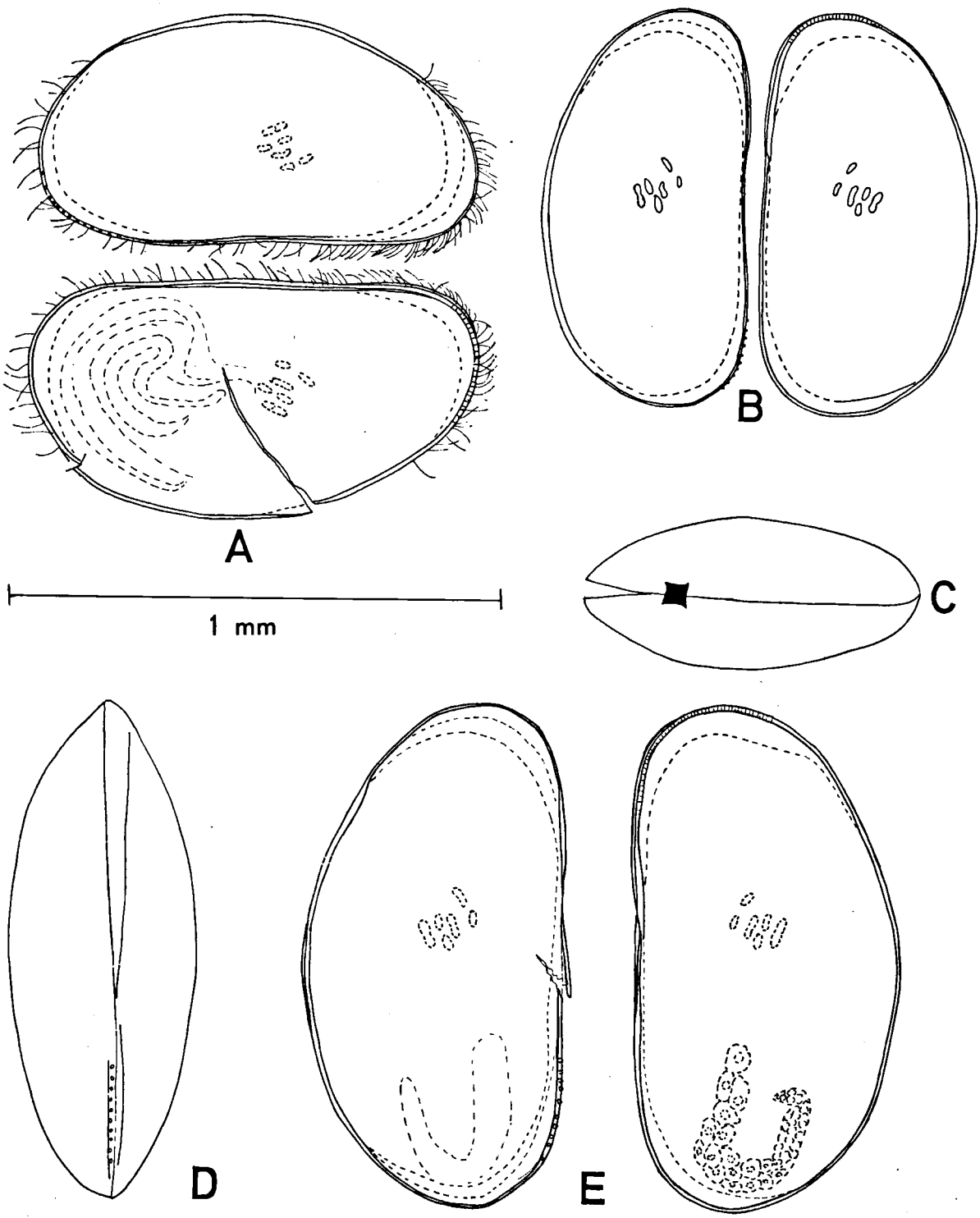

Fig. 2. A-E, *Heterocypris margaritae* Margalef, 1961 (Pos Calbas, Klein Bonaire, WH 63e; A-C, male; D-E, female): A-B, right and left valves ♂ no. 1 and ♂ no. 9; C-D, carapace in dorsal and ventral view; E, right and left valve ♀ no. 10.

Right valve: Marginal pore canals indistinct. Presenting small tubercles at the posteroventral margin. Selvage pronounced at anterior side, sometimes also clear at posterior side (fig. 2E). Vestibule anteriorly somewhat wider than in left valve, posteriorly about same width as in left valve.

Male carapace of same shape as female one, only smaller. In the restricted type-locality the mean carapace length is 0.98 ± 0.05 mm for females and 0.86 ± 0.05 mm for males, mean heights are 0.51 ± 0.03 mm and 0.45 ± 0.02 mm, respectively (table II). The male is 88% the length of the female. Sex ratio 34. In the other localities the mean length ranges from 0.86 to 1.09 mm for females and from 0.78 to 0.93 mm for males. The male length is 83-92% of the female length. Sex ratios range from 27-100, defined as number of males per hundred females.

Antennula (A 1) (figs. 3A, D):
E I: A-1*s*, P-2*l*(pl)/E II: A-1*s*, P-r/E III: A-1*s*, P- 1*s*/E IV: A-2*l*, P-1*s*-1*m*/E V: A-2*l*, P-2*l*/E VI: A-1*s*-2*l*, P-2*l*/E VII: D-y_a-1*m*-2*l*.
The chaetotaxy is identical for males and females. The proportional lengths of the segments III to VII are: 2.3 : 1.6 : 1.2 : 1.2 : 1.0.
The short seta of segment VI is about 3/4 of the length of the aesthetasc y_a, which is about as long as the third segment. Rome's organ (r) is small and bottle-shaped.

Second antenna (A 2) (figs. 3B-C, E-F):
Pr: P-1*l*/Exo: 1*l*(pl)-2*s*/E I: In-5*l*-1*s*, P-Y-1*m* (pa)/E (II+III): A-2*m*.
So far it is the same in male and female, but the rest of the chaetotaxy of E (II+III) is different:

♀: E (II+III): D-y_2-2*l*(z_2,z_3)-1*m*(z_1)-3*m* ($G_{1,2,3}$:2ser), P-1*m*(t_1:pl)-2*l*($t_{2,3}$:pl)-1*m*(t_4)/E IV: D-y_3-1*m*(G_M:2ser)-1*m*(G_m: 1ser)-1*s*-1*m*.

♂: E (II+III): D-y_2-1*s*(z_1:1ser)-1*s*(z_2)-1*l* (z_3)-3*m*($G_{1,2,3}$:1ser), P-2*s* ($t_{1,3}$:pl)-1*m*(t_2:pl)/E IV: D-y_3-1*m*(G_M:1ser)-1*s*(G_m: 1ser)-2*s*.

Measurements of the relative lengths of some segments and setae are listed in table II.

The outer swimming bristle is half as long as E I. The other five are 2.5 times as long as E I (table II). In the female there are three plumose and one smooth t setae at the postero-interior side of segment E (II+III). The setae t_1 and t_4 are somewhat longer than half E I, t_2 and t_3 are about as long as E I (fig. 3C). In the male, t_4 has disappeared, t_1 and t_3 are somewhat longer than half E I, and t_2 is 2/3 of the length of E I.

In the female the three z setae are situated at the intero-anterior side of E (II+III), z_2 and z_3 are 1.5 times as long as E I and z_1 is about as long as E I. In the male z_1 and z_2 have moved to the medio-interior side of E (II+III), z_2 is shortened to about half the length of E I and z_1 is transformed into a serrate claw half as long as E I.

The three distal claws ($G_{1,2,3}$) of E (II+III) in the female are double serrated, G_1 being antero-interiorly, G_2 antero-exteriorly and G_3 postero-interiorly situated. G_1 and G_3 are as long as and G_2 is 0.8 of the length of E I. In the male the claws bear only one row of teeth though more strongly developed; G_1 and G_2 are as long as E I while G_3 has moved somewhat anteriad and is shorter and slimmer than in the female. G_M is larger and G_m is smaller than in the female (table II).

Mandible palp (Mdp) (figs. 4A-B):
I: In-3*l*($S_{1,2}$: pl)-α/II: In-3*l*(pl)-1*m*(pl)-β, Ex-3*m*/III: In-1*m*-1*s*, Ex-1*l*-3*m*, A-2*m*-1*s*-γ/IV: D-3*m*(cs: 2ser)-3*s*.
The mandibular palp is identical in males and females. The α seta is thin and about as long as the third segment. The β seta is broad, plumose and 0.75 × the length of the third segment. The γ seta is still broader with long setules, being about half as long as segment III.

Maxillula (Mxu) (figs. 4D-E):
Mxup I: Ex-1*l*-4*m*(pl)-1*s*/II: D-3cs-3*m*/Mastic 1: In-2*m*, D-12*s*(cs)/2: D-8*m*/3: In-1*l*, D-2*m*(cs: 2ser)-3*m*-5*m*(pa).
The maxillula is identical in males and females. The three chelate setae of Mxup II are somewhat

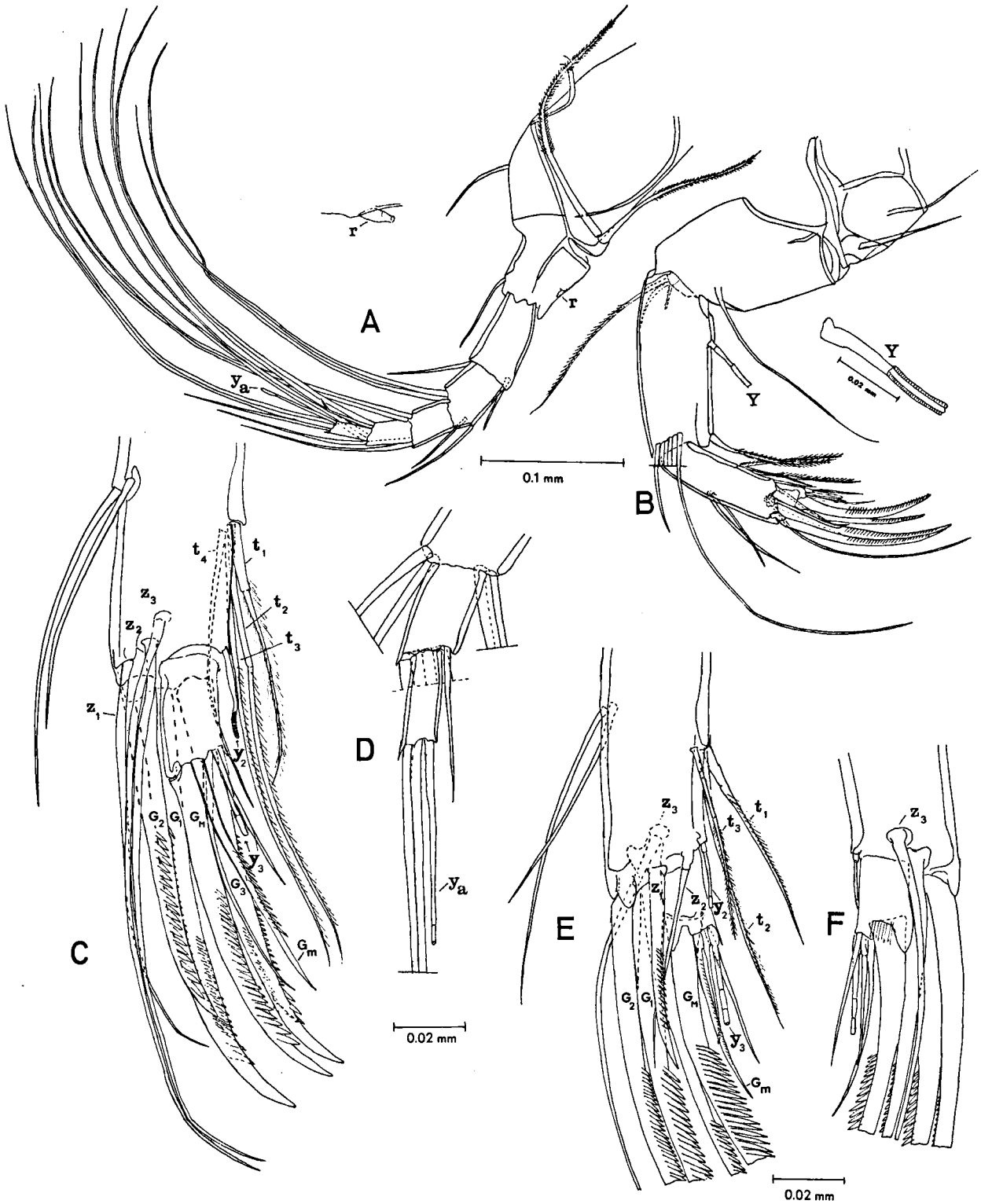

Fig. 3. A-F, *Heterocypris margaritae* Margalef, 1961 (Pos Calbas, Klein Bonaire, WH 63e; A-B, D-F ♂ no. 1; C, ♀ no. 17): A, antennule, with detail of Rome's organ (r); B, second antenna, with detail of aesthetasc Y; C, detail of second antenna; D, detail of antennule; E-F, detail of second antenna from interior and exterior side.

TABLE II

Length and height of carapaces and relative length of segments and setae of appendages of the three *Heterocypris* species in the localities chosen.

	H. margaritae (WH 63e)				*H. antillensis* (WH 383)				*H. punctata* (WH 528)			
	♂♂ mean ± SD	(*n*)	♀♀ mean ± SD	(*n*)	♂♂ mean ± SD	(*n*)	♀♀ mean ± SD	(*n*)	♂♂ mean ± SD	(*n*)	♀♀ mean ± SD	(*n*)
Carapace:												
Right valve length (mm)	0.86 ± 0.04	(19)	0.98 ± 0.05	(21)	1.17 ± 0.03	(20)	1.33 ± 0.03	(23)	1.21 ± 0.04	(14)	1.39 ± 0.04	(14)
height (mm)	0.44 ± 0.02	(17)	0.51 ± 0.03	(20)	0.58 ± 0.02	(20)	0.66 ± 0.02	(23)	0.68 ± 0.02	(12)	0.78 ± 0.03	(13)
Left valve length (mm)	0.86 ± 0.04	(22)	0.99 ± 0.05	(25)	1.20 ± 0.04	(25)	1.38 ± 0.04	(25)	1.26 ± 0.04	(14)	1.43 ± 0.05	(15)
height (mm)	0.46 ± 0.02	(21)	0.52 ± 0.03	(24)	0.61 ± 0.02	(23)	0.68 ± 0.02	(25)	0.72 ± 0.02	(13)	0.82 ± 0.03	(15)
A 2: (rest in %)												
Y / E I	34 ± 2	(25)	34 ± 2	(25)	30 ± 1.5	(25)	30 ± 1.5	(24)	29 ± 1	(15)	28 ± 1	(15)
E(II+III) / E I	69 ± 3	(25)	65 ± 3	(25)	70 ± 3	(25)	71 ± 2	(24)	69 ± 2	(15)	66 ± 2	(15)
G_M / E I	77 ± 3	(24)	68 ± 3.5	(25)	68 ± 3	(25)	62 ± 2	(24)	76 ± 4	(15)	75 ± 3	(15)
Swimming bristles / E I	242 ± 9	(25)	237 ± 14	(25)	199 ± 6	(25)	190 ± 5	(24)	236 ± 7	(15)	231 ± 6	(15)
Outer swimm. bristl. / E I	—		51 ± 3	(25)	49 ± 3.5	(25)	51 ± 2	(24)	52 ± 3	(15)	52 ± 2	(15)
Mxu:												
Mxup II Length/width	156 ± 12	(24)	154 ± 9	(25)	222 ± 11	(25)	218 ± 10	(24)	165 ± 8	(13)	166 ± 10	(15)
Mxup cs II / II	214 ± 9	(24)	217 ± 13	(25)	171 ± 11	(24)	176 ± 9	(24)	184 ± 11	(12)	185 ± 9	(15)
Mastic 3 cs: ser / Mxup II	200 ± 9	(24)	192 ± 16	(25)	154 ± 10	(25)	158 ± 10	(24)	164 ± 13	(13)	167 ± 10	(12)
T 1:												
S (E III) / E II	99 ± 7	(24)	94 ± 6	(25)	59 ± 8	(24)	59 ± 4	(24)	65 ± 5	(15)	65 ± 7	(15)
Fu:												
G_a / R	44 ± 3	(23)	45 ± 2	(23)	46 ± 1.5	(25)	49 ± 2	(25)	45 ± 2	(14)	45 ± 3	(15)
G_p / G_a	67 ± 3.5	(23)	66 ± 3	(25)	64 ± 3	(25)	66 ± 1.5	(25)	71 ± 3	(14)	72 ± 4	(14)
s_a / G_a	32 ± 2	(22)	32 ± 2.5	(22)	20 ± 3.5	(24)	41 ± 4	(25)	35 ± 3	(14)	58 ± 5	(13)
s_p / G_p	78 ± 6	(24)	83 ± 8	(25)	55 ± 4	(25)	53 ± 3	(24)	70 ± 5	(14)	81 ± 7	(15)
Zenker's rows of spines:	18 — 23		—		30 — 35		—		32 — 36		—	

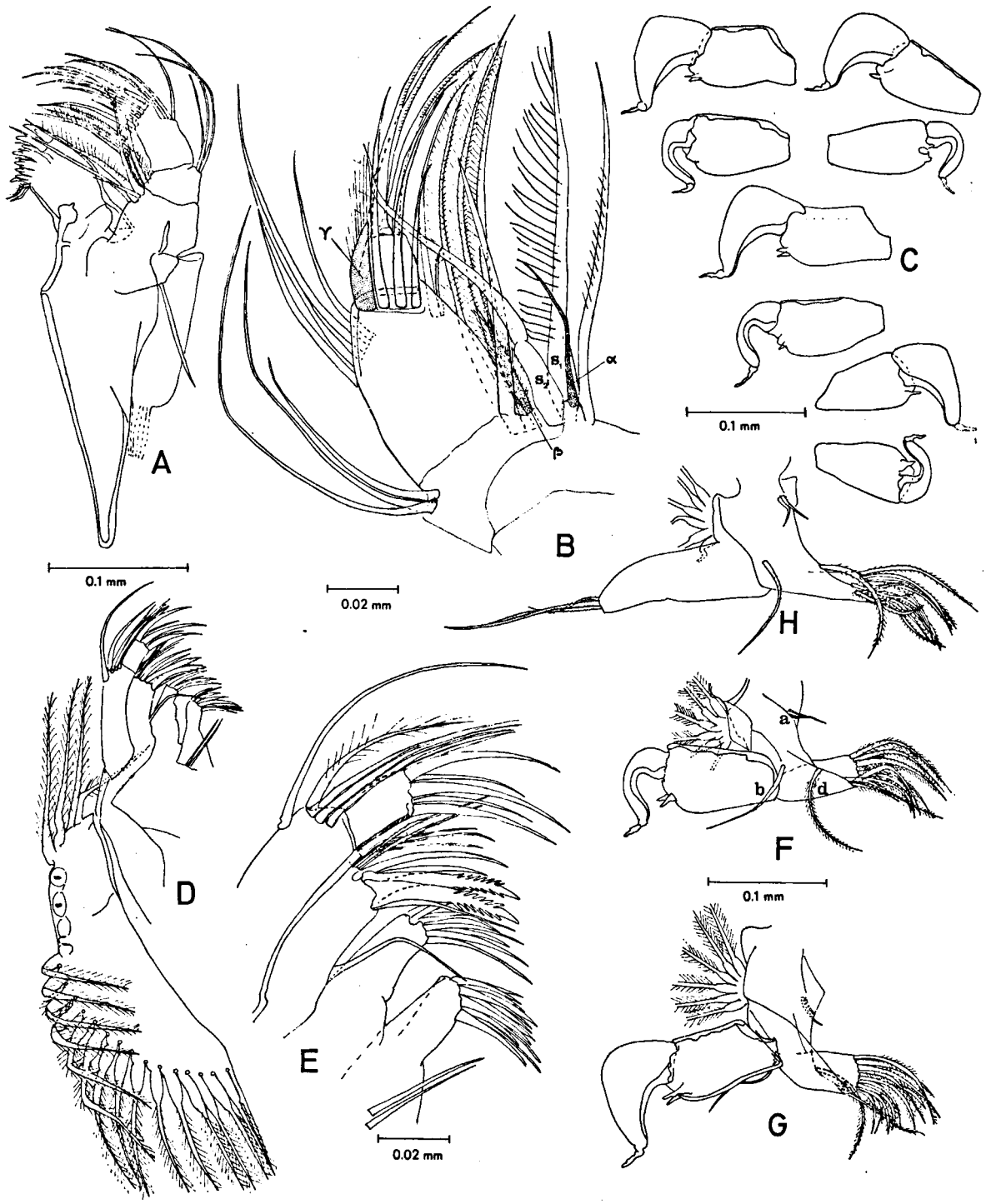

Fig. 4. A-H, *Heterocypris margaritae* Margalef, 1961 (Pos Calbas, Klein Bonaire, WH 63e; A-G, ♂ no. 1; H, ♀ no. 1): A-B, mandible and mandibular palp; C, maxillar endopodite in different males from the same station; D-E, maxillula with detail of palp; F-G, male maxillae; H, female maxilla.

longer than two times the length of their segment. Mxup II is 1.5 times as long as wide. The distal half of the two chelate setae of Mastic 3 are serrate at two sides and the setae are twice as long as Mxup II (table II).

Maxilla (Max) (figs. 4C, F-H):
Pr: A-2a, In-b-d(pu)/Mastic: D-12*s*(pu)/Ex: P-6*m*(pu)/ E .....
So far the maxilla is identical in males and females. The endopodite in the female has two medium long setae and one small seta (fig. 4H). In the male the endopodite is transformed into a claw which is different on right and left side. There is some variation in the form of this claw as is shown in fig. 4C, also depending on the orientation in the slide. However, the variation within populations equals the variation between populations. The general morphology of the claw is the same for different populations.

Thoracopod 1 (T 1) (fig. 5 A):
Pr: A-2*s*/E I: A-1*s*/E II: A-1*s*/E III: A-2*s*/E IV: D-2*s*-1*l*(G: 2ser) (all setae plumose, except the distal setae of E IV).

Proportional lengths of segments and claw are: 5.8 : 3.6 : 3 : 1 : 8.7. The terminal claw is about 2.5 times as long as E II and 1.5 times as long as E I. The longest seta of E III is as long as E II (table II).

Thoracopod 2 (T 2) (figs. 5B-C):
Pr: Ex-2*m*(pu), In-1*m*(pu)/E I: P-1*m*(pa)/E (II+III): P-1*s*(pa), D-Lo-pz_1/E IV: In-1*m*(pu)-CL-pz_2-1*s*(cs:ser).
The first and second podomere of the protopodite are completely fused, as are the second and third podomere of the endopodite. The distal part of E (II+III) is a typical "pincer" complex as in most Cypridinae.

Furca (Fu) (fig. 5E):
The furca is slightly pectinated at the lower half of the posterior side. The distal claws are pectinated for two-thirds of their length. Both posterior and anterior setae are pappose. At the restricted type-locality the relative lengths of the claws, setae and ramus are as listed in table II. There are no statistically significant differences in relative lengths between males and females. The anterior

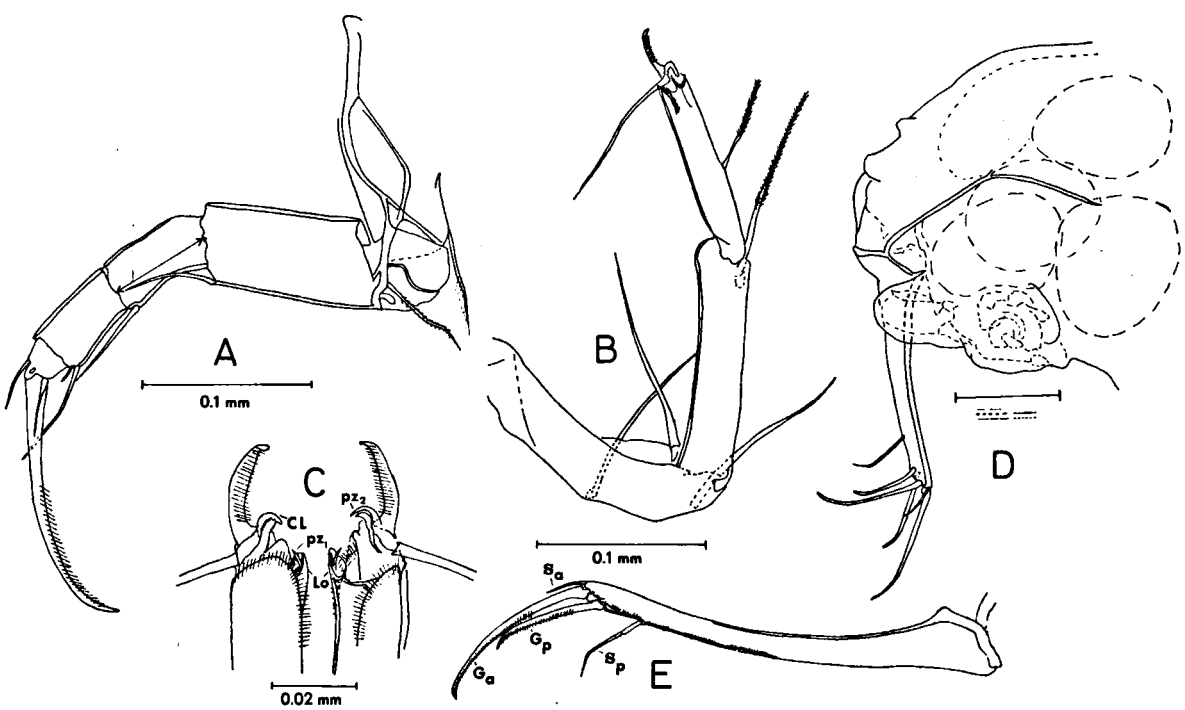

Fig. 5. A-E, *Heterocypris margaritae* Margalef, 1961 (Pos Calbas, Klein Bonaire, WH 63e; A-C, E, ♂ no. 1; D, ♀) A, thoracopod 1; B-C, thoracopod 2 and distal part; D, distal part of the female body (scale = 0.1 mm); E, furca.

claw (G_a) is nearly half the length of the ramus. The posterior claw (G_p) is two-thirds and the anterior seta (s_a) one-third of the length of G_a. The posterior seta (s_p) is 70-90% of the length of G_p.

Copulatory organs (figs. 5D, 10C):
The female copulatory organ has no particular internal characters. The outer shape is shown in fig. 5D. The organs protrude slightly posteriorly.

The Zenker's organs of the male are provided with 18 to 23 rows of spines. They are long and thin in young males and shorter and wider in older males. The hemipenis is a very complex structure which will be described along with those of the other two *Heterocypris* species, after the taxonomic descriptions.

Heterocypris antillensis n. sp.

Figs. 1, 6A-B, 7, 8A, 8C-E, 8H, 9A-E, 10A, 10D.

Material. — Holotype: ZMA Ost. 150.731, 1 ♀. Paratypes: ZMA Ost. 150.732, 24 ♀♀ and 25 ♂♂ on slides, ZMA Ost. 150.733, about 200 specimens.
Type-locality: WH 383, Bonaire, Pos Soedesthoed, 12°02'43"N 68°15'48"W.
The other stations where this species was found will be listed in part II of this paper.

Known geographical distribution. — Venezuela (Dto. Araya), Aruba, Curaçao, Bonaire, Martinique, Barbuda, Saba, St. Eustatius, St. Barthélemy, St. Martin, Virgin Gorda and Puerto Rico (fig. 1).

Description

Carapace (figs. 6A-B):
In dorsal view greatest width somewhat behind the middle at about two-fifths of the length. Left valve wider than and overlapping the right valve. In lateral view the greatest height is somewhat in front of the middle being about half the length of the carapace. At the highest part the dorsal margin forms an angle of 30° and progresses at first nearly straight, anteriorly as well as posteriorly. At the end the dorsal margin passes smoothly into the posterior and anterior margins, which are both rounded. At the top, the dorsal margin bends down stronger anteriorly than posteriorly.

The carapace is very soft and whitish transparent, its surface is smooth and densely punctated. Hinge adont. Muscle scars typical of Cypridinae.

Left valve: Marginal pore canals distinct at anterior and anteroventral margins, simple and straight. Inner lamella moderate, anteriorly somewhat wider than posteriorly. Flange anteroventrally more conspicuous. Selvage not pronounced.

Right valve: Marginal pore canals indistinct, presenting tubercles posteroventrally as well as anteriorly and anteroventrally. Selvage barely visible. Vestibule anteriorly and ventrally slightly wider than in left valve.

The form of male and female carapace is the same. Males are smaller. In the type-locality mean carapace length is 1.38 ± 0.04 mm for females and 1.20 ± 0.04 mm for males, mean height is 0.68 ± 0.02 mm and 0.61 ± 0.02 mm, respectively (table II). Sex ratio is 83.

At the other stations mean length ranges from 1.19-1.60 mm for females and from 1.06-1.36 mm for males. Male length is 81-91% of female length. Sex ratios range from 14-91.

Differences in carapace between *H. margaritae* and *H. antillensis* —. *H. antillensis* is less rounded with an angle of 30° in the dorsal margin. Tubercles of right valve are more strongly pronounced, anteriorly, anteroventrally as well as posteroventrally. Selvage less pronounced in anterior part of right valve. Marginal pore canals more distinct. Larger carapace.

Antennule (A 1) (fig. 7A):
E I: A-1*s*, P-2*l*(pl)/E II: A-1*s*, P-r/E III: A-1*s*, P-1*s*/E IV: A-2*l*, P-1*s*-1*m*/E V: A-2*l*, P-2*l*/E VI: A-1*s*-2*l*, P-2*l*/E VII: D-y_a-1*m*-2*l*.
All small setae are plumose. The chaetotaxy is identical in males and females and the same as in *H. margaritae*. The proportional lengths of the segments III to VII are: 2.3 : 1.3 : 1.1 : 1 : 1. The short seta of segment VI is slightly shorter than y_a, which is 70% of the length of E III. Rome's organ is small and bottle-shaped, like in *H. margaritae*.

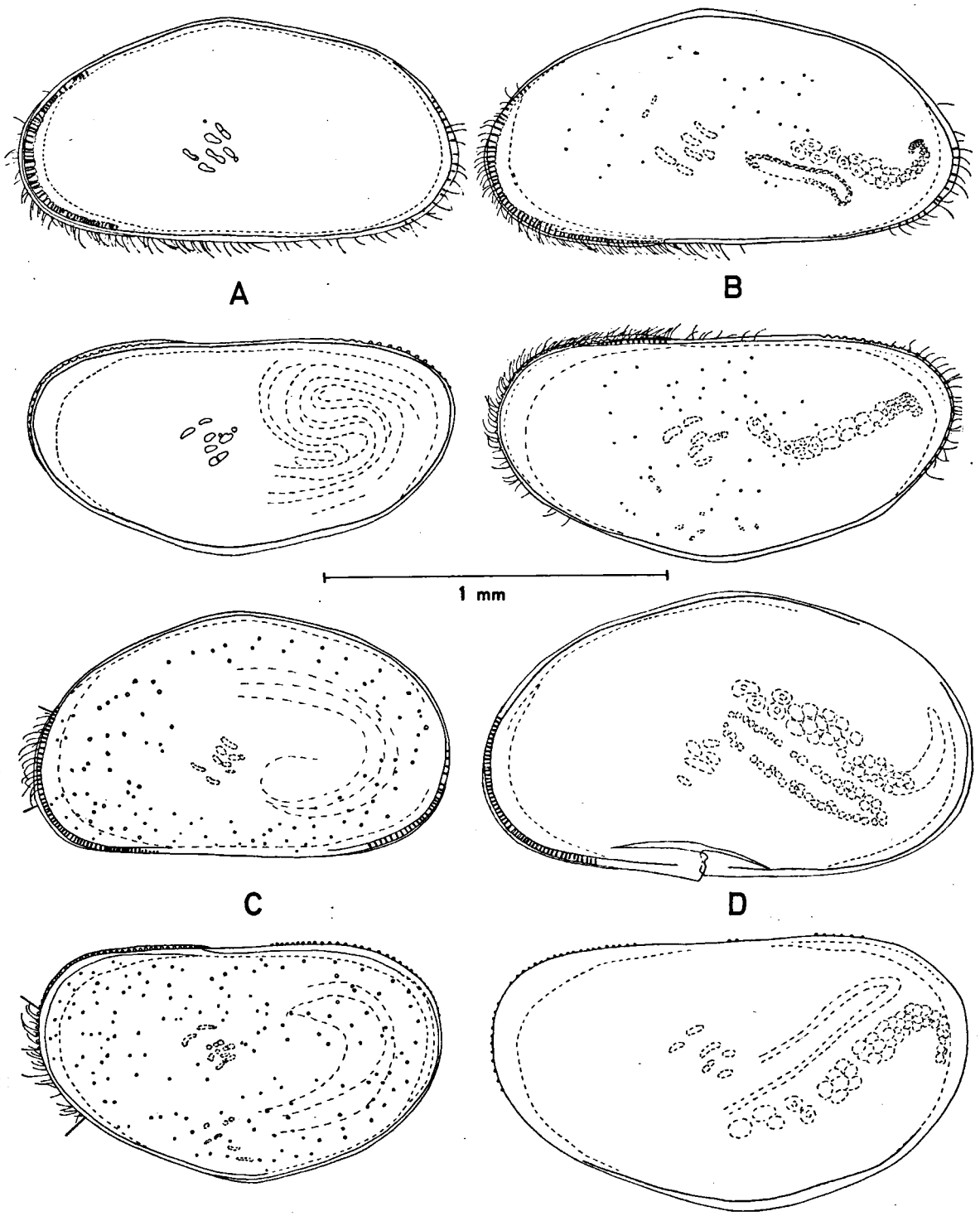

Fig. 6. A-B, *Heterocypris antillensis* n. sp. (Pos Soedesthoed, Bonaire, WH 383; A, ♂ paratype no. 2; B, ♀ holotype); C-D, *Heterocypris punctata* Keyser, 1975 (Pond of Point Blanche, St. Martin, WH 528; C, ♂ no. 2; D, ♀ no. 1); A-D, general view of left and right valves.

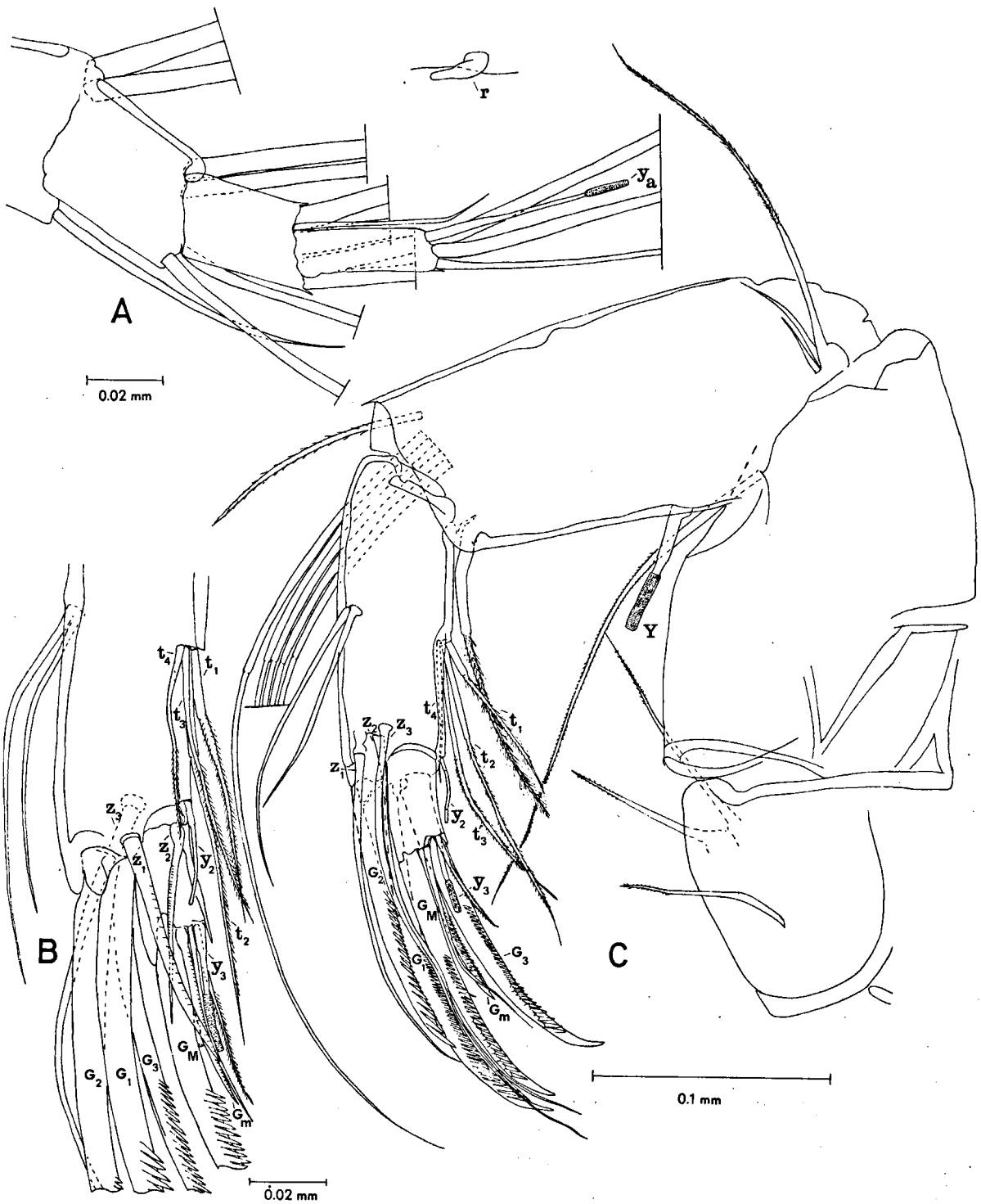

Fig. 7. A-C, *Heterocypris antillensis* n. sp. (Pos Soedesthoed, Bonaire, WH 383; A, C, ♀ holotype; B, ♂ paratype no. 1): A, detail of antennule and Rome's organ; B, detail of antenna 2; C, antenna 2.

Second antenna (A 2) (figs. 7B-C):
♂♂ and ♀♀: Pr: P-1*l*(pl)/Exo: 1*m*(pl)-2*s*/E I: In-5*l*-1*s*(pl), P-Y-1*m*(pa)/E (II+III): A-2*m*.

The rest of the chaetotaxy is different in males and females, and nearly the same as in *H. margaritae*. Only t_4 is not missing in the male. The other t and z setae are situated the same as in the males and females of *H. margaritae*. Seta z_1 is less serrate in the male, while z_2 is somewhat more clawlike and serrate, in contrast with *H. margaritae*. G_m has the same length in males and females, being only less serrate in males. G_M is somewhat smaller and G_3 stronger in females.

Relative lengths of some parts are listed in table II together with those of *H. margaritae*. The long swimming bristles are provided with long setules and are relatively shorter than in *H. margaritae*. The outer swimming bristle is about half the length of E I.

Mandibular palp (Mdp) (fig. 8A):
I: In 1*l*(pl:S_1)-2*m*(pl:S_2)-α/II: In-4*m*(pl)-β, Ex-2*l*-1*m*/III: In-1*m*-1*s*, Ex-1*l*-3*m*, A-1*s*-2*m*-γ/IV: D-3*m*(cs:2ser)-3*s*-5*s*(pa).
The mandibular palp is identical in males and females. The α seta is thin, its length being 70% of the length of segment III. The β seta is broad, plumose and as long as segment III and the γ seta still wider with long setules, its length being 60% of that of segment III. The mandibular palp is only slightly different from the one in *H. margaritae*.

Maxillula (Mxu) (fig. 8C):
Mxup I: Ex-1*l*(pl)-4*m* (pl)-1*s*/II: D-3*s*(cs)-3*s*/Mastic 1: In-2*s*, D-12*s*/2: D-8*s*/3: In-1*m*(pl), D-2*m*(cs:2ser)-3*s*-5*s*(pa).
The maxillula is identical in males and females. The chaetotaxy is the same as in *H. margaritae*. Mxup II is longer and 2.2 times as long as wide (table II). The chelate setae of Mxup II are 1.6-1.8 times as long as their segment. The distal half of the two chelate setae of Mastic 3 is serrate at two sides and 1.4-1.7 times as long as Mxup II (table II).

Maxilla (Max) (figs. 8D-E,H).
Pr: A-2a, In-b(pu)-d(pu)/Mastic: D-12*s*(pu)/Ex: P-6*m*(pu)/
So far the chaetotaxy is in males and females the same. However, the setae a are often not visible or broken off by dissection. The endopodite in the female bears at the end one medium and two small setae and somewhere in the middle a small seta, c. In the male the endopodite is transformed into a claw, which is different on the right and left side. The proximal part of these claws is somewhat longer and less wide than in *H. margaritae*. The distal part is the same for both species. There is some variation in shape, but the general form is similar in different populations.

Thoracopod 1 (T 1) (fig. 9A):
Pr: A-1*s*(pl)/E I: A-1*s*/E II: A-1*s*/E III: A-2*s*/E IV: D-2*s*-1*l*(G:2ser).
All setae plumose except the setae at the distal part of E IV. The setae of the protopodite are very vulnerable when the animal is dissected, so there could be two setae at this position like in *H. margaritae* where both setae were only encountered in one specimen. The proportional lengths of the segments and claw are: 5.6 : 3 : 2.7 : 1 : 8-9. The distal claw is 2.7-3.0 times as long as E II, and the longest seta of E III is 60% of the length of E II. This seta is much shorter than in *H. margaritae*.

Thoracopod 2 (T 2) (figs. 9B-C):
Pr: Ex-2*m*(pu), In-1*m*(pu)/E I: P-1*m*(pa)/E (II+III): P-1*s*(pa), D-Lo-pz_1/E IV: In-1*m*(pu)-CL-pz_2-1*s*(cs:ser).
The structure and chaetotaxy of this leg are the same as in *H. margaritae*, as is the pincer complex.

Furca (Fu) (fig. 9E):
The ramus is slightly pectinated at the lower third of the posterior side. The anterior and posterior claws (G_a, G_p) are pectinated for two-thirds of their length, the last even further. The top of the anterior seta is plumose while the greatest part of the posterior seta (s_p) is pappose. The relative lengths of claws and setae are provided in table II. G_a is slightly longer in the male and its length is about half that of the ramus. G_p is 60-68% of the length of G_a, as in *H. margaritae*.

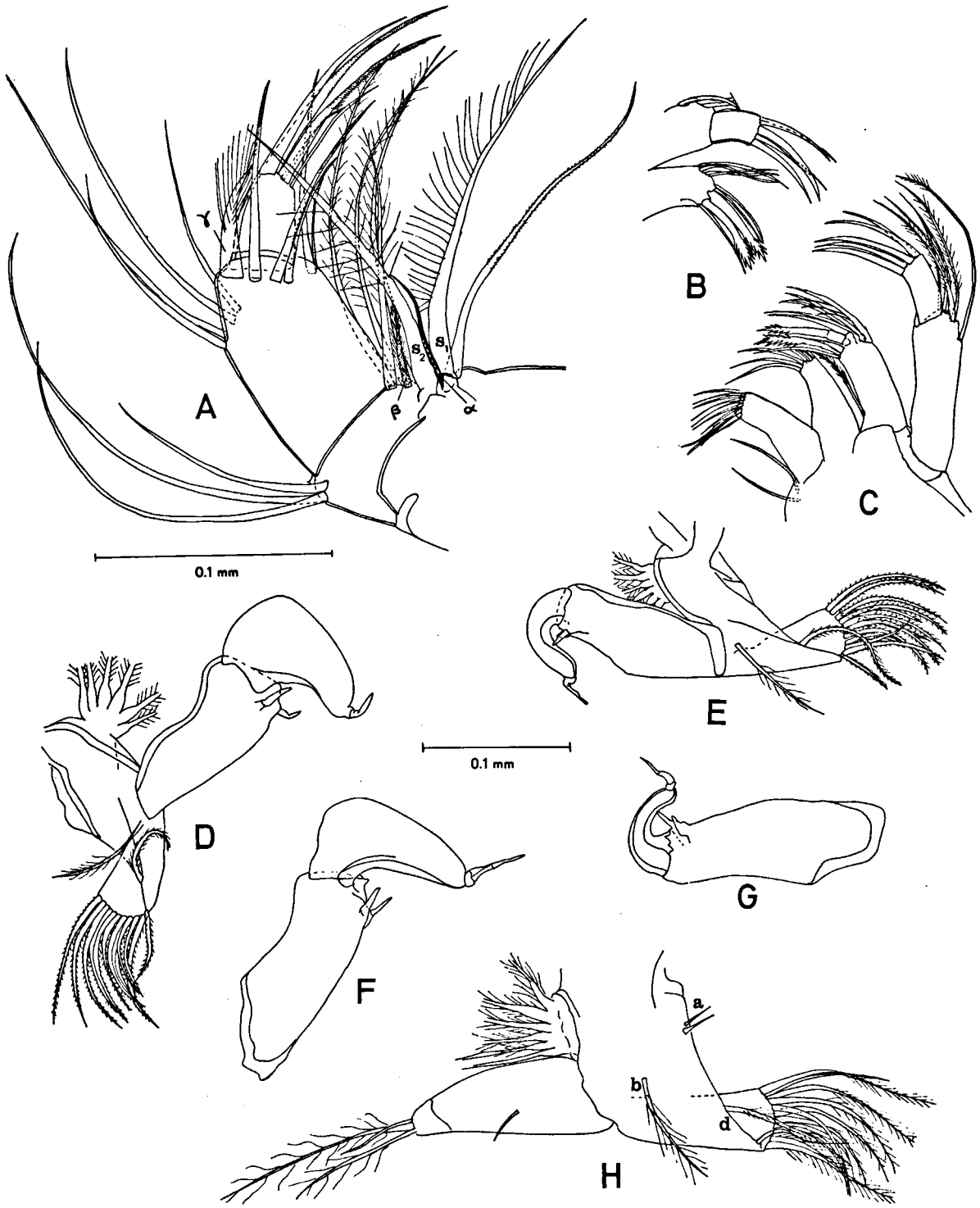

Fig. 8. A, C-E, H, *Heterocypris antillensis* n. sp. (Pos Soedesthoed, Bonaire, WH 383; A, C, H, ♀ holotype; D-E, ♂ paratype no. 1); B, F-G, *Heterocypris punctata* Keyser, 1975 (Pond of Point Blanche, St. Martin, WH 528; ♂ no. 3): A, mandibular palp; B-C, maxillulae; D-E, male maxillae and endopodites; F-G, male maxillar endopodites; H, female maxilla.

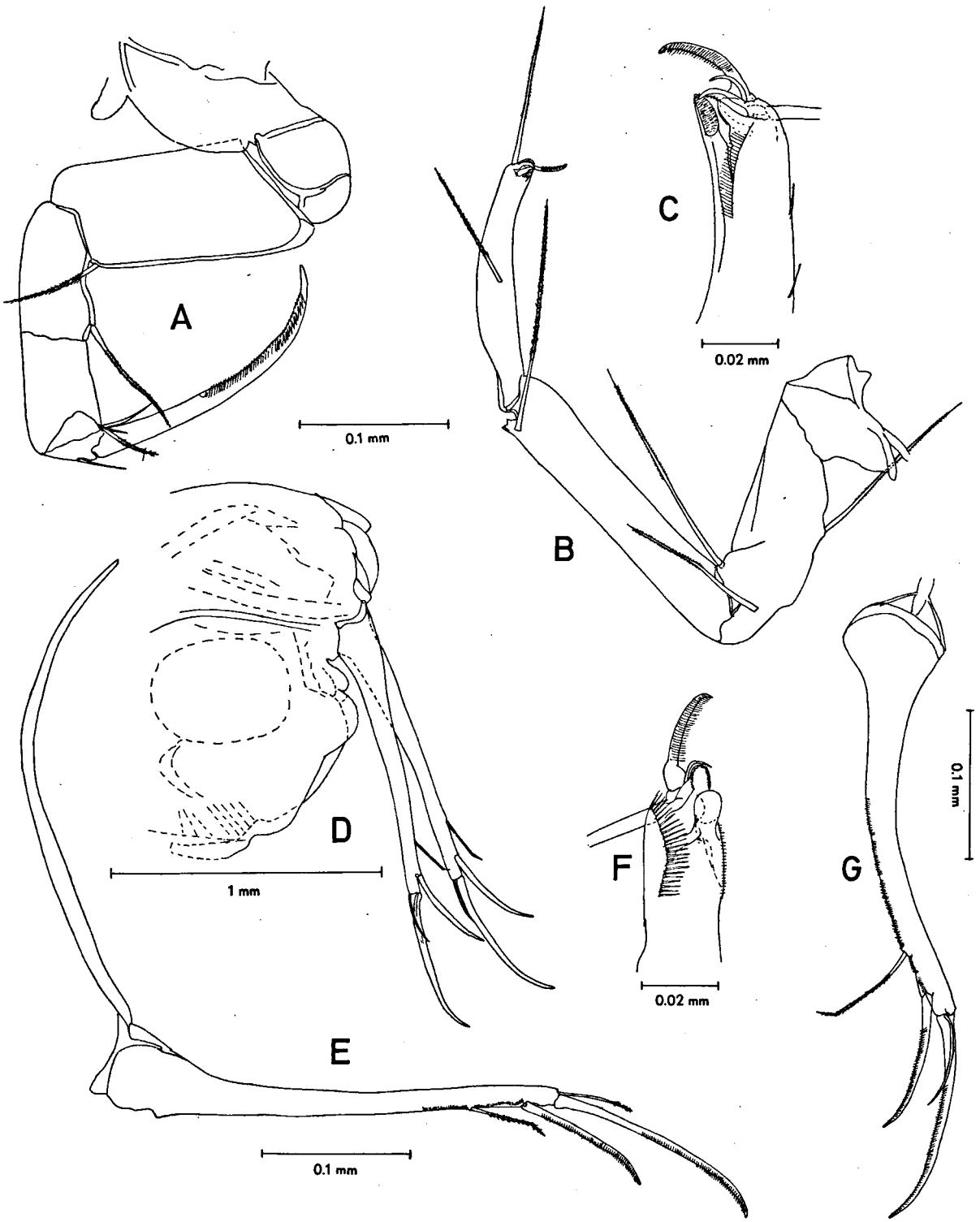

Fig. 9. A-E, *Heterocypris antillensis* n. sp. (Pos Soedesthoed, Bonaire, WH 383; A, ♂ paratype no. 5; B-E, ♀ holotype): F-G, *Heterocypris punctata* Keyser, 1975 (Godet Fields wells, South Caicos, S 79/145; ♀ no. 1): A, thoracopod 1; B-C. F. thoracopod 2 with details of distal parts; D, posterior part ot female body (scale = 0.3 mm), E, G, furca.

In the male s_a is 20% and in the female 55% of the length of G_a, while in *H. margaritae* there is no sexual difference, s_a being about 32% of the length of G_a (table II). The posterior seta is shorter than in *H. margaritae* and it has the same length in males and females. Its length is 50-60% of that of G_p (table II).

Copulatory organs (figs. 9D, 10D):
The outer shape of the female copulatory organ is shown is fig. 9D and shows no specific characters. It seems more voluminous than in *H. margaritae* and more rounded. The Zenker's organs of the males are provided with 30 to 35 rows of spines, which is about 1.5 times as much as in *H. margaritae*. The hemipenis will be described in the next section of the present paper.

Etymology. — The name of the species is derived from the name of the island arc.

Heterocypris punctata Keyser, 1975
Figs. 1, 6C-D, 8B, 8F-G, 9F-G, 10E.

Heterocypris punctata Keyser, 1975: 275-277, text-fig. 13, pl. XXII figs. 10-11.

Material. — St. Martin, Pond of Point Blanche, WH 528, 18°01'00"N 68°02'37"W; 15 ♂♂ and 15 ♀♀ used for measurement of limbs. The other stations where this species was encountered will be listed in part II of this paper.

Known geographical distribution.
Florida (USA), South Caicos, Anguilla, St. Martin, St. Kitts, Barbuda, Martinique, La Blanquilla.

Supplementary description. — The main characters of this species have been adequately described by Keyser (1975).

Carapace (figs. 6C-D):
The carapace is strongly punctated and granulated, from which the species has derived its name. The right valve is more strongly tuberculated than in both other species. The shape is also more rounded, the height being about 56-57% of the length (table II). There is more variation in carapace length than indicated by Keyser (1975), females ranging from 1.21-1.48 mm and males from 1.11-1.29 mm in mean length, while Keyser indicates 1.23-1.32 mm for females and 1.08-1.14 mm for males.

Antennule (A 1):
The chaetotaxy is similar in males and females and the same as in the other two species. Only the anterior seta of E I is medium long instead of small. The proportional lengths of the segments III to VII are: 2.6 : 1.5 : 1.1 : 1 : 1.1. The short seta of segment VI is 90% and the aesthetasc y_a is 80% of the length of E III. Rome's organ is small and bottle-shaped, like in the other two species.

Second antenna (A 2):
The chaetotaxy of the male and female second antennae is the same as in *H. antillensis*, as is the form and length of z and t setae. Only z_1 in the male is more serrate. The relative lengths of the measured parts of this limb are about the same as in *H. margaritae*. Only Y is somewhat shorter (table II).

Maxillula (Mxu) (fig. 8B):
The chaetotaxy and structure of the setae is the same as in the other two species. Mxup II is somewhat longer than in *H. margaritae* and much shorter than in *H. antillensis*, it is about 1.6-1.8 times as long as wide. The chelate setae of Mxup II are relatively shorter than in *H. margaritae* and slightly longer than in *H. antillensis* (1.7-1.95 times as long as Mxup II), as are the serrate setae of Mastic 3 (1.6-1.8 times as long as Mxup II) (table II).

Maxilla (Max) (figs. 8F-G):
The chaetotaxy is the same as in the other species. The male maxillar endopodite looks mostly like that of *H. antillensis*, but is more elongated. The other characters are about the same.

Thoracopod 1 (T 1):
The chaetotaxy is the same as in the other species. The longer seta of E III is 60-70% of the length of E II, which is somewhat longer than in *H. antillensis* and shorter than in *H. margaritae*. The distal claw is relatively longer than in both other species (2.65-2.95 times as long as E II) (table II).
The proportional lengths of the segments II to VI and the distal claw are 5.6 : 3 : 2.7 : 1 : 6-7.5.

Thoracopod 2 (T 2) (fig. 9F):
The structure and chaetotaxy of this leg are the same as in the other two species. Keyser (1975) indicates a different structure of the distal part of this leg, but it seems to be typical of the Cypridinae and the same as in the other species.

Furca (Fu) (fig. 9G):
The furca is slightly pectinated for somewhat more than half of the posterior side. The distal claws are pectinated for more than two-thirds of their length. Both posterior and anterior setae are pappose. The relative lengths of ramus, claws and setae are indicated in table II. G_a is nearly half the length of the ramus as in the other two species. G_p is slightly longer than in both other species. In the male, the length of s_a is 35% of that of G_a, about as long as in *H. margaritae*. In the female however, its length is 58% of G_a, which is longer than in both other species. S_p is 65-75% of the length of G_p in the male and 74-88% in the female. So both s_a and s_p have a different length in the two sexes, as seta s_a in *H. antillensis* (table II).

Copulatory organs (fig. 10E):
The outer shape of the female lobes is about the same as in *H. antillensis*. No special internal characters present.

The Zenker's organ has 32-36 rows of spines, which is about the same as in *H. antillensis* and more than in *H. margaritae* (table II). The structure of the hemipenis will be described in the sequel and is the same as in the drawing of Keyser (1975, text-fig. 13).

Final remarks on *H. punctata*. — The species is closely related to both other species. In some aspects its morphology is more like *H. margaritae* and in other aspects more like that of *H. antillensis* (table II).

Cyprinotus symmetricus as described by Müller, 1898, is a different species, but the female specimen encountered by Furtos (1936) in the caves of Yucatan (Mexico) could be *H. punctata* instead of *C. symmetricus*. The carapace of this specimen, according to her figures, resembles closely that of *H. punctata* (Furtos, 1936: 102, figs. 81-83).

The hemipenis of *H. nicaraguensis* (Hartmann, 1959) looks much like that of *H. punctata*, while female carapace, male maxillae and furca are also similar. But the male carapace is different and the species is much smaller.

THE STRUCTURE OF THE HEMIPENIS

There are few studies regarding the very complex structure of the male hemipenis in cypridacean ostracods. Most of this research has been done by McGregor & Kesling (1969) and Danielopol (1969, 1978, 1980), and almost exclusively on species of the Candoninae. A review of literature is presented in McGregor & Kesling (1969).

The structure of the hemipenis in the genus *Heterocypris* is for the greatest part unknown. Because some parts of this organ are highly characteristic of each species, it was attempted to homologize different structures of the three species of *Heterocypris* described in this paper.

The internal structures as shown by Klie in several of his papers and by most other authors are very unclear. Most of the time only the outer form of the peniferum (outer sheath of the hemipenis) was described, but this seems to be very constant in this genus, while the form of the distal shield (ds) is probably as variable within species as between species (figs. 10A-B).

The hemipenis in *Heterocypris* (fig. 10). — The general form of the outer sheath (peniferum) of each hemipenis is similar in all *Heterocypris* species. At the distal side lies the distal shield (ds), which is formed like a boot. At the proximal side lies the proximal shield (ps) which is triangular and contains the seminal tract with some sclerotized lobes. Like in all Cypridinae (Danielopol, 1978) there is a transversal fold on the medial side of the proximal shield (tf).

The seminal tract itself is covered by a sclerotized wall and forms the labyrinth. The first parts of this labyrinth are called sleeves A, B and C after McGregor & Kesling (1969) (d_1, d_2, d_3, in Danielopol, 1978). They are of the same type as in the Candoninae and are very similar in the three *Heterocypris* species. The fourth part, D (d_4 in Danielopol, 1978) is a very complicated

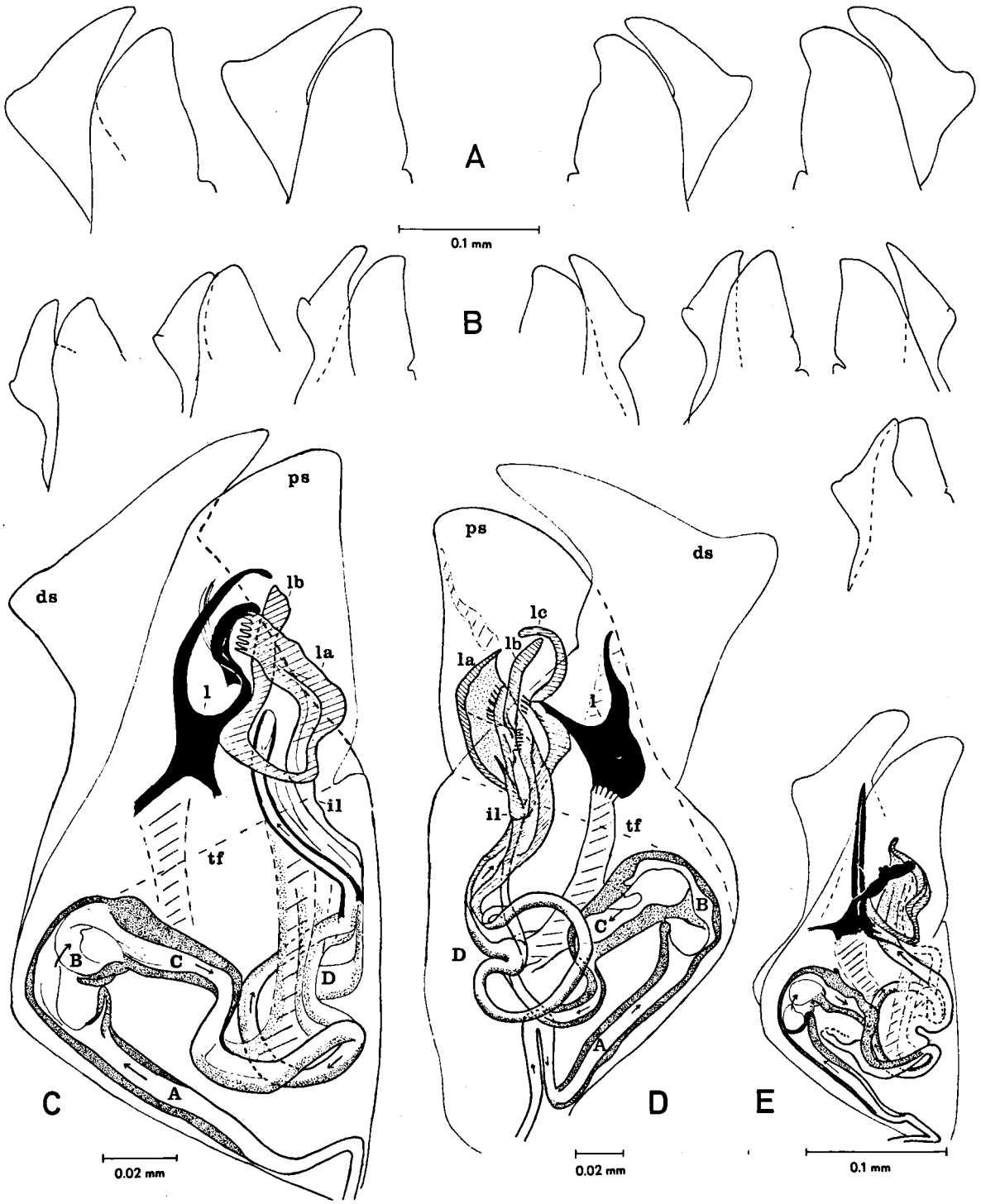

Fig. 10. A, D, *Heterocypris antillensis* n. sp. (D, Pos Soedesthoed, Bonaire, WH 383: ♂ paratype no. 1); B-C, *Heterocypris margaritae* Margalef, 1961 (C, Pos Calbas, Klein Bonaire, WH 63e; ♂ no. 1); E, *Heterocypris punctata* Keyser, 1975 (Pond of Point Blanche, St. Martin, WH 528; ♂ no. 2): A-B, Variation in shape of the distal shield of the hemipenis in various localities and in the same locality, viz. from left to right: A, S 78/54, S 76/66 at St. Martin, S 78/123 at Virgin Gorda and S 78/291 at Aruba, respectively; B, WH 898 at Bonaire, WH 867 at Barbados, WH 66 at Curaçao, WH 898, WH 5 at Araya, WH 66, and WH 66, respectively; C-E, Structure of hemipenises.
Abbreviations: A, B, C = sleeves of the labyrinth; D = knot of tubes in the labyrinth; ds = distal shield; il = inner lobe; l = latch; la, lb, lc = distal processes of the inner lobe; ps = proximal shield; tf = transversal fold on the medial side of the proximal shield.

knot of tubes connected by weakly sclerotized parts with the peniferum and inner lobe.

The inner lobe (il) is long and surrounds the terminus of the seminal tract. It terminates in a few distal processes, which are different in the three species described in this paper. They probably have a function in touching the female lobes and bringing the glans in position for copulation. They are called la, lb and, if present, lc. This lc can also be part of another structure which is called "latch" (l) in accordance with McGregor & Kesling (1969) and is supposed to have a function in folding open the distal and proximal shields. This, however, remains uncertain. It is strongly sclerotized, connected with other weakly sclerotized parts, and lying at the border of the proximal shield, maybe connected with the distal shield.

In *H. margaritae* the distal part of this latch is long and thin and folds back over the distal parts of the inner lobe and the proximal part is sickle-shaped. In *H. antillensis* the distal part is slightly bent back in the direction of the distal shield, while the proximal part is short and straight and maybe connected with a part, probably of the inner lobe, which is spirally wound and distally sickle-shaped. In *H. punctata* the distal part is long, straight and pointed, ending in the distal shield. The proximal part is bent from the basis over the distal lobes and irregularly formed. The proximal parts of these latches are probably all connected in some way with the distal processes of the inner lobe.

The distal inner lobe (la) forms a rounded sheath ending in a point in *H. antillensis* and *H. punctata* and a more flattened and straight structure ending with teeth near the proximal part of the latch, in *H. margaritae*. In *H. margaritae* and *H. antillensis* there are some other distal parts: in *H. margaritae* only one, nearly straight clublike structure (lb) connected with la by a transversal part and in *H. antillensis* two parts connected with the copulatory tube with spikes (lb) and the spirally wound structure (lc) which is also connected in some way with lb.

To clarify the hemipenal structure, further research on live material will be necessary or the hemipenis has to be dissected, which is very difficult, if at all possible.

CONCLUSIONS

The three species described in this paper are probably closely related, and also related with some *Heterocypris* species from South and Central America. It is, however, impossible to indicate any two species more closely related to each other than to the third, at this stage. In some morphological aspects *H. margaritae* is more like *H. punctata* and in other aspects *H. antillensis* is more like *H. punctata*. More research is needed to confirm the relationship between these and other *Heterocypris* species in this area, including the species from Central and South America.

The next part of this paper will deal with the ecology of the species described in the present article and with the differences in carapace length of the different populations.

ACKNOWLEDGEMENTS

I wish to thank Dr. D. L. Danielopol for initiating me in the secrets of ostracod dissection and determination and for the many discussions we had concerning ostracod morphology, ecology and evolution. Without his help this work would not have been possible. Dr. P. Wagenaar Hummelinck I wish to thank for placing at our disposal all his ostracod samples from the West Indies, which were indispensable for understanding the distribution of ostracods in this region. Prof. Dr. J. H. Stock I would like to thank for his coordination of the project. The research for this project is financed by the Netherlands Foundation for the Advancement of Tropical Research (WOTRO), The Hague. The fieldwork of the Amsterdam Expeditions has been supported by grants from WOTRO, the Beijerinck-Popping Fonds, Amsterdam, the Treub Maatschappij, Utrecht, the Amsterdamse Universiteits Vereniging, Amsterdam, and the Fonds Landbouwhogeschool, Wageningen.

REFERENCES

ALM, G., 1915. Monographie der Schwedischen Süsswasser-Ostracoden nebst systematischen Besprechungen der Tribus Podocopa. Zool. Bidr. Uppsala, **4**: 1-248.

BATTISH, S. K., 1981. Freshwater Ostracoda of the subfamily Cyprinotinae from Punjab, India, with the description of eight new species. J. nat. Hist., **15**: 645-669.

BOLD, W. VAN DEN, 1958. Distribution of fresh-water ostracods in Trinidad. Micropaleontology, **4** (1): 71-79.

BREHM, V., 1934. Über südamerikanische Ostracoden des Zoologischen Staatsinstitutes und Museums in Hamburg. Zool. Anz., **108**: 74-85.

BROODBAKKER, N. W. & D. L. DANIELOPOL, 1982. The chaetotaxy of Cypridacea (Crustacea: Ostracoda) limbs: proposals for a descriptive model. Bijdr. Dierk., **52** (2): 103-120.

DANIELOPOL, D. L., 1969. Recherches sur la morphologie de l'organe copulateur mâle chez quelques Ostracodes du genre Candona Baird (Fam. Cyprididae Baird). In: J. W. NEALE ed., The taxonomy, morphology and ecology of recent Ostracoda: 136-163 (Oliver & Boyd Ltd., Edinburgh).

——, 1978. Über Herkunft and Morphologie der Süsswasser-hypogäischen Candoninae (Crustacea, Ostracoda). Sber. öst. Akad. Wiss., (Abt. I) **187** (1-5): 1-162.

——, 1980. Sur la biologie de quelques Ostracodes Candoninae épigés et hypogés d'Europe. Bull. Mus. natn. Hist. nat. Paris, (4) (A, Zool.) **2** (2): 471-506.

FURTOS, N. C., 1936. On the Ostracoda from the cenotes of Yucatan and vicinity. In: A. S. PEARSE, E. P. CREASER & F. G. HALL eds., The cenotes of Yucatan; a zoological and hydrographic survey: 89-115 (Carnegie Institution, Washington).

HARTMANN, G., 1959. Beitrag zur Kenntnis des Nicaragua-Sees unter besonderer Berücksichtigung seiner Ostracoden (mit Beschreibung von 5 neuen Arten). Zool. Anz., **162** (9-10): 269-294.

HUMMELINCK, P. WAGENAAR, 1940a. General information. Stud. Fauna Curaçao, **1** (1): 1-58.

——, 1940b. Descriptions of the localities. Stud. Fauna Curaçao, **2** (4): 1-42.

——, 1953. Description of new localities. Stud. Fauna Curaçao, **4** (17): 1-108.

——, 1981. Land and fresh-water localities. Stud. Fauna Curaçao, **63** (192): 1-133, pls. I-IL.

KEYSER, D., 1975. Ostracoden aus den Mangrovegebieten von Südwest-Florida (Crustacea: Ostracoda, Podocopa). Abh. Verh. naturw. Ver. Hamburg, (N.F.) **18/19** 255-290, pls. XX-XXII.

KLIE, W., 1929. Ostracoden aus dem paraguayischen Teile des Gran-Chaco. Arch. Hydrobiol., **22**: 221-258.

——, 1933. Zoologische Ergebnisse einer Reise nach Bonaire, Curaçao und Aruba im Jahre 1930, No. 5. Süß- und Brackwasser-Ostracoden von Bonaire, Curaçao und Aruba. Zool. Jb., (Syst.) **64**: 369-390.

——, 1940. Süßwasserostracoden aus Nordostbrasilien, IV. Zool. Anz., **129**: 113-120.

MCGREGOR, D. L. & R. V. KESLING, 1969. Copulatory adaptations in ostracods, 1. Hemipenis of Candona. Contr. Mus. Paleont. Univ. Mich., **22** (13): 169-191.

MADDOCKS, R. F., 1969. Recent ostracods of the family Pontocyprididae chiefly from the Indian Ocean. Smithson. Contr. Zool., **7**: 1-56.

MALZ, H., 1976. Heterocypris vel Cyprinotus? Senckenberg. leth., **57**: 185-199.

MARGALEF, R., 1961. La vida en los charcos de aqua dulce de Nueva Esparta (Venezuela). Mems. Soc. Cienc. nat. La Salle, **21** (59): 75-110.

MÜLLER, G. W., 1898. Die Ostracoden. In: Wissenschaftliche Ergebnisse der Reisen in Madagaskar und Ostafrika in den Jahren 1889-95 von Dr. A. Voeltzkow. Abh. senckenb. naturforsch. Ges., **21** (2): 257-296, pls. XIII-XIX.

PÜRPER, I. & N. L. WÜRDIG-MACIEL, 1974. Occurrence of Heterocypris incongruens (Ramdohr), 1808 — Ostracoda — in Rio Grande do Sul, Brazil. Discussion on the allied genera: Cyprinotus, Hemicypris, Homocypris and Eucypris. Pesquisas, **3**: 69-91.

RAMIREZ, F. C., 1967. Ostracodos de lagunas de la Provincia de Buenos Aires. Revta. Mus. La Plata, (Zool., N.S.) **10**: 5-54, pls. 1-6.

STOCK, J. H., 1979. Amsterdam Expeditions to the West Indian Islands, Report 4. Station list. Verslagen technische Gegevens Inst. taxon. Zoöl. (Zoöl. Mus.) Univ. Amsterdam, **20**: 1-78.

TRESSLER, W. L., 1959. Ostracoda. In: W. T. EDMONDSON ed., Fresh-water biology: 657-734 (John Wiley & Sons Inc., New York).

TRIEBEL, E., 1961. Süsswasser-Ostracoden von den Karibischen Inseln, 1. Cypridini. Senckenberg. biol., **42**: 51-74, pls. 6-17.

——, 1962. Süsswasser-Ostracoden von den Karibischen Inseln, 2. Xenocypris n. g., Senckenberg. biol., **43**: 47-63.

VICTOR, R. & C. H. FERNANDO, 1981. Freshwater ostracods (Crustacea: Ostracoda) of the subfamily Cyprinotinae Bronstein, 1947 from Malaysia, Indonesia and the Philippines. Hydrobiologia, **83**: 11-27.

WIERZEJSKI, A., 1893. Skorupiaki i wrotki slodkowodne zebrane u Argentynie. Rozpr. Akad. Umiejet. Krakowie Wydz. mat.-przyr., **24**: 239-242.

Received: 30 July 1982