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HAPLOSTOMINAE (COPEPODA, CYCLOPOIDA) ASSOCIATED WITH COMPOUND ASCIDIANS FROM THE SAN JUAN ARCHIPELAGO AND VICINITY

By

SHIGEKO OOISHI

Faculty of Fisheries, Mie University, Tsu, Mie 514, Japan

and

PAUL L. ILLG

Department of Zoology, University of Washington, Seattle, Washington 98195, U.S.A.

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Introduction

The subfamily Haplostominae was proposed by E. Chatton and H. Harant (1924e) for a group of closely allied genera of the family Ascidicolidae. At that time and in the treatment of many authors (Norman, 1869; Canu, 1886, 1892; T. & A. Scott, 1895; Brément, 1909; Sars, 1921; Schellenberg, 1922; Salfi, 1926; Blake, 1929; etc.), the family was referred to the suborder Notodelphyoida. This suborder has been submerged in modern treatment (Illg, 1958; Gotto, 1960, 1966; Dudley, 1966), following the demonstration of K. Lang (1948) that the group comprises modified members of the suborder Cyclopoida.

The recognition of the subfamily grew out of a series of studies by Chatton, first in association with E. Brément (1910, 1915), later with H. Harant (1922, 1924a-e) in which the genus *Haplostoma* (originally described under the preoccupied name of *Aplostoma*) was expanded, and the nearly allied genera *Haplostomella, Haplostomides* and *Haplosaccus* were erected. These 4 genera readily receive all of our species, as they have those of authors (Gotto, 1952, 1954, 1959, 1960, 1966, 1970; Monniot, 1962; Ooishi & Illg, 1974) subsequent to Chatton and Harant. Although there is a certain confusion in the use of the subfamily among these authors, we follow the usage of Chatton and Harant.

The subfamily is actually rather poorly known, including so far 17 known and one uncertain species. Thirteen of the 17 known species were found within compound ascidians and 4 others in the alimentary canal of simple ascidians (Table 1). Most of the descriptions of the species are based on the females. Nine of our 13 haplostomins, which are all symbionts of compound ascidians, are represented by females and males, whereas the remaining 4 are represented by females only (Table 2).

Fourteen of the 17 species previously known came from the Mediterranean Sea, English Channel, Irish Sea, Atlantic Ocean and North Sea, and 3 others from the Western Pacific Ocean (Table 1). Our new species are all from the northwestern coast of the United States and vicinity (Table 2). The fact that we are able to add so many species from examination of only a few host species, from a very limited geographic area in the Eastern Pacific Ocean, leads us to expect that a very great number of species remain to be described in the subfamily.

All of the species described in the present material are identifiable on readily determinable, anatomical grounds. Most previous descriptions in the literature seem also to provide salient diagnostic features separating the species. However, in constructing the diagnoses of genera and the key for the species of each genus, we have found that most of the specific features concerning the mouthparts and other appendages shown in the literature are too incompletely presented to allow comparison with those of the present species.

Among all of the previous descriptions we are very unsure of the status of *Haplostomides beaumonti* (T. & A. Scott), the uncertain species, and perhaps of *Haplostoma eruca* (Norman). Further, when some other European species become more fully

described, there is a possibility that certain of our species will be synonyms.

In our tabulations and comparisons we are struck by the very low level of biological differentiation between the genera *Haplostoma* and *Haplostomides*. We do not regard the taxonomic separation of these as furnishing any very significant information, particularly in view of our addition to the roster of species of *Haplostoma elegans* which has intermediate features. The female of the latter species differs from other females of *Haplostoma,* in which maxillules and maxillae are absent, mainly by the presence of the maxillae. In the possesion of the maxillae this form agrees with all the males of *Haplostoma,* including the male of *H. elegans,* we have found.

Table 1. Previously reported haplostomins (females) found in compound or simple ascidians from are not now in general use. A, Atlantic Ocean; E, Eng. Chan.; I, Irish Sea; M, Med. Sea; N, North

	Haplostomin	Ascidian
1.	*Haplostoma banyulensis*	*Didemnum maculosum* (*Leptoclinum maculatum* type M.-Edw.)
		Tridemnum tenerum
2.	*Haplostoma brevicauda*	*Morchellium argus*
		Amaroucium nordmanni; A. sp. aff. *punctum; Morchellium argus; Polyclinum luteum; Sidnyum turbinatum* (*Circinalium concrescens*), epicardium
		Polyclinum luteum
		Synoicum pulmonaria
		Polyclinum aurantium; Sidnyum elegans; S. turbinatum
3.	*Haplostoma canui*	*Polyclinum aurantium*
4.	*Haplostoma eruca*	*Ciona intestinalis* (*Ascidia intestinalis*; *Styela intestinelis*), (S), intestine, gut
5.	*Haplostoma gibberum*	*Cnemidocarpa maoria,* (S), branchial sac
6.	*Haplostoma mizoulei*	*Sidnyum turbinatum* (*Parascidia turbinata*), interstitial fauna
7.	*Haplostomides amarouci*	*Amaroucium glabrum*; *Didemnum albidum* (*Tetradidemnum albidum*)
8.	*Haplostomides brementi*	*Aplidium coeruleum*? (*Aplidium coerulum*?; *Amaroucium caeruleum*?)
9.	*Haplostomides hibernicus*	an ascidian
		Polyclinum aurantium
10.	*Haplostomides scotti*	*Polyclinum aurantium*
11.	*Haplosaccus sacculus*	*Diplosoma listerianum* (*Diplosoma spongiforme*; *D. gellatinosum*)
12.	*Haplostomella australiensis*	*Styela etheridgii,* (S), gut
13.	*Haplostomella halocynthiae*	*Halocynthia roretzi,* (S), intestine
14.	*Haplostomella magellanica*	a compound ascidian
15.	*Haplostomella malacocera*	an aplidian
16.	*Haplostomella sycozoae*	*Sycozoa patagonica,* postabdomen
17.	*Haplostomella tuberculata*	*Sidnyum flavum* (*Parascidia flava*; *Amaroucium areolatum* var. *flavum*)

Therefore, the main basis of differentiation between *H. elegans* and *Haplostomides* is in the lack of maxillules. We continue to use the 2 genera because we do not want to multiply name changes among these poorly known organisms.

The above-mentioned terminology of the mouthparts is based on our interpretation of a series of studies on larval stages, from hatching nauplius through copepodid, of selected species from the genera *Haplostoma, Haplosaccus* and *Haplostomella,* all of which were originally described as lacking some mouthparts. Comparison of the mouthparts of the larvae with those of the adult forms in all the above genera as well as the genus *Haplostomides,* which is provided with a full set of mouthparts, have

various waters. Names of ascidians in parentheses are those given by authors in their original papers but Sea; P, Pacific Ocean; S, simple ascidian. *Haplostomides beaumonti*, an uncertain species, is not included.

Distribution		Author
Golfe de Lion, France	(M)	Brément, 1909; Harant, 1931
Strangford Lough, Ireland	(I)	Gotto, 1952
Wimereux, France	(E)	Canu, 1886a
Boulonnais, France	(E)	Canu, 1892
Espevœr, Norway	(N)	Sars, 1921
Gullmaren, Sweden	(N)	Lang, 1948
Strangford Lough, Ireland	(I)	Gotto, 1952
Penpoull (Roscoff), France	(A)	Chatton & Harant, 1924e; Harant, 1931
Shetland Islands, Scotland	(A)	Norman, 1869
Firth of Forth, Scotland	(N)	T. Scott, 1891; T. & A. Scott, 1892
Christiania Fjord, Norway	(N)	Sars, 1921
Strangford Lough, Ireland	(I)	Gotto, 1959
Stewart Island, New Zealand	(P)	Schellenberg, 1922
Banyuls, France	(M)	Monniot, 1962
Mount Desert, U.S.A.	(A)	Blake, 1929, 1933
Golfe de Lion, France	(M)	Chatton & Harant, 1924d; Harant, 1931
Valentia, Ireland	(A)	T. & A. Scott, 1895
Roscoff, France	(A)	Chatton & Brément, 1910; Harant, 1931
Strangford Lough, Ireland	(I)	Gotto, 1952
Penpoull (Roscoff), France	(A)	Chatton & Harant, 1924d; Harant, 1931
Strangford Lough, Ireland	(I)	Gotto, 1952
Golfe de Lion, France	(M)	Chatton & Brément, 1910; Harant, 1931
Sydney Harbor, Australia	(P)	Gotto, 1970; Anderson & Rossiter, 1969
Tohoku district, Japan	(P)	Fukui, 1965; Ooishi & Illg, 1974
Strait of Magellan, South America	(A)	Chatton & Brément, 1910
Gabés on the Tunisian coast, North Africa	(M)	Chatton & Harant, 1924c
Golfe de Lion, France	(M)	Chatton & Harant, 1924c
Patagonia, South America	(A)	Salfi, 1926, 1925
Banyuls, France	(M)	Chatton & Harant, 1924c; Harant, 1931

led to our conclusions about the terminology of the mouthparts in the subfamily. These developmental studies on the genera *Haplostoma, Haplosaccus* and *Haplostomella* will be presented as a separate paper subsequent to the present work, which is presented first in order to establish the new species according to nomenclatural propriety.

Our terminology does not always follow that which previous authors have used on the taxonomic (previously mentioned) or developmental (Canu, 1892; Anderson & Rossiter, 1969) studies on the haplostomins. Therefore, in the following diagnoses and descriptions of the subfamily, genera and species, some changes of the anatomical terminology with regard to the mouthparts of the 3 genera, *Haplostoma, Haplosaccus* and *Haplostomella*, will be noted, although we already have used the present terminology for a *Haplostomella* species (Ooishi & Illg, 1974).

Most of the known species (14 of 17) are restricted to a single host species except for 3: *Haplostoma banyulensis* with 2 hosts from the Mediterranean coast of France and the northeast coast of Ireland, *Haplostoma brevicauda* with 8 hosts from the west coasts of Norway and Sweden, the northeast coast of Ireland and the Channel coasts of France, and *Haplostomides amarouci* (=*Cryptopodns amarouci* Blake) with 2 hosts from the northeast coast of the United States (Table 1). In our area the pattern of distribution of the copepods in relation to the hosts is basically the same as in the above-mentioned known species, because the majority (8 of 13) are found in one

Table 2. Haplostomins associated with compound ascidians from sublittoral (SL) or intertidal (I) in the San Juan Archipelago (SJ), in Cape Alava, Cape Flattery and vicinity (CV), and at the Whiffin Spit (WS).

	Haplosomin	Ascidian	Locality
1.	*Haplostoma albicatum* (♀, ♂)	*Distaplia occidentalis*	I-SJ, WS; SL-SJ
2.	*Haplostoma minutum* (♀, ♂)	*Amaroucium arenatum*: egg masses, postabdomen; ♂, postabdomen	SL-SJ
3.	*Haplostoma dentatum* (♀)	*Cystodytes lobatus*: egg masses, intestine	SL-SJ; I-CV
4.	*Haplostoma setiferum* (♀, ♂)	*Eudistoma ritteri*	I-CV, WS
5.	*Haplostoma ambiguum* (♀, ♂)	*Didemnum albidum*	SL-SJ: I-SJ
6.	*Haplostoma elegans* (♀, ♂)	*Amaroucium ?constellatum*: ♀, intestine	SL-SJ
		Amaroucium propinquum	SL-SJ
7.	*Haplostomides bellus* (♀)	*Sigillinaria aequali-siphonis*: ♀, intestine	I-WS
8.	*Haplostomides luteolus* (♀)	*Amaroucium glabrum*	I-WS
9.	*Haplosaccus elongatus* (♀)	*Amaroucium arenatum*: ♀, intestine	SL-SJ
		Amaroucium glabrum	I-WS
10.	*Haplostomella dubia* (♀, ♂)	*Amaroucium arenatum*: ♀, intestine; ♂, branchial sac	SL-SJ
		Amaroucium glabrum: ♀, intestine	I-WS
11.	*Haplostomella distincta* (♀, ♂)	*Amaroucium arenatum*: ♀, intestine	SL-SJ
		Amaroucium glabrum	I-WS
12.	*Haplostomella oceanica* (♀, ♂)	*Eudistoma ritteri*: ♀, intestine	I-CV, WS
		Amaroucium arenatum	SL-SJ
13.	*Haplostomella reducta* (♀, ♂)	*Distaplia occidentalis*	SL-SJ

host species. We found 5 cases where each species had 2 hosts but we have found no case in which there were more than 2 hosts (Table 2).

In dealing with the material in our taxonomic survey, many complications entered by reason of the susceptibility of the ascidian hosts. It appears to be quite usual in our area for a given host species to have more than one species of copepod associated with it (Table 3). We also should point out that the same host species may accommodate other forms of ascidicole copepods such as botryllophilids, notodelphyids and species from still other copepod families. The ascidian species we have so far found as the most tolerant in this regard can be associated with up to 5 species of the Haplostominae as well as 3 species from the other ascidicole copepods, as seen

Table 3. Compound ascidians accommodating haplostominid (H) and other (O) ascidicole copepods from the San Juan Archipelago and vicinity.

Ascidian		Copepod
Order Aplousobranchia		
Family Synoicidae		
Amaroucium arenatum	(H)	*Haplostoma minutum*
		Haplosaccus elongatus
		Haplostomella dubia
		Haplostomella distincta
		Haplostomella oceanica
	(O)	*Botryllophilus* sp.
		Pholeterides furtiva Illg, 1958
		an unidentified copepod
Amaroucium glabrum	(H)	*Haplostomides luteolus*
		Haplosaccus elongatus
		Haplostomella dubia
		Haplostomella distincta
Amaroucium ?constellatum	(H)	*Haplostoma elegans*
	(O)	*Botryllophilus* sp.
		Pholeterides furtiva Illg, 1958
		an unidentified copepod
Amaroucium propinquum	(H)	*Haplostoma elegans*
	(O)	*Botryllophilus* sp.
Sigillinaria aequali-siphonis	(H)	*Haplostomides bellus*
Family Didemnidae		
Didemnum albidum	(H)	*Haplostoma ambiguum*
Family Polycitoridae		
Eudistoma ritteri	(H)	*Haplostoma setiferum*
		Haplostomella oceanica
	(O)	*Botryllophilus* sp.
Distaplia occidentalis	(H)	*Haplostoma albicatum*
		Haplostomella reducta
Cystodytes lobatus	(H)	*Haplostoma dentatum*
	(O)	*Botryllophilus* sp.

in the case of *Amaroucium arenatum* from the San Juan Islands. Likewise *Polyclinum aurantium* from the Atlantic coast of France and the northeast coast of Ireland has been reported as associated with 4 haplostomin species (Table 4). In most cases of the species so far known, each ascidian host has been reported as having only one species of haplostomin.

The biological relations between the copepods and hosts from our area are pointed out under "Remarks" in the specific descriptions below and are also dealt with in the discussion.

Table 4. Previously reported compound or simple ascidians accommodating haplostominid copepods from various waters.

Ascidian	Haplostomin
Order Aplousobranchia	
Family Synoicidae	
Amaroucium glabrum	*Haplostomides amarouci*
Amaroucium nordmanni	*Haplostoma brevicauda*
Amaroucium sp. aff. *punctum*	*Haplostoma brevicaude*
Aplidium coeruleum?	*Haplostomides brementi*
Morchellium argus	*Haplostoma brevicauda*
Polyclinum aurantium	*Haplostoma brevicauda* *Haplostoma canui* *Haplostomides hibernicus* *Haplostomides scotti*
Polyclinum luteum	*Haplostoma brevicauda*
Sidnyum elegans	*Haplostoma brevicauda*
Sidnyum flavum	*Haplostomella tuberculata*
Sidnyum turbinatum	*Haplostoma brevicauda* *Haplostoma mizoulei*
Synoicum pulmonaria	*Haplostoma brevicauda*
an aplidian	*Haplostomella malacocera*
Family Didemnidae	
Didemnum albidum	*Haplostomides amarouci*
Didenmum maculosum	*Haplostoma banyulensis*
Diplosoma listerianum	*Haplosaccus sacculus*
Trididemnum tenerum	*Haplostoma banyulensis*
Family Polycitoridae	
Sycozoa patagonica	*Haplostomella sycozoae*
Family Cionidae	
Ciona intestinalis	*Haplosotma eruca*
Order Stolidobranchia	
Family Styelidae	
Cnemidocarpa maoria	*Haplostoma gibberum*
Styela etheridgii	*Haplostomella australiensis*
Family Pyuridae	
Halocynthia roretzi	*Haplostomella halocynthiae*
a compound ascidian	*Haplostomella magellanica*

The first male attributed to the subfamily was described by Canu (1892) in *Haplostoma brevicauda*. However, Canu's male should be referred to as a species of *Botryllophilus* for reasons which will be explained in the diagnosis of the genus *Haplostoma* (p. 18). Therefore, the present paper is the first in which actual males of the subfamily are described. Those we have found so far are restricted to the genera *Haplostoma* (5 species) and *Haplostomella* (4 species), all showing the generalized cyclopoid male type which, however, includes both swimming and creeping forms. These males have furnished much more distinctive generic features than have the females.

Examination of the details of the fifth and sixth legs of the males has reinforced our impression that these appendages are homologous with the modified fifth legs and the spinose oviducal folds of the vermiform females of the subfamily. The homology of these appendages and organs will be referred to in the discussion.

A complete synonymy of the genera and species in the subfamily is a part of a compilation being made with regard to the whole series of ascidicole copepods assignable to the Family Ascidicolidae in its broad sense and is awaiting future publication. The literature for the present material is so sparse that it appears to us no confusion will result if principal taxonomic allocations only are indicated in connection with the taxa. The complete literature of the group can be readily traced by use of the references cited.

Nomenclature of Ascidian Hosts

The identification of ascidians furnished to us by Dr. Takasi Tokioka lists the species in accordance with the taxonomy of the standard monographic treatment of the ascidians of North and South America by W. G. Van Name (1945). We should point out that generic assignment now differs somewhat in the lists and keys in the several faunal handbooks currently in use for studies on the coasts of the United States. In these, following a precedent from revisers of the European fauna, the species listed here in *Amaroucium* would be referred to *Aplidium*; the species of *Eudistoma* to *Archidistoma*; and the species of *Sigillinaria* to *Ritterella*.

The status of certain of the host species appears to be ambiguous. Dr. Tokioka has pointed out to us that in our material, on the basis of characteristics of preserved colonies and zooids, the identification furnished for one important host species could be referred to as *Amaroucium ?constellatum* Verrill. He noted, however, that in various features, particularly in some of those noted in living examples, our form differs substantially from specimens of *A. constellatum* from the Atlantic.

Dr. Tokioka also notes that in material nominally referred to as *Distaplia occidentalis* Bancroft there is included a form with pedunculated colony collected only from deeper water. There are sufficiently differentiated anatomical features in this form to raise a question of its identity with the more widely-occurring intertidal specimens.

Material and Methods

Compound ascidians, the hosts of the copepods herein described, were collected from various stations in the San Juan Archipelago, at Cape Alava, Cape Flattery and Tatoosh Island, Washington, and also at the Whiffin Spit, Sooke, British Columbia (Table 2).

In the San Juan Islands much of the material was sublittorally acquired by trawling or dredging from the laboratory vessel Hydah. Many significant collections were also taken by SCUBA divers, at that time graduate students making regular observations and collections at specific localities. These sources were particularly important because usually the host ascidians are essentially subtidal organisms and also because rich infestations occur in such specimens. In fact the ascidians (*Amaroucium arenatum, Amaroucium ?constellatum, Amaroucium propinquum, Didemnum albidum, Distaplia occidentalis, Cystodytes lobatus*) from the sublittoral or subtidal areas of the Islands provided 10 of the 13 present new species (Table 2).

The specimens of the ascidians, *Eudisotma ritteri* and *Cystodytes lobatus,* from Cape Alava, Cape Flattery and Tatoosh Island and those of *Amaroucium glabrum, Sigillinaria aequali-siphonis, Eudistoma ritteri* and *Distaplia occidentalis* from the Whiffin Spit were all from the low intertidal. The copepods associated with these ascidians from the 2 general intertidal areas amounted to 9 of the 13 species (Table 2). Three of the 9 species were from Cape Alava and vicinity. The specimens from Tatoosh Island, off Cape Flattery, were obtained by student divers who were participating in the operation of groups of ecologists of the University of Washington. The ascidians from the Whiffin Spit showed a particularly rich and significant series of copepods, 8 of the 9 species, from the intertidal (Table 2).

The females of the subfamily are able to migrate in the host. The males are even more mobile creatures than the females. In our experience, some males (*Haplostoma albicatum* & *H. minutum*) were observed as capable of vigorously swimming in the water. These features of copepod behavior were exploited to facilitate collection by keeping the host colonies in the same sea water in which they had been collected. During the process of collecting, each ascidian species was put separately in a culture dish, jar or plastic bag. The culture dish was the most favorable container for the collection of male specimens of copepods. In the laboratory the culture dish holding a specific ascidian colony and water was kept in an aquarium or in a refrigerator. The time for which the culture dish was kept in this equipment varied but was usually from several hours to a few days. In this time the swimming males, as well as creeping males and females, came out from the colony into the water. Occasionally mature, ovigerous females, with or without a pair of egg sacs, made an appearance near the surface of the colony (Pl. I, Fig. 1). In some ascidians such mature females could be found on the surface of the matrix (common test) in nature. A substantial number of our specimens was also acquired from the colony matrix or from zooids by dissecting the ascidian in question under a binocular microscope. Some were ex-

tracted by allowing colonies to disintegrate in the container.

Each of the species of copepods was examined carefully while it was still alive. In making color descriptions, drawings and photographs of the animals, special attention was paid to the coloration of eye, gut, pigment spots and eggs. The coloration of such organs and eggs was useful in the discrimination of species coming from ascidian hosts which had more than 2 species of haplostomins or other ascidicole copepods along with them. The coloration of the eye, gut and pigment spots of the copepods is in general comparable in both sexes. Careful examination of the coloration in live specimens was particularly helpful for collecting the males, although it was usually necessary to distinguish them first by specific external features such as antennules or caudal setae. Thus the males of *Haplostoma,* which often occurred together with those of species of *Botryllophilus* in the same ascidian, were discriminated by their color, although the 2 forms have similar antennules and caudal setae. We therfore conclude that the male of a species of *Botryllophilus,* which probably was living near the female of *Haplostoma brevicauda* in the same host, was mistakenly regarded as the male of the *Haplostoma* species by Canu (1892).

The copepods were fixed in 95% ethyl alcohol and kept in storage in 70% ethyl alcohol. Anatomical details were studied on specimens dissected in lactic acid in which methyl blue had been dissolved. Type specimens that are deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D. C., are listed under the catalog numbers of the former United States National Museum (USNM), and a series of specimens is in the collection of Dr. Paul L. Illg, University of Washington.

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Subfamily HAPLOSTOMINAE Chatton & Harant, 1924

Ascidicolidae (part).—Canu, 1891, p. 475; 1892, p. 186.—Gotto, in Anderson & Rossiter, 1969, p. 464.
Ascidicolidés (part).—Brément, 1909, pp. 61–62, 86–87.
Ascidicolinae (part).—Chatton & Brément, 1915, pp. 143, 144.—Schellenberg, 1922, pp. 220, 277–281.
Enterocolidae (part).—Sars, 1921, pp. 73–74.—Blake, 1929, p. 6; 1933, p. 226.—Lang, 1948, pp. 25–27.—Monniot, 1962, p. 570.—Dudley, 1966, p. 155.—Gotto, 1966, p. 193.
Notodelphyidae (part).—Sewell, 1949, p. 174.
Haplostomiens.—Chatton & Harant, 1922, pp. 250–252; 1924d, pp. 406–407.
Haplostominae.—Chatton & Harant, 1924e, pp. 413, 415, 416–421.—Gotto, 1959, pp. 9–10.—Ooishi & Illg, 1974, p. 365.

DIAGNOSIS: In the female the body is inflated, vermiform or eruciform, with obsolescent segmentation, often with characteristic appearance because of the presence of paired egg sacs (egg strings); in life the coloration is distinctive. Usually a small orange or red eye, but sometimes a white eye, is descernible in live specimens. The gut commonly is distinctly colored (yellow or orange), often contrasting to the typically colored ova (in the oviducts, white, yellow, lavender pink, or pale purple), which tend to match the eggs (embryos in the early developmental stages) in the egg sacs (cylindrical, elliptical or fusiform).

Body regions are recognizable superficially by configuration, but are not typically set off by clear articulations. The limits of the urosome may be obscured by specialization of posterior body structures. The cephalosome bears the appendages through maxillipeds, but is not necessarily otherwise strongly demarcated. There is usually no very prominent development of a rostrum; there may be some sclerotizations in the cuticle apically.

The mid-body is a more or less fused region, with segmental composition indicated at least by the position of the legs, but with actual segmental articulations tending to obsolescence. The posterolateral corners of the mid-body vary from strongly developed prominences bearing fifth legs in *Haplostoma* to obsolescence of the prominences in the cylindrical body of *Haplosaccus*. The most prominent urosomal features, aside from caudal rami, are associated with the genital apertures.

The antennules are not strongly diagnostic of the subfamily but characterize the genera. They are reduced, usually without clear indication of segmentation, but generally with setae which are typically rather weakly developed.

The antennae are only weakly diagnostic of the subfamily. The basic composition is of 3 segments. The pattern varies through generic modifications.

The labrum is not greatly conspicuous, but may bear ornamenting structures of significance at the specific level.

The mandibles tend to reduction, always much modified, rarely absent.

The maxillules are absent in *Haplostoma* and *Haplostomella,* rather well developed in *Haplostomides,* and present, but in very reduced form, in *Haplosaccus.*

The maxillae are substantially reduced to varying degrees; the most developed examples, in *Haplostomides,* are mere lobes, with varying reduced armature. The

appendage is absent in many examples of *Haplostoma* females.

The maxillipeds are distinctive, but basically similar in pattern to those of *Botryllophilus* and allied forms. They are always present and with little sexual dimorphism in the cases where males are known. The appendage is very stout basally and tapers markedly. It is rather difficult to ascertain the segmental composition with confidence. There are basically 3 major intrinsic articulations, although the third may be suppressed. The third article, where it is apparent, is the smallest and usually appears like a short ring supporting the apical claw. The claw is sharply tapered and curved, and, with the supporting or fused third article, articulates on the large second segment in a subcheliform or cheliform pattern. It is impossible to discern whether more than one article is incorporated in the terminal complex, or alternatively, if the terminating claw represents a cuticular process or a modified seta or spine. Indentations or lines in the cuticle of the terminal claw complex may have the effect of suggesting 4 or 5 ingredient segments for the whole appendage.

Legs 1 to 4 are reduced but always represented. The protopodite probably consists of a fused element, but the actual composition and articulation on the body are usually indistinguishable. Each pair of legs lacks a coxal connecting plate. The rami are unequal. The endopodite, extremely reduced, is represented usually by a lobe, swelling or other modification of the limb surface rather than by any articulated element. The exopodite is typically more developed, but with segmentation obsolete and with articulation on the protopodite incomplete. Elements of armature present are substantially modified.

The fifth legs are characteristically modified, never with a free segment but typically represented by a setiferous lobe which usually extends from a protuberance of the general body surface. The apex of the limb may bear 2 to 3 setae or setules; the seta typically found on the basal segment of the cyclopoid fifth leg is sometimes present but inserted on the general body surface or on its protuberance. In extreme reduction the limb is represented by a single seta.

The large oviducal apertures are situated at the dorsolateral sides of the anterior part of the urosome and covered by slightly swelling folds. Each fold is ornamented with small spines arranged on the free margin.

The caudal rami are reduced, with articulation on the last urosomal segment obsolescent. They tend to small size, often exceedingly minute. The armature is much modified and no element attains large size, although typically several of the cyclopoid setae and spines are somehow represented.

The male is known only from 2 genera, *Haplostoma* and *Haplostomella,* but we think the material in hand demonstrates the male of *Haplostomides* and does not depart substantially from that of *Haplostoma.* We find that in *Haplostoma* there are 2 types of males distributed among the species, swimming forms and creeping forms.

The diagnosis below is of course based on the few males from our material, and may well be subject to modification when males for species of *Haplostomides* and of *Haplosaccus* become available.

The swimming form male is of generalized cyclopoid type, with the usual body

regionalization. The cephalosome includes the appendages through the maxillipeds. Each pair of thoracic limbs is borne on a free segment. The major body articulation is between the segment of the fourth legs and that of the fifth legs. The urosome thus includes the typically much constricted segment of the fifth legs, the expanded genital segment and 4 abdominal segments, with the last bearing the anal aperture and caudal rami. The last segment is termed the anal segment in this paper.

In all the forms from our area a distinctive feature is the presence of greatly developed "aesthetes" on the antennule. The number of aesthetes varies from few to very many and is characteristic generically. In *Haplostoma* the pattern of segmentation and ornamentation is almost identical with that found in the males of some species of *Botryllophilus*.

The antennae are characteristic but further distinctive generically so a generalized statement would be misleading.

The cephalon includes a rostrum varying in development from feeble to fairly complex. The labrum may show generic or specific features of configuration.

The mouthparts are reduced and in the 2 genera available so far the maxillules are consistently absent. The number and pattern of the mouthparts in *Haplostomella* males are comparable to those of their females. In *Haplostoma* males the number and pattern are generally different from those in the corresponding females; in most species, 2 pairs of mouthparts, maxillules and maxillae, are absent in the females.

The first to fourth legs are reasonably well developed. There is a marked tendency to strong modification of the first endopodite. The fourth endopodite tends to reduced segmental composition.

The fifth legs are slightly more typically cyclopoid in the male than in the female, with strong indication of 2-segmented composition. The apical segment tends to be clearly articulated. There is no case so far known of the setiferous basal segment occurring with a developed articulation on the body.

The sixth legs essentially consist of the usual cyclopoid setiferous lobes.

The caudal rami are cyclopoid but characteristically modified. The main apical 2 setae particularly have distinctive aspects in modification of general configuration and in texture.

In the creeping form male of *Haplostoma* the dimorphism is expressed by a substantial difference in body form. The body is wider, somewhat depressed and with marked reduction of the constriction between prosome and urosome, although the segmental composition of the body is unaltered. The caudal rami are shortened and the setation of the swimming legs and of the caudal rami is characteristically modified by a shortening and by the characteristic posture of each seta.

Key to Genera of the Subfamily Haplostominae

(Based on Females; Males are Insufficiently Known)

1a. Exopod of legs 1 to 4 terminating in a single lobe, ornamented with 1 or 2 thorn-like spines apically 2

1b. Exopod of legs 1 to 4 terminating in 2 lobules, one of them setiferous apically ..... *Haplostomella* (p. 96)
2a. All mouthparts present 3
2b. One or more pairs of mouthparts lacking... ..... *Haplostoma* (p. 15)
3a. At least some of the cephalic mouthparts partially setiferous..... *Haplostomides* (p. 77)
3b. Mandible, maxillule & maxilla reduced lobes without normal setae ..... *Haplosaccus* (p. 88)

Genus *Haplostoma* (Canu, 1886)

Enterocola (part), Norman, 1869, p. 300.

Aplostoma, Canu, 1886a, pp. 313–320 (type species, by monotypy, *A. brevicauda* Canu, 1886), not *Aplostoma* Moquin-Tandon, 1856; Canu, 1886b, pp. 1025–1027; 1891, pp. 471, 474, 475; 1892, pp. 220–223.—Scott, T., 1906, pp. 363–364; 1907, pp. 361, 369–370.—Brément, 1909, pp. 78–87; Chatton & Brément, 1909b, p. 228; 1910, pp. 80–81, 88–92.—Schellenberg, 1922, pp. 288–289, Salfi, 1926, pp. 1–2.—Neave, 1939, p. 256.—Dudley, 1966, pp. 155, 157, 158, 160.

Cryptopodus, Hesse, 1865, pp. 237–241, 255 (unidentifiable genus for 2 unidentifiable species, Hesse, 1865, no type designated).—Canu, 1892, p. 222.—Sars, 1921, pp. 74–75.—Blake, 1929, p 6; 1933, p. 226.—Lang, 1948, p. 3.

Tranestoma, Wilson, 1924, p. 14, for *Aplostoma* Canu, preoccupied (type-species, by monotypy, *Aplostoma brevicauda* Canu, 1886); 1932, p. 601 (in key).

Haplostoma, Chatton & Brément, 1915, pp. 144, 145, 153.—Chatton & Harant, 1922, pp. 249–252; 1924b, pp. 363; 1924c, pp. 399, 405; 1924d, p. 407; 1924e, pp. 413, 418–419; Harant, 1931, p. 371.—Wilson, 1932, pp. 598, 600 (in key).—Neave, 1939, p. 570.—Gotto, 1952, p. 674; 1954, p. 665; 1959, pp. 9, 10; 1960, pp. 216 (in key); 1966, p. 193; 1970; pp. 271, 272.—Monniot, 1962, p. 573.—Ooishi & Illg, 1974, p. 365.

The name *Aplostoma* was established by Canu (1886a) with *A. brevicauda* as its type by monotypy. Unfortunately, however, this generic name was preoccupied for a genus of mollusks by Moquin-Tandon (1856). Scott (1906), Brément (1909), Chatton and Brément (1910), Schellenberg (1922) and Salfi (1926) applied this generic name for their copepods. Neave (1939, p. 256) listed the name *Aplostoma* twice, once for the copepod genus, citing Canu (1886b, p. 1026) and at the same time for the molluscan genus, citing Moquin-Tandon (see above).

The name *Haplostoma* was first used, as far as we can determine, by Chatton and Brément (1915, pp. 144, 145, 153) without explaining whether it was a replacement for Canu's *Aplostoma.* Chatton and Harant (1922, pp. 249–252) followed this usage for the species *H. brevicauda,* thus apparently making a substitution for Canu's *Aplostoma.* In a footnote (p. 250) they cited Chatton & Brément (1910) apparently in connection with the name of this species, but we have been unable to verify any use of the spelling *Haplostoma* in the publication cited.

Neave (1939, p. 570) lists *Haplostoma* for Crustacea, citing Canu, 1886, Bull. Soc. Sci. Nord, (2) 9, 313. We have not been able to verify this citation in the papers of Canu.

Since the first publication by Chatton and Brément (1915) of the name *Haplostoma,* various subsequent workers (Chatton and Harant, 1922, 1924, b-e; Wilson, 1932 (in the generic key); Gotto, 1952...1970; Monniot, 1962; Ooishi & Illg, 1974) adopted the above practice and we here follow this lead, as expressed in translation by C. Monniot (1962, p. 573): "Although Chatton & Brément introduced *Haplostoma* without

explaining whether it was a replacement for Canu's *Aplostoma* we propose here to use the term *Haplostoma* as a nomen conservandum".

There are nomenclatural difficulties in this usage. Sars (1921, p. 74) noted the preoccupation of *Aplostoma* and exhumed *Cryptopodus* Hesse, 1865 (pp. 237–241, 255) to receive Canu's *Aplostoma brevicauda* (1886a) and a species he attributed to *Enterocola eruca* Norman, 1869, describing and figuring both these forms in some detail.

Wilson (1924), either in ignorance or disregard of Sar's action, cited *Aplostoma* Canu among genera of copepods preoccupied by prior application in other taxa and proposed the substitute name *Tranestoma* Wilson, 1924, with the type species of Canu, *Aplostoma brevicauda* Canu, 1886. Wilson's genus has not been invoked by other authors.

Diagnosis: Female: The body is grub-like, called eruciform by the early workers, inflated, with segmentation suppressed or modified; with the thoracic legs much modified in structure and position; with body regions not sharply marked off; the caudal rami feebly developed and often not clearly articulated with the urosome.

The cephalosome lacks pleural folds, with the cuticle in general not heavy, but with some regional sclerotization such as thickenings at the apex. There is not a prominent rostrum but such a structure is usually at least indicated.

There is a good indication of the separation of the cephalosome from the free thorax by a fold in the integument.

The bulk of the body is a trunk-like element added to the cephalosome and distinctive for the genus (and for *Haplostomides*). It includes the body regions for the 4 pairs of modified legs and for the vestigial fifth legs. The segmental composition is indicated by lines or integumental indentations or folds, not really distinct articulations. The posteriormost element incorporates, in addition to body extension, the element for the greatly modified fifth legs, with the conspicuous protrusions at the posterior corners. At the posterior limit of each anatomical segment, except that for the fifth legs, there is a midventral sclerotization which probably is a vestige of a basic articulation.

A sharp bodily constriction posterior to the protuberances of the fifth legs marks off the modified urosomal region. This is not typically demarcated by an articulation, nor are the caudal rami distinctly articulated on its terminal portion. The region is indicated as urosomal, not just abdominal, by the occurrence on it of the insemination apparatus, including one or a pair of distinct genital pores midventrally placed, diverging internal seminal canals, dorsolaterally placed oviducal apertures with covering ornamented folds, and a characteristic sclerotized area between the apertures on the dorsal surface of the urosome. There is no distinct indication as to how many abdominal segments are incorporated into the urosome.

The antennules are reduced, consisting essentially of diverging, tapered lobes, with segmentation suppressed, but retaining setiform elements of armature distributed along the appendages. These features conform to a characteristic pattern.

The antennae are characteristic. Each is a 3-segmented structure: the basal segment is short and usually well suppressed anteromedially; the second segment is longer than wide, without marked taper, and unornamented; the third segment, about as long as the second, is of the same width basally, but with a gradual taper apically. There are characteristically 4 elements of armature modified to varyingly developed spiniform projections. Mostly, one of these is inserted apically and the remaining ones occur at fairly regular intervals along the distolateral margin. Rarely, the most proximal element is setiform or absent.

The labrum is not particularly prominent; the configuration and ornamentation, which may be fairly well developed, are according to specific variations.

The mandibles are reduced, unsegmented, each consisting of a small lobe, usually far lateral from the oral aperture, and bearing 1 to 2 minute apical setae. In the female of a species with the male of creeping type the mandibles are well developed cylindrical lobes, placed close to the mouth-opening, each with 3 apical setae.

The maxillules and maxillae are typically absent, but we have found reduced maxillae in a species which has the male in creeping type.

The maxillipeds are rather generically distinctive. In each there are 2 large basal segments supporting a much narrower, clawed apical element. The first basal segment is without armature and the second segment has 2 setules near the distal end, without a distolateral protrusion. Articulated on the second segment is a narrow ring-like article supporting the terminal claw, with a uniformaly tapered outline of the 2 associated pieces. We assume the ring-like article is a third segment. The end-piece formed by the third segment and the claw articulate on the second segment in a subcheliform pattern.

The first to fourth legs are rather generalized for the genus, but remain highly modified copepod appendages. There is a great fusion of the ingredient articles and these cannot be readily identified. The basal portion of the appendage, probably representing the protopodite, is not clearly articulated on the body, and there is no indication of segmental composition. However, a heavy sclerotization forming a sort of framework probably represents the protopodite supporting the rami; the framework bears 1 lateral seta in some species (*H. ambiguum*). There is no clearly demarcated endopodite, but this portion of the appendage seems to be at least indicated by a mammiform projection or subconical lobe with no sign of articulation on the proptopodite. The projection or lobe is not distinctly developed in some species. There usually is a setule or occasionally more than one, inserted apically or subapically on the projection. The exopodite is well sclerotized, with a partial articulation laterally on the protopodite, but there is no indication of the ingredient segments. The ornamentation consists of 3 to 5 much modified elements. These usually form a row along the distolateral margin: the most proximal is always a short simple seta; the distal 2 elements are thorn-like, wide-based, short, stout spines and the remaining 1 or 2, if present, are somewhat or much smaller spines.

The fifth legs are doubtless incorporated into the characteristic paired subconical projections at the posterolateral corners of the forebody. Two or 3 short simple

setae inserted apically on each projection probably represent the normal apical setae of the fifth leg. More proximally a similar seta is inserted directly on the projection.

The oviducal folds covering the oviducal apertures are armed with a set of 1 large and 1 small spine and a row of several small spines on the median free margin. In some species a single small spine is anteriorly located at a distance from the set of 2 spines besides the row of small spines. The dorsal sclerotization between the oviducal folds is developed. On the ventral side the insemination pore and its associated internal structures are generally distinctive as previously mentioned.

The caudal rami are very characteristic; the ramus is short and tapered, with reduced ornamentation. About 3 to 5 of the usual elements of armature are probably represented by the variously developed small setae or setules and spinules or thorn-like elements borne on the ramus.

Male: The male of *Haplostoma* was described as a swimming form by Canu (1892) and his written description is reasonably applicable, though lacking in many details. However, his figures, Pl. XX, figs. 13–18, must surely refer to a male of a species of *Botryllophilus*. We feel certain this is established by his excellent figure (fig. 15) of the antenna which applies completely to a *Botryllophilus* but cannot be referred to *Haplostoma* because of the armature of 7 spiniform elements (4 is the number for *Haplostoma*). Remarkably, the generalized nature of the remainder of his illustrations, even the habitus (fig. 13), could almost as well apply to species of *Haplostoma* as to species of *Botryllophilus*.

The figures 13–15, Pl. XXI, conform well to the characteristic form of the appendages of *Haplostoma* males but a work in preparation (Illg and Dudley) demonstrates that the first leg of males of some *Botryllophilus* species have the same features.

Our material includes males from 5 of our new species, so we can provide a diagnosis for the general form in the genus. Among our male species, 3 have a typical swimming form while 2 others have a creeping form. Our material has not revealed whether both forms can occur in a single species, but the existence of dimorphism of males in the notodelphyids (*Doropygus seclusus*) was demonstrated by Dudley (1966) and there is a possiblility that the phenomenon may be of fairly wide occurrence through the ascidicolous copepods, since they are phylogenetically related and exhibit many parallels in adaptation.

The swimming form: The general body habitus, regionation and configuration correspond to the usual pattern for cyclopoid swimming males. The prosome consists of a cephalosome, very clearly marked off and bearing the appendages through the maxillipeds, and of 4 additional thoracic segments, clearly demarcated and bearing the 4 pairs of swimming legs. The urosome consists of 6 segments: a narrow thoracic segment bearing the fifth pair of legs; an elongated, slightly expanded genital segment enclosing the paired spermatophores and bearing on the ventral surface the setiferous flaps, possibly representing the sixth legs; 4 additional free abdominal segments, with the last circumanal bearing a pair of caudal rami.

There is a slightly developed rostrum. The antennules are distinctive, although

remarkably similar to those of *Botryllophilus*. There are 4 clearly articulated segments, although the actual segmental composition as indicated by ornamentation and armature is certainly much greater; each of the apparent segments is probably a complex formed by fusion of ingredient basic segments. The proximal segment is an expanded, highly ornamented basal element. It bears a specifically varying number of setae, most of these borne on distinct protrusions of the general surface. In addition, there are a large number of specifically variable aesthetes. A few of these are interspersed with the setae and similarly inserted. The greater number, which may reach over 100, form a closely set rosette on the ventral surface, from which the aesthetes radiate in a conspicuous and characteristic pattern. The second segment bears mainly setae inserted mostly on very prominent lobes; the segment is relatively short but wide. The third segment varies in proportion and is elongated in some species. The anterior distal corner of the segment usually protrudes as a setiferous lobe or a set of lobes, on which a few setae and at least one characteristic aesthete take insertion. The last segment probably incorporates several ingredient elements as demonstrated by the large number of setae variously placed and developed.

The antennae are highly characteristic for the genus; they vary slightly from the characteristic pattern for the female. There are probably 3 segments. The most basal segment is very short and reduced. The second segment is long, slender, typically unornamented. The distal segment tapers slightly apically from a basal width about the same as that of the second. The armature is characteristic, consisting of 4 elements. They are arranged along the distal half of the anterior margin and apically. The 2 apical elements are usually inserted closer together; the more proximal ones are arranged at equal intervals on the margin. These 4 elements are usually spines, but one of them occasionally is a seta or setule. The appendages are somewhat dimorphic sexually; the proportions differ and the armature is of a slightly or strongly different development than in the female.

The labrum is a slightly produced structure without marked ornamentation.

The mandibles show strong dimorphism and are highly characteristic for the genus. The appendage is small, but relatively long for its width, with cuticular indication of perhaps 2 or 3 ingredient segments. There are 2 elements of armature; one of them, inserted at the apex, is a very long seta and the other more proximally inserted element is a very short seta or setule.

The maxillule is absent. There appears to be a dimorphism with regard to the maxilla. The maxilla is lacking in most females, but represented in the males by a subconical or sack-like lobe bearing usually an apical setule or small seta.

There is a slight dimorphism in the maxilliped, mainly in the proportionately slightly greater development of that of the male, but the basic organization and ornamentation are essentially similar. The complex including the terminal claw is somewhat longer in the male, seemingly indicative of a different mode of prehension, and may involve more developed ornamentation.

The first swimming legs are characteristic, but the most distinctive feature, the modification of the endopodite, may also be shared with the genus *Botryllophilus*, as indicated by some of our studies now in progress. The protopodite is 2-segmented. The coxopodite lacks a seta, but the internal plate is present. The basipodite bears a lateral seta but lacks a medial spine. The endopodite shows characteristic modification, which consists of reduction of the ramus to 2 segments. The armature of the terminal segment tends to present features of highly specific modification. The trimerous exopodite is not particularly distinctive.

The second legs are not markedly distinctive, but seem to lack consistently the medial coxal seta. The third legs are fairly typical cyclopoid appendages, bearing the medial coxal seta. The fourth legs (with the medial coxal seta) are somewhat distinctive in the reduction of the endopodites to 2 segments with slightly reduced setation.

The very small fifth legs consist of 2 segments. The apical free segment bears 2 terminal setae. The basal portion of the leg, coalesced with the body proper, is indicated by a single seta.

The sixth legs are probably represented by 2 setae on the distal margin of the flap-like cover of each male genital orifice.

The caudal rami, although superficially basically cyclopoid in type, have distinctive generic features. The length considerably exceeds the width. The armature includes 2 elongate, main apical setae without distinctive hyaline flanges. There are 3 more elements of the armature: the lateral apical setule is short, stout and tending to spiniform configuration; a well-developed setule, presumably representing the usual dorsal subterminal element, is inserted on the dorsal surface at about the midpoint of the ramus; the usual proximal lateral setule is here considerably displaced dorsally at about the proximal third of the ramus. There is no element of the armature in the usual medial apical position.

The creeping form: The general aspect departs from that of the swimming form. The body is wider, perhaps a bit depressed, with marked reduction of the constriction between prosome and urosome. The caudal rami are shortended and may be otherwise modified. The segmental composition of the body is unaltered.

The antennules are much as in the swimming form and perhaps any notable differences are essentially at the specific level. The same would probably be the case for the antennae and mouthparts. The manibles are well-developed cylindrical lobes with 2 or 3 setae apically.

The 4 pairs of swimming legs show the distinctive generic features with additional reduction or modification of the segmentation and armature. A generic reduction in segmentation seems to be involved in the unsegmented, bizarre structure of the first endopodites with modified or reduced setae or spines. Through all 4 pairs of legs the setae seem to be shortened or curled.

The caudal rami are distinctly modified by shortening and by modification of the terminal setae. The terminal setae are short, with a consistency differing from

that of the long setae of the swimming forms.

Key to Species of *Haplostoma*, based on Females

1a. One pair of mouthparts (maxillules) lacking.....*elegans*, n. sp.
1b. Two (maxillules & maxillae) or 3 (mandibles, maxillules & maxillae) pairs of mouthparts lacking 2
2a. Armature of terminal segment of antenna including 3 spines..... 3
2b. Armature of terminal segment of antenna consisting of 4 spines..... 4
3a. Mandible with 1 small seta .....*setiferum*, n. sp.
3b. Mandible with 2 small setae .....*gibberum* (Schellenberg, 1922)
4a. Posterior margin of labrum with processes..... 5
4b. Posterior margin of labrum without processes..... 9
5a. Posterior margin of labrum with 8 distinct processes .....*dentatum*, n. sp.
5b. Posterior margin of labrum with 4 to 6 processes..... 6
6a. Exopod of legs 3 to 4 with 4 spines..... 7
6b. Exopod of legs 3 to 4 with 2 spines..... 8
7a. Posterior margin of labrum with 4 indistinct processes .....*ambiguum*, n. sp.
7b. Posterior margin of labrum with 6 distinct processes .....*banyulensis* (Brément, 1909)
8a. Posterior margin of labrum with 6 distinct processes; body length beyond 2 mm .....*eruca* (Norman, 1869)
8b. Posterior margin of labrum with 6 indistinct processes; body length less than 1.5 mm .....*minutum*, n. sp.
9a. Exopod of legs 3 to 4 with 2 spines .....*albicatum*, n. sp.
9b. Exopod of legs 3 to 4 with 3 or 4 spines..... 10
10a. Legs 1 to 4 without distinct endopod lobe.....*canui* Chatton & Harant, 1924
10b. Legs 1 to 4 with endopod represented by subconical lobe..... 11
11a. Fifth leg with 2 apical setules .....*brevicauda* (Canu, 1886)
11b. Fifth leg with 3 apical setules.....*mizoulei* Monniot, 1962

Haplostoma banyulensis (Brément, 1909)

Aplostoma banyulensis, Brément, 1909, pp. 79–87, figs. XII-XIV (type locality, Port-Vendres, Golfe de Lion, France, from a *Leptoclinum* (closely resembling *L. maculatum* type Milne-Edwards)). —Chatton & Brément, 1910, pp. 88, 89, 91.—Schellenberg, 1922, pp. 289, 294.—Salfi, 1926, p. 1.—Sewell, 1949, p. 183.

Haplostoma banyulensis, Chatton & Harant, 1924e, p. 419.—Harant, 1931, p. 371.—Gotto, 1952, p. 674; 1954, p. 665; 1960, pp. 216, 222; 1966, p. 193.—Monniot, 1962, pp. 573, 574.

Haplostoma brevicauda (Canu, 1886)

Aplostoma brevicauda, Canu, 1886a, pp. 313–320, pl. II, figs. 1–4 (type locality, Wimereux, France, from *Morchellium argus* (H. Milne-Edwards)); 1886b, p. 1026; 1892, pp. 223–224, pl. XX, figs. 5–18, pl. XXI, figs. 13–15.—Brément, 1909, pp. 83–85.—Chatton & Brément, 1910, pp. 80, 88–91. —Schellenberg, 1922, pp. 288, 295, 296.—Salfi, 1926, p. 1.

Cryptopodus brevicauda, Sars, 1921, p. 75, pl. XXXV (1).—Lang, 1948, p. 3.—Sewell, 1949, p. 188.

Haplostoma brevicauda, Chatton & Harant, 1922, pp. 250, 251; 1924e, pp. 415, 419.—Gotto, 1952, p. 674; 1954, p. 665; 1959, p. 9; 1960, pp. 216, 222, figs. 7, 11; 1966, p. 193.—Monniot, 1962, pp. 573, 574.

Haplostoma canui Chatton & Harant, 1924

Haplostoma canui, Chatton & Harant, 1924e, pp. 413–415, fig. 1 (type locality, Penpoull (Roscoff), France, from *Polyclinum aurantium* Milne-Edwards).—Gotto, 1960, p. 227.—Harant, 1931, p. 371.—Monniot, 1962, pp. 573, 574.

Haplostoma eruca (Norman, 1869)

Enterocola eruca, Norman, 1869, p. 300 (type locality, Shetland Islands, a single specimen, from *Ascidia intestinalis*—adhering to intestine; legs bearing exopods with 3 spines, without illustrations).—Brady, 1878, pp. 147–148.—Canu, 1886a, p. 318.—Scott, T., 1891, p. 301 (Firth of Forth, Scotland, 4 specimens, from *A. intestinalis*—in intestine).—T. & A. Scott, 1892, pp. 203–205 (dubiously as ?*E. eruca*, for the specimens reported by T. Scott, 1891, 4.5 mm long: legs bearing exopods with various number of spines; 4 in 1st, 3 in 2nd, 2 in 3rd & 4th), pl. XVI, figs. 1–11.

Aplostoma affinis, Scott, T., 1906, pp. 363–364 (for the specimens examined by the Scotts, 1892); 1907, pp. 369–370.

Aplostoma eruca, Brément, 1909, pp. 83–85, 87.—Chatton & Brément, 1909a, p. 196; 1909b, p. 228; 1910, p. 80 (*A. eruca* Norman=*A. affinis* T. Scott).—Schellenberg, 1922, pp. 288, 295, 296.—Salfi, 1926, p. 1.

Cryptopodus eruca, Sars, 1921, p. 76 (Christiania Fjord, Norway, 2 specimens, 2.3 mm long, from *Styela intestinalis*—in intestine), pl. XXXV(2).—Sewell, 1949, p. 188.

Haplostoma affinis, Chatton & Harant, 1924e, p. 419.

Haplostoma eruca, Chatton & Harant, 1924b, p. 363; 1924e, pp. 417, 419, as doubtful species *H. eruca* (=*H. affinis* T. Scott, 1907).—Harant, 1931, p. 371 (*H. eruca*=*H. affinis*).—Gotto, 1959, pp. 9, 10 (Strangford Lough, Ireland, a single specimen, 2.1 mm long, from *Ciona intestinalis*—in gut); 1960, pp. 216, 222; 1966, p. 193; 1970, p. 272.—Monniot, 1962, pp. 573, 574.

We are left in doubt that 2 sets of copepods—*H. eruca* (Norman) and *H. affinis* (Scott)—differing in body length (T. & A. Scott, 1892; Sars, 1921; Gotto, 1959) and/or in armature of legs (Norman, 1869; T. & A. Scott, 1892) reprensent a single species.

Haplostoma gibberum (Schellenberg, 1922)

Aplostoma gibbera, Schellenberg, 1922, pp. 288–290, figs. 5–7 (type locality, Stewart Island, New Zealand, from *Cnemidocarpa maoria* Michaelsen).—Sewell, 1949, p. 163.

Haplostoma gibbera, Gotto, 1959, p. 10.

Haplostoma mizoulei Monniot, 1962

Haplostoma mizoulei, Monniot, 1962, pp. 570–574, fig. 1 (type locality, Banyuls-sur-Mer, France, from *Parascidia turbinata* (Savigny)).—Gotto, 1970, p. 272.

Haplostoma albicatum, new species

(Figs. 1–5, Pl. I, Fig. 1)

Types: Holotypic female, USNM 169500 (type locality, off San Juan County Park, San Juan Island, Washington, July 10, 1966, from *Distaplia occidentalis* Ban-

croft); allotypic male, USNM 169501, same locality and host; paratypes and all other specimens listed below.

SPECIMENS EXAMINED:

WASHINGTON

From *Distaplia occidentalis* Bancroft

Rock Point, West side of Lopez Island, 48°29.8′N., 122°57′W., 18–40 fams., June 28, 1965, 5 females, 1 male; Friday Harbor, 48°32.2′N., 123°0.3′W., on float, June 28, 1965, 12 females; Peavine Pass, 48°34.9′N., 122°50.7′W., 31–23 fams., Aug. 18, 1965, 5 females; off San Juan County Park, 48°32.5′N., 123°9.6′W., 10 m., July 10, 1966, 20 females, 5 males (including holotype, allotype and 5 females, 1 male, USNM 169502).

BRITISH COLUMBIA

From *Distaplia occidentalis* Bancroft

Whiffin Spit, Sooke, 48°21′N., 123°43.9′W., lowest intertidal, July 27, 1965, 5 females.

DESCRIPTION: Female: The body (Fig. 1 a–c, Pl. I, Fig. 1) is somewhat expanded and of grub-like appearance with a slight dorsal curvature. It is divided into 3 regions of cephalosome, metasome and urosome, with their proportional lengths about 1: 5.4: 0.6. The body length of a single representative specimen is 2.2 mm, measured from the anteriormost to the end of the caudal rami. The cephalosome is inflated, lacking pleural folds. The cuticle of the apex includes a distinctive sclerotized region, with an inverted V-shaped configuration (Fig. 1 d). The anterior and posterolateral corners of the sclerotization are enlarged and each enlarged part encloses a large, less sclerotized depression. There are about 25 similar but much smaller depressions scattered on the sclerotized surface. These large and small depressions include either one or a few hairs which arise from the centers of mammiform projections. Ventrally the sclerotization extends into a narrow sclerotized bar between the antennules. There is no rostrum. The small median eye is situated anteriorly. The head appendages (Fig. 1 e, f) consist of antennules, antennae, mandibles and maxillipeds. Maxillules and maxillae are absent.

The metasome is separated from the cephalosome by an integumental fold surrounding the body as if the fold were a real articulation. It is divided into 4 segmental portions by similar folds, with 4 pairs of characteristic thoracic legs and a pair of extremely reduced fifth legs. The first segment is 1.4 times as long as the cephalosome, the second and third segments are slightly longer than the first, and the fourth segmental portion, actually a composite, is 1.2 times as long as the second or third segment. The fourth section incorporates the element for the fifth legs, and its posterior corners at the sides are extended into conical protrusions. The real posterior limit of the fourth leg-bearing segment is demarcated by a midventral sclerotization at the distal fourth of the last metasomal section. A similar midventral sclerotization exists at the posterior limit of each of the anterior 3 leg-bearing segments as in other *Haplostoma* females. The widest part of the body occurs at the second and third segments with the width 0.7 mm. In the first 4 pairs of legs each pair is situated somewhat posteriorly on the segment and lacks the usual coxal connecting plate between the legs which are well separtated from each other.

A shallow bodily constriction posterior to the conical protrusions marks off the

urosomal region, but without a clear articulation. The relatively short urosome (Fig. 1 g) tapers posteriorly and is divided into 3 subequal segments, bearing terminally small conical caudal rami with short spines and setae. The segments and caudal rami are demarcated by integumental folds without real articulations or

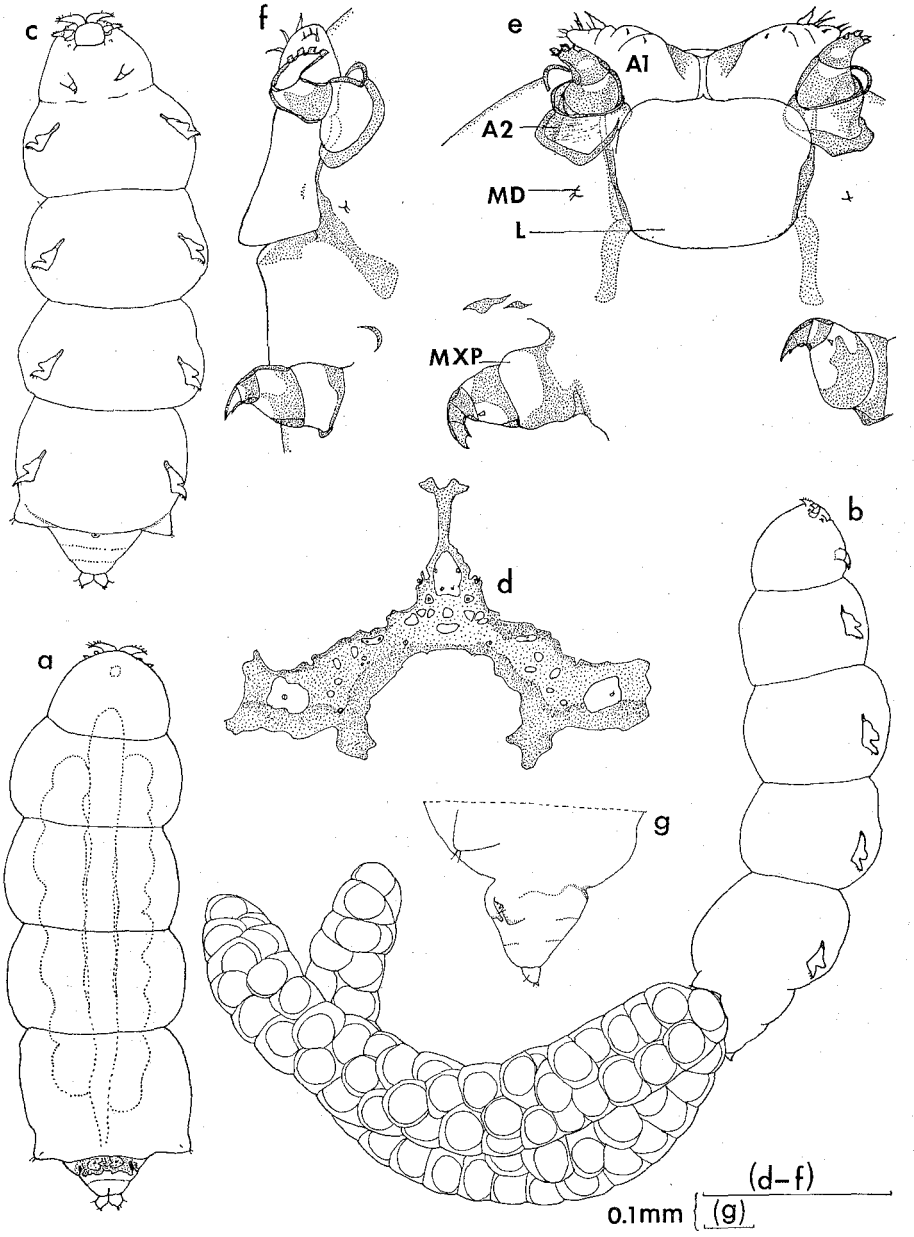


Fig. 1. *Haplostoma albicatum*, n. sp., female: a, dorsal; b, lateral; c, ventral; d, cephalic plaque; e, oral area, ventral; f, oral area, lateral; g, metasome, posterior portion, and urosome, lateral. Key to abbreviations: Al, antennule; A2, antenna; L, labrum; MD, mandible; MXP, maxilliped.

midventral sclerotizations. The first urosomal segment corresponds to the genital segment, and is marked by the small insemination pore, midventrally placed, with the narrow internal seminal canals diverging from it extending to the dorsolateral oviducal apertures. The oviducal apertures are covered by somewhat inflated folds, each bearing 6 spines (Fig. 2 h) on its medial free margin. The largest spine is placed posteriorly and is accompanied by 1 articulated smaller spine at its anterior base. The remaining 4 small spines are arranged in a row on the more anterior edge of the margin.

The egg sacs (Fig. 1 b) are as long as the body or somewhat longer, with relatively large eggs packed within their thin transparent walls. The anterior tip of each sac is attached to the above-mentioned spines. There is a dorsal sclerotization (Fig. 2 i) between the oviducal apertures. It is of trapezoidal shape with complex surface configuration and encloses a pair of large subtriangular, less sclerotized depressions, where internally some transverse muscle strands are associated. In the middle of each depression there is a hair growing from the centre of a tiny mammiform projection. When the oviducal aperture is tightly covered by the free fold, the 4 anterior spines on the medial margin of the fold are concealed under the lateral margin of the dorsal sclerotization whereas the set of 2 spines (1 large and 1 small) remains exposed outside the sclerotization.

The superficial body color is white or slightly yellowish, with white ova in the oviducts and white eggs in the transparents egg sacs. The eye is white, apparently because of some sort of covering over the usually red optic unit. The orange gut is straight, narrow and terminates in a small anus which opens as a posterodorsal slit.

The antennules (Fig. 2 j) consist of diverging lobes, each with 4 or 5 narrow sclerotizations suggesting suppressed segmentation. The armature is composed of 15 variously reduced setae. These setae are arranged along the anterior margin, most numerously toward the apex: 2 large and stout setae are inserted on distinctive protrusions at about the distal third; 2 setae are proximal to them; the remaining 11 setae cover the rounded tip of the appendage.

The antenna (Fig. 2 k) is a rigid 3-segmented structure. The first segment is extremely suppressed anteromedially whereas the posterolateral side is normally developed and about as long as the second. It is surrounded basally by a round sclerotized area on the body surface. The anterior side of the second segment is somewhat shorter than the posterior side and more sclerotized. The third segment is narrow, with the same width as the second basally but with a gradual apical taper. There are 4 short stout spines with wide bases well articulated. The largest is inserted apically and the remaining 3, somewhat smaller, occur at fairly regular intervals along the distal three fifths of the margin. A small rounded protuberance (Fig. 2 k) from the body surface lies close to the anterolateral side of each antenna.

The rather featureless labrum (Fig. 1 e) has a smooth posterior margin.

The mandible (Fig. 2 l) is a much reduced, unsegmented lobe with 2 minute simple apical setae. It is placed behind the antenna at a short distance from it but rather far lateral from the oral aperture.

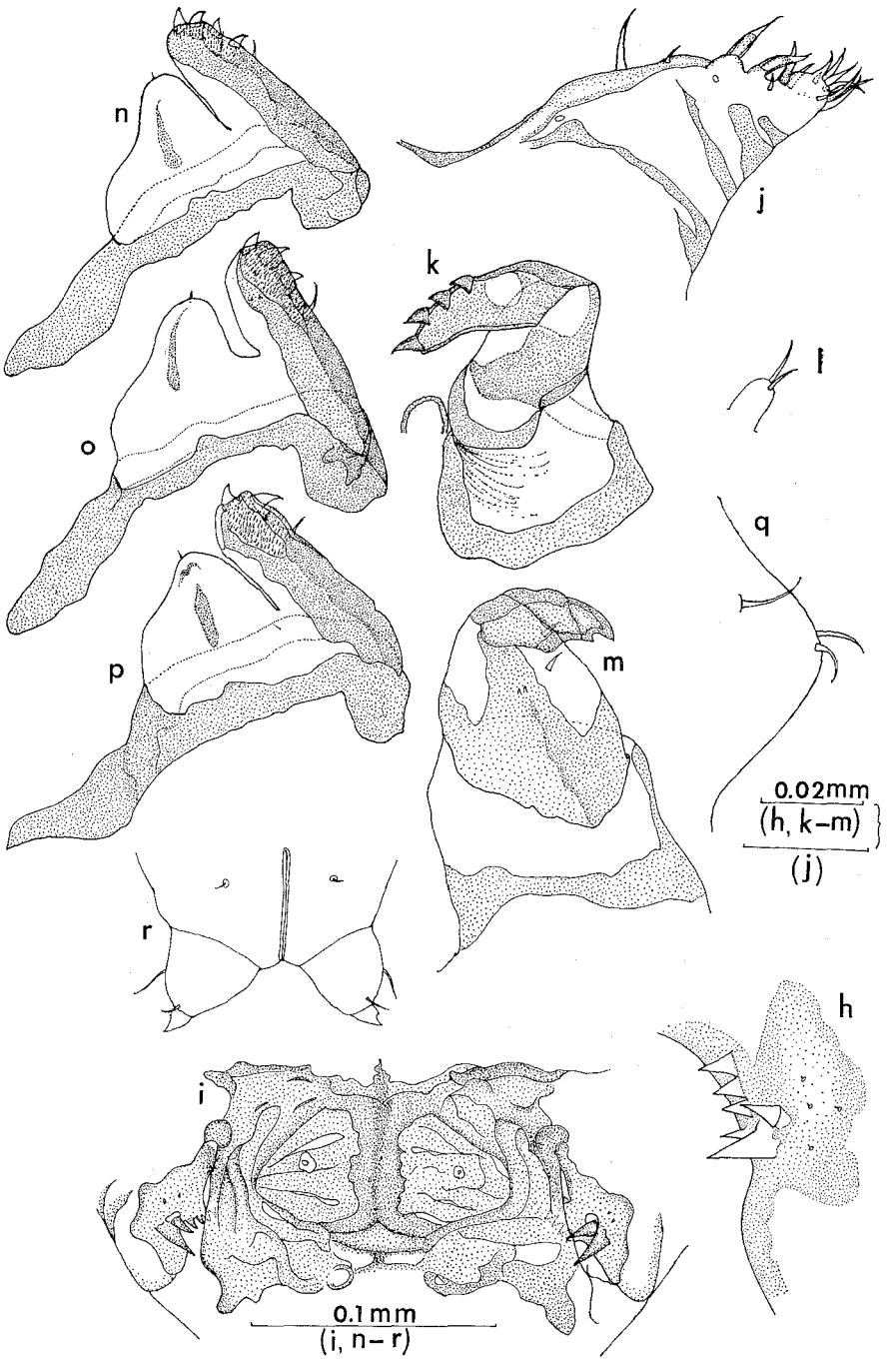


Fig. 2. *Haplostoma albicatum*, n. sp., female: h, margin of fold covering oviducal aperture; i, apparatus at oviducal apertures, including dorsal sclerotized area; j, antennule; k, antenna, surrounded by basal sclerotized bar, with lateral protuberance; l, mandible; m, maxilliped; n, leg 1; o, leg 2; p, leg 3; q, leg 5; r, caudal rami.

The maxilliped (Fig. 2 m) consists of 2 large basal segments with regional sclerotizations and a small third segment set off from the stout apical claw. The basal segment is wider than long and without a marked taper. The second segment is longer than the first and tapers slightly apically. It is set with 2 setules anteriorly and posteriorly near the distal end of the less sclerotized medial margin, arranged to enclose the terminal claw between them when it is flexed. The smallest third segment is wider than long, with the same width as the second basally and supports terminally the strong and slightly bifurcated claw which has an articulative line at the middle.

The first to fourth legs (Fig. 2 n-p) are almost alike in size and structure except for their armature. Each appendage consists of unesgmented protopodite and probably the usual rami. The protopodite is represented by an oval sclerotization or framework forming the basal part of the appendage. The framework is extremely wide, its width about twice the length of the exopodite, and extends medially beyond the basal fused parts of the rami. The endopodite is a distinct subconical projection from the protopodite, bearing 1 setule at the apex. The exopodite is narrow and longer than the endopodite. The lateral side is well sclerotized and articulated on the protopodite framework basally. Its ornamentation consists of 2–4 subequal small spines with rather wide bases and 1 short, slender simple seta. One of the spines is apical, the seta is at the distal third, and the remaining 1–3 spines (3 in the first, 2 in the second and 1 in the third and fourth exopodites) are set at fairly regular intervals between the apical spine and the lateral seta. All these are inserted somewhat posteriorly on the ramus and the corresponding anterior surface is covered with many minute hairs.

The fifth leg (Fig. 2 q) is some portion distally of the subconical projection of the fourth metasomal section and supports 3 short simple setae; 2 of these are at the apex of the projection and the remaining 1 is more proximal on the dorsal side.

The caudal rami (Fig. 2 r) are small and about as long as the terminal urosomal segment, consisting of subconical diverging elements without real articulation with the urosome. Each ramus is as long as its basal width and ornamented with 1 short, slightly bifurcated, stout spine at the apex, 1 short simple seta near the spine on the dorsal side and 1 similar seta midway on the lateral margin.

Male: The body (Fig. 3a, b) corresponds to the usual pattern for cyclopoid swimming males. It is well segmented and composed of 3 regions of cephalosome, metasome and urosome, with their proportional lengths about 1: 2: 2.6. The body length of a single representative specimen is 0.95 mm, measured on the dorsal side from the anteriormost to the end of the caudal rami, and the total length including the terminal caudal setae is 1.13 mm. Posteriorly the cephalosome is clearly marked off from the metasome and it is prolonged anteriorly and ventrally into a rather small subtriangular rostrum (Fig. 3c) with a small sclerotized margin. The apical area (Fig. 3d) of the cephalosome is covered with many characteristic rounded, small tubercles. The pleural folds at the sides are somewhat developed. The head appendages (Fig. 3c) are composed of 5 pairs: antennules, antennae, mandibles, maxillae and maxillipeds. Maxillules are absent.

The metasome consists of 4 segments, clearly demarcated, with well-developed tergal plates, and bearing 4 pairs of swimming legs. The endopodites of the first legs are characteristic, with bimerous structure and armed by spines and setae in reduced form. The widest part of the body, 0.23 mm, occurs on the first metasomal segment.

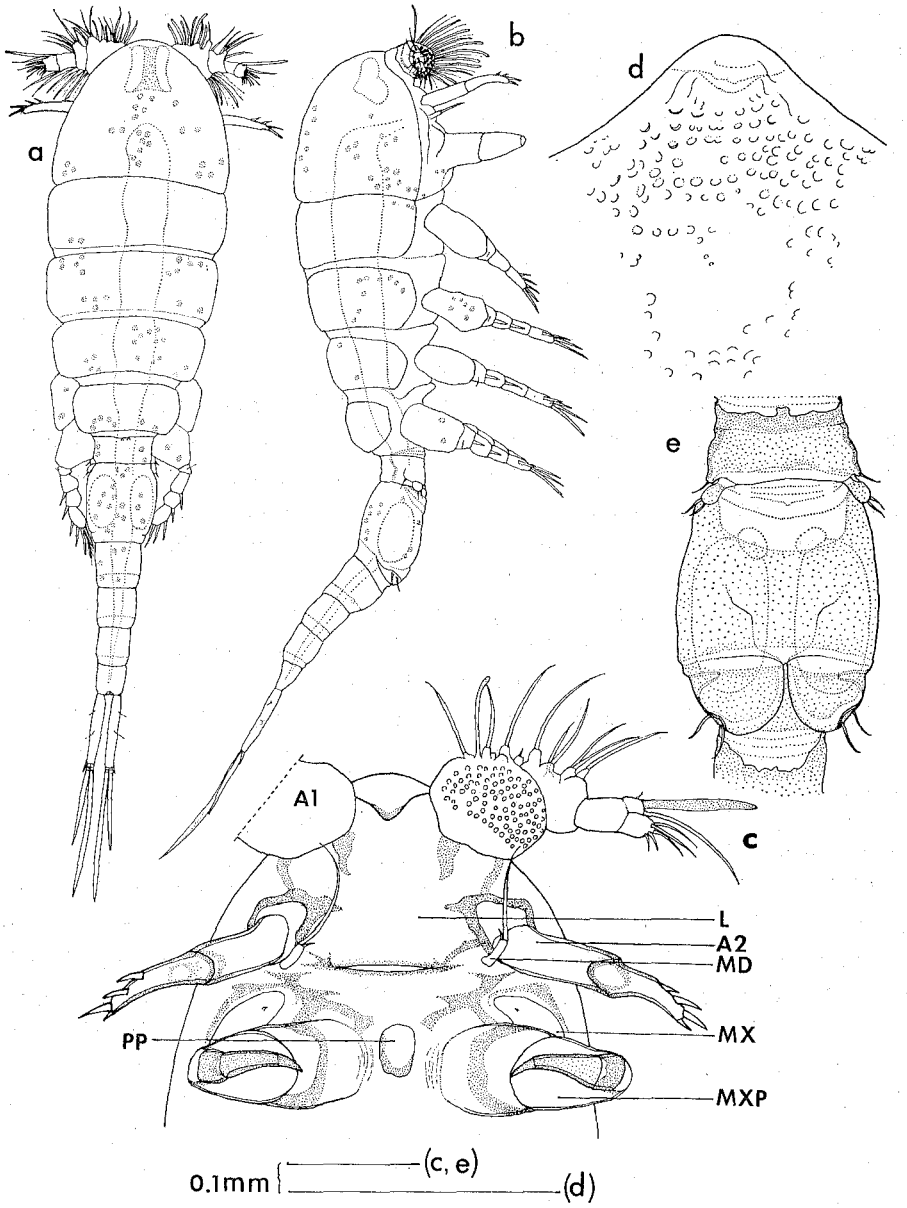


Fig. 3. *Haplostoma albicatum*, n. sp., male: a, dorsal; b, lateral; c, oral area; d, cephalic plaque; e, lst & 2nd urosomal segments, ventral. Key to abbreviations: Al, antennule; A2, antenna; L, labrum; MD, mandible; MX, maxilla; MXP, maxilliped; PP, postoral protrusion.

The urosome is 6-segmented: the short first segment bearing the simple fifth legs; the enlarged second genital segment (Fig. 3e) enclosing paired oval spermatophores and bearing on the ventral surface setiferous flaps representing the sixth legs; the third to fifth free narrow abdominal segments; the narrowest sixth anal segment, which is 0.04 mm wide, bearing a pair of caudal rami. The caudal rami are cylindrical, slender, 2.2 times as long as the anal segment, and each bears a pair of elongated setae.

The body color is slightly yellowish white, with a well-developed brilliant white eye surface enclosing the deep ruby pigment cells in the middle. There are many small round red pigment spots scattered over the body under the body wall as shown in Fig. 3a, b.

The antennule (Fig. 4f) consists of 4 segments. Each segment probably represents a complex formed by a fusion of 2 or more original segments. The proximal segment is the largest, slightly longer than wide, with an extremely expanded hemispherical ventral margin, and occupies about the proximal half of the appendage. From a single representative specimen the armature consists of 131 subequal long aesthetes, with their average length about 0.08 mm, and 10 setae variously developed; 128 of the aesthetes are arranged in a circular area, borne on distinct protrusions closely set in a rosette on the hemispherical ventral surface; the remaining 3 aesthetes and 7 long and 3 short setae are placed on the protrusions along the distal half of the anterior margin. The second segment is short, half as wide as the first, and subdivided on the dorsal side by a transverse integumental fold. It has 6 setae along the anterior margin; 3 (2 long and 1 short) proximal to the fold and 3 (1 long, 1 short and 1 much shorter) in the distal portion. The third segment is elongate, narrow, half as wide as the second and twice as long as wide; the anterior distal corner is extended as a lobe divided into 3 protrusions for 2 setae (1 long and 1 short) and 1 much longer aesthete. There are 2 denticles on the lobe and 1 setule at the distal third on the dorsal side of the segment. The last segment is the shortest, slightly narrower than the preceding segment, bearing 9 setae and 2 aesthetes: the anterodistal corner of the segment is protruded as in the third and bears 1 relatively short aesthete, which is half as long as the long aesthete on the third segment, and 1 long and 1 short seta; there are 2 short setae and 1 short aesthete along the anterior margin; the remaining 5 short setae are placed at the apex and ventral surface. These setae are all non-plumose.

The antenna (Fig. 4 g) is slender and 3-segmented. The basal segment is the shortest, although its length is not the same on each side; it has a strongly developed articulation with the second. The second segment is 3.5 times as long as wide and about 6 times longer than the first segment. There is a slight lateral curvature. The distal segment is slightly shorter than the second and tapers apically. The armature consists of 4 typical spines; 3 at fairly regular intervals along the distal half of the margin and 1, the smallest, at the apex. The distal spine among the lateral elements is the largest, about 1.8 times as long as the remaining spines.

The labrum is like that of the female.

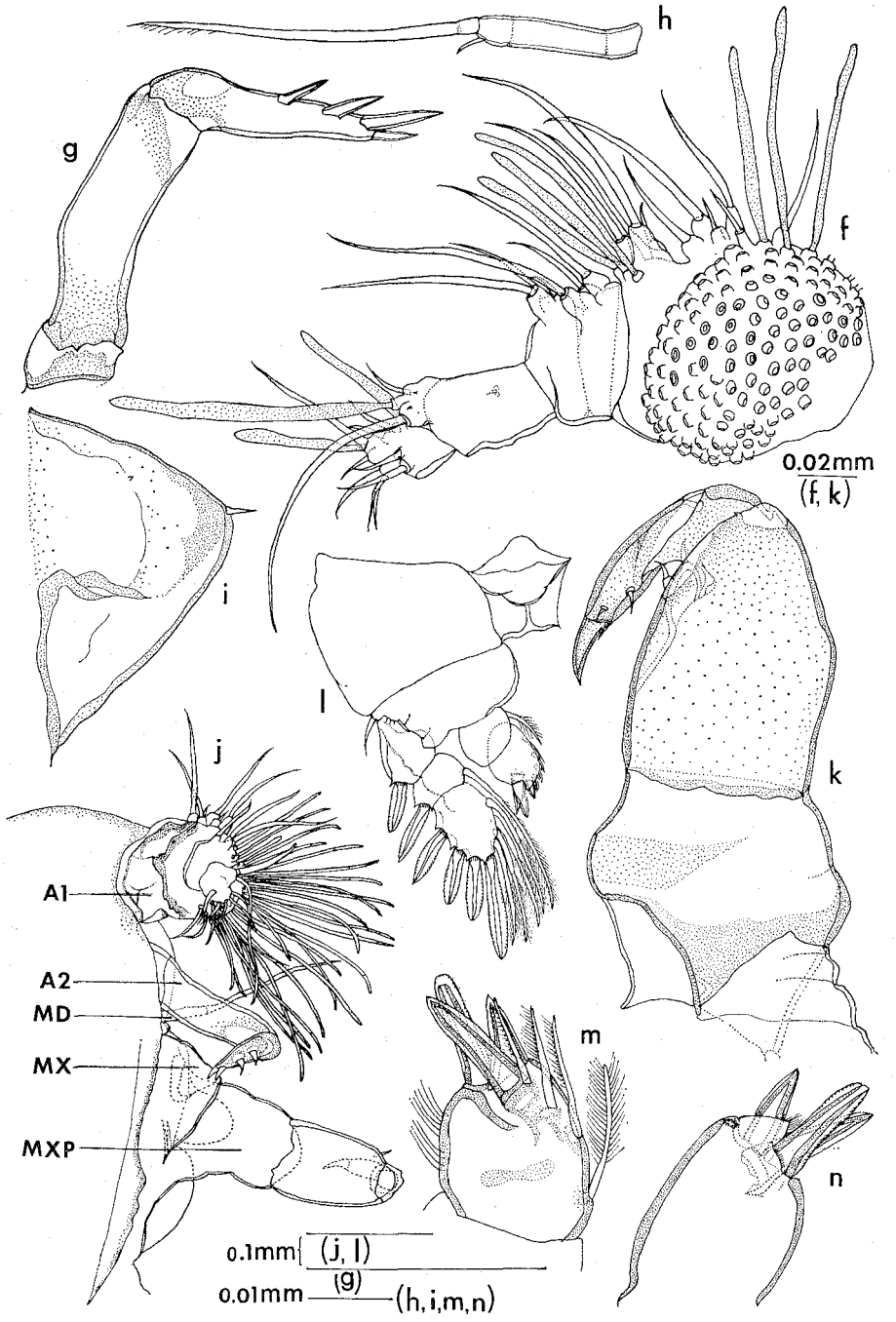


Fig. 4. *Haplostoma albicatum*, n. sp., male: f, antennule; g, antenna; h, mandible; i, maxilla; j, oral area, lateral; k, maxilliped; l, leg 1; m, same, 2nd segment of endopodite, posterjor; n, same, anterior. Key to abbreviations: Al, antennule; A2, antenna; MD, mandible; MX, maxilla; MXP, maxilliped.

The mandible (Fig. 4 h) is reduced but substantial in the male. The appendage is cylindrical, about 5 times as long as wide, with suggestion of subdivision into 3 articles with their proportional lengths from basal to distal 1: 2.8: 1, and bearing 2 setae (1 long and 1 short). The long apical seta is twice as long as the appendage, 12 times as long as the short seta at the mediodistal corner, and has a weakly developed plumose ornamentation.

The maxilla (Fig. 4 i) consists of a subconical lobe, the tip of which is directed somewhat anteriorly with 1 small apical setule. The appendage situated at the anterolateral side of the maxilliped is of subtriangular appearance in lateral view (Fig. 4 j), with the anterior, posterior and basal sides with their proportional lengths about 1: 1.3: 1.5. The inner basal margin is posteriorly articulated with the lateral proximal margin of the maxilliped, and anteriorly hollowed out in a semicircle to connect with the body surface without articulation.

The maxilliped (Fig. 4 k) is substantially comparable to that of the female, although its structure is proportionately more developed. It consists of 3 segments. The basal segment is slightly wider than long and partially sclerotized. The proximal half of the medial side is slightly pitted. The second segment tapers apically; its length is 1.5 times the basal width and 1.2 times the length of the first, measured on the lateral side. The distal half of the medial side has a depressed area and the anterior and posterior margins of the depression each has 1 setule on a small bulge protruded from the distal point. The terminal segment is short, much wider than long, and bears 1 terminal claw which can be folded up in the depression between the 2 setules on the second. The claw has an articulation at the distal third, thus dividing into 2 parts: the proximal component bears 2 setules near the articulation and at about the middle on the posterior surface; the distal component has 1 medial spinule protruded from the base, forming a slightly bifurcated claw. There is a conspicuous postoral protrusion (Fig. 3 c) vertically protruded from the body surface between the maxillipeds.

The first leg (Fig. 4 l) consists of bimerous protopodite and endopodite and trimerous exopodite. The coxopodites are yoked by an intercoxal plate. Each coxopodite lacks a coxal seta. The basipodite bears 1 reduced simple seta on the short lateral margin and is without a spine on the medial margin.

The endopodite is about half as long as the exopodite and bears 5 extremely short plumose setae and 3 much reduced spines with slightly developed hyaline flanges; the first segment has 1 medial seta; the second segment (Fig. 4 m, n) has 4 medial setae and 3 apical spines. These setae are gradually shorter from proximal to distal: the longest proximal seta on the first segment is 3 times the length of the shortest distal seta on the second segment. The medial half of the apical margin (Fig. 4 n) is protruded into a triangular lobe with marginal hairs whereas the lateral half is flat with a denticle row. At the base of the lobe on the posterior side 1 stout spine is fixed and more proximally and laterally 1 similar but longer spine is inserted. On the flat margin there is 1 spine fringed with distinctly serrated hyaline flanges. The most proximal spine on the posterior side is directed laterally to cross the tip of the an-

terior spine on the flat margin.

The first and third segments of the exopodite are nearly equal in length and the second segment is half their length. The 3-segmented ramus has 6 typical spines fringed with hyaline flanges and 5 relatively short plumose setae: the first segment has 1 lateral spine; the second segment has 1 lateral spine and 1 medial seta; the third segment has 4 spines (3 lateral and 1 terminal) and 4 medial setae. The lateral spines are about equal in length and the terminal spine is nearly half again longer than any of them. The lateral margin of each segment proximal to each spine is pointed into a spinule and at the base of the spine there is a denticle row protruded from the segment.

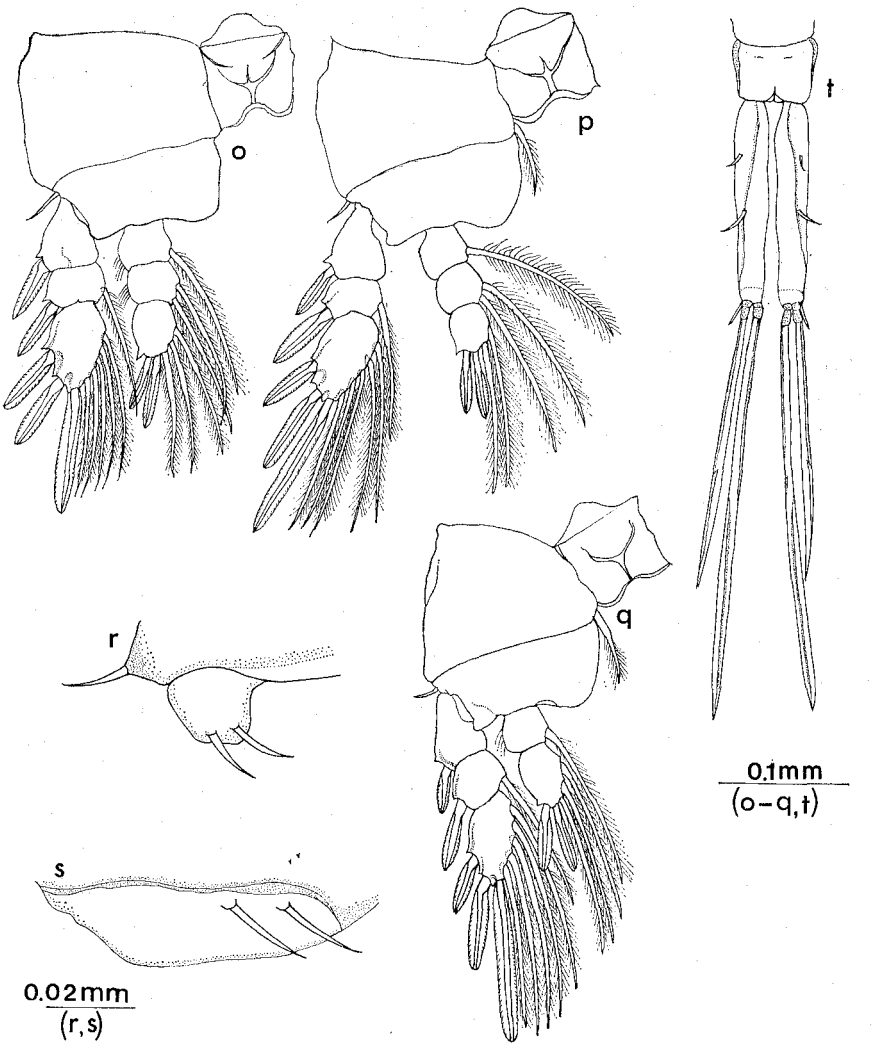


Fig. 5. *Haplostoma albicatum*, n. sp., male: o, leg 2; p, leg 3; q, leg 4; r, leg 5; s, leg 6; t, caudal rami.

The second leg (Fig. 5 o) is composed of bimerous protopodite and trimerous rami. The protopodite is like that of the first legs in structure and armature. The endopodite is about three fifths the length of the exopodite and ornamented with 6 setae and 2 spines: 1 medial seta on the first segment; 2 medial setae on the second segment; 3 medial setae and 2 spines (1 terminal and 1 distolateral) on the third segment. The exopodite has 5 spines and 6 setae; the armature is reduced by 1 lateral spine on the third segment of the first exopodite but 1 medical seta is added on the same segment.

The third leg (Fig. 5 p) is not markedly different from the second in size and structure, although it includes some exceptions in armature. The mediodistal corner of the coxopodite has a plumose seta which extends to a point at about the distal third of the medial margin of the basipodite. The setation of the endopodite is reduced by 1 seta on the third segment from that of the preceding legs. Thus the endopodite bears 2 spines and 5 setae and the exopodite has 5 spines and 6 setae.

The fourth leg (Fig. 5 q) exhibits a reduction in segmentation and armature of the endopodite. The ramus is 2-segmented, with 4 setae and 2 spines; the first segment has 1 medial seta and the second segment has 3 medial setae and 2 spines (1 apical and 1 distolateral). This leg has a coxal seta as in the third leg.

The fifth leg (Fig. 5 r) is composed of 2 portions. The basal portion coalesced with the body proper is represented by a small conical protrusion from the distolateral corner of the body and is ornamented with 1 short simple seta at the tip. The small distal portion is a subquadrilateral lobe, although the basal margin is slightly widened, and bears 2 short non-plumose setae which are placed side by side on the distal margin.

The sixth leg (Fig. 5 s) is represented by the usual sixth leg-lappet which is included in the flap-like cover on the male genital orifice, and bears 2 short simple setae placed side by side on the somewhat depressed area near the semicircular distal free margin of the cover. There are 2 denticles on the surface anterior to the setae.

The caudal ramus (Fig. 5 t) is remarkably long, 6 times as long as wide, and somewhat constricted proximally and distally. The armature consists of 2 long terminal setae without hyaline flanges, 1 small spine at the distolateral corner, 1 well-developed setule at the midpoint of the dorsal side and 1 lateral setule considerably dorsally displaced at the proximal third of the ramus. The medial seta at the apex is twice as long as the caudal ramus and 1.4 times as long as the lateral seta. The medial seta has a middorsal groove in its distal half and is sclerotized on the medial margin of its proximal half. The lateral margin of the lateral seta is sclerotized with an incision at the distal three fifths.

REMARKS: Females of this species can be easily collected in numbers from *Distaplia occidentalis* from the intertidal zone of the San Juan Archipelago, although there is some difficulty in obtaining the males. Both the female and male of the present species correspond startlingly to those of *Haplostoma minutum* in color of body, eye, gut and eggs and also in most anatomical details. However, in general the body size of this form is much larger than in *H. minutum* in both sexes. Moreover, the female

of this species is characterized by its much expanded body in comparison with that of *H. minutum*. Anatomical characteristics obviously distinguishing it from the latter species as well as all other forms are minute hairs on the anterior surface of the distal part of each exopodite in the first 4 pairs of legs and also a small rounded protuberance at the anterolateral side of the antenna.

The male belongs to the swimming type, with those of *H. minutum* and *H. setiferum*, but the antenna of the present species is distinctive from that of the above-mentioned species, and the endopodite of its first leg is much reduced.

Haplostoma minutum, new species

(Figs. 6–10)

TYPES: Holotypic female, USNM 169503 (type locality, Peavine Pass, San Juan Archipelago, Washington, Aug. 22, 1973, From *Amaroucium arenatum* Van Name); allotypic male, USNM 169504, same locality and host; paratypes and all other specimens listed below.

SPECIMENS EXAMINED:

WASHINGTON

From *Amaroucium arenatum* Van Name:

Peavine Pass, 48°34.9′N., 122°50.7′W., 31–23 fams., Aug. 18, 1965, 2 females, Aug. 22, 1973, 5 females, 12 males (including holotype, allotype and 4 females, 1 male, USNM 169505); Outside Turn Island, 48°32.1′N., 122°57.6′W., 25–5 fams., Sept. 15 ,1965, 10 females; Reid Rock, 48°32.6′N., 122°58.8′W., 20 fams., Sept. 15, 1965, 20 females; Lopez Pass, 48°28.8′N., 122°49.3′W., 12 fams., Oct. 6, 1965, 4 females; Black Rock, 48° 33′N., 122°45.9′W., 31–32 fams., Nov. 13, 1965, 3 females, April 30, 1966, 4 females; Broken Pt., 48°35.4′N., 122°57.2′W., July 1, 1966, 20 females, 17 males.

DESCRIPTION: Female: The body (Fig. 6 a-c) resembles *Haplostoma albicatum* in body structure and color, although it is much smaller in size and shows some minute anatomical differences. The body is divided into cephalosome, metasome and urosome, with their proportional lengths about 1: 4: 1, measured on the dorsal side. The body length of a single representative specimen is 1.25 mm, measured from the anteriormost to the end of the caudal rami. The subtriangular cephalosome is wider than long, somewhat depressed in the anterior half, with a sclerotized apical plaque (Fig. 6 d) of similar design to that of *H. albicatum*. The small median eye is anterior. There is no distinctive rostrum nor are there pleural folds. The cephalosome is demarcated from the metasome by an integumental fold encircling the body and has 4 pairs of appendages: antennules, antennae, mandibles and maxillipeds (Fig. 6 e). Maxillules and maxillae are absent.

The metasome is divided by integumental folds and midventral sclerotizations into 4 sections with proportional lengths similar to those of *H. albicatum*. The last section includes segments for the fourth and fifth pairs of thoracic legs. The demarcation to distinguish these is apparent only ventrally with a distinctive integumental fold and midventral sclerotization. In some specimens such a fold is not

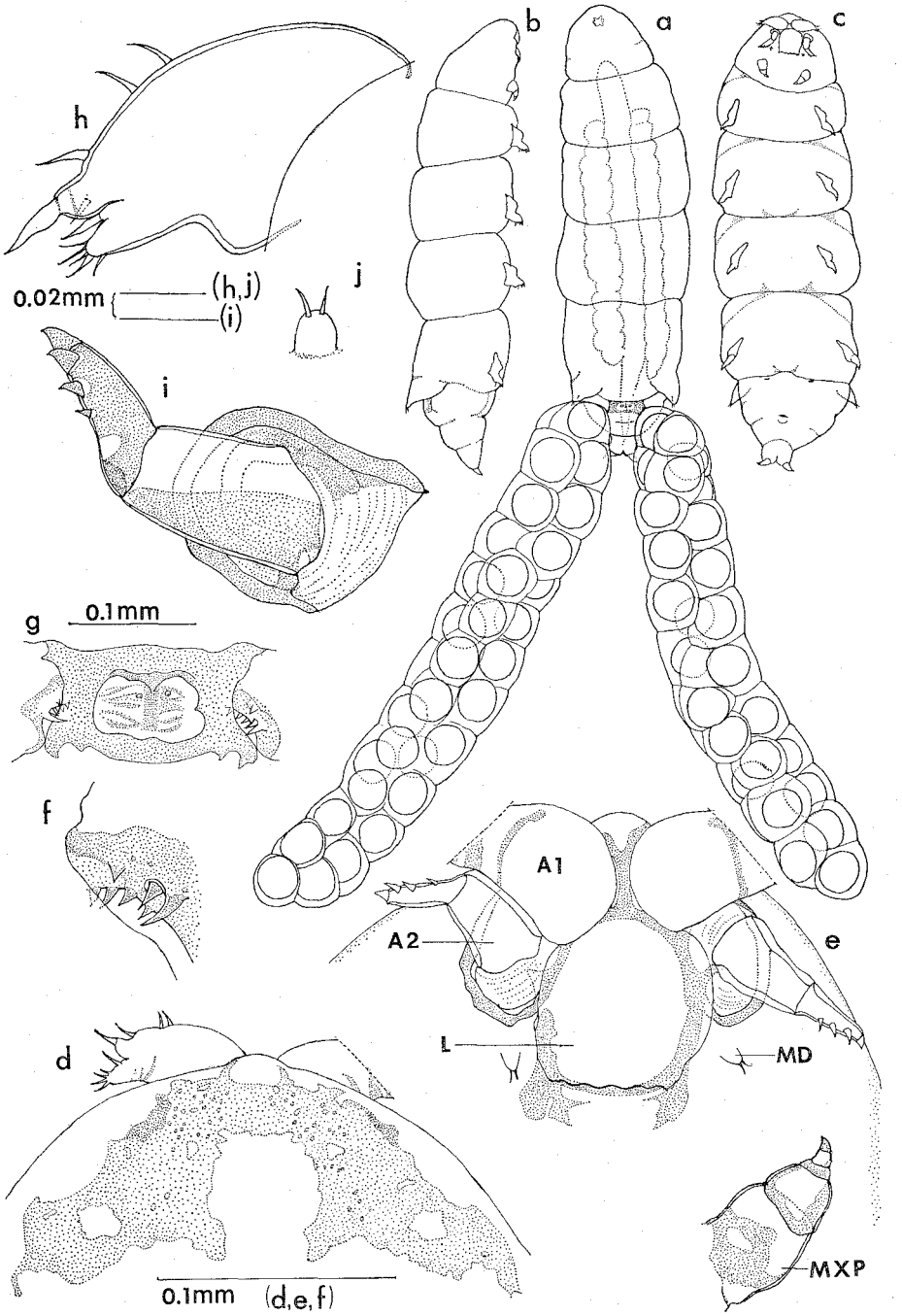


Fig. 6. *Haplostoma minutum*, n. sp., female: a, dorsal; b, lateral; c, ventral; d, cephalic plaque; e, oral area; f, margin of fold covering oviducal aperture; g, apparatus at oviducal apertures, including dorsal sclerotized area; h, antennule; i, antenna; j, mandible. Key to abbreviations: Al, antennule; A2, antenna; L, labrum; MD, mandible; MXP, maxilliped.

apparent. The posterior corners of the fifth segment are protruded at the sides into subtriangular protrusions, each with a distinct constriction at the base. The widest part of the last metasomal section is about 0.36 mm wide.

The urosome is not markedly set off from the metasome but seems to be indicated behind the dorsolateral protrusions by a gradual taper posteriorly. Integumental indentations or folds indicate composition of probably 3 segments. The first segment includes the genital apparatus which consists of lateral oviducal apertures, a dorsal sclerotization between them, a small midventral insemination pore at the posterior limit of the segment, and internal insemination canals diverging internally from it; the canals are usually imperceptible. Each oviducal aperture is covered by a lateral fold (Fig. 6 f) with 7 marginal spines: the largest spine is placed posteriorly and is accompanied by 1 articulated smaller spine at its anterior base; 1 spine-like projection is more anteriorly located at a distance from the proximal 2 spines; the remaining 4 small spines are arranged in a row on the inner edge of the fold. The dorsal sclerotization (Fig. 6 g) is rather simple in structure without integumental indentation. It is a trapezoidal framework, centrally enclosing a large rectangular less sclerotized area with a pair of hairs growing from the mammiform projections, which are situated side by side somewhat anteriorly near the middorsal line.

The last segment of the urosome is cylindrical and narrow with a constriction behind the large anterior region and bears small conical caudal rami, which are comparable to those of *H. albicatum*. The gut is narrow, terminating in a small anus opened as a posterodorsal slit.

The body is white but often tinted with faint yellow or rarely with gray. The color of the eye and gut is orange. In the grayish specimens there are 2 black pigment spots middorsally situated on the first and second metasomal segments. The egg sacs are generally longer than the body, with white or yellowish relatively large eggs. It seems that their length and egg size vary with the specimen.

The antennule (Fig. 6 h) is composed of an unsegmented lobe with about 4 sclerotized areas on the surface suggesting a suppressed segmentation, and bears about 11 setae. The setae are arranged along the distal half of the anterior margin and at the apex: the largest seta is about twice as large as the remaining ones and located on a distinct cylindrical protrusion from the surface near the apex; the rounded small apex has 5 small setae; there is 1 seta at the anterior base of the protrusion and 4 setae on the anterior margin.

The antenna (Fig. 6 i) is 3-segmented. The basal segment is extremely depressed at the anterolateral side, connected with a horseshoe-shaped sclerotized bar on the body. The second segment is the longest; it tapers slightly apically and its length is about 1.7 times the greatest basal width. The third segment is four fifths the length of the second and gradually tapers apically, bearing 4 stout spines, well articulated on the segment; one of them is placed at the apex and the remaining 3 occur at fairly regular intervals along the anterior half of the medial margin. These spines decrease in size from apical to proximal and the most proximal spine is extremely

small.

The labrum (Fig. 6 e) is characteristic with 6 feeble processes on the margin. However, the processes are not sharply pointed so the margin is merely undulated.

The mandible (Fig. 6 j) is like that of *H. albicatum*, with 2 apical simple setae on a mammiform projection.

The maxilliped (Fig. 7 k) is not distinctive, consisting of 3 segments with 2 setules on the second segment and a curved claw at the apex. The claw has an articulative line at about the middle, dividing it into 2 parts. The distal pointed part has an incision medially, forming a slightly bifurcated claw.

The first to fourth legs (Fig. 7 l–n) show indications of inclusion of protopodites and rami. In each leg an oval sclerotized framework (?protopodite) is not very wide, about 1.2 times the length of the exopodite and does not extend beyond the medial proximal margin of the base of the fused rami.

The endopodites from the first to fourth are not much different in structure, each consisting of a rather weakly developed subconical projection from the protopodite without setule.

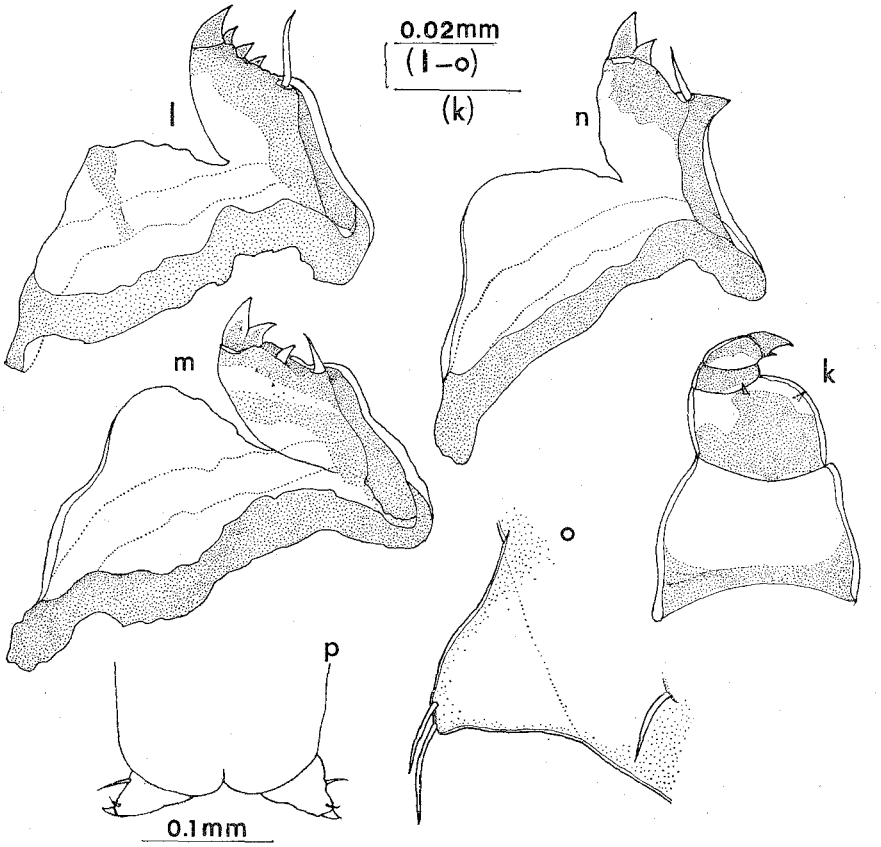


Fig. 7. *Haplostoma minutum*, n. sp., female: k, maxilliped; l, leg 1; m, leg 2; n, leg 3; o, leg 5; p, caudal rami.

In the first pair of legs the exopodite is proximally broad but diagonally truncated from a rounded lateral corner at the distal third toward the narrow apex, forming a somewhat depressed distolateral margin. The armature consists of 4 spines and 1 seta: 2 of the spines at the apex are usually fused at their bases, forming a bifurcated spine; the remaining 2 spines are inserted at regular intervals between the apical bifurcated spine and the seta. The spines gradually decrease in size from distal to proximal. The second exopodite is like the first in structure, but reduced by 1 lateral spine in armature, so it has 3 spines (1 bifurcated spine and 1 lateral spine) and 1 seta. The third and fourth exopodites closely resemble each other in structure and armature. In each the lateral corner is produced in a strong lateral point and the armature is again reduced by 1 lateral spine from the preceding ramus; so that each exopodite has 2 spines (1 bifurcated spine) and 1 seta.

The fifth leg (Fig. 7 o) is represented in part by 3 small simple setae located on the posterolateral cone protruded from the last metasomal section; 2 of the setae at the apex and the remaining one at the base of the cone on the dorsal side.

The caudal ramus (Fig. 7 p) is a small conical lobe, about half the length of the last urosomal segment, without real articulation with it. The ornamentation consists of 1 short simple spine at the apex, 1 small dorsal setule near the apical spine and 1 longer simple lateral seta midway on the lateral margin.

Male: The body (Fig. 8 a, b) corresponds to *H. albicatum* in appearance and structure, although it is much smaller in size. It is composed of the cephalosome, metasome and urosome including the caudal rami, with their proportional lengths about 1:1.7:2.3. The urosome is proportionately long, in comparison with that of *H. albicatum*. The body length of a single representative specimen is 0.75 mm, measured from the anterior limit of the cephalosome to the tip of the caudal rami, and the total length including the elongate caudal setae is about 0.9 mm. The cephalosome (Fig. 8 c) is anteriorly and ventrally prolonged into a small subtriangular rostrum and the anterior dorsal side is generally sclerotized. The head appendages consist of 5 pairs: antennules, antennae, mandibles, maxillae and maxillipeds.

The metasome is composed of 4 segments, each bearing a pair of swimming legs. The tergal plates for these segments are well developed. The widest part of the body occurs on the first segment, with the width 0.18 mm, and then gradually tapers toward the fourth. Behind the metasome the body is abruptly constricted, forming the narrow urosome.

The urosome is 6-segmented: the first segment bearing the reduced fifth legs; the second enlarged genital segment (Fig. 8 d) enclosing the paired oval spermatophores internal to the usual sixth leg-lappets; the third to fifth free narrow abdominal segments; the sixth short anal segment bearing elongate caudal rami. The caudal rami are about 2.2 times the length of the sixth segment, and each bears a pair of elongate setae terminally as in *H. albicatum*.

The body color is white but somewhat yellowish, with small red or pale green pigment spots scattered internally in the cephalosome and metasome. These pigment spots are small in number in comparison with those of *H. albicatum*. The large

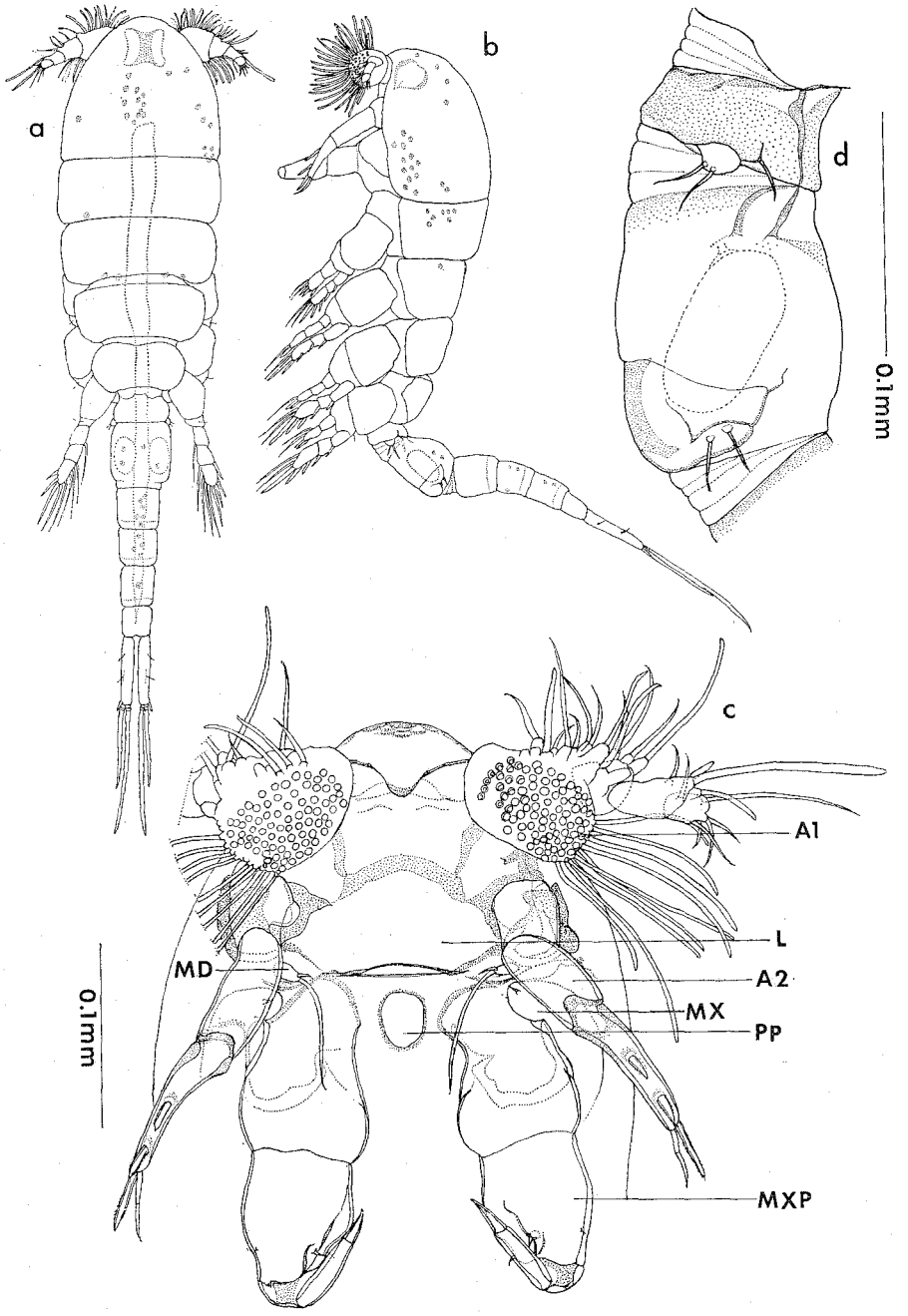


Fig. 8. *Haplostoma minutum*, n. sp., male: a, dorsal; b, lateral; c, oral area; d, lst and 2nd urosomal segments. Key to abbreviations: A1, antennule; A2, antenna; L, labrum; MD, mandible; MX, maxilla; MXP, maxilliped; PP, postoral protrusion.

median eye shows a brilliant white superficial color enclosing the deep ruby part in the middle. The gut is faintly greenish.

The antennule (Fig. 9 e) is composed of 4 segments, with a structure similar to that of *H. albicatum* but the armature is slightly reduced in this form. The large first segment bears 128 aesthetes and 9 setae; 125 of the aesthetes are borne in a circle on distinct protrusions forming a closely set rosette on the expanded ventral surface; 4 long and 2 short setae are set along the anterior margin, and the remaining 3 aesthetes and 3 long setae are borne on a conical lobe protruded from the anterodistal corner of the segment. The second segment is wider than long, incompletely divided into 2 subdivisions, bearing 6 setae in all: the proximal subdivision bears 3 long setae on distinct protrusions from the anterodistal corner; the distal subdivision has 1 much shorter seta and 2 long setae on similar protrusions. There is 1 setule on the dorsal surface of the segment. The elongate third segment is twice as long as wide, half as wide as the second, bearing 1 long and broad aesthete and also 1 ordinary long seta on distinct protrusions from the anterodistal corner, and 1 short seta at the base of these. The smallest fourth segment is ornamented by 9 graduated setae and 2 relatively short aesthetes on the surface and at the apex. None of the setae are plumose.

The antenna (Fig. 9 f) is composed of 3 segments with their proportional lengths about 1 : 4 : 3.5 from basal to distal: the basal is the widest, the second is about 3 times as long as wide and the slender third tapers apically. The armature on the third segment is composed of 3 spines and 1 slender seta. The spines are placed midway on the medial margin, at the distal fourth and at the apex, increasing in length from proximal to distal. Each spine (Fig. 9 g) is ornamented with several longitudinal rows of denticles surrounding its distal half. The seta with stiff hairs on its upper two thirds is set close to the apical spine but more laterally.

The labrum (Fig. 8 c) has the margin smooth as in *H. albicatum*.

The mandible (Fig. 9 h) is relatively short, tapers slightly apically and its length is 2.5 times the greatest basal width. It is incompletely divided into 3 segments with their proportional lengths from basal to distal 1 : 1 : 0.7. The basal segment is as long as wide and somewhat inclined medially. The distal segment has 1 short medial seta near the apex and 1 long apical seta, which is 6 times as long as the medial seta. None of the setae are plumose.

The maxilla (Fig. 9 i) consists of a subconical lobe situated at the anterolateral side of the maxilliped and bearing 1 apical setule.

The maxilliped (Fig. 9 j) is a well-developed 3-segmented structure. The first segment is proportionately long in comparison with that of *H. albicatum*. The second segment is slightly longer than the first and tapers apically, with a longitudinal depression on the medial surface which receives the flexed terminal claw. The anterior and posterior margins of the depression are each set with 1 setule at its upper third. The third segment is the shortest, wider than long, and supports terminally the distinctly articulated long apical claw. The apical claw is 3 times as long as the third segment and composed of 2 portions. The proximal portion is twice as long as the distal and bears 2 simple setules near the distal portion on the anterior margin.

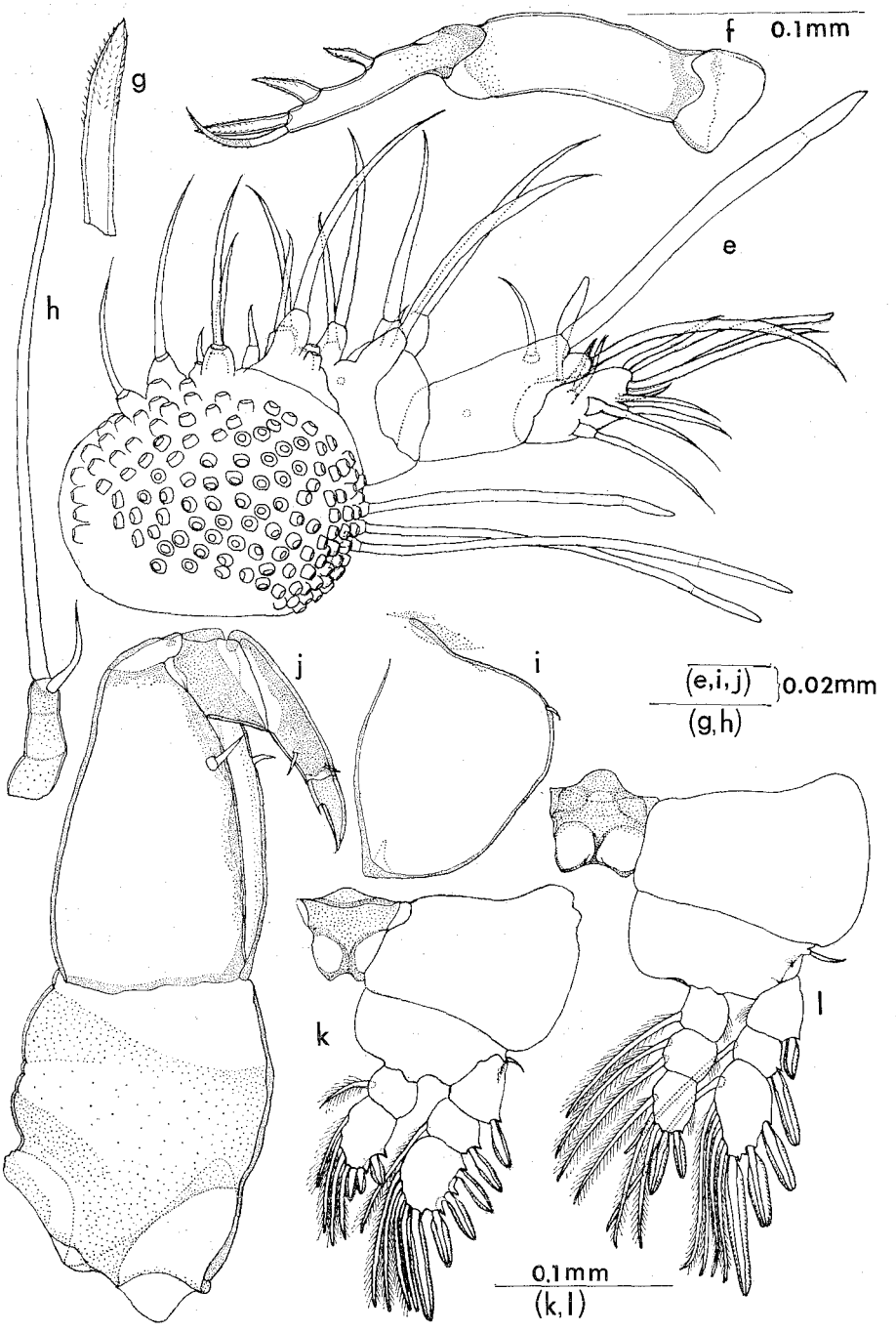


Fig. 9. *Haplostoma minutum*, n. sp., male: e, antennule; f, antenna; g, same, apical spine; h, mandible; i, maxilla; j, maxilliped; k, leg 1; l, leg 2.

The distal portion has a spinule protruded from the medial margin at the proximal third, forming a slightly bifurcated claw as in *H. albicatum*. The area between the maxillipeds (Fig. 8 c) is protruded as a postoral protrusion.

The first to fourth legs (Figs. 9 k, l; 10 m, n) are comparable to those in *H. albicatum* in segmentation and armature, except for the endopodites of the first legs. The first endopodite is 2-segmented; the distal segment is 1.5 times the length of the proximal. The proximal segment has 1 relatively short seta medially and the distal segment is ornamented with 4 medial plumose setae and 1 lateral and 2 apical short spines fringed with hyaline flanges. These setae and spines are arranged in the normal pattern on the margin, differing thus from those of *H. albicatum*. Each pair of legs is yoked by a well-developed intercoxal plate. As in *H. albicatum* 1 plumose coxal seta is set on each coxopodite in the third and fourth legs.

The fifth and sixth legs are also similar to those of *H. albicatum* in structure and armature. The fifth leg (Fig. 10 o) is represented by 1 relatively long seta on a

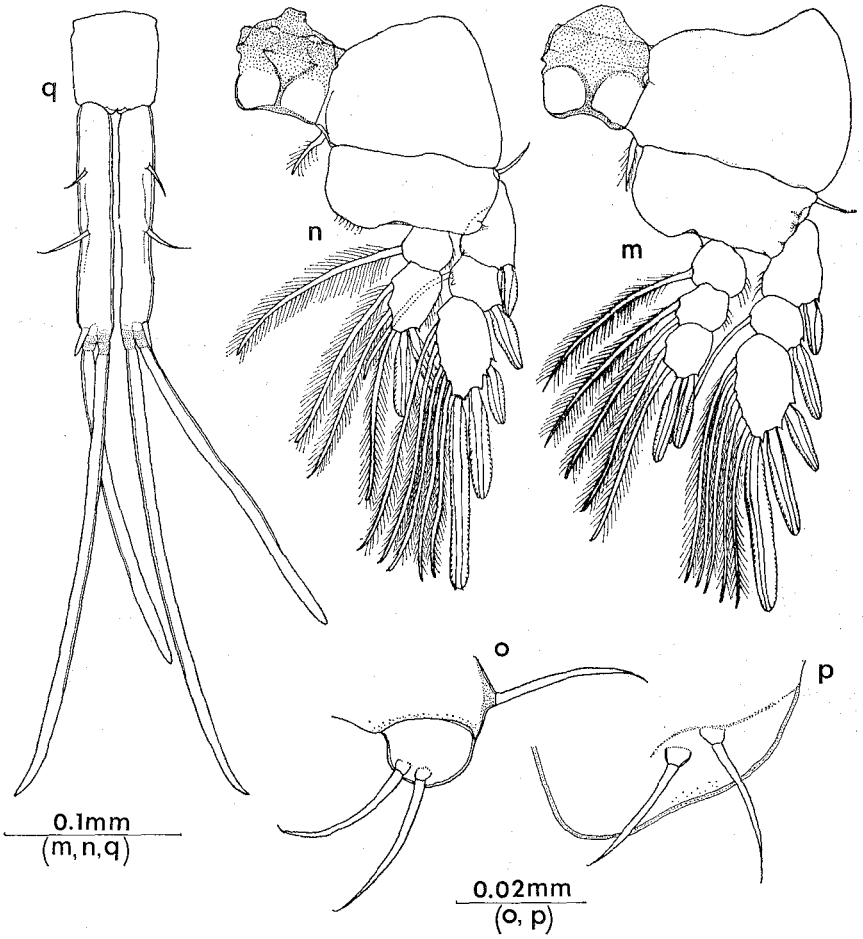


Fig. 10. *Haplostoma minutum* n. sp., male: m, leg 3; n, leg 4; o, leg 5; p, leg 6; q, caudal rami.

conical protrusion of the first urosomal segment and 2 similar setae on a quadrilateral lobe, which is articulated on the protrusion. The sixth leg lappet (Fig. 10 p) terminates in a prolongation from the second urosomal segment, and bears 2 similar setae arranged side by side in a small depressed area near the distal rounded margin. Each seta is unornamented and is set on a distinct but short bulge protruded from the surface.

The caudal rami and their setae (Fig. 10 q) are as in *H. albicatum* in anatomical details. Each ramus is about 6 times as long as wide and has 2 long but unequal terminal setae (without hyaline flanges), 1 slender, relatively long setule (or simple seta) at the middle on the dorsal surface, somewhat laterally, and 1 similar but much shorter setule at the proximal third of the same surface. Of the terminal setae the medial is twice as long as the caudal ramus and about 1.4 times the length of the lateral.

REMARKS: This species is a frequent associate of *Amaroucium arenatum* collected from the deeper water of the San Juan Archipelago. This ascidian host can hold 5 species of haplostomins (*H. minutum, Haplostomella dubia, H. distincta, H. oceanica* and *Haplosaccus elongatus*), 1 species of *Botryllophilus,* 1 species of notodelphyid (*Pholeterides furtiva* Illg, 1958) and 1 species of undescribed ascidicole copepod. In sampling, the present species including females and males outnumbered the other copepods.

Most of the female and male specimens were obtained in undefined positions in the host matrix but some have been found in the zooids. One zooid enclosed a pair of egg sacs in the postabdomen. The same position of another zooid contained a male in the probably last copepodid stage, whereas its intestine harbored an adult female of *Haplostomella distincta.* In this case, the heads of both the species were directed toward the atrium of the zooid.

The morphological grounds for distinguishing the present species are discussed in the description of *H. albicatum.*

Haplostoma dentatum, new species

Figs. (11–12)

TYPES: Holotypic female, USNM 169506 (type locality, Peavine Pass, San Juan Archipelago, Washington, Aug. 22, 1973, from *Cystodytes lobatus* (Ritter); paratypes and all other specimens listed below.

SPECIMENS EXAMINED:

WASHINGTON

From *Cystodytes lobatus* (Ritter):

Outside Turn Island, 48°32.2′N., 122°57.6′W., 66–10 fams., July 10, 1965, 10 females; Boundary Pass, off Skipjack Island, 48°43.7′N., 123°3′W., 40–90 fams., Oct. 18, 1965, 17 females; off Flat Point, 48°33′N., 122°55.6′W., 34–29 fams., Nov. 13, 1965, 15 females; Cape Alava, 48°9.5′N., 124°44′W., lowest intertidal, June 5, 1966, 11 females; Peavine Pass, 48°54.9′N., 122°50.7′W., dredged, Aug. 22, 1973, 20 plus females (including holotype and 5 females, USNM 169507).

DESCRIPTION: Female: The body (Fig. 11 a–c) is vermiform, with a slight dorsal curvature, and divided into cephalosome, metasome and urosome, with their pro-

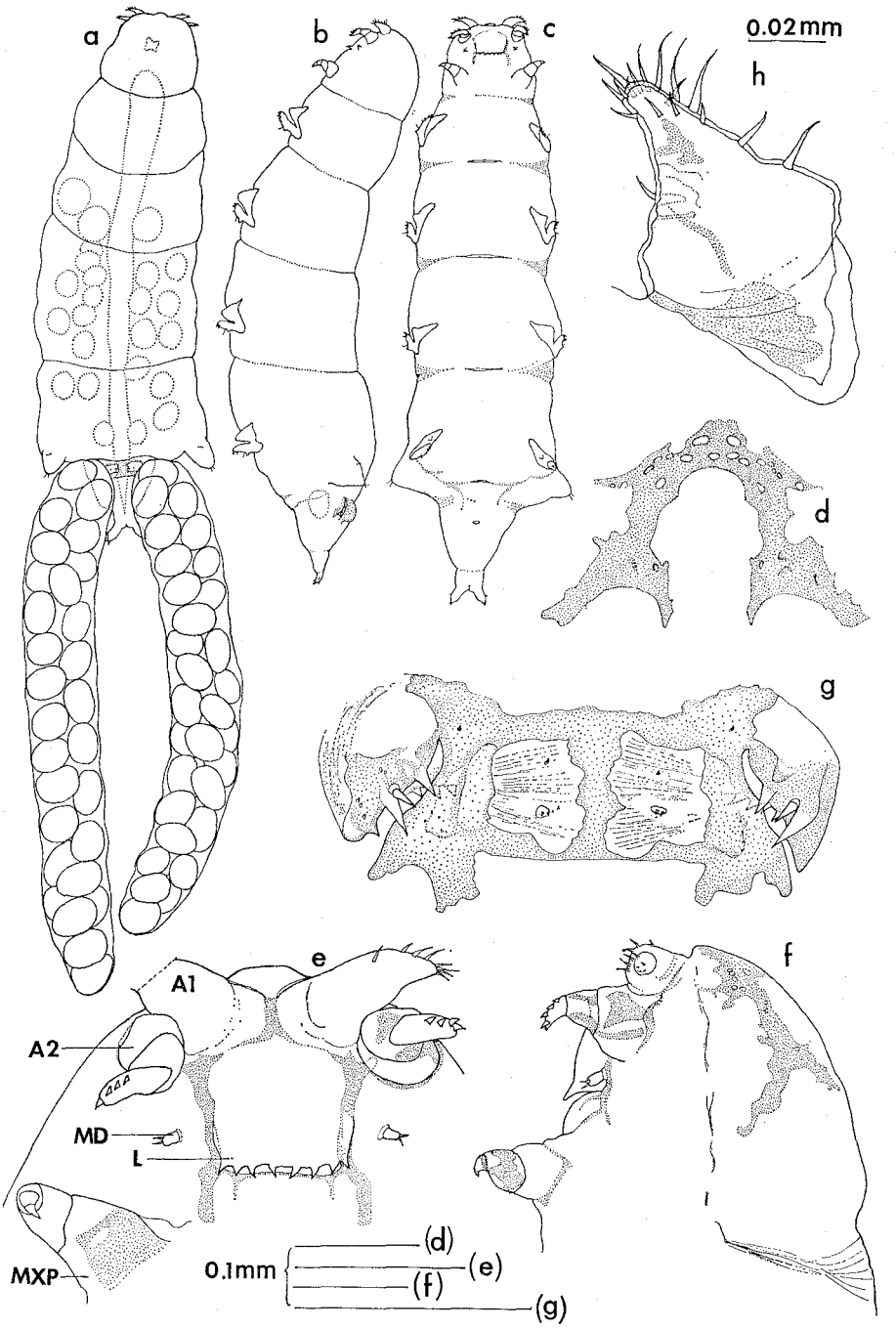


Fig. 11. *Haplostoma dentatum*, n. sp., female: a, dorsal; b, lateral; c, ventral; d, cephalic plaque; e, oral area, ventral; f, same, lateral; g, apparatus at oviducal apertures, including dorsal sclerotized area; h, antennule. Key to abbreviations: A1, antennule; A2, antenna; L, labrum; MD, mandible; MXP, maxilliped.

portional lengths about 1: 4.4: 1.1. The length of a single representative specimen is 1.6 mm, measured from the anteriormost to the end of the caudal rami. The cephalosome with a rounded anterior margin is about as long as its greatest width. The dorsal apical region (Fig. 11 d) is sclerotized in an inverted V-shaped configuration: the anterior part of the sclerotization encloses about 14 less sclerotized small depressions; the posterolateral corners lack such depressions. The cephalosome is slightly protruded ventrally like a rostrum between the antennules. Its 4 pairs of appendages are antennules, antennae, mandibles and maxillipeds (Fig. 11 e, f). Maxillules and maxillae are absent. Pleural folds are not distinctive, but a discontinuous cuticular line, which is placed at each lateral side of the head and connected with the dorsal integumental flexures between the cephalosome and metasome, suggests a fold.

The metasome is divided into 4 sections by integumental folds without real articulations. Their widths and lengths are gradually increased from the first to fourth. The widest part is 0.5 mm wide, which occurs on the most posterior section including the distinct posterolateral conical projections, and about 1.3 times the width of the first section. The first to fourth pairs of legs are located on the ventral surface, somewhat posteriorly on the actual segments; each leg is well separated from its mate without intercoxal plate. The reduced fifth legs are set on the conical projections of the last section.

The urosome is unsegmented and funnel shaped. The broad proximal part is half as wide as the posterior enlarged metasome and corresponds to the genital segment. The genital apparatus consists of a small ventral insemination pore at the proximal fourth of the urosome, internal seminal canals diverging from the pore, oviducal apertures at the sides on the dorsal surface, and a broad sclerotization between the apertures. The longitudinal oviducal aperture, which is opened at each lateral side of the dorsal sclerotization (Fig. 11 g), is covered by an ornamented cuticular fold. The fold has 7 spines arranged in the same way as in *H. minutum*: 2 spines (1 large posterior and 1 small anterior) are closely set at about the middle of the margin; 1 relatively large spine is protruded in front of these spines on the fold; a row of 4 small spines is located along the edge of the fold. The frame-like dorsal sclerotization encloses a pair of nearly quadrilateral, large, less sclerotized areas centrally. Each area is armed with a group of a few spinules posteriorly and a single spinule anteriorly. Several similar spinules are scattered on the folds. The surface of the framework has no integumental indentation. The egg sacs are elongate and each contains about 30–40 rather large eggs.

The distal third of the urosome is narrow, cylindrical, one third as wide as the proximal broad part, and bears a pair of small conical caudal rami. The gut is straight and narrow and terminates in a small anus opened as a posterolateral slit.

The body color is white, with white eye and eggs. The animal is rarely yellowish, with a red eye. The middorsal area of the urosome is often tinted orange.

The antennules (Fig. 11 h) are diverged, tapered lobes, each having about 17 short slender setae scattered along the distal third and in an assembly arrangement

at the apex.

The antenna (Fig. 12 i) is 3-segmented. The first segment is about twice as wide as long. It is markedly shortened on the medial side. The second segment is as long as wide, twice as long as the first, tapering apically. The third segment is about the length of the second but much narrower, bearing 4 short stout spines articulated on the surface. Three of the spines are located at fairly regular intervals along the distal half of the anterior margin and the remaining spine is at the apex. The spines gradually increase in length from proximal to apical.

The labrum (Fig. 11 c) has 8 distinctive pointed processes protruded from the margin.

The mandible (Fig. 12 j) is a small cylindrical appendage with a rounded apex,

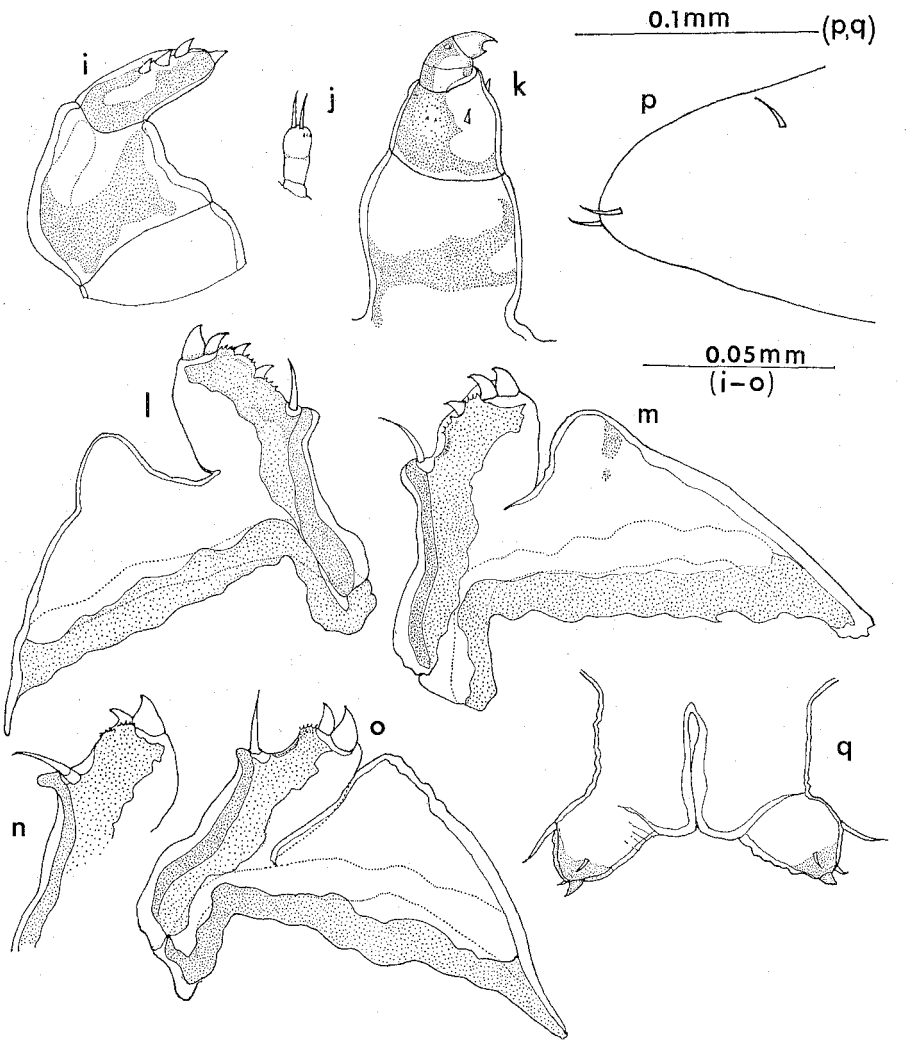


Fig. 12. *Haplostoma dentatum*, n. sp., female: i, antenna; j, mandible; k, maxilliped; l, leg 1; m, leg 2; n, leg 3, exopodite; o, leg 4; p, leg 5; q, caudal rami.

bearing 2 short, slender apical non-plumose setae. It is 3 times as long as wide and divided into 2 parts. The proximal part is one sixth the length of the appendage and marked off from the body and the distal part, which is slightly constricted about the middle and thus incompletely divided into 2 equal components. There are a few denticles on the apical surface near the setae.

The maxilliped (Fig. 12 k) is of the usual constitution with terminal claw: the first segment is the largest, as long as wide; the second segment tapers slightly apically and is set with 2 setules at the distal third on the medial surface and 2 denticles at the same level on the posterior surface; the third segment is the smallest. The slightly bifurcated terminal claw is not distinctly marked off basally and is divided into 2 subequal portions by an articulative line.

The first to fourth pairs of legs (Fig. 12 l–o) are composed of unsegmented protopodites and rami as previously mentioned in other species. The width of the proximal oval framework (?protopodite) of each leg is about 1.5 times the length of the exopodite, and the medial end of the framework does not extend beyond the basal medial margin of the endopodite.

The endopodites from the first to fourth all have the same configuration. Each consists of a distinct subconical protrusion, shorter than the exopodite, from the broad protopodite framework.

The lateral margin of each exopodite is protruded into a strong triangular projection at the distal third; the ramus tapers apically. The somewhat depressed apex, which is one third as wide as the broad part including the lateral projection, bears 2 short stout spines, the lateral one of which is relatively small. These spines are set close to each other but are not fused basally. There is 1 short non-plumose seta at the upper base of the lateral projection. In the first leg (Fig. 12 l), the disto-lateral margin between the apical spines and the lateral seta is armed with 2 smaller spines at the middle and the distal fourth. The margin is partially protruded behind each lateral spine and thus forms an undulatory lobed margin; each lobe is serrated with marginal spinules. The second exopodite (Fig. 12 m) is reduced by 1 lateral spine from the preceding ramus, so it has 3 spines (2 apical and 1 lateral) and 1 lateral seta, with 2 serrated lobes. The third exopodite (Fig. 12 n) lacks all the lateral spines, bearing 2 apical spines and 1 lateral seta, with 2 serrated lobes. The fourth exopodite is like the third but reduced by 1 serrated lobe (Fig. 12 o).

The fifth leg (Fig. 12 p) is not distinctive, consisting of a lateral cone protruded from the last metasomal section, with 2 short slender apical setae, and there is a similar dorsal seta at the upper base of the cone.

The small caudal ramus (Fig. 12 q) is about 1.3 times as long as wide. The proximal half is rather cylindrical and the ramus then tapers apically. It bears 1 small non-plumose seta about midway on the lateral margin, 1 short stout spine, which is slightly bifurcated, at the apex, 1 short stiffened setule at the lateral base of the spine and 1 dorsal setule at the distal fourth.

REMARKS: No males are known for the species. The females can be easily collected from so far undetermined positions in the matrix of the host ascidian from

the San Juan Archipelago and vicinity. It is remarkable that no other haplostomin occurs in the same host, although a *Botryllophilus* species is rarely found in the ascidian. The morphological ground for distinguishing the species from other *Haplostoma* forms is in having 8 distinct processes on the free margin of the labrum.

Haplostoma setiferum, new species

(Figs. 13–16)

TYPES: Holotypic female, USNM 169508 (type locality, Cape Alava, Washington, June 5, 1966, from *Eudistoma ritteri* Van Name); allotypic male, USNM 169509, Cape Flattery, Washington, Aug. 17, 1966, from *Eudistoma ritteri* Van Name; paratypes and all other specimens listed below.

SPECIMENS EXAMIED:

WASHINGTON

From *Eudistoma ritteri* Van Name:

Cape Alava, 48°9.5′N., 124°44′W., lowest intertidal, June 5, 1966, 10 females (including holotype and 5 females, USNM 169510); Cape Flattery, 48°23.3′N., 124°43′W., lowest intertidal, Aug. 17, 1966, 8 females, 5 males (including allotype).

BRITISH COLUMBIA

From *Endistoma ritteri* Van Name:

Whiffin Spit, Sooke, 48°21′N., 123°43.9′W., lowest intertidal, June 29, 1965, 2 females.

DESCRIPTION: Female: The body (Fig. 13 a–c) is characteristic, composed of the relatively long, cylindrical metasome between the short cephalosome and urosome, with the proportional lengths from anterior to posterior 1: 5: 0.8. The 3 regions are not sharply marked off from each other but demarcated by integumental indentations. The cephalosome is anteriorly rounded, wider than long; posterior to the metasome is the funnel-shaped urosome. The body length of a single representative specimen is 1.75 mm, measured from the anteriormost of the cephalosome to the tip of the caudal rami. The head appendages consist of antennules, antennae, mandibles and maxillipeds. There is no prominent rostrum but the usual site is indicated by a semicircular marginal sclerotization (Fig. 13 e). The apical cephalic sclerotization (Fig. 13 e) is composed of a pair of cuticular thicknings at the sides. Each sclerotization of the pair forms parallelogram in outline, longer than wide, and each of its corners is extended into a short, narrow sclerotized band. The anterior cephalosome including the sclerotization bears hairs growing from tiny mammiform projections which are symmetrically scattered on the surface. In addition to these hairs the surface is covered with many sets of denticles, each set consisting of 2 or 3 denticles.

The metasome is roughly divided into 4 subdivisions indicated by integumental indentations; the first, an actual segment, is slightly shorter than either the second or third, and the fourth, a complex of 2 segments, is the longest, about 1.3 times as long as the first. A short body element including the lateral cones in the fourth corresponds to the segment for the fifth legs and is indicated by an anterior

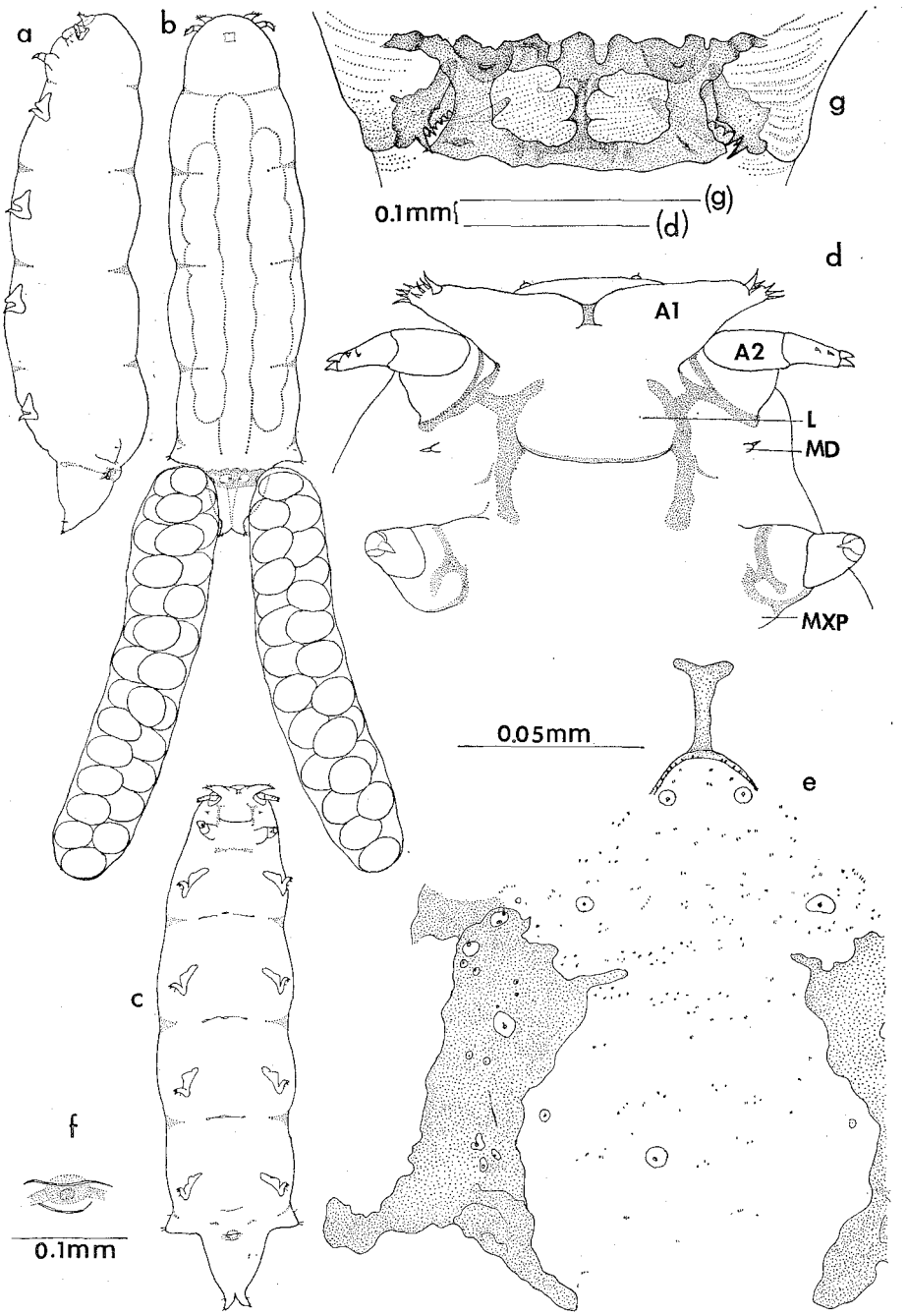


Fig. 13. *Haplostoma setiferum*, n. sp., female: a, dorsal; b, lateral; c, ventral; d, oral area; e, cephalic plaque; f, insemination pore; g, apparatus at oviducal apertures, including dorsal sclerotized area. Key to abbreviations: A1, antennule; A2, antenna; L, labrum; MD, mandible; MXP, maxilliped.

constriction at each cone. There are 4 midventral sclerotizations indicating demarcation of the 5 segmental regions for 5 pairs of legs. In the first 4 segments, one pair of legs is located somewhat posteriorly on each segment and lacks a coxal connecting plate.

The body is abruptly constricted behind the metasome, indicating the anterior extent of the urosome which bears diverging caudal rami terminally. The width of the anterior part of the urosome is about three fifths the width of the posterior metasome which includes the lateral cones. At about the anterior third, the urosome is furnished with the genital apparatus, composed of a small insemination pore (Fig. 13 f) midventrally, a rather distinct seminal receptacle internally, diverging tubes from it, a pair of oviducal apertures on the dorsolateral sides and a broad dorsal sclerotization (Fig. 13 g) between them. The insemination pore is situated between 2 short transverse cuticle folds on the surface. The oviducal aperture at each side is covered by a spinose cuticular fold with 7 spines on its medial sclerotized margin. The largest spine is protruded from the distal third of the margin and 1 small spine is set close to the anterior base of the largest one. On the same margin there is a spiniform projection in front. The internal edge bears a row of 4 small spines. The dorsal sclerotization is a trapezoidal framework, much wider than long, with anterior uneven and posterior smooth margins; the framework encloses a pair of less sclerotized areas, which are separated by a middorsal sclerotized bar of the framework. The surface of the framework has a distinct sculpture. The egg sacs are elongate and slightly shorter than the body length, containing rather large eggs.

The general body color is yellow, with an orange median eye, yellow gut and eggs.

The antennule (Fig. 14 h) consists of a tapered lobe and has about 21 short, non-plumose setae along the anterior margin and on the apical surface. A seta at the distal fourth is the largest, set on a distinct cylindrical protrusion from the margin. Behind this seta there are 5 much shorter, very stout setae arranged on the margin. The remaining 15 setae are arranged on the apex.

The antenna (Fig. 14 i) is 3-segmented, set on a sclerotized ring on the body. The first segment is much wider than long, with the medial margin short and the lateral long. The second segment is longer than wide, tapers slightly apically and exhibits regional sclerotizations. The third segment is narrow, 5 times as long as wide, about the same as the second in length. The ornamentation is characteristic, consisting of 1 short seta at the distal third of the medial margin, 1 stout spiniform projection at the distal sixth of this margin and 2 much larger robust spines at the mediodistal corner and at the apex. The spiniform projection and the mediodistal spine each has a row of denticles along each medial surface (Fig. 14 j).

The labrum (Fig. 13 d) is not distinctive; the free margin is smooth.

The mandible (Fig. 14 k) is composed of a small mammiform projection, with a single minute seta at the apex.

The conical maxilliped (Fig. 14 l) is 3-segmented, with a terminal claw. The first segment is the largest, as long as wide; the second segment is longer than wide,

slightly shorter than the first and gradually tapers, bearing 2 setules at the distal third on the medial margin. The terminal claw is twice as long as the small third segment and divided into 2 portions. The distal portion is much shorter than the proximal and protruded medially at its base into a spinule.

The first to fourth legs (Fig. 14 m, n) consist of unsegmented protopodites and rami, with the usual leg-pattern for *Haplostoma* females. However, the ornamentation is characteristic, differing from other species. The width of the oval sclerotized framework (?protopodite) is about 1.5 times the length of the exopodite and the medial distal end of the framework does not extend beyond the medial proximal margin of the endopodite.

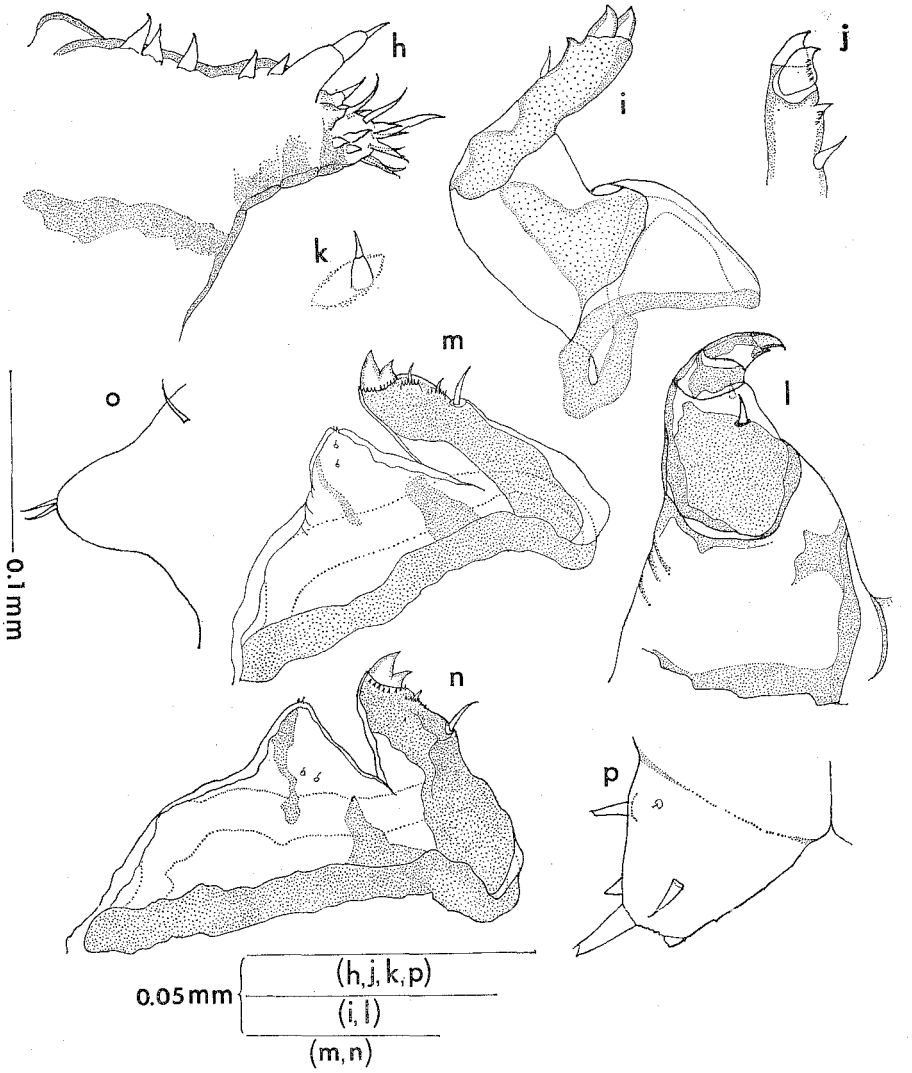


Fig. 14. *Haplostoma setiferum*, n. sp., female: h, antennule; i, antenna; j, same, apical segment; k, mandible; l, maxilliped; m, leg 1; n, leg 2; o, leg 5; p, caudal ramus.

The endopodites from the first to fourth are uniform in structure and armature. Each consists of a small conical protrusion from the broad basal part of the appendage. The apex is armed with 1 or 2 stiff setules and on the anterior surface are scattered a few hairs.

In each leg the exopodite is relatively narrow, cylindrical, with a slight apical taper, and is articulated on the protopodite laterally. The lateral margin is heavily sclerotized and ornamented with 1 short stout seta at the distal third and either 1 or 2 weakly-developed small spines distal to the seta. The apex is set with 2 short strong spines which are fused basally to each other and form a bifurcated claw. The base of the apical claw and those of the small lateral spines are each ornamented with a row of spinules protruded from the distal margin of the ramus. The first exopodite has 1 bifurcated claw (2 spines), 1 lateral seta and 2 small slender lateral spines which are arranged at fairly regular intervals between the claw and the seta. The second to fourth exopodites are the same in armature, each bearing 1 lateral spine between the apical bifurcated claw and the lateral seta.

The fifth leg (Fig. 14 o) is represented by a lateral cone protruded from the last metasomal subdivision, with 2 short slender setae at the apex and 1 similar seta at the anterior base of the cone on the dorsal surface.

The caudal ramus (Fig. 14 p) is short and the width of the basal broad part is greater than its length. It tapers distally but the apex is not pointed, usually with 3 varied spines and 2 setules: 1 stout spine at the apex; 2 short pointed spines at the lateral sides of the apical spine; 1 short simple setule near the apical spine on the dorsal surface; 1 stiffened lateral setule at the proximal third.

Male: The body habitus (Fig. 15 a, b) belongs to the swimming type. It is characterized by the rather thick and broad prosome and the narrow urosome. The body length of a representative specimen is about 1.4 mm, measured from the anteriormost extent of the cephalosome to the end of the caudal rami, and the total length including the caudal setae reaches 1.7 mm. It is divided into cephalosome, metasome and urosome, with their proportional lengths 1: 2: 3.

The cephalosome is anteriorly and ventrally prolonged into a small subtriangular rostrum. Pleural folds are developed at the sides. The appendages of the cephalosome (Fig. 15 c) consist of 5 pairs: antennules, antennae, mandibles, maxillae and maxillipeds. Maxillules are absent.

The metasome is 4-segmented, bearing 4 pairs of swimming legs. The first segment is the widest, about 0.33 mm wide and 1.7 times as wide as the width of the fourth. The first endopodite is bimerous, with characteristic armature. The tergal plates on the segments are well developed.

The urosome includes 6 narrow segments: the first segment with the reduced fifth legs; the somewhat enlarged second segment with the usual sixth leg-lappets, enclosing a pair of oval spermatophores; the third to fifth segments representing true abdominal segments; the sixth anal segment with elongate caudal rami. The caudal rami are twice as long as the last urosomal segment.

The general body color is comparable to that of the female.

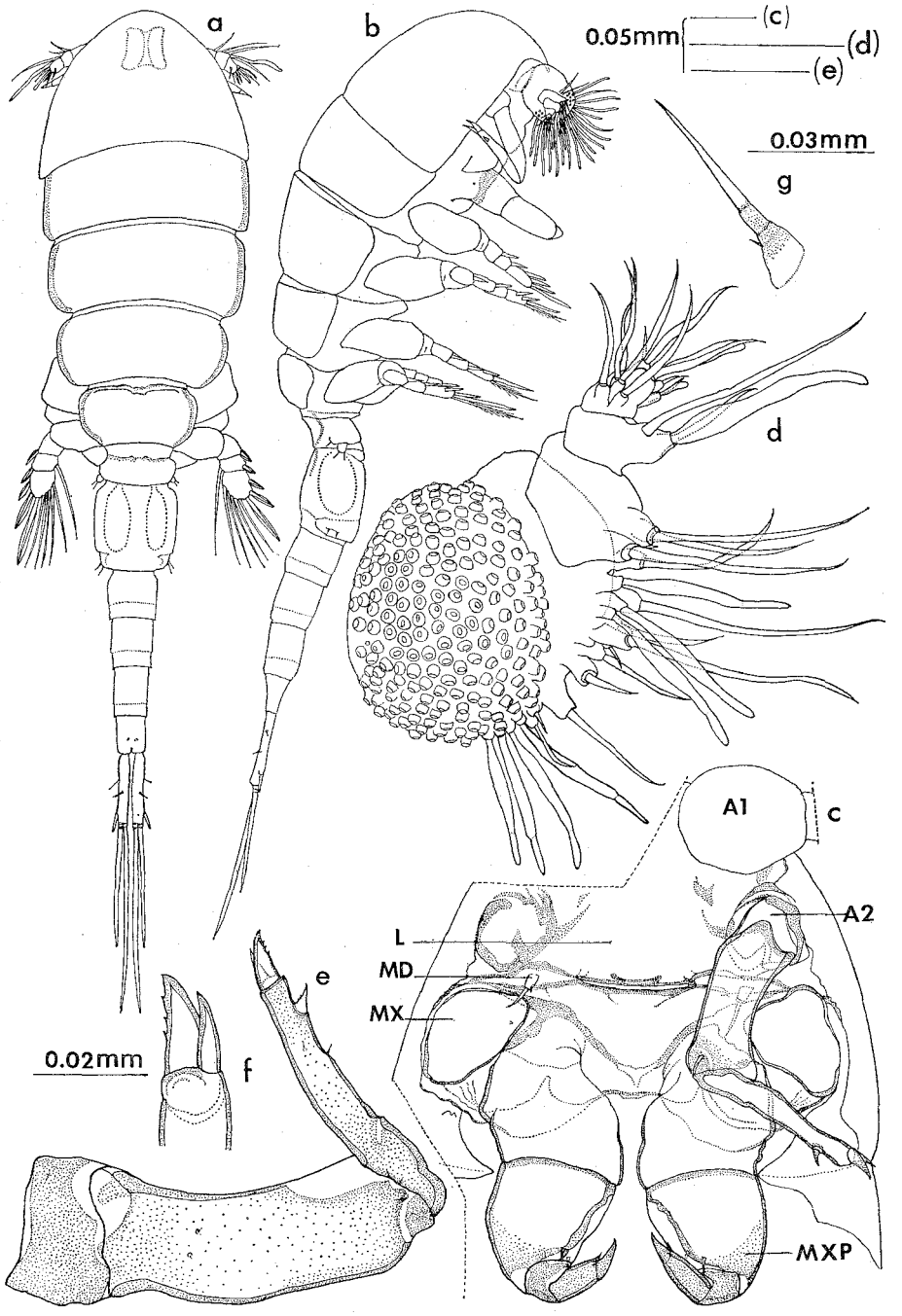


Fig. 15. *Haplostoma setiferum*, n. sp., male: a, dorsal; b, lateral; c, oral area; d, antennule; e, antenna; f, same, distal end; g, mandible. Key to abbreviations: A1, antennule; A2, antenna; L, labrum; MD, mandible; MX, maxilla; MXP, maxilliped.

The antennule (Fig. 15 d) consists of 4 segments. The ventral surface of the first segment is hemispherically expanded as in other *Haplostoma* species, with 191 long aesthetes, 8 non-plumose setae and 2 setules; 188 of the aesthetes are arranged in a circle on distinct protrusions in a closely set rosette on the expanded margin; 3 aesthetes, 6 long and 2 short setae and 2 setules are set along the distal half of the anterior margin. These setae also are borne on distinct protrusions. The second segment is much smaller than the first and the anterior margin is protruded into 3 distinct bases for 3 long setae. The third segment is as long as wide, half as wide as the second, and the anterodistal corner is elongated into a lobe, bearing 1 relatively broad and long aesthete and 2 setae (1 long and 1 short) terminally. The fourth segment is as long as the third and ornamented with 7 somewhat short and 3 much shorter setae and 2 aesthetes, one of which is borne at the anterior base and is extremely short.

The antenna (Fig. 15 e, f) is composed of 3 segments with their proportional lengths 1 : 3.3 : 2.7. The basal segment is 1.4 times as wide as long; the middle segment is 3 times as long as wide, slightly narrower than the basal, with 2 hairs on the anterior surface; the terminal segment tapers apically and bears 3 spines. Two of the spines are closely set, anteriorly and posteriorly, at the apex; the anterior spine is about 1.3 times as long as the posterior. The remaining spine is as long as the posterior apical spine and located at the distal sixth on the medial margin. Each spine is serrated with a few denticles on one edge. There is a fine spinule at the distal third on the anterior margin of the segment and a hair on the anterior surface near the spinule.

The labrum is slightly protruded ventrally into a semicircular lobe with smooth margin as in other *Haplostoma* species.

The mandible (Fig. 15 g) consists of a short subcylindrical protrusion from the body, with 1 elongate seta at the apex and 1 hair-like setule near the seta but more proximally. The appendage including the apical seta tapers gradually and is subdivided into 2 ingredient elements by an integumental indentation. The proximal element is 3 times as long as the distal and bears the setule. The apical seta is not clearly articulated with the distal element. The seta is about 3 times the length of the appendage.

The maxilla (Fig. 16 h) is a sack-like lobe situated between the mandible and the maxilliped and anterolateral to the maxilliped. In lateral view, the appendage seems to be an equilateral triangle with posterior and basal margins of equal length. The anterior margin is shorter than the other sides and bears 1 setule near the distal end.

The maxilliped (Fig. 16 i) is a 3-segmented, clawed structure with the usual pattern for the *Haplostoma* swimming males. The first segment is slightly longer than wide. The second segment is somewhat longer than the first, tapers apically and bears 2 setules at the upper third on the medial margin. The third segment is the shortest, much narrower than the second. The apical claw is 3 times the length of the third segment, with an articulative line at the distal third dividing the claw into 2 elements: the basal element has 1 setule at the mediodistal corner; and the distal element carries 1 spinule protruded at the proximal third on the medial margin, forming a slightly bifurcated claw.

The first leg (Fig. 16 j) is composed of bimerous protopodite and endopodite and trimerous exopodite. The coxopodite lacks a seta. The intercoxal plate is well developed, connecting the protopodites. The basipodite has 1 short lateral seta.

The first segment of the endopodite bears 1 ordinary medial plumose seta and lateral marginal hairs. The second segment has laterally curved medial and lateral margins and a truncated apical end. Thus the medial margin is much longer than the lateral and bears 4 plumose setae. Ornamentation on the rather broad distal margin of the second segment is characteristic, with 5 highly modified spines (Fig. 16 k) in 2 rows in front and rear. The frontal group consists of 3 spines without serrated hyaline flanges. Two of them are short and finger-like and located at the distolateral corner and at the midpoint on the margin; the latter spine is much wider than the other. The remaining spine is twice as long as the above-mentioned 2 spines, and set at the mediodistal corner. The margin between the middle and lateral spines and also the mediodistal corner of the segment form small rounded protrusions, each of which is covered with a few transverse rows of denticles. The rear group is composed of 2 oval spines placed side by side on the margin. The more medial (Fig. 16 l) has 4 longitudinal edges like a gimlet and the anterior and posterior edges are serrated with 10 to 13 tooth-like projections, whereas the medial and lateral edges are simple without such teeth. The pointed distal ends of both the toothed edges face each other and the smooth medial and lateral edges are connected distally. The cross section of the spine shows as a parallelogram with 4 acute angles. The lateral spine in the rear group is somewhat flattened, slightly smaller than the medial spine, with serrated medial and lateral margins. Distally the spine is slightly pitted between the distal pointed ends of the margins. The lateral margin of the segment has a row of hairs.

The exopodite (Fig. 16 j) is 1.8 times as long as the endopodite and bears 5 plumose setae and 6 spines fringed with serrated hyaline flanges (Fig. 16 m): the first segment with 1 lateral spine and medial hairs; the second segment with 1 medial seta and 1 lateral spine; the third segment with 4 medial setae and 4 spines (3 lateral and 1 terminal). All the lateral spines are nearly equal in length, and each one is accompanied proximally by a spinule protruded from the segment. The terminal spine is about twice as long as the others and lacks a distinct spinule from the segment.

The second leg (Fig. 16 n) consists of bimerous protopodite and trimerous rami. The protopodite is the same as the first in structure and armature. The armature of the endopodite is composed of 6 plumose setae and 2 spines fringed with hyaline flanges: the first segment with 1 medial seta; the second segment with 2 medial setae; the third segment with 3 medial setae and 2 apical spines. The lateral margin of each segment is ornamented with hairs. The exopodite is 1.5 times as long as the endopodite, with 6 setae and 5 spines: the first segment with 1 lateral spine and medial marginal hairs; the second segment with 1 medial seta and 1 lateral spine; the third segment with 5 medial setae and 3 spines (2 lateral and 1 terminal). The 5 spines are gradually increased in length from proximal to distal, which is about twice the length of the proximal. Each spine is accompanied by a proximal spinule from the

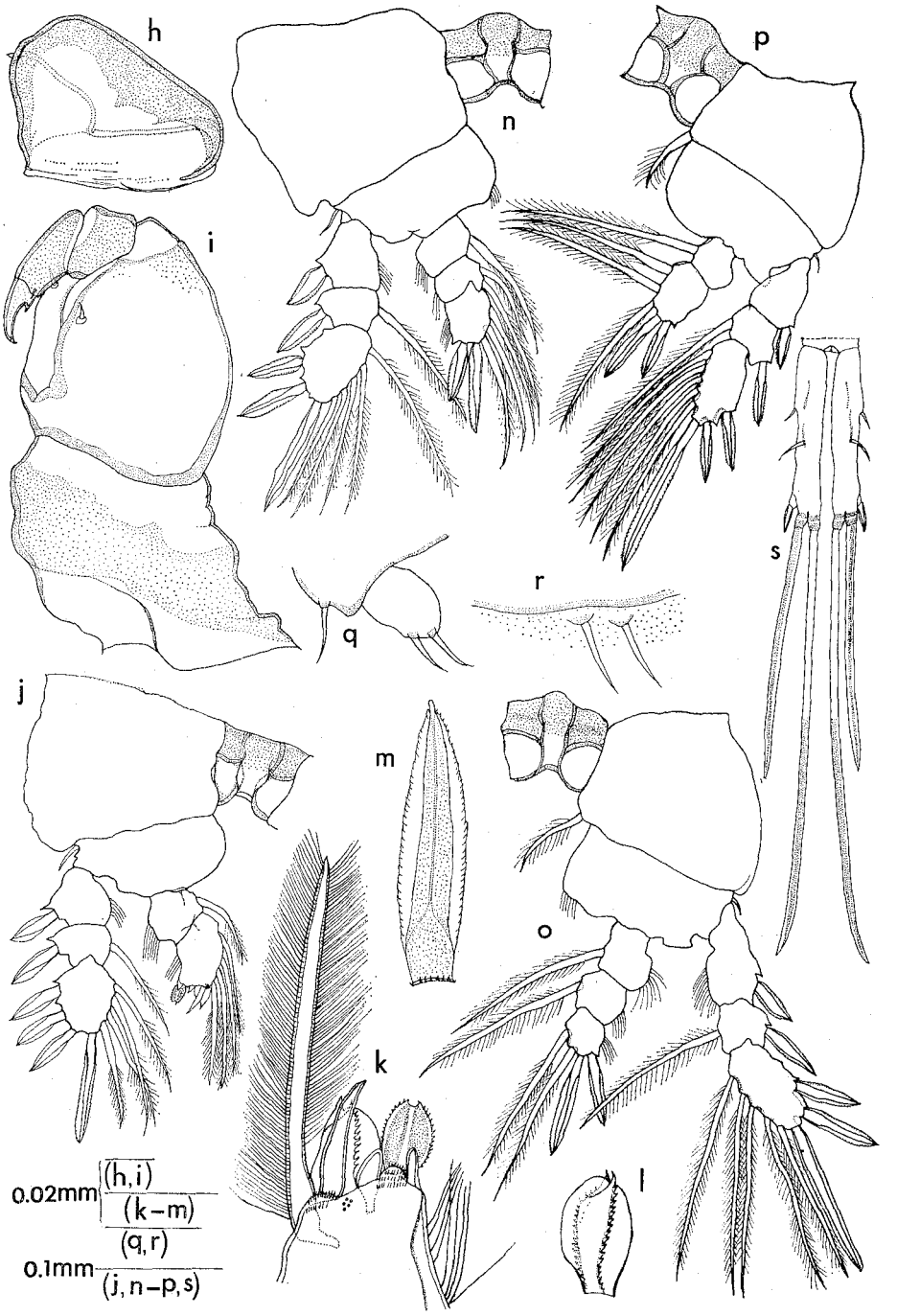


Fig. 16. *Haplostoma setiferum,* n. sp., male: h, maxilla; i, maxilliped; j, leg 1; k, same, second segment of endopodite; l, same, gimlet-like spine of posterior group of spines; m, same, spine of exopodite; n, leg 2; o, leg 3; p, leg 4; q, leg 5; r, leg 6; s, caudal rami.

segment.

The third leg (Fig. 16 o) is comparable to the second in structure, with 2-segmented protopodite and 3-segmented rami. However, the coxopodite has 1 plumose seta which reaches the distal end of the basipodite. The endopodite is reduced by 2 medial setae from the preceding ramus, thus it bears 4 setae and 2 spines: the first 2 segments each with 1 medial seta and the third segment with 2 setae (1 medial and 1 apical) and 2 spines (1 lateral and 1 apical). The exopodite is ornamented with 6 setae and 5 spines as in the second leg.

The fourth leg (Fig. 16 p) is distinctive from the second and third legs, with reduction in segmentation of the endopodite. The endopodite is 2-segmented with 4 setae and 2 spines: the first segment with 1 medial seta; the second segment with 3 medial setae and 2 apical spines. The exopodite is like the second and third legs. There is 1 coxal seta as in the third leg.

The fifth leg (Fig. 16 q) consists of 2 portions as in males of other *Haplostoma* species: the basal portion is a slightly protruded small subconical lobe and bears 1 short simple seta at the apex; the distal portion articulated on the proximal is of suboval outline and has 2 similar setae placed side by side at the terminal margin.

The sixth leg (Fig. 16 r) is indicated by 2 short simple setae arranged in a row near the distal margin of the flap-like cover of the male genital orifice.

The caudal rami (Fig. 16 s) are about 6 times as long as wide. The armature includes 2 long but unequal setae without hyaline flanges at the apex, 1 short lateral spine with hyaline flanges at the distal ninth on the margin, 1 well-developed setule at about the middle on the dorsal side, and 1 similar setule at the proximal third on the lateral margin. The medial seta at the apex is 1.6 times as long as the lateral one. These terminal setae and the lateral spine are borne on distinct protrusions from the ramus.

Remarks: Both the female and male of the present species can be obtained from undefined positions in the matrix of the host ascidian. In the female the habitus differs chiefly from other species by having a cylindrical body appearance without distinct dorsal curvature. Other good characteristics are shown in the antenna with 3 spines (4 spines in most other species), in the mandible with 1 apical seta and in the exopodite of the first leg with 1 bifurcated apical claw (2 close-set spines) and 2 extremely short, slender lateral spines (4 graduated spines in all in other species). In the male the ornamentation of the endopodite of the first leg is characteristic as previously mentioned, differing from that of other *Haplostoma* species. The host ascidian has 2 other associates, *Haplostomella oceanica* and a *Botryllophilus* species.

Haplostoma ambiguum, new species

(Figs. 17–21)

Types: Holotypic female, USNM 169511 (type locality, Minesota Reef, San Juan Island, Washington, June 29, 1965, from *Didemnum albidum* (Verrill)); allotypic

male, USNM 169512, same locality and host; paratypes and all other specimens listed below.

Specimens examined:

Washington

From *Didemnum albidum* (Verrill):

Minesota Reef, San Juan Island, 48°31.8′N., 122°58.1′W., lowest intertidal, June 29, 1965, 1 female, 1 male (including holotype and allotype); Boundary Pass, off Skipjack Island, 48°43′N., 123°4′W., 40–90 fams., Oct. 17, 1966, 4 females; Lopez Sound, 48°30′N., 122°50.7W., in trawl, Oct. 5, 1966, 4 females and 5 males (2 females, 1 male, USNM 169513).

Description: Female: The body (Fig. 17 a, b) is of rather expanded vermiform appearance, somewhat depressed, and with a slight dorsal curvature. It is divided into cephalosome, metasome and urosome including the caudal rami, with their proportional lengths about 1 : 4.2 : 1.1. The body length of a representative specimen is 1.7mm, measured from the anteriormost to the end of the caudal rami. The slender egg sacs are shorter than the body length, with relatively large eggs, but small in number, within the thin transparent walls. The cephalosome is sclerotized anterodorsally. The sclerotization (Fig. 17 c) is similar to that of *H. dentatum* (in the female) in design.

The rostrum is indistinct but the apex of the cephalosome is slightly protruded. The head appendages (Fig. 17 d) consist of antennules, antennae, mandibles and maxillipeds. Pleural folds are indistinct. The metasome is divided into 4 elements by integumental folds. Their lengths and widths are gradually increased from the first toward the fourth, and the posterolateral corners of the fourth are protruded into distinct lateral cones representing, in part, the fifth legs. The body width at the cones is 1.5 times the width of the first segment or 0.5 mm wide. Each pair of legs from the first to fourth is located somewhat posteriorly on its respective segment, and the legs are well separated from each other, without intercoxal connecting plate. The wide cone-bearing element is set off from the funnel-shaped urosome by constricting gradually but without apparent articulation with it.

The urosome is unsegmented, carrying the genital apparatus in the anterior broad region at a short distance from the anterior limit of the urosome, and terminating in the diverging caudal rami posteriorly. The genital apparatus is composed of a medial internal seminal receptacle with 2 pores for insemination (Fig. 17 e) opening on the midventral surface, internal diverging tubes from the receptacle, oviducal apertures and covering folds on the dorsolateral sides, and a rectangular dorsal sclerotization between the apertures. The oviducal aperture at each side opens as a slit and is covered by a swollen, kidney-shaped cuticular fold (Fig. 17 f). The medial margin of the fold has 7 spines (Fig. 17 g): 1 large strong spine at the distal third on the margin, accompanied by 1 small articulated spine at its anterior base; 1 short stout spiniform projection in front of them; a row of 4 small spines along the internal edge of the margin. The dorsal sclerotization is twice as wide as long, with smooth anterior and posterior margins without complexities of the surface.

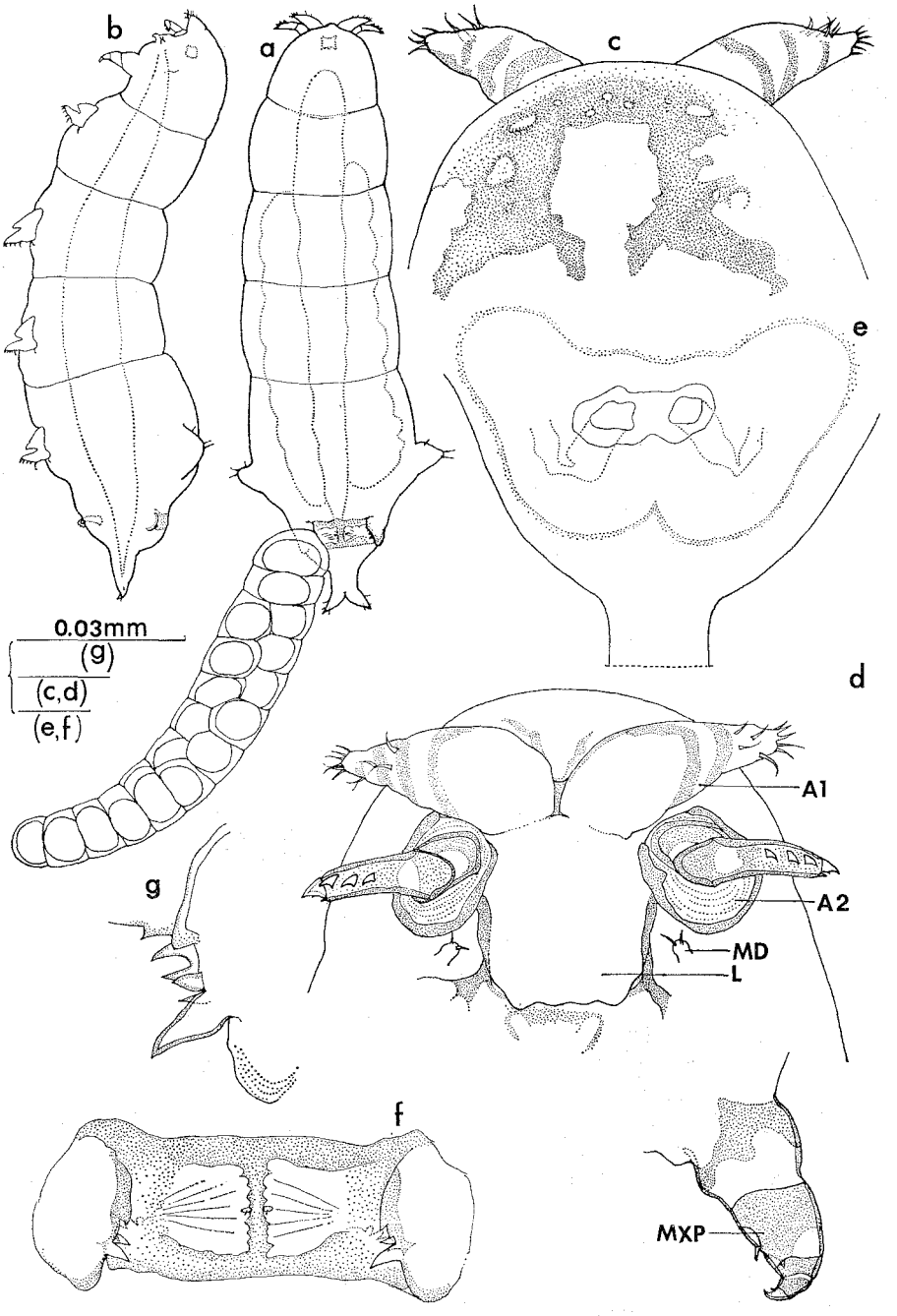


Fig. 17. *Haplostoma ambiguum*, n. sp., female: a, dorsal; b, lateral; c, cephalic plaque; d, oral area; e, insemination pores; f, apparatus at oviducal apertures, including dorsal sclerotized area; g, margin of fold covering oviducal aperture. Key to abbreviations: A1, antennule; A2, antenna; L, labrum; MD, mandible; MXP, maxilliped.

It encloses 2 less sclerotized areas at the sides of a middorsal sclerotized bar. The lateral limit of each area is indistinctly separated from the inner lateral margin of the frame-like sclerotization. Several muscle strands are perceptible underlying each less sclerotized area and running transversely from the middorsal sclerotized bar toward the oviducal fold. The anus opens as a posterodorsal slit.

The body is yellow in color, with an orange eye and gut and white eggs. In the cephalosome the color is paler.

The antennules (Fig. 18 h) consist of diverging unsegmented conical lobes, each with 15 short slender non-plumose setae: 3 of these situated separately along the anterior margin; the remaining 12 placed close together on the narrow apical part. One marginal seta at the distal third is distinctive, with a basal cylindrical bulge protruded from the general surface.

The antenna (Fig. 18 i) is composed of 3 segments. The short basal segment is surrounded by a subcircular sclerotization on the body surface. The second segment is cylindrical, curved and somewhat tapered apically, and about 1.5 times as long as wide. The third segment is narrow, the same length as the second, bearing 4 short stout spines: 1 at the apex; 3 at fairly equal intervals along the distal half of the

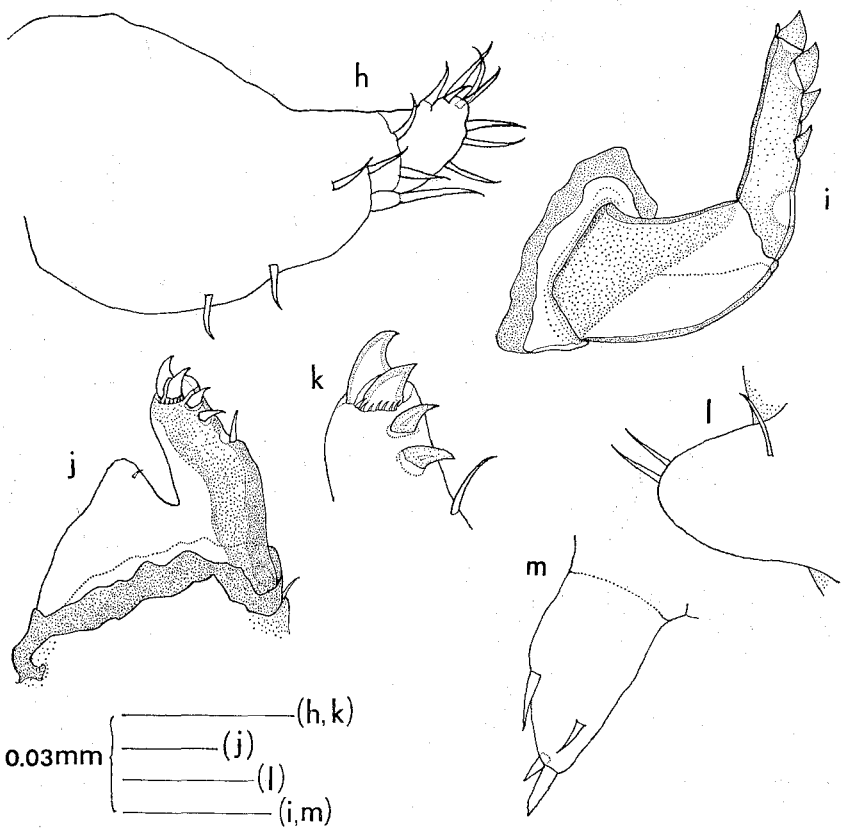


Fig. 18. *Haplostoma ambigum*, n. sp., female: h, antennule; i, antenna; j, leg 3; k, same, exopodi e; l, leg 5; m, caudal ramus.

anterior margin. Two of the distal are twice as large as the others and characterized by extremely wide bases. The distolateral corner of the segment is protruded into a spinule.

The margin of the labrum (Fig. 17 d) is sinuate, with 4 rounded lobe-like prominences distally. The most lateral prominences are somewhat larger than the central ones.

The mandible (Fig. 17 d) is a small unsegmented lobe bearing 2 short apical minute setae.

The maxilliped (Fig. 17 d) has the usual structure. There are 2 setules on the second segment and the terminal claw is arranged in the same way as that of other species.

The first to fourth pairs of legs are uniform in structure and armature with each other. Each leg (Fig. 18 j) is composed of unsegmented protopodite and rami, with a great fusion of the ingredient articles. The oval sclerotized framework, probably representing the protopodite, is not very wide; the width is about 1.2 times the length of the exopodite. There is 1 short, slender simple seta at the lateral base of the framework, probably corresponding to the usual lateral seta on the basipodite. The exopodite is relatively narrow and armed with 4 spines and 1 seta on the distal and lateral margins, without a lateral process behind the seta. The distal margin (Fig. 18 k) is somewhat depressed, with 2 short stout spines which are closely set. The remaining 2 spines are slender and located at fairly regular intervals along the lateral margin between the apical spines and the seta at the distal third. The apcial spines are ornamented basally by a row of denticles protruded from the distal margin of the ramus. The endopodite is a typical conical lobe with 1 setule near the apex.

The fifth leg (Fig. 18 l) is represented by a posterolateral cone with 2 short simple setae at the tip. A similar seta is inserted on the cone at the dorsal base.

The caudal ramus (Fig. 18 m) is a short conical lobe, with 1 stout simple spine at the apex, 1 much smaller lateral spine near the apical spine, 1 well-developed dorsal setule at the distal fourth, and 1 similar setule midway on the lateral margin.

Male: The body structure (Fig. 19 a, b) belongs to the creeping type, with relatively long prosome and short urosome and with short caudal rami and setae. The proportional lengths for the cephalosome metasome and urosome are about 1: 1.9: 2. The anterior 2 regions are proportionately widened. The body length of a representative specimen measured from the anteriormost to the end of the caudal rami is 0.9 mm and the total length including the caudal setae is 0.95 mm. The widest part occurs on the cephalosome, with the width 0.26 mm. Tergal plates on the somites are well developed, without intersegmental regions.

The cephalosome is anteriorly and ventrally prolonged into a subtriangular rostrum and the pleural folds are well developed. It (Fig. 19 c, d) bears antennules, antennae, mandibles, maxillae and maxillipeds. The 4 segments of the metasome gradually decrease in their length, width and thickness from the first to fourth, and bear 4 pairs of legs with armature reduced. The first endopodite is unimer-

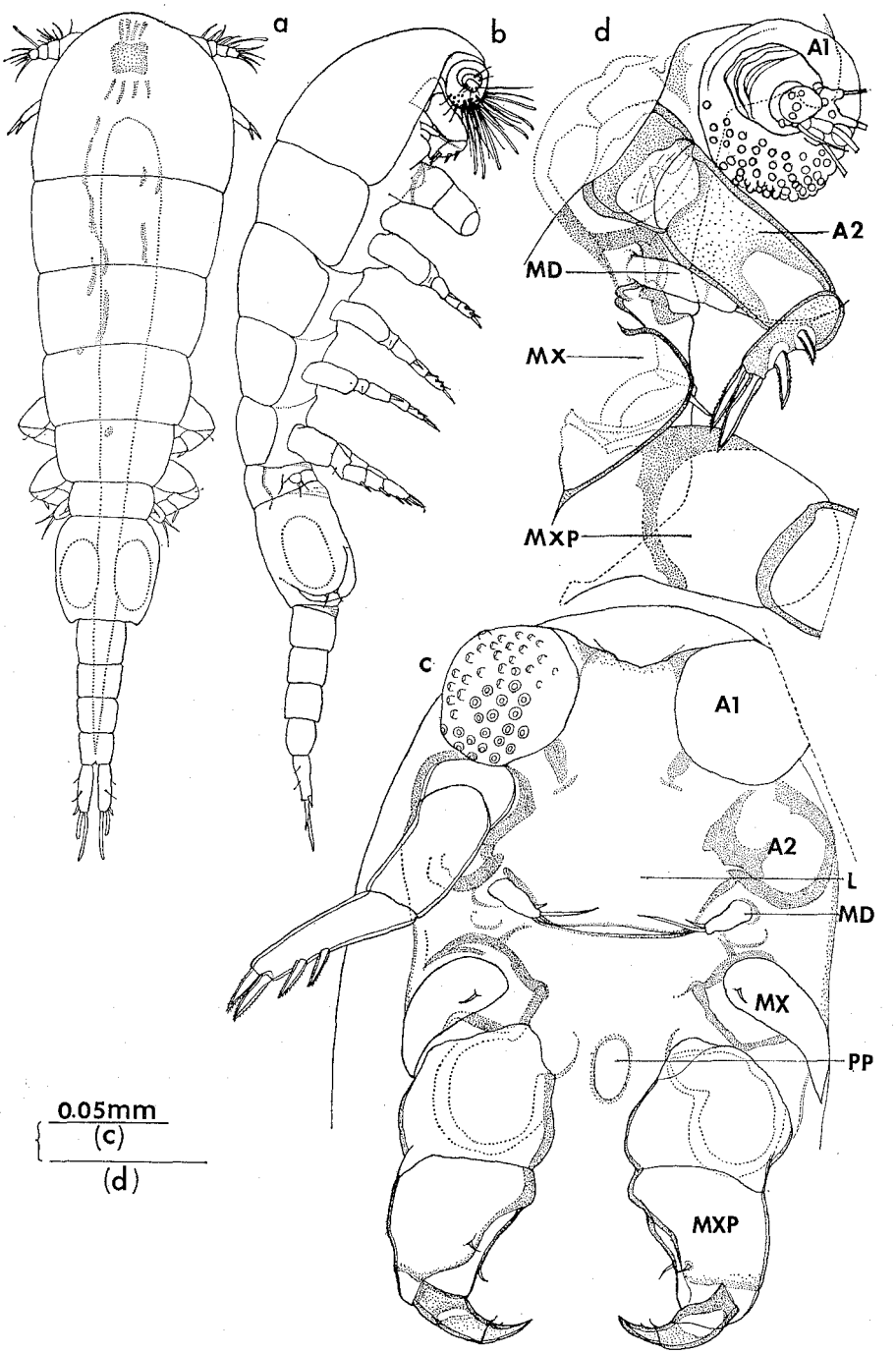


Fig. 19. *Haplostoma ambiguum*, n. sp., male: a, dorsal; b, lateral; c, oral area; d, same, lateral. Key to abbreviations: A1, antennule; A2, antenna; L, labrum; MD, mandible; MX, maxilla; MXP, maxilliped; PP, postoral protrusion.

ous, with a highly modified armature. The urosome is 6-segmented. The first 2 segments bear the fifth and sixth legs; the second segment encloses a pair of oval spermatophores. The anus opens as a posterodorsal slit on the sixth segment.

The yellow body color is comparable to that of the female, although it is much lighter in the male. The eye is brownish and the gut is tinted with pale orange. Small brownish pigment spots are scattered along the gut.

The antennule (Fig. 20 e) is as in other *Haplostoma* males with a 4-segmented

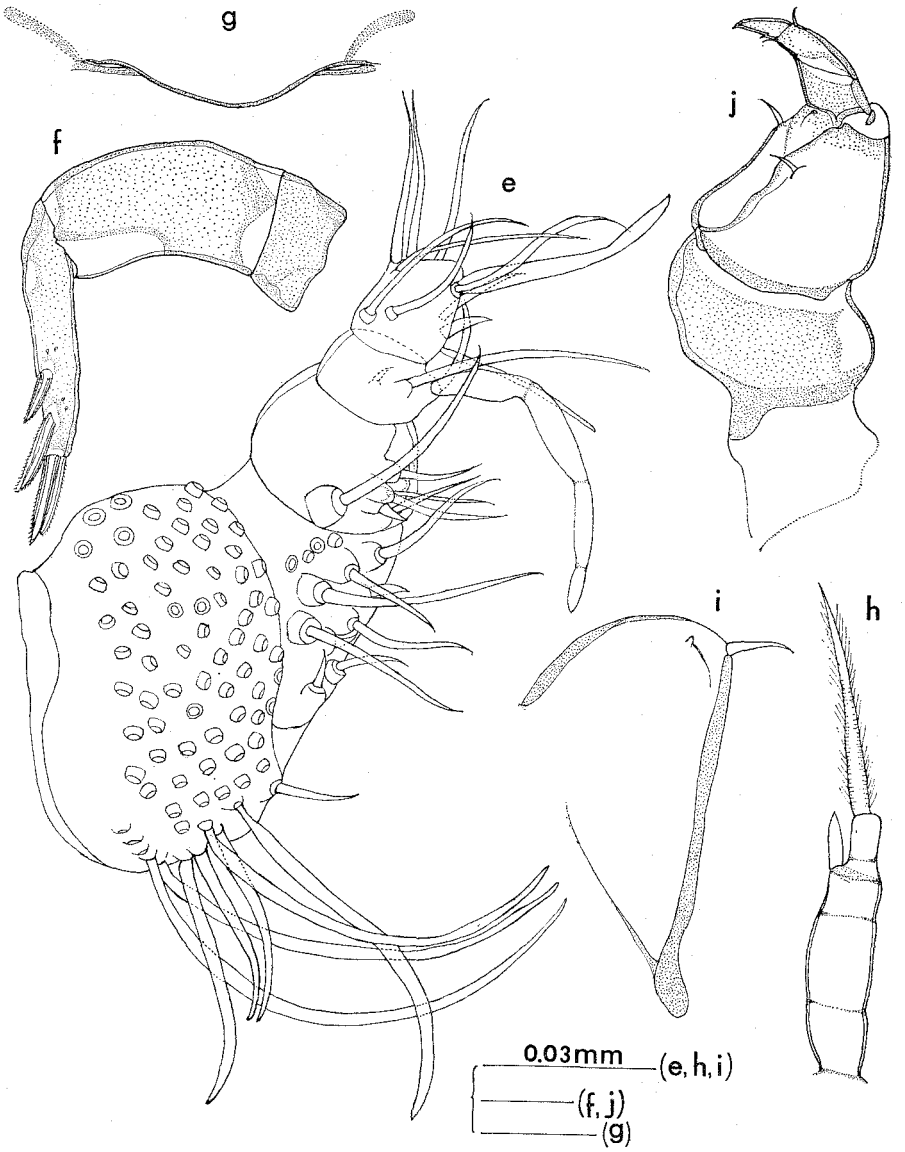


Fig. 20. *Haplostoma ambiguum,* n. sp., male: e, antennule; f, antenna; g, labrum; h, mandible; i, maxilla; j, maxilliped.

structure notable for the expanded proximal segment with numerous aesthetes and few setae. The proximal segment has 81 long slender aesthetes and 10 non-plumose setae: 77 of the aesthetes are borne on distinct protrusions closely set on a subcircular area formed on the expanded ventral margin; 4 aesthetes and 10 setae are arranged along the distal half on the anterior margin. The second segment is slightly wider than long and about one fourth the length of the first; it bears 6 to 8 setae on the anterior margin. The third segment is smaller than the second, with 1 broad and long aesthete, 2 setae and 1 setule. The fourth segment is slightly longer than wide, with 1 broad and 1 slender aesthete and 9 setae on the margins.

The antenna (Fig. 20 f) is composed of 3 segments with their proportional lengths about 1: 4: 3 from basal to distal. The basal 2 segments are cylindrical, about equal in width, and the third segment is much narrower, bearing 4 spines fringed with serrated hyaline flanges. These spines are subequal in length, with their proportional lengths about 0.8: 1: 1.2: 1, from basal to distal. The distal 2 are closely set on the apex and the others at fairly regular intervals along the distal third of the margin. There are a few hairs, each set on a mammiform bulge, which are scattered on the anterior region.

The labrum (Fig. 20 g) is as in other *Haplostoma* males, with a simple free margin.

The mandible (Fig. 20 h) is composed of a cylindrical lobe, but tapers slightly apically and is incompletely divided into 3 elements with their proportional lengths about 1: 1.5: 0.9, from basal to distal. The length is 3.2 times the widest middle part. The distal end is projected into a distinct cylindrical protrusion, which is slightly shorter than the apical element and bears 1 long plumose seta. The seta is as long as the whole appendage. The mediodistal corner of the apical element bears 1 much shorter non-plumose seta.

The maxilla (Fig. 20 i) is comparable to that of other *Haplostoma* males, consisting of a large subconical lobe with 1 short stout non-plumose seta at the apex and 1 spinule-like projection near the seta on the lateral surface. The posterior half of the appendage is located on the anterolateral side of the maxilliped.

The maxilliped (Fig. 20 j) is composed of 3 segments and a terminal claw. The first segment is somewhat constricted proximally. The second segment is slightly longer than the first, tapers apically, and has a medial longitudinal groove which receives the flexed terminal claw. There are 2 well-developed setules on the anterior and posterior margins of the groove. The third segment is the shortest, narrow, articulating with the elongate claw at the apex. The claw is divided into 2 portions: the proximal portion is about twice as long as the distal, with 2 setules near the distal margin; the apical portion is slightly bifurcated by presence of a medial spinule, offering a somewhat cheliform appearance. The area between the maxillipeds is slightly protruded as a rounded projection (Fig. 19 c).

The first leg (Fig. 21 k) consists of bimerous protopodite, unimerous endopodite and trimerous exopodite. The intercoxal plate is well developed. The coxopodite lacks the usual seta. The basipodite has 1 short, extremely slender seta on the lateral margin. The distal end of the basipodite is protruded into a pointed spatula-shaped

lobe. The endopodite is characteristic, an unsegmented kidney-shaped structure which is highly sclerotized on the posterior side. The ramus is obliquely articulated on the medial side of the subtriangular basipodite. The armature of the endopodite (Fig. 21 l) consists of 1 long chisel-like spine and 1 short elliptical spine with 4 longitudinal serrated corners. The long spine is fixed at the midpoint on the anterior surface and the short spine is set medially close to the former. The exopodite is ornamented with 5 curled, sparsely plumose setae and 6 spines fringed with denticulated

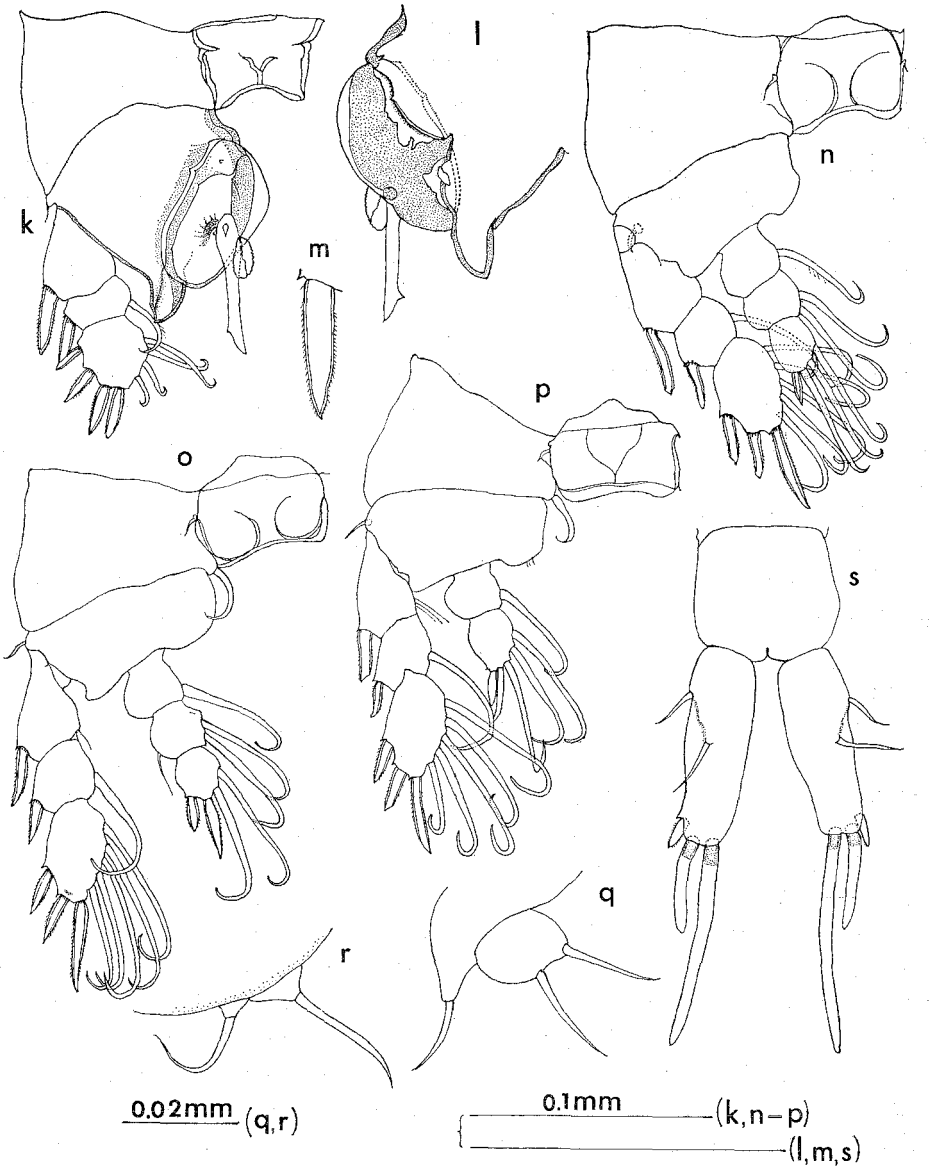


Fig. 21. *Haplostoma ambiguum,* n. sp., male: k, leg 1; l, same, endopodite, posterior; m, same, spine of exopodite; n, leg 2; o, leg 3; p, leg 4; q, leg 5; r, leg 6; s, caudal rami.

hyaline flanges (Fig. 21 m): the first segment with 1 lateral spine; the second segment with 1 lateral spine and 1 medial seta; the third segment with 2 lateral and 2 apical spines and 4 medial setae.

The second leg (Fig. 21 n) is composed of bimerous protopodite and trimerous rami. The basipodite has the usual structure with 1 short slender seta on the lateral margin. The endopodite is armed with 6 curled, sparsely plumose setae and 1 spine: the first segment with 1 medial seta; the second segment with 2 medial setae; the third segment with 3 setae (2 medial and 1 apical) and 1 short apical spine. The exopodite is about 1.6 times as long as the endopodite, bearing 6 setae and 5 spines: the first segment with 1 lateral spine; the second segment with 1 medial seta and 1 lateral spine; the third segment with 5 medial setae and 1 terminal and 2 lateral spines. The terminal spine is the longest.

The third leg (Fig. 21 o) is comparable to the second in structure, with bimerous protopodite and trimerous rami. However, the armature of the endopodite is distinct from the second. The ramus has 5 setae and 2 spines: the first segment with 1 medial seta; the second segment with 2 medial setae; the third segment with 2 medial setae and 2 spines (1 apical and 1 lateral). There is a long hair-like element on the medial margin of the second segment. The armature of the exopodite is comparable to that of the second exopodite in number and arrangement.

The fourth leg (Fig. 21 p) is slightly smaller than the preceding legs, showing a reduction in segmentation and armature in the endopodite. The endopodite consists of 2 segments, with 5 setae and 1 spine: the first segment with 1 medial seta; the second segment with 3 medial setae, 1 apical seta and 1 apical spine. The exopdite is comparable to that of the preceding leg in segmentation and armature.

The fifth leg (Fig. 21 q) is composed of 2 portions as in males of other *Haplostoma* species; the basal element is coalesced with the body proper and extends as a small conical protrusion from the distolateral margin, with a single short seta at the apex; the distal segment is distinctly articulated on the proximal and bears 2 short similar setae on the somewhat truncate apical margin.

The sixth leg (Fig. 21 r) is represented by the usual flap-like cover of the male genital orifice. It bears 2 short simple setae set on protrusions on the ventral surface near the rounded distal margin of the cover.

The caudal ramus (Fig. 21 s) is short; its length is 3 times the width at the widest point and 1.5 times as long as the anal segment. It bears 2 unequal stout terminal setae with smooth margins, 1 short spine with serrated margins at the distolateral corner, 1 short, slender simple dorsal seta at the midpoint, and 1 similar lateral seta at the proximal third. The medial terminal seta is slightly longer than the caudal ramus and 2.2 times as long as the lateral terminal seta.

Remarks: Up to the present, this species has been found associated only with *Didemnum albidum* from the intertidal area or deeper water of the San Juan Archipelago. Both its females and males inhabit undefined positions of the host matrix, rather inconspicuously, with their yellow body color corresponding to that of the matrix.

As previously mentioned, it is remarkable that in the female each basal framework of the first 4 pairs of legs bears 1 lateral seta representing the lateral seta of the basipodite. The male belongs to the creeping type, together with the male of *Haplostoma elegans,* but it is distinguished from the latter by the characteristic armature in the first endopodite. However, it is noted that in both the creeping type species so far seen the first endopodite is unsegmented and its armature includes a chisel-like spine.

Haplostoma elegans, new species

(Figs. 22–25)

TYPES: Holotypic female, USNM 169514 (type locality, Peavine Pass, San Juan Archipelago, Washington, July 25, 1966, from *Amaroucium ?constellatum* Verrill); allotypic male, USNM 169515, same locality and host; paratypes and all other specimens listed below.

SPECIMENS EXAMINED:

WASHINGTON

From *Amaroucium ?constellatum* Verrill:

Peavine Pass, 48°35.3′N., 122°49′W., July 25, 1966, dredged, 11 females, 6 males (including holotype, allotype and 5 females, 1 male, USNM 169516), Aug. 22, 1973, 3 females, 1 male.

From *Amaroucium propinquum* Van Name:

Black Rock, 48°33′N., 122°45.9′W., 31–32 fams., Aug. 18, 1965, 5 females, July 25, 1966, 7 females and 2 males, Aug. 22, 1973, 7 females, 1 male.

DESCRIPTION: Female from *A. ?constellatum*: The body (Fig. 22 a–c) is elongate, rather straight and of vermiform appearance. It consists of cephalosome, metasome and urosome with their proportional lengths about 1: 5: 1.2. The body length of a representative specimen is about 2.9 mm, measured from the anteriormost to the end of the caudal rami. The egg sacs are longer than the body length, and each sac is about 8 times as long as the widest part, with many relatively small eggs packed within its thin transparent wall. There is a small median eye. The anteriormost portion of the cephalosome (Fig. 22 d) is somewhat ventrally protruded between the antennules like a rostrum. The apical plaque (Fig. 22 d) on the anterodorsal surface is characteristically sclerotized, including many (about 100 in number) small less sclerotized depressions in which hairs are inserted. Pleural folds are not distinctive. The appendages of the cephalosome (Fig. 22 e) are composed of 5 pairs: antennules, antennae, mandibles, maxillae and maxillipeds. Maxillules are absent.

The metasome is divided into 4 sections by integumental indentations without real articulations. The first, a leg-bearing segment, is slightly longer and wider than the cephalosome. The second and third segments are almost the same in length and width, and each segment is about 1.2 times as large as the first. The fourth section is the largest, and includes segments for the fourth and fifth thoracic legs as in other species. Ventrally there are 4 midventral sclerotizations, each representing a

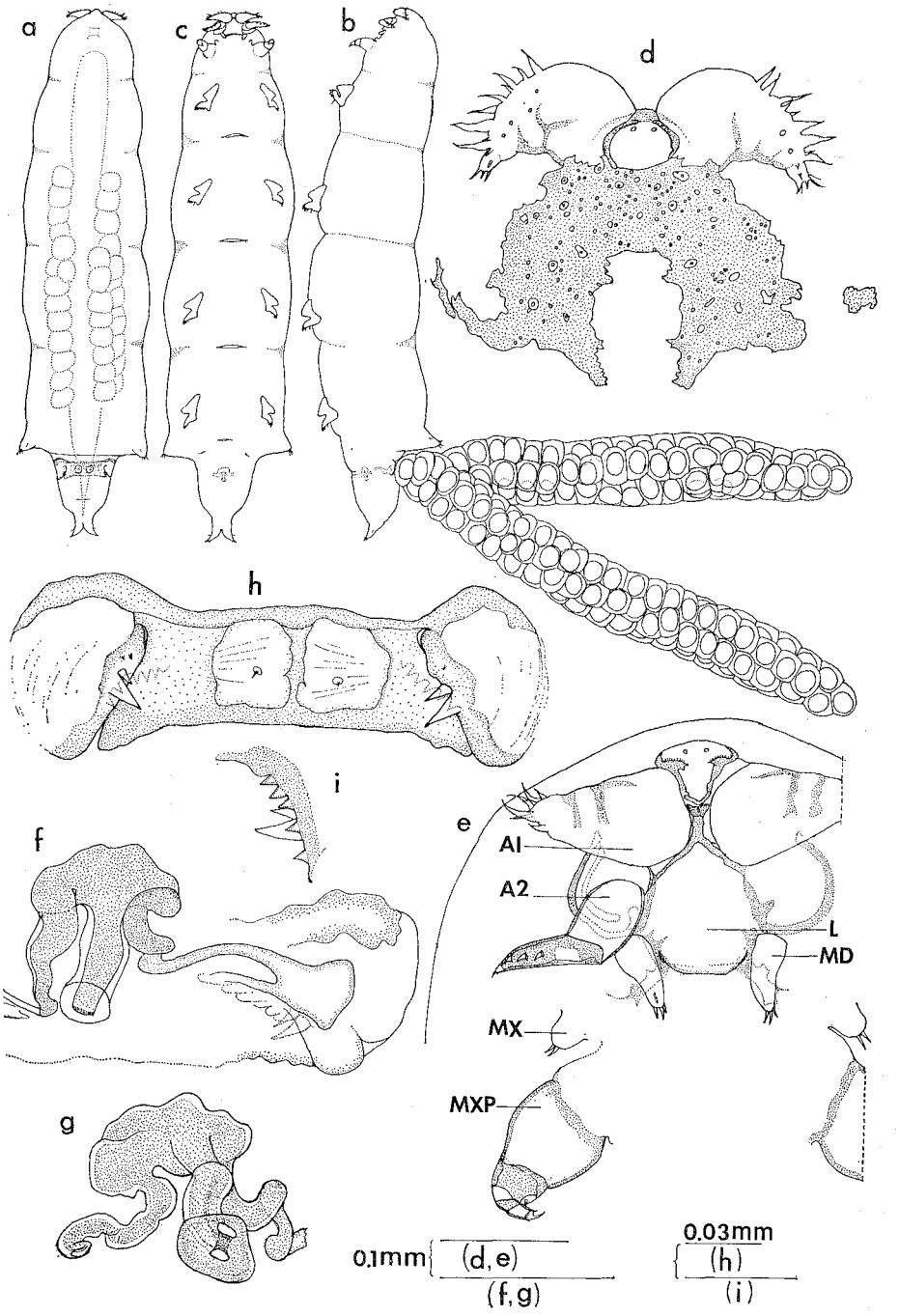


Fig. 22. *Haplostoma elegans*, n. sp., females, from *Amaroucium ?constellatum* (a-f, & h, i) and *A. propinquum* (g): a, dorsal; b, lateral; c, ventral; d, cephalic plaque and antennules; e, oral area; f, insemination apparatus, ventral; g, insemination apparatus of a specimen from *A. propinquum;* h, apparatus at oviducal apertures, including dorsal sclerotized area; i, margin of fold covering oviducal aperture, internal. Key to abbreviations: A1, antennule; A2, antenna; L, labrum; MD, mandible; MX, maxilla; MXP, maxilliped.

vestige of a basic articulation between the segments. The last sclerotization is behind the fourth legs and in front of the short widened segment protruded at the sides into subtriangular portions for the fifth legs. A major bodily constriction to the protrusions for the fifth legs sets the anterior limit of the goblet-shaped, unsegmented urosome.

The insemination apparatus (Fig. 22 f) placed anteriorly on the urosome is distinctive and includes a single short midventral internal seminal tube, which opens on the ventral surface probably by a pair of small openings (Fig. 22 g, based on a specimen from *A. propinquum*) as in the female of *H. ambiguum*, and an internal midventral chamber, from which internal tubes diverge to connect with the oviducal apertures on the dorsal side. There is a dorsal sclerotization between the oviducal apertures, which open as large slits, each covered by a swollen, kidney-shaped, cuticular fold (Fig. 22 h). The fold (Fig. 22 i) has 1 large posterior spine and 1 small anterior spine which is fixed on the middle of the medial margin, in addition to a row of 6 small spines protruding from the more inner and anterior edge of the same margin. The subrectangular dorsal sclerotization (Fig. 22 h) is a framework, much wider than long, with straight anterior and posterior margins. The framework includes a narrow middorsal sclerotized bar, which is anteriorly and posteriorly connected with the inner marginal framework, thus delimiting a pair of relatively small, trapezoidal less sclerotized depressions. Each depression has a central hair growing from a minute mammiform protrusion.

The distal fourth of the urosome is narrow, cylindrical and abruptly constricted from the anterior enlarged portion, and bears small caudal rami without real articulations. The anus opens as a posterodorsal slit. The caudal rami are relatively slender and taper apically.

The overall body color is white, with an orange eye, a yellowish gut and white eggs.

The antennules (Fig. 23 j) are composed of diverging unsegmented paired lobes. Each lobe which is proximally expanded and apically tapers with a few sclerotized coatings probably represents coalescence of several segments, and bears about 18 short non-plumose setae along the anterior margin and at the apex and about 9 tiny setules or hair-like elements on the anterior surface. At the distal fifth on the anterior margin there is a relatively large seta on a distinct bulge protruding from the surface. The apical part of the appendage distal to the bulge is narrow, bearing 11 setae. The appendage proximal to the bulge has 6 setae on the margin.

The antenna (Fig. 23 k) consists of 3 segments as in other species. The basal segment, the shortest and widest, is connected with a horseshoe-shaped sclerotized bar on the body surface and extremely suppressed anteromedially. The second segment is twice as long as the longest part of the first. The third segment is narrow with an apical taper and set with 4 short stout spines. The spine at the apex is the largest; the remaining 3 spines occur at fairly regular intervals along the distal half of the medial margin, and the distal one is much larger than the proximal 2. The medial margins of the 2 apical spines are serrated. The outer distal margin of the segment has a few denticles.

The labrum (Fig. 22 e) is ventrally protruded, with a smooth margin, midventrally slightly flattened.

The mandible (Fig. 23 l) is characteristic, consisting of an elongate lobe situated close to the lateral extent of the oral aperture, and bearing 3 short simple setae and

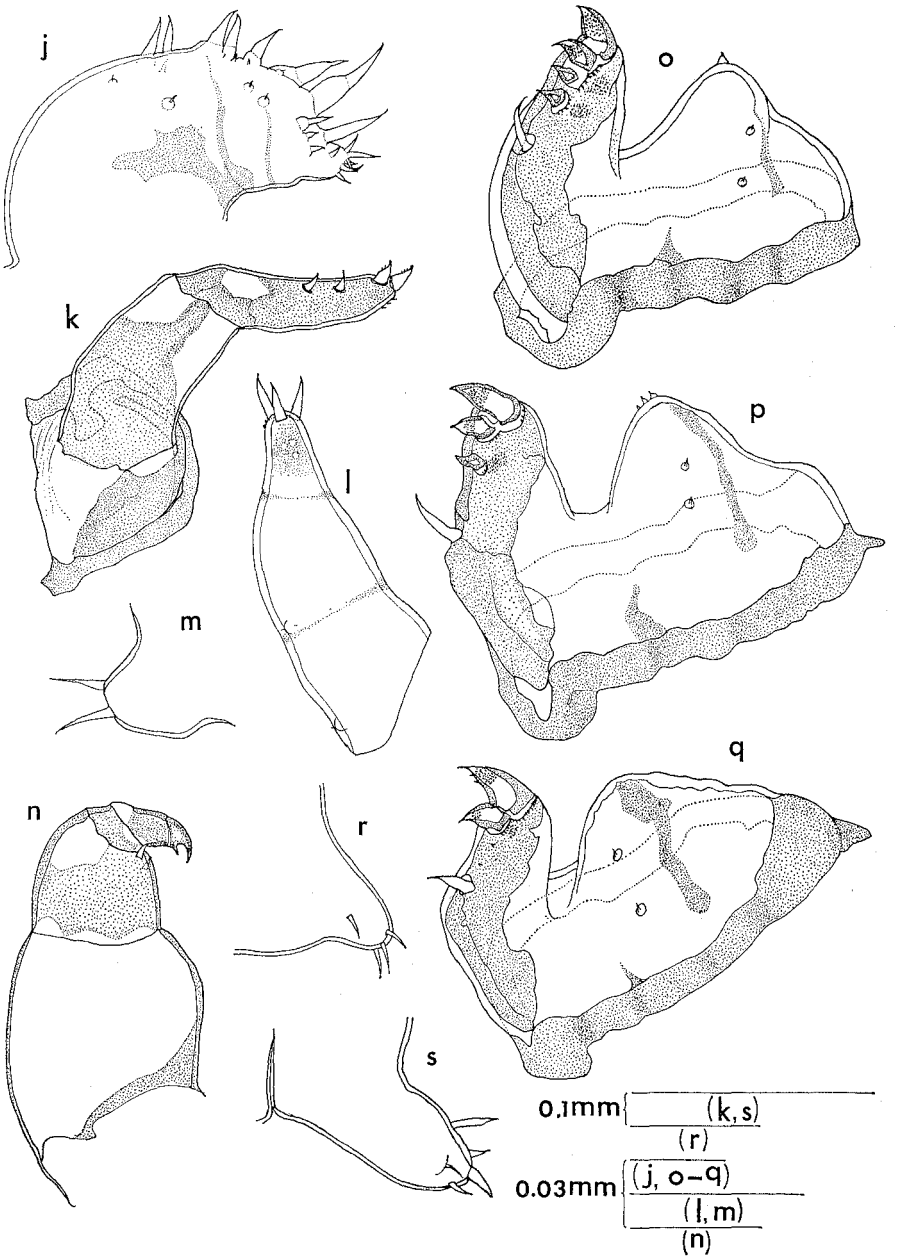


Fig. 23. *Haplostoma elegans*, n. sp., female, from *Amaroucium ?constellatum*; j, antennule; k, antenna; l, mandible; m, maxilla; n, maxilliped; o, leg 1; p, leg 2; q, leg 3; r, leg 5; s, caudal ramus.

a few denticles at the apex. The lobe is about 2.5 times as long as its basal width and obscurely divided into 3 segments with their proportional lengths about 1: 1: 0.7, from basal to distal.

The maxilla (Fig. 23 m) is placed far laterally between the mandible and maxilliped but very close to the maxilliped; it consists of a small lobe with 2 short simple setae at the apex.

The maxilliped (Fig. 23 n) is essentially as in other species, 3-segmented, with an apical claw, and with the ornamentation consisting of 2 setules on the second segment. The subcheliform claw is narrow and subdivided by an articulative line at the distal third.

The first to fourth legs (Fig. 23 o–q) are almost the same in structure and size except for the armature. The sclerotized basal framework (?protopodite) of each leg is not very wide, about 1.2 times the length of the exopodite, and the medial end of the framework does not extend beyond the medial margin of the endopodite.

The endopodites from the first to fourth are not different from each other in structure and armature. The ramus is a well-developed subconical protrusion from the protopodite and bears a few hairs growing from tiny mammiform projections on the surface.

The lateral margin of each exopodite is not protruded laterally and the apex of the ramus is somewhat depressed for insertion of the apical spine. In the first exopodite (Fig. 23 o) there is 1 short, stout non-plumose seta at the distal third on the lateral margin, and the distal two thirds of the margin between the apical spine and the lateral seta has 3 additional lateral spines. The apical spine is the largest and the lateral spines gradually decrease their size from distal to proximal. The smallest proximal spine is about half as large as the apical one. The distal lateral spine is inserted close to the apical one. Each spine is basally armed with a row of spinules protruding from the ramus. The distal surface of the spine is ornamented by many bristle-like elements. The second exopodite (Fig. 23 p) is reduced by 1 lateral spine from the first; it has 3 spines and 1 seta. The third and fourth exopodites (Fig. 23 q) are reduced again by 1 lateral spine from the second, each bearing 2 spines (1 apical and 1 distolateral) and 1 lateral seta.

The reduced fifth leg (Fig. 23 r) is represented in part by 4 short simple setae on a subconical protrusion from the posterolateral corner of the metasome; 3 at the apex and 1 more proximally on the dorsal side.

The caudal ramus (Fig. 23 s) is relatively elongate, about twice as long as the widest basal part, with 1 short stout spine at the apex, 2 setules near the apical spine on both the lateral and medial sides, 1 dorsal setule at the distal sixth and 1 lateral stiffened seta at the distal third.

Male: The body structure (Fig. 24 a, b) belongs to the creeping type with broad and thick prosome and urosome and bearing short caudal rami and setae. It is divided into cephalosome, metasome and urosome, with their proportional lengths about 1: 2: 2. The body length is 1.66 mm, measured from the anteriormost to the end of the caudal rami, and the total length including the caudal setae is about 1.7

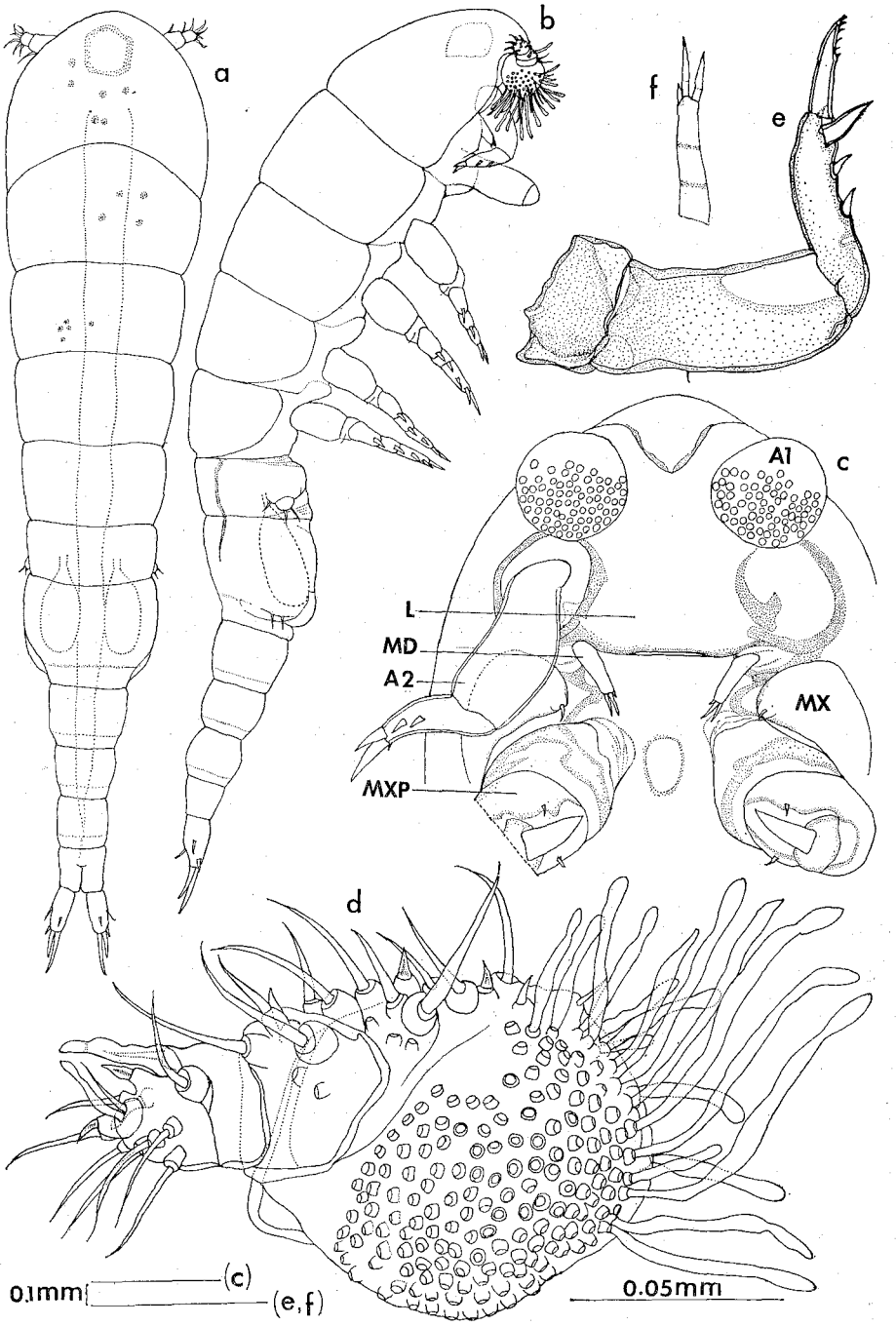


Fig. 24. *Haplostoma elegans* n. sp., male, from *Amaroucium ?constellatum*: a, dorsal; b, lateral; c, oral area; d, antennule; e, antenna; f, mandible. Key to abbreviations: A1, antennule, A2, antenna; L, labrum; MD, mandible; MX, maxilla; MXP. maxilliped.

mm. The widest part occurs on the middle point of the cephalosome with the width 0.3 mm, and then gradually tapers toward the second urosomal segment, followed by the distinctly narrow third to sixth urosomal segments.

The cephalosome (Fig. 24 c) is ventrally protruded into a sclerotized rostrum. The appendages of the cephalosome consists of 5 pairs: antennules, antennae, mandibles, maxillae and maxillipeds. Maxillules are absent. There is a large median eye. Its configuration is not distinct on the dorsal side but it is clearly recognized on the midventral area between the antennules and antennae.

The metasome is 4-segmented; each segment bearing a pair of legs with the armature reduced. The first endopodite is unimerous, with characteristically modified armature.

The urosome is composed of 6 segments with their proportional lengths about 1: 1.8: 1: 0.9: 0.9: 0.8. The first 2 segments have the reduced fifth and sixth pairs of thoracic legs; the second segment encloses a pair of oval spermatophores. The sixth segment carries a pair of caudal rami. The anus opens as a posterodorsal slit on the sixth segment.

The general body color is slightly orange, with a red eye and yellow gut. In the cephalosome the orange color is light. There are small brownish pigment spots scattered on the cephalosome and metasome.

The antennule (Fig. 24 d) is composed of 4 segments with the structure of that of the swimming type males of the genus, although the armature is somewhat reduced with shortened setae and aesthetes. The first segment occupies more than half the appendage and bears about 174 aesthetes (188 in a specimen from *A. propinquum*) and 10–12 setae; most of the aesthetes are arranged in a circle on distinct protrusions of a closely set rosette formed on the expanded ventral surface; most of the setae are inserted on the anterodistal margin of the segment. The following 3 segments, from the second to fourth, are much narrower and shorter than the first, and gradually taper apically: the second segment has 6 elements including 3 setae (4 setae in a specimen from *A. propinquum*), 1 spiniform seta with wide base and also 2 aesthetes along the anterior margin; the third segment is shorter than the second, with 1 aesthete and 2 setae at the anterodistal corner; the fourth segment has 10 setae and 2 short aesthetes on the surface.

The antenna (Fig. 24 e) is composed of 3 segments with their proportional lengths about 1: 3.5: 2.5, measured on the anterior side, and tapers apically. The second segment has 1 setule at the proximal third on the medial margin. The third segment is narrow, bearing 4 graduated spines at fairly regular intervals along the anterior half of the medial margin and at the apex; there is 1 tiny spine at the base of the apical spine on the posterior surface. The apical spine is the largest, twice as large as the subterminal spine. Each of these 2 spines has a serrated edge along the anterior half of the medial margin. The proximal 2 spines are much smaller than others, about one third as long as the subterminal spine.

The labrum (Fig. 24 c) is somewhat concave at the middle of the margin, with slightly protruded lateral corners.

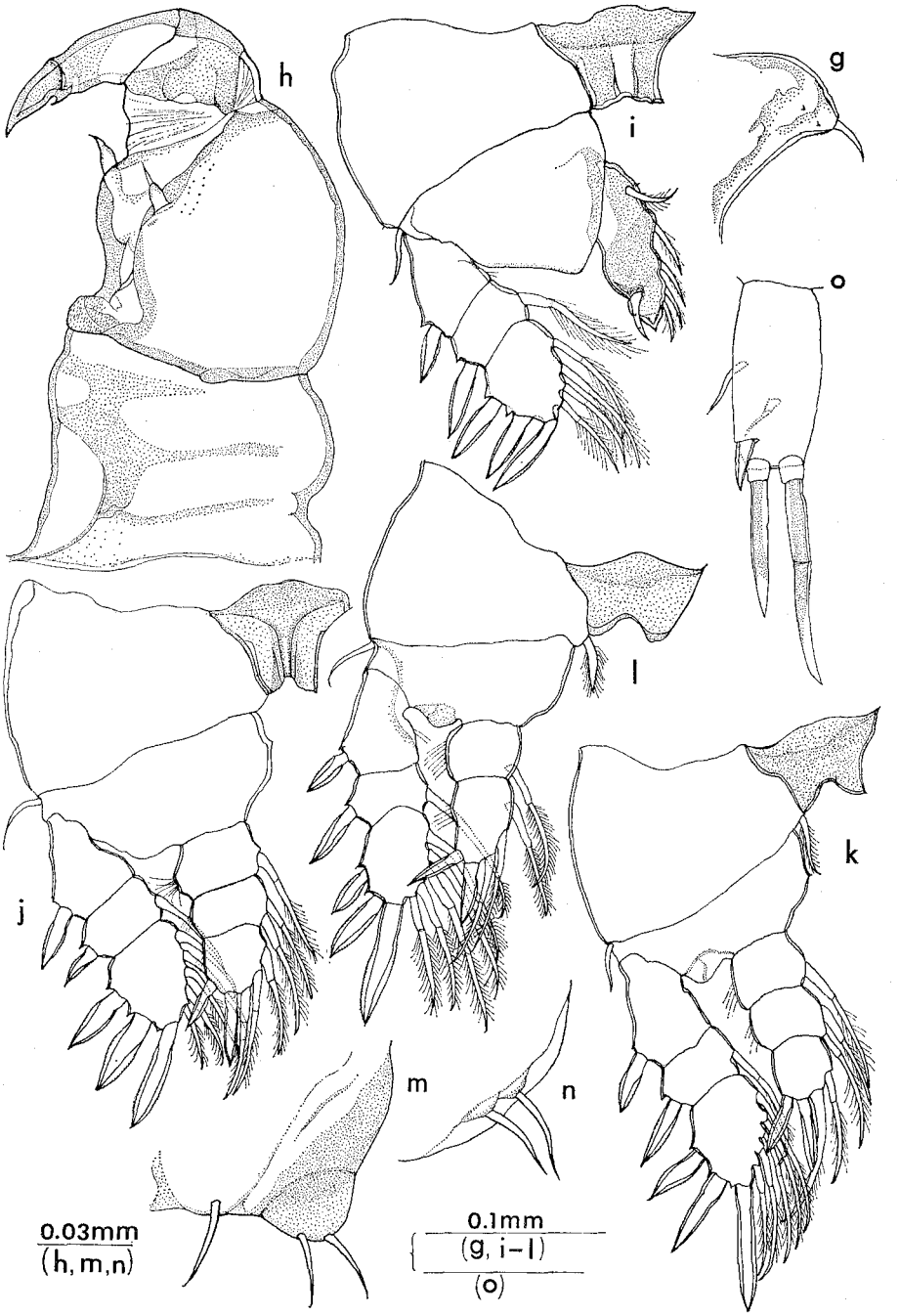


Fig. 25. *Haplostoma elegans*, n. sp., male, from *Amaroucium ?constellatum*: g, maxilla; h, maxilliped; i, leg 1; j, leg 2; k, leg 3; l, leg 4; m, leg 5; n, leg 6; o, caudal ramus, ventral.

The mandible (Fig. 24 f) is cylindrical, and basically comparable to that of the female in structure and armature. The appendage is about 3.7 times as long as the widest basal part and shows a suggestion of incomplete division into 3 segments. The ornamentation consists of 3 short non-plumose setae along the apical margin; the seta at the mediodistal point is the shortest.

The maxilla (Fig. 25 g) is a large subconical lobe protruded from the body surface. It is somewhat constricted at the distal third and bears 1 short, stout apical seta.

The maxilliped (Fig. 25 h) is 3-segmented and dumpy in appearance, with a terminal claw; each segment is proportionately somewhat shortened in comparison with that of the appendage of the swimming form males. The basal 2 segments are nearly equal in length and width and each segment is about as long as wide. The medial surface of the second segment is longitudinally concave, with 2 stout, well-developed setules on the anterior and posterior margins of the concavity which receives the folded terminal claw. The third segment is the smallest. The terminal claw is about 3 times as long as its widest basal part, and divided into 2 components by an articulative line; the distal of these is half as long as the basal and exhibits on the medial margin a distinctive proximal notch which forms a short marginal spinose projection. The area between the maxillipeds (Fig. 24 c) is as in *H. ambiguum*.

The first leg (Fig. 25 i) consists of bimerous protopodite, unimerous endopodite and trimerous exopodite. The trapezoidal intercoxal plate is well developed to yoke the protopodites. The coxopodite lacks a seta. The basipodite bears 1 relatively long non-plumose seta on the lateral margin. The endopodite is marginally well sclerotized and gradually tapers, with undulating margins and with the pointed tip triangular; it is inserted at the medial margin of the subtriangular basipodite. The ramus bears 5 short plumose setae which are placed at somewhat regular interval along the medial margin, and 1 gimlet-like spine with 2 spinules on the anterior margin, set at the distal third of the sclerotized lateral margin. The exopodite is about 1.4 times as long as the endopodite, with 5 spines fringed with slightly serrated hyaline flanges and 5 short, slightly curled plumose setae: the first segment with 1 lateral spine; the second segment with 1 lateral spine and 1 medial seta; the third segment with 3 spines (2 lateral and 1 apical) and 4 medial setae. Each spine is accompanied proximally by a spinule protruded from the margin.

The second leg (Fig. 25 j) consists of bimerous protopodite and trimerous rami. The protopodite is similar to that of the first leg. The endopodite is ornamented with 6 slightly curled plumose setae and 2 spines fringed with thin hyaline flanges: the first segment with 1 medial seta; the second segment with 2 medial setae; the third segment with 3 medial setae and 2 spines (1 apical and 1 subterminal). The lateral margin of each segment is ornamented with hairs. The exopodite is about 1.4 times as long as the endopodite and bears 6 setae and 5 spines: the first segment with 1 lateral spine; the second segment with 1 medial seta and 1 lateral spine; the third segment with 5 medial setae and 3 spines (2 lateral and 1 apical).

The third leg (Fig. 25 k) is slightly longer and slender than the second,

with minute differences in armature, although the structure is comparable. The coxopodite bears 1 short plumose seta which nearly reaches the midpoint of the basipodite. The setation of the endopodite is decreased by 1 medial seta on the third segment from that of the second. The armature of the exopodite is like that of the second. Thus the endopodite has 5 setae and 2 spines and the exopodite bears 6 setae and 5 spines.

The fourth leg (Fig. 25 l) consists of bimerous protopodite and endopodite and trimerous exopodite. The protopodite and exopodite are as in those of the third leg in structure and armature. The endopodite bears 4 setae and 2 spines: the first segment with 1 medial seta and the second segment with 3 medial setae and 2 spines (1 terminal and 1 subterminal).

The fifth leg (Fig. 25 m) consists of 2 parts: the basal element is coalesced with the body proper and formed into a small protrusion from the distolateral margin; it is set with 1 short simple apical seta. The distal element is a small subconical lobe, indistinctly articulated with the basal, and bearing 2 short, slender simple setae on the rounded apical margin.

The sixth leg (Fig. 25 n) is represented by 2 short simple setae placed side by side near the distal margin of a feebly defined cuticular ridge.

The caudal ramus (Fig. 25 o) is about 2.2 times as long as wide, bearing 2 characteristic terminal setae, 1 stout lateral spine at the distal fifth, 1 short dorsal seta at the distal third and 1 similar lateral seta midway on the margin. The medial terminal seta is slightly longer than the ramus, about 1.4 times the length of the lateral terminal seta.

Remarks: The female is distinguished from all other *Haplostoma* females in the following features: (1) the mandible is elongate, with 3 terminal setae; (2) the maxilla is present; (3) the fifth leg bears 3 terminal setae besides 1 basal seta; (4) the genital apparatus is characteristically developed.

The male belongs to the creeping type, with that of *H. ambiguum*, and is distinguished from the latter as follows: (1) the body is rather thicker (depressed in *H. ambiguum*); (2) the antennule bears many aesthetes, more than twice the number of those in *H. ambiguum*; (3) the proximal 2 spines of the antenna are extremely small (all the spines are subequal in length in *H. ambiguum*); (4) the mandible has 3 setae (2 setae in *H. ambiguum*); (5) the endopodite of the first leg has 5 setae (lacking the setae in *H. ambiguum*).

The present species has 2 ascidian hosts, *Amaroucium ?constellatum* and *A. propinquum*. There is a striking difference in the live female specimens from these hosts. The specimens from *A. ?constellatum* have a yellowish gut and white eggs instead of orange gut and lavender pink eggs of the associates of *A. propinquum*. Moreover, the specimens from *A. ?constellatum* are distinguished from the specimens from *A. propinquum* by some minutely different anatomical details as follows: the maxilla has 2 seta (1 or 2 setae in the specimens from *A. propinquum*); the distal surface of each spine of legs is ornamented with bristle-like elements (the elements indistinct in the specimens from *A. propinquum*). At the first sight, these differently

colored associates seem to be different species. However, these colors or anatomical characteristics mentioned above are not sufficiently definite factors for distinguishing them as 2 different species.

In the live male specimens inhabiting *A. propinquum,* the body has a clear orange color, marked by many brownish pigment spots, whereas the specimens from *A. ?constellatum* are much lighter in the body color with the pigment spots fewer in number. As previously mentioned there are also some minutely different anatomical details as to the number of aesthetes of the antennules.

This species is generally a dweller in undefined positions in the matrix of the ascidians. However, one of the specimens from *A. ?constellatum* was found in the intestine of a zooid. Other copepods associated with these ascidians are listed in Table 3.

Genus *Haplostomides* Chatton & Harant, 1924

Enterocola (part), T. & A. Scott, 1895, pp. 359–360.

Apolstoma (part), Brément, 1909, pp. 84, 85.—Chatton & Brément, 1909b, p. 228; 1910, pp. 84–86.—Schellenberg, 1922, pp. 288, 289.

Haplostoma (part), Chatton & Harant, 1924b, p. 363.—Gotto, 1959, p. 10.

Cryptopodus (part), Blake, 1929, p. 6; 1933, p. 226.

Haplostomides, Chatton & Harant, 1924d, pp. 406–412 (type species, by original designation, *H. scotti* Chatton & Harant, 1924); 1924e, p. 418.—Harant, 1931, p. 371.—Wilson, 1932, p. 600 (in key).—Neave, 1939, p. 570.—Gotto, 1952, p. 674; 1954, pp. 665, 666; 1960, pp. 213, 216; 1966, p. 193; 1970, p. 271.—Ooishi & Illg, 1974, p. 365.

Diagnosis: In the female the habitus is not generically distinctive; in general regionalization and configuration there is a strong resemblance to *Haplostoma.*

The antennules and antennae are like those of *Haplostoma.*

The mandible is diagnostic. It is an unsegmented or 2-segmented lobe bearing 1 to 3 apical setae. In the 2-segmented structure the basal segment represents the protopodite and has a medial projection which may be spiniform or may take the form of an articulated setiform element. The distal portion of the appendage probably represents one of the rami. There may be cuticular constrictions, perhaps suggesting component segments.

The maxillule is distinctly diagnostic. It is basically readily derived from the generalized cyclopoid type. There is a medial basal expansion, presumably a gnathobase, set with a longitudinal row of several setae. A distal setiferous lobe, usually not clearly articulated, represents the palp, with all its segmental elements coalesced. This element bears 4 or 5 setae, variously developed and placed on the margin. We interject here our conviction that the basal lobe and spine depicted by Chatton and Harant (1924d, p. 408, fig. 1, p. 411, fig, 2) on this appendage for their species, *H. scotti* and *H. brementi,* actually represent the basal element of the mandible displaced in the course of the exceedingly difficult dissection necessary to expose these minute and modified appendages. The appendage may be more reduced in structure and armature in some species.

The maxilla is a reduced lobe with the armature of 2 to 4 variously developed

elements on the margin.

The maxilliped, legs 1 to 5, the oviducal apparatus and caudal ramus do not distinguish the species generically from those of *Hoplostoma*.

The male is not yet known for any of the species. One male specimen in our hands, without host identification and without association with a known female, suggests, however, we have a species of *Haplostomides*. This specimen is much like a male of *Haplostoma* but has substantially developed maxillules, although all the other appendages are as in *Haplostoma* males.

Key to Species of *Haplostomides*, based on Females

1a. Armature of terminal segment of antenna consisting of 2 spines..... ..... *hibernicus* (T. & A. Scott, 1895)
1b. Armature of terminal segment of antenna consisting of 4 spines..... 2
2a. Maxilla with 4 setae ..... *luteolus* n. sp.
2b. Maxilla with 2 or 3 elements of armature..... 3
3a. Maxilla with 2 setae 4
3b. Maxilla with 3 variously developed elements of armature..... 5
4a. Mandible with 3 apical setae ..... *scotti* Chatton & Harant, 1924
4b. Mandible with 2 apical setae ..... *brementi* Chatton & Harant, 1924
5a. Mandible with 3 apical setae ..... *amarouci* (Blake, 1929)
5b. Mandible with 2 apical setae ..... *bellus* n. sp.

Haplostomides amarouci (Blake, 1929)

Cryptopodus amarouci, Blake, 1929, p. 6, fig. 1 (type locality, Mount Desert Island, Maine, U.S.A., from *Amaroucium glabrum*?, paratype from *Tetradidemnum albidum*); 1933, p. 226.
Haplostoma amarouci, Gotto, 1959, p. 10.
Haplostomides amarouci, P.L. Dudley, unpublished, from Dr. Dudley's personal communication in 1976.

Haplostomides brementi Chatton & Harant, 1924

Haplostomides brementi, Chatton & Harant, 1924d, pp. 410–412, fig. 2 (type locality, Argelès, Golfe du Lion, France, from *Aplidium coeruleum* Lahille? (*A. coerulum* Lah? in the original paper probably a misprint by Chatton & Harant)); 1924e, p. 418.—Harant, 1931, p. 371.—Gotto, 1960, p. 227.

Haplostomides hibernicus (T. & A. Scott, 1895)

Enterocola hibernica, T. & A. Scott, 1895, p. 360, pl. XVII, figs. 3–8 (type locality, Valentia, Ireland, from an ascidian).
Aplostoma hibernica, Brément, 1909, pp. 84, 85; Chatton & Brément, 1909b, p. 228; 1910, pp. 84–86, 89, 91, figs. III, V(4).—Schellenberg, 1922, pp. 288–289 (in key).—Salfi, 1926, p. 1.—Sewell, 1949, p. 188.
Haplostoma hibernica, Chatton & Harant, 1924b, p. 363.
Haplostomides hibernicus, Chatton & Harant, 1924d, pp. 406–407; 1924e, p. 418.—Harant, 1931, p. 371. —Gotto, 1952, p. 674; 1954, p. 666; 1960, pp. 216, 222, figs. 8, 13; 1966, p. 193.

Haplostomides scotti Chatton & Harant, 1924

Haplostomides scotti, Chatton & Harant, 1924d, pp. 406–410, fig. 1 (type locality, Penpoull (Roscoff),

France, from *Polyclinum aurantium* Milne-Edwards); 1924e, p. 418.—Harant, 1931, p. 371.—Gotto, 1952, p. 674; 1954, p. 665; 1960, pp. 216, 222; 1966, p. 193.

Species incertae sedis

Haplostomides beaumonti (T. & A. Scott, 1895)

Enterocola beaumonti, T. & A. Scott, 1895, pp. 359–360, pl. XVI, fig. 9, pl. XVII, figs. 9–12 (type locality, Valentia, Ireland, from a dredged ascidian).
Aplostoma beaumonti, Brément, 1909, pp. 84, 85.—Chatton & Brément, 1909b, p. 228.—Schellenberg, 1922, pp. 288, 289, 294 (from *Botryllus schlosseri* (Pall.)).—Sewell, 1949, p. 188.
Haplostoma beaumonti, Chatton & Harant, 1924b, p. 363.
Haplostomides beaumonti, Chatton & Harant, 1924d, pp. 406–407; 1924e, p. 418.—Gotto, 1954, p. 665.

We are very unsure of this species. When Schellenberg (1922) examined a specimen which lacked mandibles and maxillae, taken from *Botryllus schlosseri*, he named it *Aplostoma beaumonti* (T. & A. Scott, 1895). Chatton and Harant (1924d) pointed out that in general features Scott's species could be very close to one or the other of 2 similar species, *Haplostomides scotti* Cha. & Ha., 1924 and *H. brementi* Cha. & Ha., 1924; in their succeeding paper (1924e) this species was noted as a doubtful species. Gotto (1954) indicated that it might be a possible synonym of *H. scotti*. But since the head appendages in the original description are incompletely described there is no valid basis for a decision as to whether to assign it to *Haplostoma* or to *Haplostomides*.

Haplostomides bellus, new species

(Figs. 26–27)

TYPES: Holotypic female, USNM 169517 (type locality, Whiffin Spit, Sooke, British Columbia, June 29, 1965, from *Sigillinaria aequali-siphonis* (Ritter & Forsyth); all other specimens listed below.

SPECIMENS EXAMINED:
BRITISH COLUMBIA
From *Sigillinaria aequali-siphonis* (Ritter & Forsyth)
Whiffin Spit, Sooke, 48°21′N., 123°43.9′W., lowest intertidal, June 29, 1965, 1 female (holotype), July 27, 1965, 2 females (specimens no longer exist).

DESCRIPTION: Female: The body (Fig. 26 a–c) is rather elongate, of cylindrical appearance, with the total length including the caudal rami about 2.1 mm in a representative specimen. As in many haplostomins, the body is contractile, so measurements of length will vary according to the degree of constriction. The egg sacs are usually shorter than the body, with relatively large eggs packed in several series within the transparent thin walls. The body is divided into cephalosome, metasome and urosome, with their proportional lengths about 1: 6: 1.1. The relatively small cephalosome (Fig. 26 d) has a small triangular rostrum anteroventrally and 6 pairs of appendages: antennules, antennae, mandibles, maxillules, maxillae and maxillipeds. Dorsally the cephalosome is sclerotized, forming an apical plaque. However, the configuration of the plaque is indistinct in dorsal view, because the anterior part is strongly directed ventrally.

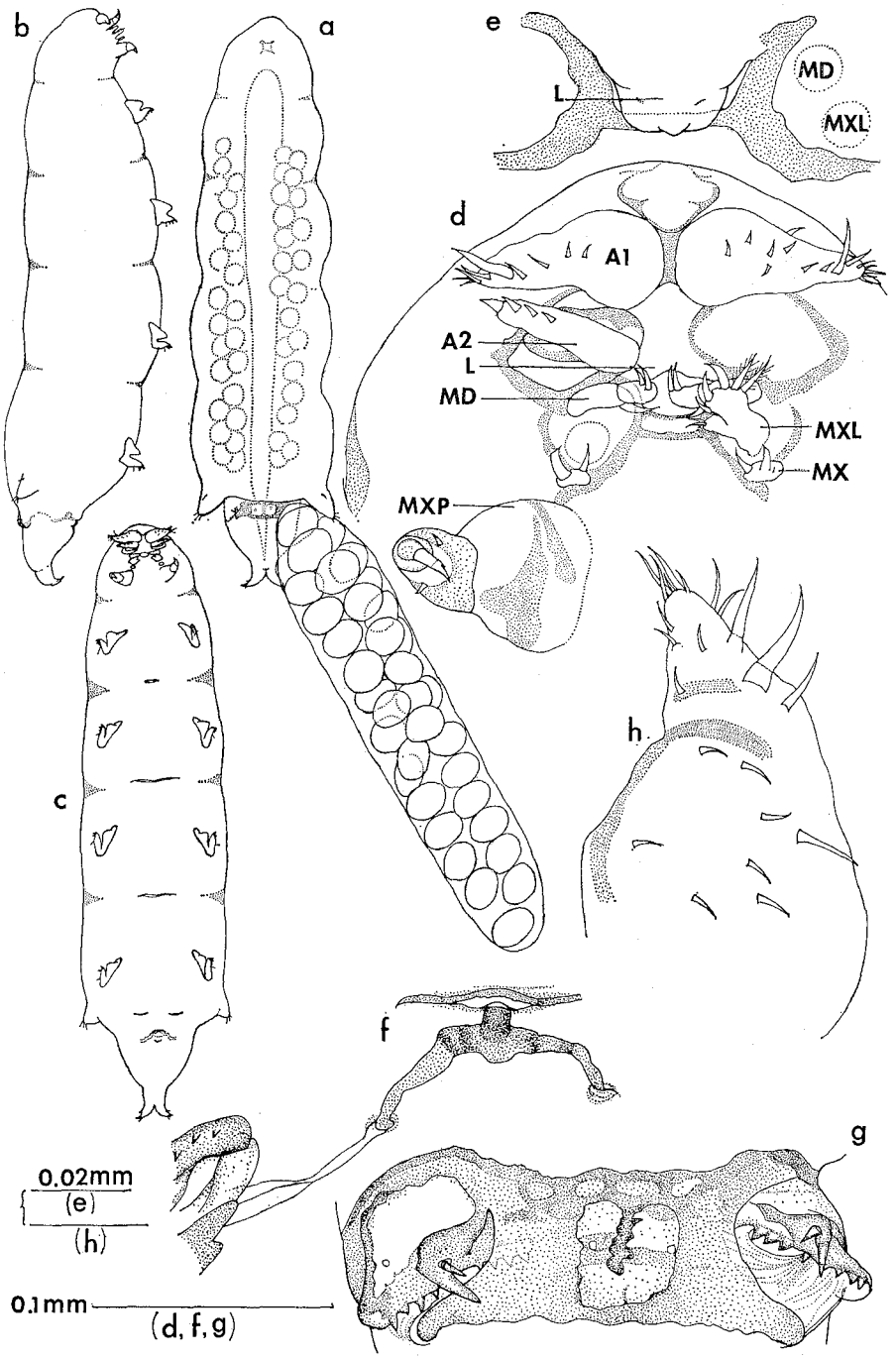


Fig. 26. *Haplostomides bellus*, n. sp., female: a, dorsal; b, lateral; c, ventral; d, oral area; e, labrum; f, insemination apparatus; g, apparatus at oviducal apertures, including dorsal sclerotized area; h, antennule. Key to abbreviations: A1, antennule; A2, antenna; L, labrum; MD, mandible; MX, maxilla; MXL, maxillule; MXP, maxilliped.

The metasome is separated by slight indentations into 4 sections: a small midventral sclerotization is placed at the posterior limit of each of the first 3 sections, actually segments, and there are similar but paired sclerotizations at the end of the actual fourth segment. The last section is a complex of the actual fourth segment coalesced with the fifth leg-bearing element; the fifth legs are represented in part by distal lateral cones protruded from the element.

The urosome is of funnel-shaped appearance, tapering posteriorly and bearing the caudal rami. The broad proximal part bears the insemination apparatus (Fig. 26 f, g), which consists of a small insemination pore situated midventrally, distinct internal seminal tubes from it, a pair of oviducal apertures dorsally, and a broad dorsal sclerotization between the apertures. A single midventral seminal tube (Fig. 26 f) is directed toward the dorsal side and shortly diverges laterally, connecting with the oviducal apertures within the urosome. Each lateral tube makes a coil and has a thick wall. Behind the coiled portion the wall becomes much thinner. The oviducal aperture is covered by a fold with 10 spines on the medial free margin (Fig. 26 g): 1 large spine protrudes from about the middle of the margin and 1 small spine is set close to its anterior base; the remaining 8 small spines are arranged in a row at fairly regular intervals along the more inner edge. The dorsal sclerotization is much wider than long, enclosing a relatively small less sclerotized depression. The depression is set with a pair of minute bulges, probably with hairs.

The body color is white, somewhat yellowish in the metasome, with a small reddish eye and narrow yellow gut. The eggs in the ovisacs are pale purple in color.

The antennule (Fig. 26 h) is a conical lobe with 1 large conspicuous seta at the distal fourth on the anteroventral margin, about 10 smaller marginal setae proximal to the large one, and also 11 short setae on the apical margin. These setae are all non-plumose.

The antenna (Fig. 27 i) is composed of 3 segments: the first segment is wider than long; the second segment is about 3 times as long as the first and tapers slightly; the third segment is narrow, as long as the second. The ornamentation consists of 4 spines on the third segment; 3 at fairly regular intervals along the distal half of the medial margin and 1 at the apex. These spines increase in size from proximal to distal.

The labrum (Fig. 26 e) is a prolonged blunt lobe with a subtriangular projection midway on the free margin.

The mandible (Fig. 27 j) is roughly divided into 2 parts: the basal part is segment-like, as long as the distal portion, and its mediodistal corner (Fig. 27 k) is protruded into a large broad spine; the distal portion tapers gradually and shows an indication of subdivision into 3 regions, the most distal with 2 apical non-plumose setae. There are 2 spinules near the setae. The appendage is located in front of the maxillule within a circular sclerotized framework at the side of the mouth-opening (Fig. 26 d, e).

The maxillule (Fig. 27 l) is composed of an unsegmented basal protopodite and a rounded distal palp. The medial margin of the protopodite is protruded medially

into a lobe set with 5 non-plumose setae. The palp has 5 setae; 3 of them are non-plumose, placed on the apical margin, and the remaining 2 are plumose, on the lateral margin. There are also some fine hairs inserted on the apical margin.

The maxilla (Fig. 27 m) is a subconical lobe, with 1 strong spine at the apex, 1 slender seta medially and 1 setule near the spine on the anterolateral margin.

The maxilliped (Fig. 27 n) is typical for the genus (and for *Haplostoma*) with the same basic structure and armature. The second segment of the 3-segmented appendage bears 2 well-developed setules on the medial margin. The slightly bi-

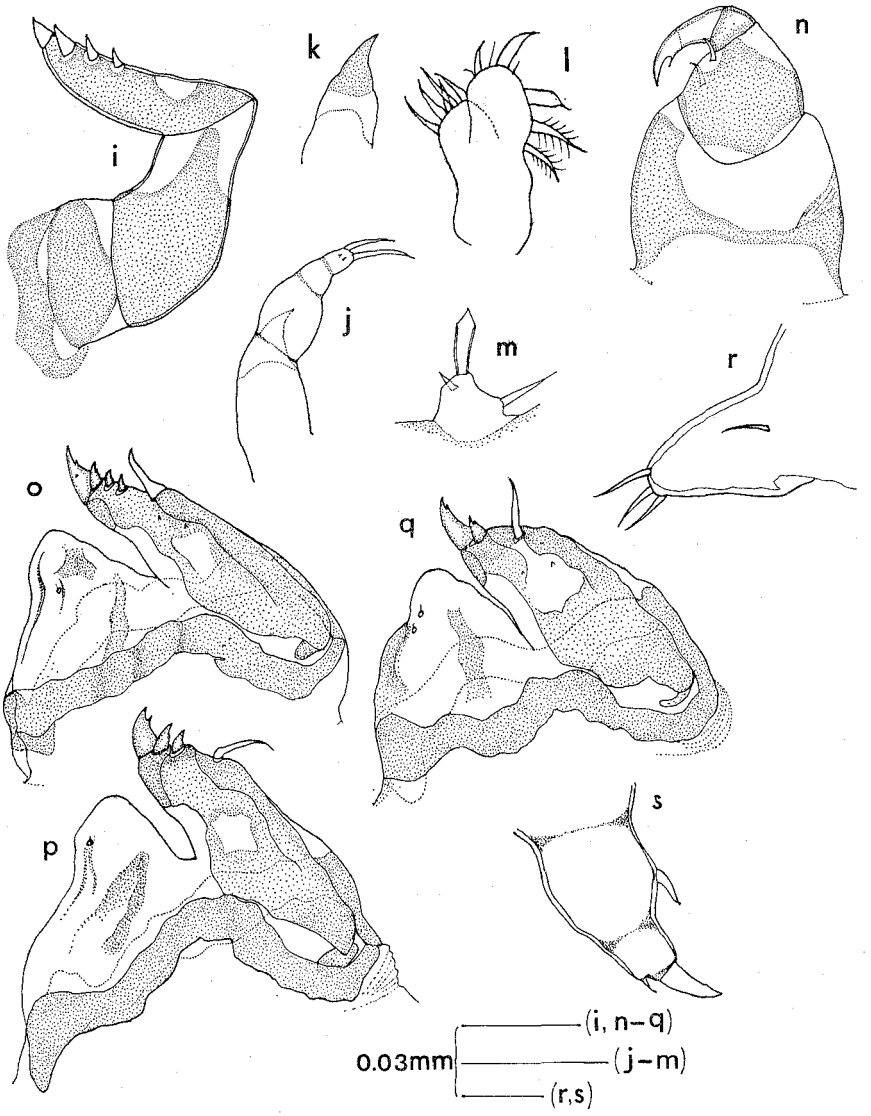


Fig. 27. *Haplostomides bellus*, n. sp., female: i, antenna; j, mandible; k, same, apical point of basal segment; l, maxillule; m, maxilla; n, maxilliped; o, leg 1; p, leg 2; q, leg 3; r, leg 5; s, caudal ramus.

furcated terminal claw on the third segment is narrow and subdivided by an articulative line at about the middle.

The first to fourth legs (Fig. 27 o–q) consist of unsegmented protopodites, without distinct articulations with the body, and rami. The protopodite is probably represented by an oval sclerotization surrounding the base of the appendage, and the width is about 1.3 times the length of the exopodite.

The endopodites from the first to fourth are the same in structure, each consisting of a well-developed conical lobe, which is protruded from the protopodite and with a few hairs growing on tiny mammiform bulges scattered near the apex.

The exopodite of each leg is sclerotized laterally and articulates fairly distinctly with the protopodite. The ramus gradually tapers and lacks a marked lateral process on the margin. The first exopodite (Fig. 27 o) has 1 short, stout simple seta at the distal fourth and, distal to the seta, 4 spines along the lateral margin and at the apex: 1 spine at the apex is the largest and is slightly bifurcated at the tip; 1 similar but much smaller spine is closely set at the lateral base of the apical spine; the remaining 2 small simple spines are arranged at fairly regular intervals along the distal half of the margin between the lateral seta and the above-mentioned 2 spines. The second exopodite (Fig. 27 p) is reduced by 1 lateral spine from the preceding ramus, including 3 spines (1 apical, 1 distolateral and 1 lateral) and 1 lateral seta. In the third and fourth exopodites (Fig. 27 q), each is again reduced by 1 lateral spine from the second exopodite, bearing 2 spines (1 apical and 1 distolateral) and 1 lateral seta.

The fifth leg (Fig. 27 r) is represented by a distinct lateral cone set with 4 short simple setae: 3 setae at the apex and 1 seta dorsally at about the base of the cone.

The caudal ramus (Fig. 27 s) is twice as long as its basal width and is directed rather ventrally. The distal fourth of the ramus is narrow, cylindrical and half as wide as the greatest basal width. The ramus bears 1 strong terminal claw, 1 setule at the mediodistal corner and 1 short simple seta midway on the lateral margin.

REMARKS: The present species closely resembles in habitus and many anatomical details copepod specimens from *Amaroucium glabrum* collected by P. L. Dudley, from off Cape Cod, Massachusetts, and the coast of Maine. The present species is distinguished from the Atlantic specimens, *H. amarouci* redescribed by Dudley (unpublished), by having the mandible with 2 apical setae (3 setae in the Atlantic specimens), the maxillule with 5 setae on the apical ramus (4 setae in the Atlantic specimens), and the oviducal fold with 10 spines in all (7 spines in the Atlantic specimens). It is noted that *A. glabrum* from the waters of the San Juan Archipelago and British Columbia is associated with 4 kinds of haplostomins (see Table 3) but never involves *H. amarouci*. The male of the present species is unknown.

Haplostomides luteolus, new species

(Figs. 28–29)

TYPES: Holotypic female, USNM 169518 (type locality, Whiffin Spit, Sooke,

British Columbia, June 29, 1965, from *Amaroucium glabrum* Verrill; paratypes and all other specimens listed below.

SPECIMENS EXAMINED:

BRITISH COLUMBIA

From *Amaroucium glabrum* Verrill

Whiffin Spit, Sooke, 48°21'N., 123°43.9'W., lowest intertidal, June 29, 1965, 18 females (including holotype and 5 females, USNM 169519), Aug. 27, 1965, 7 females.

DESCRIPTION: Female: The body (Fig. 28 a, b, c) is cylindrical and of vermiform appearance with a slight dorsal curvature, and is indistinctly divided into cephalosome, metasome and urosome. The body is characterized by the relatively elongate metasome between the relatively small cephalosome and urosome, with their proportional lengths about 1: 7: 1.2. The body length of a representative specimen is about 1.7 mm, measured from the anteriormost to the end of the caudal rami. The egg sacs are slightly longer than the body, with relatively large eggs within their transparent thin walls.

The cephalosome is somewhat depressed in the anterior dorsal region and sclerotized. The sclerotization (Fig. 28 d) has about 30 tiny mammiform bulges (probably with hairs) which are scattered on the surface. There is not a distinct rostrum but the structure is indicated by a subtriangular swelling (Fig. 28 e) with a finely denticulated and sclerotized margin between the antennules. A small median eye is located anteriorly within the cephalosome. The head appendages (Fig. 28 f, g) consist of antennules, antennae, mandibles, maxillules, maxillae and maxillipeds. The anterior 5 pairs of these are arranged in a close spatial relationship to the labrum.

The metasome is demarcated from the cephalosome by an integumental indentation and divided into 4 sections. These sections, the anterior 3 of which are segments, are separated by indentations and also marked by midventral sclerotizations, each of which consists of 1 longitudinal and 2 transverse short narrow lines. The 4 sections gradually increase in length from the first to fourth. Each section has a pair of thoracic legs located somewhat posteriorly, and with the 2 members of the pair well separated from each other on the ventral surface. The posterolateral limits of the fourth section are protruded into very small rounded cones coalesced with the reduced fifth legs. Thus the last metasomal section includes the 2 elements for the fourth and fifth legs. The element for the fifth legs is rather long anteriorly to the conical fifth leg projections, then appears posteriorly to continue directly without articulation as the short urosome.

The urosome tapers posteriorly; the genital apparatus lies in the anterior portion. A small insemination pore (Fig. 28 h) is midventrally placed, with ornamentation of 3 rows of small papilla-like bulges in front and rear of the pore, and is internally connected with a narrow seminal tube which diverges laterally. The covering structures of the oviducal apertures on the dorsolateral sides and the dorsal sclerotization between them (Fig. 28 i) are well developed. Each oviducal aperture consists of a long slit-like pore overlaid by a kidney-shaped fold. The fold is set with 14 spines

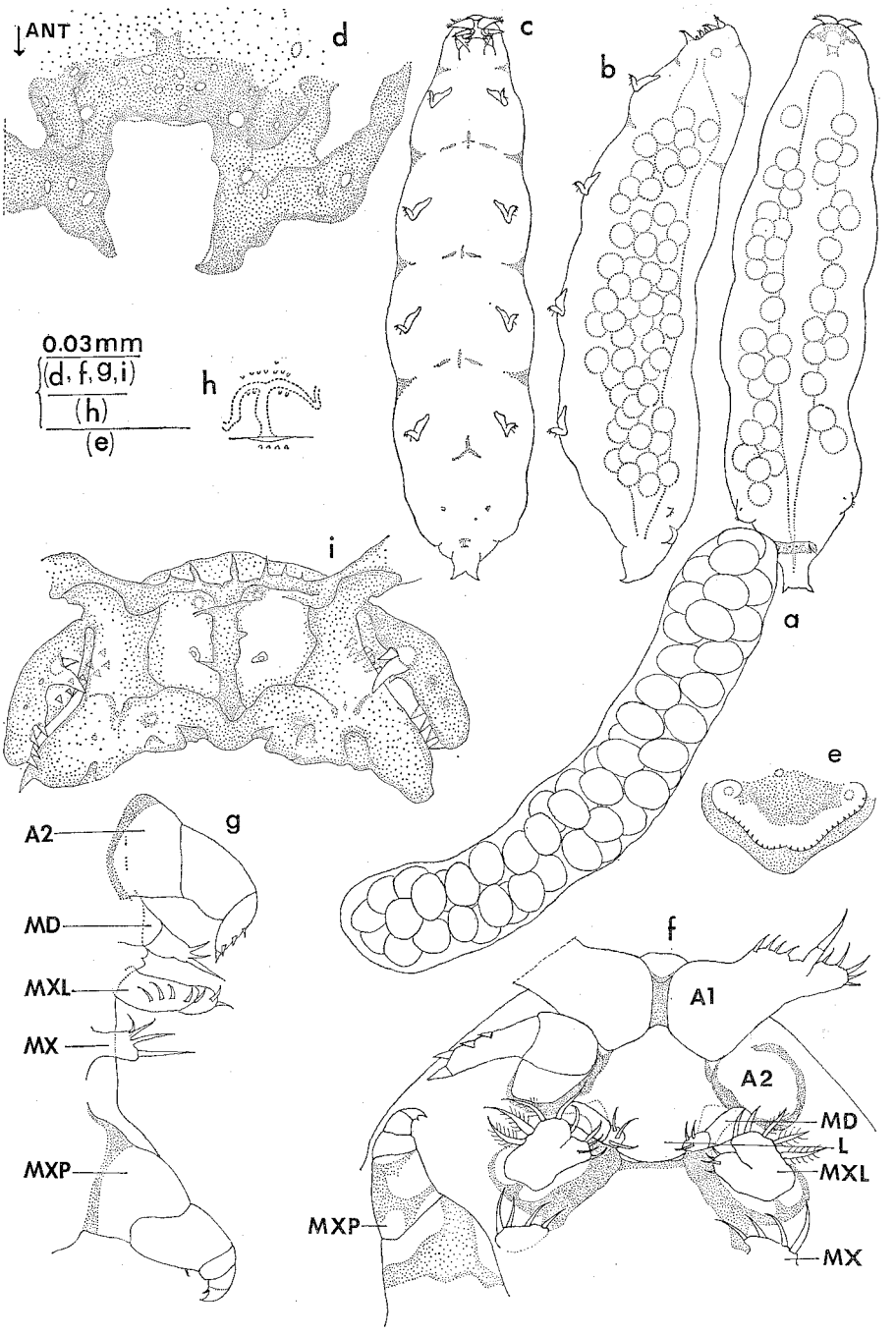


Fig. 28. *Haplostomides luteolus*, n. sp., female: a, dorsal; b, lateral; c, ventral; d, cephalic plaque; e, rostral swelling; f, oral area, ventral; g, same, lateral; h, insemination pore and adjacent area; i, apparatus at oviducal apertures, including dorsal sclerotized area. Key to abbreviations: A1, antennule; A2, antenna; L, labrum; MD, mandible; MX, maxilla; MXL, maxillule; MXP, maxilliped.

on the free margin: 4 small spines are placed in a row along the margin of the distal third of the fold; 2 spines (1 large and 1 small movable) are closely set on the margin at the proximal third, thus at some distance from the posterior spines; 8 small spines are more proximally arranged in 2 rows on the more inner edge covered by the lateral margin of the dorsal sclerotization. Some parts of the fold apparatus and doubtless all or some of the ornamenting spines furnish a firm attachment for the egg sac. The dorsal sclerotization is subrectangular and strongly textured with folds and indentations, enclosing a pair of less sclerotized irregularly rectangular fields. There is a tiny hair set centrally within each of the enclosed areas.

The distal third of the urosome is narrow and cylindrical: terminally it bears, without distinct articulation, a pair of small caudal rami, the tips of which are ventrally directed.

The general body color is yellow or yellowish orange with an orange eye and gut. The eggs in the ovisacs are pale purple or yellowish (before hatching).

The antennule (Fig. 29 j) is a tapered lobe, retaining setiform elements as the armature. There are 15 short setae arranged along the anterior margin and at the apex. One of the setae at the distal fourth is distinctive, massive and arising from a bulge on the surface.

The antenna (Fig. 29 k) consists of 3 segments with their proportional lengths from proximal to distal about 1: 2: 2. The basal segment is wider than long, and is basally reinforced by a sclerotized marginal bar on the body. The second segment is longer than wide and from the distal half gradually tapers apically. The third segment is narrow and subcylindrical, basally with the same width as the apex of the second. The armature is composed of 4 spines; 3 at fairly regular intervals along the distal half of the medial margin and 1 at the apex. These spines increase in size from proximal to distal.

The labrum (Fig. 28 f) shows very little protrusion.

The mandible (Fig. 29 l) consists of 2 segments. The first segment is cylindrical and slightly longer than wide, probably representing the protopodite, with 1 seta at the mediodistal corner. The second segment is smaller than the first and the distal half is abruptly bent laterally and tapers gradually. The apex is broadly rounded and bears 3 equal, long, non-plumose setae.

The maxillule (Fig. 29 m) retains to a degree the structure and armature of the generalized cyclopoid type. The appendage consists of a basal protopodite including a gnathobase, which is protruded medially, with 5 non-plumose setae along the medial margin, and a distal element, possibly one of the distal rami, with 5 setae. Two of the setae on the distal element are non-plumose, placed on the medial margin; the more proximal of these is extremely short. The remaining 3 setae on the element are large and plumose, arranged at the apex and the lateral margin.

The maxilla (Fig. 29 n) is a truncated cone with the lateral margin twice as long as the medial. The flat apex has 4 graduated non-plumose setae arranged in a row.

The maxilliped (Fig. 29 o) consists of 3 segments and a terminal claw, with the general pattern for that in the genus and in the *Haplostoma* females. The first segment

is the largest, with extensive sclerotized areas. The second segment is shorter and narrower than the first, with 2 setules on the medial surface; the surface between the setules is longitudinally depressed to receive the apical claw when it is flexed. The third segment is the shortest, wider than long, and articulates with the terminal claw. The claw has an articulative line at the middle and is slightly bifurcated at the tip.

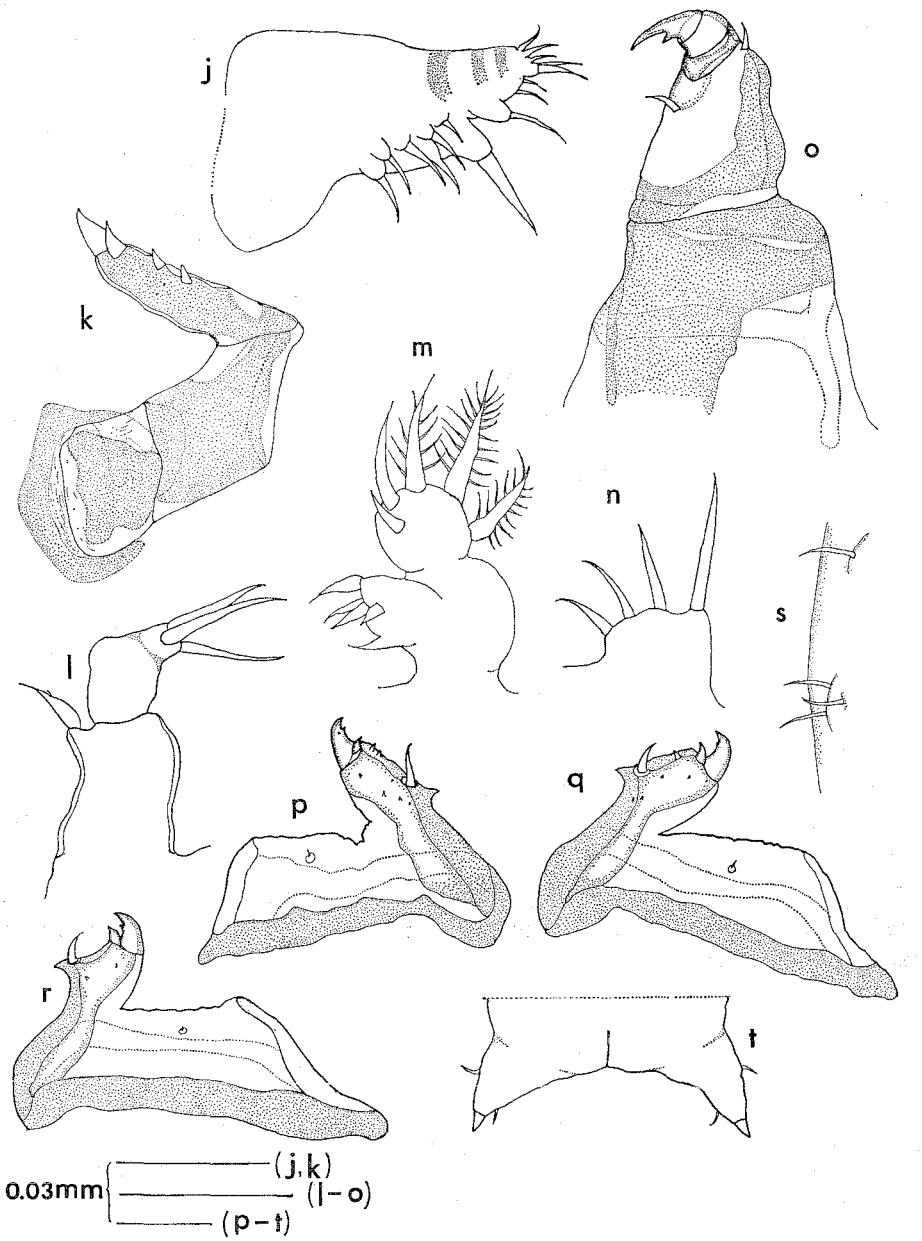


Fig. 29. *Haplostomides luteolus*, n. sp., female: j, antennule; k, antenna; l, mandible; m, maxillule; n, maxilla; o, maxilliped; p, leg 1; q, leg 2; r, leg 3; s, leg 5; t, caudal rami.

The first to fourth legs (Fig. 29 p–r) are composed of coalesced protopodites and rami. In each leg, the width of proximal oval sclerotized framework (?protopodite) supporting the rami is about 1.4 times the length of the exopodite.

The endopodites from the first to fourth, if present, are incorporated into the medial and apical margins of the protopodites and show the same structure in all 4 paired legs. Each has a flat and broad apex instead of the usual conical lobe. This apical margin is about half the width of the basal framework and laterally fused with the medial proximal half of the exopodite.

In the first to fourth legs, the exopodite is well sclerotized laterally and this lateral margin is protruded into a strong, somewhat curved, pointed process at the distal third. There is 1 short simple seta on the upper base of the process. The narrow apical margin is set with 1 wide-based stout spine, which is slightly forked laterally near the tip, and 1 much smaller simple spine closely set to the preceding at the distolateral corner of the ramus. In the first legs (Fig. 29 p), the exopodite has 2 more spines, which are extremely small and arranged at fairly regular intervals along the distal half of the lateral margin between the apical 2 spines and the lateral seta. The second exopodite (Fig. 29 q) is reduced by 1 of these lateral spines and the third and fourth exopodites lack these lateral spines. Thus the second exopodite has 3 spines and 1 seta whereas the third and fourth (Fig. 29 r) each has 2 spines and 1 seta.

The fifth leg (Fig. 29 s) is represented by an indistinct lateral cone located on the posterolateral corner of the metasome, with 4 short simple setae: a trio of setae are set around the apex and the remaining one at the anterior base of the cone on the dorsal side.

The caudal ramus (Fig. 29 t) is small, conical in shape, as long as the basal width, with 1 small terminal spine, 1 short simple medial setule at the distal fourth and 1 lateral setule midway on the margin.

Up to the present the male is unknown.

Remark: This species is a dweller in undefined positions in the matrix of *Amaroucium glabrum* from the lowest intertidal. The host ascidian may serve as host to 4 haplostomin species: the present species, *Haplosaccus elongatus*, *Haplostomella dubia* and *H. distincta*. The latter 3 species are also found in colonies of *A. arenatum* from deeper water of the San Juan Archipelago. However, the present species has never been found in it. Anatomically, this species is most saliently characterized by having the maxilla with 4 setae.

Genus *Haplosaccus* Chatton & Harant, 1924

Aplostoma (part), Chatton & Brément, 1910, pp. 86–92.—Schellenberg, 1922, p. 289.—Salfi, 1926, p. 1.
Haplostoma (part), Chatton & Harant, 1922, pp. 249, 251, 252.
Haplosaccus, Chatton & Harant, 1924e, pp. 413, 415, 419 (type species, by original designation, *Aplostoma sacculus* Chatton & Brément, 1910).—Harant, 1931, p. 371.—Wilson, 1932, pp. 600 (in key).—Neave, 1939, p. 569.—Gotto, 1960, p. 227; 1970, p. 271.—Ooishi & Illlg, 1974, p. 365.

Diagnosis: In the female the body is elongate, of cylindrical appearance, with

the regionation obsolete. There are no protrusions or duplicatures of the general body surface. The urosome is not definitely demarcated; it is indicated only by the positions of the fifth legs, the oviducal apertures and the insemination pore, and by the associated cuticular developments.

The rostrum is characteristically developed.

The antennules are characteristicaly short, of conical apearance, with segmentation not clearly indicated, and with ornamentation consisting mainly of elements perhaps representing setae arranged in characteristic circular patterns.

The antennae are characteristic and 3-segmented. The ornamentation is represented by 1 or 2 stout spiniform elements on the terminal segment: the apical spine is very stout, continuing the taper of the terminal segment, with distinct articulation on the segment; the proximal spine, when present, is inserted near the base of the apical spine.

The mandibles are characteristic, each consisting of a cylindrical lobe, terminally bilobed. The armature is absent.

The labrum is not particularly prominent.

The maxillules and maxillae are reduced, represented by rounded firm lobes without actual setae or spines. However, early copepodid stages demonstrate substantial and even setiferous lobes in the usual positions. The conclusion reached is that the appendages are in a very regressed state in the adult but have not actually disappeared.

The maxillipeds are like those of the *Haplosotma* females, but with a more slender apical claw on the terminal segment. The proximal second segment lacks the usual 2 setules.

The first to fourth pairs of legs are very characteristic. There is no clear articulation on the body and the protrusion representing each leg is tapered from a wide base, which is prolonged medially and laterally. The long, sloping medial and lateral margins support internal structures, probably muscle strands, and are well cuticularized on the surface. The usual leg structure for *Haplostoma* or *Haplostomides* females is present distally, consisting of unsegmented rami supported by a sort of framework representing the protopodite, at least, in part. The edopodite is a small subconical lobe with 1 or 2 apical setules. The armature of the exopodite is reduced, with 1 simple (1 spine) or 1 deeply bifurcated (2 spines) claw-like element at the tip of the ramus; the usual lateral seta is absent.

The fifth legs are vestigial, each probably represented by a small setule directly inserted on a slight bulge at the appropriate position on the body surface.

The oviducal apparatus is basically the same as that of *Haplostoma* and *Haplostomides* in structure and armature.

The caudal rami are minute and set terminally, with armature of highly modified elements.

Most of the mouthparts and the fifth legs were not described in the original characterization of the genus and its single original species, but they probably would have been discerned with more extended observation at higher magnifications.

The male is not known.

Key to Species of *Haplosaccus*, based on Females

1a. Antenna with 1 terminal spine; exopod of legs 1 to 4 with 1 simple claw-like element (1 spine) ..... *sacculus* (Chatton & Brément, 1910)

1b. Antenna with 1 terminal and 1 subterminal spine; exopod of legs 1 to 4 with 1 deeply and equally bifurcated claw-like element (2 spines) ..... *elongatus* n. sp.

Haplosaccus sacculus (Chatton & Brément, 1910)

Aplostoma sacculus, Chatton & Brément, 1910, pp. 86–92, figs. I(2), IV, V(2) (type locality, Port-Vendres, Golfe du Lion, France, from *Diplosoma spongiforme* Giard).—Schellenberg, 1922, p. 289.—Safi, 1926, p. 1.

Haplostoma sacculus, Chatton & Harant, 1922, pp. 249, 251, 252.

Haplosaccus sacculus, Chatton & Harant, 1924e, pp. 415, 419.—Harant, 1931, p. 371.—Gotto, 1960, p. 227.

Haplosaccus elongatus, new species

(Figs. 30–32)

TYPES: Holotypic female, USNM 169520 (type locality, Peavine Pass, San Juan Archipelago, Washington, July 22, 1965, from *Amaroucium arenatum* Van Name), paratype and all other specimens listed below.

SPECIMENS EXAMINED:

WASHINGTON

From *Amaroucium arenatum* Van Name:

Outside Turn Island, 48°32.1′N., 122°57.6′W., 25–5 fams., Sept. 15, 1965, 1 female; Peavine Pass, 48°34.9′N., 122°57.6′W., July 22, 1965, dredged, 1 female (holotype), Sept. 22, 1966, 1 female; Black Rock, 48°33′N., 122°45.9′W., Sept. 20, 1966, dredged, 1 female (USNM 169521).

BRITISH COLUMBIA:

From *Amaroucium glabrum* Verrill:

Whiffin Spit, Sooke, 48°21′N., 123°43.9′W., lowest intertidal, June 29, 1965, 5 females.

DESCRIPTION: Female: The body (Fig. 30 a, b) is elongate and of cylindrical appearance, with a distinct dorsal curvature. The length is 2–5 mm, measured along the body axis from the anteriormost extent of the cephalosome to the end of the caudal rami. This species has no integumental folds indicating segmentation. There are no distinct lateral cones representing the areas of the fifth legs. The regional demarcation for cephalosome, metasome and urosome is perceptible only by the slightly undulating body-outline, the positions of the appendages and the insemination apparatus. The cephalosome (Fig. 30 c, d, e) is extremely small, about 1/10 as long as the metasome, bearing antennules, antennae, mandibles, maxillules, maxillae and maxillipeds. These are characteristically situated at the anterior end of the body; the whole assemblage is only discernible in the anterior view of the cephalosome. There is a cylindrical lobe (postoral protrusion) with wide base, protruded from the midventral surface just behind the mouth-opening. Dorsally the cephalosome (Fig. 31 f) is well sclerotized as a butterfly-shaped apical plaque, with

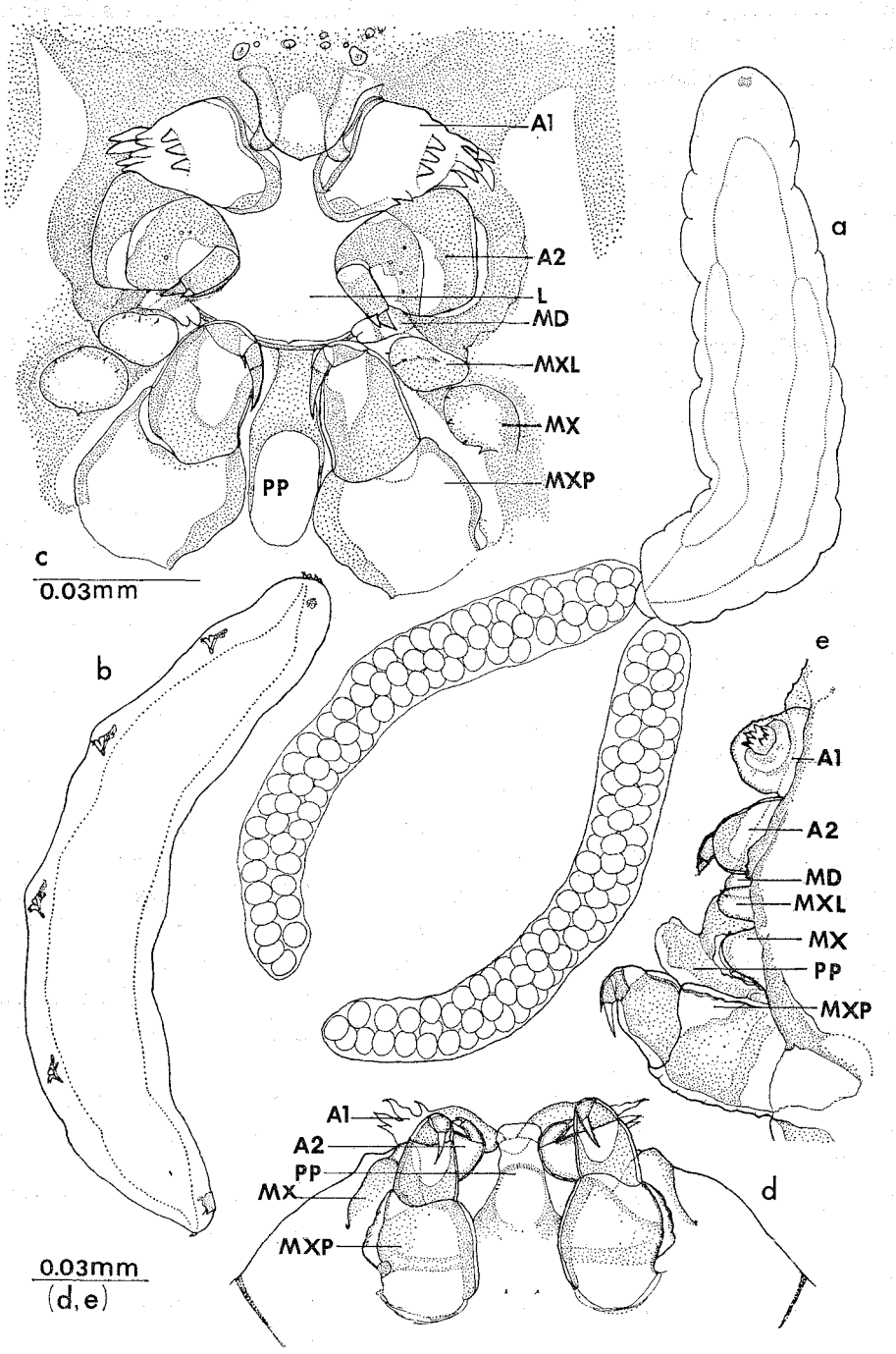


Fig. 30. *Haplosaccus elongatus*, n. sp., female: a, dorsal; b, lateral; c, oral area, anterior; d, same, ventral; e, same, lateral. Key to abbreviations: A1, antennule; A2, antenna; L, labrum; MD, mandible; MX, maxilla; MXL, maxillule; MXP, maxilliped; PP, postoral protrusion.

fine hairs arising on scattered tiny mammiform bulges. Behind the sclerotization the surface is ornamented with many similar protrusions, but the hairs on them are not always distinguishable.

The rostrum (Fig. 31 g) is characteristic, consisting of a rounded protrusion, the undersurface of which has a pair of sclerotized narrow bars. Each bar has a slight lateral curvature and is situated at the side of the rostrum; the distal half of the medial margin is serrated with 7 to 9 spinule-like processes and its distolateral corner also has 1 similar process. The distal fourth of the bar extends beyond the apical margin of the rostrum.

The metasome has 4 pairs of legs; each leg is basally supported by internal muscle strands, which are directed from the medial and lateral bases of the leg toward the outer body surfaces, diverging from each other. Thus the leg is protruded conically on the body surface. Each pair of legs is probably situated somewhat posteriorly on each segment as in the other haplostomins. The fifth legs are extremely reduced structures situated far behind the fourth legs.

The body region posterior to the fifth legs tapers gradually, representing the urosomal region. The middle part of the urosome is occupied by an insemination apparatus, oviducal apertures and a dorsal sclerotization. A small insemination pore (Fig. 31 h, i) is midventrally placed and internally connected with the narrow, short seminal tube, which shortly diverges into 2 large lateral tubes that finally reach the oviducal apertures. The oviducal apertures are dorsally placed at the sides and involve slit-like openings as well as flap-like folds over them (Fig. 31 j). Each fold (Fig. 31 k) has 7 strong spines along the proximal half of the medial free margin: the most distal of these spines is the largest and is accompanied by 1 small spine inserted anteriorly at its base; there is 1 much smaller spine on the same margin of the fold but set at a distance from the distal 2 spines; the remaining 4 spines are set in a row along the more inner edge. The dorsal sclerotization (Fig. 31 j) between the oviducal folds is thick and quadrilateral in shape without surface complexities, and encloses a pair of kidney-shaped, less sclerotized depressions. There is a pair of hairs growing from tiny mammiform projections from the surface between the depressions. The anterior margin of the sclerotized framework has 3 indentations whereas the posterior margin is smooth.

Terminally the urosome is pointed. The anus opens as a posterodorsal slit. The small caudal rami are fixed at the sides of the pointed urosomal end but somewhat ventrally.

The body color is yellowish white, or orange-like yellow, with a small red eye and large orange gut. Ova in the oviducts and embryos in the early stages in the egg sacs are pale purple.

The antennule (Fig. 31 g) is conical, with a distinct basal articulation and with a few transverse integumental folds, probably representing the suppressed segmentation. The appendage is markedly expanded on the anteroventral margin and ornamented with a patch of hairs growing on a limited area at the proximal third, 2 spinules near the hairs, and 5 seta-like or spine-like projections protruded from the

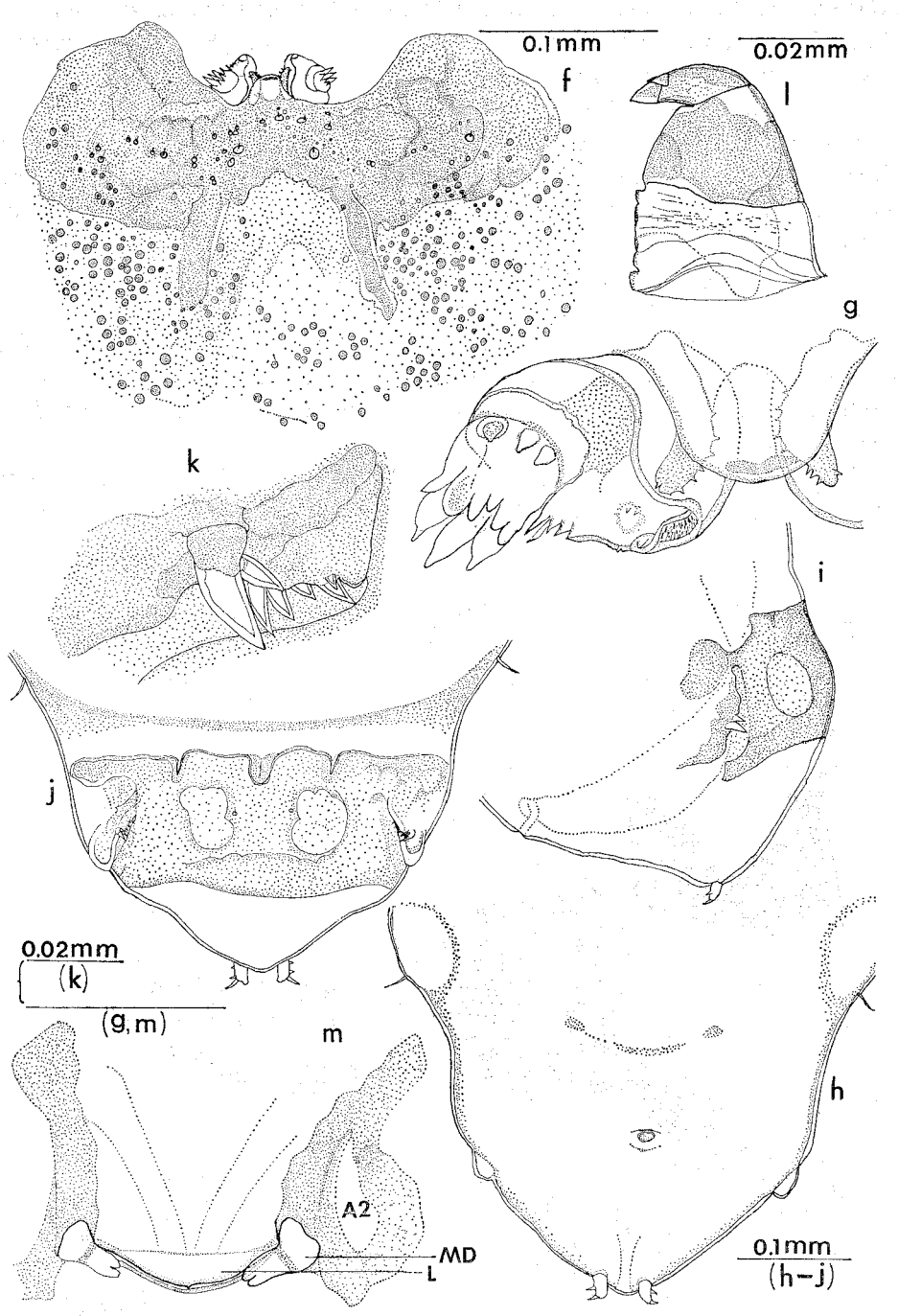


Fig. 31. *Haplosaccus elongatus*, n. sp., female: f, cephalic plaque; g, rostrum and antennule; h, urosome, ventral; i, same, lateral; j, same, dorsal; k, margin of fold covering oviducal aperture; l, antenna; m, labrum and mandibles. Key to abbreviations: A2, antenna; L, labrum; MD, mandible.

distal third on the margin. The distal narrow part is ornamented with about 12 lobule-like setae, which are arranged in a few transverse rows; 3 setae are protruded in a row proximally and the remaining setae are set around the apex.

The antenna (Fig. 31 l) consists of 3 segments: the first segment is about twice as wide as long, with regional sclerotizations; the second segment is as long as the first, with a marked taper apically; the third segment is narrow, twice as long as wide, with 1 stout spine at the apex and 1 similar but much smaller spine at the mediodistal corner.

The labrum (Fig. 31 m) is broad, with a slightly semicircular margin; at the middle the margin forms a minute posteriorly directed point.

The mandible (Fig. 32 n) is characteristic, of cylindrical appearance, with a slight taper apically. The length is about twice the basal width and the apex is divided into 2 rounded lobes. The appendage is sclerotized at about the middle and near the bases of the lobes.

The maxillules and maxillae (Fig. 30 c, e) are the same in structure and armature. The appendages are firm rounded lobes, situated between the mandibles and

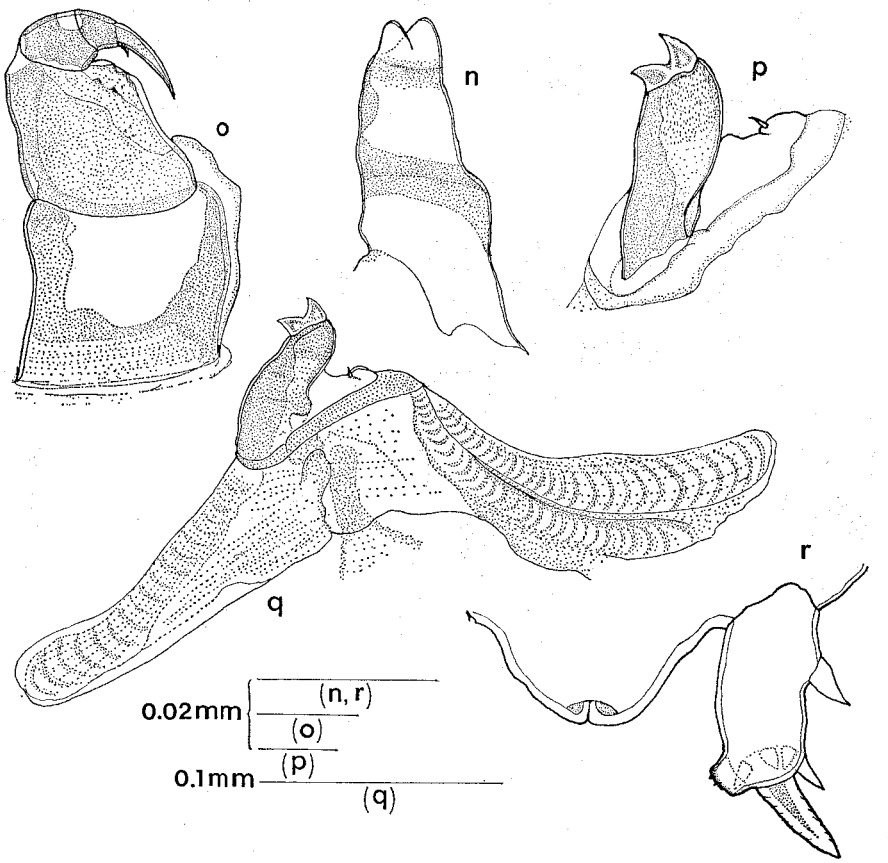


Fig. 32. *Haplosaccus elongatus*, n. sp., female: n, mandible; o, maxilliped; p, leg 2; q, leg 4; r, caudal ramus and anus.

maxillipeds but somewhat laterally, each with 1 or 2 transverse rows of fine spinules on the apical surface.

The maxilliped (Fig. 32 o) consists of 3 segments and an apical claw. The first segment is slightly wider than long, and the medial margin is fringed with a membranous cuticular flange. The second segment is longer than wide, slightly narrower than the first, with a marked taper apically; the medial distal margin is depressed to receive the flexed terminal claw, forming a depression with anterior and posterior margins sclerotized. Each sclerotized margin is protruded into a few spinule-like projections. There are several spinules on the posterior surface near the depression. The third segment is the smallest, as long as wide, articulated with the slender terminal claw, which is twice as long as the segment and with 1 spinule protruded from the medial margin near a sharply defined articulative line at the proximal third.

The first to fourth legs (Figs. 32 p, q) are the same in structure and armature, although the first legs are the smallest in size. Each is composed of much-modified, unsegmented protopodite, exopodite and extremely reduced endopodite. The protopodite is probably represented in part by an oval sclerotized framework surrounding the base of the leg. The framework is supported by long and broad internal muscle strands medially and laterally, producing a skirt-like appearance. The anterior surface between the medial and lateral muscle strands is well sclerotized. The endopodite is probably represented by a feebly developed medial conical lobe with a setule at the apex. The exopodite is slightly shorter than the width of the basal framework, laterally sclerotized, and set with a stout bifurcated claw-like element (2 spines) at the apex as in the third and fourth legs of some species of *Haplostoma* and *Haplostomides*.

The fifth leg (Fig. 31 h, j) is represented by a single short simple seta set directly on the body surface, which forms a small, somewhat swollen, round area surrounding the seta.

The caudal ramus (Fig. 32 r) is a cylindrical element about twice as long as wide, with the mediodistal corner protruded into a truncated protuberance. The ornamentation probably consists of 3 (or 6) elements: 1 large spine at the apex; 1 much smaller spine at the distolateral corner; (probably a row of 3 similar spines at the same level on the ventral side); and 1 somewhat smaller spine-like element at the proximal third of the lateral margin.

The male is so far unknown.

REMARKS: The genus *Haplosaccus* was created by Chatton and Harant (1924e) for the Mediterranean species, which was originally named *Aplostoma sacculus* by Chatton and Brément (1910). In the original description the authors remarked that 3 pairs of mouthparts (mandibles, maxillules and maxillae) and the fifth legs are absent or extraordinarily reduced. The present species, however, is furnished with all the above-mentioned appendages, although these usually can be recognized with difficulty because of their modified or shortened structure. In *H. sacculus* the features of the apical plaque, antennules, antennae, maxillipeds, thoracic legs and oviducal apparatus are very much like those of the present species. The present species is

distinguished from *H. sacculus* by having a slender body, about 5 times as long as the widest part (3–5 times in *H. sacculus*), and the exopodite with 1 deeply bifurcated claw-like element on the first 4 legs (1 simple claw-like element in *H. sacculus*).

This species is usually found in undefined positions of the matrix of 2 kinds of host ascidians, *Amaroucium arenatum* and *A. glabrum*. One of the specimens from *A. arenatum* was found in the intestine of a zooid.

Genus *Haplostomella* Chatton & Harant, 1924

Aplostoma (part), Chatton & Brément, 1910, pp. 82–84, 89–91.—Schellenberg, 1922, p. 289.—Salfi, 1926, pp. 1–4.—Sewell, 1949, pp. 174.

Rhabdomorpha, Fukui, 1965, pp. 61–63 (type species, by monotypy, *R. halocynthiae* Fukui, 1965).

Haplostomella, Chatton & Harant, 1924c, pp. 398–406 (type species, by original designation, *H. malacocera* Chatton & Harant, 1924); 1924d, pp. 404–406; 1924e, pp. 413, 417, 419–421.—Wilson, 1932, p. 601 (in key).—Neave, 1939, p. 570.—Gotto, 1969 (in Anderson & Rossiter), p. 464; 1970, pp. 267–272.—Ooishi & Illg, 1974, pp. 365–374.

Diagnosis: Female: The body form is variable, tending to elongation with a trend from elongated fusiform to stoutly subcylindrical. Body regions and segments are not clearly articulated but are suggested by indentations, folds—depending on the degree of contraction or extension, or shallow grooves, but only by an undulating body outline in some species. A head region may be indicated by a slight surface indentation but in some species there is no such indication. In the metasome there is a strong indication of a composition including 5 segments formed by the tendency to formation of dorsal protuberances or duplicatures, definitely placed in relation to the positions of limbs 1 to 5 and to the occurrence of a trio of strange cuticular protuberances laterally placed near the insertions of limbs 1 to 4; all of these elements may be lacking in some species. The urosome varies in aspect from indications of several segmental components to no apparent segmental indications. There may be a regular posterior taper or a substantial subterminal constriction forming a narrow end-piece supporting the caudal rami.

The antennules are not greatly distinctive but are relatively recognizable, possibly mostly on a specific basis, due to fair correspondence to the form in *Haplostoma*.

The antennae are characteristic, with segmentation not clearly apparent and armature modified. Setiform and, rarely, spiniform elements are present in a fairly distinctive pattern of insertion, but tending to feeble dimensions.

The labrum is characteristic for the genus, with the distal free margin concave to meet the convex distal margin of the labium.

The much reduced mandibles are characteristic; in most forms the appendage is a low protuberance with a single apical spiniform element, but rarely without the element. In some forms the appendage is palp-like with a small apical seta; in some others 2 articles are indicated, with a small seta on each article.

The maxillules are generally absent.

The maxillae are unsegmented as in those of *Haplostoma* males but in a more developed form ending in an unarticulated point with 1 or 2 apical setae. However,

some species have a more developed apex consisting of 2 protrusions, one of which may be setiform.

The maxillipeds are characteristically modified from the basic form for the subfamily, consisting of 2 large basal segments with a terminal claw complex. The second segment usually has 1 strong or modified spiniform or setiform element on the anterior margin near a protuberance from the mediodistal corner of the segment. The terminal claw complex has a fused basal portion which is typically seen as a separated third segment in other genera. This apical complex is opposed to the second segment in a subcheliform pattern.

The first to fourth legs are characteristic. The protopodite is not distinctly demarcated from the body surface nor into components. Usually a lateral seta, presumably referrable to the basipodite, occurs. The endopodites of the first to fourth legs are not articulated nor well defined; their presence is suggested by a projection from the protopodite, apically bilobed and fairly bulky in most species, simple but of fair size in some species. The exopodite is unsegmented but well articulated in a depression in the protopodite. Apically the ramus is bilobed in a most peculiar fashion: the anterior portion of the ramus forms a well sclerotized lobule terminating in a fairly sharp point; the posterior part of the ramus is a less sclerotized lobule with the usual armature of 1 or 2 distinct apical setae.

The fifth legs are reduced or lacking in some of the so far known species; when present the appendage may be a small lobe or a plate-like sclerotized area. The armature is variable, typically 2 or 3 reduced setae.

The oviducal apertures are marked by more or less circular areas including swellings, sometimes markedly conspicuous, and also sclerotized cuticular plates with folds. On the interior surface of the fold covering the oviducal aperture there is a row of 3 spines or tooth-like cuticular projections. There is no sclerotized dorsal area between the paired oviducal structures, but there are externally visible substantial internal muscle strands. On the ventral side, the insemination pore is very inconspicuous, and the associated internal structures are not usually visible.

The caudal rami are small and subcylindrical. The armature consists only of reduced setae, usually 4 or 5, varying in length; possibly setae are lacking entirely in some of the known species.

Male: The male of *Haplostomella* is known exclusively from 4 new species from our area. All are swimming forms, characteristic in habitus, and usually with eye and gut coloration resembling that of the female; sometimes with the same general body color as the female. The body regions and configurations correspond to the usual pattern for cyclopoid males.

The antennules are characteristic, 8-segmented, with a distinctive complement of prominent aesthetes besides setae and setules. There are 5 aesthetes, very long, transparent and placed one each on the proximal segments except the fifth segment. There may be a few additional smaller aesthetes distally. The number of setae and setules is varied specifically.

The antennae are characteristic for the genus, corresponding very well in anat-

omy and armature with that of the female.

The labrum is essentially the same as that of the female.

The mandibles show a slight dimorphism with minor specific variations. The same is the case for the maxillae, perhaps slightly more developed in the male than in the female, and for the maxillipeds.

The first through fourth thoracic legs approach the general cyclopoid type. In the first leg the usual medial spine and lateral seta of the basipodite occur, although the coxopodite lacks armature. The endopodite is slightly reduced, 1- to 3- segmented, with the armature reduced to only 2 spines and 1 seta. The exopodite is trimerous, with a more or less generalized armature of spines and setae.

The second to fourth legs are biramous, with trimerous rami and with a pattern of spines and setae varying specifically but rather generalized. In these legs the coxopodite lacks armature.

The fifth leg is a relatively reduced setiferous lobe not articulated on the body. The armature is 2 or 3 variously developed and variously placed setae sometimes accompanied by additional setules or spinules.

The sixth leg is probably represented by a simple structure with 3 elements on the distal margin of the flap over the genital orifice; usually the most lateral element is a seta and the others are spinule- or spine- like elements.

The caudal ramus is characteristic for the genus. The ramus is shortened, with 2 long apical setae with distinct hyaline flanges, 2 short stout spines at the 2 distal corners, 1 dorsal subterminal seta and mostly with a setule in the usual lateral emargination; this setule is lacking in one of our species.

Key to Species of *Haplostomella,* based on Females

1a. Posterolateral protrusion for fifth leg distinct; mandible developed as lobe 2
1b. Posterolateral protrusion for fifth leg indistinct; mandible reduced into spiniform projection, or absent 3
2a Mandible unimerous with 1 terminal seta; exopod of legs 2 to 4 with 1 terminal seta ..... *tuberculata* Chatton & Harant, 1924
2b Mandible partially bimerous each with 1 seta; exopod of legs 2 to 4 with 2 terminal setae ..... *dubia* n. sp.
3a Antennule cylindrical with rounded end; body lacking indentations or folds to suggest body regions or segments ..... *reducta* n. ap.
3b. Antennule conical; body with or without indentations or folds to suggest body regions or segments 4
4a. Urosome relatively short, comprising about 1/7–1/10 of body length 5
4b. Urosome relatively long, comprising about 1/3 of body length 8
5a. Caudal ramus lacking setae ..... *sycozoae* (Salfi, 1926)
5b. Caudal ramus with setae 6
6a. Antennule 4-segmented; caudal ramus with 1 terminal seta ..... *magellanica* (Chatton & Brément, 1910)
6b. Antennule unsegmented; caudal ramus with 5 setae 7
7a. Maxilla (mandible by Chatton & Harant, 1924c, p. 401, Fig. 1(3)) with 1 seta; fifth leg with 2 setae and 1 spine ..... *malacocera* Chatton & Harant, 1924
7b. Maxilla with 2 setae; fifth leg with 2 setae ..... *oceanica* n. sp.
8a. Each metasomal segment with well-developed dorsolateral plates of suboval outline 9

8b. Each metasomal segment with weakly-developed dorsolateral plates of subtriangular outline.....*distincta* n. sp.
9a. Urosome 4-segmented .....*australiensis* Gotto, 1970
9b. Urosome unsegmented.....*halocynthiae* (Fukui, 1965)

The following list of the known *Haplostomella* species is not phylogenetically but alphabetically arranged as was done for the known species of the other genera in this paper.

Haplostomella australiensis Gotto, 1970

Hoplostomella australiensis, Gotto, in Anderson & Rossiter, 1969, p. 464 (type locality, Sydney Harbor, New South Wales, Australia, from *Styela etheridgii* Herdman); 1970, pp. 267–272, figs, 1–13. —Ooishi & Illg, 1974, pp. 365, 372, 373, 374.

Haplostomella halocynthiae (Fukui, 1965)

Rhabdomorpha halocynthiae, Fukui, 1965, pp. 61–63, figs. 2 (2a–c), 4 (2d) (type locality, Onagawa Bay, Tohoku district, Japan, from *Halocynthia roretzi* (Drasche)).
Haplostomella halocynthiae, Ooishi & Illg, 1974, pp. 365–375, figs. 1–3, pl. XI.

Haplostomella magellanica (Chatton & Brément, 1910)

Aplostoma magellanica, Chatton & Brément, 1910, pp. 82–84, figs. I(3), II (type locality, Strait of Magellan, South America, from a compound ascidian).—Schellenberg, 1922, pp. 289, 295.—Sarfi, 1926, p. 1.—Sewell, 1949, p. 174.
Haplostomella magellanica, Chatton & Harant, 1924c, pp. 398, 399, 404, 405; 1924e, p. 420.—Gotto, 1970, pp. 267, 271, 272.—Ooishi & Illg, 1974, pp. 365, 373.

Haplostomella malacocera Chatton & Harant, 1924

Haplostomella malacocera, Chatton & Harant, 1924c, pp. 399–401, fig. 1 (type locality, Argelès, Golfe du Lion, France, from an aplidian.—Chatton & Harant, 1924e, p. 420.—Harant, 1931, p. 371. —Gotto, 1960, p. 227; 1970, pp. 267, 271.—Ooishi & Illg, 1974, pp. 365, 373.

Haplostomella sycozoae (Salfi, 1926)

Aplostoma sycozoae, Salfi, 1926, pp. 1–4, figs. 1, 2 (type locality, Patagonia (see Salfi, 1925), South America, from *Sycozoa patagonica* Salfi).
Aplostoma sycozoæ salpi, Sewell, 1949, p. 183.
Haplostomella sycozoae, Gotto, 1959, pp. 9, 10; 1970, pp. 267, 271.—Ooishi & Illg, 1974, pp. 365, 373.

Haplostomella tuberculata Chatton & Harant, 1924

Haplostomella tuberculata, Chatton & Harant, 1924c, pp. 402–404, fig. 2 (type locality, Abeille, Banyuls, France, from *Parascidia flava* Milne-Edwards); 1924e, p. 421.—Harant, 1931, p. 371.—Gotto, 1960, p. 227; 1970, p. 267, 271.—Ooishi & Illg, 1974, pp. 365, 373.

Haplostomella dubia, new species

(Figs. 33–37)

TYPES: Holotypic female, USNM 169522 (type locality, West of Blakely Island, San Juan Archipelago, Washington, July 1, 1966, from *Amaroucium arenatum* Van Name); allotypic male, USNM 169523, same locality and host; paratypes and all other specimens listed below.

SPECIMENS EXAMINED:

WASHINGTON

From *Amaroucium arenatum* Van Name:

Off Rock Point, Lopez Island, 48°29.8′N., 122°57′W., 20–40 fams., Aug. 10, 1965, 2 females; San Juan Channel, 48°35′N., 123°1.7′W., 67–72 fams., Aug. 23, 1965, 14 females; Reid Rock, 48°32.6′N., 122°58′W., 30 fams., Sept. 15, 1965, 7 females, 1 male; West of Blakely Island, 48°33.3′N., 122°50′W., 16–18 fams., July 1, 1966, 3 females, 4 males (including holotype, allotype and 2 females, 1 male, USNM 169524).

BRITISH COLUMBIA

From *Amaroucium glabrum* Verrill:

Whiffin Spit, Sooke, 48°21′N., 123°43.9′W., lowest intertidal, July 27, 1965, 20 plus females, 8 males; Aug. 27, 1965, 3 females, 1 male; July 29, 1966, 20 plus females.

DESCRIPTION: Female: The body (Fig. 33 a–c) is rather straight, elongate, and of fusiform or caterpillar-like appearance. When it is well extended the total length of a representative specimen is 1.3 mm. It consists of 3 regions, the cephalosome, metasome and urosome including the caudal rami, with their proportional lengths about 1: 6: 2. The maximum width, occuring at the third metasomal segment, is 0.24 mm. The proportional maximum widths, measured on the widest part of each of the 3 regions, are about 2: 3.7: 2. These regions are divided by integumental grooves or folds. The metasome and urosome are divided into 5 and 4 segments respectively by similar grooves or folds. The folds are distinctly formed by folding the posterior end of each region or segment on its corresponding groove. Therefore, the body regions and segments are clearly distinguishable.

The dorsal cephalosome is roughly triangular, covered with hairs borne on conspicuous mammiform projections arranged sparsely and symmetrically (Fig. 33 d). It is projected into a tiny rostrum toward the ventral side between the antennules. Ventrally it bears 5 pairs of appendages: antennules, antennae, mandibles, maxillae and maxillipeds (Fig. 33 e, f). Maxillules are absent. In front of the antennae and close to the lateral sides of the labrum there is a pair of nipple-like prominences or papillae apically ornamented with minute hairs (Fig. 33 e–g). The eye is absent.

Each of the 5 metasomal segments bears a pair of legs, although the fifth pair is reduced, differing from the anterior pairs in shape and size. All these legs are placed ventrolaterally near the distal margin of the corresponding segment, and the legs of each pair are widely separated from each other. The dorsolateral plicae existing in relation to the 5 pairs of legs in some members of this genus are not well developed here, only indicated as semicircular marginal folds which are posteriorly connected with the segmental folds on the dorsal side (Fig. 33 b). Lateral tubercles for each limb

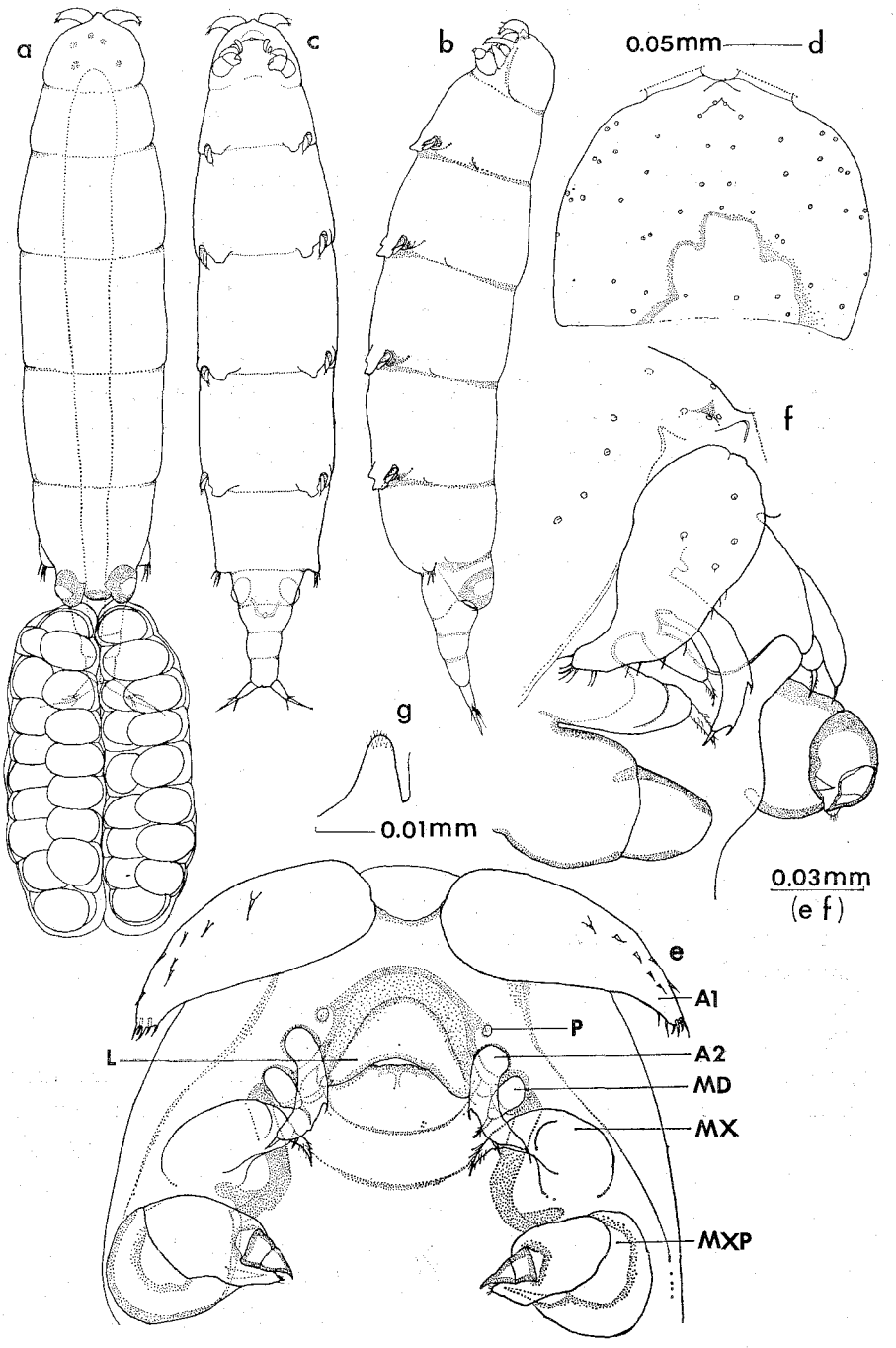


Fig. 33. *Haplostomella dubia,* n. sp., female: a, dorsal; b, lateral; c, ventral; d, cephalosome, dorsal; e, oral area; f, same, ventrolateral; g, papilla at anterior base of antenna. Key to abbreviations: Al, antennule; A2, antenna; L, labrum; MD, mandible; MX, maxilla; MXP, maxilliped; P, papilla.

are absent. The posterolateral corners of the fifth segment terminate in conical projections tipped by the fifth legs.

The urosome is abruptly constricted from the last metasomal segment, with indentations suggesting division into 4 segments with their proportional lengths from the first to fourth about 10: 7: 7: 8. The proportional maximum widths, measured on the widest part of each, are about 7: 5: 3.5: 2.5. On the first segment, situated dorsally, there is a pair of covering structures of the oviducal apertures, each consisting of a round plate and a semicircular fold. The plate (Fig. 34 h, i) is marginally sclerotized, surrounding a less sclerotized oval area centrally. The fold is articulated with the posterior margin of the above-mentioned central area and covers the oviducal opening. The posterior free margin of the fold (Fig. 34 i, j) terminates in a transverse row of 3 strong spines, which are strongly curved toward the actual oviducal outlet under the fold. There is no sclerotized dorsal area between the oviducal structures, although there are some internal mucscle strands running transversely.

The paired egg sacs (Fig. 33 a) are attached to the oviducal apertures under the folds. Each sac is elliptical, about 3 times as long as the widest part, containing about 30–40 rather large eggs in rows within the transparent thin wall. The egg sacs adhere to each other medially but they can easily be separated. In some specimens the eggs are packed into a single large egg sac, the width of which is nearly twice that of the usual sac of the pair.

The second urosomal segment is ornamented with 2 pairs of spinules closely set side by side on the dorsal side behind the oviducal structures. A tiny insemination pore (Fig. 33 c) is located on the ventral side of the second segment at the proximal third, connecting with diverging tubes running internally toward the oviducal apertures. The fourth segment is truncated diagonally at the sides and roughly articulated with subcylindrical caudal rami, which are directed posterolaterally with an angle of more than 45° between the rami. The anus opens as a posterodorsal slit, the anterior limit of which reaches about the middle of the anal segment. On each side of the slit there is a small tubercle (Fig. 34 h).

The body wall is of soft texture with minute transverse flexures. It is covered by many rows of fine denticles and hairs growing from mammiform protrusions on the ventral surface whereas the dorsal surface seemingly lacks the denticles.

The body color is white with a yellow or orange gut and pink or pale purple eggs. Throughout the body small green pigment spots are rather characteristically placed; these spots are occasionally reddish in some specimens. Their number consists of 4 or 5 in the cephalosome, 2 in the first metasomal segment and 2 in the second urosomal segment, usually situated symmetrically on the dorsal side. In some specimens minute purplish pigment spots are dispersed all over the body in much greater number, instead of the above-mentioned distinctive spots. There is a large red pigment mass around the mouth-opening on the ventral side.

The antennule (Fig. 34 k) is unsegmented and tapers apically, with a short peduncle at the base. The ornamentation consists of about 14 setae arranged on the an-

terior margin and at the apex. One of them, situated at the distal fourth, is very long but the remaining setae are all short and non-plumose.

The antenna (Fig. 34 l) is roughly divided into 3 articles. The first article is the longest, without armature. The second article bears 1 short simple seta and 1 tiny spine at the mediodistal corner. The terminal article is slightly shorter than the second, about one fourth the length of the appendage, and tipped by 1 stout simple

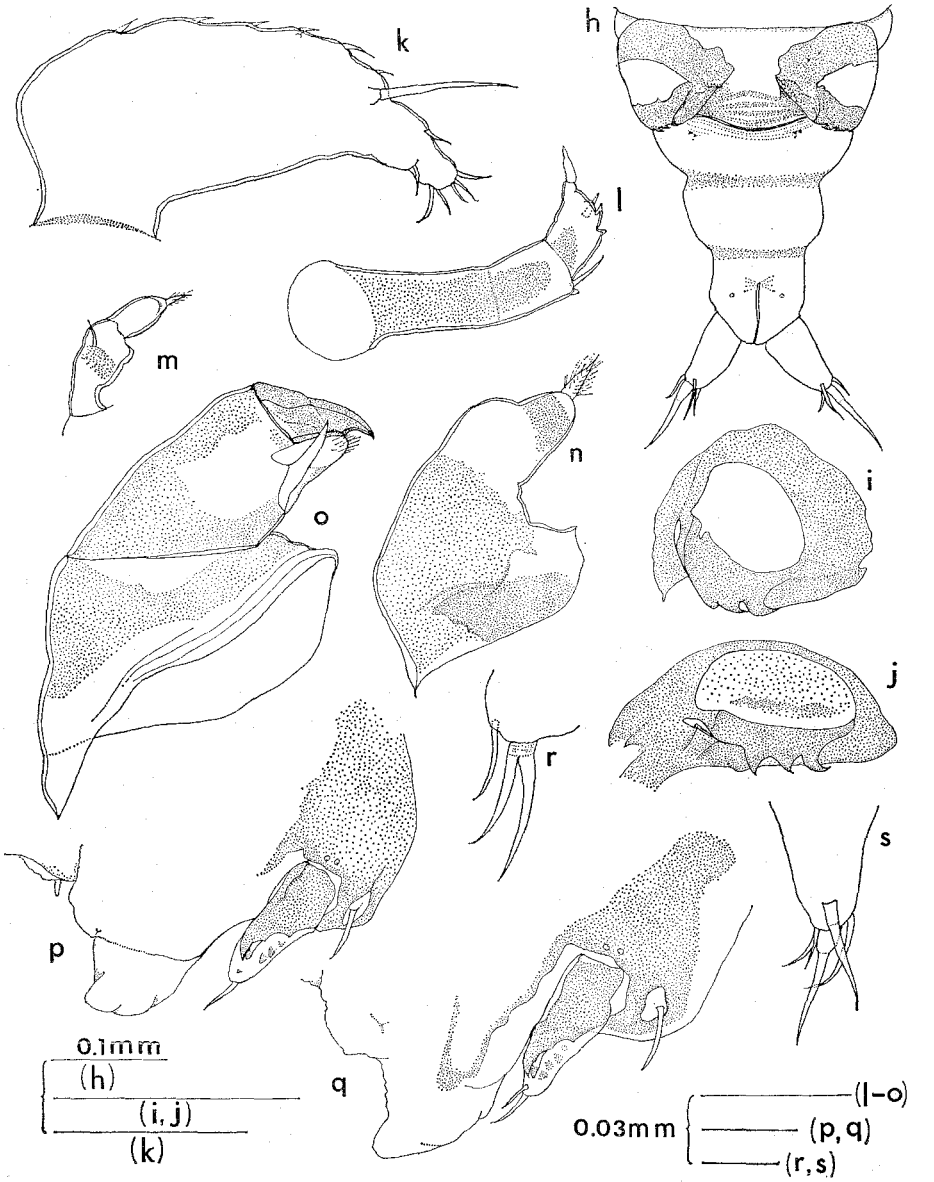


Fig. 34. *Haplostomella dubia,* n. sp., female: h, urosome including caudal rami; i, apparatus at oviducal aperture; j, same, internal; k, antennule; l, antenna; m, mandible; n, maxilla; o, maxilliped; p, leg 1; q, leg 2; r, leg 5; s, caudal ramus with 5 setae.

seta at its pointed apex. There is 1 short simple seta at the distal third on the posterior surface somewhat medially and the medial margin of the segment is protruded into 2 spiniform projections near the seta.

The labrum (Fig. 33 e, f) is slightly concave on the medial margin, more or less meeting the convex labium.

The mandible (Fig. 34 m) is a palp-like lobe, partially divided into 2 articles, and the apex is strongly directed toward the mouth-opening. The basal element is 1.5 times as long as the terminal and bears 1 short simple seta at the distal third; at the level of insertion of this seta a sclerotized band is formed. The terminal article is narrower than the basal, with 1 short apical plumose seta; near the apex the outer surface has a rounded projection.

The maxilla (Fig. 34 n) is an unsegmented lobe bearing 1 stout plumose seta at the rounded apex. The appendage is strongly curved midventrally, with a much longer lateral margin and a short medial margin. The distal seventh of the lobe is distinctly narrowed with a step on the lateral margin.

The maxilliped (Fig. 34 o) is composed of 2 large basal segments and a complex of a small terminal article firmly fused with an apical claw. The first segment is wider than long, with the medial margin remakably short. The second segment is longer than wide, narrower than the first, with 1 strong simple spine on the anterior medial margin near the rounded lobe-like projection covered with hairs at the mediodistal corner. The apical claw complex when flexed is seen folded between the above-mentioned anterior spine and posterior projection of the second segment.

The first leg (Fig. 34 p) is characteristic, but the composition is basically the same as that of other species of *Haplostomella*. The protopodite is not distinctly demarcated from the body surface, but its extent is suggested by a sclerotization on the lateral side, bearing 1 slender lateral seta growing from a small well-sclerotized depression behind the exopodite. The lateral seta presumbly represents an ornament of the basipodite. There are 2 hairs at the level of the lateral seta on the anterior surface.

The endopodite is suggested by a bulging projection from the body surface, probably including part of the protopodite. This structure is much longer than the exopodite and the mediodistal apex is protruded into a small lobe directed medially. There is a small spiniform projection at the medial base of the lobe.

The unsegmented exopodite is an elongate lobe, about 3 times as long as its basal width, and articulated in a large depression in the protopodite. The ramus tapers apically and is divided into shorter anterior and longer posterior lobules at the apex. The anterior lobule is subdivided into 2 terminal projections (1 outer spiniform and 1 inner finger-like). The anterior surface of the ramus including the outer spiniform projection is well sclerotized. The sclerotized lateral edge is produced slightly into points at 2 levels. The tip of the inner finger-like projection is also sclerotized. The posterior lobule is terminally rounded and less sclerotized, with 1 slender simple seta at the tip. One spinule is set near the seta on the anterior surface and 3 finger-like sclerotizations are arranged in a row along the lateral margin.

The second to fourth legs (Fig. 34 q) are similar to the first legs in structure, but differing from them in armature. There is no spiniform projection at the medial base of the endopodite lobe. In the exopodites each posterior lobule has 2 apical setae.

The fifth leg (Fig. 34 r) is mainly represented by 3 non-plumose setae fixed at the tip of the small lateral cone of the last metasomal segment. Two of them are borne on a single basal peduncle and the remaining smaller seta is inserted more laterally on the cone.

The caudal ramus (Fig. 34 h) is twice as long as its basal width, tapers gradually, and has 1 long terminal and 3 short subterminal (dorsal, medial and lateral) setae. In some specimens, the setal component consists of 5 setae as shown in Figure 34 s, in which one more lateral seta is inserted subterminally besides the 4 setae mentioned above; the dorsal subterminal seta is almost as long as the long terminal seta.

Male: The body (Fig. 35 a, b) is of the cylcopoid aspect in dorsal view and well segmented. The length of a representative specimen is about 1.13 mm, measured from the anteriormost to the end of the caudal rami. The total length including the caudal setae is 1.36 mm. The body is composed of cephalosome, metasome and urosome, with their proportional lengths about 1: 2: 2.6. The cephalosome is slightly shorter than the width of the widest part, and prolonged anteroventrally into a spatula-shaped rostrum. Posteriorly it includes the first thoracic segment and thus bears 5 pairs of appendages: antennules, antennae, mandibles, maxillae and maxillipeds (Fig. 35 c, d). Maxillules are absent. The eye is absent.

The metasome consists of 4 segments, gradually tapering from the first to fourth; the first segment is the largest, 0.3 mm wide, and the fourth segment is 0.18 mm wide. The 4 segments each bears a pair of swimming legs. The endopodites of the first legs are 3-segmented. Pleural folds are developed. The urosome is composed of 6 segments; the first segment is short, narrower than the fourth metasomal segment, and bears the reduced fifth pair of legs (Fig. 35 b, e); the second segment is about 3 times as long as the first, bearing the usual sixth leg-lappets (Fig. 35 b, e), and contains a pair of oval spermatophores; the third to fifth segments are much smaller than the preceding segments and taper gradually; the sixth segment is the smallest, with the anus opening as a posterodorsal slit. Articulation between the metasome and urosome is more marked than articulation between segments. The caudal rami are 1.5 times as long as the anal segment, with long caudal setae.

Under the transparent body wall there are many round green or red pigment spots (Fig. 35 a, dotted areas) all over the body. As in the female these are symmetrically arranged but in much greater number: a quartet of tiny red spots, at the anterior limit of the cephalosome, suggesting the usual median eye; 3 or 4 pairs of larger red spots along the lateral margins of the cephalosome; a pair of red spots on each segment of the 4 metasomal and the first 2 urosomal segments; 3 (2 red & 1 green) spots on the left side and 1 (red) spot on the right side in the third urosomal segment; 1 green (on the right side) and 2 red (on the left side) spots in the fourth urosomal segment. In the oral area surrounding the mouth-opening there are several pigment spots: 1 green spot at the base of the labrum; a large red

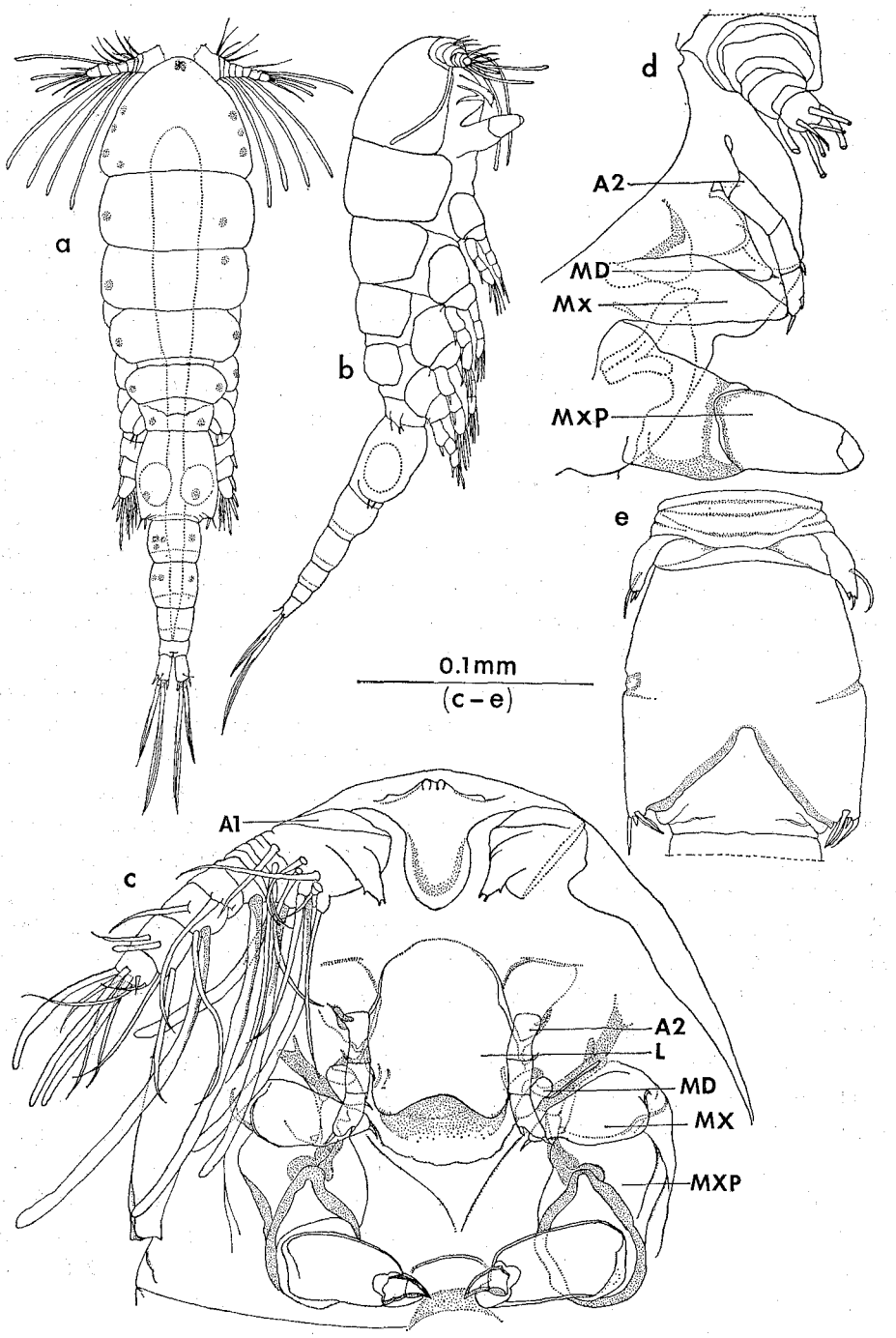


Fig. 35. *Haplostomella dubia* n. sp., male: a, dorsal; b, lateral; c, oral area; d, same, lateral; e, lst and 2nd urosomal segments, ventral. Key to abbreviations: A1, antennule; A2, antenna; L, labrum; MD, mandible; MX, maxilla; MXP, maxilliped.

pigment mass around the mouth-opning; 1 anterior and 3 posterior red spots on each side of the mouth-opening. Each of the 4 swimming legs has 2 or 3 red spots. In some specimens, minute purplish pigment spots are dispersed all over the body instead of the above-mentioned conspicuous spots, as was seen in the female.

The antennule (Fig. 36 f) is 8-segmented and ornamented with graduated elongate aesthetes, non-plumose setae and setules. The segments are rather well sclerotized and the distal part of each segment overlaps the proximal part of the succeeding segment. The first segment is the largest, one third as long as the appendage, and has a proximal ventral area protruded into a small cone, which has 2 tooth-like projections apically. The following 3 subequal segments are much wider than long; each segment is one fifth as long as the first and much narrower than it. The fifth segment is twice as long as the preceding segment. The sixth and seventh seg-

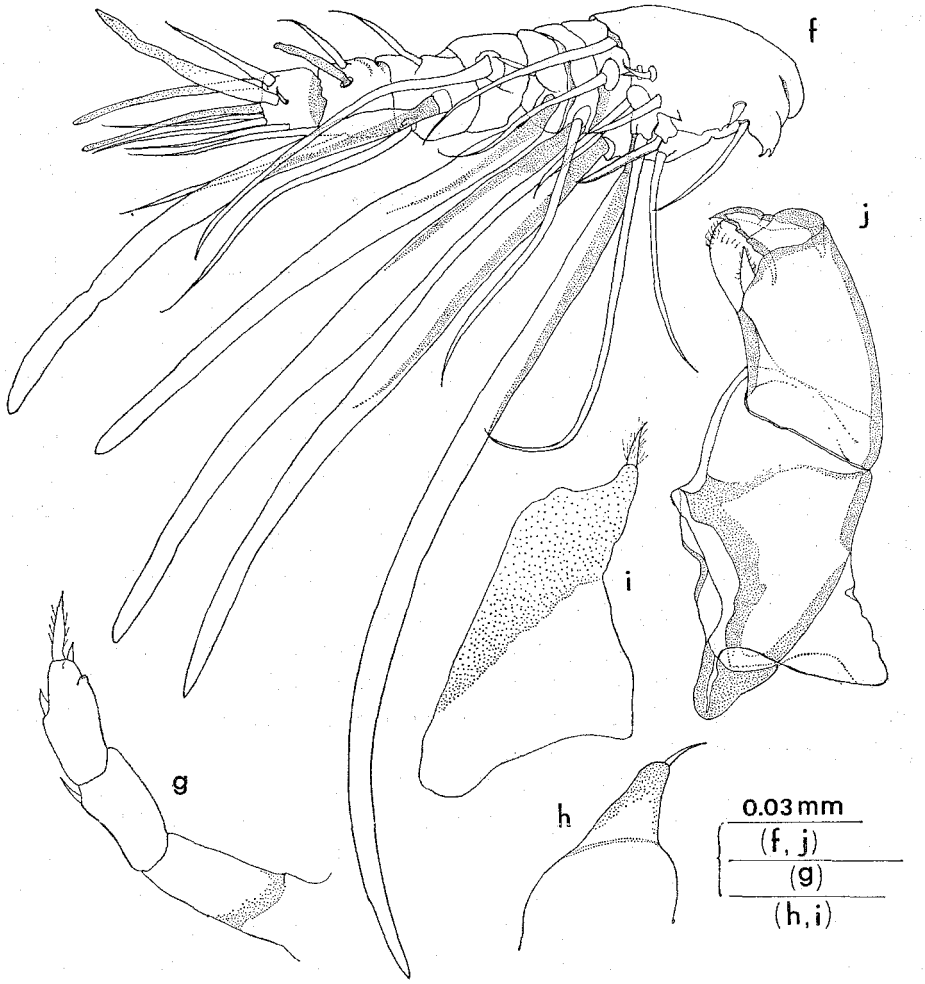


Fig. 36. *Haplostomella dubia*, n. sp., male: f, antennule; g, antenna; h, mandible; i, maxilla; j, maxilliped.

ments are as long as wide, slightly narrower and longer than the fifth. The eighth segment is smaller again, with a truncated terminal margin. The ornamentation is complicated, with the following tabulation of arrangement of setae (s), setules (st), large aesthetes (A) and small aesthetes (a) in the 8 segments (I-VIII): I-7s, 3st, 1A; II-1s, 1A; III-1s, 1A; IV-1s, 1A; V-1s; VI-2s, 1A; VII-3s, 1a; VIII-4s, 1st, 3a. The 5 large aesthetes (A) on the segments I, II, III, IV and VI are transparent, with their proportional lengths about 1: 0.8: 0.8: 0.64: 0.6.

The antenna (Fig. 36 g) is slender and consists of 3 segments with their proportional lengths about 4: 3: 3 from the first to third. The first segment is not demarcated from the body surface and has a sclerotized band at the proximal fourth. The second segment is ornamented with 1 short simple seta near the mediodistal corner. The third segment carries 1 short simple seta midway on the medial margin and 1 plumose seta at the apex accompanied by 1 setule laterally. The lateral margin is protruded at the distal fourth into a small rounded bulge with tiny hairs.

The labrum and labium (Fig. 35 c) are comparable to those of the female. The protruding distolateral corners of the labrum are ornamented with minute hairs.

The mandible (Fig. 36 h) is an unsegmented conical lobe, somewhat divided into broad basal and narrow distal parts, with 1 short simple seta terminally. The distal part is directed medially, forming a medial integumental fold between the distal and proximal parts.

The maxilla (Fig. 36 i) is an unsegmented trapezoidal lobe which is much longer than wide. The medial margin is rather straight and the distal end is protruded into a small bulge with 1 short plumose seta. The lateral margin is abruptly directed medially near the apex, forming a somewhat swollen distolateral corner. The distal half of the lobe is sclerotized.

The maxilliped (Fig. 36 j) is composed of 2 large basal segments and a terminal claw complex as in the female, but the basal segment is not so shortened medially. The second segment has a short stout plumose seta near the mediodistal corner on the anterior surface instead of the spine in the female. The terminal claw complex seems to be formed by an apical claw fused with an apical article (probably the third segment in other genera) above the second segment.

The 4 pairs of swimming legs are composed of bimerous protopodites and trimerous rami, retaining a generalized aspect. The protopodites of each pair are connected by a trapezoidal, sclerotized intercoxal plate. Throughout the 4 pairs of legs the coxopodite lacks a coxal seta.

The first leg (Fig. 37 k) is the smallest. The basipodite has 1 short, stout blunt spine with marginal denticles (Fig. 37 l) at the mediodistal corner and 1 short slender non-plumose seta on the lateral margin. The endopodite is slightly shorter than the exopodite, with 1 plumose seta and 2 elongate spines fringed with slightly serrated hyaline flanges. The second segment has hairs on the medial margin and a spinule protruded from the distolateral corner. The terminal segment bears 1 medial seta and 2 spines (1 medial and 1 terminal); the distolateral corner and the limited apical margin between the spines are protruded into a few spinules. The exopodite bears 3

plumose setae and 4 graduated spines: the first segment with 1 short lateral spine with marginal denticles (Fig. 37 m) and hairs on the medial margin; the second segment with 1 short lateral spine with slightly serrated hyaline flanges (Fig. 37 n), accompanied by a proximal spinule, and hairs on the medial margin; the third segment with 3 medial setae, 2 spines (1 short distolateral and 1 long terminal) fringed with slightly serrated hyaline flanges, and a few spinules protruded from the distolateral corner. The proportional lengths of these 4 spines from proximal to distal are about 1: 2: 2: 4.

The second leg (Fig. 37 o) is slightly larger than the first leg. The basipodite bears 1 short slender seta on the lateral margin and hairs at the mediodistal corner. The

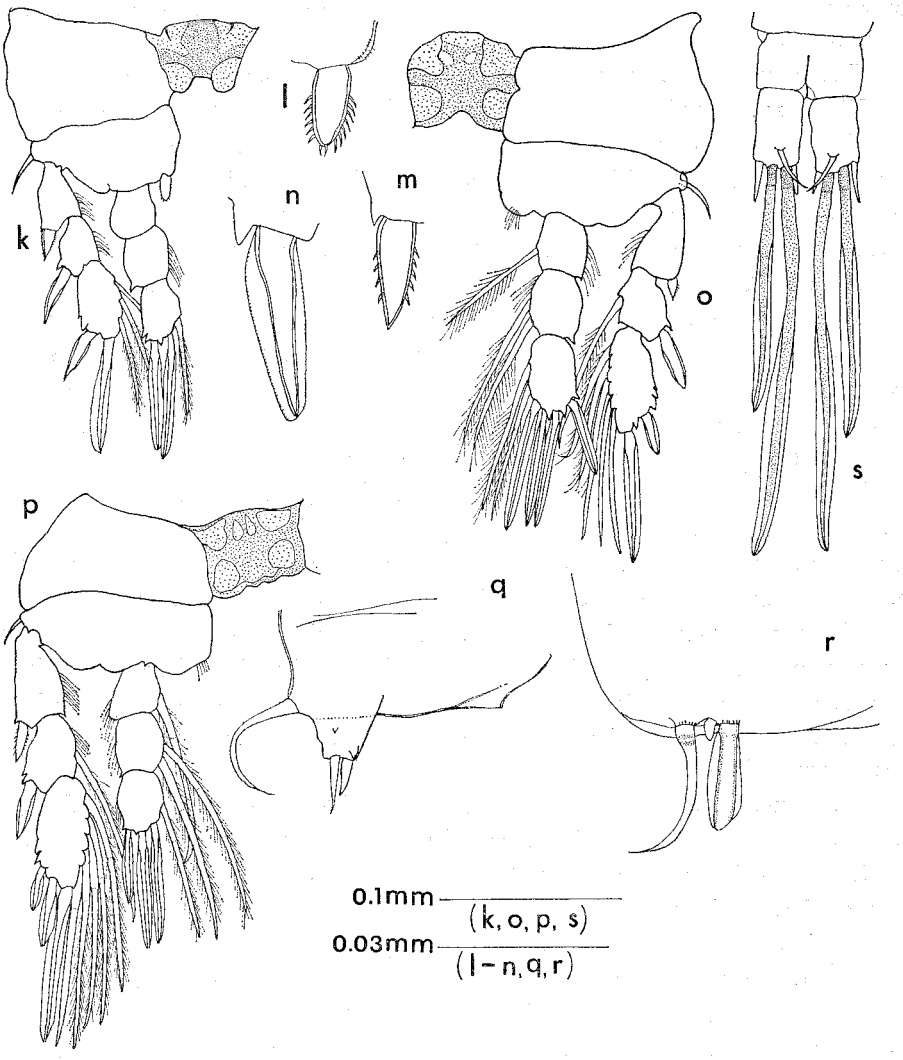


Fig. 37. *Haplostomella dubia,* n. sp., male: k, leg 1; l, same, spine of basipodite; m, same, spine of lst segment of exopodite; n, same, spine of 2nd segment of exopodite; o, leg 2; p, leg 4; q, leg 5; r, leg 6; s, caudal rami.

endopodite is about five sixths as long as the exopodite, with 5 plumose setae and 4 spines fringed with slightly serrated hyaline flanges: the first segment with 1 medial seta and hairs on the lateral margin; the second segment with 2 medial setae; the third segment with 2 medial setae and 4 spines (1 medial, 2 terminal and 1 lateral). Each of the last 3 spines is accompanied by 1 spinule protruded from the segment at its lateral base. The exopodite has 6 setae and 4 graduated spines: the first segment with 1 small lateral spine with marginal denticles and hairs on the medial margin; the second segment with 1 medial seta and 1 lateral spine fringed with slightly serrated hyaline flanges; the third segment with 5 medial setae and 2 spines (1 long terminal and 1 short lateral) fringed with hyaline flanges. The second segment is protruded into a spinule behind the spine. The lateral and medial margins of the third segment are serrated.

The third leg is comparable to the second leg in size, structure and armature.

The fourth leg (Fig. 37 p) is slightly smaller than the preceding legs but larger than the first. Ornamentation of the rami consists of 4 setae and 3 spines in the endopodite and 6 setae and 5 spines in the exopodite; the endopodite is reduced by 1 medial seta and 1 medial spine on the third segment from the second or third legs, whereas 1 lateral spine is added to the exopodite on the third segment.

The fifth leg (Figs. 37 q) is a small subconical lobe (corresponding to the lateral cone in the female), protruded from the posterolateral margin of the first urosomal segment. The lobe is well extended beyond the distal margin of the segment, and bears 1 short simple seta proximally but on the dorsal side and 2 much shorter unequal setae at the somewhat truncated terminal margin. There are 2 tiny protrusions; one on the central surface and one near the ventrodistal corner.

The sixth leg (Fig. 37 r) is represented in part by a trio of different components situated along the distal margin of the lappet-like prolongation from the second urosomal segment. There is 1 stout and broad spine fringed with hyaline flanges ventrally, 1 tiny simple spine centrally and 1 slender non-plumose seta dorsally.

The caudal ramus (Fig. 37 s) is cylindrical, twice as long as wide, bearing 2 elongate terminal setae (1 medial and 1 lateral) fringed with hyaline flanges, between 2 short simple terminal spines, and 1 short simple dorsal seta at the distal fourth. The medial terminal seta is 5 times as long as the ramus and 1.5 times the length of the lateral terminal seta.

Remarks: The female closely resembles *Haplostomella tuberculata* Chatton & Harant, 1924 from the Mediterranean Sea, among the species of the genus now known, in having a caterpillar-like appearance and about the same size (1 mm long in *H. tuberculata*). However, this species is anatomically distinguishable from *H. tuberculata* in the following details: the weakly developed dorsolateral plates without armature (*H. tuberculata* with conspicuous plates, each with 1 tiny seta); the antennule with 1 long seta beside short setae (*H. tuberculata* without such a long seta); the papilla-like protrusion existing in front of the antennule (*H. tuberculata* without it); the mandible with 2 setae (*H. tuberculata* with 1 seta); each exopodite in the second to fourth legs with 2 apical setae (*H. tuberculata* with 1 seta).

Both sexes of this species are generally found in undefined positions of the matrix of 2 kinds of ascidians. However, they are also occasionally found as a couple in one zooid. The female inhabits the intestine of the zooid whereas the male lives in the branchial sac of the same zooid. In this case their heads are directed toward the stomach of the zooid. The present species can be readily obtained from the ascidian host, *Amaroucium glabrum*, in the lowest intertidal, but is also common in another host, *A. arenatum*, from deeper water (see Table 2).

Haplostomella distincta, new species

(Figs. 38–41, Pl. I, Fig. 2)

TYPES: Holotypic female, USNM 169525 (type locality, Peavine Pass, San Juan Archipelago, Washington, Aug. 22, 1973, from *Amaroucium arenatum* Van Name; allotypic male, USNM 169526, same locality and host; paratypes and all other specimens listed below.

SPECIMENS EXAMINED:

WASHINGTON

From *Amaroucium arenatum* Van Name:

Black Rock, 48°33′N., 122°45.9′W., 31–32 fams., Aug. 18, 1965, 2 females, Nov. 13, 1965, 2 females, 1 male; Lopez Pass, 48°28.8′N., 122°49.3′W., 12 fams., Oct. 6, 1965, 5 females; Paevine Pass, 48°35.3′N., 122°49′W., 6–12 fams., Oct. 24, 1966, 5 females, Aug. 22, 1973, 8 females, 2 males (including holotype, allotype and 5 females, 1 male, USNM 169527).

BRITISH COLUMBIA

From *Amaroucium glabrum* Verrill:

Whiffin Spit, Sooke, 48°21′N., 123°43.9′W., lowest intertidal, Aug. 27, 1965, 1 female, July 18, 1966, 2 females.

DESCRIPTION: Female: The body (Fig. 38 a–c, Pl. I, Fig. 2) is elongate and of fusiform appearance. It consists of cephalosome, metasome and urosome, with their proportional lengths about 1: 7: 3. The total length of a representative specimen is 3.1 mm, measured from the tip of the cephalosome to the end of the caudal rami, although the length easily can be changed by body movements of extension or contraction. The small cephalosome is shorter than its basal width and ventrolaterally slightly protruded into poorly developed pleural folds. It bears 5 pairs of appendages: antennules, antennae, mandibles, maxillae and maxillipeds (Fig. 38 d). Maxillules are absent. Dorsally the cephalosome is well sclerotized as in *H. oceanica* (see Fig. 42 d for *H. oceanica*). The sclerotization of this species includes about 45 hairs symmetrically scattered on the surface. The dorsolateral corners of the sclerotization indicate the posterior end of the cephalosome, connecting with the margins of the pleural folds. The rostrum is meagerly developed with a semicircular outline. The metasome is composed of 5 segments, with their proportional lengths about 1: 1.3: 1.5: 1.5: 1.2. The maximum width is 0.6 mm, on the third and fourth segments.

Each segment of the metasome bears a pair of legs. The legs are placed nearly at the posterior end of the segment and separated laterally from each other. The

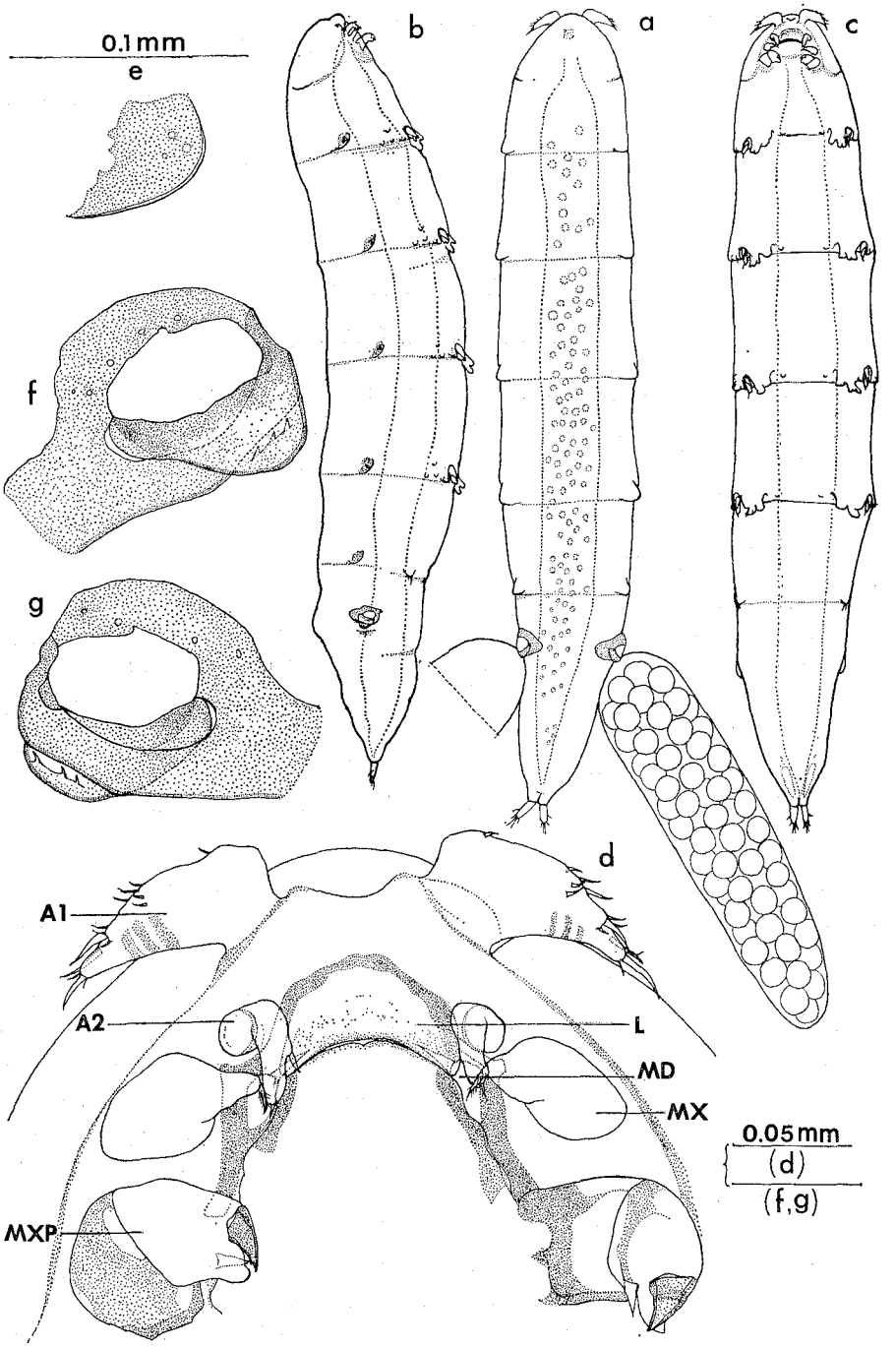


Fig. 38. *Haplostomella distincta*, n. sp., female: a, dorsal; b, lateral; c, ventral; d, oral area; e, dorsolateral plate of 3rd metasomal segment; f, apparatus at oviducal aperture; g, same, internal. Key to abbreviations: A1, antennule; A2, antenna; L, labrum; MD, mandible; MX, maxilla; MXP, maxilliped.

endopodites of the first 4 legs are specifically distinctive. In correspondence to the positions of all the legs including the fifth, each segment carries a pair of dorsolateral plates of semicircular outline (Fig. 38 e); the plates on the fifth segment are the smallest in size. Each plate is sclerotized, rounded on the ventroposterior margin, and covered with a few hairs on the surface. In the first 4 pairs of legs there is a small rounded protrusion near the medial base of each leg (Fig. 38 c). Behind the protrusions at the sides of each segment there is a distinct integumental ventral fold representing the posterior end of the segment. The ventral folds clearly delimit the segments of the first 4 legs. Similar but indistinct folds occasionally are formed on the dorsal side behind the 5 pairs of dorsolateral plates connecting with the ventral folds, although the fifth segment has no distinct ventral fold. Distinctively arranged lateral groupings of 4 small tubercles (Fig. 38 b) are located dorsolaterally near the insertions of each of the first 4 pairs of legs. The fifth legs are set on small sclerotized projections protruded from the posterolateral corners of the fifth segment.

The segment of the fifth legs is followed by the gradually tapered urosome terminating in a truncated narrow distal margin, the width of which is about one sixth as wide as the anterior widest part of the urosome. A pair of oviducal apertures (Fig. 38 a) is placed at about the proximal fourth of the urosome, bearing a pair of egg sacs. Each sac is of elliptical appearance, 1.5 mm long and 0.37 mm in the greatest width, containing rather small eggs (over 60 in number) within its transparent thin wall. Each oviducal aperture involves an oval plate and crescent fold covering the aperture. The plate (Fig. 38 f, g) is marginally well sclerotized but centrally it is less sclerotized. The posterior margin of the central area is articulated with the anterior margin of the fold, and the oviducal aperture is opened as a large slit under the fold and between the fold and the posterior marginal plate. The fold is an extension from the ventral side of the marginal plate and its dorsal end is attached to the inner dorsal side of the plate. The undersurface of the fold is equipped with a transverse row of 3 relatively slender spines near the posterior margin. A tiny insemination pore probably opens midventrally much behind the level of the oviducal apertures, distally on the urosome as in *Haplostomella halocynthiae* (see Ooishi & Illg, 1974). The caudal rami are small, cylindrical, bearing short setae. The anus opens as a posterodorsal slit.

The body is tinted either with ruby red or mixed colors including red, orange and yellow. Generally the color is rich in the main body, but less so for the cephalosome and the posterior urosome. The gut, with characteristic surface appearance of bubble-like texture, is yellow in color, running along the body axis and lying between the oviducts, in which purplish ova are packed. The small median eye is red in color. The body wall is covered with many transverse denticle rows on the ventral side and tiny hairs probably on the dorsal side.

The antennule (Fig. 38 d) is an unsegmented lobe, broader proximally and attenuated toward the tip, and slightly constricted near the body surface. The armature consists of about 14 short simple setae arranged on the anterior margin. Two of the setae are distinctly larger than the others; one at the distal seventh on the anterior

margin and one at the apex.

The antenna (Fig. 39 h) is unsegmented, nearly cylindrical and about 3.5 times as long as its widest part. The appendage shows suggestion of subdivision into 3 segments by regional sclerotizations, with proportional lengths from proximal to distal of the indicated segments about 2 : 1 : 1. The probable second segment has 1 short simple seta at the mediodistal corner. The terminal segment carries 2 similar setae and 1 setule; 1 seta at the apex, 1 seta at the distal third on the medial margin and 1 setule near the apical seta laterally. The mediodistal corner is slightly protruded into

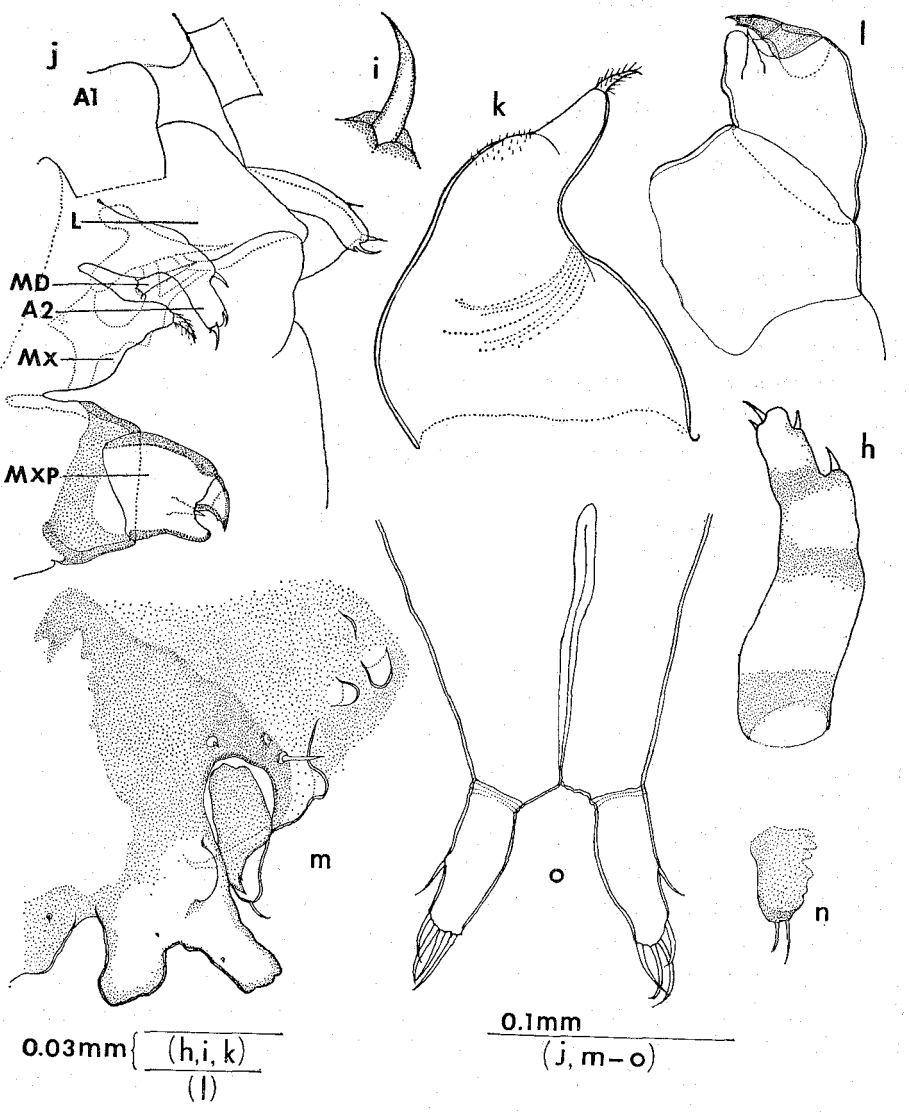


Fig. 39. *Haplostomella distincta*, n. sp., female: h, antenna; i, mandible; j, oral area, ventrolateral; k, maxilla; l, maxilliped; m, leg 1; n, leg 5; o, caudal rami. Key to abbreviations: A1, antennule; A2, antenna; L, labrum; MD, mandible; MX, maxilla; MXP, maxilliped.

a small rounded projection between the setae.

The labrum and labium are not specifically characteristic.

The mandible (Fig. 39 i) is reduced to a curved stout spine, inserted on the slightly swollen surface at the lateral base of the mouth-opening between the labrum and labium (Fig. 39 j).

The maxilla (Fig. 39 k) is an unsegmented conical lobe, broader basally, and somewhat tapered apically, bearing 1 short plumose seta. The appendage is strongly medially curved at the upper third and the rounded outer surface of the curved corner is ornamented with short hairs.

The maxilliped (Fig. 39 l) consists of 2 large basal segments and a complex of a small terminal article fused with an apical claw. It is similar to that of *Haplostomella dubia* (female) in structure and armature: the second segment with 1 spine-like projection on the anterior medial surface near the rounded projection protruded from the mediodistal corner; the terminal claw with an articulative line at about the middle. The terminal claw complex is opposed to the cleft between the spine and the projection of the second segment.

The first to fourth legs (Fig. 39 m) resemble each other in structure and armature. The protopodite is not articulated on the body surface but seems to be indicated by the sclertotized integument, in which 1 short simple lateral seta representing an ornament of the basipodite is fixed proximal to the exopodite, and 2 short hairs growing from mammiform projections are placed more medially.

The endopodite is represented by a large projection from the body surface, probably including part of the protopodite and apically divided into 2 lobes, each with a somewhat truncated apical margin; the lateral lobe is longer than the medial.

The exopodite, clearly articulated, is apically divided into 2 lobules anteriorly and posteriorly. The anterior lobule is shorter than the posterior and pointed like a spine; the lateral margin has an incision near the spine. The surface of the ramus including the spine-like projection is well sclerotized. The posterior lobule, longer and wider than the anterior, bears 1 slender simple seta on the rounded apex.

The fifth leg (Fig. 39 n) is represented by a small, somewhat elongate projection from the segment, with 2 short simple seta at its apex.

The caudal ramus (Fig. 39 o) is cylindrical, 3 times as long as the widest part, and truncated at the apex. The ornamentation consists of 5 simple setae: 1 lateral seta at about the middle on the margin, 2 setae terminally and 2 setae subterminally at the sides of the 2 terminal setae.

Male: The body (Fig. 40 a) is well segmented with the usual pattern for the *Haplostomella* males. The length of a representative specimen is 0.9 mm, measured from the tip of the cephalosome to the end of the caudal rami, with the width about 0.2 mm in the first metasomal segment, which is the widest part of the body. The total body length including the caudal setae is 1.1 mm. Dorsally the cephalosome is nearly triangular and covered with minute hairs. The large median eye is well developed. The rostrum is indistinct. The head appendages (Fig. 40 b, c) are antennules, antennae, mandibles, maxillae and maxillipeds. Maxillules are absent. The metasome

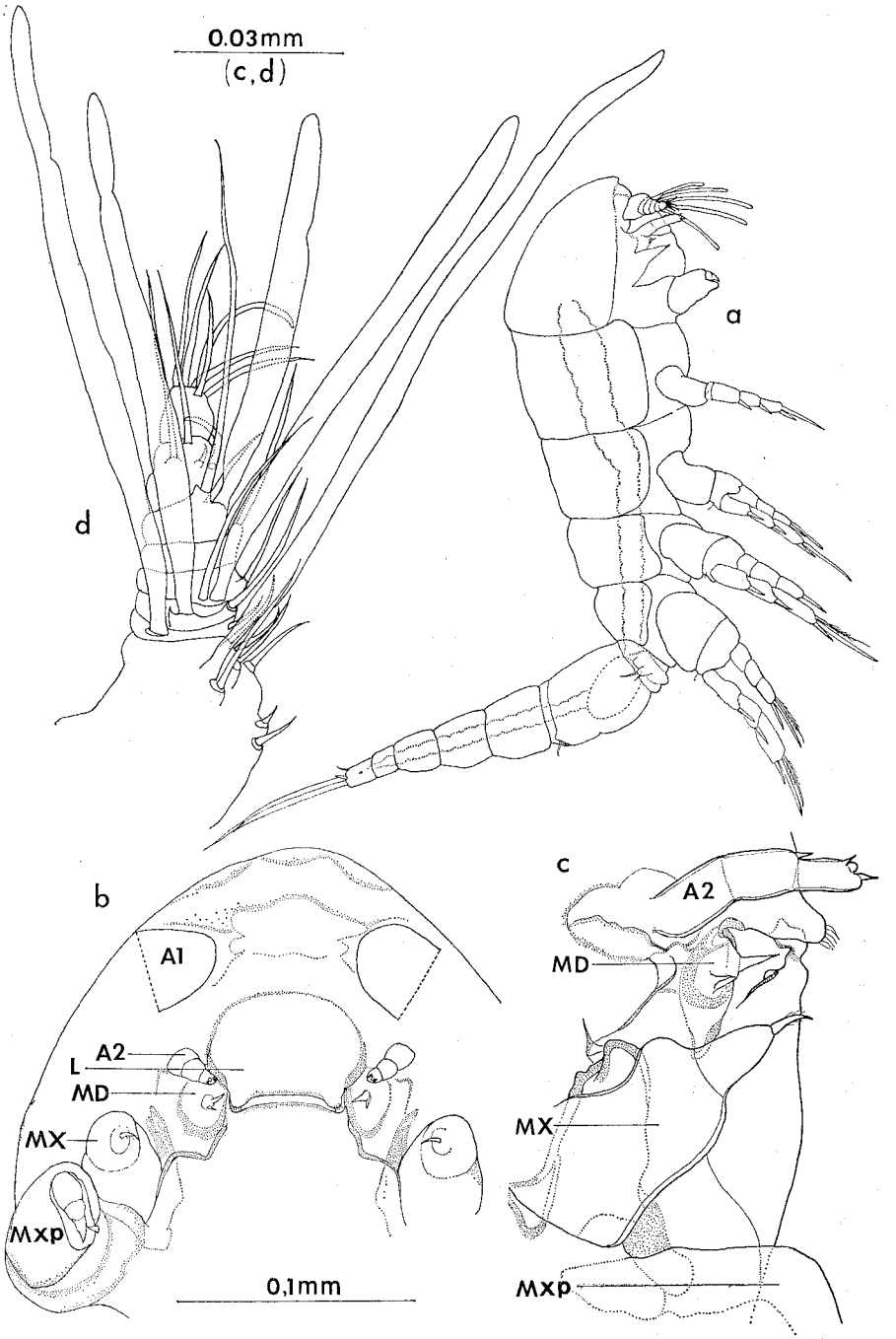


Fig. 40. *Haplostomella distincta*, n. sp., male: a, lateral; b, oral area; c, same, lateral; d, antennule. Key to abbreviations: A1, antennule; A2, antenna; L, labrum; MD, mandible; Mx, maxilla; MXP, maxilliped.

is 4-segmented, each segment bearing a pair of swimming legs. The endopodites of the first legs are 2-segmented. The tergal plates are well developed. The urosome is 6-segmented, including the anatomically sixth and seventh thoracic segments, 3 abdominal segments and an anal segment. The short first urosomal segment bears the simple fifth legs. The large second segment bears the sixth legs and contains a pair of oval spermatophores. The caudal rami are slightly longer than the anal segment, each ramus bearing 2 elongate caudal setae with hyaline flanges.

The body color is comparable to that of the female, but it is much lighter in the male. The eye is red and the gut is orange in color. Many round orange pigment spots are arranged along or surrounding the gut. In some specimens the body color is white and the pigment spots are much smaller in number as in the male of *Haplostomella oceanica*.

The antennule (Fig. 40 d) consists of 8 segments; the first segment is not demarcated from the body surface and is the longest and widest; the second to sixth segments are much wider than long and somewhat compressed; the seventh and eighth segments are narrower and longer than the preceding 5 segments. The ornamentation including setae (s), setules (st), large aesthetes (A) and small aesthetes (a) in these segments (I-VIII) is shown in the following table: I-6s, 1 st, 1A; II-1s, 1A; III-1s, 1A; IV-2s, 1A; V-1s; VI-2s, 1A; VII-2s, 1st, 1a; VIII-5s, 1a. As in other males of the genus, 5 aesthetes (A) on the segments I-IV and VI are extraordinarily long and transparent, with their proportional lengths about 1: 0.8: 0.7: 0.72: 0.5 from the proximal to distal.

The antenna (Fig. 40 c–A2) is cylindrical, about 5 times as long as wide, with a slight lateral curvature. It is incompletely divided into 3 subequal segments by integumental folds. The armature is like that in the female but reduced by 1 lateral setule in the terminal segment, so it consists of 1 small simple seta at the mediodistal corner in the second segment and 2 similar setae near the apical rounded projection in the third segment.

The labrum (Fig. 40 b) is midventrally concave on the posterior free margin as in the female, but the posterolateral corners protruded as rounded lobes are ornamented with tiny hairs as in the male of *H. dubia*.

The mandible (Figs. 40 c–MD) is almost comparable to that of the female: a simple spine is inserted on the slightly swollen surface between the labrum and the labium and close to the mouth-opening. In the male, however, there is a setule behind the spine on the same surface.

The maxilla (Fig. 41 e) is a large conical lobe with 1 short apical plumose seta as in the female. The lobe is divided by a flexure into basal and distal portions with their proportional lengths about 3: 1, measured on the lateral margin. The basal portion is partially sclerotized.

The maxilliped (Fig. 41 f) is composed of 2 large basal segments and a terminal claw complex. The basal segment is rather straight, twice as long as wide, and about 1.3 times as long as the second segment. The second segment is 1.5 times as long as wide, truncated apically, and the mediodistal corner is slightly protruded

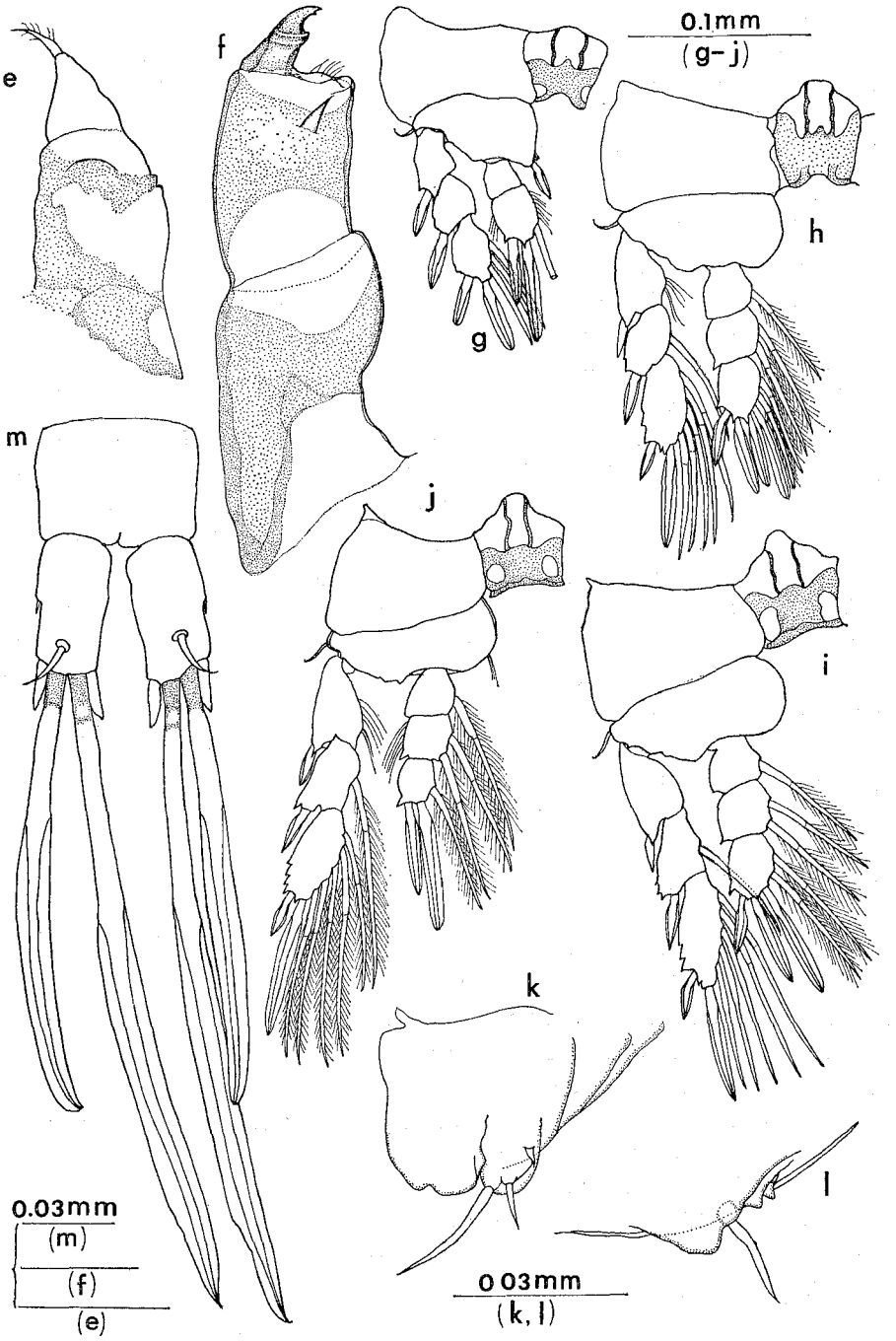


Fig. 41. *Haplostomella distincta*, n. sp., male: e, maxilla; f, maxilliped; g, leg 1; h, leg 2; i, leg 3; j, leg 4; k, leg 5; l, leg 6; m, caudal rami.

into a small rounded projection with rather long hairs. There is a spine-like projection on the anterior surface at the distal third. The claw complex is half as wide as the second basally, probably consisting of a small article fused with a terminal claw, which is slightly curved medially and with a subapical bifurcation.

The first leg (Fig. 41 g) is the smallest of the 4 pairs of swimming legs. It consists of bimerous protopodite and endopodite and trimerous exopodite. The protopodites are connected by a trapezoidal intercoxal plate. The basipodite bears 1 short spine fringed with hyaline flanges at the mediodistal corner and 1 short, slender simple seta on the short lateral margin. The endopodite carries 1 medial plumose seta and 2 spines (1 terminal and 1 lateral) fringed with hyaline flanges on the second segment. Both sides of the second segment are ornamented with hairs. The exopodite has 3 short setae and 4 spines: the first 2 segments each with 1 lateral spine and the third segment with 3 medial setae and 2 spines (1 terminal and 1 lateral). The distal segment of the endopodite and the proximal segment of the exopodite are pointed into spinules near the lateral bases of the spines.

The second leg (Fig. 41 h) is much larger than the first in size and composed of bimerous protopodite and trimerous rami. The intercoxal plate is well developed and protruded on the proximal margin. The basipodite bears 1 short slender seta on the lateral margin. The endopodite bears 5 plumose setae and 4 spines fringed with hyaline flanges: the basal segment with 1 medial seta; the second segment with 2 medial setae; the third segment with 2 medial setae and 4 spines (2 medial, 1 terminal and 1 lateral). The exopodite bears 6 setae and 4 spines: the basal segment with 1 short lateral spine; the second segment with 1 medial seta and 1 short lateral spine; the third segment with 5 medial setae and 2 terminal spines (1 short and 1 long). The medial margin of the first segment is ornamented with hairs. The lateral margins of the segments have a tendency to serration with spinules protruded from the margins. There are similar spinules generally at the lateral bases of the spines in the endopodite.

The third leg (Fig. 41 i) is slightly larger than the second with the same general structure. However, the endopodite is reduced by 1 medial spine in the third segment. Thus the ramus has 5 setae and 3 spines. The exopodite carries 6 setae and 4 spines as in the second.

The fourth leg (Fig. 41 j) is similar to the third in structure but again reduced in armature. The endopodite is reduced by 1 medial seta and 1 lateral spine in the third segment, so it has 4 setae and 2 spines. The exopodite has 6 setae and 4 spines as in the preceding legs.

The fifth leg (Fig. 41 k) is characteristic, formed as a broad and relatively flat projection from the segment. It is apically divided into 2 somewhat rounded lobes; the medial (or ventral) lobe is narrower than the lateral (or dorsal) and bears 1 short medial and 1 long lateral non-plumose seta on the apical margin and also 1 setule more proximally and medially.

The sixth leg (Fig. 41 l) consists of a triangular small lobe protruded from the distal margin of the usual leg-lappet, with 3 elements of armature on the lobe: 1

relatively long non-plumose seta at about the middle of the medial margin; 2 small spiniform projections on the more medial margin.

The caudal ramus (Fig. 41 m) is cylindrical and twice as long as wide. Terminally the ramus bears 2 elongate setae fringed with hyaline flanges. The medial seta of these is 5 times as long as the caudal ramus and about 1.5 times the legnth of the lateral seta. The apex also has 2 stout simple spines at the sides of these setae. Dorsally the ramus bears 1 short simple seta at the distal fifth and laterally 1 small setule midway on the margin.

Remarks: The female belongs to the fusiform type, in which *Haplostomella australiensis* and *H. halocynthiae* living in solitary ascidians are included. However, the present species living in compound ascidians is much smaller in size, and is without the well-developed dorsolateral plates which are characteristic for the haplostomellids from solitary ascidians. The feature which is readily distinguishable from all other species including the 2 species mentioned is in the first 4 legs, in which each endopodite is deeply divided at the apex into 2 lobes.

The male closely resembles anatomically the male of *Haplostomella oceanica*. The present species is different from the latter species by having the maxilla with 1 terminal seta (2 setae in *H. oceanica*) and by the the characteristic fifth and sixth legs.

Both sexes of the present species are generally found in undefined positions of the matrix of 2 ascidians, *Amaroucium arenatum* and *A. glabrum*. Paired egg sacs are often found in the intestine of a zooid. A female specimen was obtained from the intestine of a zooid as previously mentioned in *Haplostoma minutum* (p. 43).

Haplostomella oceanica, new species

(Figs. 42–45, Pl. I, Fig. 3)

Type: Holotypic female, USNM 169528 (type locality, Tatoosh Island, off Cape Flattery, Washington, April 7, 1966, from *Eudistoma ritteri* Van Name); allotypic male, USNM 169529, Cape Flattery, Washington, Aug. 17, 1966, from *Eudistoma ritteri* Van Name; paratypes and all other specimens listed below.

Specimens examined:

Washington

From *Eudistoma ritteri* Van Name:

Cape Alava, 48°95′N., 124°44′W., lowest intertidal, June 5, 1966, 6 females; Tatoosh Island, off Cape Flattery, 48°24′N., 124°44′W., April 7, 1966, 6 females (including holotype and 5 females, USNM 169530); Cape Flattery, 48°23.31′N., 124°43′W., lowest intertidal, Aug. 17, 1966, 13 females and 5 males (including allotype).

From *Amaroucium arenatum* Van Name:

Mukkaw Bay, just above water line at 0.0 tide, March 3, 1966, 1 female.

British Columbia

From *Eudistoma ritteri* Van Name:

Whiffin Spit, Sooke, 48°21′N, 123°43.9′W., lowest intertidal, June 29, 1965, 4 females, July 27, 1965, 3 females, Aug. 27, 1965, 5 females.

DESCRIPTION: Female: The body (Fig. 42 a–c) is cylindrical and of vermiform appearance with a slight dorsal curvature. The body regions are not strongly separated but subdivision is indicated by indentations and the positions of legs and genital apparatus into cephalosome, metasome and urosome, with their proportional lengths about 1 : 6 : 1.2. The body length of a representative specimen is 2.4 mm, measured from the tip of the cephalosome to the end of the caudal rami. The cephalosome is nearly triangular with the basal width greater than the length. Dorsally it has a sclerotized cephalic plaque (Fig. 42 d) with distinct semicircular posterolateral margins. The plaque is covered with hairs growing from mammiform projections arranged sparsely and symmetrically. The cephalosome (Fig. 42 e) has 5 pairs of appendages: antennules, antennae, mandibles, maxillae and maxillipeds. It lacks maxillules. The rostrum is not conspicuous.

The metasome is divided into 5 segments, with their proportional lengths about 1: 1.5: 1.7: 1.7: 1.5. Their proportional widths are not much different from each other, but the third and fourth segments are somewhat wider than the others, with their width 0.5 mm. Each segment has a pair of legs, although the fifth pair is of reduced form. The legs on each segment are well separated and situated on the ventrolateral sides. In direct relation to the positions of the legs each segment carries a pair of dorsolateral plates (Fig. 42 b). Each plate (Fig. 42 f) is sclerotized in a nearly equilateral triangular shape with a somewhat rounded marginal posterolateral corner, and covered with a few hairs arising from mammiform projections. When the body is well constricted the plates participate in forming an integumental fold like an articulation between the somites dorsally as in *H. distincta*. In relation to the first 4 pairs of legs, there is a ventral broad integumental fold formed by the distal end of each segment between the legs. Distinctly arranged lateral groupings of 3 tubercles are located near the insertions of limbs and between the limbs and the corresponding dorsolateral plicae (Figs. 42 b; 43 r).

The urosome is short and unsegmented. Anteriorly it is not demarcated from the metasome which is at that point the same width as the anterior part of the urosome, but it abruptly constricts behind the anterior part which includes the oviducal apertures at the dorsolateral sides. Each oviducal aperture is covered by an oval plate (Fig. 42 g), which is marginally sclerotized to enclose a smaller oval, less sclerotized area centrally, and a semicircular sclerotized fold. The anterior margin of the fold is articulated with the inner posterior margin of the central, less sclerotized area, but its ventral side is connected with the ventral marginal plate. The undersurface of the fold (Fig. 42 h) has a transverse row of 3 relatively slender spines. The egg sacs are attached to the oviducal apertures by adhesion to the spines. Each egg sac is about 6 times as long as wide and two thirds the body length, packing about 40 eggs within its thin wall. In some specimens the eggs in the sac are relatively larger in size but smaller in number. A small round insemination pore (Figs. 42 c; 43 t) is located midventrally at about the distal two fifths of the urosome. The anus opens as a posterodorsal slit. There is a pair of tiny but distinct mammiform projections on the dorsal side opposite the corresponding side of

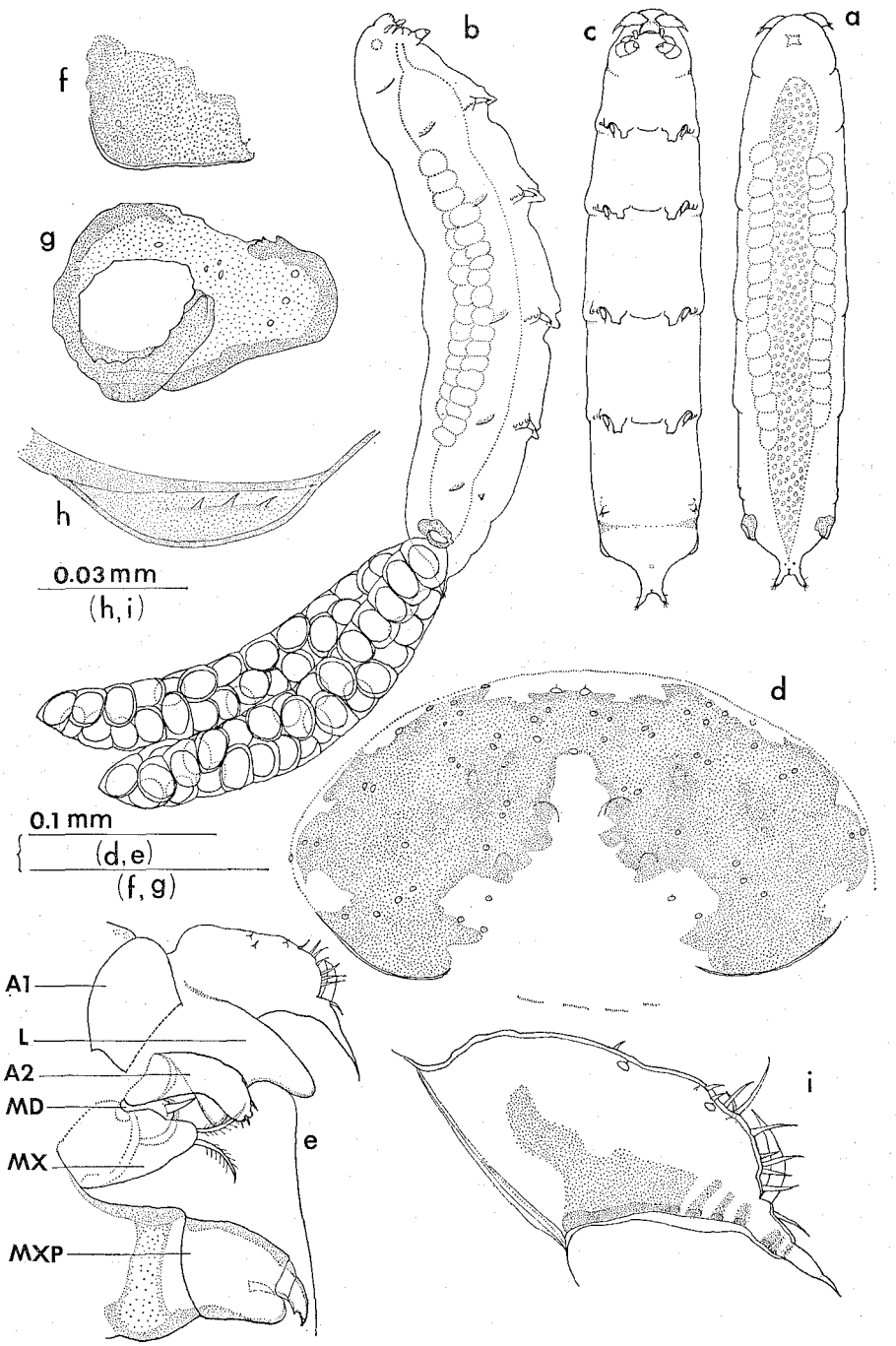


Fig. 42. *Haplostomella oceanica*, n. sp., female: a, dorsal; b, lateral; c, ventral; d, apical plaque; e, oral area, ventrolateral; f, dorsolateral plate of lst metasomal segment; g, apparatus at oviducal aperture, left; h, fold covering oviducal aperture, internal; i, antennule. Key to abbreviations: A1, antennule; A2, antenna; L, labrum; MD, mandible; MX, maxilla; MXP, maxilliped.

the insemination pore and anterior to the anal slit. The caudal rami diverge posterolaterally at an angle of more than 45°.

The body color is transparent orange. The color is faint in the cephalosome and urosome but rich in the metasome, here partially tinted with red. The yellow gut is straight and large, lying between the oviducts which usually contain dark purple ova. The small eye is red in color. The body wall is covered with many transverse denticle rows, mainly located on the ventral side, and with hairs growing from mammiform projections on the dorsal side.

The antennule (Fig. 42 i) is a relatively large unsegmented lobe with several integumental sclerotized areas. It is abruptly constricted at the distal sixth and terminates in a narrow cylindrical portion. The large proximal portion bears 11 short simple setae along the distal half of the anterior margin. The apical narrow portion has 2 large, stout non-plumose setae. One of them is inserted at the anterior base, but is strongly directed toward the proximal portion, bordering along its anterior margin. The remaining seta is set at the apex, with the basal width the same as the apical portion. There is 1 short seta between these 2 large setae.

The antenna (Fig. 43 j) is a cylindrical unsegmented lobe with a slight lateral curvature. It has a suggestion of subdivision into 3 segments by regional sclerotizations, with their proportional lengths about 3: 1: 1 from the first to third. The structure and armature are basically comparable to those in the female of *H. distincta*. The presumably second segment bears 1 small simple seta at the mediodistal corner. The terminally rounded third segment is ornameted by a few hairs near the apex. The medial side has a small mammiform projection near the tip and there is 1 short simple seta before the projection and 1 similar seta behind it. The lateral margin of the segment bears 1 setule distally.

The labrum (Fig. 43 k) has the posterior free margin concave corresponding with the convex anterior border of the labium as in other species of the genus.

The mandible (Fig. 43 l) is reduced into a relatively long, apically serrated spine, with a slight anterior curvature, articulated on a reduced, rounded prominence. The prominence is located at the side of the mouth-opening between the labrum and labium, and the spine is directed medially beneath the labrum.

The maxilla (Fig. 43 m) is an unsegmented lobe with a subtriangular configuration in the posterolateral view. Distally it is constricted, thus forming narrow distal and broad proximal portions. The appendage is medially directed, and the lateral margin is much shorter than the medial margin, which is strongly curved at an angle of over 45°. The armature is distinctive, consisting of 2 well-developed plumose setae at the somewhat truncated apex.

The maxilliped (Fig. 43 n, o) consists of 2 large basal segments with a terminal claw complex. The first segment is very wide, nearly as long as the second and gradually tapers. The second segment is about as long as wide, with the same width as the first basally, and the mediodistal corner is protruded into a large projection with a pointed tip. The anterior side of the projection (Fig. 43 p) has 2 small spiniform protrusions, and posteriorly to the base there is articulated 1 stout spine.

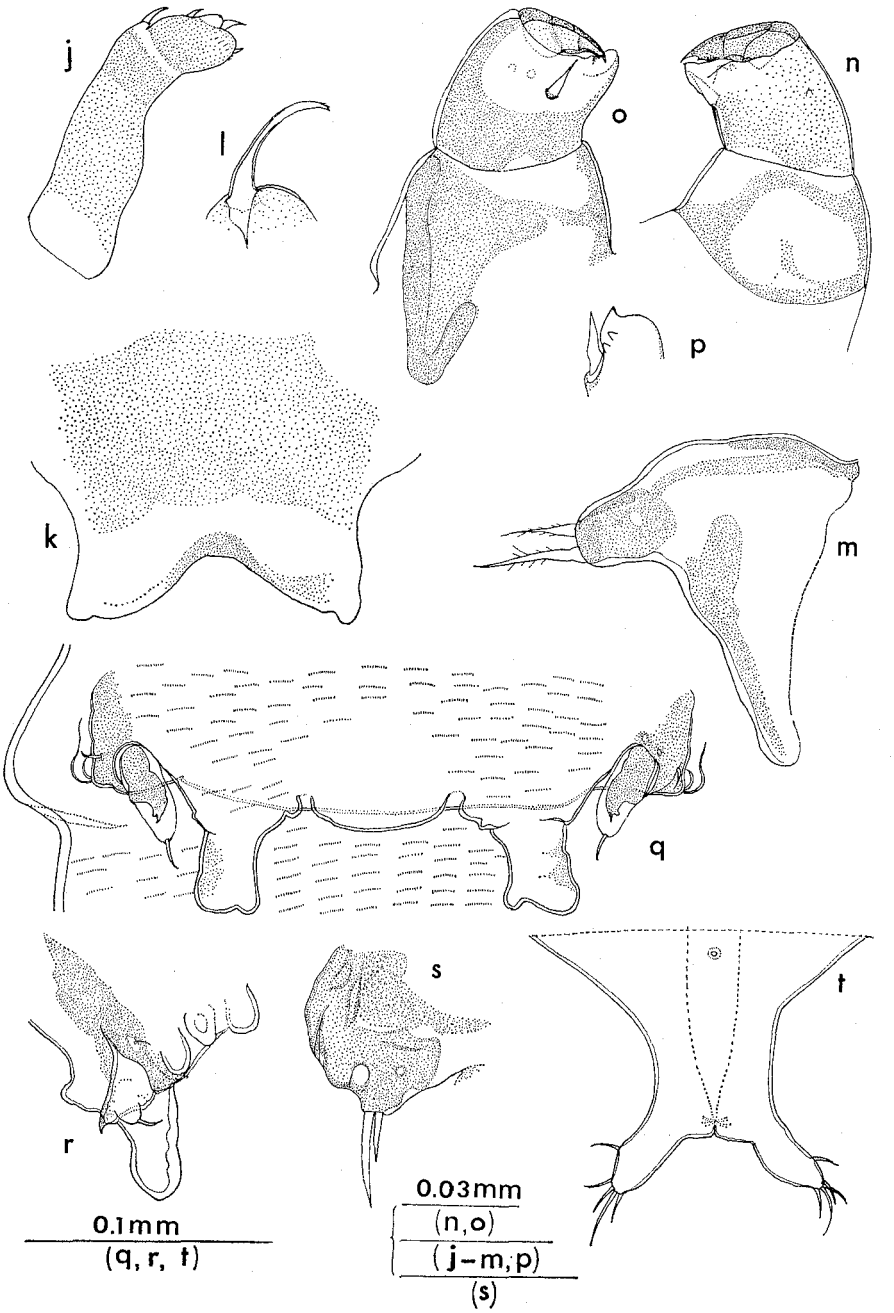


Fig. 43. *Haplostomella oceanica*, n. sp., female: j, antenna; k, labrum; l, mandible; m, maxilla; n, maxilliped; o, same, anterior; p, same, mediodistal corner of 2nd segment, anteromedial; q, lst legs; r, lst leg, left, ventrolateral; s, leg 5; t, urosome, showing insemination pore and caudal rami.

The claw complex includes a small article (probably the third segment) fused with a claw terminally. The terminal claw forms an articulative line at about the middle. The claw complex is opposed to the second segment in a cheliform appearance.

The first to fourth legs (Figs. 43 q, r) are almost the same in size and structure. The protopodite is not articulated with the body surface but marked off by its integumental sclerotization, in which 1 simple lateral seta is located, representing the usual basipodite seta, and 2 hairs are placed behind the exopodite. There is a large medial cylindrical projection from the body surface, much longer than the exopodite, representing the endopodite and probably including some of the protopodite. Distally this lobe is slightly divided into narrow medial and broad lateral parts. Proximally the medial margin has a small integumental swelling. The exopodite is an elongate lobe, dividing into shorter anterior and longer posterior lobules. The anterior lobule is pointed at the apex like a spine, and the surface of the ramus including the apical spine is well sclerotized. The sclerotization is again protruded into a small rounded projection near the spine on the lateral margin. The posterior lobule is apically rounded, bearing 1 short simple seta at the apex.

The fifth leg (Fig. 43 s) is represented by 2 unequal simple setae inserted on a small lateral projection from the fifth metasomal segment. The projection is half as large as the fifth dorsolateral plate and well sclerotized.

The caudal ramus (Fig. 43 t) is twice as long as its proximal width and the distal half tapers gradually, bearing 5 setae including 1 terminal, 3 subterminal (laterally, medially and dorsally) and 1 lateral seta at about the midpoint of the margin.

Male: The body (Fig. 44 a, b) is well segmented, with the usual pattern for the *Haplostomella* males. The length of a representative specimen is 1.14 mm, measured from the anteriormost point of the cephalosome to the end of the caudal rami, and the total length including the caudal setae is 1.35 mm. The widest part which occurs on the first metasomal segment is 0.21 mm wide. The cephalosome is nearly triangular, without a distinct rostrum, although the head region between the antennules is slightly protruded ventrally and sclerotized. The median eye is well developed. The head appendages (Fig. 44 c) are composed of antennules, antennae, mandibles, maxillae and maxillipeds. Maxillules are absent.

The metasome is 4-segmented, each segment bearing a pair of swimming legs; the first endopodites are unsegmented.

The urosome is 6-segmented: the first segment is short, much narrower than the last metasomal segment, and bears the simple fifth legs comparable to those in the female; the large second segment is longer than wide, 3.6 times as long as the first, having the usual sixth leg-lappets and containing a pair of oval spermatophores; the third segment is much narrower and shorter than the second and the succeeding 2 segments are again decreased in size and without limbs; the sixth and last segment is the smallest, with the anus which opens as a posterodorsal slit. The cylindrical caudal rami are slightly longer than the anal segment, each bearing a pair of long caudal setae with hyaline flanges.

The body color is white, with a brilliant red eye and narrow yellow or orange

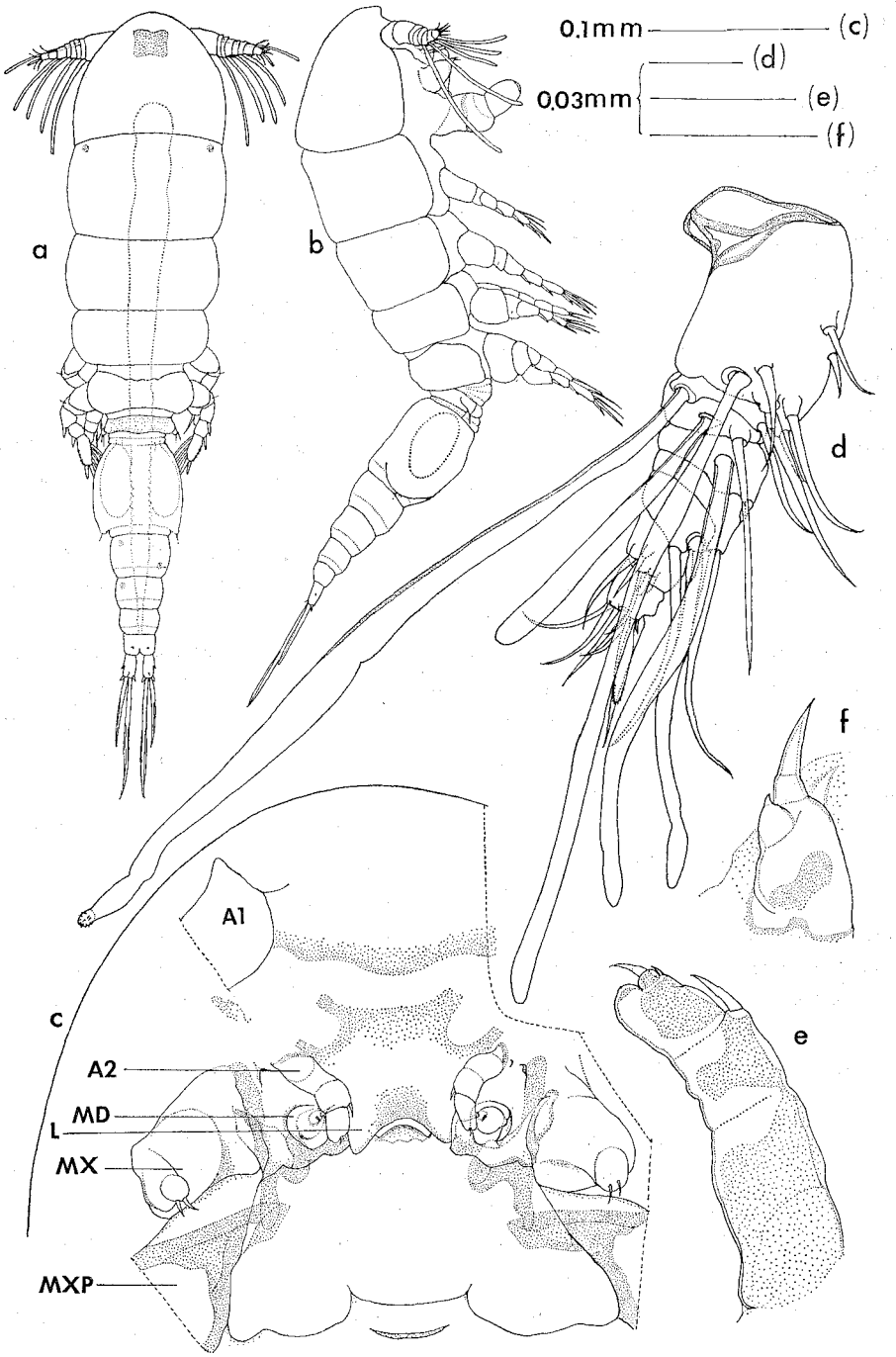


Fig. 44. *Haplostomella oceanica*, n. sp., male: a, dorsal; b, lateral; c, oral area; d, antennule; e, antenna; f, mandible. Key to abbreviations: A1, antennule; A2, antenna; L, labrum; MD, mandible; MX, maxilla; MXP, maxilliped.

gut. The colors for the eye and gut are comparable to those of the female. Under the body wall there are small red pigment spots internally: a pair of them in the first metasomal segment; 3 or 4 pairs, situated rather ventrally, in the second urosomal segment; a pair in the third; a single spot in the fourth (left side).

The antennule (Fig. 44d) is 8-segmented and gradually tapers from the first segment to the eighth. The first segment is well articulated on the body surface and is the largest, occupying nearly the proximal two fifths of the total length. The second to sixth segments are much wider than long. The seventh and eighth segments are narrower than the preceding segments and the distal end of the eighth is truncated. The ornamentation is as in the following tabulation of the arrangement of setae (s), setules (st), large aesthetes (A), and small aesthetes (a), in the first to eighth segments (I-VIII): I-6s, 1A; II-1s, 1A; III-1s, 1A; IV-1st, 1A; V-1s; VI-2s, 1A; VII-5s; VIII-5s, 1st, 1a. The 5 large aesthetes (on I, II, III, IV and VI) are extremely long and transparent, with their proportional lengths about 1: 1.2: 0.4: 0.7: 0.5. The longest aesthete (on II) is tipped by hairs at the apex. The small aesthete (on VIII), covered by hairs at the apex, is about one ninth as long as the longest one, and is accompanied by a setule-like projection protruded from its base.

The antenna (Fig. 44 e) is comparable to that of the female in structure. It is of cylindrical appearance with a slight lateral curvature. As in the female it is roughly divided into 3 segments with their proportional lengths about 3: 1: 1 from the first to third. The second segment has 1 short, stout simple seta at the mediodistal corner. The third segment is slightly notched at the apex by a central groove, dividing into a rounded projection medially and one laterally. The medial projection has 1 short simple seta at the posterior side and 1 setule at the medial side of the base. One more setule at the lateral base of the lateral projection in the female is indistinct in the male.

The labrum and labium (Fig. 44 c) are similar to those of the female.

The mandible (Fig. 44 f) is composed of a stout conical lobe, with a stout simple spine at the tip and a setule on a small rounded bulge protruded from the posterolateral margin. The appendage is basically comparable to that in the male of *H. distincta* in structure and armature.

The maxilliped (Fig. 45 h) consists of 2 large basal segments and a terminal claw complex. The first segment is of cylindrical appearance, longer and wider than the second, and partially well sclerotized, with the less sclerotized flexible part mediproximally. The second segment tapers gradually, with the same width as the first basally, and the mediodistal corner is protruded into a large rounded projection with apical hairs. On the anterior surface of the segment there is a plumose seta at the base of the projection and just behind the medial base of the claw complex. The terminal claw complex (Fig. 45 i) includes a small article firmly fused with an apical claw which has a medial curvature and is slightly bifurcated distally. The claw has an articulative line at about the middle. The opposition of the claw complex to the second segment produces a substantially cheliform appearance.

Through the 4 pairs of swimming-type legs the exopodites are gradually increased

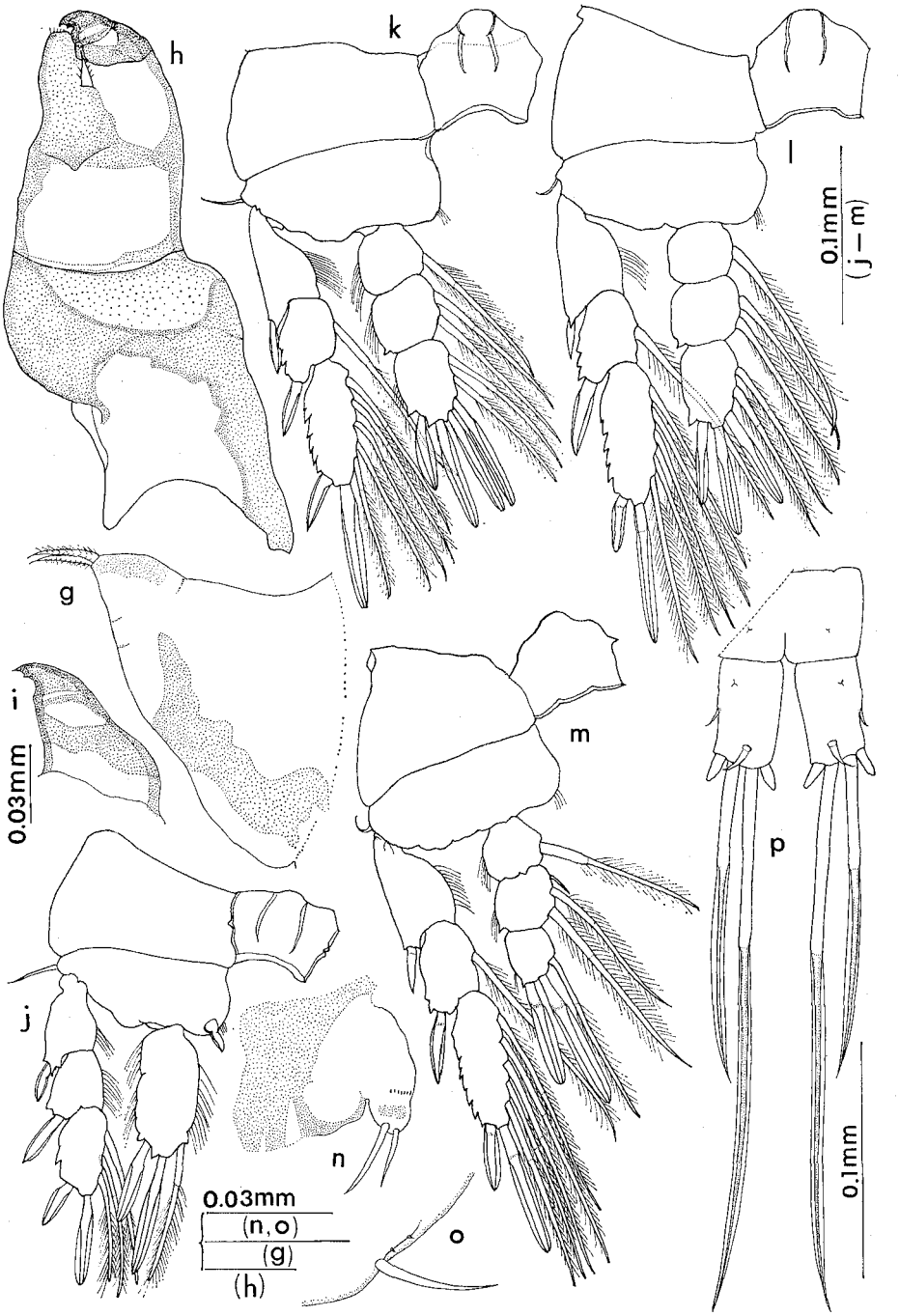


Fig. 45. *Haplostomella oceanica*, n. sp., male: g, maxilla; h, maxilliped; i, same, apical claw; j, leg 1; k, leg 2; l, leg 3; m, leg 4; n, leg 5; o, leg 6; p, caudal rami.

in length, from the first to fourth, with their proportional lengths about 1: 1.3: 1.4: 1.4. In each leg the endopodite is always shorter than the corresponding exopodite and the coxopodite lacks a coxal seta. The first leg (Fig. 45 j) consists of bimerous protopodite, unimerous endopodite and trimerous exopodite. The coxopodites are connected medially by a subrectangular intercoxal plate. The basipodite carries 1 short spine at the mediodistal corner, several hairs behind it and 1 short simple seta on the lateral margin. The endopodite is two thirds as long as the exopodite and bears 1 mediosubterminal plumose seta and 2 spines (1 terminal and 1 laterosubterminal) fringed with hyaline flanges. These seta and spines are each accompanied by a proximal spinule protruded from the segment. Both lateral and medial margins of the ramus are armed with marginal hairs. The exopodite is provided with 3 plumose setae and 4 spines fringed with hyaline flanges: each of the first 2 segments has 1 lateral spine at the distal corner and hairs on the medial margin; the third segment bears 3 medial setae and 2 spines (1 terminal and 1 distolateral). The lateral margins in these 3 segments are partially serrated with spinule-like projections from the segments.

The second leg (Fig. 45 k) consists of bimerous protopodite and trimerous rami. The basipodite bears 1 short simple seta on the lateral margin and hairs on the mediodistal corner. The intercoxal plate is well developed. The endopodite carries 5 plumose setae and 4 spines fringed with hyaline flanges: the first segment with 1 medial seta; the second segment with 2 medial setae; the third segment with 2 medial setae and 4 spines (2 mediosubterminal, 1 terminal and 1 distolateral). Each segment is ornamented with hairs on the lateral margin. The distolateral corner of the second segment and the bases of the lateral and terminal spines of the third segment are pointed. The exopodite bears 6 plumose setae and 4 spines fringed with hyaline flanges: the first segment with 1 lateral spine at the produced distal corner and hairs on the medial margin; the second segment with 1 medial seta and 1 lateral spine; the third segment with 5 medial setae and 2 spines (1 terminal and 1 laterosubterminal). The second and third segments are distinctly serrated with 3 and 6 spinules protruded from the lateral margins respectively.

The third leg (Fig. 45 l) is similar to the second in structure and armature, except that the endopodite is reduced by 1 mediosubterminal spine from the second. Thus the endopodite has 5 setae and 3 spines and the exopodite bears 6 setae and 4 spines.

The fourth leg (Fig. 45 m) is again reduced by 1 medial seta and 1 mediosubterminal spine on the terminal segment of the endopodite. Thus the endopodite bears 4 setae and 2 spines. The exopodite has 6 setae and 4 spines as in the preceding legs.

The fifth leg (Fig. 45 n) is represented by a small lateral projection consisting of broad proximal and narrow distal portions. The distal portion is a small cylindrical lobe protruded from the medial side of the proximal portion and bears 2 short simple setae at the rounded apex. There is a row of denticles on the proximal surface of the distal portion.

The sixth leg (Fig. 45 o) is a simple structure with 1 short slender seta on the distal margin of the large lappet protruded from the segment. There are 2 spinules

placed side by side on the ventral margin near the seta.

The caudal ramus (Fig. 45 p) is cylindrical, twice as long as wide, bearing 2 long terminal setae, 2 short stout spines at the sides of the terminal setae, 1 short dorsal seta at the distal fifth and 1 lateral setule about midway on the margin. At the apex, the medial seta is about 1.5 times as long as the lateral seta. Both the terminal setae are fringed with hyaline flanges along the margins from the distal two thirds to the tip in each.

REMARKS: The female is easily distinguishable from other *Haplostomella* species in our area by its cylindrical appearance with the short urosome and by the characteristic body color mentioned previously. However, the species resembles *H. malacocera* from the Mediterranean Sea and *H. sycozoae* from the South Atlantic Ocean, being cylindrical in appearance. Among these 2 known species, the present species is closely related to *H. malacocera* with 5 setae on the caudal ramus (*H. sycozoae* without the setae), but it is different from *H. malacoera* in the following anatomical details: the antennule with 2 large terminal setae which are directed in opposite directions from each other (*H. malcocera* with 3 large termical setae normally arranged); the maxilla with 2 terminal plumose setae (*H. malacocera* with 1 seta, in the mandible by Chatton & Harant (1924c)); the fifth leg with 2 setae (*H. malacoera* with 2 setae and 1 spine).

The maxilla of the male is comparable to that of the female and is also a distinct characteristic of this species from other *Haplostomella* males.

Both sexes generally live in undefined positions in the matrix of the ascidian host, *Eudistoma ritteri*. However, the female often can be found in the intestine of a zooid of the ascidian, directing her head toward the stomach, as seen in Pl. I, Fig. 3. *Haplostoma setiferum* is another associate of this ascidian. A specimen of the female was obtained from *Amaroucium arenatum*.

Haplostomella reducta, new species

(Figs. 46–49)

TYPES: Holotypic female, USNM 169531 (type locality, East of Frost Island, San Juan Archipelago, Washington, June 30, 1966, from *Distaplia occidentalis* Bancroft); allotypic male, USNM 169532, same locality and host; paratypes and all other specimens listed below.

SPECIMENS EXAMINED:

WASHINGTON

From *Distaplia occidentalis* Bancroft:

Potato Patch, 48°34.6′N., 122°51′W., 23 fams., June 19, 1965, 10 females; Near Decatur Id., 48°32.5′N., 122°50′W., 12–13 fams., June 29, 1965, 4 females; West side of Blakely Island, 48°34′N., 122°50′W., 17 fams., July 21, 1965, 7 females, 4 males; East of Frost Island, 48°32.8′N., 122°50.6′W., 25 fams., June 30, 1966, 13 females, 10 males (including holotype, allotype and 5 females, 1 male, USNM 169533).

DISCRIPTION: Female: The body (Fig. 46 a–c) is stout and cylindrical with

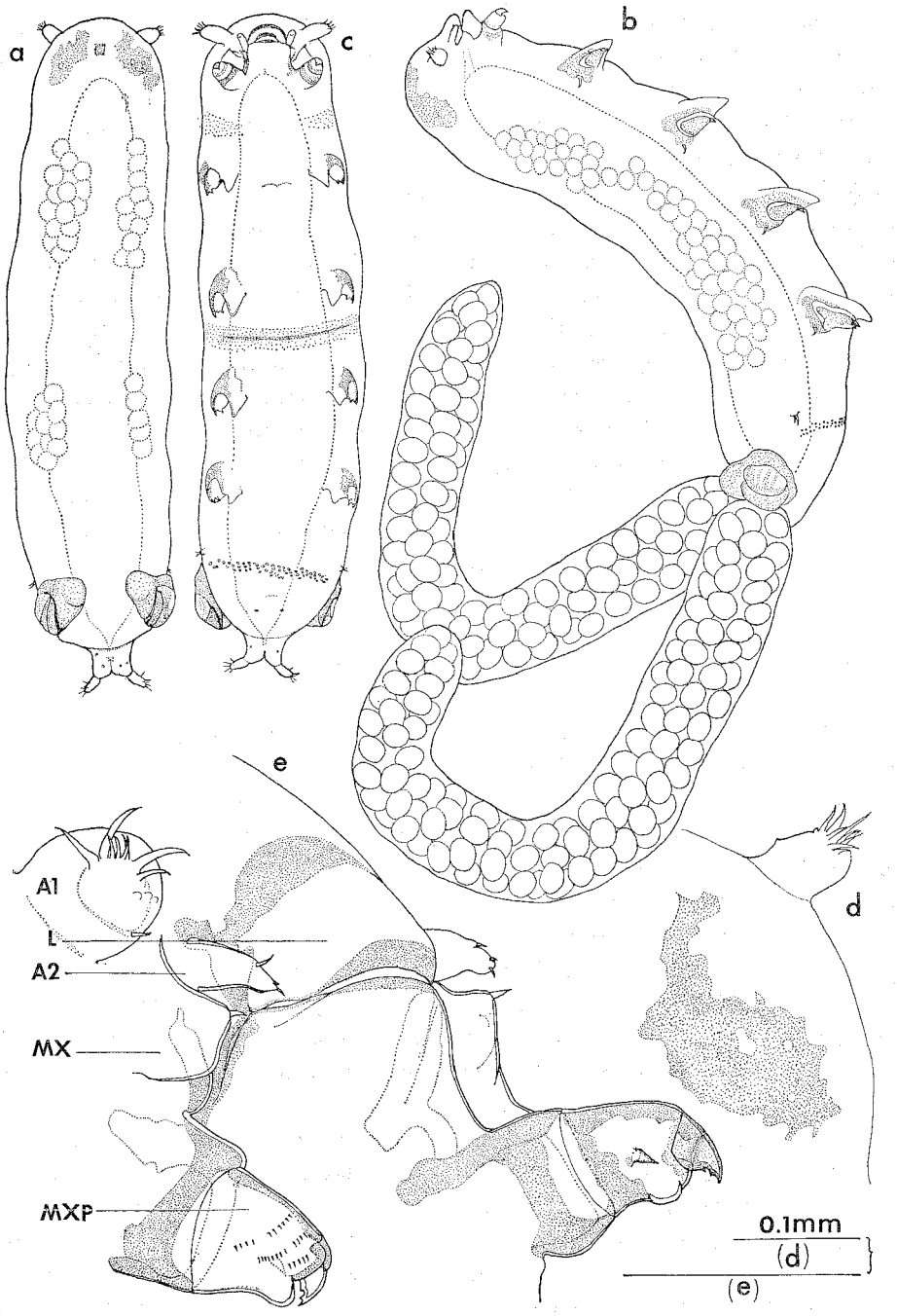


Fig. 46. *Haplostomella reducta*, n. sp., female: a, dorsal; b, lateral; c, ventral; d, cephalic plaque, right; e, oral area, ventrolateral. Key to abbreviations: A1, antennule; A2, antenna; L, labrum; MX, maxilla; MXP, maxilliped.

a slight dorsal curvature. The body regions of cephalosome, metasome and urosome are delimited only by very shallow grooves at the limits of the regions and by the positions of the legs and oviducal apertures. The body length of the usually encountered representative specimen is 2 mm, from the anteriormost on the cephalosome to the end of the caudal rami. The cephalosome (Fig. 46 d, e) is anteriorly rounded, without rostrum, dorsally sclerotized, and ventrally has antennules, antennae, ?mandibles (extremely reduced), maxillae and maxillipeds. Maxillules are absent. The metasome is divided into 5 leg-bearing segments, although the fifth segment has reduced legs. Their proportional widths are not much different from each other; the widest part, which occurs on the second and third segments, is 0.5 mm. In a giant specimen, the body length is 4 mm and the widest part is 1 mm.

The 5 metasomal segments are not clearly articulated but marked off only by an undulating body outline between the segments. The first 4 pairs of legs are characteristic, with relatively large rami including pointed endopodites. The legs of each pair are separated from each other, without any transverse integumental fold or projection between the legs. The fifth legs are situated laterally on the small conical protrusions from the segment, as if they were directly inserted on the body surface. The ventral surface of the segment between the fifth legs is covered with many characteristic small tubercles (Figs. 46 c, 47 h), which are about 90 in number. There are neither dorsolateral plates nor lateral tubercles developed in relation to the 5 pairs of legs.

The urosome is relatively short, about as long as the cephalosome, and one fourth the length of the metasome. Anteriorly it is not distinctly demarcated from the metasome but it is abruptly constricted behind the oviducal apertures. Each oviducal aperture is covered by an oval plate (Fig. 47 f) and semicircular fold of cuticle. The plate has a marginal sclerotization encircling a central, less sclerotized, oval area. The fold (Fig. 47 g) is sclerotized, with a posterior free margin. Its undersurface has 3 spines protruded from the surface. The oviducal aperture is a wide slit between the fold and the sclerotized marginal plate posteriorly. The egg sacs (Fig. 46 b) are longer than the body and attached to the oviducal apertures. A small insemination pore (Fig. 47 h) lies midventrally on the narrow posterior urosomal part, just behind the level of the posterior end of the oviducal apertures. The anus opens as a posterodorsal slit. The caudal rami are diverged posterolaterally, with an angle of more than 45° between them, and bear several small setae.

The body is white, with a small red eye, yellow or orange gut, and pale purple ova in the oviducts. The eggs in the egg sacs are lavender pink in color. In a giant specimen the bulky gut is brownish. In the cephalosome there are 1 or 2 pairs of small round pigment spots on the dorsal side. Similar pigment spots are located in the narrow urosomal part. Ventrally there is a large pigment mass around the mouth opening. The body wall is covered with many rows of denticles on the ventral side (Fig. 47h).

The antennule (Figs. 47 i) is a short expanded lobe with rounded apical margin. The armature consists of 12 relatively short, stout non-plumose setae including 1

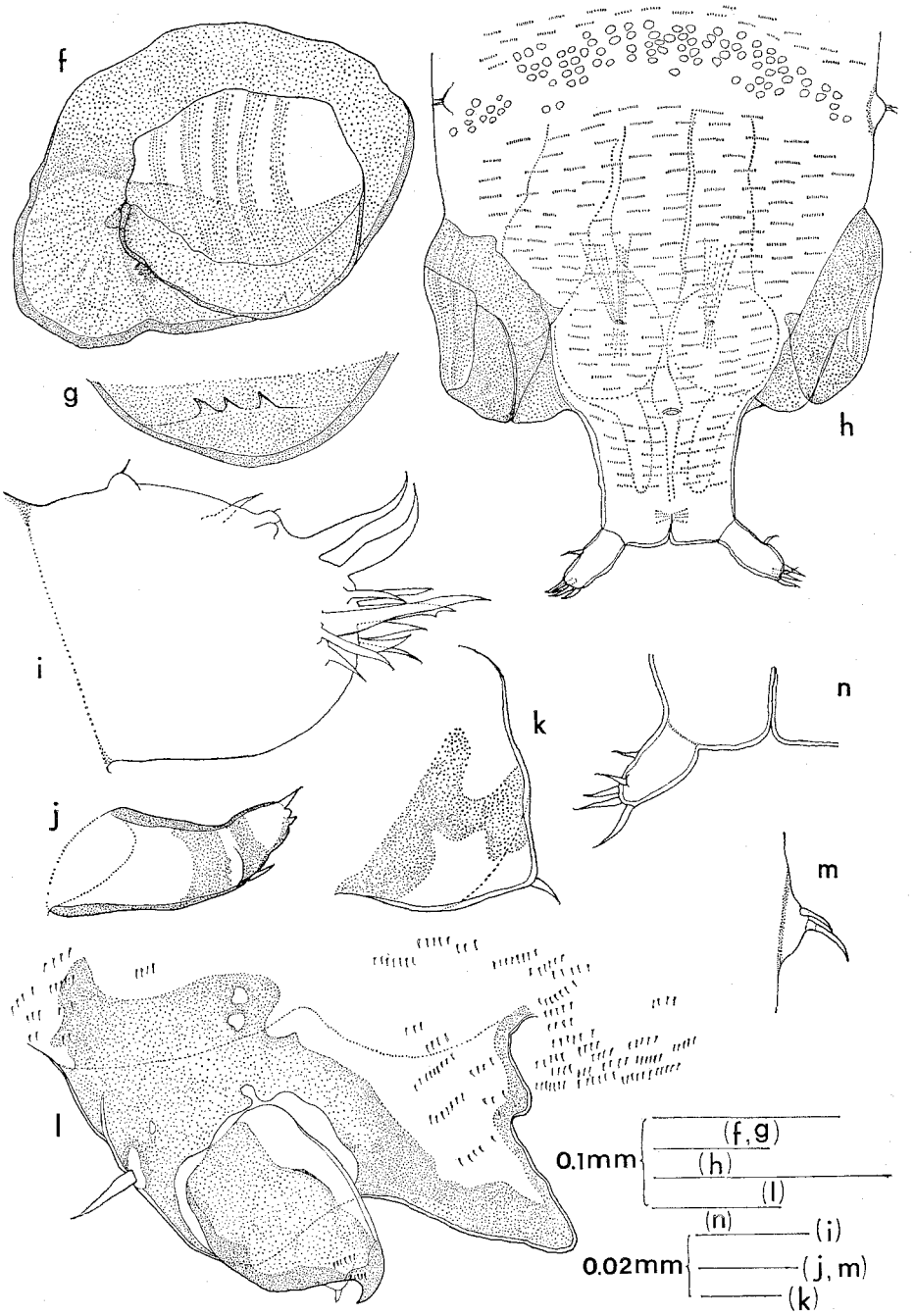


Fig. 47. *Haplostomella reducta*, n. sp., female: f, apparatus at oviducal aperture; g, fold covering oviducal aperture, internal; h, urosome, ventral; i, antennule; j, antenna; k, maxilla; l, leg 3; m, leg 5; n, caudal ramus.

spiniform, apically bifurcated element. Most of the setae are set on the terminal margin, and 1 seta and 3 hairs growing from mammiform projections are arranged on the anterior margin.

The antenna (Fig. 47 j) is a narrow cylindrical lobe with a slight lateral curvature and tapers slightly apically. It is ornamented by 1 short simple seta at the distal fourth on the medial margin and 1 similar seta (laterally) and 1 setule (medially) on the apex. The margin between the apical lateral seta and medial setule is protruded into a rounded mammiform projection. The cuticle is sclerotized in a pattern suggesting perhaps 3 ingredient segments, although there are no joints on the appendage.

The labrum (Fig. 46 e) has a broad smooth free margin, slightly concave on the central distal margin to meet the convex distal margin of the labium.

The mandible is reduced and usually not discernible. However, the remnant of the appendage may be found at the usual place for the appendage.

The maxilla (Fig. 47 k) is a triangular lobe bearing 1 simple seta at the tip.

The maxilliped (Fig. 46 e) consists of 2 large basal segments and an apical claw complex. The structure and armature are similar to those of *H. oceanica* and *H. distincta*. The first segment is slightly shorter than the second, measured on the lateral margin, and without articulation with the body surface. The second segment is somewhat longer than wide and the mediodistal corner is protruded into a rounded projection. The segment is ornameted with 1 short simple spine on the anterior surface near the projection and several transverse rows of denticles on the posterolateral margin. The articulation of the terminal claw complex occupies only a part of the terminal margin of the second segment. The complex includes a small basal article fused with an apical claw; the claw is relatively short, 1.5 times as long as the article and the medial distal margin is serrated with 2 tiny spinules protruded from the margin.

The first to fourth legs (Fig. 47 l) resemble each other in structure and armature. Each leg is relatively large and is somewhat modified from the usual type of leg for the genus. The protopodite is not articulated with the body surface but is marked off by the sclerotized integument, with 1 short simple seta representing the usual basipodite seta, behind the exopodite on the lateral margin.

The endopodite is represented by a triangular projection protruded from the body surface and probably includes part of the protopodite basally. It is longer than the exopodite and the medial margin is protruded into a small rounded projection at the proximal third. The structure is sclerotized along the medial and lateral margins, and the anterior surface, as well as that probably belonging to the protopodite, is ornamented with many rows of denticles. Similar denticles are located on the ventral surface between the legs of the pair.

The exopodite is an unsegmented conical lobe, well articulated in a large depression in the protopodite. The apex of the ramus is bilobed anterior-posteriorlly. The anterior lobule is heavily sclerotized and terminates in a strongly and laterally curved spine ornamented with 2 rows of denticles basally. The posterior lobule is

less sclerotized, slightly shorter than the anterior and bears 1 small simple seta at the rounded tip.

The fifth leg (Fig. 47 h, m) is represented by 2 short simple setae and probably in part by the short prominence on which they are set.

The caudal ramus (Fig. 47 n) is cylindrical and 2.5 times as long as its proximal width, obscurely articulating diagonally with the urosome. The armature consists of 5 short setae, including 1 lateral seta midway on the margin, 1 terminal seta, 2 subterminal setae (at the sides of the terminal seta) and 1 dorsal seta near the terminal seta.

Male: The body (Fig. 48 a, b) is of the swimming type for the genus. The body length of a representative specimen is about 1.4 mm, from the anteriormost to the end of the caudal rami. The total length including the terminal caudal setae is 1.6 mm. The body is composed of the cephalosome, metasome and urosome. Dorsally the cephalosome is covered with hairs growing from small but distinct mammiform projections which are placed symmetrically (Fig. 48 c). Anteriorly the cephalosome is well sclerotized, without a rostrum. The median eye is relatively small in comparison with that of other species. The head appendages consist of antennules, antennae, mandibles, maxillae and maxillipeds, although the mandibles are extremely reduced (Fig. 48 d). Maxillules are absent.

The metasome is composed of 4 segments each bearing a pair of legs; the endopodites of the first pair of legs are 2-segmented. Pleural folds are slightly developed on the cephalosome and metasome. The widest point of the body is 0.3 mm wide on the first metasomal segment.

The urosome consists of 6 segments. The first 2 segments bear the fifth and sixth reduced legs respectively. The third to fifth abdominal segments are ornamented with transverse rows of distinct denticles encircling each segment. The sixth anal segment, with the same ornamentation, bears terminally a pair of caudal rami which are slightly longer than the segment. The anus opens as a posterodorsal slit. The first segment is narrower than the last metasomal segment and the main body articulation occurs between them.

The body color is white, with a red eye and orange gut. Four red pigment spots are situated in the cephalosome (3) and the first metasomal segment (1) and 2 or 3 similar spots in the last 2 urosomal segments.

The antennule (Fig. 48 e) is a nearly cylindrical structure consisting of 8 segments. The first segment is the longest and widest but is not extremely expanded. There is a distinct articulation with the body surface. The next 2 segments are short, much wider than long. The fourth is twice as long as either of the preceding short segments. The fifth is as long as the fourth and the anterodistal corner is extended into a distinct protrusion for insertion of a seta. The seventh and eighth are as long as wide and slightly narrower and longer than the sixth. The terminal margin of the eighth is truncated. The ornamentation on the 8 segments (I-VIII) consists of setae (s), setules (st), large aesthetes (A) and small aesthetes (a) and the arrangement is as follows: I-5s, 1st, 1A; II-1s, 1A; III-1s, 1A; IV-1st, 1A; V-1s; VI-2s, 1A; VII-2s, 1st, 1a;

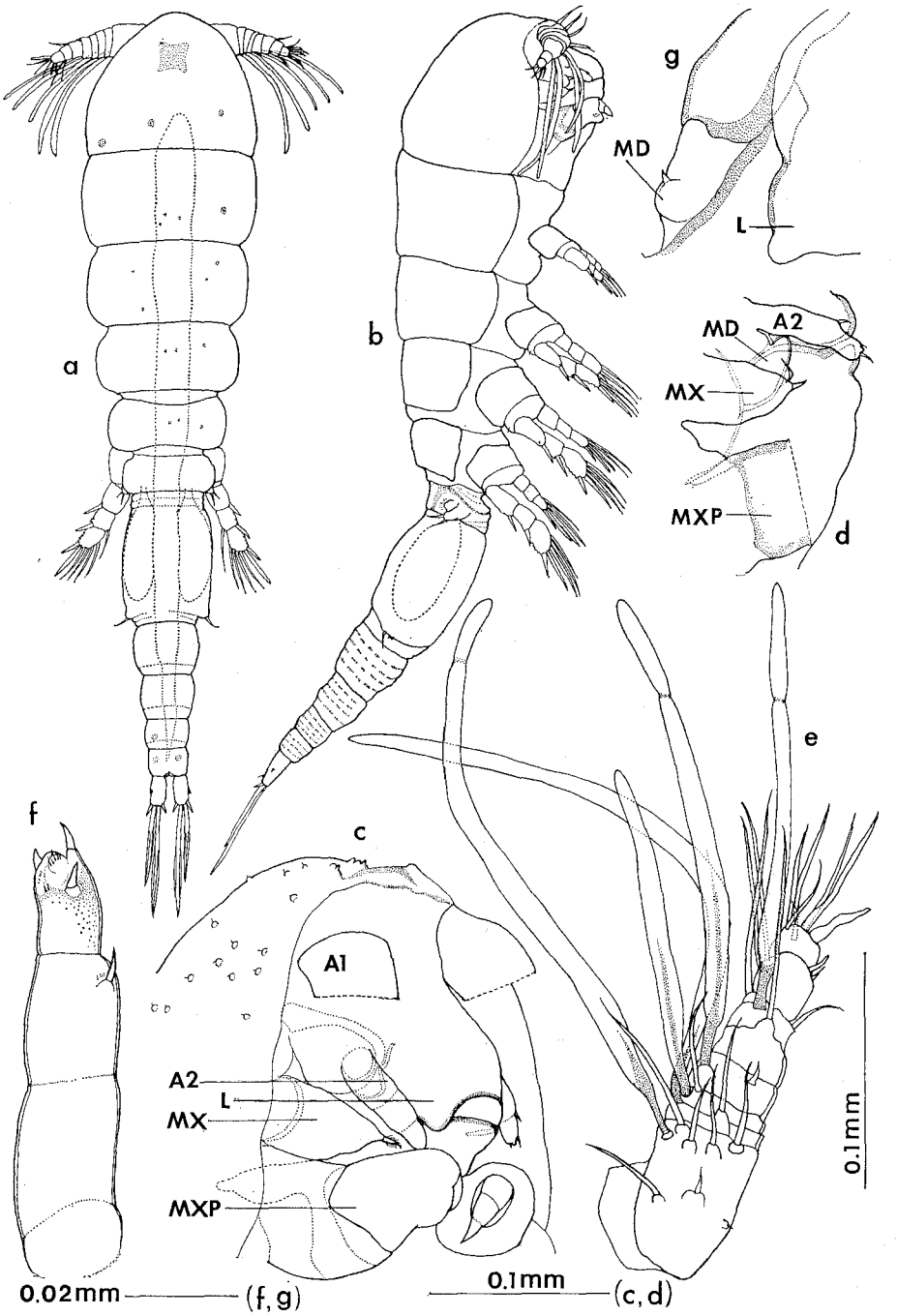


Fig. 48. *Haplostomella reducta,* n. sp., male: a, dorsal; b, lateral; c, oral area, ventrolateral; d, same, lateral; e, antennule; f, antenna; g, mandible, medioventral. Key to abbreviations: A1, antennule; A2, antenna; L, labrum; MD, mandible; MX, maxilla; MXP, maxilliped.

VIII- 6s, 1a. Five large aesthetes (A) on the segments I-IV and VI are transparent, with their proportional lengths about 1 : 1 : 0.6 : 0.8 : 0.7 from the proximal to distal.

The antenna (Fig. 48 f) is cylindrical, 4 times as long as its basal width, obscurely divided into 3 segments with their proportional lengths 2: 1.2: 1, from the basal to distal. The middle segment bears 1 short simple seta on a small mammiform protrusion from the surface at the distal fourth on the anterior margin. There is a row of hairs near the seta. The terminal segment has 1 similar seta at the distal third on the medial margin and 2 setae at the apex. The terminal margin between the apical setae is protruded into a small rounded projection covered with a row of hairs. Similar hairs are placed behind the projection more laterally.

The labrum (Fig. 48 c, g) is similar to that of the female.

The mandible (Fig. 48 g) is represented by 1 setule arising from a somewhat expanded surface close to the lateral base of the mouth-opening between the labrum and labium.

The maxilla (Fig. 49 h) is a large conical lobe bearing 1 plumose seta at the apex.

The maxilliped (Fig. 49 i) is composed of 2 large basal segments and an apical claw complex with the usual structure and armature for the genus. The roundly protruded mediodistal corner of the second segment is covered with hairs which are distinctive in the male; the anterior surface of the second segment has 1 short simple spine as in the female.

The first to fourth pairs of legs show a gradual increase in lengths of the exopodites from the first to fourth, with their proportional lengths 1: 1.2: 1.4: 1.5. In each leg the endopodite is always shorter than the corresponding exopodite and the coxopodite lacks a coxal seta. The armature of these legs consists of plumose setae, spines fringed with hyaline flanges, and hairs. The first leg (Fig. 49 j) is composed of bimerous protopodite and endopodite and trimerous exopodite. The protopodites are connected by a rectangular intercoxal plate. The basipodite bears 1 short spine at the mediodistal corner and 1 short simple seta on the lateral margin. The endopodite is about half as long as the exopodite, bearing 1 medial seta and 2 long terminal spines on the second segment. The segmental margin near the lateral base of each spine is somewhat serrated. The exopodite has 3 setae and 4 spines: the first 2 segments each with 1 lateral spine and hairs on the medial margin; the third segment with 3 medial setae and 2 spines (1 terminal and 1 distolateral). The lateral margin of each segment shows a tendency to serration.

The second leg (Fig. 49 k) is composed of bimerous protopodite and trimerous rami. The intercoxal plate is well developed between the protopodites. The basipodite is ornamented with 1 short simple seta on the lateral margin and hairs on the mediodistal corner. The endopodite bears 5 setae and 4 spines: 1 medial seta on the first segment; 2 medial setae on the second segment; 2 medial setae and 4 spines (2 medial, 1 terminal and 1 lateral) on the third segment. The lateral margin of the second segment is serrated with 5 spinules protruded from the margin. The exopodite is 1.4 times as long as the endopodite, with 5 setae and 4 spines: 1 short lateral spine on the first segment; 1 similar lateral spine and 1 medial seta on the second seg-

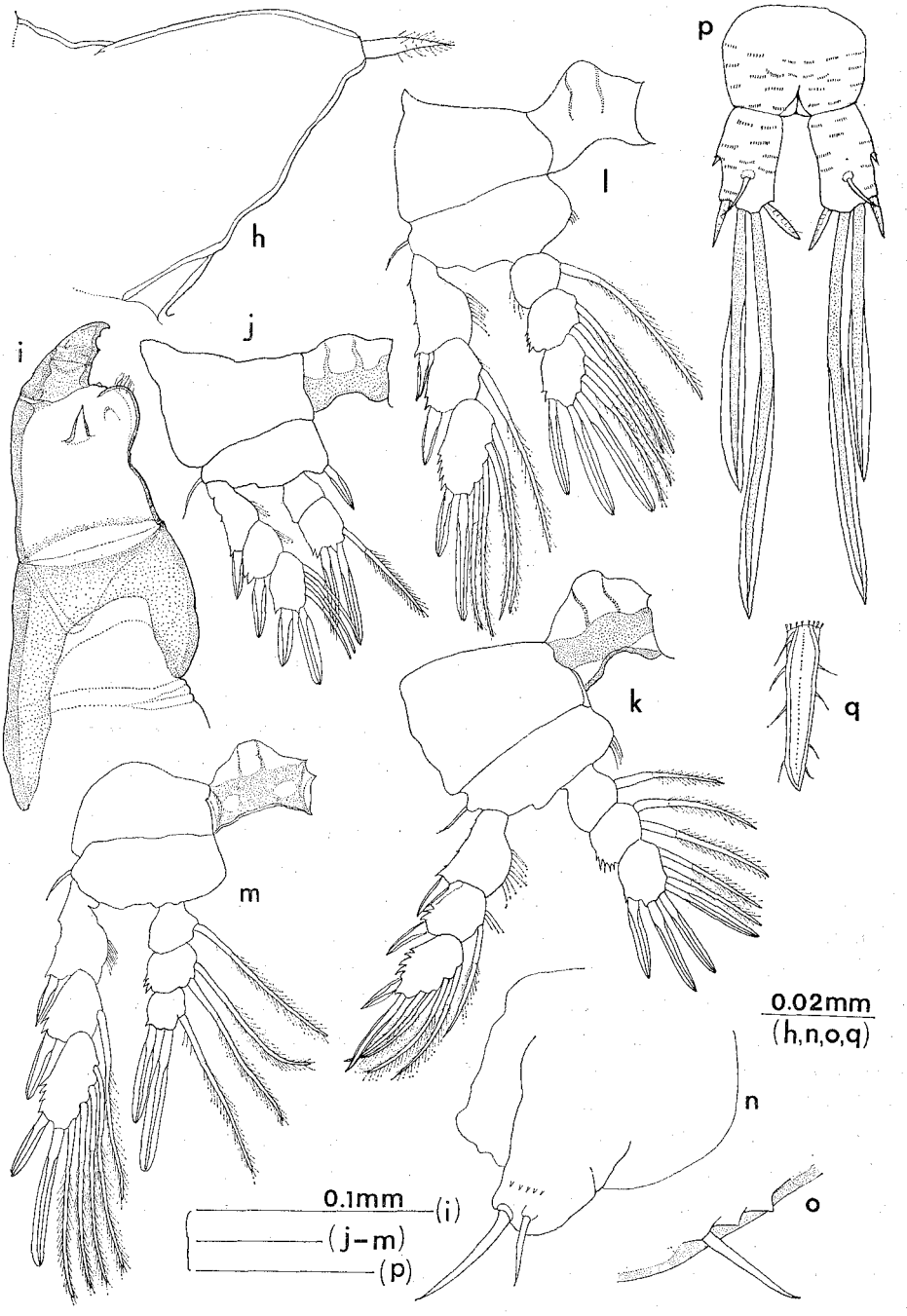


Fig. 49. *Haplostomella reducta*, n. sp., male: h, maxilla; i, maxilliped, anterior; j, leg 1; k, leg 2; l, leg 3; m, leg 4; n, leg 5; o, leg 6; p, caudal rami; q, distolateral spine of caudal ramus, lateral.

ment; 4 medial setae and 2 spines (1 long terminal and 1 short distolateral) on the third segment. The lateral margin of the first segment is weakly serrated whereas the serration on the second and third segments is well developed with 3 or 4 distinct spinules protruded from each lateral margin.

The third leg (Fig. 49 l) resembles the second leg in structure and armature, except that the endopodite is reduced by 1 medial spine on the third segment. Thus the armature consists of 5 setae and 3 spines in the endopodite and 5 setae and 4 spines in the exopodite. These setae and spines are slightly longer than those in the second leg.

The fourth leg (Fig. 49 m) is again reduced by 1 medial seta and 1 medial spine on the third segment of the endopodite. Therefore, the endopodite is ornamented with 4 setae and 2 spines. The exopodite is twice as long as the endopodite, bearing 5 setae and 4 spines as in the third leg.

The fifth leg (Fig. 49 n) is comparable to that of the female in having 2 non-plumose simple setae on a lateral projection protruded from the first urosomal segment. The projection, however, is more developed in the male and resembles that in *H. oceanica* and *H. distincta*. It is composed of broad basal (or lateral) and narrow distal (or medial) portions. The distal portion is cylindrical; the tip is extended beyond the distal margin of the segment and bears 1 short ventral and 1 long dorsal seta. There is a denticle row behind the 2 setae on the outer surface.

The sixth leg (Fig. 49 o) is indicated by 1 seta (laterally) and 2 small spiniform projections (medially) arranged on the distal rounded margin of the lappet-like structure protruded from the genital segment.

The caudal ramus (Fig. 49 p) is cylindrical, twice as long as wide. The ramus, like the anal segment, is ornamented with transverse denticle rows, and bears 2 long terminal setae with hyaline flanges, 2 short subterminal spines at the sides of the above-mentioned long setae, 1 short simple dorsal seta at the distal fourth and also 1 lateral spinule midway on the margin. Of the terminal setae the medial one is 1.4 times as long as the lateral. The subterminal spines are characteristic with 2 longitudinal rows of hairs along the widely spaced anterior and posterior margins (Fig. 49 q).

REMARKS: There are several distinctive features in the female. The body structure is extremely reduced without even integumental folds suggesting the body regions or segments. The antennules and thoracic legs are much specialized in structure and armature as previously mentioned, differing from all other species. However, the male represents the typical pattern for *Haplostomella* males.

The male resembles *H. distincta* by having 2-segmented endopodites in the first legs (3-segmented in *H. dubia*; unsegmented in *H. oceanica*). The male of the present species is distinguished from that of *H. distincta* in having the reduced mandible without spine (*H. distincta* with spine and setule).

Both sexes of the present species inhabit undefined positions of the matrix of *Distaplia occidentalis* including the pedunculated form which can generally be collected in deeper water of the San Juan Archipelago. The ascidian from the deeper water is also associated with *Haplostoma albicatum* besides the present species.

We have no basis to interpret the size dimorphism among the females of this species. Occasional specimens reach impressively giant proportions but correspond with the more usual individuals in all anatomical features.

Discussion

In summarising the relations (Tables 2 & 3) between the copepods and hosts which we have already noted under "REMARKS" in each description of species, we emphasize the following features.

(1) In some cases a given copepod is associated with 2 hosts, but there seems to be a definite preference for one of the hosts. Furthermore, the apparent main host for the copepod is far removed taxonomically from the other ascidian, and thus has a different anatomical structure. This pattern is seen in the associations between *Haplostomella oceanica* and its 2 hosts, *Eudistoma ritteri* (Family Polycitoridae) and *Amaroucium arenatum* (Family Synoicidae). The former ascidian is the main host for the copepod (see P. 130).

(2) In other cases of copepods associated with 2 hosts, the copepods seem to live equally commonly in both hosts without distinctive habitat preference. In such cases these hosts are closely related taxonomically with similar anatomical structure. This type of relation is shown in the cases of *Haplostoma elegans, Haplosaccus elongatus, Haplostomella dubia* and *Haplostomella distincta* and their respective hosts. Among these copepods some showed a different coloration of the body, particularly in regard to the ova and gut, in occurrence with the different host species. It seems that the change of coloration probably occurs mainly because of some features of the host species such as the substance composing of the colony matrix or of the zooids. Such a case is seen in *H. elegans* associated with *Amarocuium ?constellatum* and *A. propinquum* from deeper water (see pp. 76–77).

(3) In 2 copepods sharing the same host, one of the copepods may show a preference for the specific environment in which the host lives, such as intertidal or deeper water. This situation is found in *Haplostoma albicatum* and *Haplostomella reducta* which are dwellers in *Distaplia occidentalis*; the former from the intertidal area and deeper water and the latter mainly from deeper water. Additional specimens of both species, but mainly of *H. reducta,* have been collected from a pedunculated deep water form of *D. occidentalis,* the specific status of which is not yet clear (see p. 8).

The inter-relations of the haplostomins to other ascidicole copepods, which can coexist with haplostomins, and the relations to their hosts have not been treated in the present discussion, because these relations seemed to be too complicated in relation to our meager sampling. In our experience, examples of these complex relations increase in proportions to increased collection of the material.

In the 17 previously known species, the sites of the copepods (females) in the ascidian hosts were reported mostly as in the matrix of colonies, except for 4 species, *Haplostoma gibberum, H. eruca, Haplostomella australiensis* and *H. halocynthiae,* which live in the alimentary canal (branchial sac, gut and intestine) of simple ascidians (Table 1). The epicardium and postabdomen of zooids in compound ascidians were mentioned as additional sites for 2 species, *Haplostoma brevicauda* and *Haplostomella sycozoae.*

The sites of the present species in the ascidians were varied, giving much more

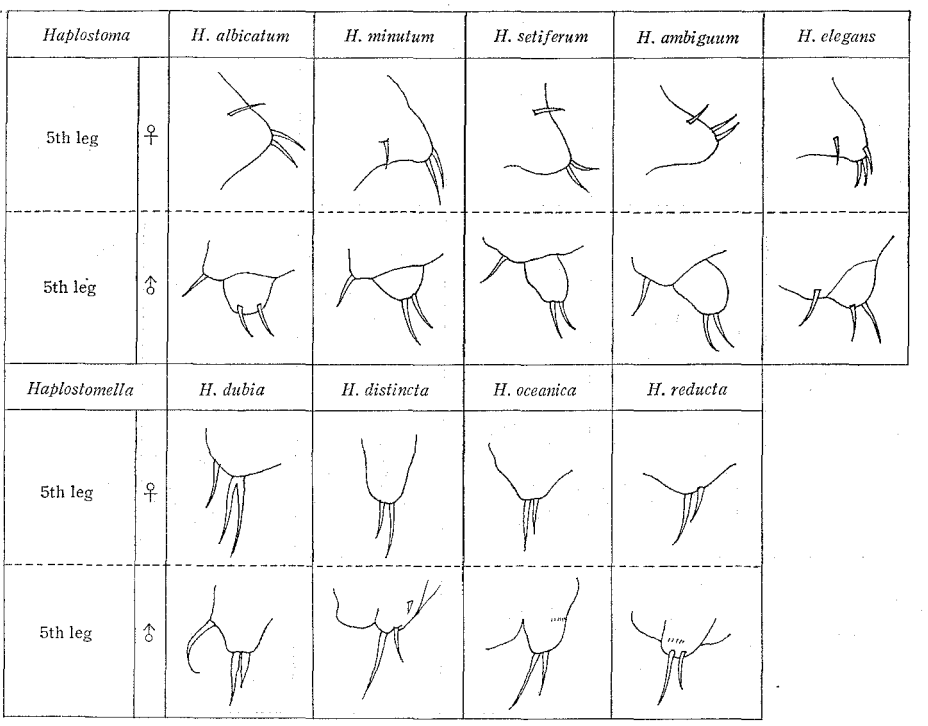
new information about the sites. The general site of most specimens of these species was the common test, but various parts of the zooids were also occasionally noticed as their sites of some specimens in the majority of the species. Females with or without egg sacs, young males probably in the last copepodid stage and egg sacs without the female were observed in the branchial sac, stomach, intestine or postabdomen, with an explicit site tending to be characteristic for any given species (Table 2). In 8 of the 13 present species individuals were found in these sites in addition to the matrix. Females inhabiting the intestine were distributed in all the genera, but in relatively few species of *Haplostoma*. We were able to find many more specimens of *H. dubia* (female and male) in the alimentary canal than any other species. Our lists in regard to the locations, however, should be extended because the number of the species, which are related to the alimentary canal or to some other parts of zooids, will surely be increased proportionately with increased collections of material and more careful observations on living ascidians.

The present studies have disclosed many anatomical details of these poorly known copepods, particularly as regards the structure and armature of the appendages or organs in both sexes. The fifth legs of the females of our species are morphologically in conformity with those described in most of the known species, although many authors seem to have overlooked the armature of the appendages. Canu (1892) illustrated the structure and armature of the fifth legs of the female and male of *Haplostoma brevicauda* in his beautiful work. Unfortunately, the appendages he attributed to the male really referred to the male of another copepod, as we have stated. Therefore, no previous valid comparison has been made on the appendages in both sexes of any species of the subfamily.

The fifth legs of the males of 9 of our species, in the genera *Haplostoma* and *Haplostomella,* have been anatomically compared with those of their corresponding females. In the *Haplostoma* species, the fifth leg is represented by a lateral cone in the females and by a small segmented lobe in the males, bearing 3 small setae in both sexes (Table 5). There is an exception in regard to the number of the setae of the appendage of the female in *H. elegans* which has 4 setae. In all the *Haplostoma* species, the lateral cone in the female is regarded by us as a somewhat reduced or otherwise modified form from an element equivalent to the segmented lobe in the male. Moreover, the setae in both sexes have basically the same arrangement consisting of one basal seta and 2 (3 in the female of *H. elegans*) apical setae. The armature in the female of *H. elegans* is comparable to that in the females of *Haplostomides* from our area. We have already mentioned that the female of *H. elegans* is regarded as intermediate between *Haplostoma* and *Haplostomides* by the possession of an additional pair of mouthparts, the maxillae, which the females of *Haplostomides* also have. Therefore, the feature of the fifth legs in *H. elegans* would be regarded as another evidence of its being an intermediate form.

In all the *Haplostomella* species the fifth legs are comparable in structure and armature in both sexes, each leg consisting of a small conical lobe with 2 or 3 small setae (Table 5). In the females, the appendages are slightly more modified than

Table 5. Morphological comparison of 5th legs (right) of females with those of males in *Haplostoma* and *Haplostomella*.

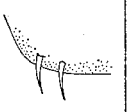
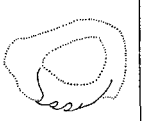


those of the males, as in the case of the females of *Haplostoma*.

In comparing the oviducal folds of the females with the sixth legs of the males, in the genera *Haplostoma* and *Haplostomella* (Table 6), we have concluded there probably is an homology in these organs and appendages as regards the structure and armature. In the *Haplostoma* species, a set of 2 spines on the oviducal fold seems to be comparable to a pair of slender setae on the lappet fold situated on the lateral sides of the genital segment in the males (Table 6). In all the species, the oviducal fold has a row of small spines on the inner margin and in some species another isolated spine or spiniform projection near the row of small spines, in addition to the 2 main spines. We think that the serrated margin with these small spines may correspond to the somewhat sclerotized, rounded margin of the lappet fold in the males. Therefore, the spinose oviducal folds could be regarded as in part modified appendages, from which hang a pair of egg sacs produced from the oviducal apertures.

In 3 of the previously known species of *Haplostoma,* as in our species, the same structure and armature of the oviducal fold have been reported (*H. banyulensis, H. canui* and *H. mizoulei*). We conjecture that a similar armature has been overlooked in the 3 other known species (*H. brevicauda, H. eruca* and *H. gibberum*) which have been described as not having an armature on the fold. All of our species in the genera *Haplostomides* and *Haplosaccus* have a similar structure and armature. There-

Table 6. Morphological comparison of oviducal folds (right) of females with 6th legs (right) of males in *Haplostoma* and *Haplostomella*.

Haplostoma		*H. albicatum*	*H. minutum*	*H. setiferum*	*H. ambiguum*	*H. elegans*
Oviducal fold	♀					
6th leg	♂					
Haplostomella		*H. dubia*	*H. distincta*	*H. oceanica*	*H. reducta*	
Oviducal fold	♀					
6th leg	♂					

fore, we assume that these anatomical features probably also occur in all of the previously described species of these genera, although the details are mentioned only for *Haplosaccus sacculus*. A strong, unequally bifurcated spine and a small spine in *H. sacculus* would seem to correspond to the set of 2 spines and one isolated small spine in *H. elongatus* from our area.

In the known *Haplostomella* species, no detailed description had been previously reported as regards the ornamentation of the oviducal folds, until the redescription of *H. halocynthiae* (Ooishi & Illg, 1974). In the present *Haplostomella* species, the oviducal fold is armed with 3 subequal spines on the posterior margin or on the undersurface of the fold (Table 6), as was seen in *H. halocynthiae*. The 3 spines may be equivalent to 3 elements which in part represent the sixth leg on the lappet fold in the males, although the elements in the males consist of 1 seta and 2 variously modified, reduced spines. Thus it is possible that a portion of the oviducal fold in the *Haplostomella* species is also homologous with the sixth legs of the males.

There exist some opinions or suggestions by a few previous authors in interpreting the phylogeny of the subfamily. In this connection Chatton and Harant (1924e, pp. 420–421) divided the subfamily into 2 series, one consisting of the 3 related genera *Haplostomides*, *Haplostoma* and *Haplosaccus* and the other including the genus *Haplostomella*. The first series was characterised as parasites wandering and burrowing

within the colony matrix of compound ascidians. The second series was marked by the characteristics of sedentary forms which lose the power of activity. These conceptions were founded on the characteristics of behavior of the female copepods.

Gotto (1970, pp. 271–272) tried to interprete the phylogeny of the genus *Haplostomella* on the basis of features of the locations and habits of the females in the ascidians and also on the ground of the morphological features. He thought that "the alimentary canal probably represents the original site of infection by ascidicole copepods whatever their present location may be". In addition he maintained that "caution must be exercised in interpreting phylogenies on the basis of single anatomical characters". However, he encountered a contradiction in his work on *Haplostomella australiensis,* because on the basis of location, this copepod, as the dweller in the gut of a simple ascidian, may be closer to the original stock than the other 4 *Haplostomella* species which are inhabitants in the colony matrix of compound ascidians. However, *H. tuberculata,* inhabiting the colony matrix of a compound ascidian, was regarded as the most primitive species on the basis of purely morphological features. He concluded that the morphologically most primitive species *H. tuberculata* is perhaps followed by *H. malacocera* or *H. australiensis, H. sycozoae* and *H. magellanica* on the basis of morphological features in that order. Other doubts were pointed out as to the habits of the genus *Haplostoma,* which he considered to be closely related to *Haplostomella. Haplostoma* includes 2 species, *H. eruca* and *H. gibberum,* inhabiting the alimentary canal of simple ascidians as in *Haplostomella australiensis.* The 4 remaining, *H. banyulensis, H. brevicauda, H. canui* and *H. mizoulei,* live in compound ascidians. However, he reached no conclusion in regard to the origin of both these genera, emphasizing that problems arise from the wide ecological occurrence of the ascidian hosts including the interstitial fauna which is the habitat of the host of *H. mizoulei.*

The subfamily now includes 30 species (exclusive of the uncertain species) by adding the present 13 species. We find that additional information suggests closer relationships among the genera and species in the subfamily. The present anatomical studies based on the females add as well details concerning the males, which have more distinctive generic features than the females. In separating or grouping the genera by their morphological characteristics, the male's features seem to be significantly useful, particularly in the case where the genera include females of extremely or characteristically reduced forms. Thus we think that anatomical features of both sexes should be regarded as the most informative evidence in interpreting phylogeny.

On the basis of morphological features in the present females and males, the subfamily probably can be divided into 2 series, in agreement with the opinion which Chatton and Harant reached on ecological grounds, because one of the series consists of the same 3 genera *Haplostomides, Haplostoma* and *Haplosaccus* and the other includes the genus *Haplostomella.* However, we consider that the first series is distinctly separated from the second mainly by the morphological features of females as regards the first to fifth thoracic legs and the oviducal apparatus, which we have just discussed previously.

Among the 3 genera in the first series, the genera *Haplostomides* and *Haplostoma*

are closely related to each other by the species, *Haplostoma elegans,* with intermediate features as previously mentioned. This conclusion has been reached from our study of the morphology of the females. If the male described by us as possibly a *Haplostomides* (p. 78) is indeed so, our conclusions are reinforced by the morphological characteristics of the males. Furthermore, the remaining genus in the first series, *Haplosaccus,* seems to be rather eccentric among these 3 genera, because, although it has a full set of mouthparts as in *Haplostomides,* these appendages are characteristically modified and reduced in a pattern differing from that of *Haplostomides* and *Haplostoma.* Therefore, the phylogeny remains indistinct in the series. It seems too soon to suggest the phylogenies within each genus or the whole series, without definite details of the males of the genera *Haplostomides* and *Haplosaccus.*

The second series–genus *Haplostomella*–presents no such problem since both sexes are known. In the beginning of this research, however, the female of *H. reducta* caused us much trouble because of its regressive characteristics such as the expanded body with segmentation obsolete, the short antennules with rounded apex and the thoracic legs heavily sclerotized and seemingly different from those of the other species. Later, by studying the male, we found its morphological features conformed to those of the genus *Haplostomella,* and thus the problem of assigning the female was resolved.

The genus *Haplostomella* is now represented by 10 species including the present 4 species. The present species seem to involve a series of forms from primitive *H. dubia* to the most regressive *H. reducta.* We agree with Gotto's opinion as regards *H. tuberculata* as the most primitive *Haplostomella* on the basis of morphological featrues, although he compared only 5 species known at that time. However, we must add *H. dubia* from our area to the same category as an extremely primitive species; indeed we wonder whether *H. dubia* is a synonym of *H. tuberculata* with minor morphological and some ecological differences. In this way the species of *Haplostomella* probably can be grouped in the following order, based on the females: (1) *H. dubia* and *H. tuberculata* (2) *H. halocynthiae, H. australiensis* and *H. distincta,* ?(3) *H. magellanica,* (4) *H. oceanica, H. malacocera* and *H. sycozoae,* (5) *H. reducta.* This order is somewhat different from that which Gotto proposed and it also includes an ambiguous species with inconsistent morphological features–*H. magellanica.* We think that in his arrangement *H. malacocera* should have been related to *H. sycozoae* and not to *H. australiensis,* because the 2 former species are now shown by us to be closely related to *H. oceanica* from our area as was pointed out in the "Remarks" for *H. oceanica.* As Gotto mentioned, the ambiguous species, *H. magellanica,* might be a specialized species among its congeners because of the segmented antennules. However, the description of this species is lacking many anatomical details, giving rise to these ambiguities. Similar lack of details of anatomy causes problems in connection with most of the previously described species.

Because of the generally weakly developed thoracic appendages in the females of the species in the second series, their behavior in the ascidians might be expected to be inactive in comparison with the behavior of the females in the first series, in which sclerotized thoracic legs with many more spines are developed. Likewise,

the different morphological features of the males in these 2 series might give rise to some differences in their behavior. However, because the morphological divergence is so strong, these features of behavior would probably not be regarded as the salient features to separate the second series from the first in our interpretation of the phylogenies.

The facts mentioned previously as regard to the sites of copepods in the ascidians suggest to us that all the copepods of the subfamily probably have a special connection with the alimentary canal. However, an interesting difficulty enters because the habitats of the larval copepods in the ascidians are unknown. The case of *Haplostomella dubia,* which is regarded as one of the most primitive haplostomellids and lives in the alimentary canal, thus does not offer the contradiction which Gotto met in *H. tuberculata* with primitive morphological features in spite of inhabiting the colony matrix. In any case, these features of the locations and habits of the adult copepods should best be considered as supplementary information to morphology in interpreting the phylogenies.

The developmental studies on the present material, which will be published following this taxonimic paper, support our concept of 2 subdivisions within the subfamily. Therefore, there are some grounds to approach the hypothesis that the subfamily has diphyletic origins in its evolution, as Chatton and Harant proposed.

Since Thorell (1895) established the family Ascidicolidae for his genus *Ascidicola,* many authors have used the family to assign various kinds of ascidicole copepods. This had led to much confusion. Canu (1892) used the family Ascidicolidae for his genus *Aplostoma* (=*Haplostoma*) and for other genera of notodelphyids and enterocolids. While Chatton and Harant were working on the subfamily Haplostominae, which they referred to the family Ascidicolidae, Sars (1921) introduced the family Enterocolidae for 3 genera, *Cryptopodus* (=*Haplostoma*), *Enterocola* and *Mychophilus.* In his treatment the Ascidicolidae comprised only Thorell's genus *Ascidicola.* The usage of Enterocolidae to include *Haplostoma* was followed by Blake (1929), Monniot (1962), Dudley (1966) and Gotto (1966), so that the subfamily which Chatton and Harant proposed was not always recognized by all of these authors.

However, Dudley (1966, p. 158) pointed out that the female of *Aplostoma* (*Haplostoma,* Family Enterocolidae) is closely related to the female of *Botryllophilus* (Family Botryllophilidae), because she confirmed that the appendage regarded as the maxilla of *Aplostoma* by Canu (1892) was actually the maxilliped and the structure was similar to that in *Botryllophilus.* She also proposed that *Aplostoma* (with the genera *Enterocola* and *Enteropsis*) belongs to the Cyclopoida gnathostoma as do the botryllophilids as pointed out by Lang (1948) for the Botryllophilidae, although Lang thought that the Enterocolidae Sars must be incorporated in the subsection Cyclopoida poecilostoma.

We recognize Dudley's discovery concerning the misidentified appendage of *Aplostoma* as the maxilliped and her suggestions in interpreting the taxonomy of *Aplostoma.* These have helped the present studies to arrive at the use of subfamily Haplostominae, referring it to the family Ascidicolidae in a revised concept. Studies

on the remainder of the Ascidicolidae in that concept (Illg and Dudley) will be published later.

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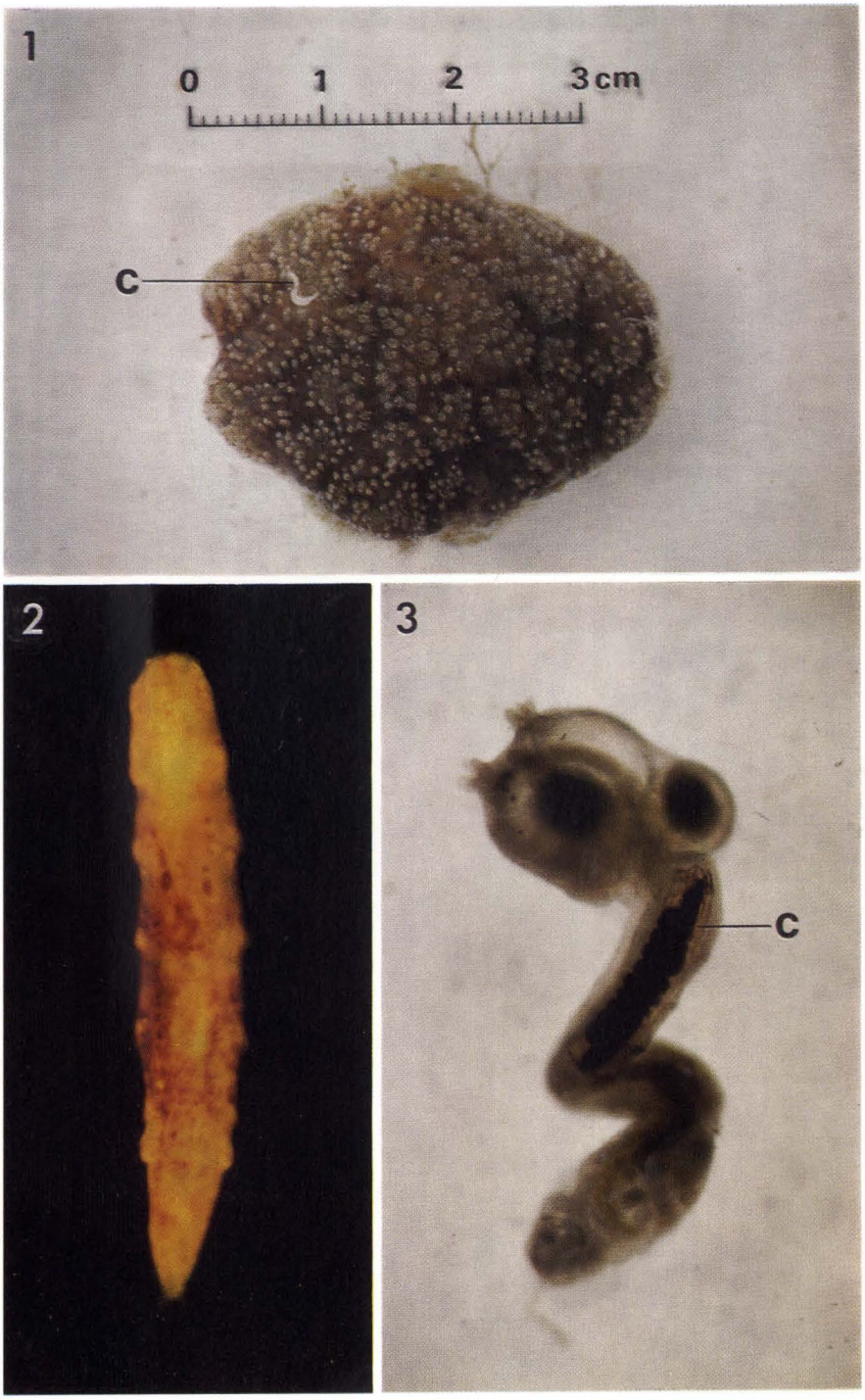
EXPLANATION OF PLATE I

Fig. 1. *Haplostoma albicatum*, n. sp., female (with egg sacs), near the surface of the matrix (common test) of a fresh colony of *Distaplia occidentalis* Bancroft. c, copepod.

Fig. 2. *Haplostomella distincta*, n. sp., a live female specimen (without egg sacs), collected from *Amaroucium arenatum* Van Name, dorsal view. ×28.

Fig. 3. *Haplostomella oceanica*, n. sp., female (with ova in the oviducts), in the intestine of a fresh zooid of *Eudistoma ritteri* Van Name. ×14. c, copepod.



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