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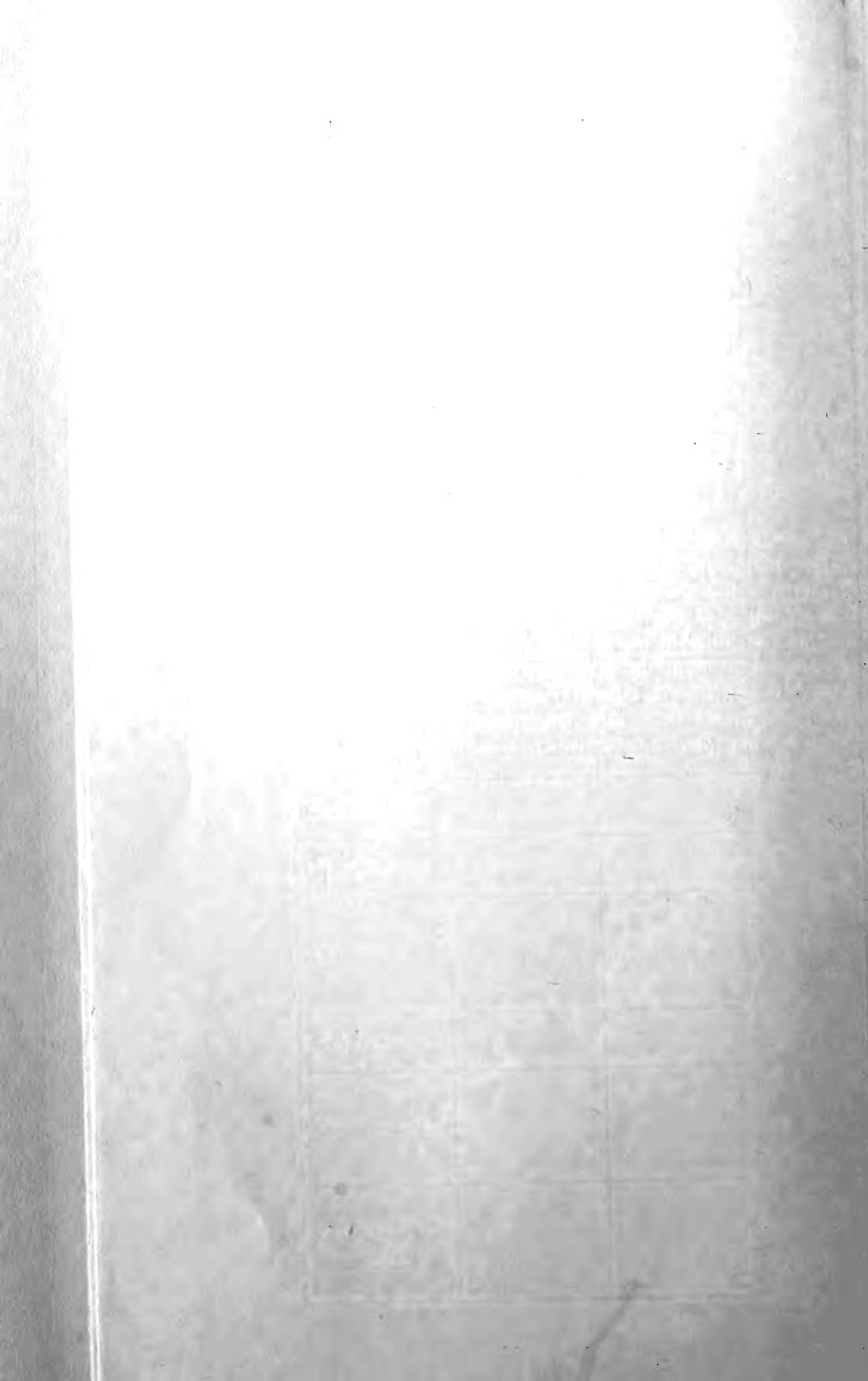
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Bulletin 26

Pelagic Ostracods  
of the  
Sargasso Sea off Bermuda

by

✓ Georgiana B. <sup>axter</sup> Deevey

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BULLETIN 26

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Pelagic Ostracods of the  
Sargasso Sea off Bermuda:  
Description of Species  
Seasonal and Vertical Distribution

BY  
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NEW HAVEN, CONNECTICUT  
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## PELAGIC OSTRACODS OF THE SARGASSO SEA OFF BERMUDA:

DESCRIPTION OF SPECIES, SEASONAL AND VERTICAL DISTRIBUTION

by GEORGIANA B. DEEVEY\*

### ABSTRACT

Forty-three species of pelagic ostracods, including one Cypridinid and 42 Halocyprids, were identified and are described and figured from samples collected at Station "S", at 32°10'N, 64°30'W, in the Sargasso Sea. Most of the samples studied were collected at bi-monthly intervals by oblique hauls, 500-0 m, during the period from March 1961 to April 1962, but other samples obtained from 1958-1960, including three series of samples taken at 100 m intervals down to 500 m and several deeper hauls, were also examined as well as three samples collected in August 1964. Thirty-two of the species were found in samples from the upper 500 m; eleven species were recorded only from depths below 450-500 m. The hitherto unrecognized male of *Conchoecia parthenoda* is the only new form described, but two species, *C. secernenda* and *C. porrecta*, previously synonymized with two other species, are here considered separate species. The species which occurred year-round in the upper 500 m include *Halocypris brevirostris*, *Archi-conchoecia striata*, *Conchoecia acuminata*, *C. curta*, *C. imbricata*, *C. magna*, *C. oblonga*, *C. parthenoda*, *C. procera*, *C. rotundata*, *C. secernenda*, *C. spinifera*, *C. spirostris*, and *C. subarcuata*. *C. spirostris* was the most abundant species, followed by *C. curta* and *C. procera*.

For the samples collected with a meter net of both No. 2 and No. 8 mesh nylon, quantitative counts made on the total zooplankton gave a mean figure of 19.49 ostracods/m<sup>3</sup>, for the upper 500 m per year. The numbers/m<sup>3</sup> of the commonest species of ostracods in the upper 500 m were obtained, by actual count, from several series of samples collected at 100 m depth levels in June and October 1959 and February 1960 with a No. 2 mesh net. Simultaneous tows with No. 2 (0.366 mm aperture) and No. 8 (0.203 mm aperture) nets showed that the No. 2 net does not retain adequately the smallest species, whereas about 65% of the ostracods caught by the No. 8 net were the smallest recognizable, but unidentifiable, ostracod larvae.

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# ПЕЛАГИЧЕСКИЕ ОСТРАКОДЫ САРГАССОВОГО МОРЯ В РАЙОНЕ БЕРМУДСКИХ ОСТРОВОВ: ОПИСАНИЕ ВИДОВ И ИХ СЕЗОННОГО И ГЛУБИННОГО РАСПРОСТРАНЕНИЯ

ЖОРЖИАНА Б. ДИВИ

## Р Е З Ю М Е

43 вида пелагических остракодов, включая один сипридинид и 42 галосиприды, были установлены, описаны и изображены на базе образцов, собранных на станции "S" стоящей на 32°10' северной широты и 64°30' западной долготы в Саргассовом море. Большинство изученных образцов были собраны косой выборкой от 500 м до 0 м, с двухмесячными перерывами, за период с марта 1961 по апрель 1962; изучались тоже и другие образцы, полученные за период времени с 1958 по 1960 г., включая три серии образцов, выловленные на 100-метровых интервалах до глубины в 500 м и глубже, а также и три образца, собранные в августе 1964 г. 32 вида были обнаружены среди образцов, взятых на глубине до 500 м, и 11 видов зарегистрированы только на глубинах ниже 450-500 м. Неопознанные до сих пор самцы *Conchoecia parthenoda* являются единственным новым описанным видом, а два вида *C. secernenda* и *C. porrecta*, раньше принятые за синонимы двух других видов, здесь считаются самостоятельными видами. Виды, появляющиеся на глубинах до 500 м. в течение круглого года включают *Halocypris brevirostris*, *Archiconchoecia striata*, *Conchoecia acuminata*, *C. curta*, *C. imbricata*, *C. magna*, *C. oblonga*, *C. parthenoda*, *C. procera*, *C. rotundata*, *C. secernenda*, *C. spinifera*, *C. spinirostris* и *C. subarcuata*. Чаще всего встречались *C. spinirostris*, а за ними следовали *C. curta* и *C. procera*.

Количественный подсчет всего зоопланктона в образцах пойманных посредством метровых нейлоновых сетей №2 (ячей в 0,366 мм) и № 8 (ячей в 0,203 мм) дал 19,49 остракодов/м<sup>3</sup> в год на глубине до 500 м. Количество наиболее распространенных видов остракодов на кубометр в слое до 500 м глубины было получено прямым подсчетом образцов взятых на 100-метровых уровнях посредством сети № 2 в июне и октябре 1959 г. и в феврале 1960 г. Проведенные одновременно уловы посредством сетей № 2 и № 8 показали, что сеть № 2 (0,366 мм) не удерживает достаточно мелких видов, тогда как около 65 процентов остракодов пойманных сетью № 8 (0,203 мм) были наиболее мелкими видимыми, хотя и неопознанными, личинками.



# PELAGIC OSTRACODS OF THE SARGASSO SEA OFF BERMUDA:

## DESCRIPTION OF SPECIES, SEASONAL AND VERTICAL DISTRIBUTION

by GEORGIANA B. DEEVEY\*

### INTRODUCTION

Pelagic ostracods constitute an appreciable part of the zooplankton of some regions, especially of tropical and subtropical oceans. They are not numerous in species or numbers in Arctic waters, but many species have been described and recorded from the Antarctic. Some species live in the upper few hundred meters, others frequent intermediate depths, whereas some are bathypelagic. Very little is known of their ecology, or the seasonal or vertical distributions of the species, and there are virtually no quantitative data available. Most of our knowledge of the species and their distributions was obtained by the great oceanographic expeditions of the last century. Of all the major groups of pelagic organisms, the ostracods have been the most neglected. Therefore, in the course of an investigation on the annual cycle in quantity and composition of the zooplankton of the Sargasso Sea, based on a year's collection of samples, it was decided to make a more thorough study of the ostracods. The primary purpose of this report is to describe and figure the various species which occurred year-round, seasonally, or only occasionally during the period studied, but also included are some quantitative data, especially on the vertical distributions of the commonest species. No attempt is made at present to alter the classification of these ostracods as it was established by Müller (1906a) and modified by Skogsberg (1920) and Poulsen (1962). Poulsen (personal communication) is presently engaged in an exhaustive study of the numerous species of Halocyprids in the Dana Collections, and until his results are published it would be unwise to confuse further the taxonomy of these organisms.

The zooplankton of warmer oceanic waters is sparse, but extraordinarily diverse. At Station "S" in the Sargasso Sea, the mean total number of organisms obtained for the year was 316/m<sup>3</sup>, of which copepods, invariably the dominant group, constituted 62.7%, larger Protozoa 12.5%, and pelagic tunicates 7.2%. Ostracods ranked fourth and made up 6.6% of the total numbers of organisms. All other groups, including other crustacea such as amphipods and euphausiids, chaetognaths, pteropods, heteropods, polychaetes, coelenterates, and many other forms, occurred in smaller numbers. At another station in the Sargasso Sea, Station "E" at 35°N, 48°W, Fish (1954) reported that, in night surface collections

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with a No. 2 net, ostracods ranked fourth in numbers after copepods, Appendicularia, and Mollusca. However, since the commonest ostracod species in the upper 500 meters of the Sargasso Sea are small, most being 1-2 mm in length, in terms of dry weight and displacement volume they make up a smaller fraction of the total zooplankton. Menzel and Ryther (1961a) found that the ostracods constituted a mean of only 3.6% dry weight of the total zooplankton at Station "S". In terms of dry weight, copepods, chaetognaths, siphonophores, pteropods, coelenterates, tunicates and other crustacea constituted larger fractions of the total population.

Most of the literature on pelagic ostracods was written around or before the turn of the century by German-speaking biologists such as C. Claus and G. W. Müller, and is difficult now to obtain for reference. Moore (1949), for example, in his report on the zooplankton of the upper waters of the Bermuda area of the North Atlantic, omitted the ostracods from consideration "on account of lack of available literature for identification." Therefore, since many of the species that occurred at Station "S" have wide distributions, it is hoped that this report may be of use to zooplanktologists and other biologists as well as to ostracod experts.

## MATERIALS AND METHODS

The ostracods considered in this report were obtained from zooplankton samples collected by D. W. Menzel, then of the Bermuda Biological Station, at Station "S", 32°10'N, 64°30'W, 15 miles southeast of Bermuda in approximately 3000 meters of water. The majority of the samples examined were those used for the study of the seasonal cycle of the total zooplankton at Station "S"; these samples were collected at approximately bi-monthly intervals from March 16, 1961 to April 7, 1962 as oblique hauls, 500-0 m, with a meter net of both No. 8 and No. 2 nylon equipped with a Schuler meter for recording the number of liters of water filtered. In addition, 25 samples, most of them from 500-0 m, collected between December 1957 and December 1959 were examined; these were obtained by oblique tows with a 0.75 m diameter No. 2 plankton net with a meter wheel mounted in its mouth. All the samples were collected in daytime, in late morning or early afternoon.

Quantitative data on the depth distributions of the various species were obtained from special tows made with Leavitt opening and closing nets at selected depth intervals. On June 23-26, 1959 samples were collected at various intervals down to 1800 m. On Feb. 17-18, 1960 another series down to 2000 m was obtained. On Oct. 9, 1959 samples were collected at 100 m intervals for the upper 500 m. All the ostracods were removed from these 19 samples and counted.

To compare numbers of ostracods caught by different mesh sizes of net, two more series were counted. On July 10, 1959, No. 2 (0.366 mm aperture) and No. 20 (0.076 mm aperture) nets were towed 500-0 m simultaneously. On Aug. 5, 1959 simultaneous hauls with No. 2 and No. 8 (0.203 mm aperture) nets were made.

In addition the ostracods were examined and counted from three samples collected by G. A. Riley at Station "S" in August 1964 at depth intervals of 750-1500 m, 450-900 m, and 700-1500 m with a giant Clarke-Bumpus sampler with a No. 2 net.

For the period from March 1961 to April 1962 only the estimated total numbers/m<sup>3</sup> of ostracods are available. At the time these counts were made, it was not possible to differentiate the species. Counts on the total zooplankton were made by diluting the sample to a known volume, stirring thoroughly, removing several aliquots of 5 or 10 cc to a counting chamber, and identifying and counting the organisms. The numbers per cubic meter were then estimated.

Throughout the period when the zooplankton samples were collected, standard hydrographic measurements were made on temperature, salinity, inorganic phosphorus, total phosphorus, nitrite, nitrate, silicate and dissolved oxygen down to depths of up to 2600 m. Analyses for chlorophyll *a* in mg/m<sup>3</sup> down to 100 m and the dry weights of the total zooplankton in mg/m<sup>3</sup> are also available. Many of these data have been published by Menzel and Ryther (1960, 1961b, 1961c).

## THE CLASSIFICATION OF THE OSTRACODS

In this report Poulsen's (1962) classification of the Ostracoda is followed; this is based mainly on the work of G. O. Sars and G. W. Müller. Poulsen agreed with Skogsberg (1920), who divided Sars's Myodocopa into two suborders, the Cypridiniformes and the Halocypriformes.

### KEY TO THE FIVE SUBORDERS

1. Exopodite of second antenna with at most 2 joints .....2
1. Exopodite of second antenna with at least 7 joints .....3
2. Second antenna biramous, flattened, with numerous bristles or spines .....  
..... Cytherelliformes(=Sars' Platycopa). Marine
2. Second antenna pediform with claws at the tip .....  
..... Cypriformes(=Sars' Podocopa). Mostly freshwater
3. Only five pairs of limbs ..... Polycopiformes(=Sars' Cladocopa). Marine
3. Seven pairs of limbs (the seventh often much reduced), exopodite of second  
antenna with long natatory bristles .....4
4. Furcal lamellae anteriorly with a long, slender claw proximally of the antero-  
distal corner ..... Halocypriformes. Marine
4. The most anterior furcal claw directly on the antero-distal corner .....  
..... Cypridiniformes. Marine

The great majority of the ostracods from Station "S" belonged to the Halocypriformes, but one species of Cypridiniformes was found occasionally. Except for a single specimen of *Rutiderma* sp., which will not be considered further, all the species recorded are truly pelagic forms. According to Poulsen (1965), species of Rutidermatidae (suborder Cypridiniformes) occur in shallow water, sometimes in association with corals, in tropical and warmer temperate regions of the Atlantic, Indian and Pacific Oceans. The suborder Cypridiniformes includes four families, for which Poulsen (1965, p. 5) has published a revised key. The great majority of the species of the Cypridiniformes appear to be bottom-dwelling or shallow water forms. Perhaps only two genera belonging to the family Cypridiniidae may be considered truly pelagic, although some species of the genus *Cypridina* migrate to the surface at night. Of these two, only *Macrocypridina* has thus far been recorded from the upper waters of the Sargasso Sea. The other genus is *Gigantocypris*; according to Poulsen (1962), these are bathypelagic forms, individuals of which may attain lengths of 32 mm, and have been found almost entirely at depths below 1000 m and down to 3500 m depths. Poulsen recorded a temperature range of 2.1-4.9°C for *Gigantocypris*, and a salinity range of 34.6-35.4‰. This genus may well occur in the deeper waters of the Sargasso Sea.

The suborder Halocypriformes contains but one family, the Halocypridae, which in the present state of our knowledge includes two subfamilies and five genera. Skogsberg (1920) discussed the classification of the Halocyprids, and agreed

with the classification advanced by Müller (1906a). In this report Müller's classification will be followed, and not that of Claus (1890, 1891) or Claus's classification as modified by Granata and di Caporiacco (1949). Four of the five genera of Halocyprids were represented in the material from Station "S."

KEY TO SUBFAMILIES OF FAMILY HALOCYPRIDAE  
(from Müller, 1906, 1912)

1. First antenna of 6 segments, the three distal segments with long swimming bristles or setae .....  
Thaumatoocyprinae, 1 Genus *Thaumatoocypris*, 1 species *T. echinata* Müller
1. First antenna of less than 6 segments, segmentation indistinct, setae of distal two segments are developed completely or in part as delicate sensory filaments ..... Conchoecinae

KEY TO THE GENERA OF CONCHOECINAE  
(from Müller, 1912)

1. The two terminal, often fused, segments of the first antenna with 5 setae ... 2
1. These segments with more than 5 setae ..... 3
2. Basal segment of endopodite of second antenna with a tubercle or processus mammillaris on its anterior margin ..... *Conchoecia*
2. This segment without a processus mammillaris ..... *Halocypris*
3. Terminal segments of first antenna with 6 similar sensory filaments .....  
..... *Archiconchoecia*
3. These segments with more than 6 sensory filaments and with other setae .....  
..... *Euconchoecia*

## SPECIES LIST

Forty-three species of ostracods were found in the samples collected at Station "S" and in all probability other species were present as unidentifiable larvae. Thirty-two of the species were found in samples from the upper 500 m; eleven species were recorded only from samples collected at depths below 450-500 m. Doubtless, this is the largest number of species of pelagic ostracods ever recorded from a single station. A more thorough sampling of the deeper waters would surely in-

TABLE 1. List of ostracod species, with observed periods of occurrence and sample depth ranges.

Species	Period of Occurrence	Sample Depth Range
<i>Macrocypridina castanea</i>	Occasional, throughout year	0-500 m, 750-1500 m
<i>Halocypris brevisrostris</i>	Year-round	0-500 m, 1000-2000 m
<i>H. globosa</i>	February to June	0-2000 m
<i>Archiconchoecia striata</i>	Year-round	0-500 m, 1250-2000 m
<i>A. cucullata</i>	Jan., Feb., Aug., Oct.	0-2000 m
<i>A. cuneata</i>	Aug., Oct., Feb.	0-500 m
<i>Euconchoecia chierchiaie</i>	Sept. to April	0-500 m
<i>Conchoecia acuminata</i>	Year-round	0-500 m
<i>C. aquisetula</i>	Feb., Aug.	500-1500 m
<i>C. ametra</i>	Jan., Feb., June	0-1800 m
<i>C. atlantica</i>	Every month, except May	0-500 m
<i>C. bispinosa</i>	June-Aug., Nov.-April	0-2000 m
<i>C. borealis</i>	June, Sept.	0-1800 m
<i>C. brachyaskos</i>	Feb., June, Aug.	450-2000 m
<i>C. concentrica</i>	Occasional, Sept.-April	0-500 m
<i>C. curta</i>	Year-round	0-2000 m
<i>C. daphnoides</i>	Every month, except Sept.	0-500 m, 1250-2000 m
<i>C. dichotoma</i> (?)	Feb., June	1000-2000 m
<i>C. discophora</i>	June	500-1000 m
<i>C. elegans</i>	Occasional, year-round	0-1000 m
<i>C. glandulosa</i>	Aug.	700-1500 m
<i>C. imbricata</i>	Year-round	0-2000 m
<i>C. kampta</i>	Feb., Aug.	750-2000 m
<i>C. kyrtophora</i>	June, Aug.	750-1800 m
<i>C. lophura</i>	May, Aug., Sept.	0-500 m
<i>C. loricata</i>	Oct.-Feb., April	0-2000 m
<i>C. macrocheira</i>	Jan.	0-1500 m
<i>C. magna</i>	Year-round	0-2000 m
<i>C. mamillata</i>	Feb., June	1000-2000 m
<i>C. oblonga</i>	Year-round	0-2000 m
<i>C. parthenoda</i>	Year-round	0-2000 m
<i>C. porrecta</i>	Mar., Apr., June, Sept, Nov., Dec.	0-500 m
<i>C. procera</i>	Year-round	0-2000 m
<i>C. pusilla</i>	June	500-1800 m
<i>C. reticulata</i>	Feb.	1250-2000 m
<i>C. rhyngchena</i>	Feb.	1250-2000 m
<i>C. rotundata</i>	Year-round	0-2000 m
<i>C. secernenda</i>	Year-round	0-2000 m
<i>C. skogsbergi</i>	Feb., June	500-2000 m
<i>C. spinifera</i>	Year-round	0-2000 m
<i>C. spinirostris</i>	Year-round	0-2000 m
<i>C. subarcuata</i>	Year-round	0-500 m, 1250-2000 m
<i>Conchoecia</i> sp.	April	0-100 m

crease the species list, since for this study the results of only a few deeper tows were available. Table 1 lists the species, of which 42 are Halocyprids, and gives the noted periods of occurrence and the depth ranges of the samples from which the species were recorded.

*Archiconchoecia striata* and *Halocypris brevirostris* occurred year-round. *Eiconchoecia chierchiaie* was relatively numerous seasonally, during autumn and winter. The species of *Conchoecia* which were fairly abundant year-round in the upper 500 m include *C. curta*, *C. magna*, *C. oblonga*, *C. parthenoda*, *C. procera*, *C. rotundata* and *C. spinirostris*. *C. imbricata*, *C. secernenda* and *C. spinifera* also occurred throughout the year, but were less numerous.

The species list contains two species which Müller (1906a, 1912) considered synonymous with two other species that occurred at Station "S." These are *C. secernenda* Vávra which Müller synonymized with *C. bispinosa* Claus, and *C. porrecta* Claus which Müller considered synonymous with *C. spinirostris* Claus. Although he lacked material, Skogsberg (1920) believed that these might be separate species, and they are so considered here. Also, two of the three species into which Iles (1953) divided Müller's *C. rotundata* were found at Station "S"; i.e., *C. rotundata* Müller and *C. skogsbergi* Iles. A hitherto underscribed form which occurred commonly in the samples from Station "S" is the male of *C. parthenoda*. Müller (1906a) described the species from the female only. Also one female specimen of the genus *Conchoecia*, which may represent a new species, is listed and described in this report as *Conchoecia* sp.

## DESCRIPTION OF SPECIES

SUBORDER CYPRIDINIFORMES Skogsberg, 1920

FAMILY CYPRIDINIDAE Dana

GENUS *Macrocypridina* Skogsberg, 1920

*Macrocypridina castanea* (Brady) s. str.

(Figure 1)

*Cypridina castanea*, Brady, 1897, p. 88, Pl. XVI, Figs. 1-4.

*Cypridina castanea*, Müller, 1906a, p. 130, Pl. V, Figs. 1, 2, Pl. XXXIII, Figs. 11-16, Pl. XXXIV, Figs. 10-13.

?*Cypridina obesa*, Vávra, 1906, p. 67, Pl. VII, Figs. 132b-142.

*Cypridina (Macrocypridina) castanea*, Skogsberg, 1920, p. 281, Figs. XLVII-LI.

*Macrocypridina castanea* (Brady) s. str., Poulsen, 1962, p. 119, Figs. 61-74.

For further synonymy and description, see Skogsberg and Poulsen.

**DISCUSSION AND DESCRIPTION.** Only one species of this genus has been described, since it is believed that Vávra's specimen was a larva of *M. castanea*. This species is widespread in the Atlantic, Pacific and Indian Oceans. Poulsen (1962) designated the Atlantic form described by Brady as *M. castanea* s. str. and the Indo-Pacific form as *M. castanea* var. *rotunda*. *M. castanea* s. str. has been recorded from 56°N-35°S in the Atlantic. Poulsen noted a wide vertical distribution for this species, 35-3000 m for larvae and adults. It was rare in the upper 100 m, most numerous from 1000-3500 m, with its main habitat probably mainly between 1500 and 3000 m depths. Therefore, it is not a bathypelagic species, but one which frequents intermediate depths. The salinity range was 34.4-36.9‰, and the observed temperature range was 3.0-18.9°C, compared with a temperature range of 2.1-4.9°C recorded for the bathypelagic *Gigantocypris* species.

The classification of the species, taken from Poulsen's keys, is summarized as follows:

Suborder Cypridiniformes: most anterior furcal claw directly on antero-distal corner.

Family Cypridinidae: last joint of mandible with more than four bristles or claws.

Subfamily Cypridininae: no hairs on margin of furcal lamellae of the claws.

Genus *Macrocypridina*: furca with 8-14 pairs of claws; upper lip undivided and semicircular with small postero-lateral processes.

SHELL LENGTH. Mature individuals: males, 6.0-7.3 mm; females with eggs or embryos in the brood chamber, 5.5-7.6 mm.

In his Atlantic material Poulsen found six size groups, corresponding to the five larval stages and the mature stage. The largest embryos in the brood chamber were 0.9 mm long. The mean lengths of the five larval stages and the adult were



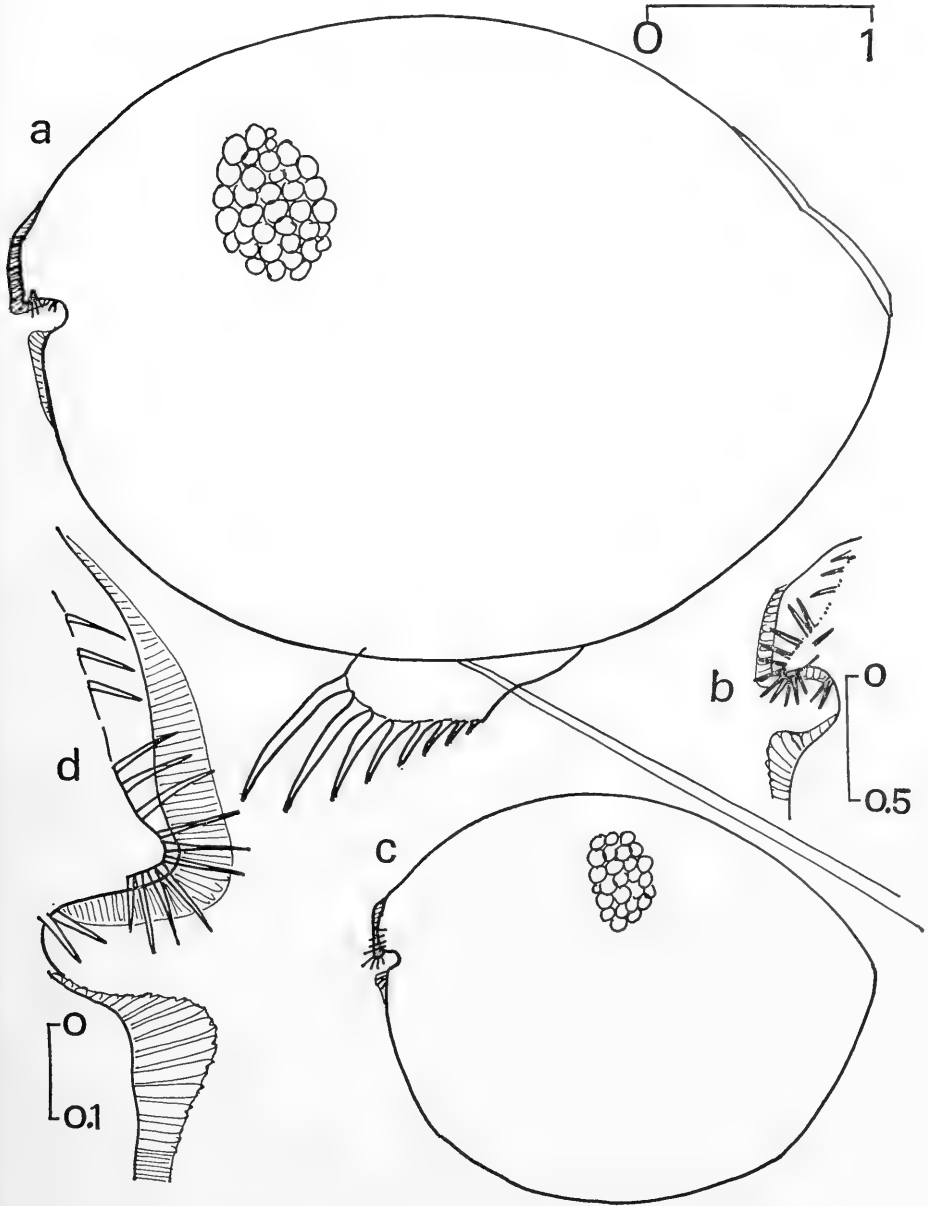


Figure 1. *Macrocypridina castanea* (Brady). a, lateral view of 3.9 mm Stage V larva. b, inside right rostrum of Stage V larva. c, lateral view of Stage III larva, 2.1 mm long. d, inside left rostrum of Stage III larva. Scale at upper right for a and c; at lower left for d; at right for b. All scales in mm.

as follows: 1.1 mm, 1.5 mm, 2.1 mm, 2.9 mm, 4.2 mm, and 6.4 mm for the mature stage.

In the material from Station "S" no mature individuals were found, but the first, second, third and fifth larval stages were noted as occasional specimens throughout the year. Stage III and stage V individuals are shown in Figure 1. In

the first several larval stages the shell is pale, transparent and fragile and nearly round in lateral view. The shell becomes more elongate and opaque as the animal matures; the shape of stage V individuals is similar to that of the adult. The specimen figured (Fig. 1a) was 3.9 mm long by 2.85 mm high. *M. castanea* is easily distinguished from the other ostracods collected at Station "S" by its size and shape and by the presence of two large reddish lateral eyes, which are quite striking in the early larval stages, but less noticeable as the animal matures and the shell darkens. Halocyprids have no lateral eyes. The fact that the most anterior furcal claw is directly on the antero-distal corner (see Fig. 1a) also distinguishes this Cypridinid from the Halocyprids. The arrangement of spines around and inside the rostrum (Fig. 1b, d) is also distinctive.

There is some evidence that *M. castanea* is a carnivorous, or at least an omnivorous, species. The guts of several larvae contained whole copepods, in one case a Corycaeid and a Paracalanid, together with other crustacean remains. Also at least two specimens were preserved clutching other organisms, one an Oncaeid copepod, the other an Appendicularian.

COLLECTION DATA. The extreme possible temperature range in the upper 500 m when *M. castanea* was present was 16.0-28.1°C. This might seem to imply a temperature range considerably higher than that noted by Poulsen, but at 300 m the temperature rarely exceeds 18°C, and the specimens may well have been caught over the 300-500 m depth range. This was the case on the only occasion (Oct. 9, 1959) when *M. castanea* larvae were taken in the samples collected at 100 m intervals. Two larvae were taken in the 300-400 m sample, the maximum temperature being 17.6°C, and four larvae were present in the 400-500 m sample. On this date numbers of 7 and 11/1000 m<sup>3</sup> were recorded for the two depth levels.

SUBORDER HALOCYPRIFORMES Skogsberg, 1920

FAMILY HALOCYPRIDAE Dana 1852

SUBFAMILY CONCHOECINAE Müller 1906

GENUS *Halocypris* Dana 1852

The genus *Halocypris* is separated from the genus *Conchoecia* by the lack of a tubercle or processus mammillaris on the basal segment of the endopodite of the second antenna (see Fig. 3b, for example), and from the genera *Archiconchoecia* and *Euconchoecia* by the presence of five setae (actually one seta and four sensory filaments) on the two distal, often indistinct segments of the first antenna (see Fig. 3a, c). The shell of this genus is always short, height at least two-thirds of length. The rostrum is short, in one species, *H. brevirostris*, it is scarcely developed. The left asymmetrical gland opens just anterior to the postero-dorsal corner of the shell; the right asymmetrical gland opens near the postero-ventral corner of the shell, but is dorsally displaced in one species, *H. globosa*. Skogsberg (1920) and Müller (1906a) have described and discussed the morphology of this genus.

J. D. Dana (1849, 1852) was the first to describe species of the truly pelagic genera *Halocypris* and *Conchoecia* from material collected by the United States Exploring Expedition under Captain Wilkes in 1838-1842. Müller (1906a) recog-

nized five species of *Halocypris*, two of which occurred at Station "S". His key to the five species is as follows:

- 1. Right asymmetrical shell glands displaced dorsally ..... *H. globosa*
- 1. Right asymmetrical glands in usual place ..... 2
- 2. Rostrum indistinct, in its place a slighty concave bump .... *H. brevirostris*
- 2. Rostrum distinct ..... 3
- 3. Shoulder vaults lacking ..... *H. striata*
- 3. Shoulder vaults distinct ..... 4
- 4. Sexually mature animals at least 3 mm long ..... *H. cornuta*
- 4. Mature animals smaller than 2 mm ..... *H. bicornis*

*Halocypris brevirostris* (Dana)

(Figure 2 a-f; Figure 3 c-e)

?*Conchaecia brevirostris* and *C. inflata*, Dana, 1849, p. 52.

?*Halocypris inflata* and *H. brevirostris*, Dana, 1852, p. 1301.

*H. concha*, *H. pelagica* and *H. distincta*, Claus, 1890, p. 24-25.

*H. inflata*, Müller, 1906a, p. 50, Pl. VII, Figs. 19-28.

*H. brevirostris*, Skogsberg, 1920, p. 584, Figs. CXII-CXV.

The above much abbreviated list of synonyms is given to indicate the confusion that has existed concerning the identity of this species. For a more complete list of synonyms and references, see Skogsberg. Part of the confusion arose originally because Dana, due to slight differences in the shape of the shells, presumably described the males and females as separate species. Also, this species apparently varies fairly widely in size at maturity in different regions. Skogsberg, however, made a careful study of all the organs of a male 0.95 mm long and found that they agreed in all respects with those of males 1.4-1.6 mm long.

DESCRIPTION. This species is characterized by the lack of a distinct rostrum (Fig. 2a, d, f). The female shell is appreciably shorter than the male's in proportion to its height, the height being 80% or more of the length. For the male shell the height is 66-70% of the length. Lateral, anterior and ventral views of both are shown in Figure 2a-e. The frontal organ and first antenna (Fig. 3c) are similar in both sexes. The endopodite of the male right second antenna with the right clasping organ is illustrated in Figure 3e, the left clasping organ in Figure 3d.

LENGTH. In the material from Station "S" males were 0.95-1.15 mm long, females 1.1-1.3 long. Müller (1906a) gave the length of males as 1.15-1.75 mm and of females as up to 1.8 mm. Skogsberg's (1920) females were 1.6-1.8 mm long.

COLLECTION DATA. *H. brevirostris* occurred throughout the year in the upper 500 m at Station "S" and was present in every sample collected from March 1961 to April 1962. In the samples taken at 100 m depth intervals it was usually most numerous in the upper 200 m (see Fig. 65c and Table 3). In June 1959, the highest number of 79/1000 m<sup>3</sup> was found in the 0-100 m sample; in October 1959 it was most abundant in the 100-200 m sample (109/1000 m<sup>3</sup>). It was most numerous in February 1960, when numbers of 508/1000 m<sup>3</sup> were recorded for

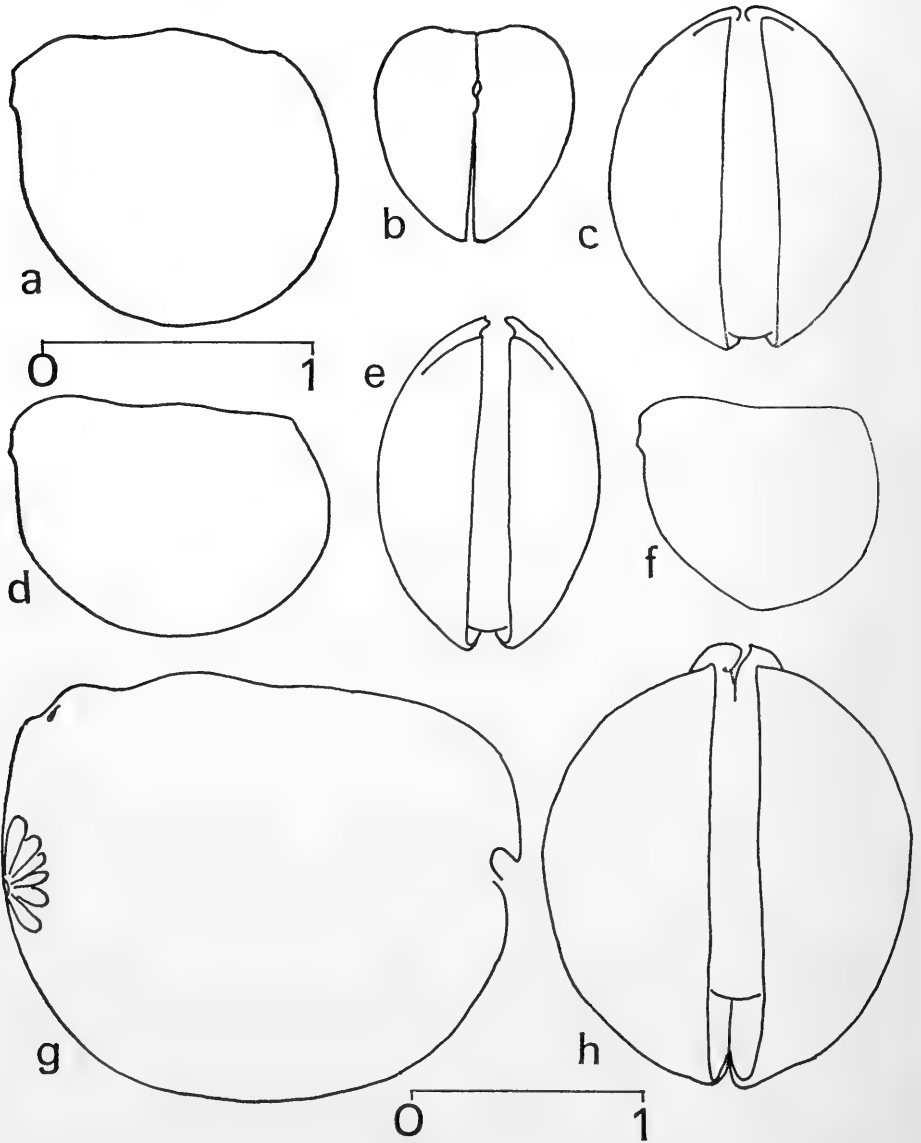


Figure 2. *Halocypris breviostris* (Dana) and *H. globosa* (Claus). a-c, lateral, anterior, and ventral views of female *H. breviostris*. d and e, lateral and ventral views of male *H. breviostris*. f, larval *H. breviostris*, lateral view. g and h, lateral and ventral views of female *H. globosa*. Scale at upper left for *H. breviostris*, at bottom for *H. globosa*. Both scales in mm.

the 100-200 m sample and of 341/1000 m<sup>3</sup> for the 200-300 m haul. The extreme temperature range in the upper 500 m during the year was 15.9-28.5°C. Skogsberg (1920) reported specimens caught in surface samples at temperatures of 21.1-26.8°C.

DISTRIBUTION. 60°N-40°S in the Atlantic; Pacific and Indian Oceans. According to Granata and di Caporiacco (1949), it occurs to 60°S. Lat. in the Atlantic.

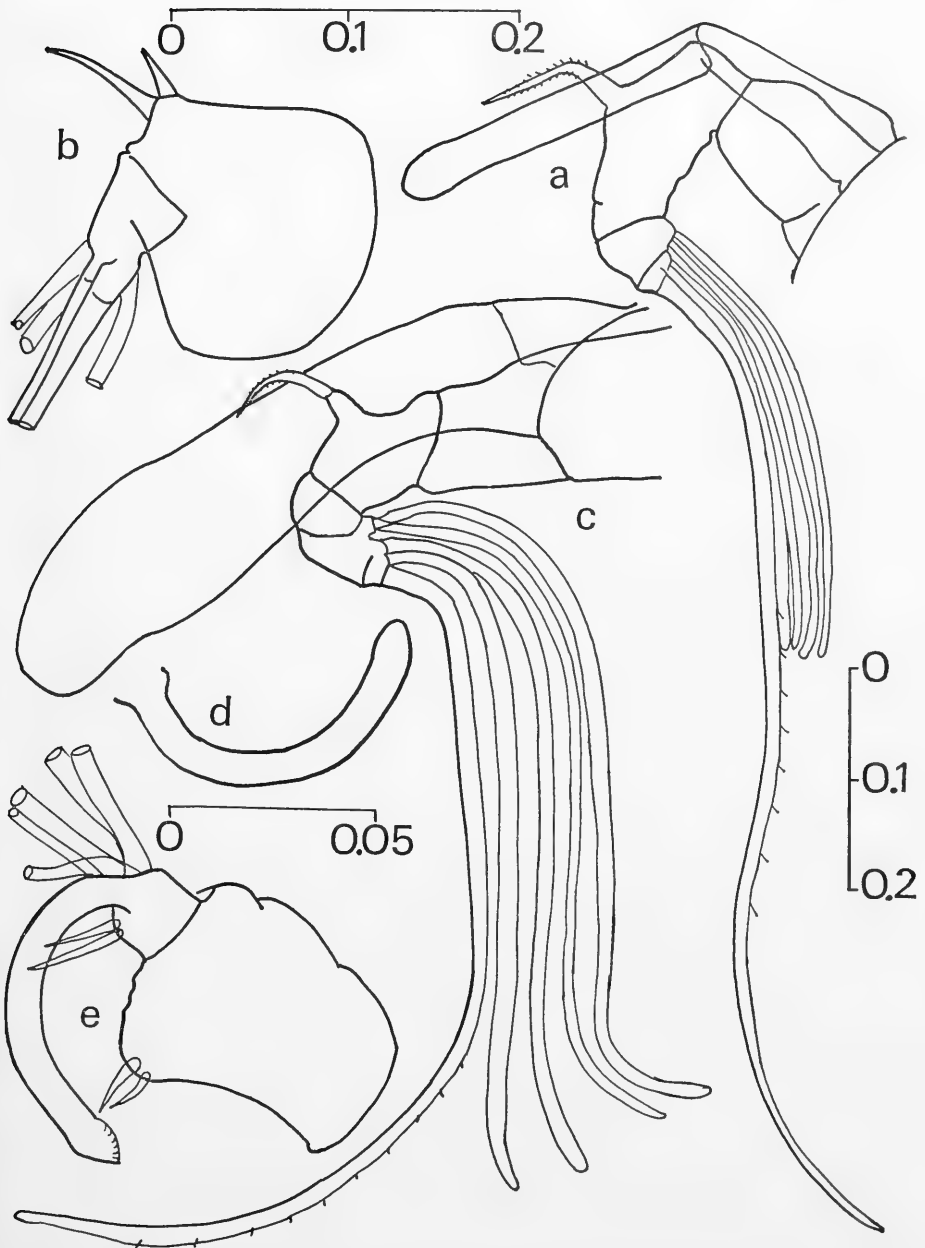


Figure 3. a and b, *H. globosa*. a, frontal organ and first antenna of female. b, endopodite of female second antenna (setae and filaments cut off). c, d, and e, *H. brevisrostris*. c, female frontal organ and first antenna. d and e, left clasp organ of male and endopodite of male right second antenna (setae and filaments cut off). Scale at top for b and c; at right for a; at left for d and e. All scales in mm.

*Halocypris globosa* (Claus)  
(Figure 2g, h; Figure 3a, b)

*Halocypris globosa*, Claus, 1874b, p. 178.

*Halocypris globosa*, Müller, 1906a, p. 47, Pl. VIII, Figs. 13-16, 18, 19, Pl. XXV, Fig. 1; 1912, p. 57.

*Halocypris globosa*, Skogsberg, 1931, p. 5, Fig. 1.

For further synonymy and supplementary description, see Skogsberg.

**DESCRIPTION.** This species is characterized by the dorsal displacement of the right asymmetrical gland, which opens at approximately one-half the shell height. The female shell is delicate, transparent and flexible; it is short, the height approximately two-thirds the length (Fig. 2g, h). The rostrum is small, pointed, and bent downwards. The female frontal organ and first antenna, and the endopodite of the female second antenna, lacking the processus mammillaris, are illustrated in Figure 3a and b. According to Müller, the male shell is more elongate, the rostrum large, rounded and pointing forwards, the height three-fifths of the length. No males were found in the samples from Station "S", although several immature males, 1.7 mm long, were noted. In spite of an abundance of material, Skogsberg also found only females.

*H. globosa* is at least in part a predatory species. Chitinous remains, such as claws, spines and a copepod mandible, were found in the gut.

**LENGTH.** Females 2.6-3.0 mm; males 1.6-2.25 mm (Müller). Claus's specimens were 2.0-2.2 mm long, Skogsberg's females 2.3-2.7 mm long. Females from Station "S" were 2.0-2.5 mm long.

Measurements on a number of specimens indicated the presence of six stages in the following length ranges: stage I, 0.45-0.5 mm; stage II, 0.7-0.75 mm; stage III, 0.9-1.15 mm; stage IV, 1.3-1.5 mm; stage V, 1.6-1.9 mm; mature females, 2.0-2.5 mm.

**COLLECTION DATA.** *H. globosa* was definitely a winter-spring form at Station "S", and occurred during the period from early February to June. In the samples collected at 100 m intervals in February 1960 this species was most numerous in the upper 100 m, where it constituted 44.3% of the total number of ostracods and 910/1000 m<sup>3</sup> were recorded. Total numbers decreased to 42/1000 m<sup>3</sup> in the 400-500 m sample. In June 1959 only 4/1000 m<sup>3</sup> were recorded for the 0-100 m sample. The extreme possible temperature range during the period of its occurrence was 15.9-22.8°C. The temperature range in the upper 100 m in February was 19.77-20.06°C.

**DISTRIBUTION.** 60°N-35°S in the Atlantic; Indian and Pacific Oceans.

GENUS *Archiconchoecia* Müller 1894

The genus *Archiconchoecia* is separated from the genus *Conchoecia* by the absence of a tubercle or processus mammillaris on the endopodite of the second antenna (see Figs. 4f, g, 6d), and from the genera *Halocypris* and *Euconchoecia* in that the last two segments of the first antenna have six nearly equal long sensory filaments (Fig. 6f). The furca has six claws (Fig. 4i). Four species have been described, all quite different in size and shape, of which three occurred at Station "S".

KEY TO SPECIES OF *Archiconchoecia*  
(Müller, 1912)

1. Postero-dorsal corner of right shell with a long point ..... *A. cucullata*
1. Postero-dorsal corner of right shell without any points ..... 2
2. Shell with concentric striations ..... *A. striata*
2. Shell smooth or with indistinct longitudinal striations ..... 3
3. Frontal organ pointed at tip ..... *A. ventricosa*
3. Frontal organ rounded at tip ..... *A. cuneata*

*Archiconchoecia striata* Müller

(Figure 4)

*Archiconchoecia striata* Müller, 1894, p. 225, Pl. 6, Figs. 31-46, Pl. 8, Fig. 34; 1906a, p. 45, Pl. VII, Figs. 13-17; 1912, p. 56.

DESCRIPTION. This is the smallest ostracod which occurred at Station "S", males and females being 0.5-0.6 mm long, but it is of such a distinctive shape that the species is easily recognizable. The postero-dorsal, postero-ventral and antero-ventral corners are rounded, and there is a distinctive indentation at about the middle of the dorsal margin (Fig. 4a, c). The right and left asymmetrical glands open on the posterior margin at approximately two-thirds of the shell height. There are concentric striations on the surface of the shell, more noticeable on the anterior shell half. This is a compact species, the body tightly filling the shell. The female and male shells are slightly different in shape, the height of the female shell being greater in proportion to its length. The shells also differ in ventral view (Fig. 4b, d). The first antenna is similar in both sexes, with a dorsal bristle on the second segment. The frontal organ is undifferentiated (Fig. 4e) and rounded at the tip in both sexes. The endopodites of the male right and left second antennae are shown in Figure 4f and g; the basal segment has two long bristles bent at an angle, but no processus mammillaris; the right clasping organ is swollen near the proximal end. The furca has six claws (Fig. 4i) and an unpaired bristle behind the claws in both sexes.

COLLECTION DATA. *A. striata* occurred year-round in the upper 500 m and was present in every sample collected from March 1961-April 1962. Because of its small size, it was noted only occasionally in the No. 2 net samples. In the simultaneous tows with No. 2, No. 8 and No. 20 nets the following numbers were obtained: 2-5/1000 m<sup>3</sup> with the No. 2 net; 145/1000 m<sup>3</sup> with the No. 8 net; 448/1000 m<sup>3</sup> with the No. 20 net. The extreme possible temperature range during its period of occurrence was 15.9-28.8°C.

DISTRIBUTION. 36°N (Grice and Hart, 1961, 1962) to 37°S (Müller) in the Atlantic; Indian and Pacific Oceans; Mediterranean.

*Archiconchoecia cucullata* (Brady)

(Figure 5)

*Conchoecissa cucullata*, Brady, 1902, p. 191, Pl. XXIV, Figs. 1-8.

*Archiconchoecia cucullata*, Müller, 1906a, p. 44, Pl. VII, Figs. 7-12, 18; 1912, p. 56.

*Archiconchoecia cucullata*, Skogsberg, 1931, p. 4.

DESCRIPTION. This species is far different in appearance from *A. striata* (Fig.

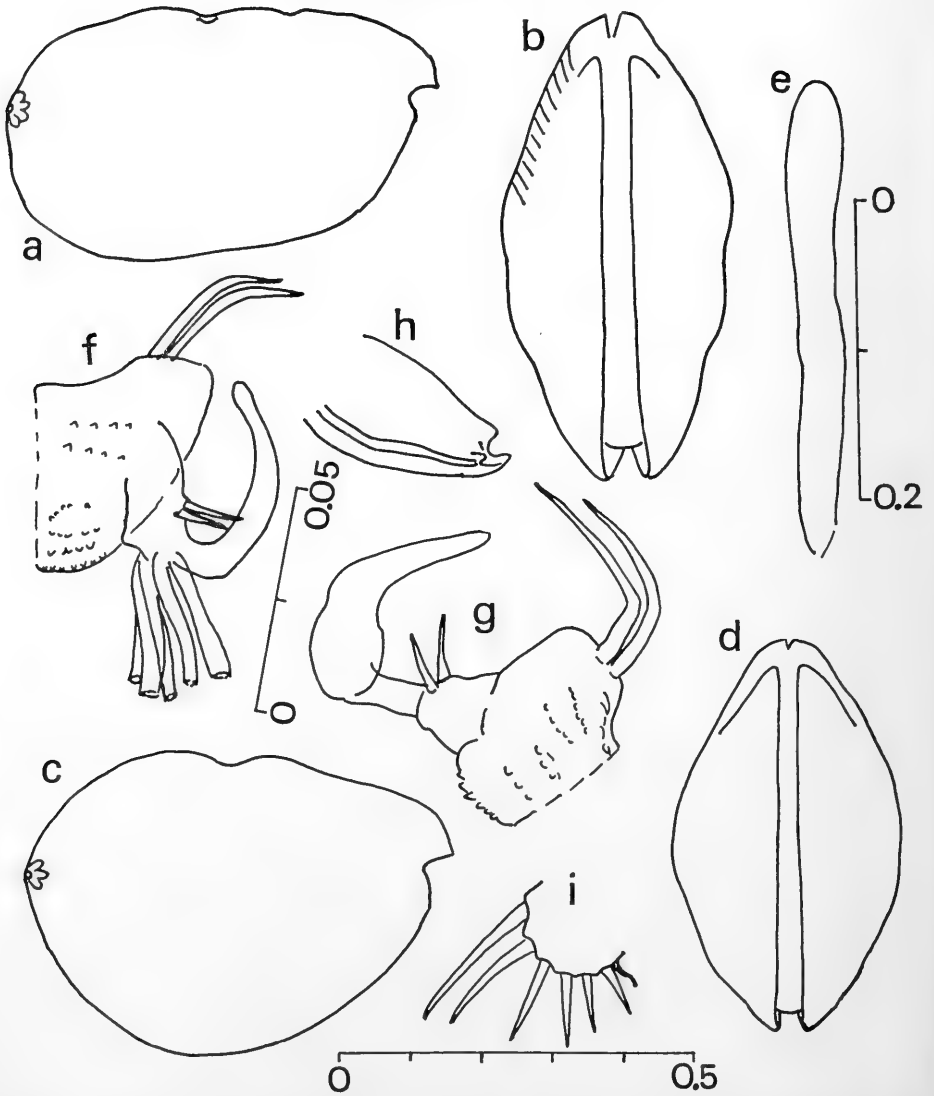


Figure 4. *Archiconchoecia striata* Müller. a and b, lateral and ventral views of male. c and d, lateral and ventral views of female. e, male frontal organ. f and g, endopodites of male left and right second antenna (setae and filaments cut off in f, not shown in g). h, penis. i, furca. Scale at bottom for a-d; at right for e, h, and i; at left for f and g. All scales in mm.

5). The shell in both sexes is elongated, height clearly less than half the length, usually nearer one-third. The rostrum is straight and projects forward on the left for one-fifth to one-quarter the body length; the right rostrum is shorter. The posterior margin of the shell is rounded on the left side; the right shell has a sharp point at the postero-dorsal corner. Glands open on processes on the posterior margin. The process on the left shell is near the postero-dorsal corner, the right process farther down the posterior margin. The shape and sculpturing of the shell is distinctive (Fig. 5b). The shell appears thick and white by direct light, opaque and dark by reflected light.



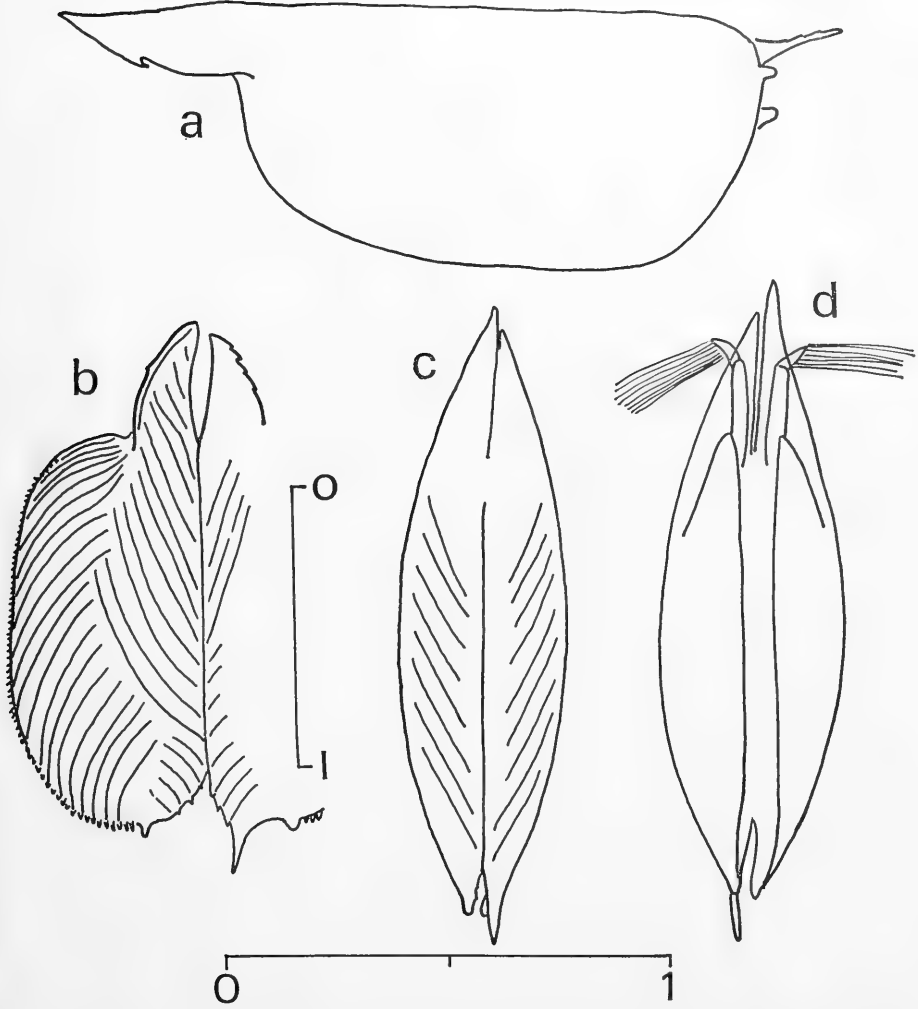


Figure 5. *Archiconchoecia cucullata* (Brady). a, c, and d, lateral, dorsal and ventral views of female. b, female shell opened out (after Müller, 1906). Scale at bottom for a, c, and d, at left center for b. Both scales in mm.

LENGTH. Müller gave the lengths of females as 1.85-2.2 mm, and of males as 1.8-2.2 mm. Skogsberg's one male specimen was 1.7 mm long. Females from Station "S" were 1.75-2.2 mm long. The single mature male taken was 1.6 mm long. One immature male was 1.45 mm long.

COLLECTION DATA. Only 11 specimens of this species were taken at Station "S", and of these only two were from above 500 m; the others were taken over a depth range of 500-2000 m. Except for one specimen from a 0-500 m tow, which was probably caught in the lower limits of this range, the extreme possible temperature range was 3.6-16°C.

DISTRIBUTION. 52°N-42°S in the Atlantic; Indian Ocean. Müller noted that it was not found between 1°N and 31°S in the Atlantic.

*Archiconchoecia cuneata* Müller  
(Figure 6)

*Archiconchoecia cuneata* Müller, 1908, p. 63, Pl. VIII, Figs. 1-4.

DESCRIPTION. Müller described this species from a single female and a larval specimen taken at 19°S, 20°W in the Atlantic in October 1901. In the female shell the height is slightly greater than half the length. The shape of the shell is shown in Figure 6a-c. The rostrum bends sharply ventrally, and the anterior margin is swollen so that in ventral view the rostrum is just barely visible. The surface of the shell has weak striations, most visible paralleling the margins. The left asymmetrical gland lies just beneath the postero-dorsal corner; the right gland opens at half the shell height on the posterior margin (Fig. 6e).

The frontal organ is undifferentiated and bare of spinules; it extends just beyond the first antenna (Fig. 6f). The first antenna has six long sensory filaments of equal length, and the second segment has a large dorsal bristle which has around 10 large spines distally, at least some of which are paired. The endopodite of the second antenna is illustrated in Figure 6d. There are two bristles on the basal segment, the smaller curved, the larger almost straight and with a number of spines distally. The united second and third segment has five long sensory filaments of equal length. Müller believed *A. cuneata* to be most closely related to *A. ventricosa*.

SIZE. Four specimens of this species were taken at Station "S", three females and an immature male. The females were 0.82, 0.87, and 0.9 mm long by 0.45-0.47 mm high. The immature male was 0.68 mm long. Müller's female specimen was 1.0 mm long. The mature male is not known.

COLLECTION DATA. The specimens from Station "S" were all taken from the upper 500 m. One female was in the 0-500 m sample collected on Aug. 5, 1959, one female was in the 100-200 m sample obtained on Oct. 9, 1959, and the remaining female and larva were in the 300-400 m sample collected on Feb. 17, 1960. The extreme possible temperature range was 17.6-26.9°C. Three of the specimens were taken over a temperature range of 17.7-19°C.

DISTRIBUTION. 19°S and 32°N in the Atlantic.

#### GENUS *Conchoecia* Dana

Shell of variable shape, sometimes elongate, sometimes short and high. Rostrum always well-developed and usually bent more ventrally in females than in males. First antenna dimorphic. Male frontal organ of three or at least two jointed segments, of which the middle one is held fast to the first antenna by a ring-shaped spine, or retinaculum, on the second segment of the first antenna. The distal segment of the frontal organ, the capitulum, is usually bent downwards and may have spines or spinules, particularly on the ventral surface. In the female the first and second segments are usually not separated, and the frontal organ is not attached to the first antenna by a ring-shaped spine; the capitulum, which is usually bent down and may have spinules, is not movable or only slightly so. The last two segments of the male first antenna have five setae, three on the last segment and two on the next to last segment; two of the last segment and

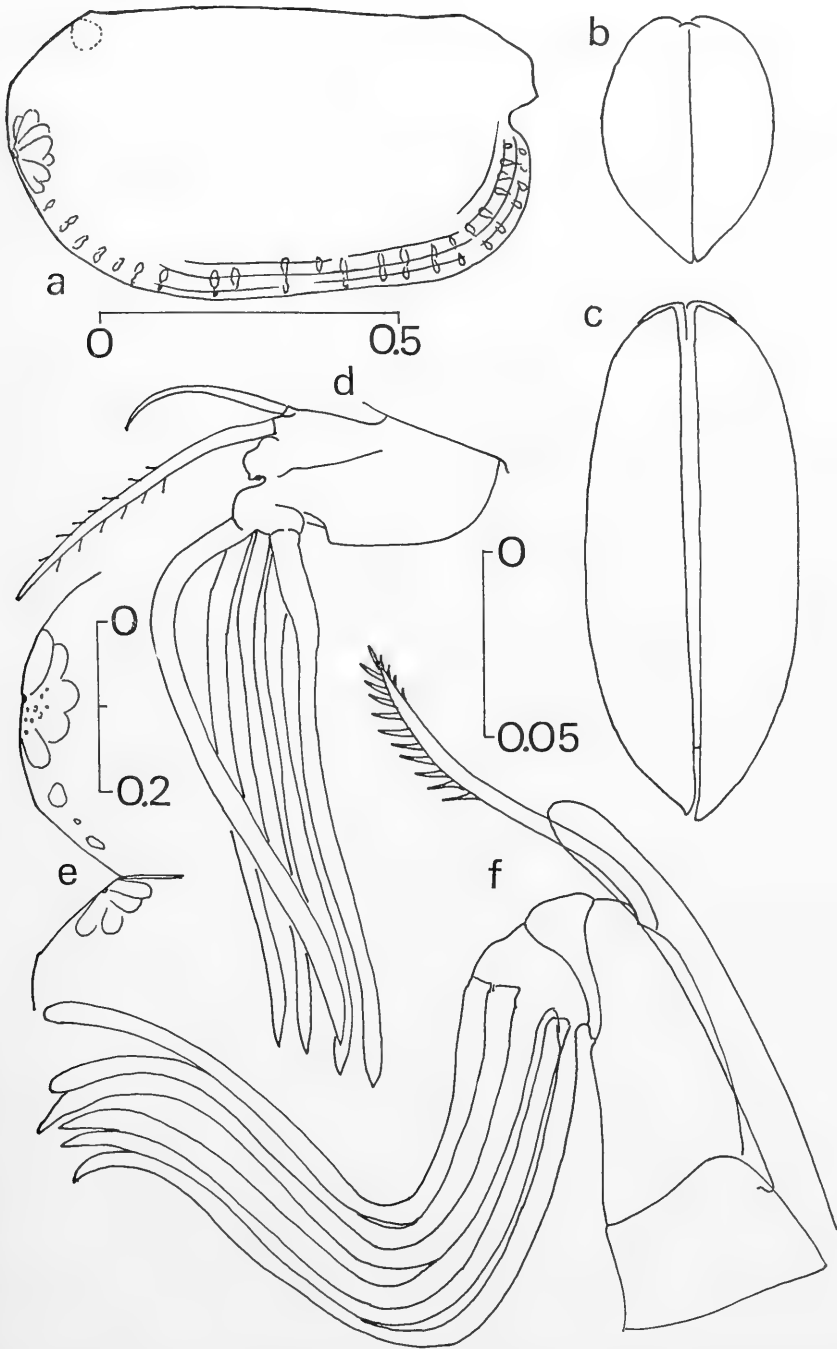


Figure 6. *Archiconchoecia cuneata* Müller. a, b, and c, lateral, posterior and ventral views of female. d, endopodite of female right second antenna. e, posterior margin of right shell, opened out, from inside. f, frontal organ and first antenna of female. Scale at upper left for a, b, c; at center left for e; at center right for d and f. Scales in mm.

one of the next to last segment are typical long setae, whereas the other two are delicate sensory filaments. The most distal seta is called the "principal seta" (Skogsberg's "e bristle", Müller's "Hauptborste") and is armed on its posterior side with a varying number of spines which usually point proximally; the other two setae, "secondary setae", are usually somewhat shorter than the principal seta and may have spinules or a pad-like thickening or callous (Müller's "Schwiele"). The female first antenna is usually shorter and weaker than the male's, and usually indistinctly segmented. Only one of the five setae of the last two segments is a typical slim seta, the female principal seta, the other four are sensory filaments. In most species, dorsally on the second segment is a straight bristle, corresponding to the male retinaculum; in some species this bristle is missing, but the males always have the retinaculum. The armature of the male principal seta is an important character in distinguishing the species. Figure 7 shows the general features of the anatomy of *Conchoecia*.

The second antenna is strongly developed as the appendage used in swimming; the exopodite is eight-jointed and carries long natatory bristles; the endopodite on its basal segment has two protuberances or processes, of which one, the processus mammillaris, is more or less conical in shape and is near the middle of the anterior side, the other is situated more distally, is larger and rounded and bears two bristles. In the male the second segment of the endopodite is short but powerful and usually armed with five bristles or setae, of which two are short and weak, two are longer, and one is a short spine-like bristle at the base of the two long bristles. The third segment has three setae which are developed as sensory filaments; it also bears the clasping organ, a powerful hook of varying size and shape which is usually more strongly developed on the right endopodite. In the female the endopodite is weaker, and the second and third segments are more or less united and have fewer setae. Even though the segments are fused, the setae are from the second segment and the filaments from the third.

The mandible, maxilla, and fifth limb vary only slightly in members of this genus, but Claus (1890, 1891) used the mandible coxale endite as the main distinguishing character for his genera. The sixth limb is dimorphic and much more powerfully developed in the male where it is used in swimming. The seventh limb is little developed. The penis, or copulatory limb, may vary considerably in size and shape in the different species. The furca has eight claws and sometimes an unpaired bristle behind the claws. For a fuller description of these appendages, see Skogsberg (1920) or Müller (1927).

Müller considered the shell glands of considerable importance in differentiating the species and in recognizing related species. He described three types of glands: the asymmetrical, lateral, and medial. The asymmetrical glands occur in all *Conchoecinae* and are easily detected. These consist of a group of cells which usually open laterally by a common pore near the shell or hinge margin. In *Conchoecia*, the left gland usually opens dorsally just anterior to the postero-dorsal corner of the shell, the right gland opens near or on the postero-ventral corner of the shell; when the asymmetrical glands open in these situations they are said to be "in the usual place". These glands, however, may be displaced in various ways in different species. The left gland may be moved forward to the anterior half of the shell, or the right gland may be displaced dorsally on the

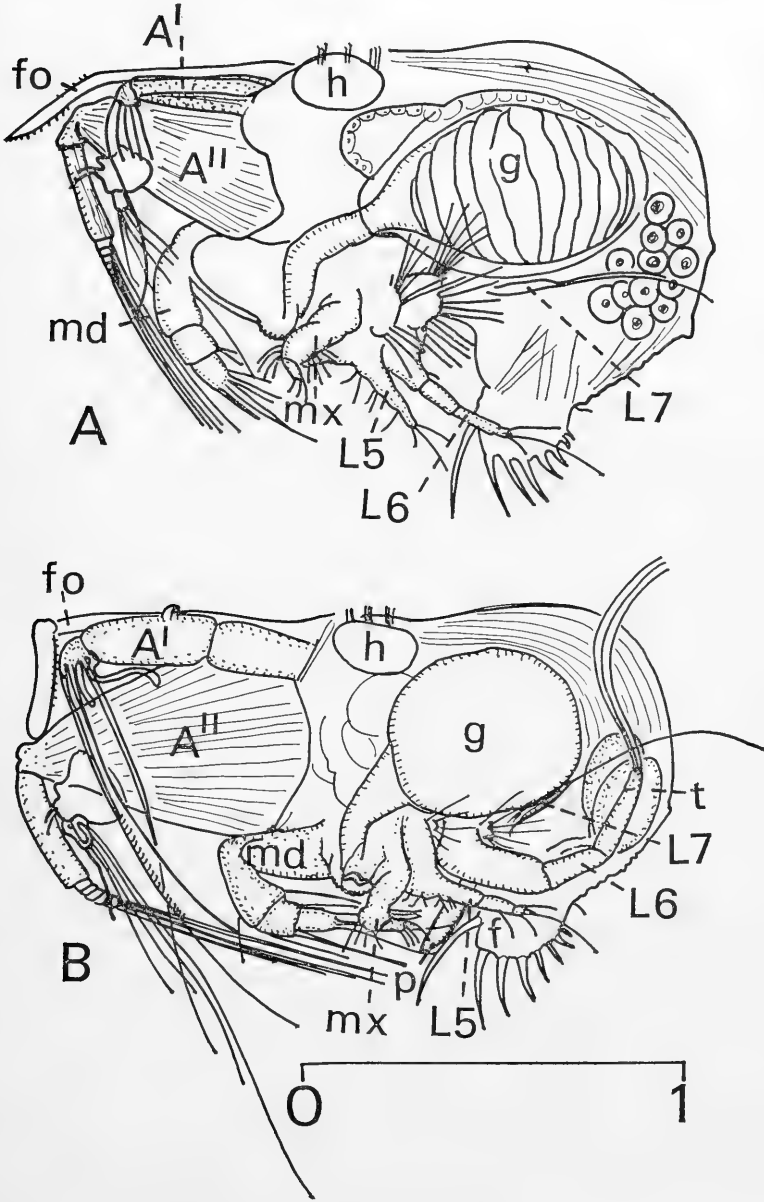


Figure 7. General features of the anatomy of *Conchoecia*. a, female. b, male. A': first antenna; A'': second antenna; fo: frontal organ; h: heart; md: mandible; mx: maxilla; L5, L6, L7: fifth, sixth, and seventh limbs; g: gut; t: testis; p: penis; f: furca. Scale in mm. [After Claus's (1891) figures of *C. magna*.]

posterior margin, or anteriorly on the ventral margin as in *C. daphnoides*. The lateral glands, commonly called the lateral corner glands ("Eckdrüse"), open on the outside and the medial glands on the inner surface of the shell. Both of these may or may not be present. The medial glands are generally confined to a row lying near the shell margin and open in parallel lines. The lateral

glands are usually combined in groups of cells with a common opening. Usually the lateral glands open at the postero-ventral corner of each shell, the right one in close proximity to, and sometimes obscured by, the right asymmetrical gland.

Aside from these glands, in one group of species, the Magna group, most of the species have two or three enlarged gland cells opening near the anterior margin beneath the rostral incisure. Also the ventral glands in the Incisa group should be noted. There is great diversity in the development and position of the shell glands in the various species of *Conchoecia*.

The great majority of Halocyprids belong to this genus. Over 100 species of *Conchoecia* have been described. Müller (1906a) listed 96 species in his "Valdivia" report. Claus (1890, 1891) divided the genus *Conchoecia* into a number of genera and this system was modified by Granata and di Caporiacco (1949), although neither Müller nor Skogsberg (1920) were able to find sufficient differences between the species to merit this. Instead, Müller tried to group species together into more or less natural groups of closely related forms, though later (1912) he abandoned this system and devised a key for 80 species, which appears not altogether satisfactory. Skogsberg, after an exhaustive study of a number of species, followed Müller's original procedure of grouping species in natural groups.

When the relationships between the species are better known, the genus *Conchoecia* will doubtless be subdivided into a number of genera. Müller's system of classifying the species in groups is used in this report. Thirty-six species of *Conchoecia* have thus far been recorded from Station "S".

#### SPINIFERA GROUP MÜLLER

Müller (1906a) included 12 species in this group, which Skogsberg did not consider entirely a natural group. It contains the following species: *C. spinifera*, *C. inermis*, *C. oblonga*, *C. allotharium*, *C. aequisetata*, *C. hirsuta*, *C. mamillata*, *C. echinata*, *C. dorsotuberculata*, *C. reticulata*, *C. caudata*, and *C. dasyophthalma*. Five of these species, *C. spinifera*, *C. oblonga*, *C. aequisetata*, *C. reticulata*, and *C. mamillata*, were present in the samples from Station "S".

In most of the species the postero-dorsal corner of the right shell has a spine and there is none on the left, but in *C. inermis* and *C. dorsotuberculata* both shells lack a spine. In *C. mamillata* there is also a small projection on the left shell. *C. caudata* has a long spine on the right valve and a small one on the left. The asymmetrical glands open in the usual places in most of the species, but in *C. aequisetata*, *C. hirsuta*, *C. dorsotuberculata*, and *C. mamillata* they undergo more or less far-reaching displacements. Lateral gland groups are lacking. The armature of the principal seta in both sexes is characteristic of the group. In the females, in particular, there are long hairs on the anterior surface of the principal seta near the proximal end.

#### *Conchoecia spinifera* (Claus) (Figures 8, 9)

*Paraconchoecia spinifera*, Claus, 1890, p. 14; 1891, p. 65, Pl. X, Figs. 1-7.

*Conchoecia spinifera*, Müller, 1906a, p. 56, Pl. IX, Figs. 1-10, 14, 15; 1912, p. 69.

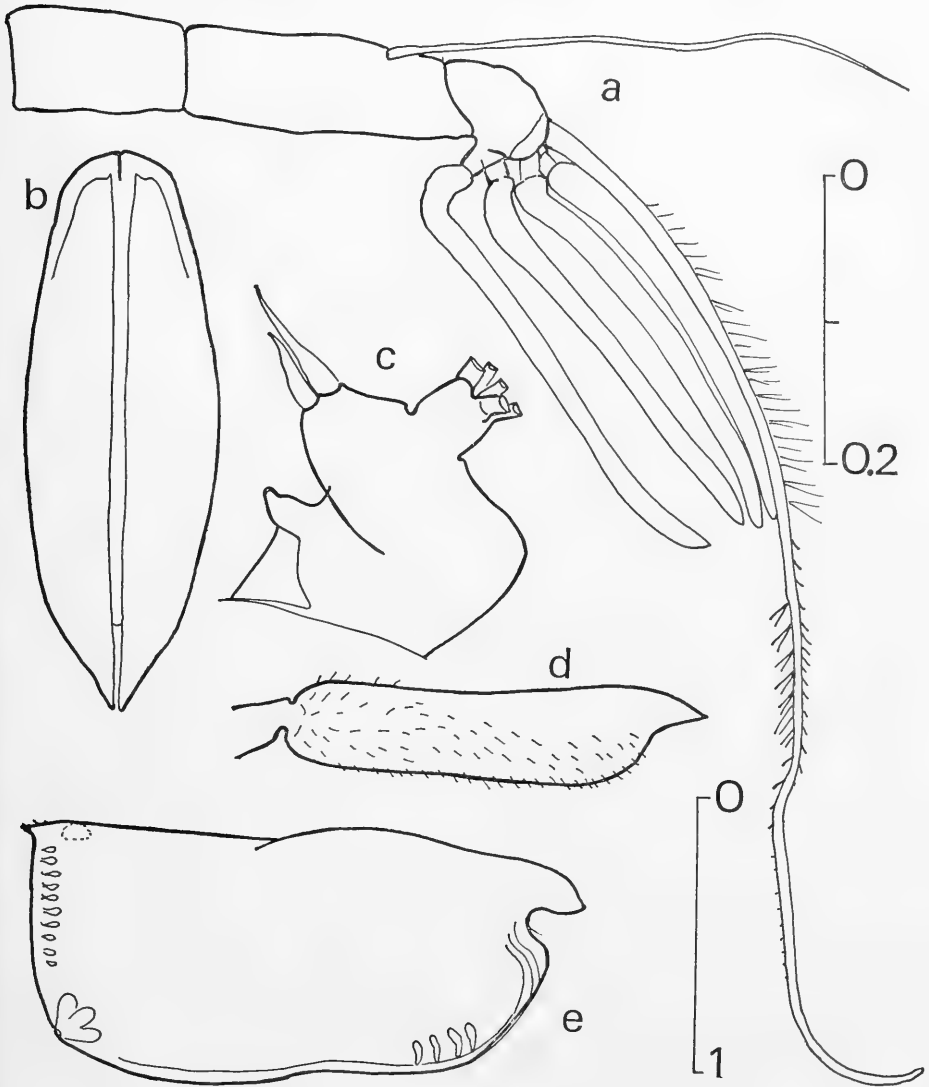


Figure 8: Female *Conchoecia spinifera* (Claus). a, first antenna. b, ventral view of female. c, endopodite of second antenna (setae and filaments cut off). d, capitulum of frontal organ. e, lateral view of female. Scale at lower right for b and e, at upper right for a, c, and d. Scales in mm.

**DESCRIPTION.** The shell is elongate, about twice as long as high, thin and transparent, with a spine at the postero-dorsal corner of the right valve (Figs. 8e, 9a). Glandular cells along the posterior margin and a few at the antero-ventral corner are characteristic of this species. The shoulder vaults are strongly developed and sharp-edged (Fig. 9c), and this distinguishes *C. spinifera* from *C. oblonga*, which is also slightly smaller. Only one other species taken at Station "S", *C. borealis*, has sharp-edged shoulder vaults and this species has the postero-dorsal corners of both shells rounded. The asymmetrical glands are in the usual place.

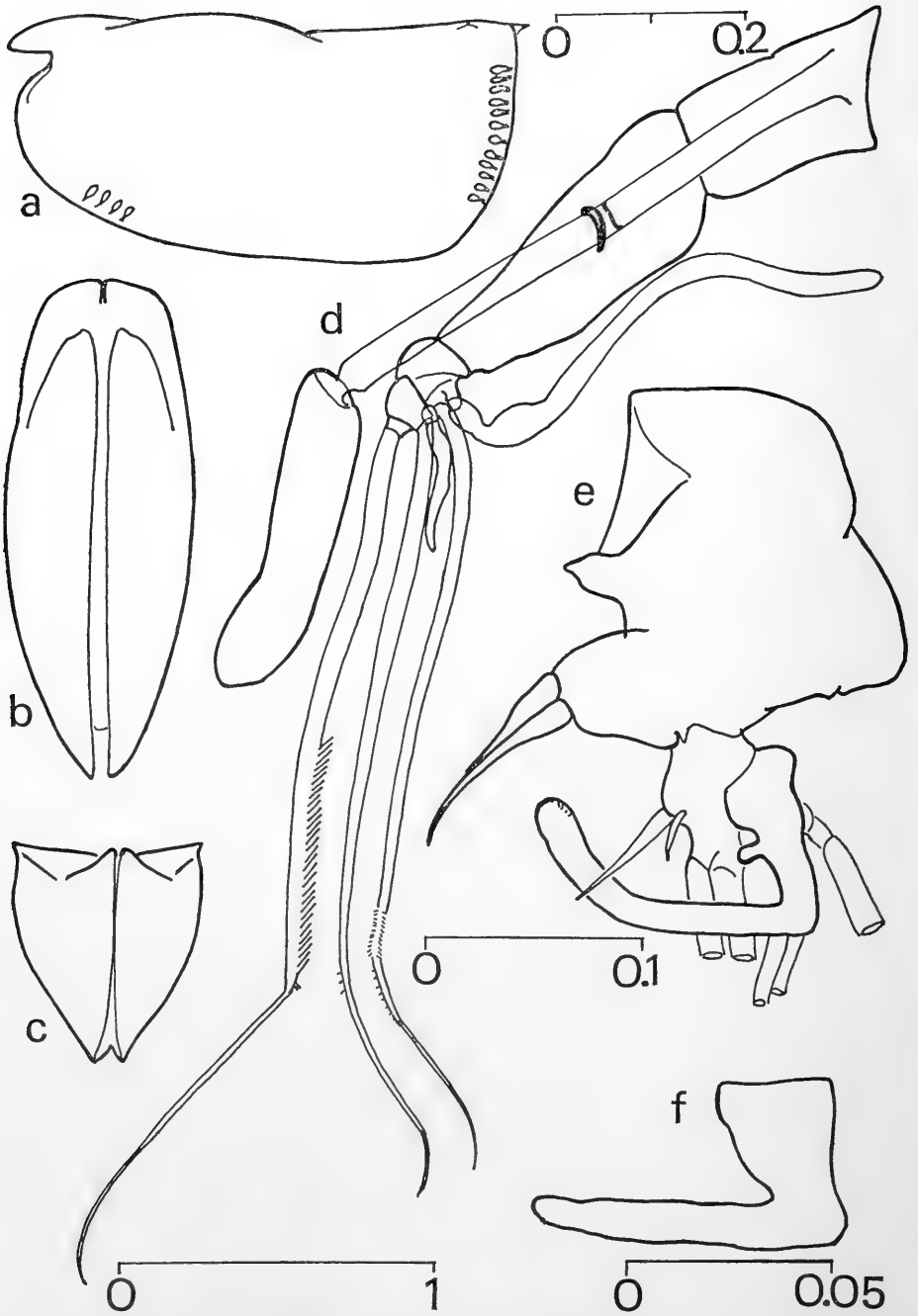


Figure 9. Male *Conchoecia spinifera* (Claus). a, b, and c, lateral, ventral and posterior views of male. d, frontal organ and first antenna. e, endopodite of right second antenna. f, left clasp organ. Scale at lower left for a-c; at lower right for f; lower center for e; upper right for d. Scales in mm.



The armature of the female and male principal setae of the first antenna is also diagnostic (Figs. 8a, 9d). The male principal seta has a double row of 29 long spines directed proximally and two small spines at the distal end, directed distally. The female principal seta has, on the anterior surface, some long thin hairs proximally, as well as spinules more distally on the anterior and posterior surface. The capitulum of the male frontal organ (Fig. 9d) is bare of spinules and bends upward near the rounded distal end. That of the female is covered with spinules on the ventral surface and on the dorsal surface proximally and is pointed at the tip (Fig. 8d). The shape of the male clasping organs is shown in Figure 9e and f.

LENGTH. Females 1.9-2.2 mm, males 1.75-2.0 mm, according to Müller. At Station "S", females were 1.9-2.0 mm long, males 1.6-1.75 mm long. This was one of the largest species which occurred commonly at Station "S".

COLLECTION DATA. This species occurred year-round in the upper 500 m at Station "S", and was present, usually in small numbers, in every sample collected from March 1961 to April 1962. *C. spinifera* was relatively most numerous at depths below 200 m and down to 1000 m, although a few specimens occurred in the upper waters. In the samples taken at 100 m depth intervals, *C. spinifera* did not occur in the 0-100 m samples (see Fig. 65d and Table 3) and was not present at temperatures higher than 19-20°C. The extreme possible temperature range of the samples in which it occurred, however, was 3.6-28.8°C. The highest recorded numbers, 348/1000 m<sup>3</sup>, were obtained for the 200-300 m sample collected in June 1959.

DISTRIBUTION. 52°N-35°S in the Atlantic; Indian and Pacific Oceans.

*Conchoecia oblonga* (Claus)

(Figures 10, 11)

*Paraconchoecia oblonga*, Claus, 1890, p. 13; 1891, p. 63, Pl. VIII, Figs. 10-11, Pl. IX, Figs. 1-14.

*Conchoecia oblonga*, Müller, 1906a, p. 58, Pl. IX, Figs. 11-13, 16-25; 1912, p. 69.

*Conchoecia oblonga*, Skogsberg, 1920, p. 617, Fig. CXVI.

For further synonymy and supplementary description, see Skogsberg.

DESCRIPTION. This species has a point at the postero-dorsal corner of the right shell, but is distinguished from *C. spinifera* by its smaller size and rounded shoulder vaults (Fig. 10b). Also, *C. oblonga* lacks the gland cells at the antero-ventral corner and along the posterior margin, which were quite striking in the specimens of *C. spinifera* from Station "S." The capitulum of the male frontal organ has some spinules ventrally and may have a very few dorsally (Fig. 11g), whereas that of the *C. spinifera* male is bare. The female capitulum (Fig. 10d, e) is pointed at the tip, but is slimmer than that of *C. spinifera* females, and has fine hairs on the ventral surface and possibly also dorsally near the proximal end. The male principal seta is armed with 28-29 pairs of long thin teeth directed proximally, with two pairs of spinules pointing distally at the distal end of the row (Fig. 11c). The female principal seta (Fig. 10d) has some long fine hairs on the anterior surface near the proximal end, fewer than in the *C. spinifera* female, and there are no spinules on the anterior surface distal to these. The male right clasping organ

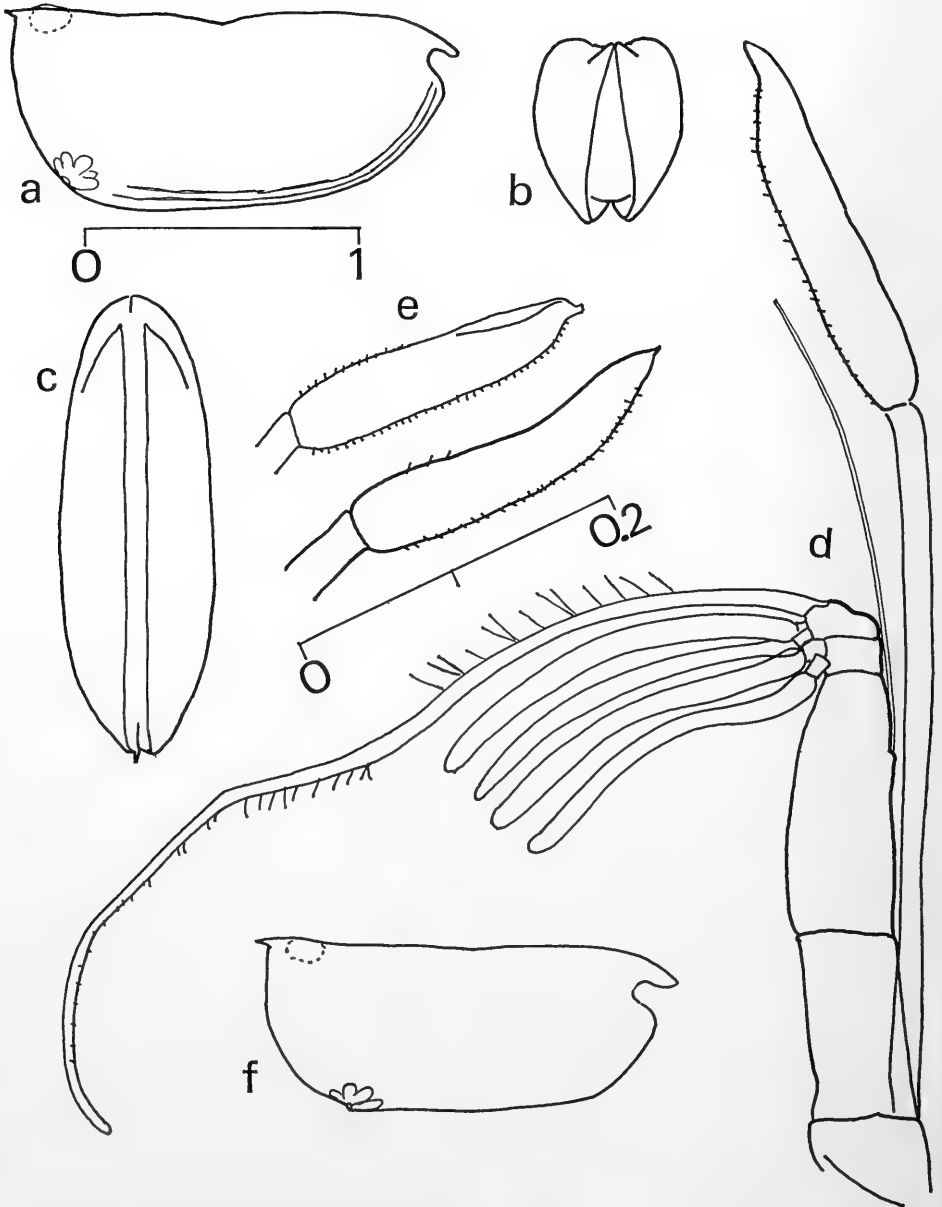


Figure 10. Female *Conchoecia oblonga* (Claus). a, lateral view of female with the right asymmetric gland in the usual place. b and c, posterior and ventral views of female. d, frontal organ and first antenna. e, capitulum of frontal organs of other females. f, lateral view of female with right asymmetric gland moved forward. Scale at top left for a, b, c, and f, at center for d and e. Scales in mm.

(Fig. 11d) curves fairly evenly, whereas that of the male *C. spinifera* (Fig. 9e) is bent at an angle. Müller noted the displacement anteriorly on the ventral margin of the right asymmetrical gland in some of his specimens of *C. oblonga*. A number of the specimens from Station "S" also showed this forward displacement of the

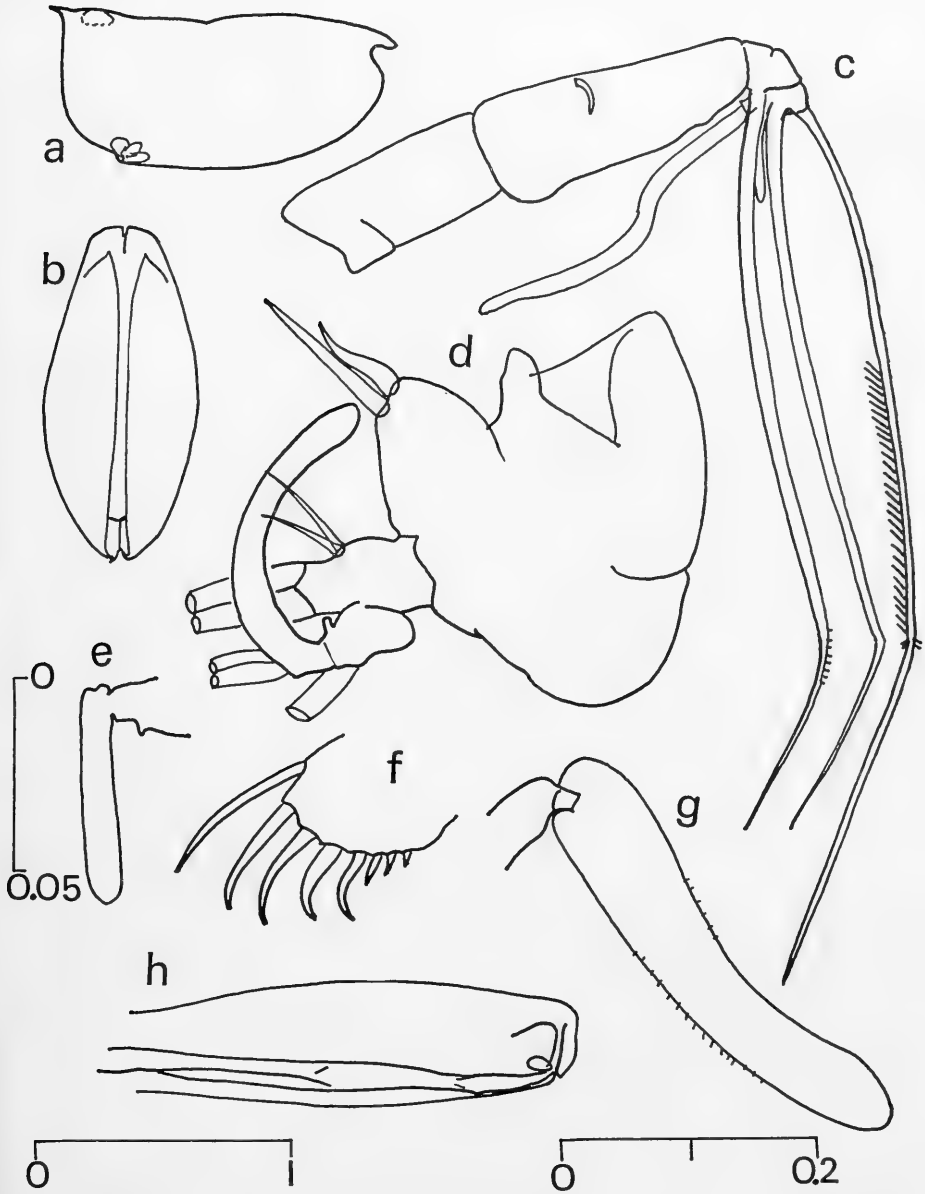


Figure 11. Male *Conchoecia oblonga* (Claus). a, lateral view of male with right asymmetric gland moved forward. b, ventral view. c, first antenna. d, endopodite of right second antenna (setae and filaments cut off). e, left clasp organ. f, furca. g, capitulum of frontal organ, 0.23 mm long. h, penis. Scale at lower left for a and b, at lower right for c, d, f, and h. Scale beside e for e. Scales in mm.

right asymmetrical gland (Figs. 10f, 11a), but no other differences were noted between these specimens and those with the gland in the usual place. Another distinguishing character of *C. oblonga* is that the fifth claw on the furca is decidedly bent (Fig. 11f).

LENGTH. According to Claus, both sexes were 1.4-1.5 mm long; Müller recorded lengths of 1.6-1.8 mm for females, 1.45 mm for males. Skogsberg's females were 1.5-1.8 mm long, males 1.4-1.6 mm in length. In the material from Station "S," the females were 1.5-1.7 mm long, the males 1.35-1.5 mm long.

COLLECTION DATA. *C. oblonga* was a common species at Station "S" and occurred throughout the year in every sample collected from March 1961 to April 1962. Although it was present in the upper 100 m and was taken at a depth of 20 feet in January (at 19.5°C), it was relatively most numerous in the 100-500 m depth range (see Fig. 65h and Table 3). Highest numbers of 857/1000 m<sup>3</sup> were obtained for the 200-300 m sample collected in February 1960. In June and October 1959, the highest numbers were recorded for the 100-200 m samples, 558 and 406/1000 m<sup>3</sup>, respectively. The extreme temperature range in the upper 500 m during the period of its occurrence was 15.9-28.8°C.

DISTRIBUTION. 38°N (Grice and Hart, 1961) to 37°S in the Atlantic; Indian Ocean and Mediterranean.

*Conchoecia aquiseta* Müller

(Figure 12a-c)

*Conchoecia aquiseta* Müller, 1906a, p. 59, Pl. XI, Figs. 1-6, 11-14; 1912, p. 69.

DESCRIPTION. The shell is similar in outline to that of *C. spinifera*; the postero-dorsal corner of the right shell has a slender spine, sometimes lacking in females; the shoulder vaults are rounded (Fig. 12a-c). The right asymmetrical gland is displaced dorsally to near the middle of the posterior margin, and this distinguishes this species from all others of this group, except *C. hirsuta*. For further description, see Müller (1906a). Müller was unable to differentiate the females of this species from the females of *C. hirsuta*, which he described at the same time.

LENGTH. Males 2.7-2.9 mm, females 3.1-3.3 mm (Müller).

COLLECTION DATA. A single immature male, 2.2 mm long by 0.95 mm high, was obtained at Station "S" from a sample collected on Aug. 12, 1964 over a depth range of 700-1500 m. One other larval specimen, 1.45 mm long, was taken in the 500-1250 m sample on Feb. 18, 1960, the temperature range being 5-17°C.

DISTRIBUTION. 24°N-31°S in the Atlantic; Indian Ocean. *C. hirsuta* was recorded over a much narrower range 35°S-37°S in the Atlantic, and 26°S-29°S in the Indian Ocean. This species appears to differ only slightly from *C. aquiseta*, in the presence of fine hairs on the distal bristle of the basal segment of the endopodite of the male second antenna in *C. hirsuta*. The larval specimens from Station "S" therefore extend the distribution of *C. aquiseta* to 32°N.

*Conchoecia mamillata* Müller

(Figure 12d-f)

*Conchoecia mamillata* Müller, 1906a, p. 60, Pl. XVI, Figs. 1-9, Pl. XXXV, Fig. 8; 1912, p. 70.

DESCRIPTION. The shell is fragile and elongate, the height approximately two-fifths of the length, the right postero-dorsal corner produced in a spine. On the left shell there is a short blunt process at the postero-dorsal corner and there is

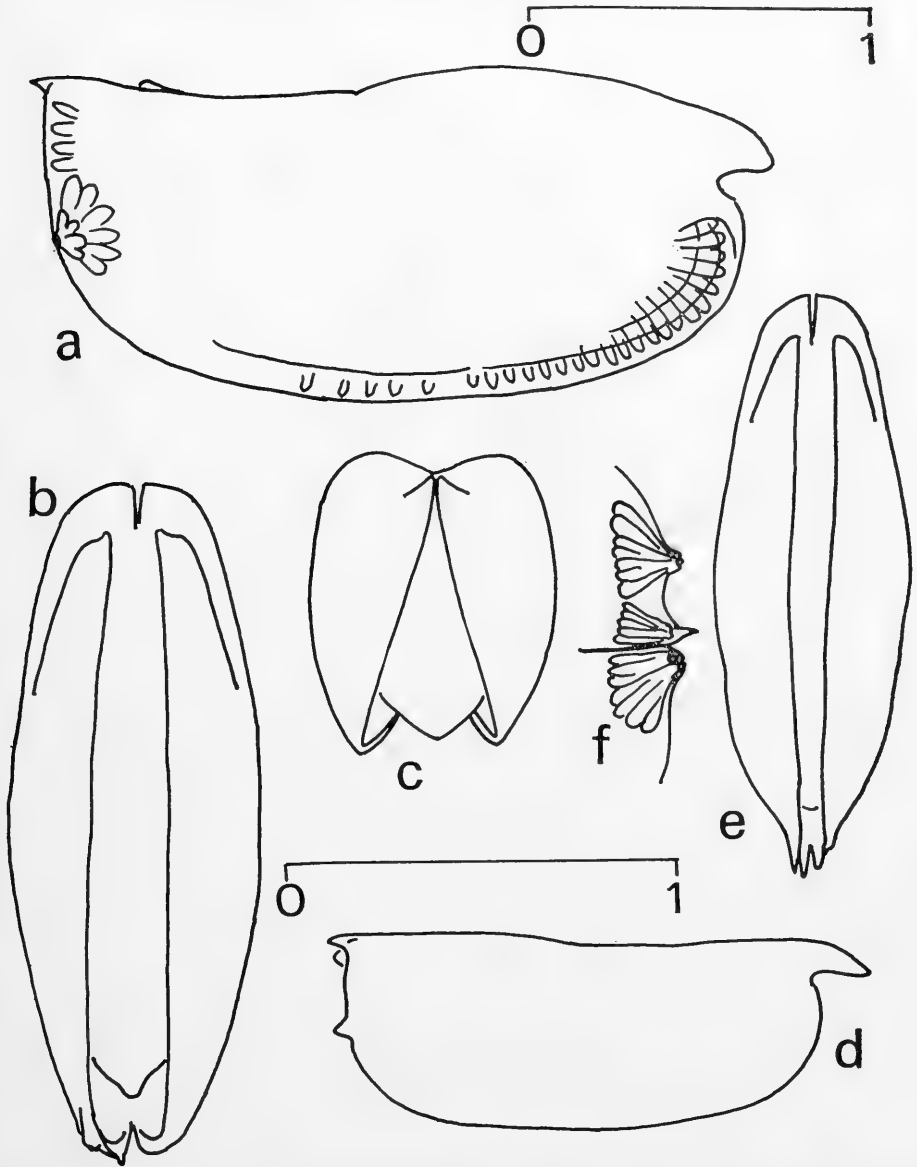


Figure 12. a, b, and c, *Conchoecia aquiseta* Müller. Lateral, ventral and posterior views of immature male. d, e, and f, *Conchoecia mamillata* Müller. d, e, lateral and ventral views of 1.4 mm larva. f, posterior margin of male shell, opened out (from Müller, 1906). Scale at top right for a, b, c, at bottom center for d, e, f. Scales in mm.

a short process on the posterior margin of the right shell at about half the shell height (Fig. 12d). The asymmetrical glands open at the ends of these blunt processes (Fig. 12f); in the male the dorso-medial gland also opens on the left process. The surface of the shell is more or less clearly sculptured with criss-crossing parallel lines.

LENGTH. Females 1.4-2.1 mm, males 1.35-1.75 mm (Müller).

**COLLECTION DATA.** Although only four larval specimens of this species were found at Station "S", the shape is so distinctive that there is no doubt as to their identity. Specimens 1.05, 1.1, and 1.4 mm long were collected in the 1250-2000 m haul of February 1960. One larva 1.35 mm long was also obtained in the 1000-1800 m sample of June 1959. The extreme possible temperature range was 3.6-7°C.

**DISTRIBUTION.** Müller's specimens were found from 29°N-31°S in the Atlantic, and to 30°S in the Indian Ocean. Granata and di Caporiacco (1949) recorded a single female from a surface sample collected at 47°53'N in the Atlantic.

*Conchoecia reticulata* Müller  
(Figure 13)

*Conchoecia reticulata* Müller, 1906a, p. 64, Pl. XII, Figs. 10-17; 1912, p. 71.  
*Macroconchoecia reticulata*, Granata and di Caporiacco, 1949, p. 33, Pl. IV, Fig. 13.

**DESCRIPTION.** The shell height is less than half the length, the postero-dorsal corner somewhat right-angled, the left corner little rounded, the right corner produced in a spine. The posterior margin is rounded, the postero-ventral corner strongly rounded. The shell has striking sculpture which is only indicated in Figure 13a, b, and e. The right asymmetrical gland opens somewhat dorsally of the postero-ventral corner.

The female principal seta has a row of long hairs on the anterior surface near the proximal end (Fig. 13c), such as is characteristic of females of this group, but the principal seta is otherwise bare of spinules. The capitulum of the frontal organ (Fig. 13d) is rounded at the tip, relatively long and slim, and covered with spinules over the proximal half which extend somewhat more distally on the ventral surface. For a fuller description, see Müller (1906a).

**LENGTH.** Females 3.2-4.1 mm, males 3.1 mm, according to Müller.

**COLLECTION DATA.** A single female, 3.55 mm long by 1.3 mm high, was taken in the 1250-2000 m sample collected on Feb. 17, 1960. Lateral, ventral and anterior views of this female are shown in Figure 13a, b, and e. The extreme possible temperature range of the waters sampled was 3.6-5.0°C.

**DISTRIBUTION.** Müller's specimens were found between 1 and 5°N in the Atlantic from sample depths of 1300 and 3000 m, and from 4°N-30°S in the Indian Ocean. Granata and di Caporiacco recorded specimens from almost 34°N in the Atlantic. Their specimens were also caught at sample depths down to 1500-4880 m.

ELEGANS GROUP MÜLLER

In this group Müller (1906a, p. 67) included only two species, *C. elegans* and *C. discophora*. In these species the shell is small and delicate; the right postero-dorsal corner is produced in a small spine, the left is not. The asymmetrical glands are as usual. The principal seta of the male first antenna has, at about two-thirds of its length, a characteristic oval plate like a suction organ, seemingly formed of long fragile spines cemented together. These species are at most 2.1 mm long and usually smaller. They are distinguished from similar forms of the Spinifera

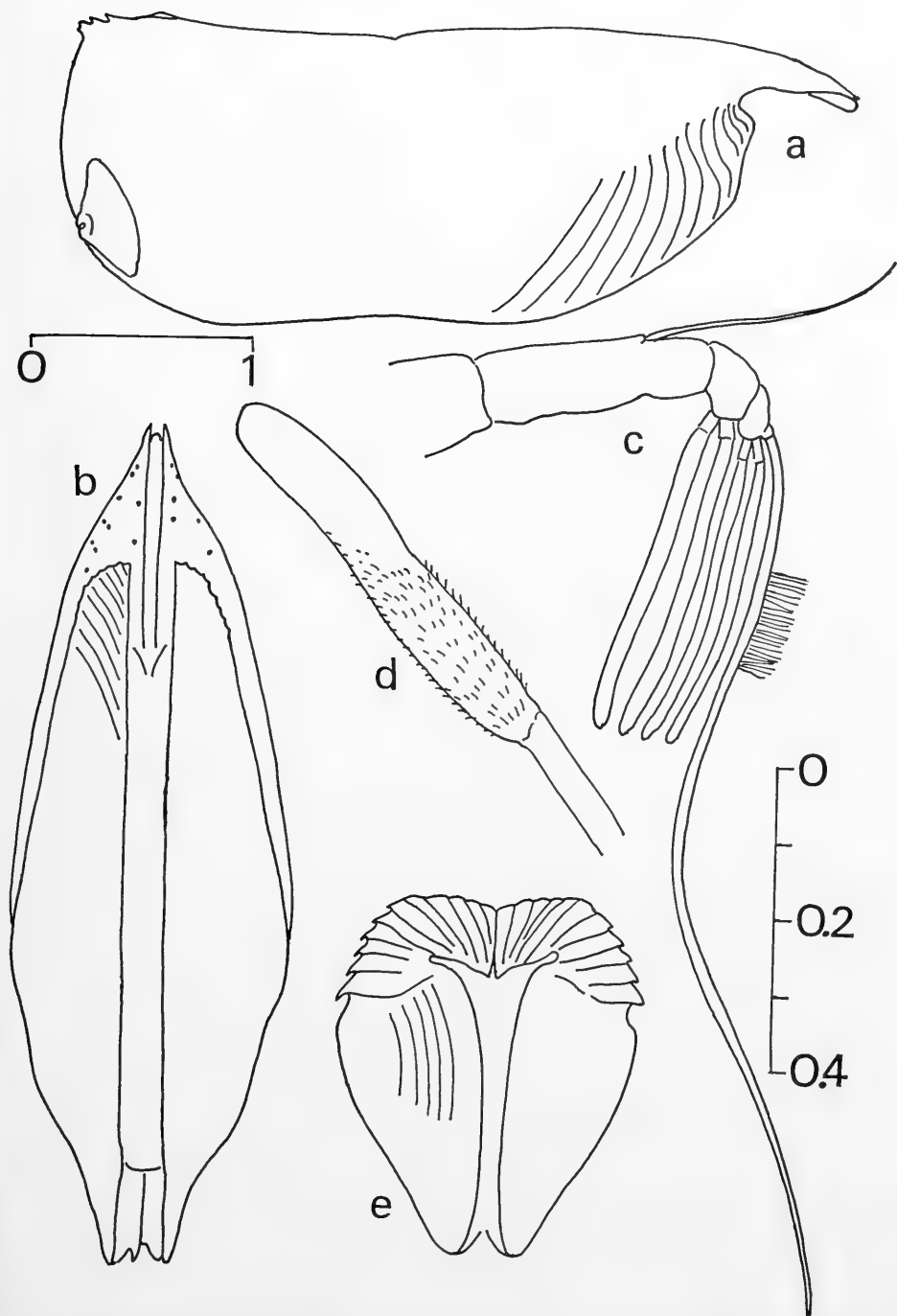


Figure 13. *Conchoecia reticulata* Müller. a, b, and e, lateral, ventral and anterior views of female. c, female first antenna. d, capitulum of female frontal organ. Scale at upper left for a, b, e, at lower right for c and d. Scales in mm.

group by the lack of spines on the principal seta of the male first antenna and the lack of the dorsal row of hairs on the female first antenna, from the *Procera* group by the position of the right asymmetrical gland and the more slender shell, and also by the presence of a dorsal seta on the first antenna of female *C. discophora*, and from the *Dentata* group by the lack of distinct shell sculpture.

*Conchoecia elegans* Sars

(Figure 14)

*Conchoecia elegans* Sars, 1865, p. 117.

*Paraconchoecia gracilis*, Claus, 1890, p. 15; 1891, p. 66, Pl. XII, Figs. 1-12.

*Conchoecia elegans*, Müller, 1906a, p. 69, Pl. XIII, Figs. 10, 11, 19-26; 1912, p. 72.

*Conchoecia elegans*, Skogsberg, 1920, p. 624, Figs. CXVII, CXVIII.

For further synonymy, see Skogsberg.

**DESCRIPTION.** The shell is elongate and narrower anteriorly, with the greatest depth in the posterior half, the height somewhat less than one-half the length (Fig. 14a, b). One or two small spines at the postero-dorsal corner of the right shell are usually more noticeable in the female. The asymmetrical glands are as usual, except that in the female the postero-ventral corners are so rounded that the right asymmetrical gland appears to be on the posterior margin, rather than at the postero-ventral corner (Fig. 14a). The capitulum of the frontal organs of both sexes (Fig. 14i, j) is bare of spinules. The males are readily distinguished by the oval plate, like a suctorial organ, which is approximately two-thirds of the way down the principal seta of the first antenna (Fig. 14h), and also by the shape of the penis (Fig. 14k), which is characteristically bent down at the end. The two bristles of the basal segment of the endopodite of the second antenna are sharply curved in both sexes, as is shown for the male in Figure 14f. In size and shape the specimens of *C. elegans* from Station "S" most closely resembled *C. procera*, but they are easily distinguished from this species by the position of the right asymmetrical gland, which is moved somewhat forward on the ventral margin in *C. procera*, as well as by the structure of the frontal organs and the first and second antennae.

**LENGTH.** This species varies considerably in size in different localities. Claus gave the length as 1.2-1.3 mm, Müller as 1.0-2.1 mm, the largest specimens being from Arctic waters. Skogsberg listed the following lengths for males: from the Skagerrak and Kattegat, 2.05-2.25 mm; from Lofoten, 2.1-2.25 mm; from the Arctic Ocean, 2.05-2.2 mm; from the Antarctic, 1.45-2.0 mm; and from the Atlantic, 1.2 mm. The females had a similar size range, but his Atlantic specimens ranged in length from 1.15-1.6 mm. The specimens from Station "S" were all small, both males and females being 1.15-1.25 mm long.

**COLLECTION DATA.** Occasional specimens of *C. elegans* were noted throughout the year in the upper 500 m at Station "S", but none were found in the deeper hauls. This species was never taken in numbers. The extreme possible temperature range during its period of occurrence was 16.0-27.9°C.

**DISTRIBUTION.** 79°58'N-55°S in the Atlantic; Indian Ocean.



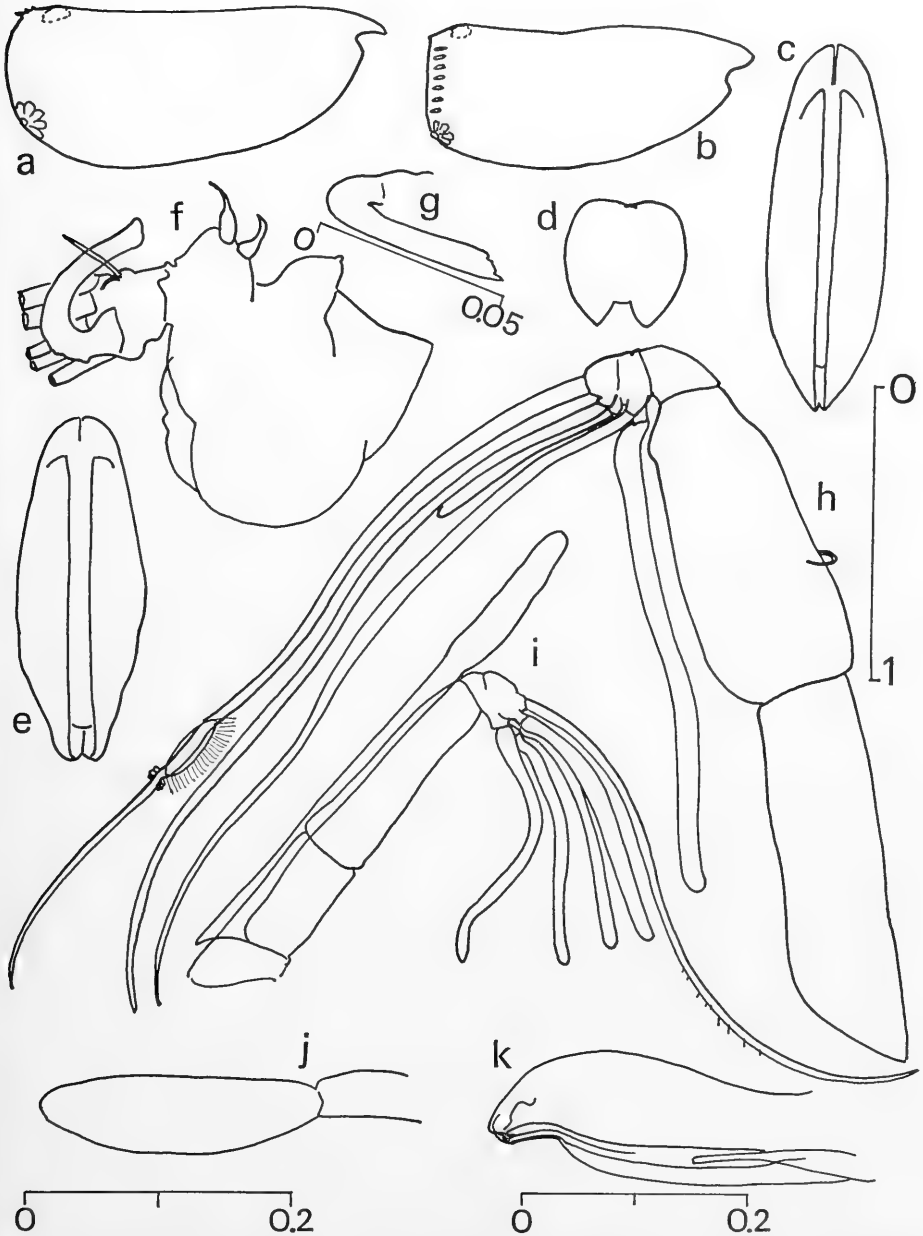


Figure 14. *Conchoecia elegans* Sars. a and c, lateral and ventral views of female. b, d, and e, lateral, posterior and ventral views of male. f, endopodite of male right second antenna (setae and filaments cut off). g, male left clasper organ. h, male first antenna. i, female frontal organ and first antenna. j, capitulum of male frontal organ, 0.1 mm long. k, penis. Scale at right center for a-e; scale at lower right for f and k; scale at lower left for h and i; scale at top center for g. Scales in mm.

*Conchoecia discophora* Müller

(Figure 15)

*Conchoecia discophora* Müller, 1906a, p. 67, Pl. XIII, Figs. 1-9, 12-18; 1912, p. 71.

DESCRIPTION. A single female of this species was taken in the 500-1000 m sample collected on June 24, 1959. The female is similar in appearance to female *C. elegans*. The shell is elongate; the height clearly less than half the length; the antero-ventral and postero-ventral corners are rounded; and there is a small spine at the postero-dorsal corner of the right shell (Fig. 15a, b). The shell tapers anteriorly. The right asymmetrical gland is moved slightly dorsally. There was some sculpturing on the shell, most easily discernible along the antero-ventral margin (Fig. 15a). Female *C. discophora* is differentiated from female *C. elegans* by features of the first antenna and the endopodite of the second antenna. There is a dorsal seta on the second segment of the first antenna (Fig. 15d), which is lacking in *C. elegans*; also the sensory filaments of the first antenna are longer than half the length of the principal seta. The sensory filaments of the last segment of the endopodite of the second antenna are all of about the same length (Fig. 15c), the setae being developed more or less like filaments, one being only slightly longer than the other four; in female *C. elegans* the sensory filaments are only two-thirds the length of the longest seta. Also the two bristles of the basal segment of the endopodite are almost straight in this specimen of *C. discophora*, whereas in both sexes of *C. elegans* these bristles are bent sideways, as is shown for the male in Figure 14f.

LENGTH. The single female from Station "S" was 1.15 mm long and 0.45 mm high. According to Müller, females were 1.25-1.5 mm long, males 1.1-1.2 mm long. The extreme possible temperature range was 7.7-17.7°C.

DISTRIBUTION. Müller's specimens were taken in the Atlantic 24°N-14°N, and in the Indian Ocean. The female from Station "S" extends the range to 32°N in the Atlantic.

## PROCERA GROUP MÜLLER

This group contains three small species, at most 1.6 mm long. Two of these, *C. procera* and *C. brachyaskos*, were found in the Sargasso Sea; the third, *C. decipiens*, has been recorded only from the Indian Ocean. The shell is small and delicate, commonly with a tiny point at the postero-dorsal corner of the right shell, and with only the usual gland groups. In the two species found at Station "S", the capitulum of the frontal organ of the male has two rows of long thin hairs of varying extent on the ventral surface. The female capitulum is pointed at the tip. There is no dorsal seta on the second segment of the female first antenna. In the female, the sensory filaments of the endopodite of the second antenna are approximately four-fifths as long as the longest seta, whereas in the male these are strikingly short, only one-fifth as long as the longest setae.

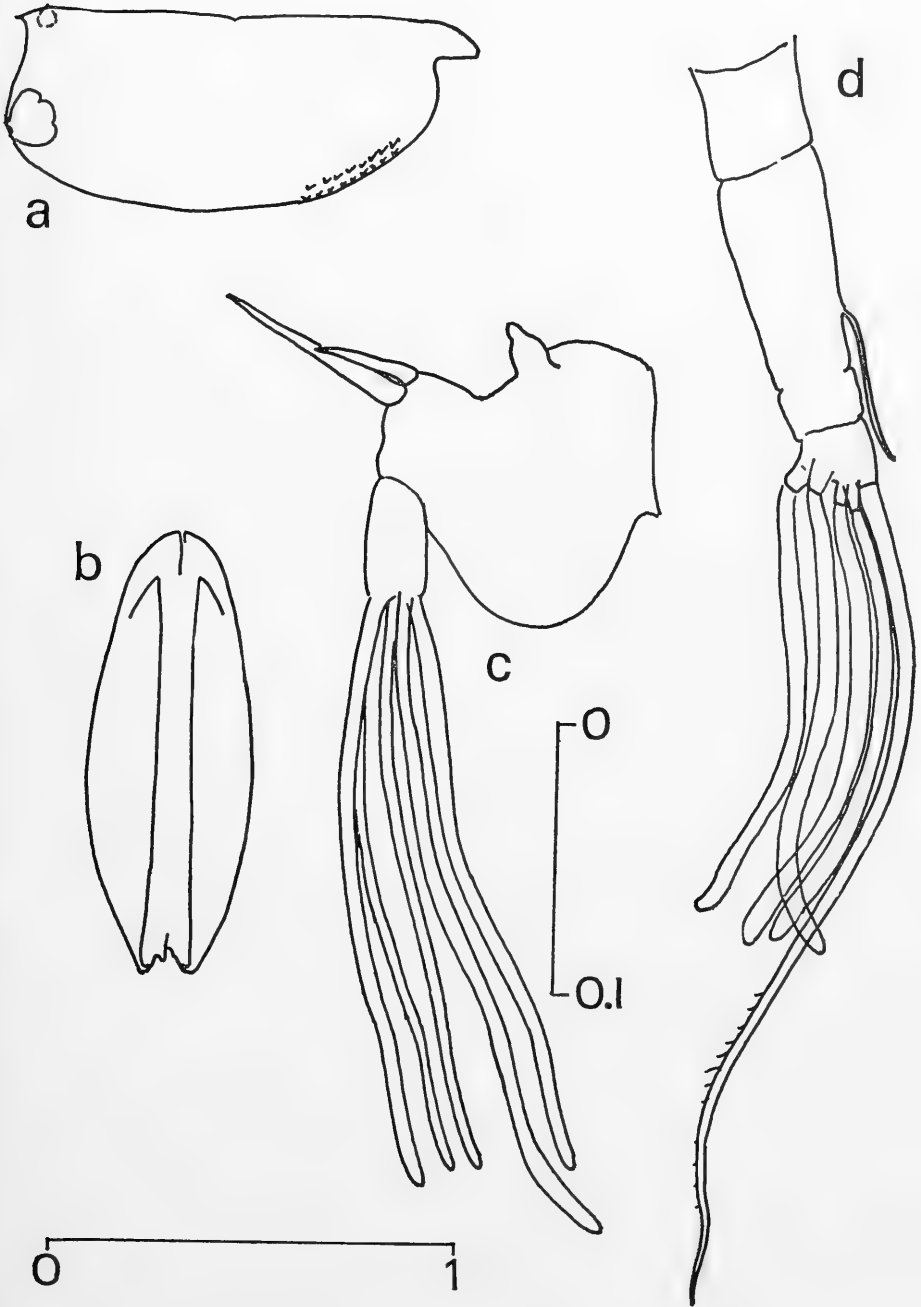


Figure 15. *Conchoecia discophora* Müller. a, b, lateral and ventral views of female. c, endopodite of female second antenna. d, female first antenna. Scale at lower left for a and b, at center for c and d. Scales in mm.

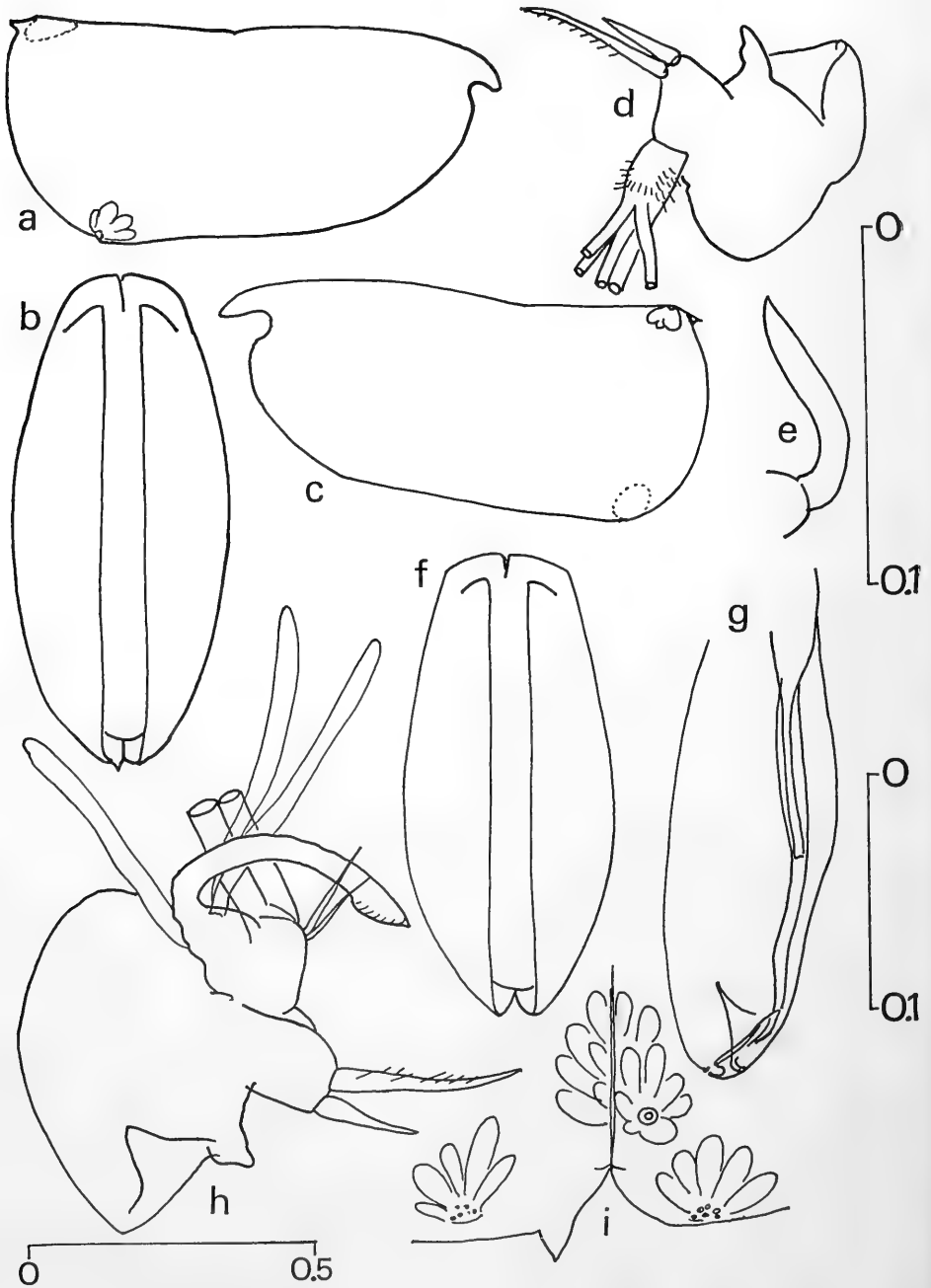


Figure 16. *Conchoecia procera* Müller. a and b, lateral and ventral views of female. c and f, lateral and ventral views of male. d, endopodite of female second antenna (filaments and setae cut off). e, male left clasper. g, penis. h, endopodite of male right second antenna (setae cut off). i, postero-dorsal corners of male shell, from inside. Scale at lower left for a, b, c, f; at lower right for d, g and i; at upper right for e and h. All scales in mm.

*Conchoecia procera* Müller  
(Figures 16, 17)

*Conchoecia procera* Müller, 1894, p. 228, Pl. 6, Figs. 47, 48, 50-58; 1906a, p. 71, Pl. XIII, Figs. 37-47, Pl. XIV, Figs. 3-6; 1912, p. 72.

DESCRIPTION. The shell is elongate, the height clearly less than half the length, and tapered anteriorly. The postero-dorsal corner is rounded, with a small spine, sometimes lacking in the male, which bends downwards on the right shell. The postero-ventral corner is strongly rounded, and the right asymmetrical gland is at the posterior end of the ventral margin, rather than at the ventral end of the posterior margin, as it is in *C. elegans* (compare Figs. 16a and 14a and b). *C. procera* also differs from *C. elegans* in ventral view, in that it has a shorter, broader rostrum, whereas *C. elegans* is slim in ventral view.

The capitulum of the female frontal organ is pointed, with some spinules on the ventral surface (Fig. 17a); in the male it is rounded at the tip and has two rows of long fine hairs on the ventral surface (Fig. 17b, c). The principal seta

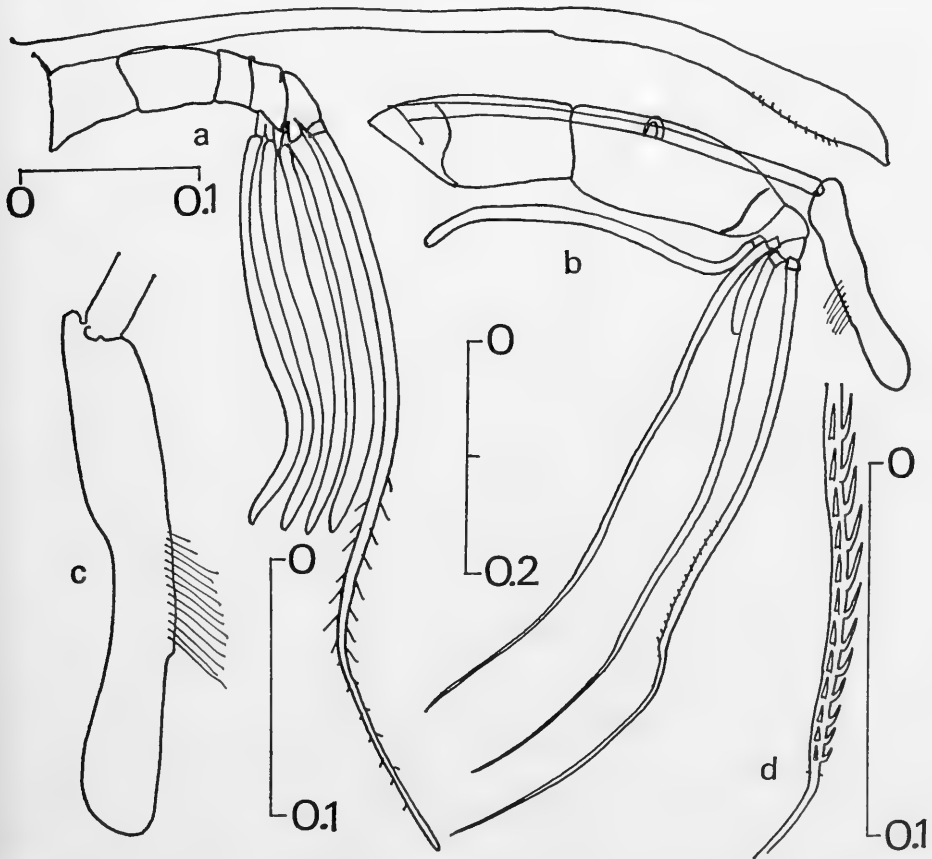


Figure 17. *Conchoecia procera* Müller, a female frontal organ and first antenna. b, male frontal organ and first antenna. c, capitulum of male frontal organ, 0.2 mm long. d, armature of principal seta of male. Scale at upper left for a; at lower left for c; at center for b; at lower right for d. Scales in mm.

of the female first antenna has around eight pairs of spines beginning half way down its length and smaller spinules continuing towards the tip of the seta. The male principal seta has, well down its length, 11-16 pairs of long spines or teeth directed proximally and beyond these and proximal to the bend of the seta one or two pairs of tiny spines pointing distally (Fig. 17d). The proximal sensory filament is long, reaching to the base of the first antenna. The second or possibly the fused second and third segment of the endopodite of the female second antenna has long spines on two sides, proximal to the sensory filaments (Fig. 16d). The male clasping organs are illustrated in Figure 16e and h.

LENGTH. Females 1.05-1.35 mm, males 0.85-1.2 mm, according to Müller. The specimens from Station "S" were small, the females varying from 0.9-1.25 mm and the males from 0.8-1.05 mm in length. Sometimes two size groups were present, the males being either 0.8 mm or 1.0 mm long. Although only a superficial examination was made of smaller and larger males, the only difference noted between the two size groups was in the number of pairs of teeth on the principal seta. Males 0.8 mm long had 11-13 pairs of spines, whereas males 1.0 mm long had 14-16 pairs of spines on the principal seta.

COLLECTION DATA. *C. procera* was one of the commonest species found at Station "S" and occurred throughout the year in every sample. It was numerous in the upper 500 m, but was taken in small numbers in the deeper hauls. In the samples collected at different depths, *C. procera* was most numerous between 100 and 400 m (see Table 3 and Fig. 65). The highest recorded number was 975/1000 m<sup>3</sup> for the 100-200 m depth interval on June 23, 1959. The simultaneous tows with No. 2 and No. 8 nets, 500-0 m, made on Aug. 5, 1959, showed that far greater numbers of this species were retained by the No. 8 net on this occasion (see Table 4), 653/1000 m<sup>3</sup>, compared with 250/1000 m<sup>3</sup> caught by the No. 2 net. The extreme possible temperature range during the period of occurrence of *C. procera* was 15.9-28.1°C.

DISTRIBUTION. 31°N-37°S in the Atlantic; Indian Ocean and Mediterranean. The specimens from Station "S" extend the range slightly to 32°N.

*Conchoecia brachyaskos* Müller  
(Figure 18)

*Conchoecia brachyaskos* Müller, 1906a, p. 70, Pl. XIV, Figs. 1, 2, 7-14; 1912, p. 72.

DESCRIPTION. The shell is moderately delicate and elongate, somewhat smaller anteriorly, the height slightly less than half the length, the posterior dorsal corner rounded and with or without a small spine on the right shell, the posterior margin rounded to the ventral margin (Fig. 18a, b). The right asymmetrical gland is at the postero-ventral corner, the left is moved slightly forward on the dorsal margin. There may be striations on the anterior shell half which parallel the shell margin and converge toward the rostrum. In ventral view (Fig. 18c, d) the male rostrum is broad, that of the female is narrower.

The female frontal organ (Fig. 18j) is three times as long as the first antenna, the capitulum a little thicker than the stem, with no hairs or spines, and pointed at the tip. That of the male has the double row of long thin hairs characteristic of this group (Fig. 18g). In the single specimen from Station "S", the male

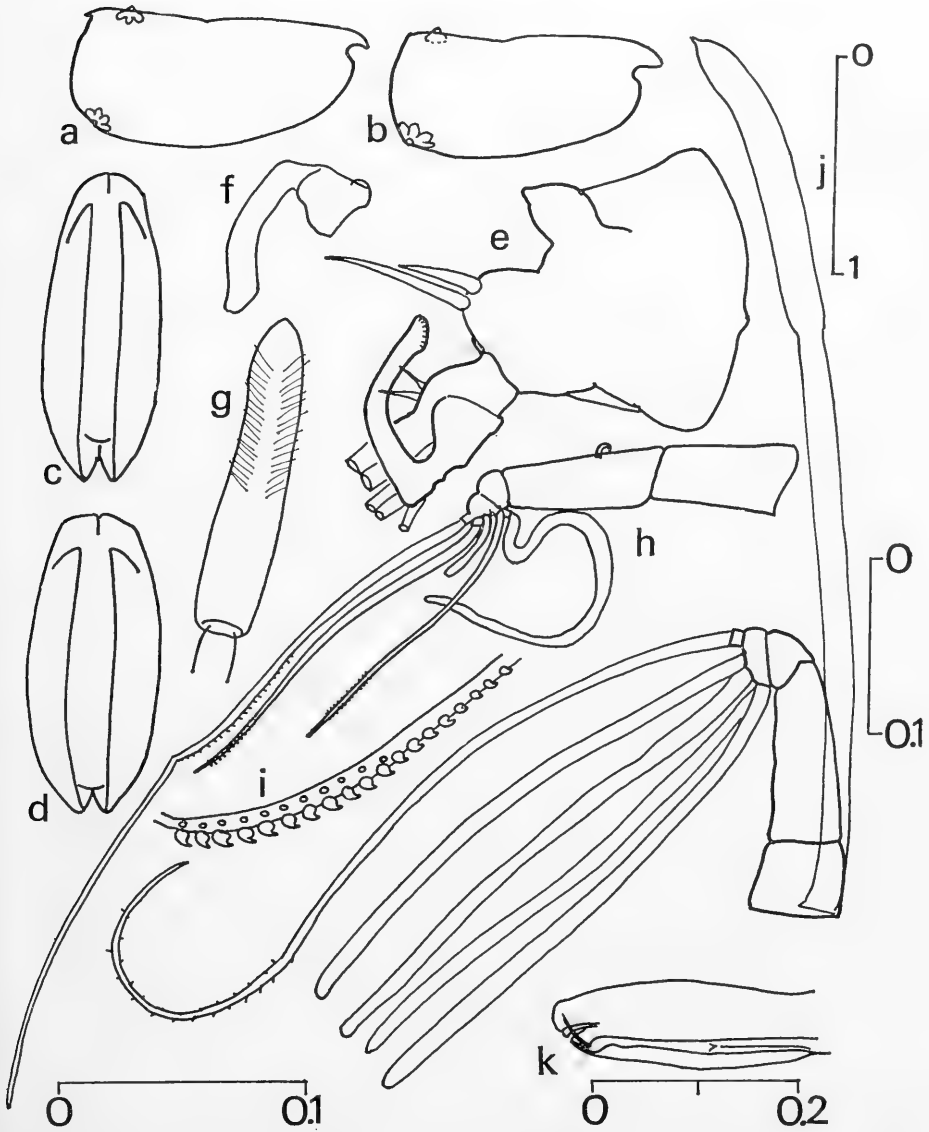


Figure 18. *Conchoecia brachyaskos* Müller. a and c, lateral and ventral views of female. b and d, lateral and ventral views of male. e, endopodite of right second antenna of male (setae and filaments cut off). f, male left clasper. g, ventral view of capitulum of male frontal organ. h, male first antenna. i, armature of principal seta of male first antenna. j, female frontal organ and first antenna. k, penis. Scale at upper right for a-d; at center right for g and j; bottom right for h and k; at bottom left for e, f, and i. All scales in mm.

principal seta showed in profile 19 short fat teeth, decreasing in size proximally, of which at least the distal 10 were paired (Fig. 18i). The secondary setae were relatively short, the distal one reaching to the bend in the principal seta, the proximal one slightly shorter (Fig. 18h). The secondary setae had a row, possibly paired, of 15 to 20 or more tiny spines near the tip. The proximal sensory filament was long. The clasper organs differed somewhat in shape from those of the

*C. procera* male (compare Fig. 18e, f with Fig. 16e and h). Also, the larger bristle of the basal segment of the endopodite of the second antenna of *C. procera* has spinules (Fig. 16d, h), but none were noted there in *C. brachyaskos* (Fig. 18e).

LENGTH. According to Müller: females 1.2-1.6 mm long, males 1.15-1.5 mm long. The females from Station "S" were 1.35-1.45 mm long, the single male 1.35 mm long.

COLLECTION DATA. Only four mature specimens were found at Station "S", all from depths greater than 450 m. One male and one female were taken in the 1000-1800 m haul on June 24, 1959, one female in the 1250-2000 m sample on Feb. 17, 1960, and one female in the 450-900 m sample collected in August 1964. The extreme possible temperature range of the depths sampled when this species was found was 3.8-17°C

DISTRIBUTION. 24°N in the Atlantic to 63°S in the Antarctic Drift. Indian Ocean. These specimens extend the range to 32°N.

#### ACUMINATA GROUP MÜLLER

In this group the shell is of characteristic shape. The straight posterior margin forms a pointed angle with the dorsal margin. Near the posterior margin of the shell in the male there is a row of hairs. The asymmetrical glands are in the usual place. The frontal organ of the female is rod-shaped, without a thicker or clearly defined capitulum. The setae of the third, or the fused second and third, segment of the endopodite of the second antenna are very short, measuring less than half the longest seta of the second segment, and in the female are clearly of differing lengths.

This group includes two closely related species, *C. acuminata* and *C. giesbrechti*. Müller also provisionally included *C. edentata*. *C. acuminata* was the only member of this group that occurred at Station "S".

#### *Conchoecia acuminata* (Claus) (Figure 19)

*Conchoecetta acuminata*, Claus, 1890, p. 16; 1891, p. 67, Pls. XIII and XIV.

*Conchoecia acuminata*, Müller, 1906a, p. 76, Pl. XV, Figs. 17-23; 1912, p. 74.

*Conchoecia acuminata*, Skogsberg, 1931, p. 9.

*Conchoecetta acuminata*, Granata and di Caporiacco, 1949, p. 21.

For further synonymy, see Skogsberg.

DESCRIPTION. This is a fairly large species of distinctive shape. The shell is usually transparent, the body of the animal far from filling it. The female shell is approximately three times as long as high, tapered anteriorly, the dorsal and posterior margins forming an acute angle (Fig. 19a); the male shell is somewhat shorter with respect to its height (Fig. 19c), less tapered anteriorly, and the dorsal and posterior margins form a less acute angle. Near the posterior margin of the male shell there is a row of long hairs. Claus (1891, Pl. XIV, Fig. 1) figured a small spine at the postero-dorsal corner of each shell. At least one female from Station "S" had a slim spine at the left postero-dorsal corner and a tiny spine at the right corner. Vávra (1906) noted that the shells of young specimens have a



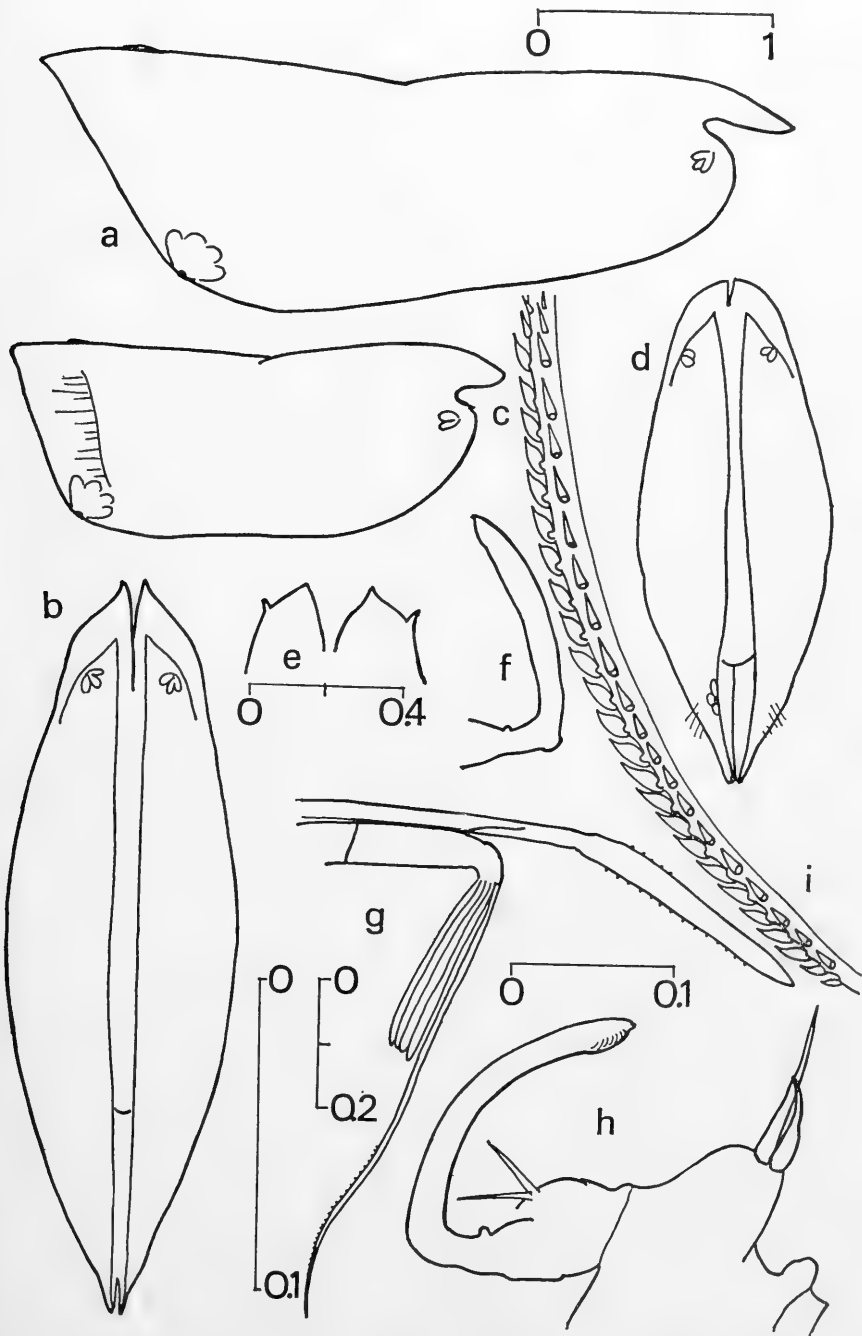


Figure 19. *Conchoecia acuminata* (Claus). a and b, lateral and ventral views of female. c and d, lateral and ventral views of male. e, ventral view of rostrum of larva 1.9 mm long. f, male left clasp organ. g, frontal organ and first antenna of female. h, part of endopodite of male right second antenna. i, armature of male principal seta. Scale at top right for a-d; at center for e; at lower right for f and h; at lower center for g; at lower left for i. Scales in mm.

sharp anteriorly directed tooth on each side of the rostrum, visible in ventral view. Larvae up to 2.2 mm long from Station "S" had such spines (Fig. 19e).

The female frontal organ is slim and straight with a few spines dorsally at the proximal end of the capitulum which increase in number ventrally so that more than half of the ventral surface has spines proximally (Fig. 19g). The capitulum of the male frontal organ is rounded and bent slightly upwards, with tiny spinules over the proximal third to half. The male principal seta has 23 spines directed proximally, according to Skogsberg. Figure 19i shows the armature of a 2.2 mm male from Station "S". There were two rows of teeth not evenly paired, 26 spines in one row, 21 spines in the other. Distally the armature started with a single small spine and it ended proximally with two small teeth. The clasping organs of the male are shown in Figure 19f and h. The processus mammillaris of the endopodite of the second antenna is small and rounded in both sexes (Fig. 19h).

LENGTH. Females 3.0-3.8 mm, males 2.0-2.6 mm. At Station "S", females were 3.0-3.6 mm and males 2.2-2.45 mm long.

COLLECTION DATA. Occasional specimens of *C. acuminata* were found throughout the year in the upper 500 m. Most were larval forms. Females were taken in April, July, August, and October to January. Males were found in April, June, September, November and December. In the quantitative samples taken at different depth levels, *C. acuminata* was found between 0 and 400 m. Highest numbers of 14/1000 m<sup>3</sup> were recorded for the 0-100 m sample of October 1959. In the simultaneous tows with No. 2 and No. 8 nets, numbers of 3-5/1000 m<sup>3</sup> were obtained for the upper 500 m (see Table 4). None were taken in the deeper hauls. The extreme possible temperature range was 16.1-28.1°C.

DISTRIBUTION. 43°N-37°S in the Atlantic; Pacific and Indian Oceans.

#### ROTUNDATA GROUP MÜLLER

Müller (1906a, p. 79) included seven species in this group: *C. macromma*, *C. pusilla* var. *major* and var. *minor*, *C. glandulosa*, *C. kyrtophora*, *C. nasotuberculata*, *C. rotundata*, and *C. isocheira*. Iles (1953) separated *C. rotundata* into three species: *C. rotundata* Müller, *C. skogsbergi* Iles, and *C. teretivalvata* Iles.

This group is characterized by the position of the asymmetrical glands: the left one opens in the anterior third near the hinge margin, sometimes on the rostrum; the right one opens on the dorsal upper third of the posterior margin. The posterior margin is strongly arched and there is no point or spine at the postero-dorsal corner. The female first antenna is usually short and weak, the second segment without a dorsal seta. The setae of the last two segments of the endopodite of the second antenna are about the same length in the female, in the male those of the last segment are usually short and usually characteristically bent. These are mostly very small forms, only one is of ordinary size, and another species exceptionally reaches almost 2 mm in length. Skogsberg (1920) considered this a natural group; he gave supplementary descriptions of *C. rotundata* from the Antarctic south of 53°S.Lat. (the form which Iles has since referred to *C. skogsbergi*) and of *C. isocheira*.

Five species of this group occurred at Station "S", including two of the forms of Müller's *C. rotundata*, i.e., *C. rotundata* and *C. skogsbergi*. *C. rotundata* was the common year-round form in the upper 500 m, whereas a few specimens of *C. skogsbergi*, *C. kyrtophora*, *C. glandulosa*, and *C. pusilla* were taken at depths below 500 m.

*Conchoecia rotundata* Müller

(Figure 20e-j; Figure 21b, c, e, i, j, k; Figure 22b-e)

*Conchoecia rotundata* Müller, 1890, p. 275, Pl. XXVIII, Figs. 41-43, Pl. XXIX, Fig. 44.

DESCRIPTION. Müller's first description of *C. rotundata* from specimens found in the tropical Pacific was by no means complete, but insofar as it is now possible to ascertain, it seems highly probable that the common form which occurred at Station "S" belongs to this species. The other small form of *C. rotundata* which Müller (1894) described from the Bay of Naples, and which Iles (1953) has since redescribed as *C. teretivalvata*, differs in shape and other respects, though not in size, from the common form at Station "S".

In *C. rotundata* the shell is elongate, the height approximately half the length (Fig. 20e, Fig. 21b), the postero-dorsal corner is evident, the postero-ventral and antero-ventral corners rounded. The right asymmetrical gland opens at the postero-dorsal corner, the left just behind the rostrum. In *C. teretivalvata* the height of the shell is noticeably greater than half the length. Compared with *C. skogsbergi* the rostral incisure is larger (see Fig. 20a and e; Fig. 21a and b) and the shell more tapered anteriorly.

The capitulum of the female frontal organ (Fig. 20g, h) has spinules on the ventral surface, whereas that of female *C. skogsbergi* (Fig. 20c) has more spinules, including some on the dorsal surface proximally. The principal seta of the female first antenna (Fig. 20i) has a few fine spinules ventrally. The capitulum of the male frontal organ (Fig. 22e) has spinules ventrally for the greater part of its length and a few dorsally at the proximal end. The principal seta of the male first antenna is armed with 8-12 pairs of teeth (Fig. 22b-d), the number varying with the length of the specimen. Males 0.8 mm long had 8-9 pairs of teeth, males 0.9-0.97 mm long had 10-12 pairs of teeth on the principal seta. In the *C. rotundata* males, the secondary setae of the first antenna are noticeably shorter (see Fig. 22b) than the principal seta and are armed with a few small spinules at the bend. The male clapping organs are illustrated in Figure 21i-k and do not differ appreciably in shape from those of male *C. skogsbergi* (Fig. 21f-h).

LENGTH. Females from Station "S" were 0.77-1.0 mm long, males 0.75-0.97 mm long. Müller's Pacific specimens were 1.15 mm long.

COLLECTION DATA. *C. rotundata* was a common species at Station "S" and occurred throughout the year in the upper 500 m. It was less frequent in the upper 100-200 m and was found in greater numbers between 200 and 500 m (see Fig. 65f). It was also taken in the deeper hauls. The numbers per 1000 m<sup>3</sup> of *C. rotundata* at 100 m depth intervals in the upper 500 m, on which the histograms of Figure 65 are based, are listed in Table 3. Table 4, which compares the

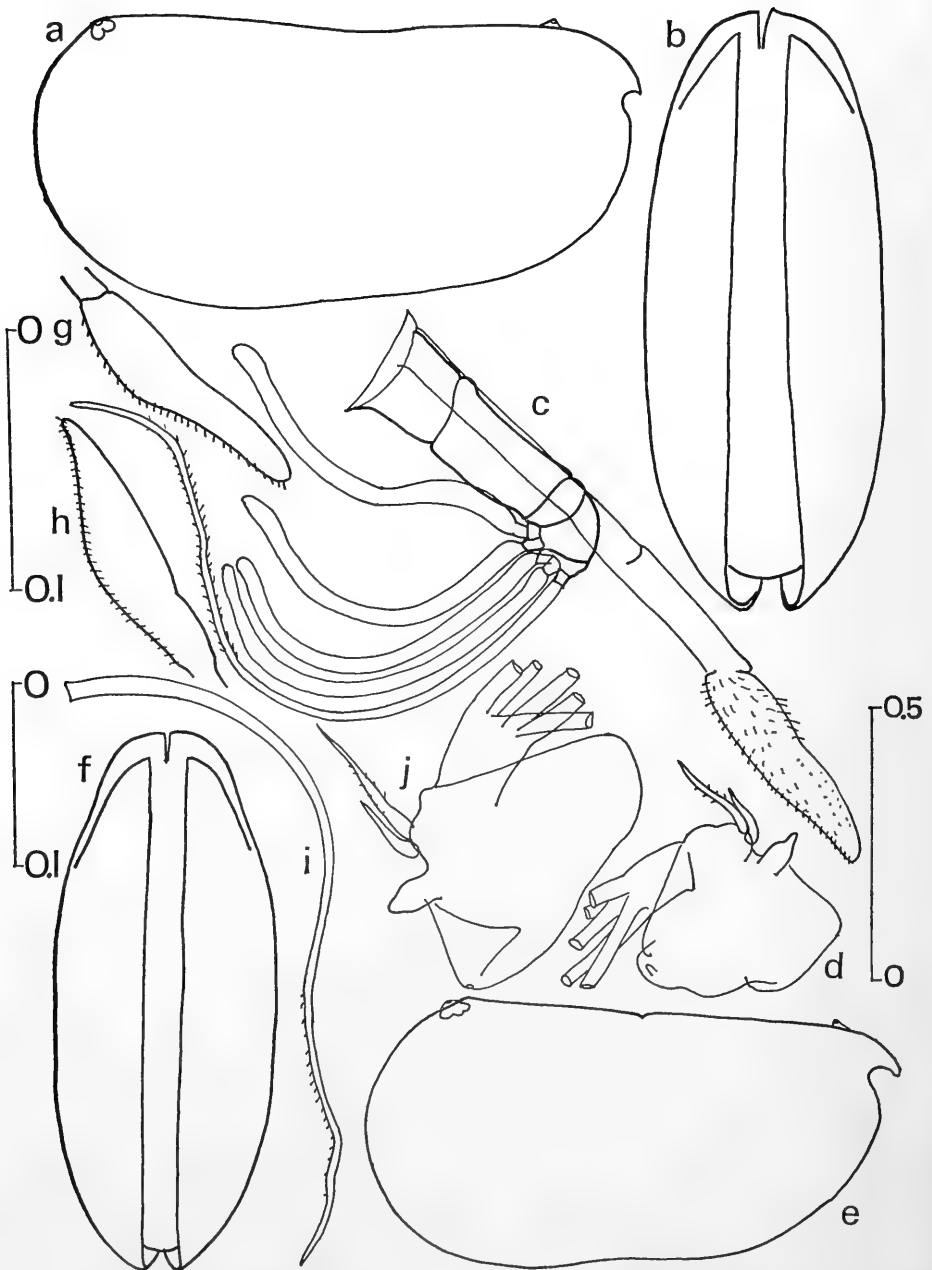


Figure 20. *Conchoecia skogsbergi* Iles, a-d. a and b, lateral and ventral views of female. c, frontal organ and first antenna of female. d, endopodite of female second antenna (setae and filaments cut off). *Conchoecia rotundata* Müller, e-j. e and f, lateral and ventral views of female. g, h, capitulum of frontal organs of two females. i, female principal seta. j, endopodite of female second antenna (setae and filaments cut off). Scale at right for a, b, e, f; at lower left for c and d; at upper left for g-j. Scales in mm.

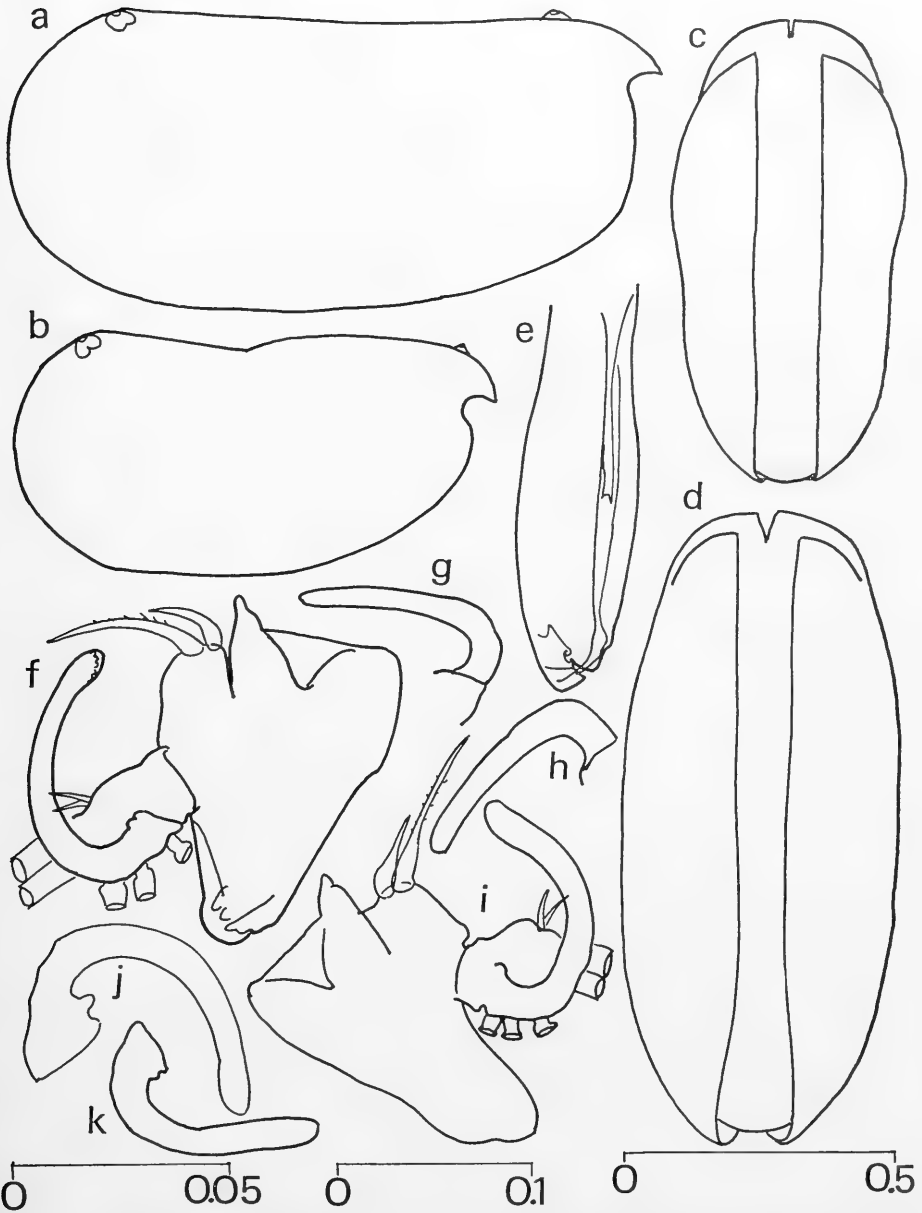


Figure 21. *Conchoecia skogsbergi* Iles, a, d, f, g, h. a and d, lateral and ventral views of male. f, endopodite of male right second antenna (setae and filaments cut off). g, left clasper of same 1.1 mm male. h, left clasper of a 1.15 mm male. *Conchoecia rotundata* Müller, b, c, e, i, j, k. b and c, lateral and ventral views of male. e, penis of 0.97 mm male. i, endopodite of right second antenna of 0.8 mm male (setae and filaments cut off). j, right clasper of another 0.8 mm male. k, left clasper of male whose right clasper is shown in i. Scale at lower left for f-k; at bottom center for e; at bottom right for a-d. Scales in mm.

numbers retained by simultaneous tows with No. 2 and No. 8 nets, indicates that more than twice as many specimens were caught by the finer net, 267/1000 m<sup>3</sup>, compared with 103/1000 m<sup>3</sup> taken by the No. 2 net. The extreme possible temperature range of the waters sampled was 3.8-28.1°C.

DISTRIBUTION. Tropical Pacific; Atlantic at 32°N.

*Conchoecia skogsbergi* Iles

(Figure 20a-d; Figure 21a, d, f-h; Figure 22a)

*Conchoecia rotundata*, Skogsberg, 1920, p. 649, Figs. CXXII, CXXIII.

*Conchoecia skogsbergi* Iles, 1953, p. 264.

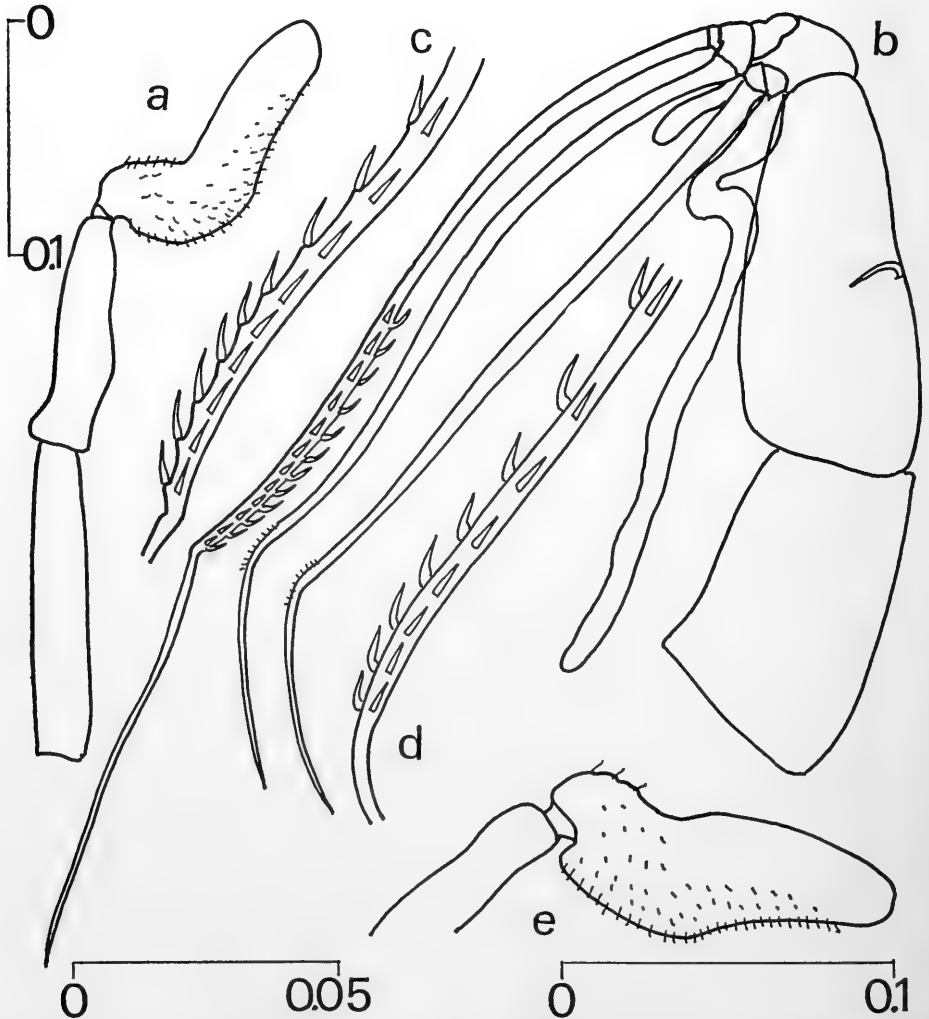


Figure 22. a, frontal organ of a 1.1 mm male *Conchoecia skogsbergi*. b-e, male *Conchoecia rotundata*. b, first antenna of a 0.97 mm male. c, d, armature of principal seta of two 0.8 mm males. e, capitulum of frontal organ of a 0.8 mm male. Scale at top left for a and b; at lower left for c and d; at lower right for e. Scales in mm.

DESCRIPTION. A few specimens of this species were taken in the deeper hauls at Station "S", and although they are smaller than Skogsberg's Antarctic specimens, they agree in shape and structure with his description. The shell is elongate, the height less than half the length, the dorsal margin nearly straight, the shoulder vaults rounded, all the corners rounded (see Figs. 20a, 21a). The capitulum of the male frontal organ (Fig. 22a) as well as that of the female (Fig. 20c) has more spinules than that of *C. rotundata* males and females. The female principal seta (Fig. 20c) has spinules on the anterior and posterior surfaces over the distal third or so of its length. The male first antenna is similar to that figured for *C. rotundata* (Fig. 22b), except that the two secondary setae are almost as long as the principal seta, not noticeably shorter as in *C. rotundata*. The armature of the male principal seta consisted of 11-12 pairs of teeth, as in the larger male *C. rotundata*. In Skogsberg's specimens the male principal seta had 14-15 pairs of teeth. The male clasping organs (Fig. 21f-h) are curved.

LENGTH. Males and females both varied in length from 1.0-1.2 mm. Skogsberg's specimens were 1.45-1.6 mm long.

COLLECTION DATA. The few males and females taken at Station "S" were in the 500-1000 m and 1000-1800 m samples of June 1959 and the 1250-2000 m sample of Feb. 17, 1960. The extreme temperature range of the waters sampled was 3.8-17°C.

DISTRIBUTION. 48-65°S in the Atlantic and Antarctic (Skogsberg). Benguela Current (Iles). The specimens from Station "S" extend the range to 32°N in the Atlantic.

*Conchoecia kyrtophora* Müller  
(Figure 23)

*Conchoecia kyrtophora* Müller, 1906a, p. 82, Pl. XVII, Figs. 1-10; 1912, p. 76.

DESCRIPTION. Only six specimens of this species, five females and an immature male, were taken in two of the deeper hauls. The shell of the female is relatively short, the height slightly greater than half the length (Fig. 23a). The posterior margin is swollen, and the postero-dorsal, postero-ventral and antero-ventral corners are rounded. In ventral view (Fig. 23b) the animal is oval in shape. There are fine striations on the shell, paralleling the shell margins. The capitulum of the frontal organ of the female has many fine spinules (Fig. 23c) and, as in other species of this group, it extends well beyond the first antenna. The principal seta has some fine spinules ventrally and distally. The left asymmetrical gland is situated just behind the rostrum, the right gland opens close to the postero-dorsal corner (Fig. 23e, f). The endopodite of the female second antenna is illustrated in Figure 23d. The setae and sensory filaments of the last two segments are all of about the same length. This species is very similar in appearance to *C. rotundata*, but the right asymmetrical gland is not at the postero-dorsal corner, as in *C. rotundata*. Also, the larger bristle on the basal segment of the endopodite of the second antenna has stronger spinules and is not bent as sharply as in *C. rotundata*.

According to Müller, the male *C. kyrtophora*, none of which were taken at

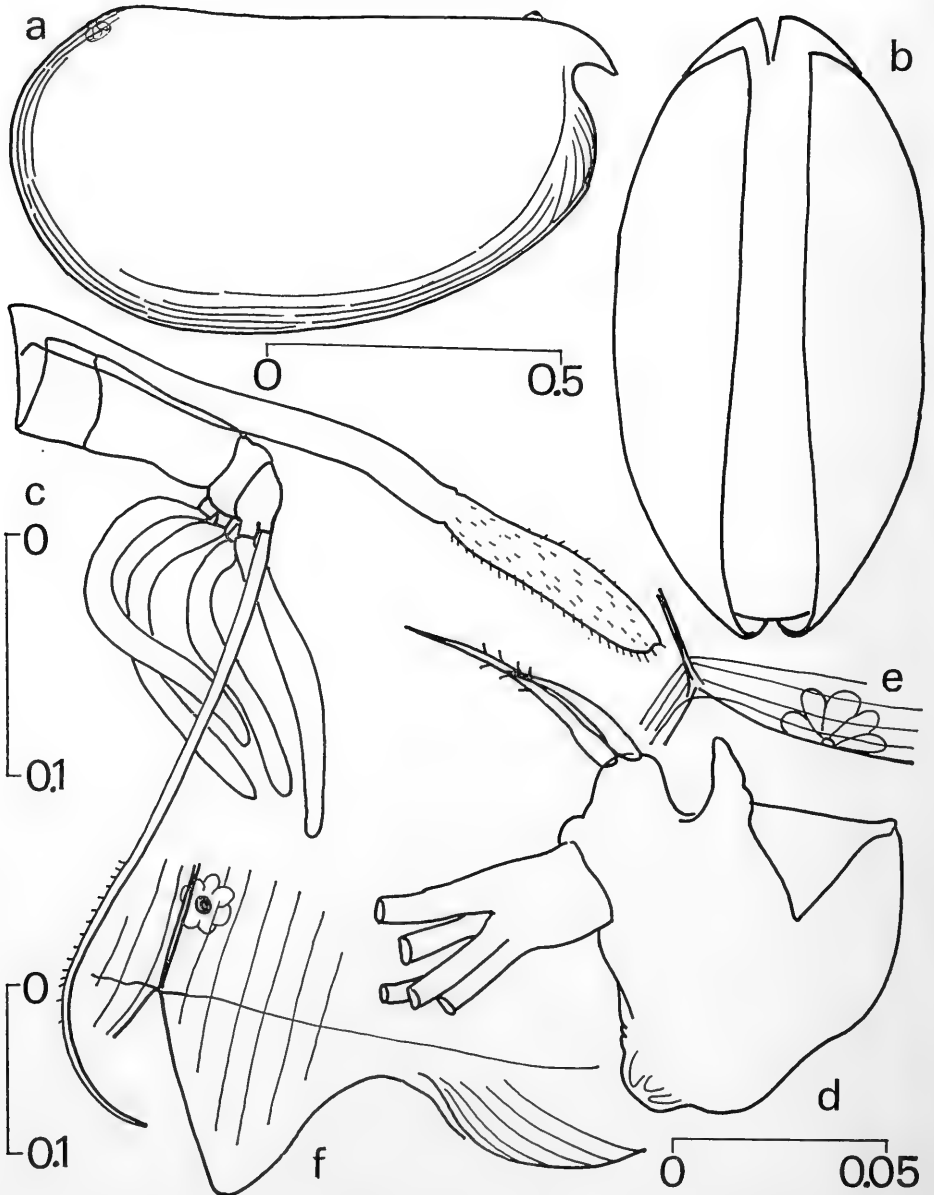


Figure 23. *Conchoecia kyrtophora* Müller. a and b, lateral and ventral views of female. c, female frontal organ and first antenna. d, endopodite of female second antenna (setae and filaments cut off). e, postero-dorsal corner of right shell, showing position of right asymmetric gland. f, rostrum opened out to show position of left asymmetric gland, from inside. Scale at top center for a and b; at center left for c; at lower left for e and f; at bottom right for d. Scales in mm.

Station "S", is easily distinguished by the armature of the principal seta, which has nine pairs of sharp teeth standing at right angles to the seta.

LENGTH. Females 0.8-0.9 mm, males 0.75-0.85 mm (Müller). The females from Station "S" were 0.95-1.0 mm long.



COLLECTION DATA. Three females were taken in the 1000-1800 m sample collected on June 26, 1959, and two females and an immature male were obtained in the 750-1500 m sample collected on Aug. 12, 1964. The extreme possible temperature range was 3.8-13°C.

DISTRIBUTION. 14°N-35°S in the Atlantic, and 7°N-10°S in the Indian Ocean. These specimens therefore extend the range in the Atlantic to 32°N.

*Conchoecia glandulosa* Müller

(Figure 24)

*Conchoecia glandulosa* Müller, 1906a, p. 81, Pl. XXX, Figs. 29-35; 1912, p. 76.

DESCRIPTION. Although only a single larval specimen was found, it agrees so well with Müller's description of the shape and location of the asymmetrical glands of *C. glandulosa*, that this species is included in the list from Station "S". This is the largest species of the Rotundata group; according to Müller, males are 1.85 mm long, females 1.9 mm long. The female shell is elongate, the height shorter than half the length, and tapered anteriorly. The posterior margin is strongly swollen, with a corner, more obvious on the right shell, at about two-thirds to three-fourths of its height where the right asymmetrical gland opens. The left asymmetrical gland is on the dorsal margin approximately one-fourth of the way back from the anterior end. There are many gland cells on the anterior margin. The surface of the shell is smooth. The male shell is somewhat shorter, but otherwise like the female shell. The male principal seta has around 15 pairs of thin basally directed spines.

COLLECTION DATA. The single specimen taken at Station "S" was a third or fourth stage larva, 0.82 mm long (see Fig. 24), but it showed the distinguishing characters of this species, and there seems little doubt as to its identity. It was obtained in the 700-1500 m sample collected on Aug. 12, 1964. The temperature range over those depths would have been approximately 4-14°C.

DISTRIBUTION. Müller's "Valdivia" specimens were taken at 26-29°S in the Indian Ocean, his Deutsche Südpolar Expedition specimens at 27-35°S in the Atlantic and at 64°S in pack ice. The larva from Station "S" therefore extends the range to 32°N in the Atlantic.

*Conchoecia pusilla major* Müller

(Figure 25)

*Conchoecia pusilla* var. *major* Müller, 1960a, p. 80, Pl. XVI, Figs. 30, 31, 34-37, Pl. XVII, Figs. 35, 36.

*Conchoecia pusilla major* Müller, 1912, p. 75.

DESCRIPTION. This species is characterized by the position of the asymmetrical glands, the right gland being at five-sixths the shell height on the posterior margin, protruding from the margin and somewhat farther removed from the postero-dorsal corner than in *C. kyrtophora* (Fig. 25a and i). The shell is elongate, the height half the length, the postero-dorsal corner is definite, but the posterior margin is strongly arched, the postero-ventral and antero-ventral corners rounded. In lateral view males and females appear quite similar, but in ventral view the

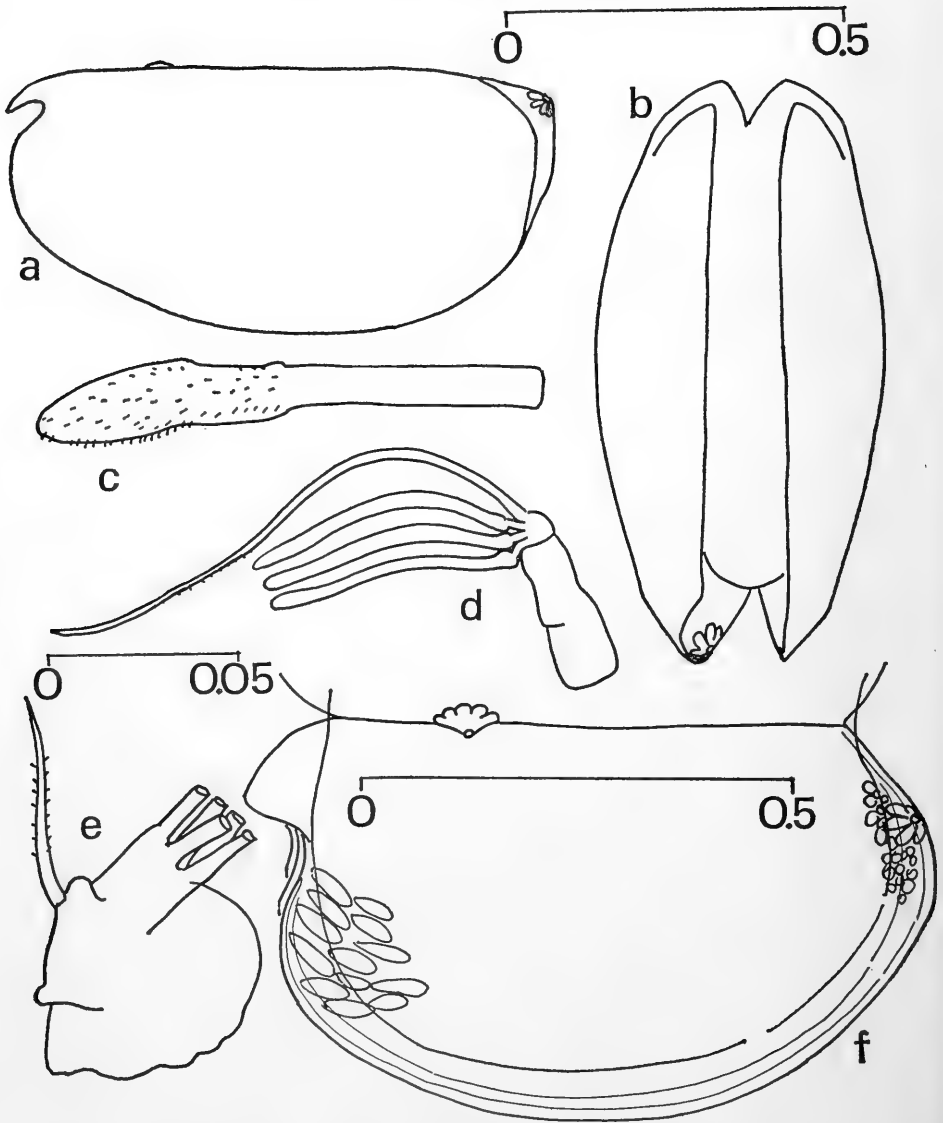


Figure 24. *Conchoecia glandulosa* Müller. a and b, lateral and ventral views of 0.82 mm larva. c, frontal organ of larva. d, first antenna of larva. e, endopodite of second antenna of larva (setae and filaments cut off). f, right shell spread out to show position of gland cells, from inside. Scale at upper right for a and b, at left for c, d, and e. Scale on f for f. Scales in mm.

male rostrum is broad (Fig. 25b), whereas the female rostrum is pointed (Fig. 25h). The left asymmetrical gland opens immediately behind the rostrum and in lateral view protrudes noticeably. The armature of the male principal seta is distinctive, as is the shape of the clasping organs. The male principal seta (Fig. 25d, g) has distally eight pairs of teeth, with 9-10 single teeth more proximally. The *C. pusilla minor* male differs from *C. pusilla major* males in being slightly smaller in size and in the armature of the principal seta, which has four pairs of teeth distally and an irregular row of eight single teeth.

LENGTH. Females 0.9-0.98 mm, males 0.85-0.95 mm (Müller). According to Müller, *C. pusilla minor* females were 0.7-0.85 mm long, males 0.75-0.8 mm long.  
 COLLECTION DATA. Only two specimens, a male and a female, were taken at Station "S". Although the male was only 0.8 mm long, the armature of the prin-

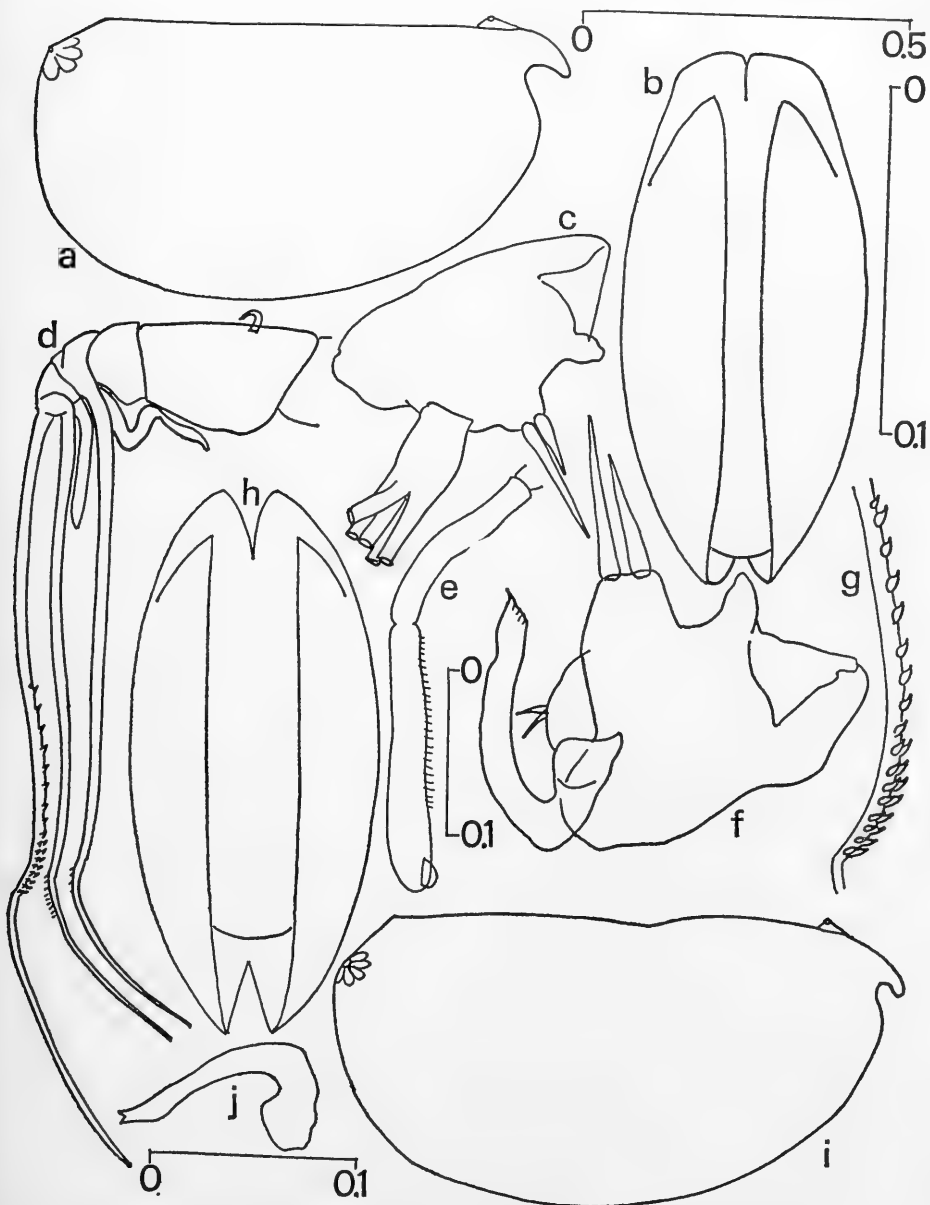


Figure 25. *Conchoecia pusilla major* Müller. a and b, lateral and ventral views of male. c, endopodite of female second antenna. d, male first antenna. e, male frontal organ. f, endopodite of male right second antenna (setae and filaments not shown). g, armature of male principal seta. h and i, ventral and lateral views of female. j, male left clasp organ. Scale at top right for a, b, h, i; at upper right for c, f, g, j; at lower center for e; at bottom left for d. Scales in mm.

cipal seta was that of the *C. pusilla major* male. The female was 0.9 mm long. The male was found in the 500-1000 m sample collected on June 24, 1959, the female in the 1000-1800 m sample of June 26, 1959. The extreme possible temperature range of the waters sampled was 3.8-17°C.

DISTRIBUTION. Müller recorded this species from 24°43'N to 3°55'S in the Atlantic, and from equatorial waters of the Indian Ocean. He also (1908) recorded a female from 64°S in pack ice. *C. pusilla minor* was found only in equatorial Indian Ocean waters.

#### CURTA GROUP MÜLLER

This group includes four small species, 0.75-1.25 mm in length: *C. curta*, *C. acuticostata*, *C. echinulata*, and *C. stigmatica*, which are not always easy to differentiate. The shell is always short and high, with a strongly curved ventral margin, and usually with striking sculpture. The left asymmetrical gland is in the usual place, the right is displaced dorsally to approximately half the shell height. In the female the three proximal, exceptionally all four, of the sensory filaments of the first antenna are deeply bipartite; in the male the proximal filament is bipartite. The principal seta of the male first antenna has a single row of short spines. *C. curta* and *C. echinulata* are less than 1 mm long, the two other species over 1 mm. *C. curta* was the only member of this group which occurred at Station "S".

#### *Conchoecia curta* Lubbock

(Figure 26)

*Conchoecia curta* Lubbock, 1860, *C. curta* (male) plus *Halocypris rostrata* (female), p. 188, 189, Pl. 29, Figs. 31-34.

*Mikroconchoecia clausii*, Claus, 1890, p. 22; 1891, p. 73.

*Conchoecia clausi*, Müller, 1894, p. 230, Pl. 6, Figs. 21, 23-30, Pl. 8, Figs. 31, 32.

*Conchoecia curta*, Müller, 1906a, p. 86, Pl. XXX, Figs. 1-9; 1912, p. 77.

*Conchoecia curta*, Skogsberg, 1920, p. 661, Fig. CXXV.

*Mikroconchoecia curta*, Granata and di Caporiacco, 1949, p. 18.

For further synonymy and description, see Müller (1906a) and Skogsberg.

DESCRIPTION. This is a small rounded compact species. The shell is short, and in the female the height is two-thirds of the length, the male shell slightly less high. The postero-dorsal corner forms a definite angle, but the posterior margin curves into the ventral margin (Fig. 26a, c). The males and females are of slightly different shape; the males have a straight rostrum, whereas the female rostrum curves downward. The shell is strikingly sculptured and reticulated, with striations paralleling the shell margins cut across by finer cross-striations, less noticeable in the female than in the male. The shape of males and females differs in ventral view (Fig. 26b, d). The right asymmetrical gland opens below half the shell height, the left near the postero-dorsal corner.

The female frontal organ is small, bare of spinules and the capitulum scarcely delimited from the stem. The capitulum of the male frontal organ is larger and longer, over half the stem length, rounded at the tip and without spinules (Fig. 26e). The principal seta of the male has been recorded to have 8-13

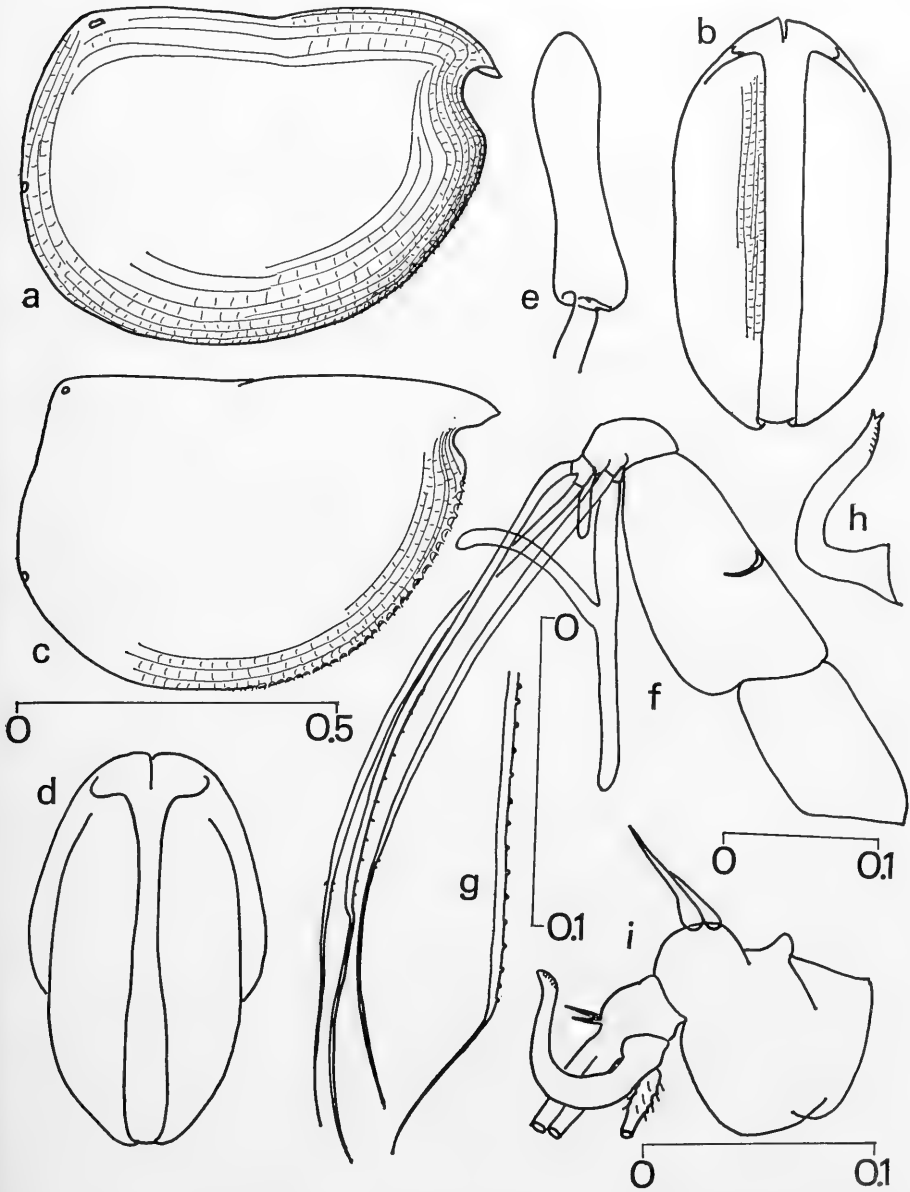


Figure 26. *Conchoecia curta* Lubbock. a and b, lateral and ventral views of female. c and d, lateral and ventral views of male. e, capitulum of male frontal organ. f, male first antenna. g, armature of male principal seta. h, male left clasper. i, endopodite of male right second antenna (setae and filaments cut off). Scale at left for a-d; at bottom right for e, h, and i; below f for f; and at center for g. Scales in mm.

short spines (Müller), 7-14 (Claus), and 11-13 (Skogsberg). Males from Station "S" had 8-15 tiny knob-like spines (Fig. 26f, g). The secondary setae are bare, except for a few spinules and almost as long as the principal seta. The proximal sensory filament is bipartite. The shapes of the male clasper organs, which aid in differentiating this species from *C. echinulata*, are illustrated in Figure 26h and i.

LENGTH. Both sexes, 0.7-0.95 mm. At Station "S" females were 0.75-0.85 mm long, males 0.75-0.8 mm long.

COLLECTION DATA. *C. curta* was a common species at Station "S", occurred throughout the year in every sample in the upper 500 m, and was present in the deeper hauls. It was most abundant between 100 and 400 m depths (see Fig. 65b and Table 3), and with *C. procera* and *C. spinirostris* was one of the three most numerous species at Station "S". Highest numbers of 4420/1000 m<sup>3</sup> were obtained for the 200-300 m sample collected in February 1960. The extreme possible temperature range was 3.8-28.1°C.

DISTRIBUTION. Atlantic from 42°N-37°S; Indian and Pacific Oceans and Mediterranean.

#### BISPINOSA GROUP MÜLLER

Müller characterized this group by the following criteria: excluding the dorso-medial glands, some of the medial gland cells of the posterior margin are enlarged; aside from the asymmetrical glands there are no lateral gland groups; one of the two lateral setae of the second segment of the endopodite of the male second antenna is strikingly long; and the female has, in the same place, a bristle approximately as long as the segment. The males of this group have, on the proximal secondary seta of the first antenna, a pad or callous distally, near the distal end of the armature of the principal seta.

This group includes several species, *C. haddoni*, *C. bispinosa*, *C. secernenda*, and *C. striola*, which are very similar, and *C. orthotrichota* and *C. atlantica*, which are less closely related. Müller thought that *C. incisa* might also belong in this group, but Skogsberg placed *C. incisa* in the Gaussi group with *C. gaussi*. Müller (1912) considered *C. secernenda* a synonym of *C. bispinosa*. However, Skogsberg, although he had no specimens of *C. secernenda*, believed them to be separate species because of differences in size and in the armature of the male principal seta. At Station "S" *C. secernenda* occurred commonly throughout the year, whereas *C. bispinosa* was taken only rarely.

These species are medium to large in size and range in length from 1.6 mm (*bispinosa*, *orthotrichota*) to up to 4.8 mm (female *atlantica*). In *C. bispinosa*, *C. secernenda*, and *C. striola* the postero-dorsal corners of both shells are produced into a point, in male *C. orthotrichota* (this species was described from a single specimen) only the right shell has a point. *C. haddoni* and *C. atlantica* lack postero-dorsal points. *C. bispinosa*, *C. secernenda*, and *C. atlantica* occurred at Station "S".

#### *Conchoecia bispinosa* Claus

(Figures 27, 28)

*Conchoecia bispinosa* Claus, 1890, p. 10; 1891, p. 59, Pl. V. Figs. 1-10, Pl. VI, Fig. 1, Pl. VIII, Figs. 7, 8.

*Conchoecia bispinosa*, Skogsberg, 1920, p. 672, Fig. CXXVIII.

DESCRIPTION. In males and females the height of the shell is slightly less than half the length. The female shell narrows anteriorly, the male shell does not. Both

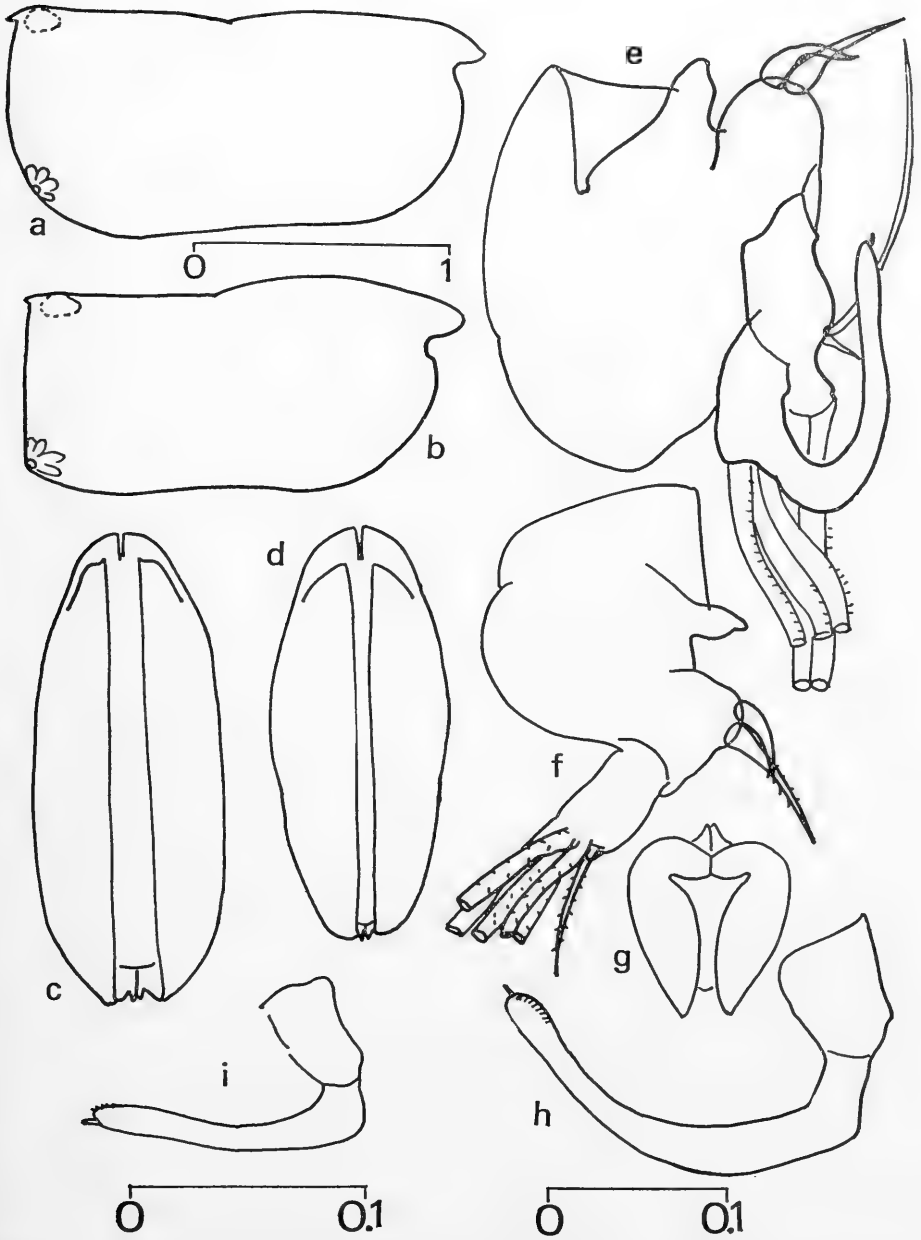


Figure 27. *Conchoecia bispinosa* Claus. a and c, lateral and ventral views of female. b and d, lateral and ventral views of male. e, endopodite of male left second antenna (setae and filaments cut off). f, endopodite of female second antenna. g, anterior view of male. h and i, male right and left clasper organs. Scale at upper left for a-d, g; at lower left for e, h, i; at lower right for f. Scales in mm.

postero-dorsal corners are produced into a spine, that of the right shell slightly longer than that of the left (Fig. 28a). The shoulder vaults are powerful, but smoothly rounded (Fig. 27a, b, g). The postero-ventral corners of the female shell are rounded. The posterior margin of the male shell is almost straight and

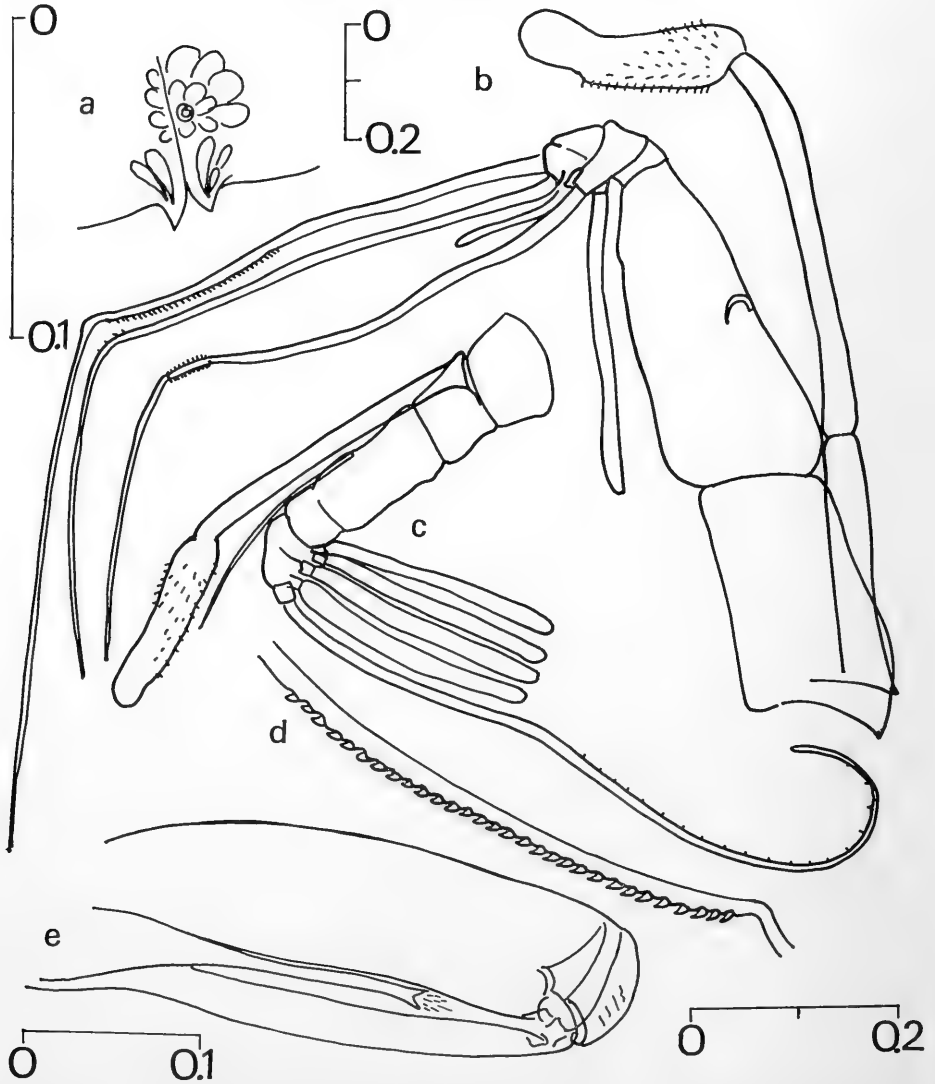


Figure 28. *Conchoecia bispinosa* Claus. a, postero-dorsal corners of female shell, from inside. b, male frontal organ and first antenna. c, female frontal organ and first antenna. d, armature of male principal seta. e, penis. Scale at top left for d; at top center for a; at bottom right for b and c; at bottom left for e. Scales in mm.

there is a definite postero-ventral corner. In ventral view the rostrum of the male is more broadly rounded than that of the female (Fig. 27c, d).

The capitulum of the male frontal organ is characteristically bent (Fig. 28b), that of the female is straighter and slimmer (Fig. 28c); both have spinules at the proximal end which increase in number ventrally. The female principal seta has a number of spinules on the ventral surface; the male principal seta is distinguished by 29-30 pairs of short wide teeth or spines (30-32, according to Skogsberg), directed proximally (Fig. 28d). As in other members of this group, the proximal secondary seta has, well down its length, a widened area or "pad" (Fig.



28b). Figure 27e illustrates the endopodite of the male left second antenna, showing the exceptionally long bristle characteristic of this group. The male clasping organs are shown in Figure 27e, h, and i. The extra bristle on the second segment of the endopodite of the female second antenna is shown in Figure 27f. The bases of the setae and sensory filaments of the last segment of the endopodite in both sexes are covered with spinules.

LENGTH. 1.5-1.8, according to Claus; Skogsberg's male was 1.75 mm long, his females 1.6-1.95 mm long. The males from Station "S" ranged in length from 1.65-1.8 mm, the females from 1.8-1.95 mm.

COLLECTION DATA. *C. bispinosa* was not a common species at Station "S," since only nine males and 11 females were found during the period studied. These were taken at all sample depths over the 0-2000 m sampling range, and in all months except January, May, September and October. Although the extreme possible temperature range was 3.8-25.7°C, most of the specimens were taken over a range of approximately 16-22°C. Skogsberg's specimens were taken over a range of 21.1-26.4°C.

DISTRIBUTION. Skogsberg verified specimens collected from 42°N-11°S in the Atlantic; Iles (1953) recorded this species from the Benguela Current, thus extending the range to 20°S in the Atlantic.

*Conchoecia secernenda* Vávra  
(Figures 29-31)

*Conchoecia secernenda* Vávra, 1906, p. 59, Pl. VI, Figs. 121-127.

DESCRIPTION. This is a fairly massive, thick species. The shell is usually opaque and grey by reflected light, and pale striations may be visible starting back from the rostrum (Figs. 29a, 30a). The shoulder vaults are powerfully developed but smoothly rounded (Figs. 29b, 30c), as in *C. bispinosa*. In general appearance and in the proportions of the shell, *C. bispinosa* and *C. secernenda* differ only in size. In some males the posterior margin is convexly rounded and the postero-ventral corner is rounded to the ventral margin; also, the spines or points at the postero-dorsal corner may be proportionately longer and slimmer (Fig. 30g) than in *C. bispinosa*. The frontal organs are similar to those of *C. bispinosa*, although the capitulum of the male is not bent upwards in as pronounced a way as that of the *C. bispinosa* male (Fig. 31a). The male principal seta of the first antenna (Fig. 31b) has 42-50 short wide spines directed proximally; the proximal secondary seta has, opposite the armature of the principal seta, a thickening or pad, as in the other members of this group. The female principal seta (Fig. 29d) has more spinules ventrally, distal of the sensory filaments, than that of female *C. bispinosa*. The male clasping organs (Fig. 30d, e) are fairly similar in shape to those of male *C. bispinosa*.

DISCUSSION. Müller (1912) considered this species a synonym of *C. bispinosa*, for which he gave length ranges of 1.74-3.0 mm for females and 1.66-2.4 mm for males. Because of the discontinuity in the size ranges of the larger and smaller forms and differences in the male principal setae, Skogsberg believed the larger *C. secernenda* was a separate species, although he had no specimens. Vávra described this species from specimens collected at 20 stations from the Gulf Stream, the Sargasso Sea,

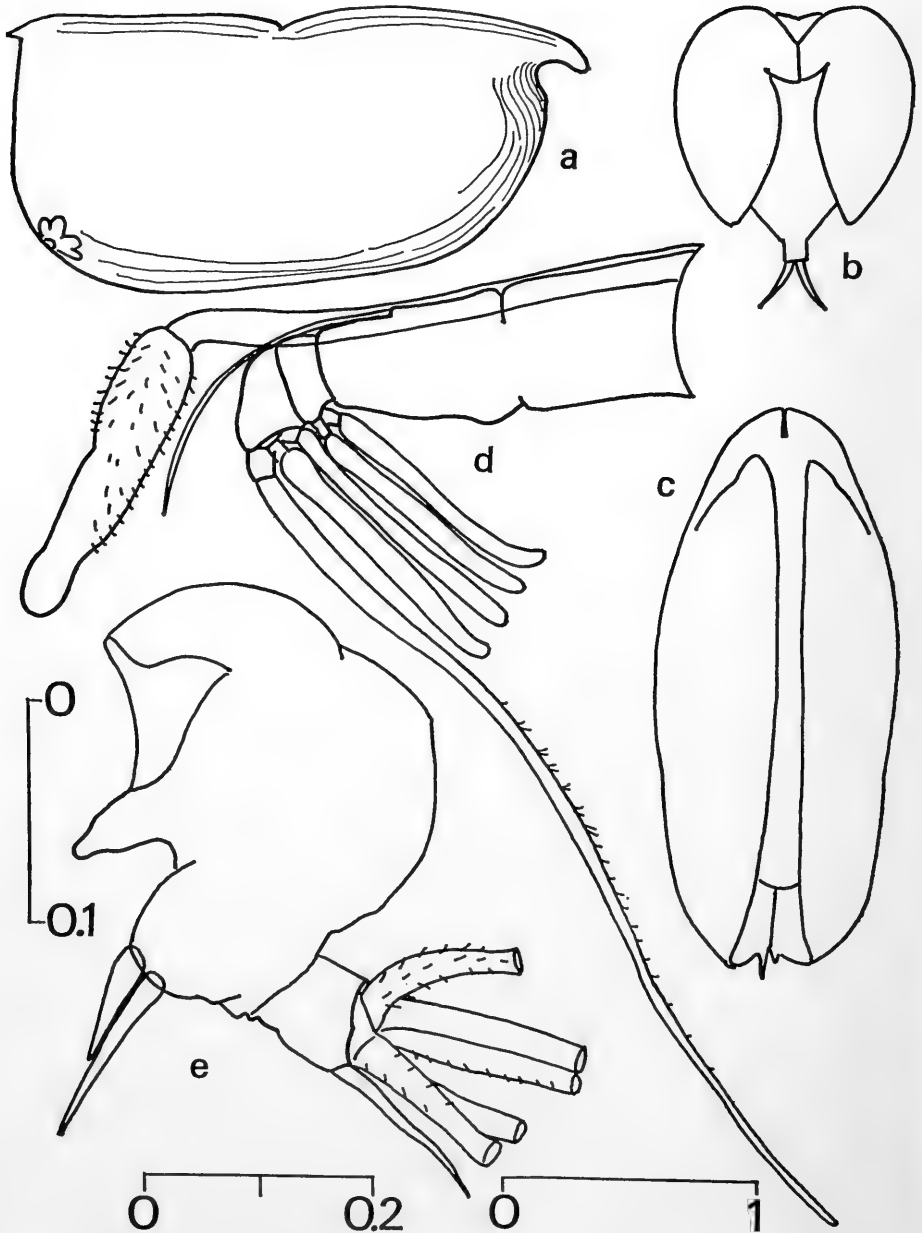


Figure 29. Female *Conchoecia secernenda* Vávra. a, b, and c, lateral, anterior, and ventral views of female. d, frontal organ and first antenna. e, endopodite of second antenna. Scale at bottom right for a-c; at bottom left for d; at left for e. Scales in mm.

the North and South Equatorial Currents and the Guinea Current, and did not record the smaller *C. bispinosa* from any of these localities.

LENGTH. Vávra gave the length of males as 2.5 mm, of females as 2.8 mm. Males from Station "S" were 2.0-2.5 mm long, females 2.2-2.85 mm long.

Some data are available on the lengths of the third to fifth larval stages: 14

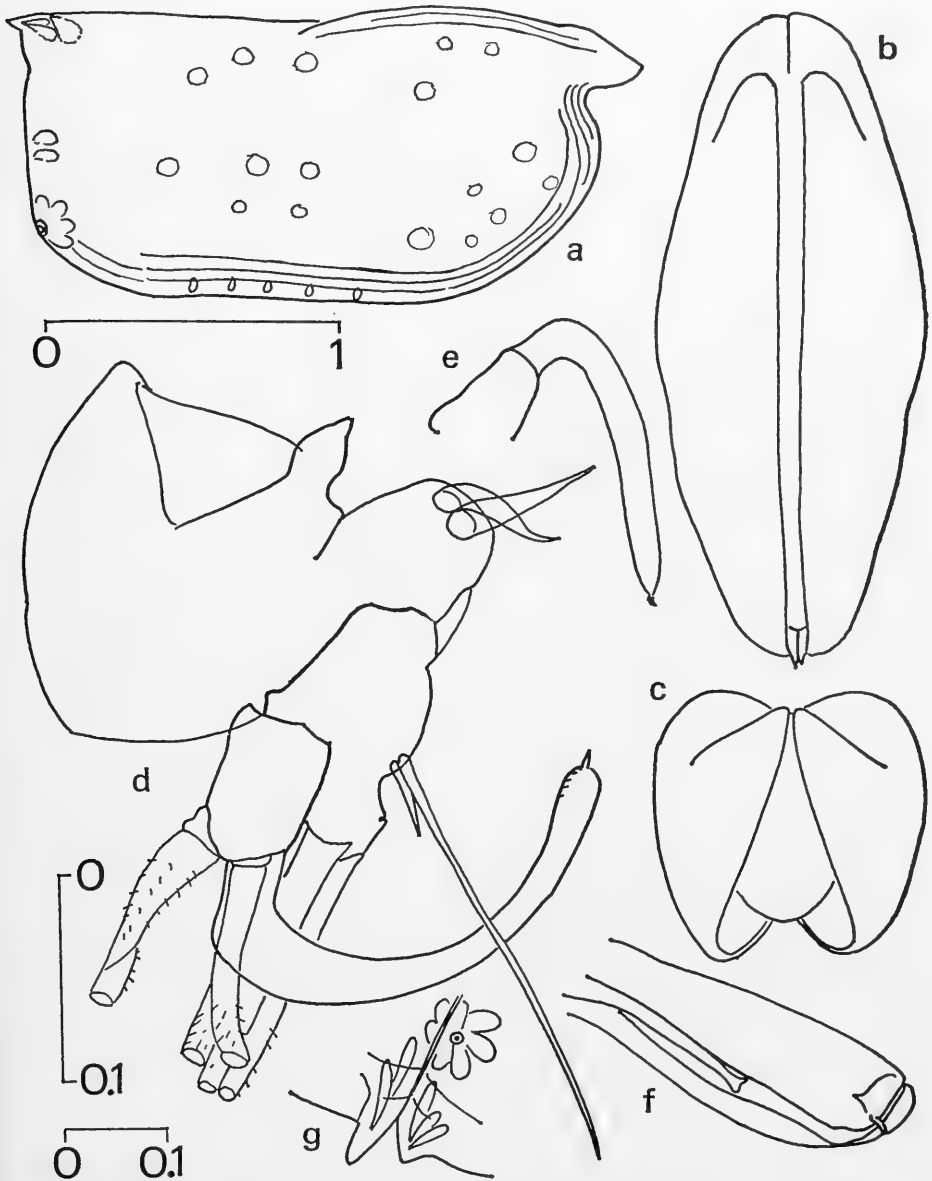


Figure 30. Male *Conchoecia secernenda* Vávra. a, b, and c, lateral, ventral and posterior views of male. d, endopodite of male right second antenna (setae and filaments cut off). e, male left clasper. f, penis. g, postero-dorsal corners of shell, from inside. Scale at upper left for a-c; at bottom left for f and g; in left margin for d and e. Scales in mm.

stage III larvae, 0.7-0.85 mm long, gave a mean length of 0.75 mm; 43 stage IV larvae, 0.95-1.15 mm long, mean length 1.057 mm; 70 stage V larvae, 1.4-1.8 mm long, mean length 1.62 mm.

COLLECTION DATA. *C. secernenda* was the largest species that occurred year-round in the upper 500 m of the Sargasso Sea. Table 2 lists the numbers per 1000 m<sup>3</sup> obtained for this species in the samples taken at 100 m depth intervals. C.

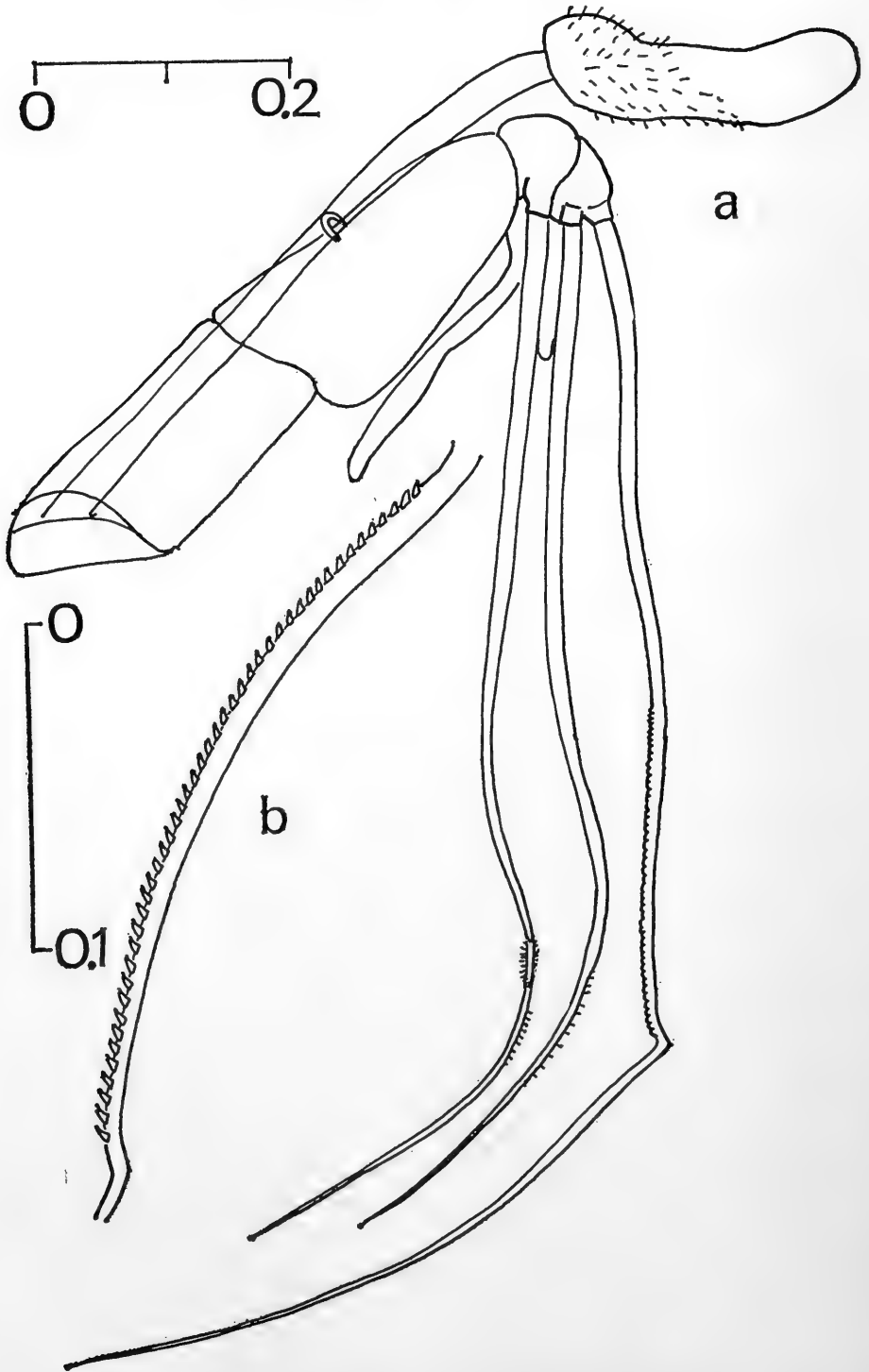


Figure 31. Male *Conchoecia secernenda* Vávra. a, frontal organ and first antenna. b, armature of principal seta. Scale at top left for a, at left for b. Scales in mm.

TABLE 2. Numbers/1000 m<sup>3</sup> of *Conchoecia secernenda* for 100 m depth intervals on June 23 and Oct. 9, 1959 and Feb. 17, 1960.

Depth in Meters	June	Oct.	Feb.
0-100	4	2	7
100-200	208	18	54
200-300	50	12	48
300-400	17	7	54
400-500	—	16	42

*secernenda* was always least numerous in the upper 100 m. Fewest numbers were recorded in October. It was most abundant in the 100-200 m sample of June 1959, when 208/1000 m<sup>3</sup> were recorded. In February 1960, it was fairly evenly distributed between 100 and 500 m. In the simultaneous tows, 500-0 m, collected with No. 2 and No. 8 nets in August 1959 (see Table 4), *C. secernenda* was taken in slightly greater numbers by the No. 2 net (56/1000 m<sup>3</sup>) than the No. 8 net (40/1000 m<sup>3</sup>). The extreme possible temperature range in the upper 500 m was 15.9-28.1°C during the year. Vávra's specimens were caught from an overall depth range of 0-700 m.

DISTRIBUTION. 37°N-7°S in the Atlantic.

*Conchoecia atlantica* (Lubbock)  
(Figure 32)

Müller (1906a, p. 92) listed the synonymy of this species, which includes a variety of generic and specific names: *Halocypris atlantica* (Lubbock, 1856), *Conchoecia cuneata* (Müller, 1890), *C. agassizii* (Müller, 1895 and Vávra, 1906), and *Halocypris torosa* (Scott, 1894). Granata and di Caporiacco (1949) refer to this species as *Orthoconchoecia atlantica*. For references and description, see Müller (1906a, p. 92, Pl. V, Figs. 6, 7, Pl. XIX, Figs. 17-28).

DESCRIPTION. This is a large, massive, thick species of characteristic shape (Fig. 32a, b, c, d). The height of the shell is less than half the length in mature individuals, but greater than half in larval forms. The postero-dorsal corner is bluntly rounded and the shell narrows anteriorly, especially in the female. The asymmetrical glands are in the usual place.

The male principal seta is very long (a male 3.5 mm long had a principal seta 3.35 mm long), almost twice as long as the secondary setae, and has approximately 74 pairs of teeth directed proximally; at the distal end of this tooth row there are two groups of five spines each, pointing distally (Fig. 32f, g). The proximal secondary seta has a pad and several spinules dorsally and the distal seta a row of spinules distally near the armature of the principal seta. As in other members of this group, one of the lateral bristles of the second segment of the endopodite of the male second antenna is very long. The shapes of the frontal organs and clasping organs are shown in Figure 32e, h-j.

LENGTH. Females 3.3-4.8 mm, males 3.15-4.6 mm (Müller). The largest specimens, 4.2-4.8 mm, were found in the Pacific; Indian Ocean specimens were 3.15-3.65 mm long, and those from the Atlantic north of 11°S Lat. were 3.2-3.9 mm in length. At Station "S" only four mature individuals were obtained, one female

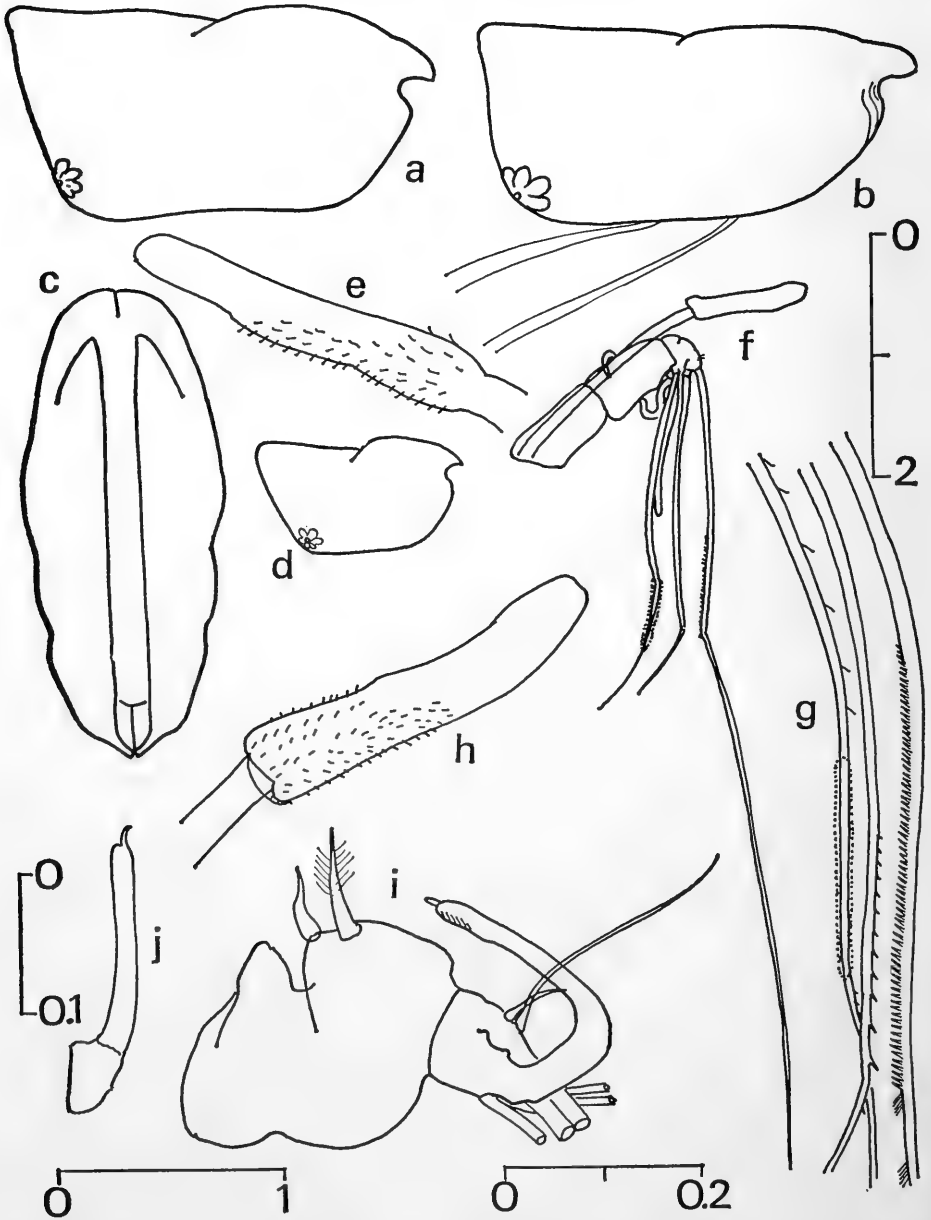


Figure 32. *Conchoecia atlantica* (Lubbock). a, lateral view of female. b and c, lateral and ventral views of male. d, Stage IV larva. e, capitulum of female frontal organ. f, male frontal organ and first antenna. g, armature of male principal seta and of two secondary setae. h, capitulum of male frontal organ. i, endopodite of male right second antenna (setae and filaments cut off). j, male left clasp organ. Scale at upper right for a-d; at lower right for e, g, h, i; at bottom left for f; on left margin for j. Scales in mm.

3.6 mm long in February 1962, and three males 3.45-3.5 mm long in August, September and November 1961.

COLLECTION DATA. Larval stages of *C. atlantica* were found occasionally throughout the year in the upper 500 m, although none were noted in January and May. Also, none were taken in the deeper hauls. Measurements on these larvae indicated that four stages were present. Stage I was not noted, but stage II individuals were 0.65-0.7 mm long, stage III were 0.9-1.0 mm long, stage IV were 1.4-1.6 mm long, and stage V were 2.1-2.7 mm long. The extreme possible temperature range during its period of occurrence was 15.9-28.1°C.

DISTRIBUTION. 39°48'N (Grice and Hart, 1961) to 37°S in the Atlantic; Indian and Pacific Oceans.

#### OBTUSATA GROUP MÜLLER

This group includes *C. obtusata* Sars, *C. obtusata* var. *antarctica* Müller, and *C. parthenoda* Müller. Müller described only the female of *C. parthenoda*, the species which occurred at Station "S." Males of *C. parthenoda* were common at Station "S" and are here described. According to Skogsberg (1920), *C. obtusata* has been recorded from the Arctic Ocean and the Atlantic chiefly north of 60°, and *C. obtusata* var. *antarctica* from the Antarctic Ocean 26°S-53°S. It is doubtful whether *C. parthenoda* belongs in this group.

Lacking the males of *C. parthenoda*, Müller characterized this group by the striking asymmetry of the endopodite of the *C. obtusata* male second antenna. In this species the right clasping organ is extraordinarily large and the left is small. In the *C. parthenoda* male the right clasping organ is larger than the left, but not exceptionally so. Müller noted that only the usual glands are present, and that the females have no outstanding characteristics.

#### *Conchoecia parthenoda* Müller

(Figures 33, 34, 35)

*Conchoecia parthenoda* Müller, 1906a, p. 78, Pl. XVI, Figs. 24-29; 1912, p. 75.

DESCRIPTION. Female: The postero-dorsal corner of the shell is definite, but the posterior margin and the postero-ventral corners are fairly strongly rounded (Fig. 33a). The shell narrows anteriorly, so that the maximum height is in the posterior half and is slightly greater than half the length. The right asymmetrical gland is on the posterior margin, somewhat dorsal of the postero-ventral corner. This species is characterized by the position of the left asymmetrical gland, which is moved somewhat forward on the dorsal margin, and is developed into a bump which projects above the margin. The body of the female is compact and opaque and usually completely fills the shell. In ventral view (Fig. 33b) the body narrows anteriorly to the rostrum. The female frontal organ is small and thin, the capitulum scarcely delimited from the stem, with no hairs or spinules on smaller specimens, and is pointed at the tip (Fig. 33c). Larger females may have a few spinules ventrally on the capitulum (Fig. 33d). The female principal seta has some spinules over most of the ventral surface and a few proximally on the dorsal surface (Fig. 33c). Both bristles of the basal segment of the endopodite of the second antenna have easily visible spinules (Fig. 33e).

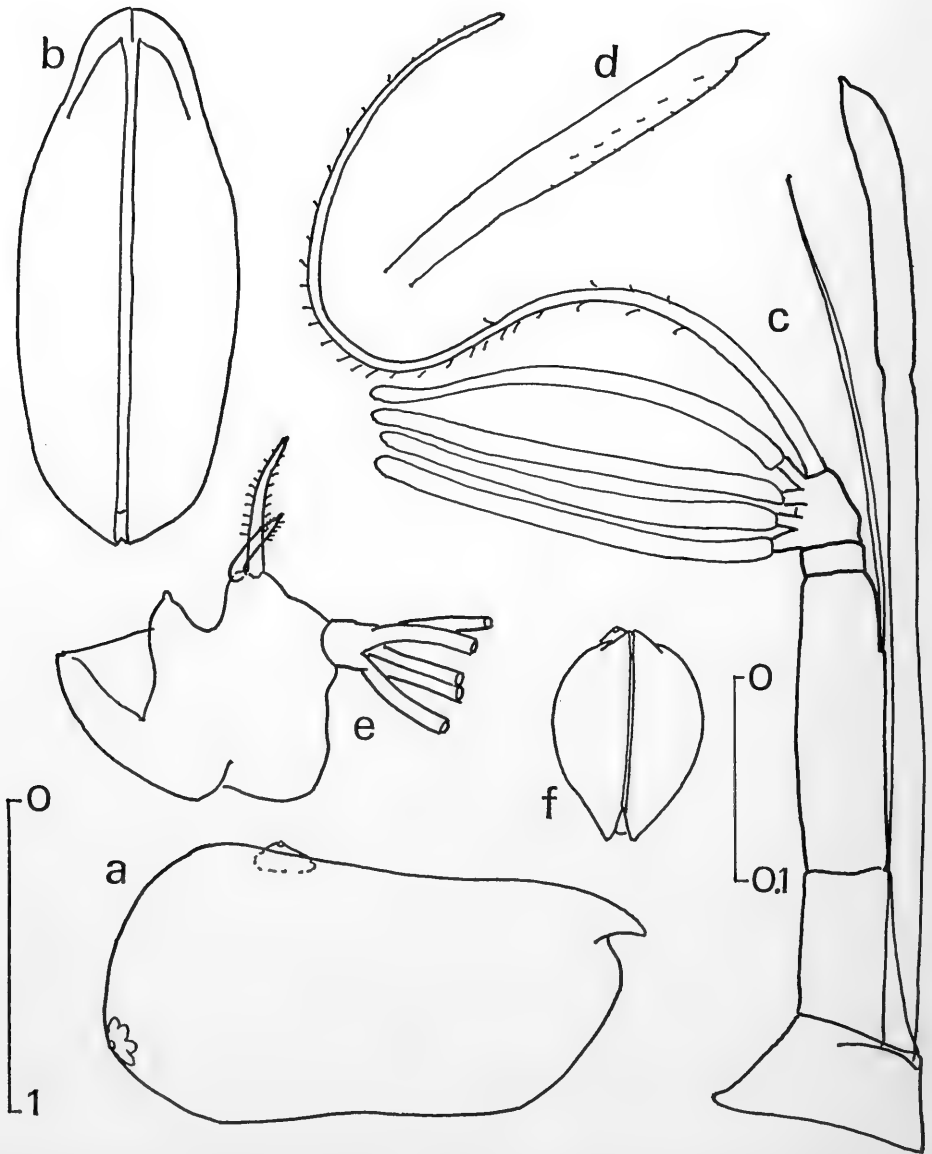


Figure 33. Female *Conchoecia parthenoda* Müller. a, b and f, lateral, ventral and posterior views of female. c, frontal organ and first antenna of 1.6 mm female. d, capitulum of frontal organ of 1.8 mm female. e, endopodite of second antenna (setae and filaments cut off). Scale at left for a, b, f, at right for c, d, e. Scales in mm.

LENGTH. Females 1.7-1.8 mm long, according to Müller. In the material from Station "S," females 1.5-1.65 mm long occurred throughout the year in every sample. However, in the depth series collected in June 1959, larger females up to 1.8 mm long were present in the 0-100 m sample.



*Conchoecia parthenoda*, male  
(Figures 34, 35)

?*Conchoecia magna* (part), Müller, 1906a, p. 103.

?*Conchoecia magna* var. *typica* (part), Müller, 1912, p. 84.

?*Conchoecia tetragona*, Skogsberg, 1931, p. 16.

DESCRIPTION. Specimens of a male *Conchoecia*, different from other described males, occurred throughout the year in the upper 500 m at Station "S." These males were differentiated from other males in that the left asymmetrical gland was displaced somewhat forward on the dorsal margin, and, especially when viewed from the left side, the gland projects as a bump on the dorsal margin, just as it does in female *C. parthenoda*. However, otherwise these males were very similar in appearance to, but slightly smaller than, the male of *Conchoecia magna* and are of the shape characteristic of males of the Magna Group. Since *C. parthenoda* females and these males occurred commonly together, and since the disposition and development of the left asymmetrical gland are similar, these are considered to be the males of *C. parthenoda*.

These males varied in length from 1.35-1.5 mm, the shell being almost rectangular in shape (Fig. 35a) and about twice as long as high. The shell is transparent by reflected light, with no definite sculpture, the body dark and usually compactly filling the shell. The right asymmetrical gland is at the postero-ventral corner, the left moved somewhat forward on the dorsal margin. Dorso-medial glands are present at the postero-dorsal corners of the shell (Fig. 34d), but there are no gland cells beneath the rostral incisure, such as occur in *C. magna*.

The frontal organ and first antenna resemble those of the male *C. obtusata* as figured by Skogsberg (1920, Fig. CXX). The capitulum of the frontal organ is rounded at the tip, with tiny spinules around it at the proximal one-third dorsally to one-half ventrally (Fig. 34b); the capitulum also resembles that of the male *C. magna* in shape, but has fewer spinules. The armature of the principal seta is similar to that of the male *C. magna* and is of the type figured by Skogsberg for the *C. obtusata* male, in that the distal spines are paired, and then, continuing proximally, the spines alternate, ending in a single row. Males of *C. spinirostris* and *C. porrecta* have a similar type of armature. Approximately 25 spines or teeth, directed proximally, may be counted in profile, of which the distal eight are paired, then there are five or so alternating pairs which merge to a single line of 10 teeth, making a total of 36 single teeth (Fig. 34a).

The structure of the endopodite of the second antenna is shown in Figures 34c and 35c. The larger of the two bristles of the basal segment of the endopodite (Skogsberg's "b" bristle) may have one or two pairs of long hairs, such as are characteristic of the Magna group. The smaller bristle is bent sharply sideways as in female *C. parthenoda* (Fig. 33e). The processus mammillaris is conical. The right clasping organ (Figs. 34c, 35d) is squared and very similar in shape to that of the *C. magna* male, illustrated in Figure 36g, but the distal portion beyond the bend is shorter and thicker than in *C. magna*. The left clasping organ (Fig. 35c, e) is considerably smaller than the right.

The penis is somewhat squared at the tip, and of characteristic shape (Fig.

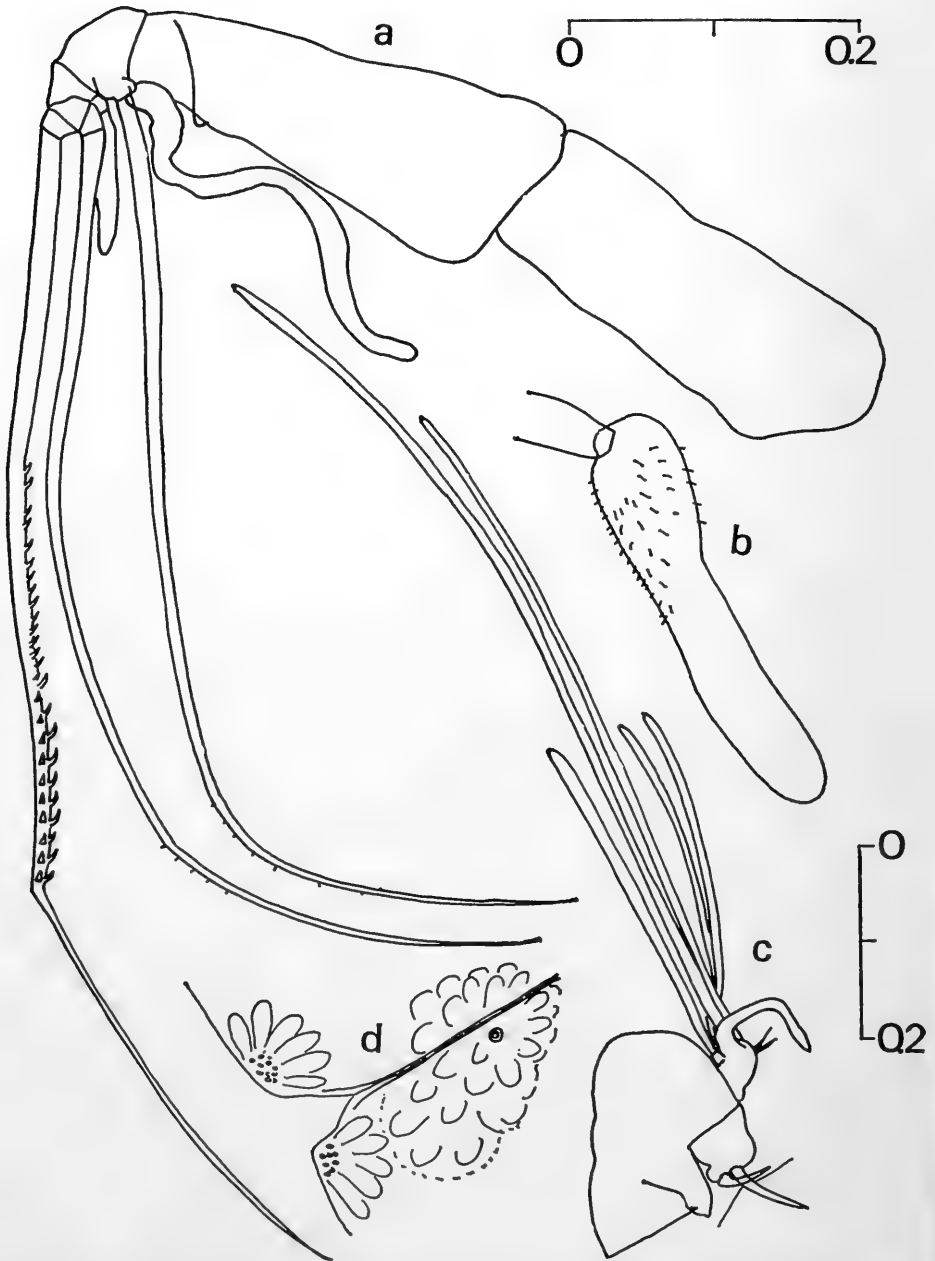


Figure 34. Male *Conchoecia parthenoda*. a, first antenna. b, capitulum of frontal organ. c, endopodite of right second antenna. d, postero-dorsal corners, from inside. Scale at top right for a and b, at lower right for c and d. Scales in mm.

35g), noticeably different from that of the *C. magna* male (Fig. 36f), which is more pointed at the tip.

Since the *C. parthenoda* male is so similar in appearance to the *C. magna* male, being only slightly smaller, Müller may not have differentiated it from the

*C. magna* males in his samples. In his description of *C. magna* from the Bay of Naples (1894), where *C. parthenoda* has not been recorded, he gave the lengths of *C. magna* males as 1.66-1.8 mm. In his later works (1906a, 1912), he gave the lengths of *C. magna* males as 1.4-2.0 mm. It is possible that his smaller *magna* males may have been *parthenoda* males. Although the *C. parthenoda* male may

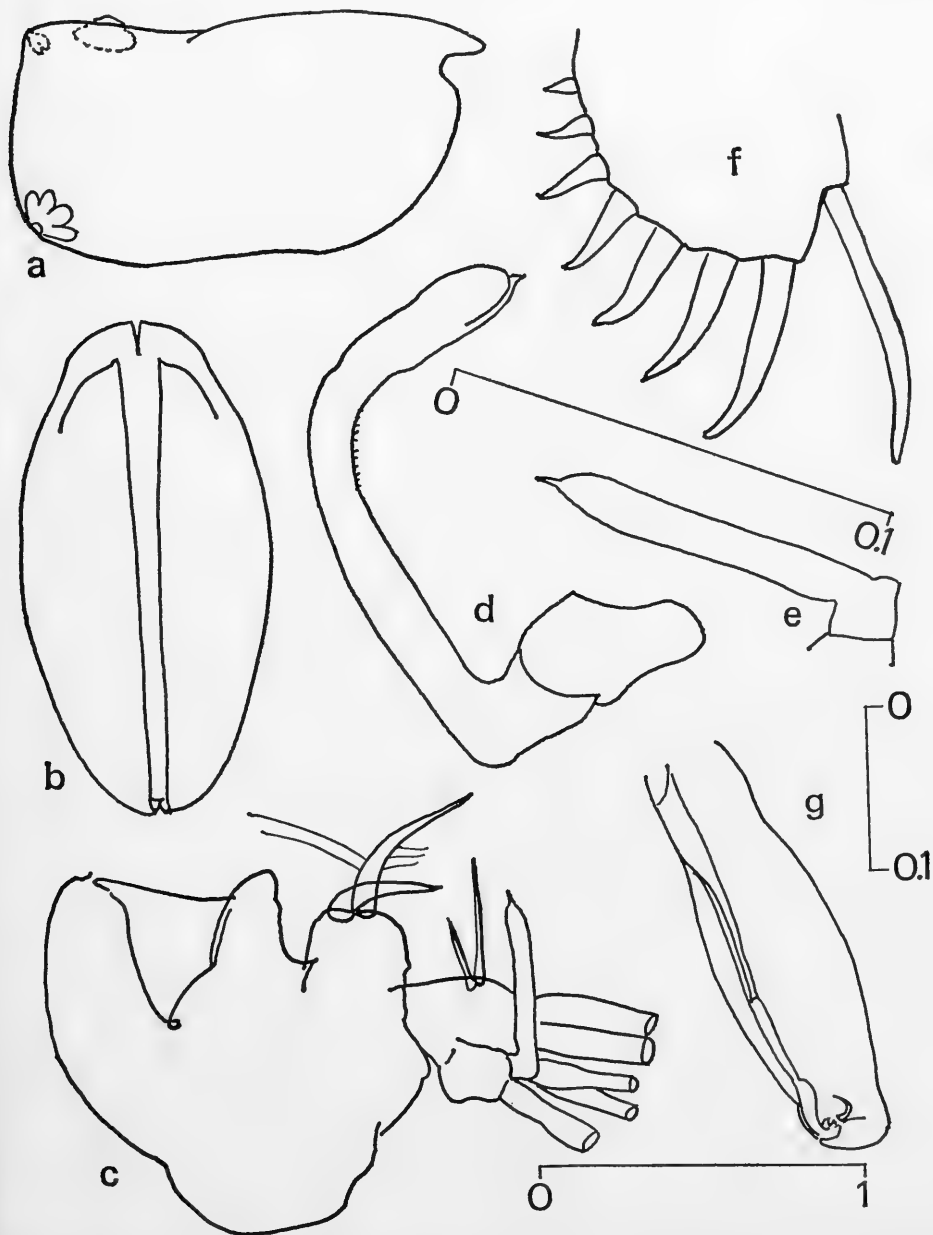


Figure 35. Male *Conchoecia parthenoda*. a and b, lateral and ventral views of male. c, endopodite of left second antenna. d and e, right and left clashing organs. f, furca. g, penis. Scale at bottom right for a and b; on right margin for c, f, g; above e for d and e. Scales in mm.

be easily differentiated from the *C. magna* male by the position of the left asymmetrical gland, this does not protrude as noticeably as in the female and could have been overlooked. In the shape of the shell and of the right clasping organ and in the armature of the principal seta it closely resembles the *C. magna* male. The gland cells beneath the rostral incisure, usually visible in *C. magna*, have not been noted in *C. parthenoda*, but this character is of doubtful value, since these gland cells are often difficult to distinguish.

Also, it is possible that Skogsberg's (1931) supplementary description of *C. tetragona* males may indeed refer to *C. parthenoda* males. He had two males, 1.5-1.55 mm long, from 34°N and 40°N in the Atlantic, which in size were closer to *C. parthenoda* than to *C. magna* or Sars's *C. tetragona*. His description of the armature of the principal seta of these males agrees with that of *C. parthenoda*. With this description he gave no figures other than one of the distal part of the penis, and this agrees in shape with that here shown (Fig. 35g) for male *C. parthenoda*.

**COLLECTION DATA.** The depth distribution of *C. parthenoda* in the upper 500 m, given as percentages of the total numbers of ostracods, is shown in Figure 65e. Table 3 lists the numbers per 1000 m<sup>3</sup> of *C. parthenoda* obtained, by actual count, from the samples collected at 100 m depth intervals. In this series, *C. parthenoda* was least numerous in February 1960. Highest numbers of 525/1000 m<sup>3</sup> were taken in the 100-200 m sample of June 1959. In October 1959, *C. parthenoda* was most numerous in the upper 200 m.

**DISTRIBUTION.** Müller's female specimens were recorded from the Indian Ocean and from 24°N-30°S in the Atlantic. This range was extended by Grice and Hart (1961), who recorded this species from the Gulf Stream and from 37°N in the Sargasso Sea.

#### MAGNA GROUP MÜLLER

The male shell is similar in all representatives of this group. It is moderately elongate, not tapered anteriorly, and the dorsal and posterior margins form a right angle, except in *C. magna* var. *rhombica*, the point only slightly rounded. The posterior margin is almost straight, the postero-ventral corner moderately rounded, and the ventral margin is shallowly concave. The female shell is characteristically more rounded, in some species tapered anteriorly. The postero-dorsal corner is rounded, the posterior margin more or less strongly arched, the postero-ventral corner rounded, the ventral margin more or less strongly concave. There is sculpturing in all the species, consisting mainly of concentric lines parallel to the margin, but it is not always noticeable.

The asymmetrical glands are in the usual locations. Paired lateral corner glands are present in three species (*C. lophura*, *C. parvidentata*, and *C. hyalophyllum*), on the right side near and dorsal to the asymmetrical gland and similarly located on the left side. In all the species, except *C. spinirostris* and *C. porrecta*, two enlarged gland cells open close together on each side near the anterior margin beneath the rostral incisure. These are often hard to find.

In most members of this group the longer bristle of the first segment of the endopodite of the male second antenna has long hairs near its base.

Aside from the five species mentioned above, Müller included *C. macrocheira*, *C. subarcuata*, and *C. magna* in this group, which he considered a natural one, with the possible exception of *C. spirostris*. In this report, *C. porrecta* Claus, which Müller believed a synonym of *C. spirostris*, is considered a separate species. Skogsberg also thought it probable that *C. porrecta* was a different species. *C. lophura*, *C. subarcuata*, *C. magna*, *C. spirostris*, and *C. porrecta* occurred at Station "S", *C. magna* and *C. spirostris* being two of the commonest species. A stage III larva of *C. macrocheira* was also taken, so that six species of this group were recorded from Station "S". It should be added that much time was spent in trying to determine whether *C. hyalophyllum* Claus was present. Females of this species are reported to be very similar in shape and size to female *C. magna*, differing only in that they supposedly have lateral corner glands and are of "weak dimensions." Many transparent thin females and larvae were examined, but it was not possible to find any lateral corner glands, so it was assumed that these transparent specimens must have been recently moulted *C. magna*. Also, no males with the principal seta armed as described for *C. hyalophyllum* were found.

*Conchoecia magna* Claus

(Figures 36, 37)

*Conchoecia magna* Claus, 1874a, p. 6, Pl. I, Fig. 6c, Pl. II, Figs. 16, 18; 1890, p. 8; 1891, p. 57, Pl. II, Figs. 1-9, Pl. III, Figs. 1, 2.

*Conchoecia tetragona*, Sars, 1887, p. 254, Pl. XI, Figs. 5, 6, Pl. XIII, Figs. 5-9.

*Conchoecia magna*, Müller, 1894, p. 228, Pl. V, Figs. 7-12, 16-22, 27-31, 35-39, 45-52.

Müller's later (1906a, 1912) descriptions of this species are not included in the list of synonyms, since, as noted above, he may have in part confused *C. magna* and *C. parthenoda* males. However, his description of *C. magna* from the Mediterranean, where *C. parthenoda* is not known to occur, can apply only to this species. Also, Skogsberg's (1931) *C. tetragona* is not included in the list of synonyms, since it is probable that his specimens were male *C. parthenoda*.

**DESCRIPTION.** The male shell is of the rectangular shape characteristic of males of this group, the height slightly greater than half the length, the posterior margin almost straight, the ventral margin shallowly concave, the postero-dorsal corner right-angled (Fig. 36c). The female shell is thick and fleshy and the body fits compactly in the shell. The posterior margin is rounded, the postero-ventral corner rounded, the ventral margin concave, and the anterior margin arched (Fig. 36a). The asymmetrical glands are in the usual place and the gland cells beneath the rostral incisure are usually visible.

The capitulum of the female frontal organ (Fig. 37d) is long and slim, similar to that of the female *C. subarcuata*, pointed at the tip, with spines over most of the ventral surface and over the proximal half to third dorsally. The male frontal organ (Fig. 37a) is similar in shape to that of male *C. subarcuata* and male *C. parthenoda*, possibly with a few more spines or spinules. The female principal seta has some tiny spinules distally on the posterior surface (Fig. 37c). The male principal seta (Fig. 37a, b) is only slightly longer than the secondary

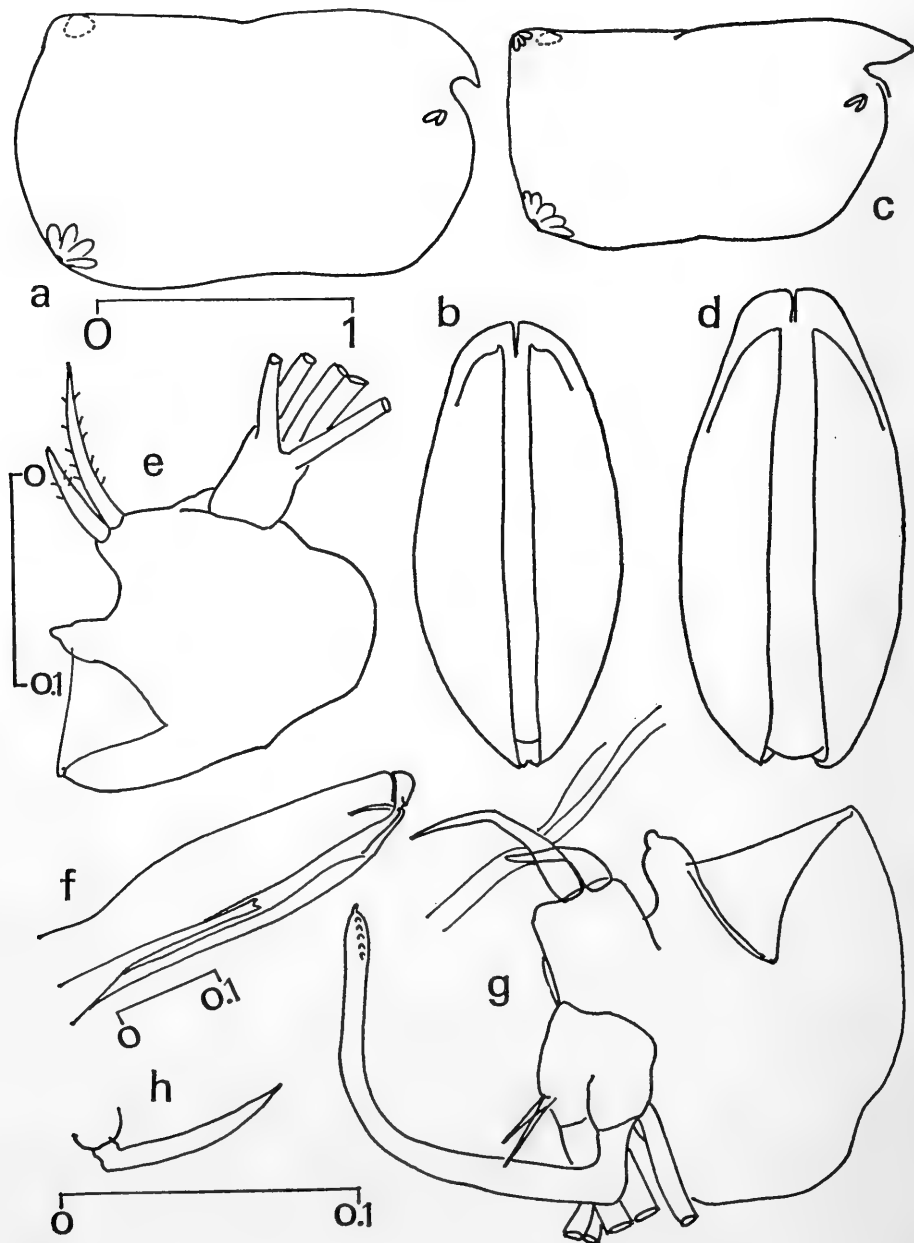


Figure 36. *Conchoecia magna* Claus. a and d, lateral and ventral views of female. b and c, ventral and lateral views of male. e, endopodite of female second antenna (setae and filaments cut off). f, penis. g, endopodite of male right second antenna (setae and filaments cut off). h, male left clasper organ. Scale at upper left for a-d; in left margin for e; below f for f; at bottom left for g and h. Scales in mm.

setae; its armature is difficult to distinguish and is of the type described above for the male *C. parthenoda*, in that the distal teeth are thickly set and paired, then the teeth alternate and end in a single row. Specimens from Station "S"

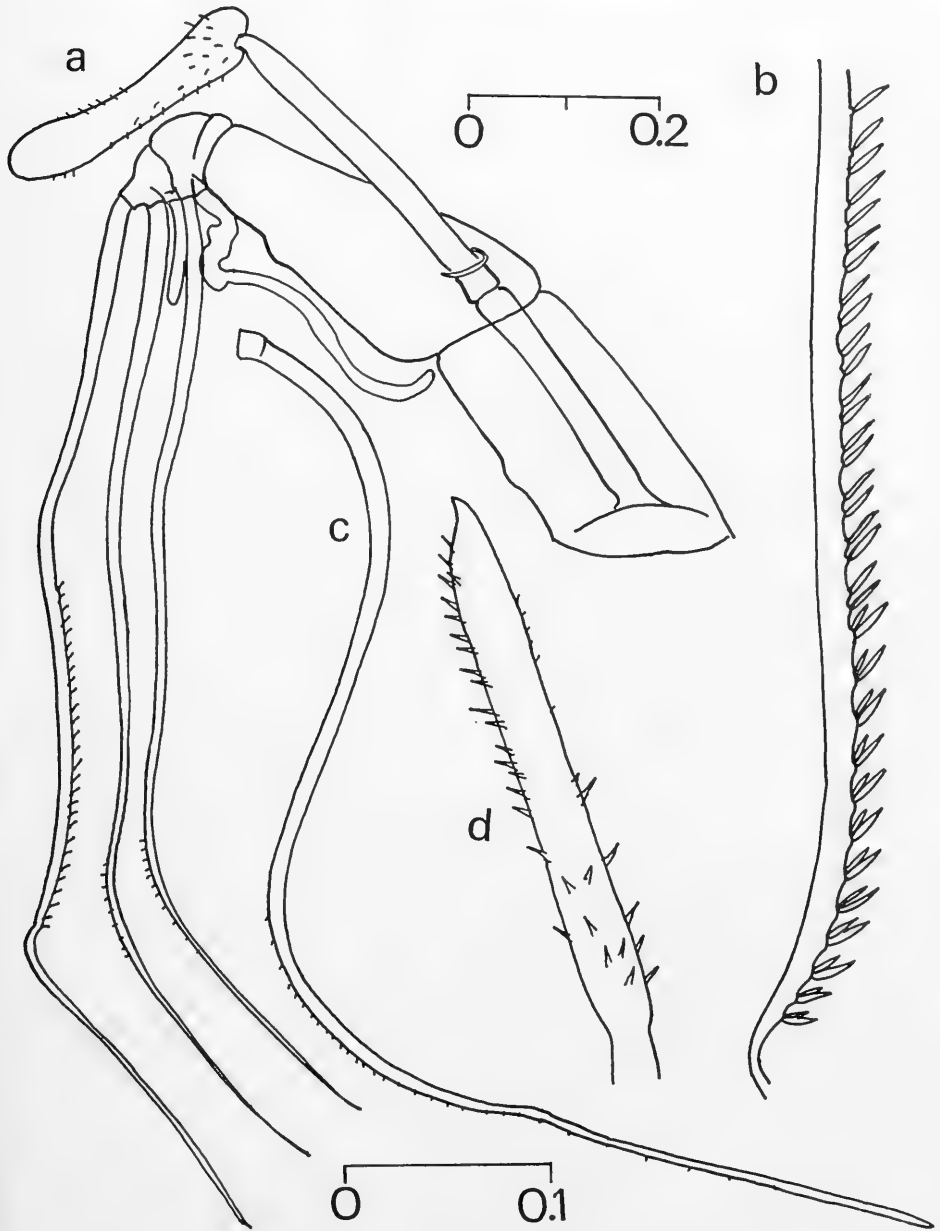


Figure 37. *Conchoecia magna* Claus. a, male frontal organ and first antenna. b, armature of male principal seta. c, female principal seta. d, capitulum of female frontal organ. Scale at top for a, at bottom for b-d. Scales in mm.

had in profile 33-38 teeth, making totals of usually 45-48 single teeth, so arranged, with 12 pairs distally and around 20 alternating teeth becoming a single row proximally. The right clasp organ of the male (Fig. 36g) is right-angled, as in the *C. parthenoda* male, not obliquely angled as in *C. subarcuata*, but the distal portion is longer and slimmer than in *C. parthenoda*.

LENGTH. Both sexes: 1.6-1.8 mm, according to Claus (1890, 1891); 1.66-1.8 mm, according to Müller (1894). At Station "S", females were 1.7-1.9 mm long, males 1.6-1.75 mm long.

COLLECTION DATA. *C. magna* was a common species at Station "S" and occurred throughout the year in the upper 500 m. It was also taken in the deeper hauls. In the samples collected at 100 m depth intervals (see Fig. 65j), *C. magna* was most numerous below 100 m and was found in highest numbers between 100 and 300 m (Table 3). The highest number, 565/1000 m<sup>3</sup>, was recorded for the 100-200 m sample of February 1960. It was in general more numerous in the February 1960 samples than in those collected in June and October 1959. The simultaneous tows with No. 2 and No. 8 nets in August 1959 gave figures of 90-95 *C. magna*/1000 m<sup>3</sup> for the upper 500 m (Table 4). The extreme possible temperature range was 3.8-28.1°C.

DISTRIBUTION. 52°N-55°S in the Atlantic; Indian and Pacific Oceans and Mediterranean.

*Conchoecia spinirostris* Claus  
(Figures 38, 39)

*Conchoecia spinirostris* Claus, 1874a, p. 6, Pl. I, Figs. 1, 6a, Pl. II, Figs. 11, 14, 15.  
*Conchoecia pellucida*, Sars, 1887, p. 252, Pl. XI, Figs. 1-4, Pl. XII, Pl. XIII, Figs. 1-4.

*Conchoecia spinirostris* Claus, 1890, p. 7; 1891, p. 56, Pl. I, Figs. 1-12.

*Conchoecia spinirostris*, Müller, 1894, p. 227, Pl. VI, Figs. 1-9, 13.

*Conchoecia spinirostris*, Skogsberg, 1920, p. 697, Fig. CXXXIV.

For further synonymy, see Skogsberg.

DESCRIPTION. The male shell is of the shape typical of this group (Fig. 38c). The female shell tapers anteriorly and resembles the *C. parthenoda* and *C. porrecta* female shells in shape (Fig. 38a). In ventral view the male rostrum is broad (Fig. 38d), whereas the female rostrum rounds to a point (Fig. 38b). In both sexes the height of the shell is approximately half the length. In the material from Station "S", female *C. spinirostris* may be distinguished from female *C. porrecta* by its smaller size; from females of *C. parthenoda* by its smaller size and by the fact that the left asymmetrical gland is in the usual place; from female *C. procera* by the lack of a tiny spine on the right shell and by the fact that the right asymmetrical gland is at the postero-ventral corner and not moved slightly forward on the ventral margin, as in *C. procera*, or slightly dorsal on the posterior margin, as in *C. elegans*. At Station "S", females of the last two species may be of the same size and are similar in shape. The male *C. spinirostris* is distinguished from other males of this group by its smaller size.

The female frontal organ is bare of spinules, little differentiated, and pointed at the tip (Fig. 38i), similar to that of the *C. parthenoda* female. The second segment of the first antenna lacks the dorsal seta, which is present in other members of the group, except *C. porrecta*. The principal seta has fine spinules along the anterior side in its proximal third and on the posterior side distally (Fig. 38e). The capitulum of the male frontal organ is rounded at the tip, with some fine spinules dorsally and ventrally (Fig. 39c). The armature of the princi-



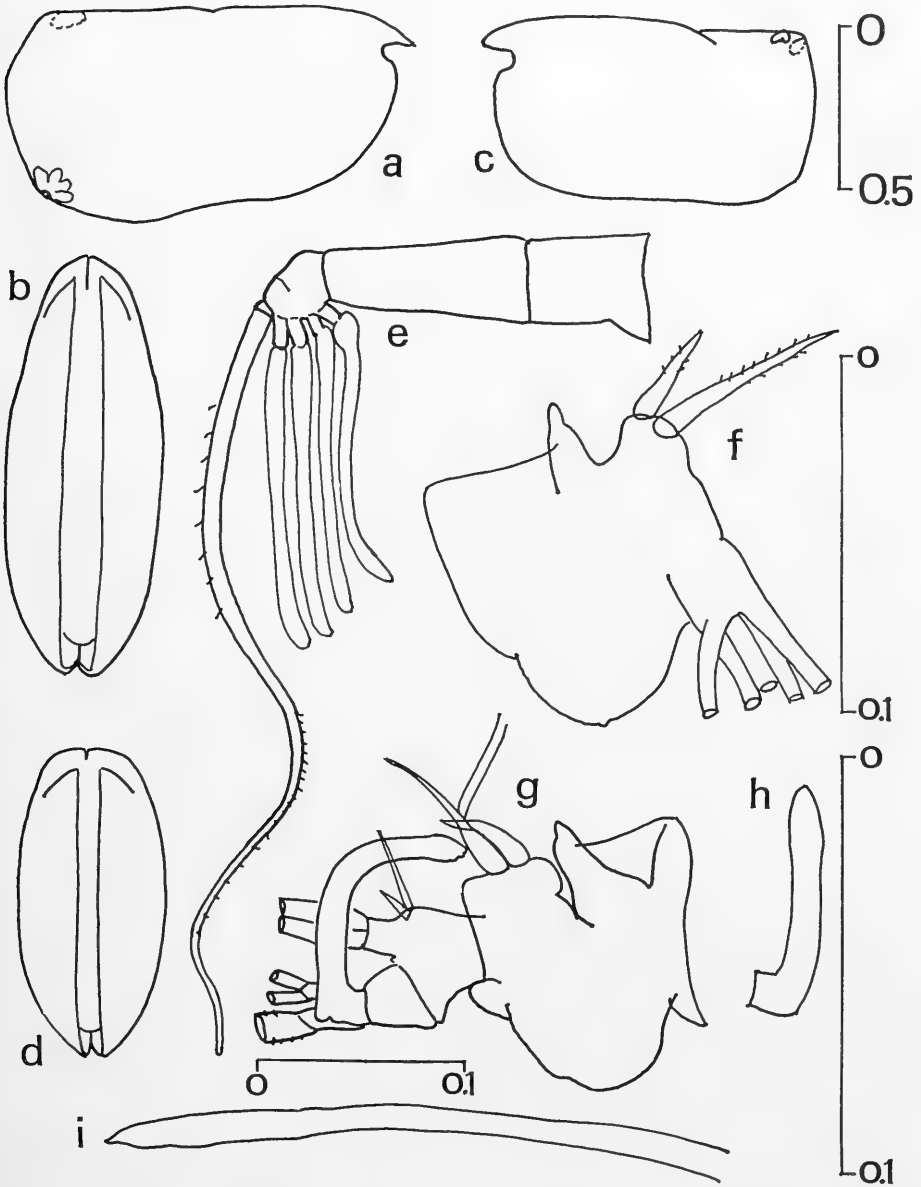


Figure 38. *Conchoecia spirostris* Claus. a and b, lateral and ventral views of female. c and d, lateral and ventral views of male. e, female first antenna. f, endopodite of female second antenna (setae and filaments cut off). g, endopodite of male right second antenna (setae and filaments cut off). h, male left clasper. i, female frontal organ. Scale at top right for a-d; center right for f; bottom right for h; bottom center for e, g, i. Scales in mm.

pal seta is of the same type as in male *C. parthenoda*, *C. magna*, and *C. porrecta*; distally there are eight or more pairs of teeth, and the teeth then alternate to form a single row proximally (Fig. 39b). According to Skogsberg, 20-25 spines may be counted in profile, of which the distal 8-10 are paired, making a total of 30-40 single teeth. The males from Station "S" had eight paired teeth and around 14

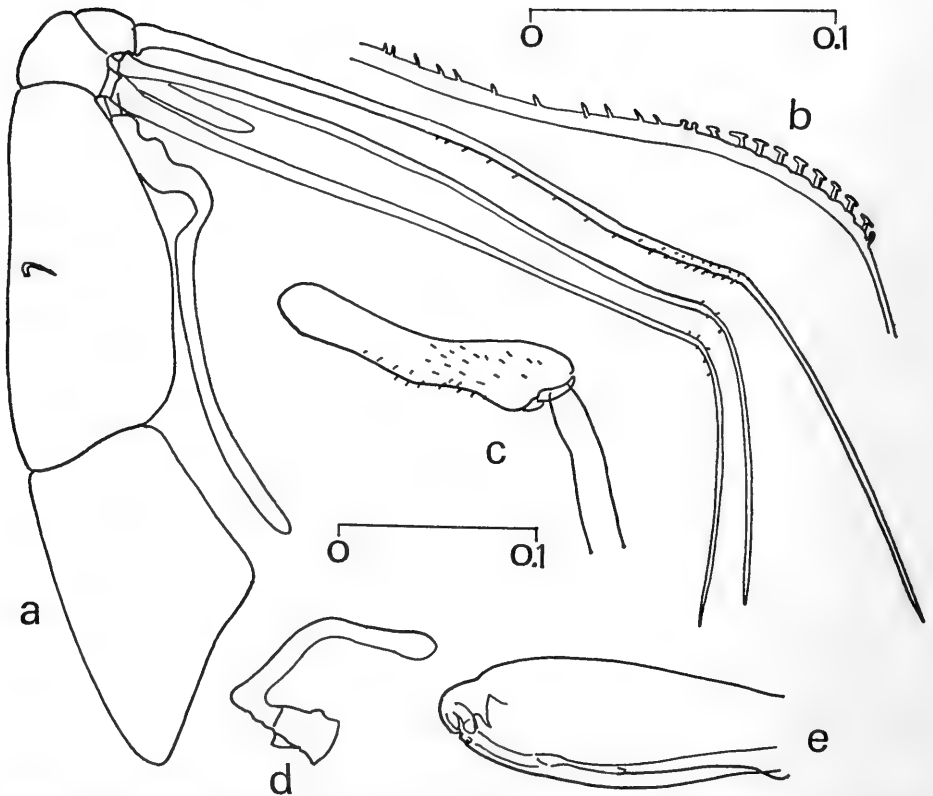


Figure 39. *Conchoecia spinirostris* Claus. a, male first antenna. b, armature of male principal seta. c, capitulum of male frontal organ. d, right clasp organ of another male, more obliquely angled than that shown in 38g. e, penis. Scale at top right for b, at lower center for a, c, d, e. Scales in mm.

single ones. The male right clasp organ is right-angled (Fig. 38g) or more obliquely angled (Fig. 39d) in different specimens. The longer bristle of the basal segment of the endopodite of the male second antenna may have a couple of long hairs, as in other members of the Magna group (Fig. 38g). Both bristles of the first joint of the female endopodite have spinules (Fig. 38f).

**LENGTH.** Claus (1890) gave the length as 1.1-1.25 mm. Skogsberg's (1920) males were 0.9-1.05 mm long, his female specimens 1.1-1.15 mm long. At Station "S", females were 0.95-1.22 mm long, males 0.9-1.12 mm long.

**COLLECTION DATA.** *C. spinirostris* was one of the commonest, and in all probability the most abundant, species at Station "S", males and females occurring throughout the year in the upper 500 m. Both Skogsberg and Granata and di Caporiacco (1949) noted that males were found in greater numbers than females, but this was not the case at Station "S". In the samples taken at different depths, *C. spinirostris* was the most abundant species in the upper 200 m, but it also occurred in all the deeper hauls. The total numbers of *C. spinirostris* recorded from the 100 m depth series are listed in Table 3. Highest numbers of 4000/1000 m<sup>3</sup> were obtained in February 1960 for the 100-200 m sample. In June 1959, slightly higher numbers, 1690/1000 m<sup>3</sup>, were present in the upper 100 m, than at

deeper levels. This species was also most numerous, 1340/1000 m<sup>3</sup>, in the 0-100 m sample of October 1959. *C. spinirostris* was also the most abundant species in the 500-0 m simultaneous tows with No. 2 and No. 8 nets (see Table 4). The No. 8 net caught 800/1000 m<sup>3</sup>, the No. 2 net 727/1000 m<sup>3</sup>. Figure 65a shows how high a percentage *C. spinirostris* made up of the total numbers of ostracods in the upper 500 m. The extreme possible temperature range of the depths sampled was 3.8-28.1°C. Skogsberg's specimens were taken in surface tows over a temperature range of 18.5-26.8°C.

DISTRIBUTION. Müller's (1906a) records are not valid, since he included the larger *C. porrecta* with *C. spinirostris*. Following Skogsberg (1920), the distribution of this species as definitely known is in the Atlantic from 45°N to 24°S, the Pacific at 33°N, and the Mediterranean.

*Conchoecia porrecta* Claus  
(Figures 40, 41)

*Conchoecia porrecta* Claus, 1890, p. 12; 1891, p. 61, Pl. VII, Figs. 1-13.

DESCRIPTION. The shell is relatively transparent, more than twice as long as high; the asymmetrical glands are in the usual place, and no gland cells have been noted beneath the rostral incisure. The male shell (Fig. 40a) is of the shape typical of the Magna group. The female shell (Fig. 41a) is very similar in size and shape to the female *C. parthenoda*, but the left asymmetrical gland is in its usual location and does not form a bump on the dorsal margin. In the material from Station "S", the male shell was intermediate in size between the somewhat smaller male *C. spinirostris* and the slightly larger male *C. parthenoda*, both of which are of the same shape.

The female frontal organ is undifferentiated and slim (Fig. 41c, d), sometimes with a very sharp point, as in female *C. spinirostris* and *C. parthenoda*. The female principal seta (Fig. 41d) has fine spinules down its anterior surface for most of its length and down the posterior surface distally beyond the sensory filaments. As in female *C. spinirostris*, there is no dorsal bristle on the second segment of the first antenna. The capitulum of the male frontal organ is rounded at the tip, and has some spinules on the proximal third to half or so of its length. The principal seta of the males examined (Fig. 40d, e) had 13-16 pairs of closely set spines distally, several pairs then alternated, ending proximally in a single row of more sparsely set teeth. In profile 40-43 teeth were counted, of which the distal 13-16 were paired. The secondary setae were bare, except for several spinules distally.

The larger bristle of the basal segment of the endopodite of the male second antenna (Fig. 40g) has two to four long hairs. The female bristle (Fig. 41e) is covered with spinules. The processus mammillaris is relatively small, slender and pointed. The male right clasping organ is somewhat obliquely angled (Fig. 40g). *C. porrecta* differs from *C. spinirostris* primarily in size and in the armature of the principal seta. It should be noted that Müller's (1906a, Pl. XXII, Fig. 25) figure of the armature of the principal seta of *C. spinirostris* in fact depicts that of *C. porrecta*.

As noted above, Müller (1906a, 1912) synonymized *C. porrecta* with *C.*

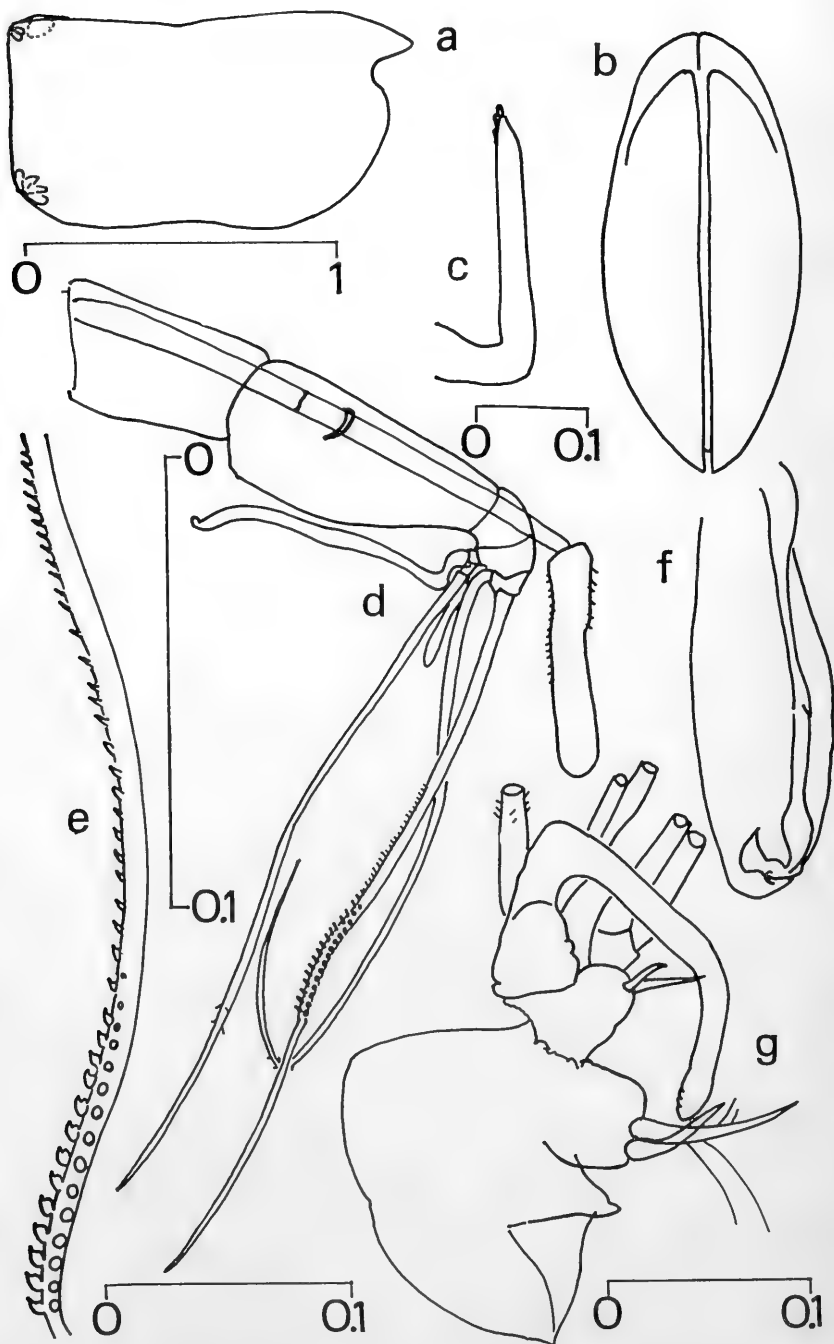


Figure 40. Male *Conchoecia porrecta* Claus. a and b, lateral and ventral views of male. c, left clasp organ. d, frontal organ and first antenna. e, armature of principal seta. f, penis. g, endopodite of male right second antenna (setae and filaments cut off). Scale at top left for a and b; at left center for c and e; at lower left for g; at lower right for f; at upper center for d. Scales in mm.

*spinirostris*. Skogsberg (1920, p. 704) believed they were different species, since he had two male specimens, 1.3-1.4 mm long, which were similar to Claus's description, and also because Müller found the larger forms only from 24°N-2°N in the Atlantic, whereas the smaller forms had a wider range.

LENGTH. The females collected at Station "S" were 1.5-1.6 mm long, the males 1.25-1.35 mm long.

COLLECTION DATA. *C. porrecta* was found only rarely in the upper 500 m at

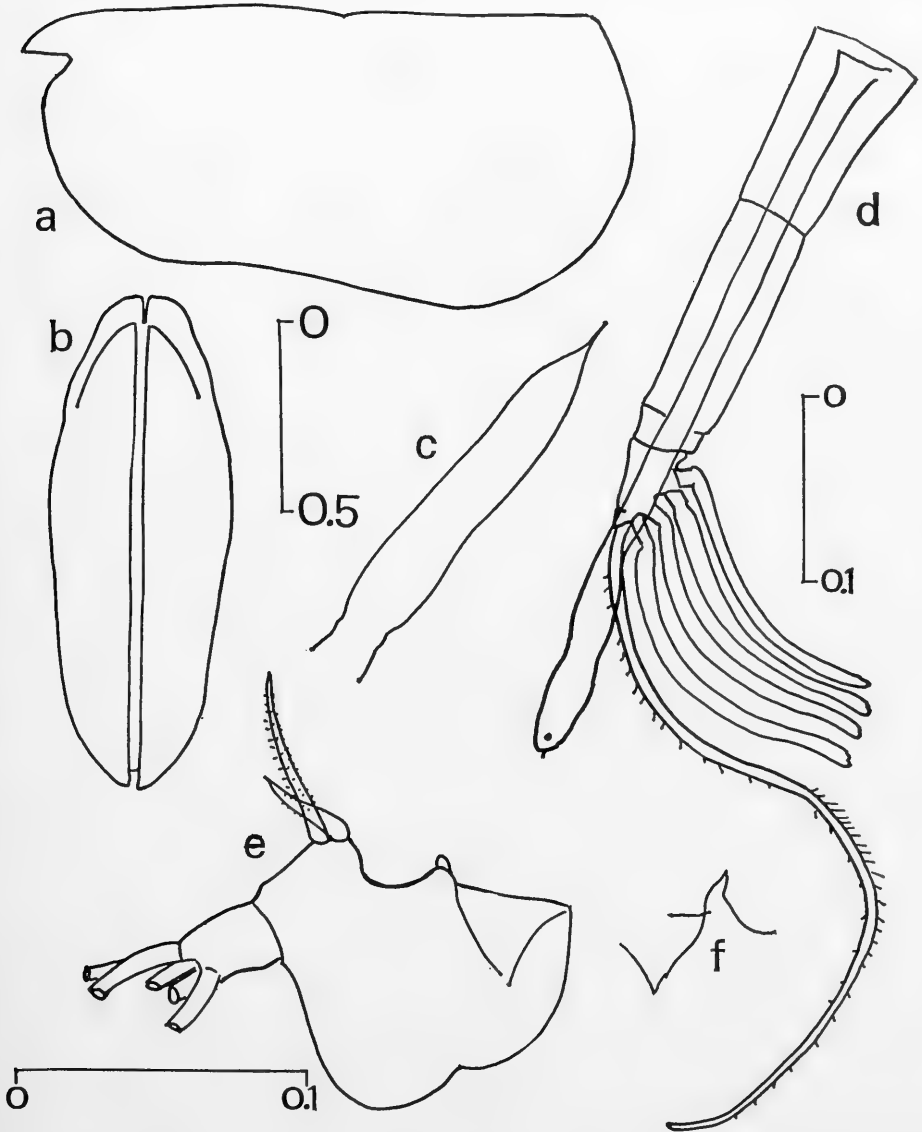


Figure 41. Female *Conchoecia porrecta* Claus. a and b, lateral and ventral views of female. c, capitulum of a female frontal organ, more pointed than that shown in d. d, frontal organ and first antenna. e, endopodite of second antenna. f, processus mammillaris of another female endopodite. Scale at upper left for a and b; at right for c and d; at bottom left for e and f. Scales in mm.

Station "S". Only six males and ten females were taken, in March, April, June, August, September, November and December. None were found in the deeper hauls. The extreme possible temperature range was 16.8-27.9°C. Skogsberg's specimens were found at a temperature of 22.5°C.

DISTRIBUTION. 41°N-2°N in the Atlantic.

*Conchoecia subarcuata* Claus

(Figures 42, 43)

*Conchoecia subarcuata* Claus, 1890, p. 9; 1891, p. 58, Pl. III, Figs. 3-9, Pl. IV.

*Conchoecia striata* Claus, 1890, p. 12; 1891, p. 62, Pl. VIII, Figs. 1-6.

*Conchoecia subarcuata*, Müller, 1906a, p. 102, Pl. XXI, Figs. 10-16, 19; 1912, p. 83.

*Conchoecia subarcuata*, Skogsberg, 1920, p. 695.

For further synonymy, see Skogsberg.

DESCRIPTION. The male shell is of the shape typical of the Magna group (Fig. 42b). The posterior margin of the female shell is rounded to the ventral margin and the ventral margin is characteristically concave (Fig. 42a). This shape distinguishes the female from female *C. magna*. The asymmetrical glands are in the usual location and gland cells beneath the rostral incisure are usually visible. For both sexes the height is approximately half the length.

The capitulum of the female frontal organ (Fig. 43a) is long, slim, and pointed, barely if at all thicker than the stem, and furnished with some sparse spines; that of the male (Fig. 43c, e) is rounded at the tip with more spinules ventrally than dorsally. The male principal seta (Fig. 43c, d) has 20-23 pairs of long slim spines directed proximally; the female's has some tiny spinules on the distal half of its length.

On the endopodite of the female second antenna, both bristles of the basal segment have some spines and curve evenly (Fig. 43b); in the male, the larger bristle has two to four long hairs and no spines (Fig. 42e). The male right clasping organ (Fig. 42e) is obliquely-angled and noticeably larger than the left clasping organ (Fig. 42f). The shape of the female shell and the armature of the male principal seta and the shape of the right clasping organ aid in distinguishing this species.

LENGTH. 1.8-2.1 mm (Claus). Females 2.0-2.2 mm, males 1.8-2.0 mm (Müller). In the material from Station "S", females were 1.85-2.2 mm long, males 1.75-1.95 mm long.

COLLECTION DATA. Although *C. subarcuata* never occurred in any numbers, occasional specimens of males and females were found every month of the year in the upper 500 m at Station "S". One female and one male were taken in the 1250-2000 m haul of February 1960. The extreme possible temperature range is therefore 3.8-28.1°C. Skogsberg's specimens were taken at temperatures of 18.5-20.1°C.

DISTRIBUTION. 37°N-56°S in the Atlantic; Indian and Pacific Oceans.

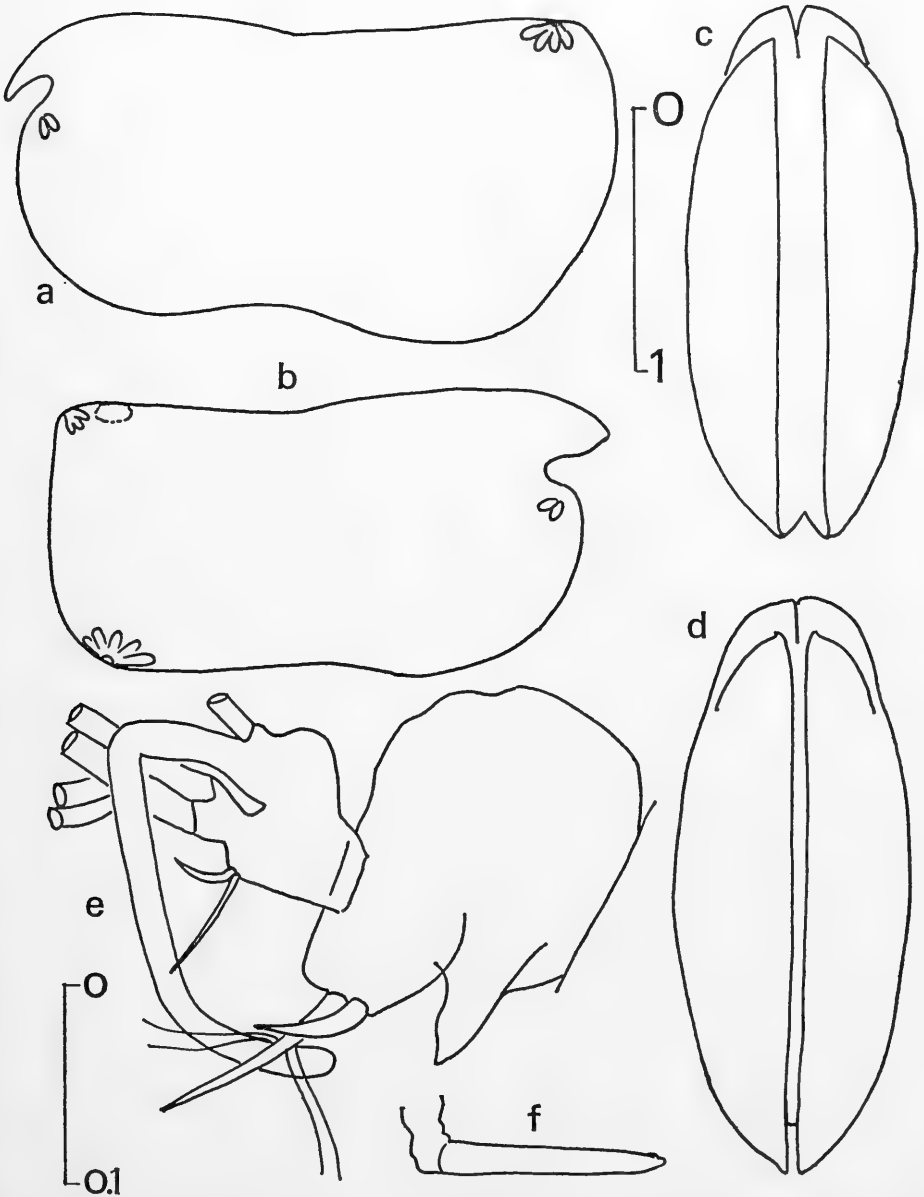


Figure 42. *Conchoecia subarcuata* Claus. a and c, lateral and ventral views of female. b and d, lateral and ventral views of male. e, endopodite of male right second antenna (setae and filaments cut off). f, male left clasp organ. Scale at upper right for a-d, at bottom left for e, f. Scales in mm.

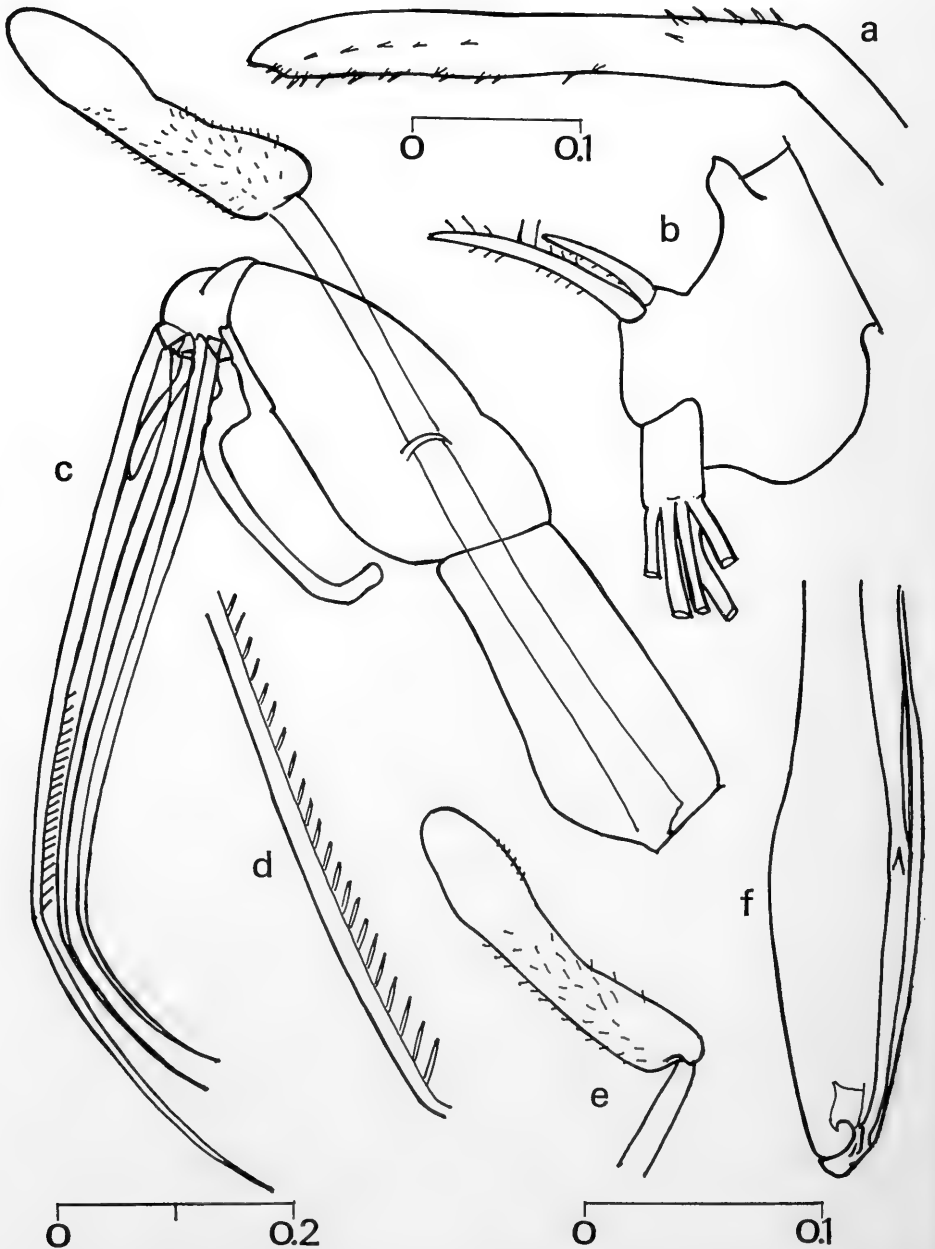


Figure 43. *Conchoecia subarcuata* Claus. a, capitulum of female frontal organ. b, endopodite of female second antenna (setae and filaments cut off). c, male frontal organ and first antenna. d, armature of male principal seta. e, capitulum of frontal organ of another male. f, penis. Scale at top center for a; at bottom left for c, e, f; at bottom right for b and d. Scales in mm.



*Conchoecia lophura* Müller

(Figure 44)

*Conchoecia lophura* Müller, 1906a, p. 99, Pl. XX, Figs. 1-10; 1912, p. 82.

*Conchoecia lophura*, Skogsberg, 1920, p. 689, Fig. CXXXI; 1931, p. 12.

DESCRIPTION. The shells of males and females (Fig. 44a) are fairly similar, the height approximately half the length, not tapered anteriorly. The asymmetrical glands are in the usual place and lateral corner glands are present opening on the shell margin, the right one dorsal to the asymmetrical gland. There are also gland cells beneath the rostral incisure. This species is differ-

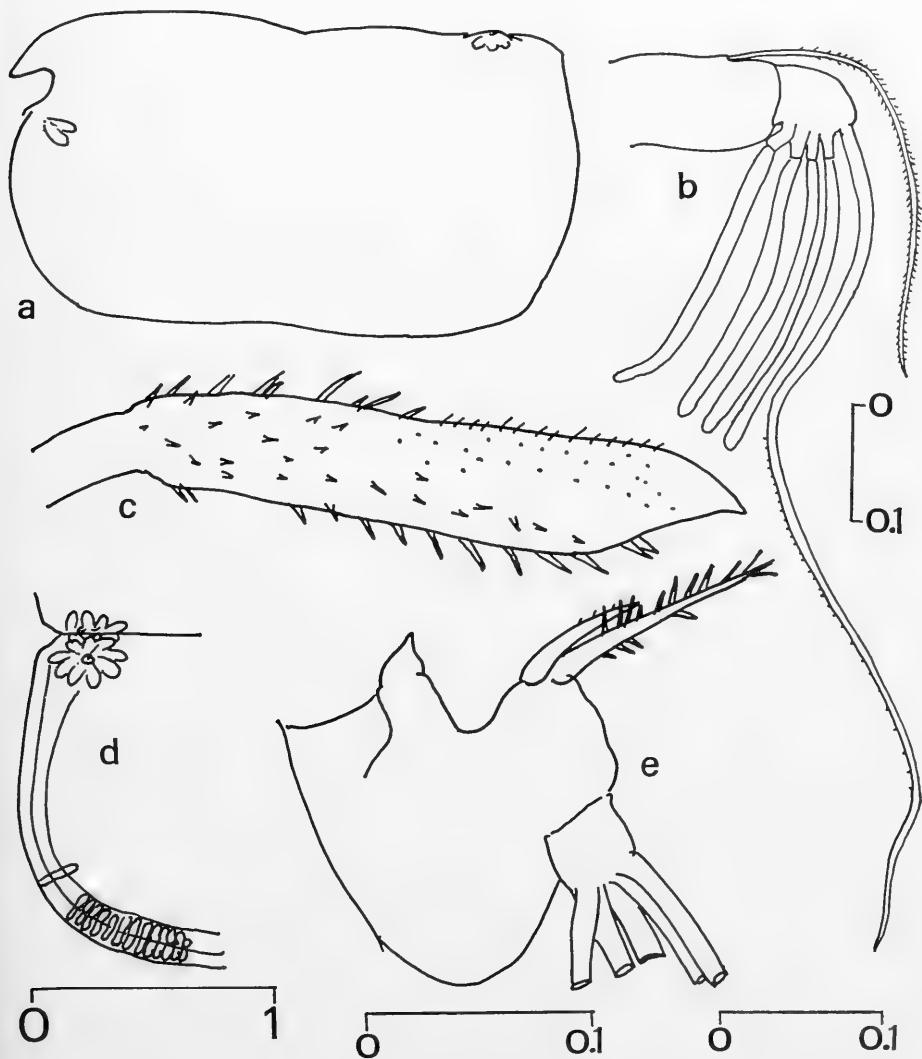


Figure 44. Female *Conchoecia lophura* Müller. a, lateral view. b, first antenna. c, capitulum of frontal organ. d, posterior margin of left shell, from inside. e, endopodite of second antenna (setae and filaments cut off). Scale at lower left for a, d; at bottom center for e; at bottom right for c; at right center for b. Scales in mm.

entiated from other members of this group by the presence of a large group of gland cells on the ventral margin at the postero-ventral corner of the left shell (Fig. 44d).

The capitulum of the female frontal organ is pointed and largely covered with spines and spinules of varying size (Fig. 44c); that of the male is rounded at the tip, with some spinules dorsally at the proximal end which increase in number ventrally to cover most of that surface. The female principal seta (Fig. 44b) is armed with tiny spinules ventrally over the distal two-thirds of its length. According to Skogsberg (1920), the male principal seta has 65-67 pairs of spines or teeth and proximal to these on the anterior or dorsal surface is a sparse row of short bristles. On the endopodite of the female second antenna, the processus mammillaris is pointed (Fig. 44e) and the larger bristle of the basal segment has some rather powerful spines. In the male this bristle has, proximal to these spines, a group of long hairs.

LENGTH. 2.2-2.8 mm (Müller). Females from Station "S" were 2.4-2.5 mm long.

COLLECTION DATA. Only three female specimens were taken at Station "S" in 0-500 m hauls collected in August 1959 and May and September 1961. The extreme possible temperature range was 16.6-27.3°C.

DISTRIBUTION. 46°N-48°S in the Atlantic; Indian and Pacific Oceans.

*Conchoecia macrocheira* Müller  
(Stage III larva, Figure 45)

*Conchoecia macrocheira* Müller, 1906a, p. 101, Pl. XXI, Figs. 1-9; 1912, p. 83.

*Conchoecia zetesios*, Fowler, 1909, p. 254, Pl. 25, Figs. 247-253.

*Conchoecia macrocheira*, Skogsberg, 1931, p. 12, Fig. III.

For full description, see Müller and Skogsberg.

SPECIMEN DESCRIPTION. A 1.15 mm larva of distinctive shape, collected in the 0-500 m sample of Jan. 19, 1962, apparently belongs to this species. Fowler (1909, Fig. 252) described and named a larva similar in shape, 1.5 mm long, together with later stage larvae around 2.4 mm long, as *C. zetesios*. Skogsberg had in his material specimens of Fowler's stage V *C. zetesios* together with mature *C. macrocheira* and concluded that Fowler's specimens were larval stages of *C. macrocheira*. The single Stage III larva from Station "S" is illustrated in Figure 45. The shell was transparent and there was little sculpturing, other than fine striations paralleling the margins. The height of the anterior end of the shell was noticeably greater than that of the posterior end, due to the development of the cephalic region (Fig. 45a-c, g); the rostrum was bent sharply downwards, the right rostrum slightly longer than the left (Fig. 45c, g) and the anterior margin was also swollen. All the corners of the shell were rounded and the asymmetrical glands were as usual (Fig. 45a, d). On both sides beneath the rostral incisure there was a group of several gland cells, as in some other members of the Magna group. The stage of development of the frontal organ, first antenna and the endopodite of the second antenna is shown in Figure 45e and h. The furca (Fig. 45f) had five claws and an unpaired seta.

Mature females are fairly similar in shape to *C. lophura*, but the anterior

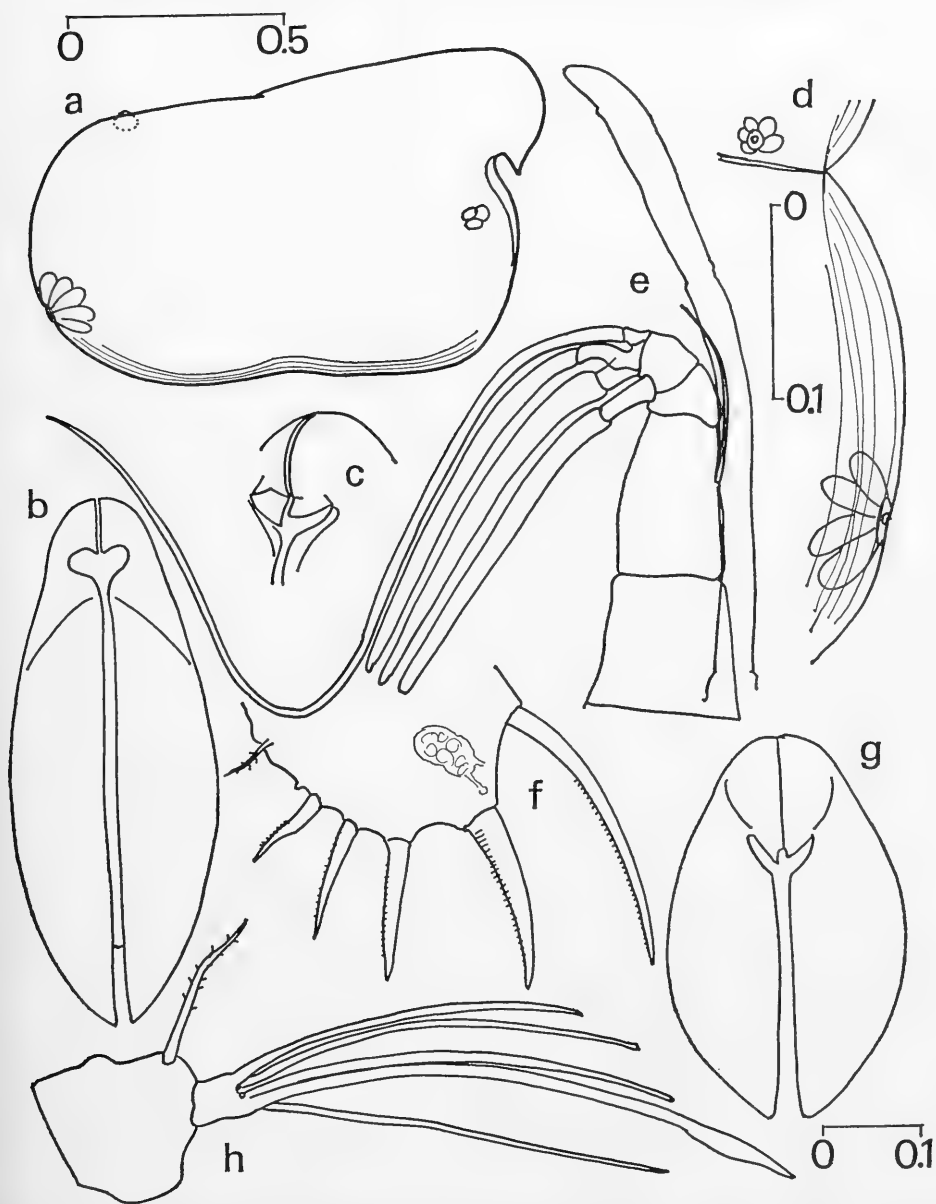


Figure 45. *Conchoecia macrocheira* Müller, Stage III larva. a and b, lateral and ventral views of larva. c, oblique view of rostrum. d, posterior margin of right shell, from inside. e, frontal organ and first antenna. f, furca. g, anterior view of larva. h, endopodite of second antenna. Scale at upper left for a, b, c, g; at upper right for e, f, and h; at bottom right for d. Scales in mm.

margin beneath the rostral incisure is more strongly swollen and the rostrum is bent more sharply downwards. Length of females, 3.2-3.8 mm, of males 2.8-3.3 mm.

Aside from the stage III larva described, only one other specimen, an earlier larva, 0.77 mm long, was obtained in the 0-1500 m sample of Jan. 14, 1958. The

temperature range in the upper 500 m when the stage III larva was collected was approximately 16-20°C.

DISTRIBUTION. 48°N-34°S in the Atlantic; Indian and Pacific Oceans.

#### LORICATA GROUP MÜLLER 1906

In this group the posterior and dorsal margins of the shell form approximately a right angle with no spines, the posterior margin is fairly straight, and the postero-ventral corner is rounded. Lateral corner glands are present, the one on the right side opening over the asymmetrical gland. The asymmetrical glands are in the usual place. Müller included *C. loricata typica* and *minor*, *C. ctenophora* and *C. serrulata* in this group. Skogsberg (1920) placed *C. serrulata* in a separate group which he believed might include *C. concentrica*. *C. loricata* and *C. concentrica* occurred at Station "S", and since the latter species has not been definitely assigned to any group, it seems most convenient in this report to consider *C. concentrica* after *C. loricata*.

#### *Conchoecia loricata loricata* (Claus)

(Figures 46, 47)

*Conchoecissa loricata*, Claus, 1894, p. 4, Pl. III, Figs. 24-30.

*Conchoecia loricata* var. *typica*, Müller, 1906a, p. 95, Pl. XXII, Figs. 1-9.

*Conchoecia loricata loricata*, Müller, 1912, p. 80.

DESCRIPTION. In the specimens from Station "S", the height of the shell is somewhat greater than half the length. Females and males were of similar shape in lateral view, the shoulder vaults smoothly rounded, the postero-ventral corners rounded, and the shell tapering anteriorly (Fig. 46a, b, d). The male rostrum is broader in ventral view (Fig. 46c, e). There is some sculpturing, especially on the anterior half of the shell, consisting of lines running back dorsally from the rostrum and running down towards the anterior and ventral margins, with some cross striations. The asymmetrical glands are in the usual place and lateral corner glands are present. Dorso-medial glands are present on the posterior margin only in the male.

The shapes of the frontal organs and clasping organs are shown in Figures 46g and 47b-d. The male principal seta is only slightly longer than the two secondary setae and has a row of 20-23 pairs of rather long blunt teeth directed proximally over the medial third of its length (Fig. 47a). Distal of this row there may be several fine spinules directed distally. The two secondary setae have a few fine spinules opposite the distal end of the armature of the principal seta. In the specimens from Station "S", the proximal sensory filament of the male first antenna curves back around the second segment of the antenna, and is longer than figured by Müller (1906a), who indicated it ended at the point where it curves around the antenna (Fig. 47a). The males from Station "S" differed in one other small detail from those described by Müller, in that Müller made no mention of the several tiny spinules distal of the armature of the principal seta. As noted by Müller, the larger bristle of the basal segment of the endopodite of the male second antenna had either one to four pairs of fine hairs proximally (Fig. 47b), or else they were lacking.

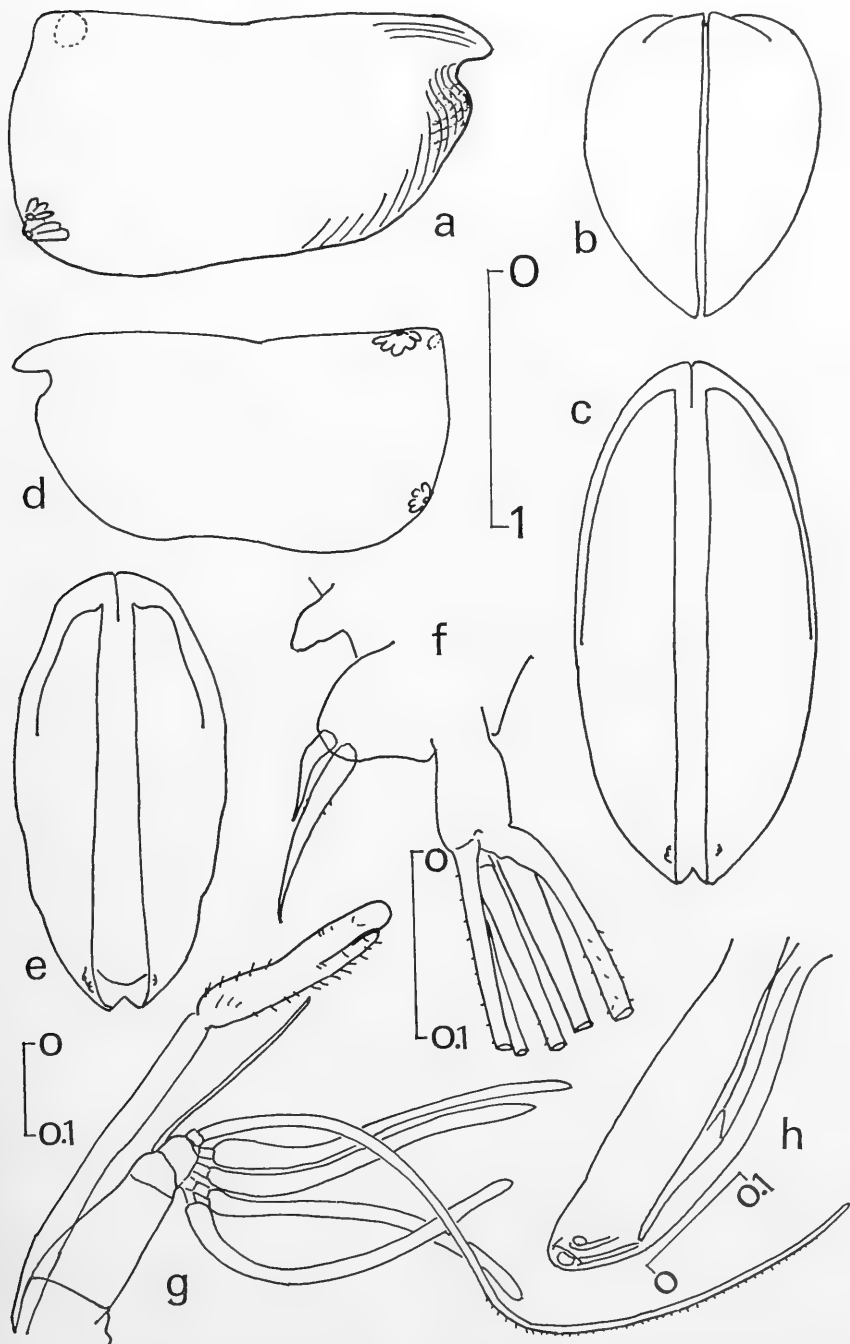


Figure 46. *Conchoecia loricata loricata* (Claus). a-c, lateral, posterior and ventral views of female. d and e, lateral and ventral views of male. f, part of endopodite of female second antenna (filaments and setae cut off), g, frontal organ and first antenna of female. h, penis. Scale at upper center for a-e; at lower left for g; lower center for f; lower right for h. Scales in mm.

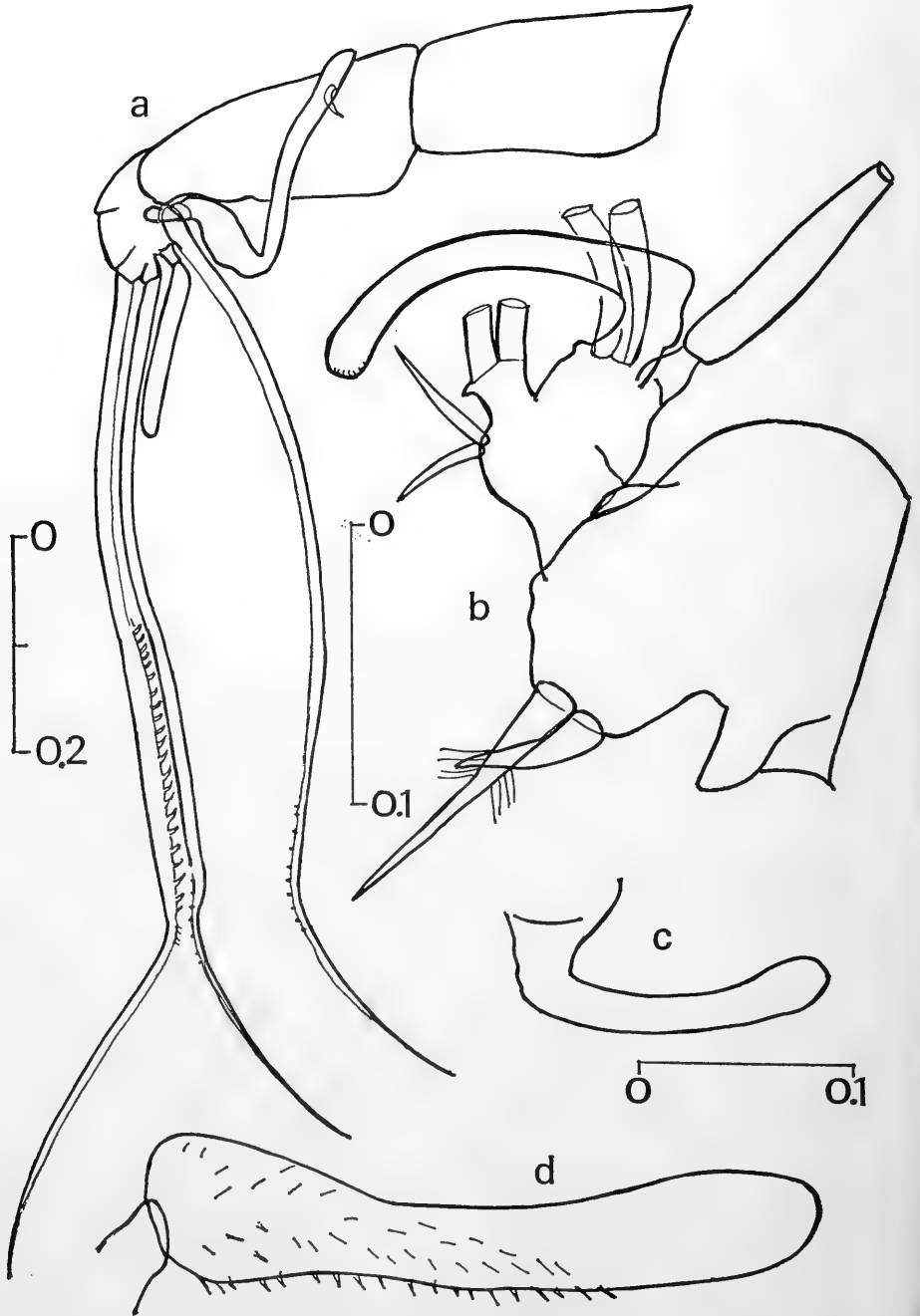


Figure 47. *Conchoecia loricata loricata* (Claus). a, male first antenna. b, endopodite of male right second antenna (setae and filaments cut off). c, male left clasp organ. d, capitulum of male frontal organ. Scale at left for a; at center for b and c; at lower right for d. Scales in mm.

LENGTH. Females 1.8-2.0 mm, males 1.7-1.9 mm (Müller). The males from Station "S" were 1.7-1.8 mm long, the females 1.8-1.85 mm in length.

COLLECTION DATA. Only seven females and seven males and a number of larvae of *C. loricata* were taken at Station "S", in January, April, and October to December 1959 and in February 1960. They were from samples collected 0-500 m and 1250-2000 m. The extreme possible temperature range was therefore 3.8-24°C, but several of the specimens were taken over a range of 15-19°C.

DISTRIBUTION. 43°N-37°S in the Atlantic; Indian Ocean and Mediterranean.

*Conchoecia concentrica* Müller

(Figures 48, 49, 50)

*Conchoecia concentrica* Müller, 1906b, p. 10, Pl. I, Figs. 1-9; 1912, p. 82.

This is a relatively small species that has not as yet been assigned definitely to any group. Müller thought it might be closest to *C. serrulata*, which he provisionally placed in the Loricata group, because of the presence and location of the lateral glands. Skogsberg (1920, p. 681) thought *C. serrulata* sufficiently different to be placed separately in the Serrulata group, and he considered it possible that *C. concentrica* might belong to this group, but he had no specimens.

DESCRIPTION. The shell usually has striking reticulations (Fig. 49i) running longitudinally dorsally, laterally around the shoulder vaults, and in side view posteriorly from the rostrum and shoulder vaults. The height of the shell is clearly greater than half the length (Fig. 49a, d, i). The postero-dorsal corners may both be produced into a tiny spine or blunt process, usually longer on the left shell, or there may be a tiny spine only on the left shell. According to Müller, there was a point on the right shell only. Immature specimens (Fig. 49d) usually have no spines at the postero-dorsal corners. In males the shoulder vaults are powerful and may be smoothly rounded as in Figure 49h; however one male had more pointed shoulder vaults, such as are illustrated for the female in Figure 49b. In immature specimens and females the shoulder vaults are relatively sharp-edged and may have projecting blunt spines (Fig. 49b, d, e), evidently prolongations of the sculpturing, which are proportionately larger in smaller individuals or may be lacking or broken off. Especially in larval specimens, the shoulder vaults project upwards like wings, as in Figure 49d and e. The postero-ventral corner is more strongly rounded in the female shell (Fig. 49a) which also tapers anteriorly. The male shell is more rectangular in shape, although the antero-ventral corner is rounded (Fig. 49i). The asymmetrical glands are in the usual place and lateral corner glands are present, but may be obscured by the sculpturing.

Two features of the male anatomy are immediately noticeable: the right clasping organ (Fig. 48c) is exceptionally large for the size of the animal, and the penis is very broad, in lateral view as large or larger than the furca (Fig. 50d). The capitulum of the male frontal organ is bent strongly upwards distally (Fig. 48b), as in male *C. bispinosa*. The male principal seta has 44-50 pairs of long, moderately slender teeth and, as in members of the *Bispinosa* and *Mollis* groups, there is a pad or callous on the proximal secondary seta and distal of this pad a

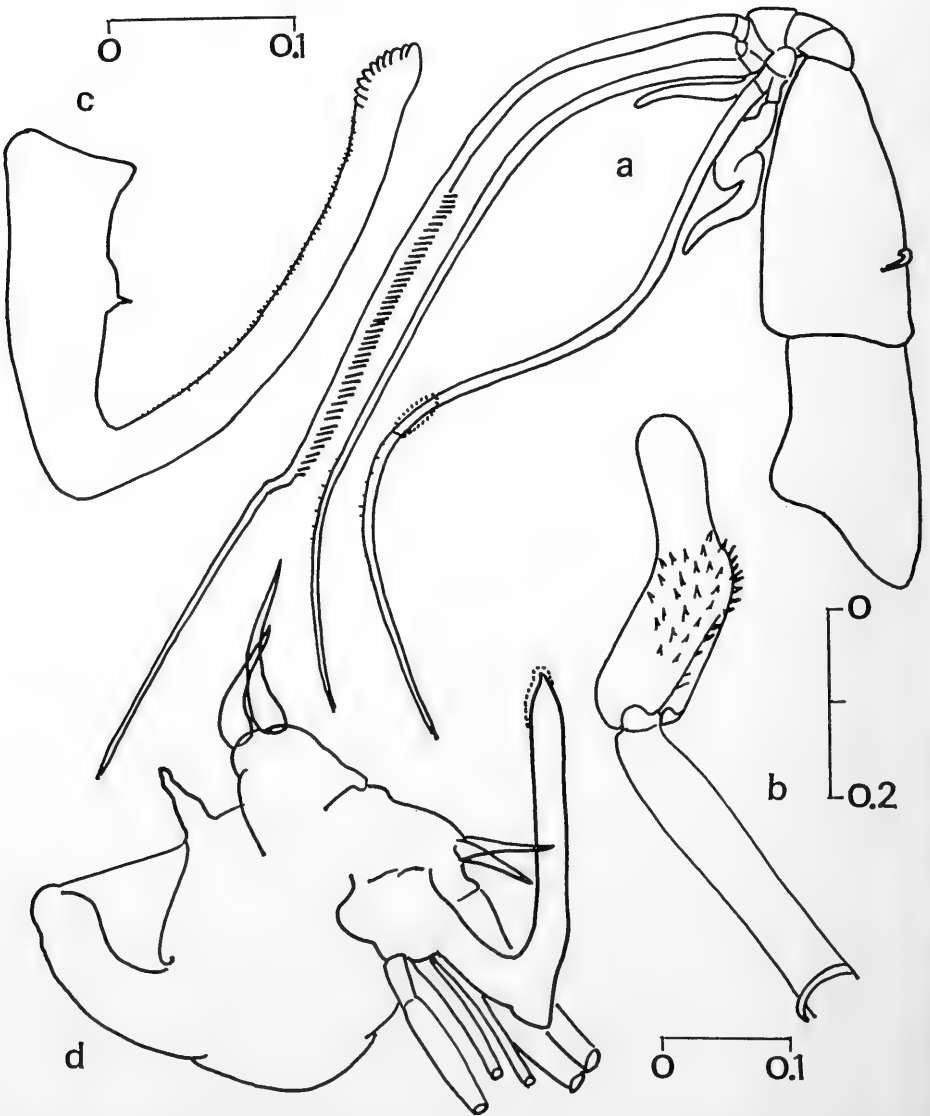


Figure 48. *Conchoecia concentrica* Müller. a, male first antenna. b, male frontal organ. c, male right clasp organ. d, endopodite of male left second antenna (setae and filaments cut off). Scale at upper left for c; at right for b and d; at bottom right for a. Scales in mm.

few tiny spinules (Fig. 48a). A few spinules are similarly located on the distal secondary seta.

The capitulum of the female frontal organ (Fig. 50a, b) is wider than the stem, bent slightly upwards, pointed at the tip, with spinules over most of the ventral surface, spreading laterally proximally. Beyond the sensory filaments, the female principal seta has tiny spinules almost to the tip on the ventral or posterior surface (Fig. 50a).

In both sexes the processus mammillaris on the basal segment of the



endopodite of the second antenna is exceptionally long and slender (Figs. 48d, 50c).

LENGTH. Females 1.6 mm, males 1.45 (Müller). Two males from Station "S" were 1.55 mm long; females were 1.55-1.8 mm long.

COLLECTION DATA. *C. concentrica* was not a common species at Station "S", but occasional specimens, mostly larval, were found in February, March, June, July,

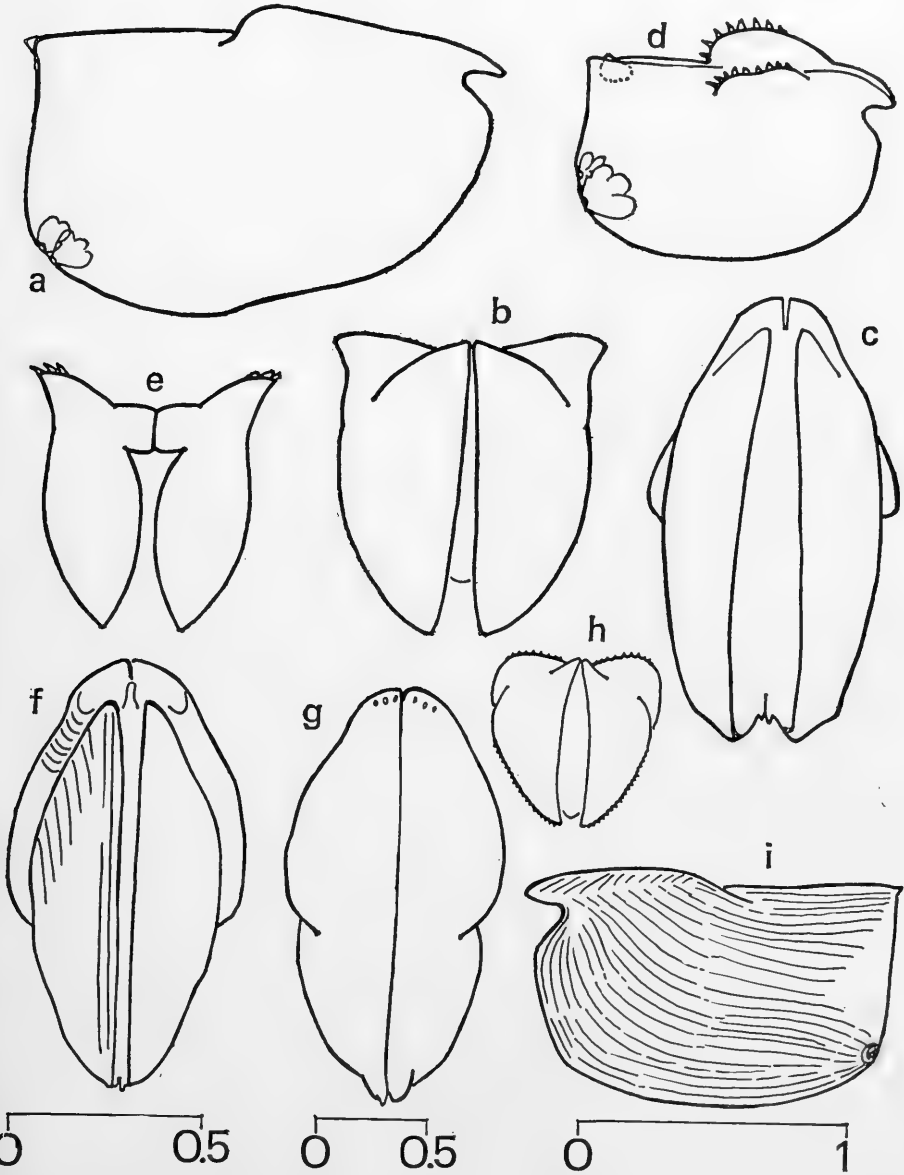


Figure 49. *Conchoecia concentrica* Müller. a, b, and c, lateral, posterior and ventral views of female. d and e, lateral and anterior views of 0.8 mm larva. f-i, ventral, dorsal, posterior and lateral views of male. Scale at bottom right for a-c, f, g, i; at bottom left for d, e; at bottom center for h. Scales in mm.

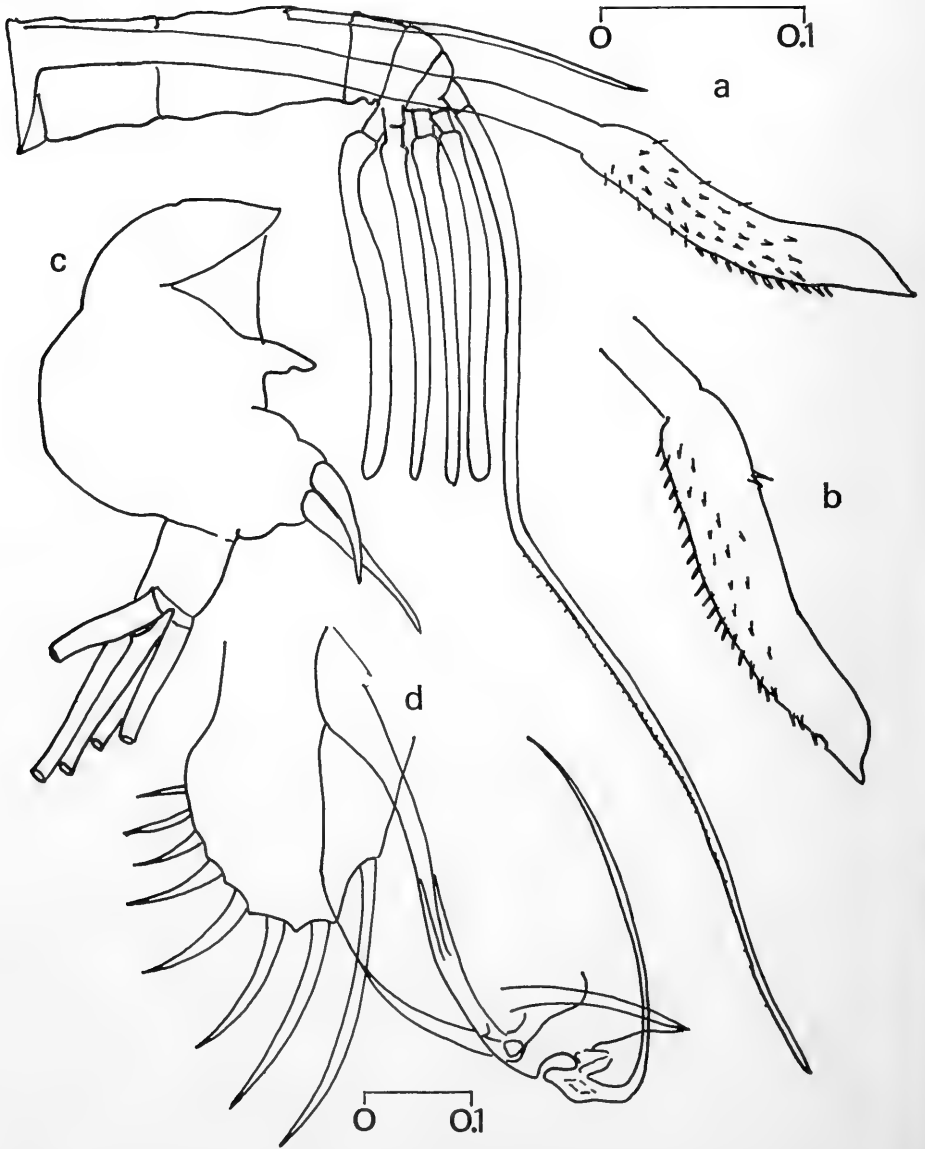


Figure 50. *Conchoecia concentrica* Müller. a, female frontal organ and first antenna. b, frontal organ of another female. c, endopodite of female second antenna (setae and filaments cut off). d, male furca and penis. Scale at top right for a-c, at bottom for d. Scales in mm.

and September to December in the upper 500 m. None were taken in the deeper hauls. The two males were taken in September and November. The extreme possible temperature range when this species occurred was 15.0-27.8°C.

**DISTRIBUTION.** Müller described this species from three females and one male taken on the "Siboga" expedition in the Banda Sea and Flores Sea. Grice and Hart (1961) recorded this species from the Gulf Stream at 38°N and the Sargasso Sea at 35°35'N. The known distribution is therefore the Malay Archipelago and 32-38°N in the Atlantic.

## MOLLIS GROUP MÜLLER 1906

In this group the postero-dorsal and ventral corners are rounded. The asymmetrical glands are in the usual place. Single lateral corner glands are present on both sides, opening on or near the shell margin. Medial dorsal glands occur in both sexes, at least in the known females, and are sometimes moved from the postero-dorsal corner. The species in this group are large, most around 3 mm long, except for *C. distans*, which is 2.15 mm in length. Also, except for *C. distans*, there is sculpturing on the shell.

The male principal seta has a double row of leaf-like structures which give the impression of pointed teeth, and distal to them there are usually some distally directed teeth; the end part of the principal seta is broadened and lance-like except in one species, *C. rhynchena*. The proximal secondary seta has a callous, as in the Bispinosa group, and distally of this some hairs or spines.

Müller included 11 species in this group. Four of these (*C. mollis*, *C. amblyoposta*, *C. kampta*, and *C. acanthophora*) are very similar, the females are difficult to distinguish, and the males are known by the armature of the proximal secondary seta. Three more species (*C. tyloda*, *C. borealis* and *C. borealis* var. *maxima* and var. *antipoda*, and *C. distans*) are less closely related. *C. dichotoma*, *C. plactolycos*, *C. rhynchena*, and *C. cellularis* were also included in this group. *C. sibogae* (Müller, 1906b) is believed closely related to *C. rhynchena*.

The females of this group are very poorly known. It has not been possible to identify positively one female, 2.65 mm long, and two similar immature males, 1.85 and 1.9 mm long and two Stage IV larvae. These specimens are described as *C. dichotoma* (?). *C. kampta*, *C. borealis*, and *C. rhynchena* also occurred at Station "S". These four members of the Mollis group were all collected in tows below 500 m.

*Conchoecia kampta* Müller  
(Figures 51, 52, 53)

*Conchoecia kampta* Müller, 1906a, p. 108, Pl. XXIV, Figs. 11, 12, 14-16; 1912, p. 86.

**DESCRIPTION.** The shell height is nearly half the length; the dorsal and ventral margins are parallel; the posterior margin is nearly straight; the postero-ventral and antero-ventral corners are rounded (Figs. 51a, 52a); and the shoulder vaults are smoothly rounded (Figs. 51c, 52b). In ventral view, the male rostrum is broad, the female's narrower (Figs. 51b, 52c). The asymmetrical glands are in the usual place and lateral corner glands are present. The surface of the shell is sculptured, especially in the anterior half, with fine lines somewhat paralleling the anterior margin.

The capitulum of the male frontal organ is long and slim, with spinules around the proximal half; that of the female is also long and slim, pointed at the tip, with spines over most of the ventral surface and over the proximal half dorsally (Fig. 51e). This species is differentiated from others of this group by a row of powerful distally directed spines on the distal secondary seta of the male first antenna (Fig. 53a); also, the proximal secondary seta has a clear callous

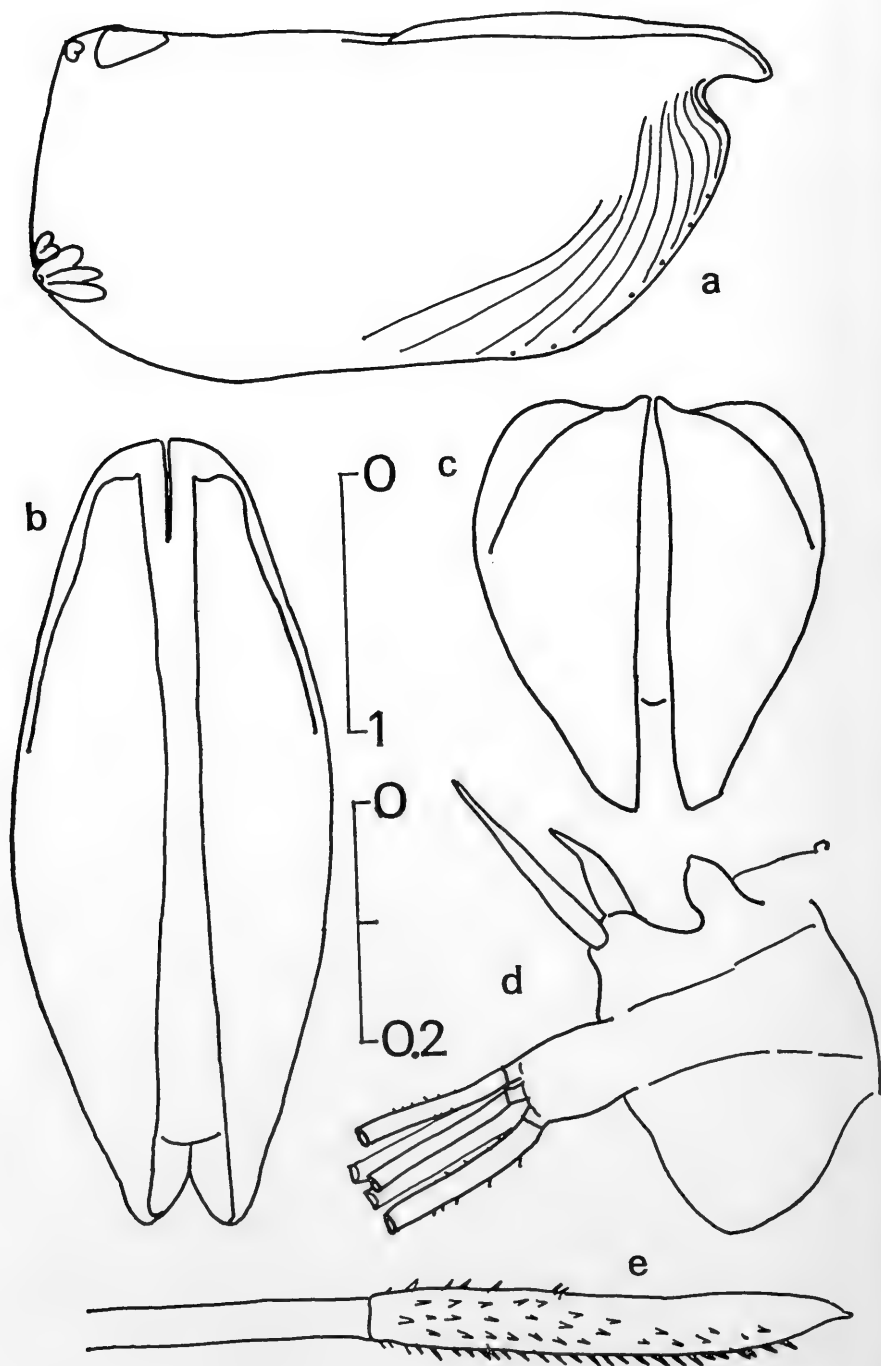


Figure 51. Female *Conchoecia kampta* Müller. a-c, lateral, ventral and posterior views of female. d, part of endopodite of second antenna (setae and filaments cut off). e, frontal organ. Scale at upper center for a-c, at lower center for d, e. Scales in mm.

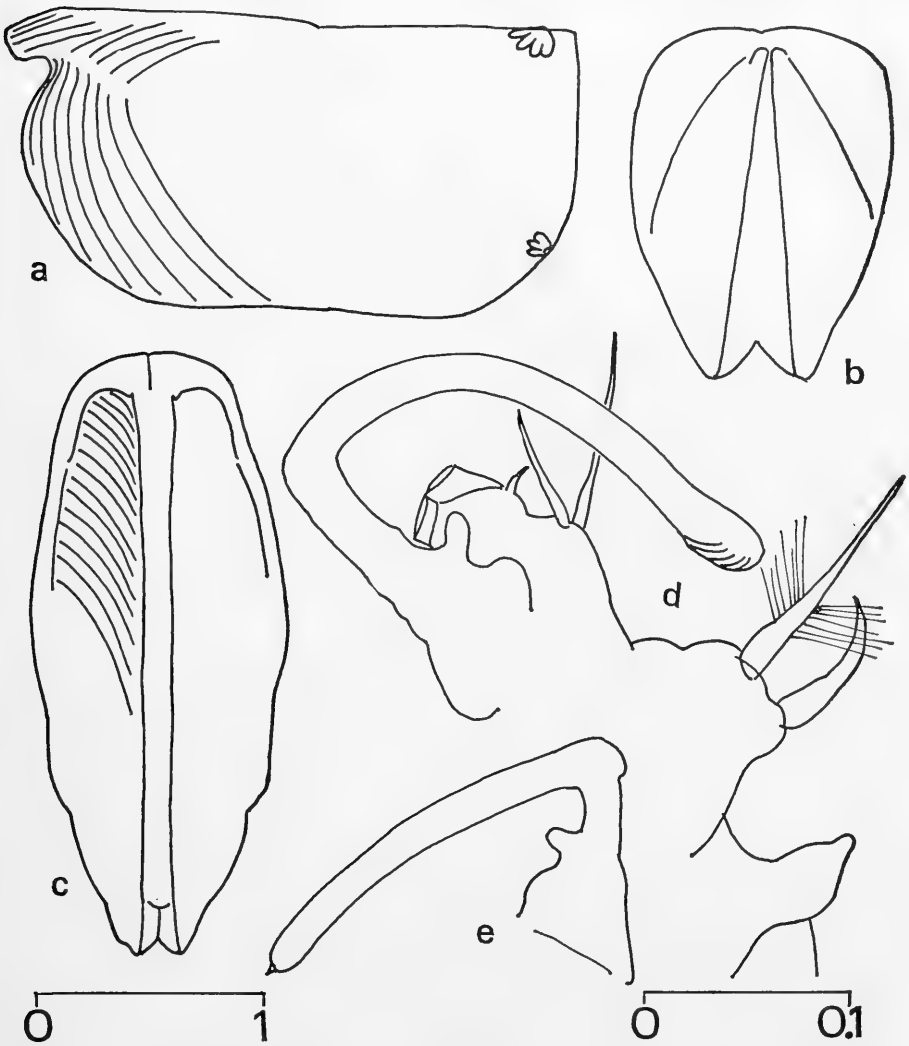


Figure 52. *Conchoecia kampta* Müller, male. a-c, lateral, posterior and ventral views of male. d, part of endopodite of right second antenna (setae cut off, filaments not shown). e, left clasper organ. Scale at bottom left for a-c, at bottom right for d and e. Scales in mm.

(Fig. 53b), different from those of the Bispinosa group, well down its length, and distally of this there are several spinules. The male principal seta has 47-50 leaf-like teeth directed proximally and decreasing in length proximally, and several pairs of distally directed spinules at the distal end of this row. The distal quarter or so of the principal seta is broadened and lance-like. The female first antenna has a plumose seta dorsally on the second segment; the principal seta has spinules ventrally down most of its length, beyond the sensory filaments.

The larger bristle of the basal segment of the endopodite of the second antenna is straight in both sexes (Figs. 51d, 52d); the female's is bare of spinules,

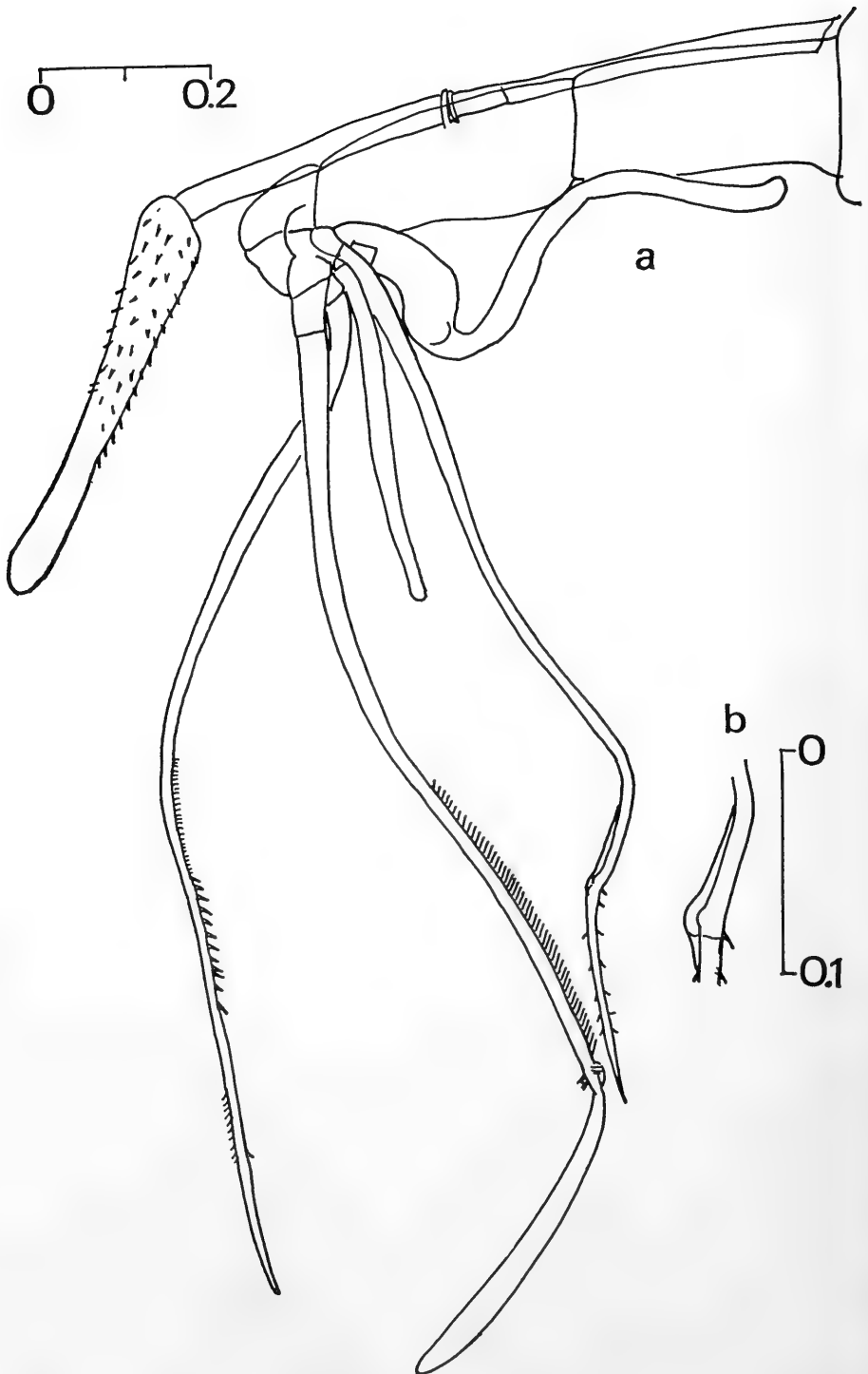


Figure 53. Male *Conchoecia hampta* Müller. a, frontal organ and first antenna. b, callous on proximal secondary seta. Scale at top left for a, at right for b. Scales in mm.

but the male's has seven to eight pairs of long hairs on the proximal half; the smaller bristle is characteristically bent. The male clasping organs are illustrated in Figure 52d and e.

LENGTH. Females 2.9-3.3 mm, males 2.6-2.7 mm (Müller).

COLLECTION DATA. A single male, 2.75 mm long, was collected at Station "S" in August 1964 in a 750-1500 m haul. A single female was taken in the 1250-2000 m sample of February 1960. The extreme possible temperature range for the female was 3.8-5.0°C, for the male it was approximately 4-13°C.

DISTRIBUTION. Müller's specimens were found only in the Atlantic from 31°N-2°N. Granata and di Caporiacco (1949) extended the range in the Atlantic to 46°57'N.

### *Conchoecia borealis* Sars

(Figure 54)

*Conchoecia borealis*, Skogsberg, 1920, p. 708, Figs. CXXXV, CXXXVI.

For synonymy and supplementary description, see Skogsberg.

DESCRIPTION. The shape of this species is distinctive. The height is less than half the length, the shell tapers anteriorly with the greatest depth in the posterior half (Fig. 54a); the shoulder vaults are well-developed and sharp-edged (Fig. 54c), as in *C. spinifera*, but *C. borealis* differs from *C. spinifera* in that the postero-dorsal corners are rounded and have several tiny spinules near and on the corner. The shell is sculptured to a greater or lesser degree, with diagonal quadrangular reticulations.

LENGTH. Males 2.1-2.3 mm, females 2.4-2.9 mm (Skogsberg). These measurements apply to specimens from the Skagerrak, Lofoten, and the Arctic Ocean.

COLLECTION DATA. Only three specimens of this species were taken at Station "S", all larval. The largest, an immature male 1.75 mm long, is illustrated in Figure 54. These specimens were collected in June 1959 over a depth range of 500-1800 m. However, the shape of the shell, the sculpturing, the sharp-edged shoulder vaults, and the presence of lateral corner glands are so distinctive, that these must belong to the species *C. borealis*. The extreme possible temperature range for these specimens is 3.8-17.7°C.

DISTRIBUTION. Two forms of this species have been described: *C. borealis* Sars var. *maxima* Brady and Norman, and *C. borealis* Sars var. *antipoda* Müller. *C. borealis* var. *maxima* has been recorded from the North Atlantic and Arctic Oceans, 60°N-84°N. *C. borealis* var. *antipoda* was described from the Antarctic; most of Müller's material was collected south of 55°S. According to Skogsberg, *C. borealis* has been recorded from the Skagerrak, west coast of Norway, the Arctic Ocean and the Labrador Current. The latter locality, at 50°N, appears to be the most southerly record. The immature male from Station "S" thus extends the overall range from approximately 80°N down to 32°N in the Atlantic.

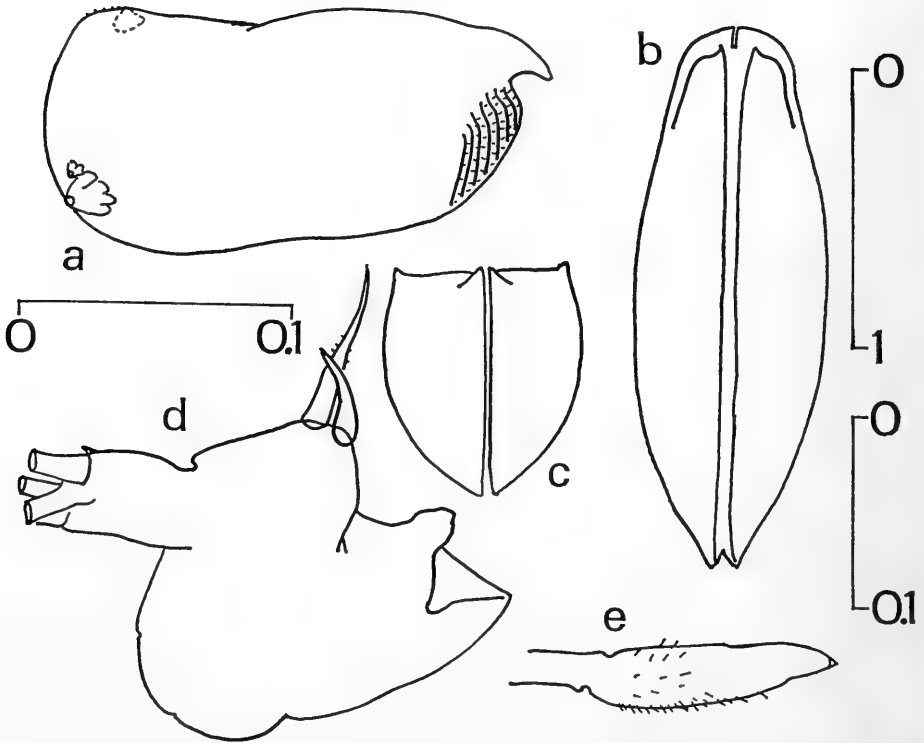


Figure 54. *Conchoecia borealis* Sars. a-c, lateral, ventral and posterior views of immature male, 1.75 mm long. d, endopodite of second antenna of immature male. e, capitulum of frontal organ of immature male. Scale at upper right for a-c; at lower right for e; at left for d. Scales in mm.

*Conchoecia dichotoma* Müller (?)  
(Figure 55)

*Conchoecia dichotoma* Müller, 1906a, p. 111. Pl. XXIV, Figs. 23-29, Pl. XXV, Fig. 1; 1912, p. 87.

DESCRIPTION. Five specimens obtained in two of the deeper hauls cannot be definitely assigned to this species, since most of the females of the Mollis group have not been adequately described, and, unfortunately, no mature males were taken. Müller's (1906a, p. 111) description of *C. dichotoma* may be summarized as follows: The height of the female shell is about half the length, tapered anteriorly. The posterior and dorsal margins form a right angle with a moderately rounded point, the posterior margin is slightly swollen, the posterior ventral corner strongly rounded. The surface of the shell usually has indistinct sculpture, consisting of parallel lines which can cross and form diagonal fields. The sculpture is clearest in the anterior half of the ventral margin. The male shell is somewhat elongated, not tapered anteriorly. The right asymmetrical gland is displaced slightly dorsally. Lateral corner glands are present in both sexes, on the right near the asymmetrical gland. A medial dorsal gland is present only in the male; in the female in its place there is a group of three or four gland cells which are not



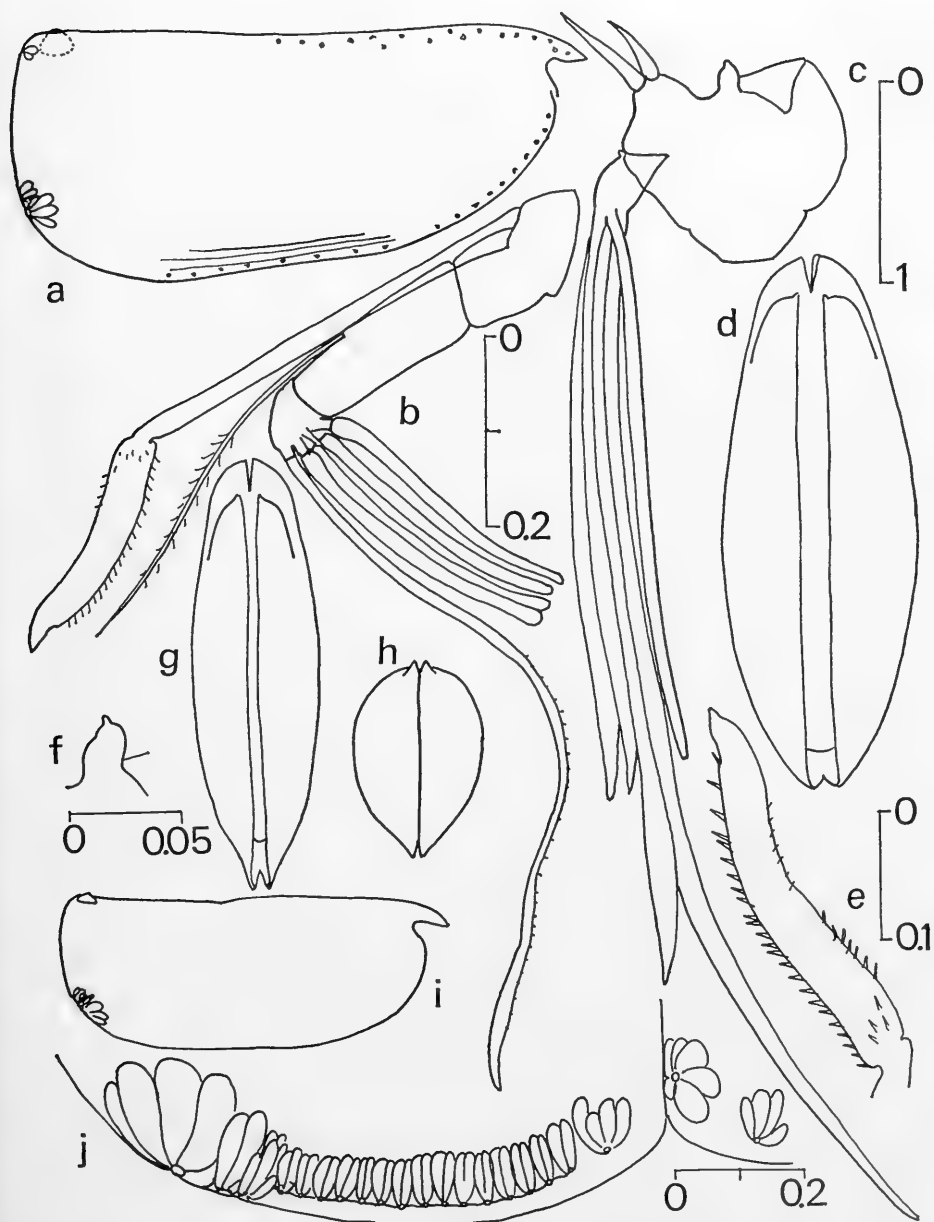


Figure 55. *Conchoecia dichotoma* Müller (?). a and d, lateral and ventral views of female. b, female frontal organ and first antenna. c, endopodite of female second antenna. e, capitulum of female frontal organ. f, processus mammillaris of endopodite of female second antenna, enlarged. g, h, i, ventral, posterior and lateral views of immature male, 1.9 mm long. j, posterior margin of right female shell, from inside. Scale at upper right for a, d, g, h, i; at upper center for b and c; at lower right margin for e; at left for f; at bottom right for j. Scales in mm.

larger than the medial gland cells. The latter open in pairs in a line. The female frontal organ has a long thin S-shaped capitulum, with strong spines on the ventral margin. The principal seta of the male first antenna is broadened at the end and has a double row of thickly set flat teeth.

Müller's females were 2.25-2.35 mm, males 1.85 mm long. The five specimens taken at Station "S" include one female, 2.65 mm long; two immature males, 1.85 and 1.9 mm long; and two stage IV larvae, 1.35 mm long. In general appearance (Fig. 55a, d, g-i) they resemble *C. borealis*, but the dorsal margin is almost straight and the shoulder vaults are rounded. The capitulum of the female frontal organ (Fig. 55b, e) is somewhat S-shaped, with strong spines, as described by Müller for female *C. dichotoma*. The frontal organ extends well beyond the tip of the first antenna. The dorsal seta on the second segment of the first antenna is long and plumose; the principal seta is widened at the end and has some fine spinules ventrally. The groups of gland cells on the posterior margin of the female right shell (Fig. 55j) are as Müller described for female *C. dichotoma*. If these specimens should prove not to belong to this species, they must at least be closely related. These specimens differ from Müller's description of *C. dichotoma* in two respects: they are slightly larger, and the height of the shell is less than half the length.

SIZE. Female shell, 2.65 mm long and 1.2 mm high; the immature male shells, 1.85-1.9 mm long by 0.8 mm high.

COLLECTION DATA. The female and one immature male were obtained in the 1250-2000 m haul collected on Feb. 17, 1960. One immature male and two stage IV larvae were taken in the 1000-1800 m sample on June 24, 1959. The extreme possible temperature range of the waters sampled was 3.6-7.7°C.

DISTRIBUTION. 2°N in the Atlantic, and near the equator in the Indian Ocean.

*Conchoecia rhynchena* Müller  
(Figure 56)

*Conchoecia rhynchena* Müller, 1906a, p. 113, Pl. XXVI, Figs. 17-25; 1912, p. 88.

DESCRIPTION. This is a fairly large and relatively massive species; the height of the shell is slightly less than half the length with shoulder vaults powerful but rounded. The shape of the shell is similar in both sexes, the posterior margin straight, the antero-ventral corners rounded (Fig. 56a). There is more or less marked sculpturing, especially on the anterior part of the shell, consisting of lines curving down from the rostral region along the anterior and ventral margins. Dorso-medial and lateral corner glands are present in both sexes; the asymmetrical glands are in the usual place.

The capitulum of the male frontal organ is of characteristic shape (Fig. 56c), with spinules over the proximal half or so. The male principal seta (Fig. 56d) has 42-43 pairs of leaf-like structures which look like thin pointed teeth; distal of these the seta is widened by a hyaline membrane for half the remaining distance then narrows to the tip. This narrow tip distinguishes this species from other males of this group. The proximal secondary seta has a pad or callous (Fig. 56e) and distal of this several small spinules. On the one specimen examined, one of the distal secondary setae had, opposite the distal end of the armature of the principal

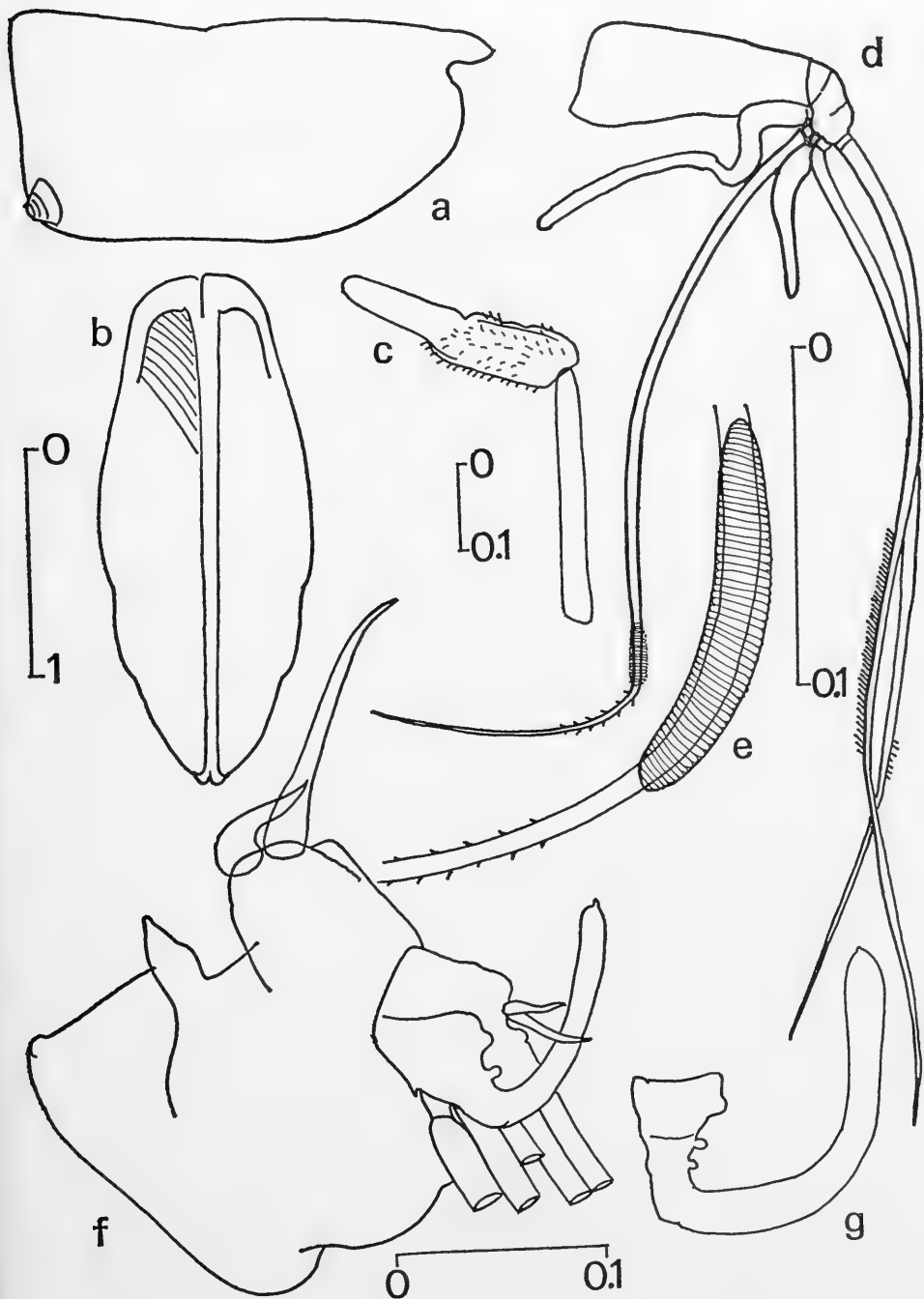


Figure 56. Male *Conchoecia rhynchena* Müller. a and b, lateral and ventral views of male. c, frontal organ. d, first antenna. e, enlargement of pad on proximal secondary seta. f, endopodite of left second antenna (filaments and setae cut off). g, right clasp organ. Scale at left for a and b; at center for c and d; at right for e; at bottom center for f and g. Scales in mm.

seta, a row of seven spinules, the other distal secondary seta had only one spinule in this location. These three setae are of approximately the same length. The shape of the clasping organs is shown in Figure 56f and g. The larger bristle of the basal segment of the endopodite of the second antenna is bare of hairs or spines.

LENGTH. Females 2.55-2.7 mm, males 2.45 mm (Müller).

COLLECTION DATA. A single male, 2.3 mm long, was taken at Station "S" in the 1250-2000 m sample collected on Feb. 17, 1960. The extreme possible temperature range at these depths was 3.8-5.0°C.

DISTRIBUTION. Müller's specimens were collected between 32°N and 35°S in the Atlantic and Indian Oceans. Granata and di Caporiacco (1949) extended the range in the Atlantic to 46°31'N.

#### IMBRICATA GROUP MÜLLER 1906

In this group the shell is strikingly sculptured. The postero-dorsal corner of the shell is produced into a definite point on both sides. The postero-ventral corner on the right, or on both sides, has a process bearing the openings of the asymmetrical and lateral corner glands, or only the latter. The principal seta of the male has a row of lamellae, similar to those of the Mollis group, or it may have a row of large teeth, standing at right angles to the seta.

The members of this group are large species and include *C. plinthina* (4.8-5.9 mm long), *C. symmetrica* (3.7-4.6 mm long), *C. ametra* (3.7-4.6 mm long), *C. imbricata* (2.5-3.5 mm long) and *C. squamosa* (3.75-4.2 mm long). Müller provisionally included *C. prosadene* as related to this group, although it is different in shape and lacks the striking shell sculpture. Two of these species, *C. imbricata* and *C. ametra*, occurred at Station "S".

#### *Conchoecia imbricata* (Brady)

(Figures 57, 58)

*Halocypris imbricata*, Brady, (part) 1880, p. 167, Pl. XLI, Figs. 1-10, Pl. XLII, Figs. 1-8.

*Conchoecissa armata*, Claus, 1890, p. 19; 1891, p. 70, Pls. XVI, XVII, XVIII.

*Conchoecia imbricata*, Müller, 1890, p. 277; 1906a, p. 118, Pl. XXVIII, Figs. 1-6; 1912, p. 91.

*Conchoecissa imbricata*, Granata and di Caporiacco, 1949, p. 20.

DESCRIPTION. This species is distinguished from others of this group by its smaller size, characteristic shell shape, and the armature of the male principal seta. The postero-dorsal corners of the shell are produced into sharp points, considerably longer on the left than on the right (Figs. 57a-c). At the postero-ventral corners, large processes are developed where the right asymmetrical gland and the lateral corner glands open. The rostrum is sharply pointed in ventral view. The sculpturing of the shell is striking.

The frontal organs and first antennae of the female and male are shown in Figure 58a-d, the clasping organs in Figure 57d and e. The principal seta of the male (Fig. 58a) has 8-10 pairs of large teeth, evenly spaced, and easily visible at a low magnification.

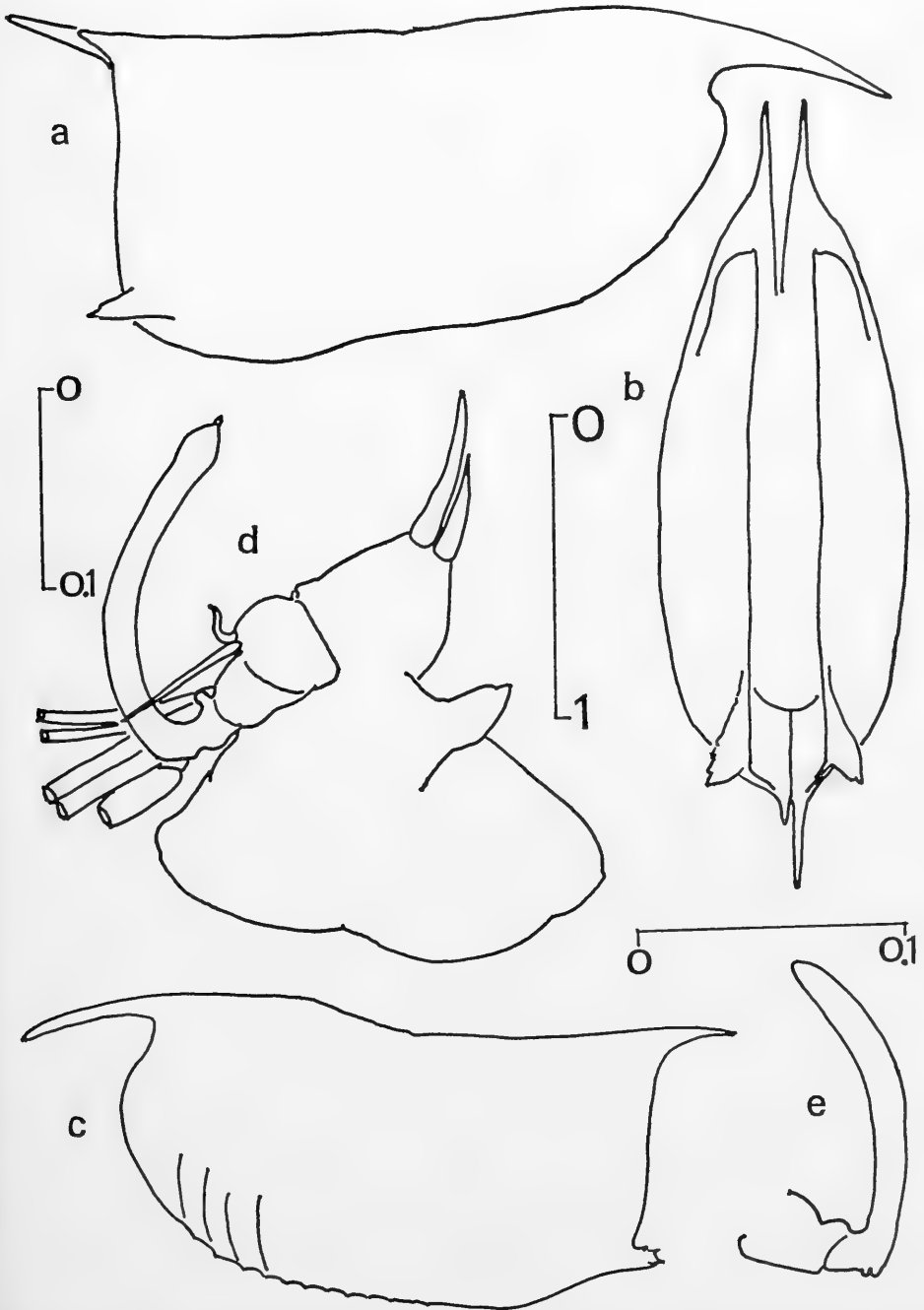


Figure 57. *Conchoecia imbricata* (Brady). a and b, lateral and ventral views of female. c, lateral view of male. d, endopodite of male right second antenna. e, male left clasper. Scale at right center for a-c; at upper left for d; at lower right for e. Scales in mm.

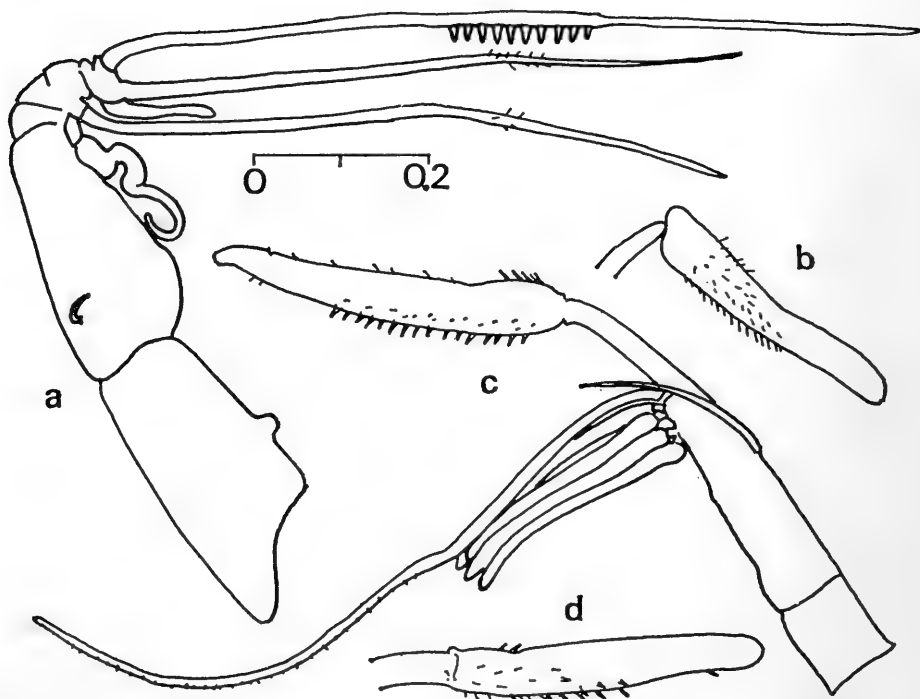


Figure 58. *Conchoecia imbricata* (Brady). a, male first antenna. b, capitulum of male frontal organ. c, female frontal organ and first antenna. d, capitulum of another female frontal organ. Scale in mm.

LENGTH. Males 2.5-3.0 mm, females 3.0-3.5 mm (Müller, 1906a, p. 118). The specimens from Station "S" were smaller; males were 2.25-2.45 mm long, females 2.7-3.0 mm long.

COLLECTION DATA. Although never numerous, this was a common species at Station "S". Larval specimens occurred in every sample throughout the year in the upper 500 m and were present in the deeper hauls. In the samples collected at different depths, *C. imbricata* did not occur in the upper 200 m and was most numerous between 300 and 500 m (Fig. 65i). The highest number, 256/1000 m<sup>3</sup>, was recorded for the 200-300 m sample of Oct. 9, 1959. In the 0-500 m simultaneous hauls with No. 2 and No. 8 nets, 17-18/1000 m<sup>3</sup> were taken (Table 4).

The smallest larvae found were stage II larvae, 0.45 mm long. Stage III larvae were 0.85-1.0 mm long, stage IV larvae were 1.3-1.4 mm long, and stage V individuals were 1.7-2.1 mm in length. Stages III-V were found most commonly.

The extreme possible temperature range of the waters sampled was 3.8-28.1°C. In the depth series within the upper 500 m, mature individuals were found over a range of 15.4-17.7°C.

DISTRIBUTION. 60°N-55°S in the Atlantic; Pacific and Indian Oceans.

*Conchoecia ametra* Müller

(Figure 59)

*Conchoecia ametra* Müller, 1906a, p. 117, Pl. XXVII, Figs. 11, 12, 14, 17-19; 1912, p. 90.

*Conchoecia insignis*, Vávra, 1906, p. 56, Pl. V, Figs. 105-107, Pl. VI, Figs. 108-113.

*Conchoecia ametra*, Skogsberg, 1931, p. 19.

*Conchoecissa ametra*, Granata and di Caporiacco, 1949, p. 19.

DESCRIPTION. In this species the rostrum is rounded, but both sides come to a sharp point, the left point definitely longer than the right (Fig. 59b). Also there are sharp points at the postero-dorsal corners, the left point longer than the right. The opening of the left lateral corner gland clearly projects beyond the shell margin at the postero-ventral corner, but the projection in the same location on the right shell is larger and also includes the opening of the right asymmetrical gland. The shell is sculptured as is partly indicated in Figure 59a. The capitulum of the female frontal organ and the endopodite of the female second antenna are illustrated in Figure 59c and d.

LENGTH. Females 3.9-4.6 mm, males 3.4-4.1 mm (Müller). The single female taken at Station "S" was 4.5 mm long.

COLLECTION DATA. Only seven specimens were collected at Station "S", all presumably from depths greater than 500 m, although two larvae were taken in a 0-1500 m haul. The larval stages were 1.2, 1.8, 1.95, and 3.0 mm long. The extreme possible temperature range was 3.8-17.7°C. The single female was taken from waters with a range of 3.6-7.7°C.

DISTRIBUTION. 60°N-37°S in the Atlantic; Indian and Pacific Oceans.

## DAPHNOIDES GROUP MÜLLER 1906

This group is characterized by the position of the right asymmetrical gland, which is at the anterior end of the shell margin beneath the rostral incisure. In two species, *C. elongata* and *C. chuni*, the left asymmetrical gland opens on the posterior margin well removed from the postero-dorsal corner, at approximately half the shell height or less. Lateral gland groups are usually present on the posterior margin. This group includes three species of elongate shape: *C. chuni*, *C. elongata*, and *C. daphnoides*. *C. daphnoides* was the only member of this group that occurred at Station "S".

*Conchoecia daphnoides* (Claus)

(Figure 60)

*Conchoecilla daphnoides*, Claus, 1890, p. 17; 1891, p. 68, Pl. XV, Figs. 1-12.

*Conchoecia daphnoides*, Vávra, 1906, p. 45, Pl. III, Figs. 49-55.

*Conchoecia daphnoides* var. *typica* and var. *minor*, Müller, 1906a, p. 126, Pl. XXXI, Figs. 1-15.

*Conchoecia daphnoides daphnoides* and var. *minor*, Müller, 1912, p. 94.

*Conchoecia daphnoides*, Skogsberg, 1931, p. 20.

For further synonymy, see Skogsberg.

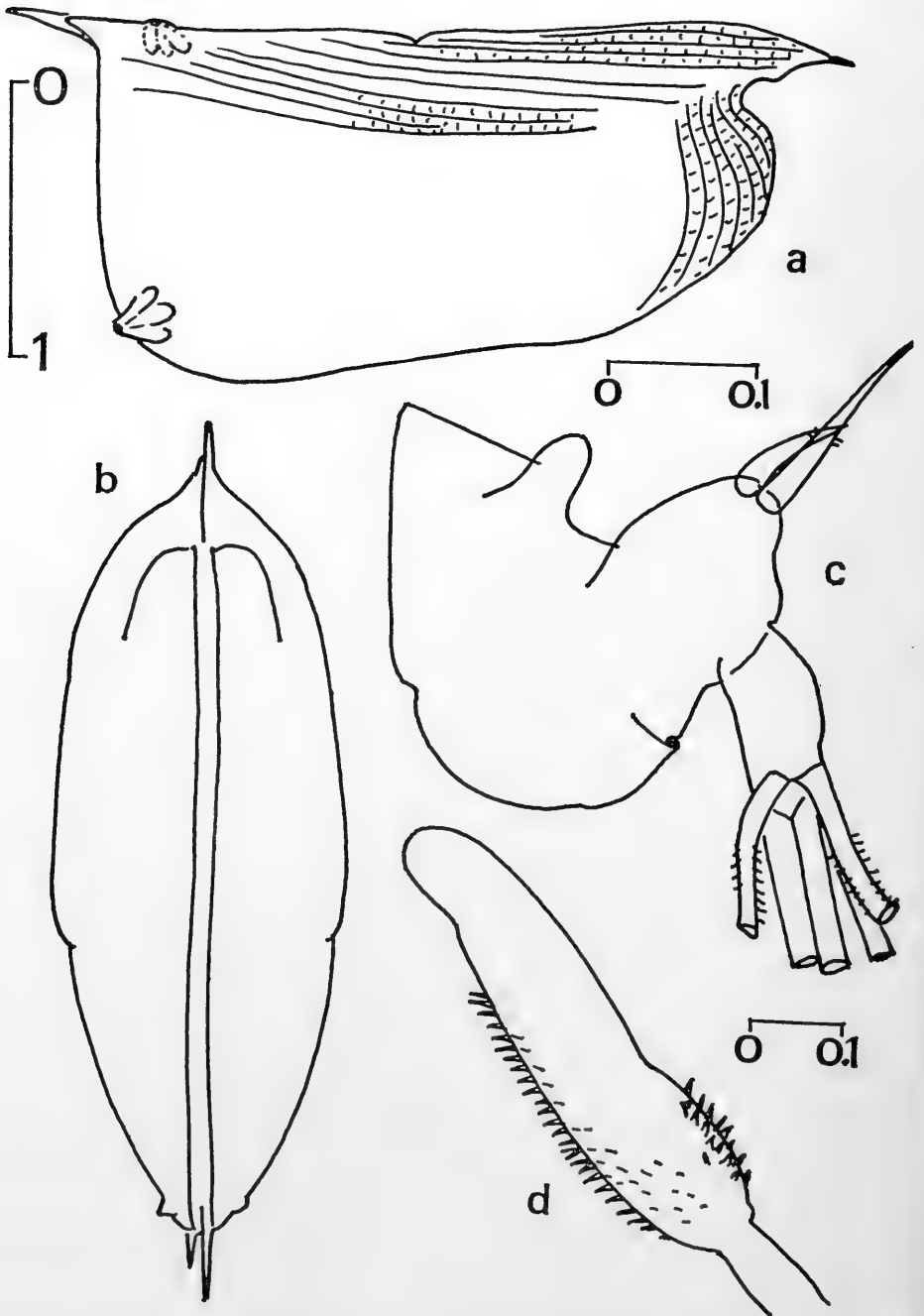


Figure 59. *Conchoecia ametra* Müller. a and b, lateral and ventral views of 3.0 mm larva. c, endopodite of female second antenna (setae and filaments cut off). d, capitulum of female frontal organ. Scale at top left for a and b; at upper right for c; at lower right for d. Scales in mm.



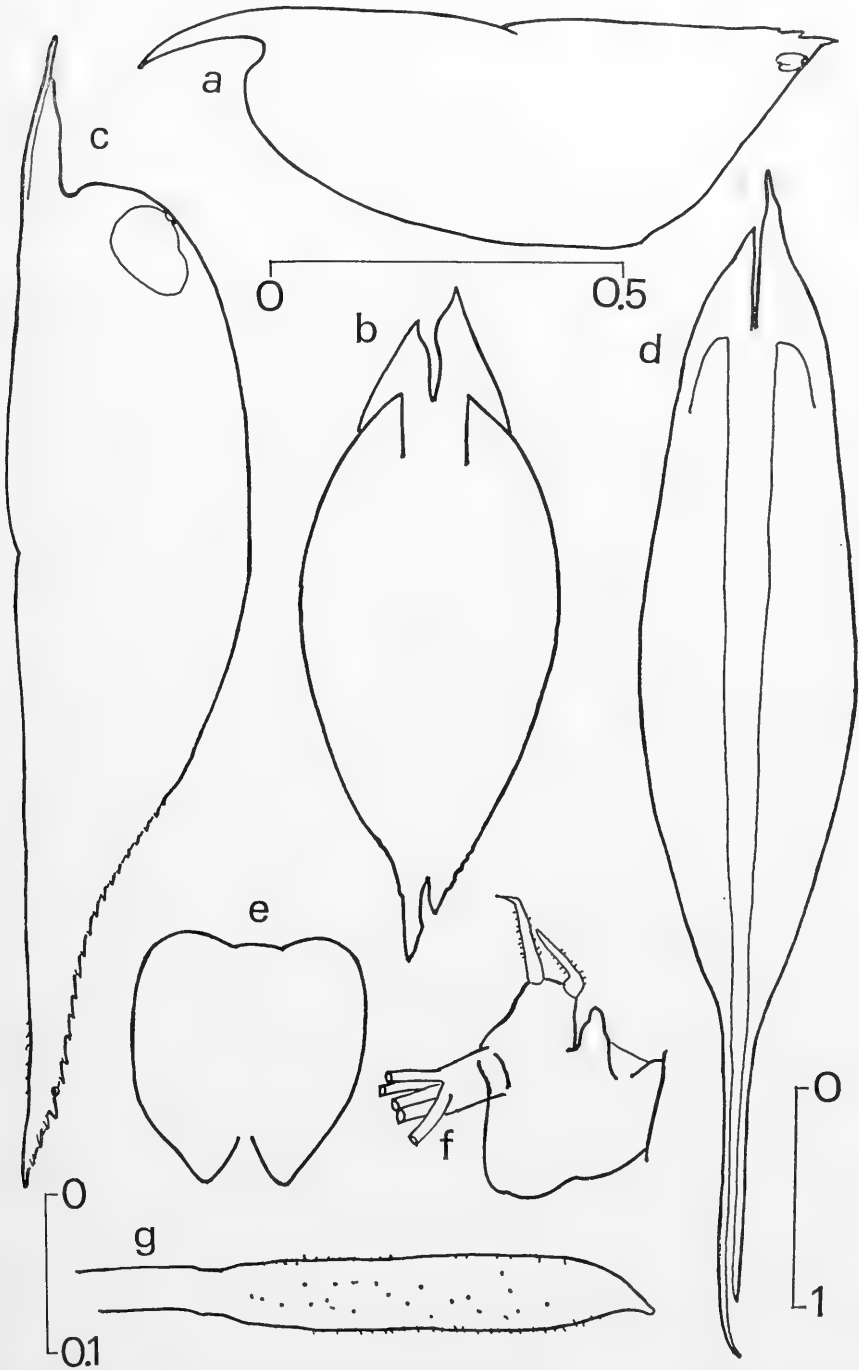


Figure 60. *Conchoecia daphnoides* (Claus). a and b, lateral and ventral views of larva, 1.0 mm long. c, d, e, lateral, ventral and posterior views of 5.2 mm female. f, endopodite of female second antenna (setae and filaments cut off). g, capitulum of female frontal organ. Scale at top center for a and b; at lower right for c, d, e; at bottom left for f and g. Scales in mm.

DESCRIPTION. This species is of characteristic shape (Fig. 60a-e). The length of the shell may be four times its height, although the height is proportionately greater in the early larval stages (Fig. 60a). Young larvae of this species may be easily differentiated from young *C. acuminata* by the shape of the rostrum in ventral view (Fig. 60b). The rostrum is pointed and longer on the left side and the postero-dorsal corner is produced into a longer point on the right shell. The right asymmetrical gland is on the anterior margin beneath the rostral incisure (Fig. 60c), the left on the posterior margin just below the postero-dorsal curve. The capitulum of the female frontal organ and the endopodite of the female second antenna are shown in Figure 60f and g. This species varies greatly in the size of mature individuals and it was largely because of this that Müller (1906a) established two varieties. Skogsberg (1931) found mature specimens of intermediate size, and therefore didn't consider it possible to keep the two subspecies separate. There is as yet no explanation for these size variations.

LENGTH. Females 4.2-5.9 mm, males 2.25-3.25 mm. Two females from Station "S" were 4.8 and 5.2 mm long.

The earliest larval stage found at Station "S" was 0.9-1.05 mm long (Fig. 60a, b), the next stage 1.7-1.9 mm long, and the next stage 2.8-3.3 mm long.

COLLECTION DATA. At Station "S", larval stages of *C. daphnoides* occurred for the greater part of the year in the upper 500 m and within the upper 100 m in the October 1959 depth series. Although never numerous, more specimens were found in winter and spring and none were noted in September. Highest numbers of 71/1000 m<sup>3</sup> were obtained in the 200-300 m sample of February 1960, when *C. daphnoides* was most abundant. The simultaneous tows with No. 2 and No. 8 nets gave, for *C. daphnoides*, numbers of 2-3/1000 m<sup>3</sup> (see Table 4). Only two females were found and no mature males. The extreme possible temperature range when *C. daphnoides* was present was 3.8-26.9°C, but it commonly occurred at temperatures above 16°C and most specimens were probably taken from waters with a range of 16-20°C.

DISTRIBUTION. 60°N-37°S in the Atlantic; Indian and Pacific Oceans.

*Conchoecia* sp.  
(Figure 61)

It has not been possible to assign to a known species a single very recently moulted female specimen, which was at first believed to be a female *Conchoecia alata* Müller. However, comparison of this specimen with identified specimens of *C. alata*, kindly given to me by E. M. Poulsen, showed that, although similar to *C. alata* in some respects this specimen does not belong to that species, but probably represents a new species. It is not named as a new species at this time, since it would be desirable to have more material, especially a male specimen, before this is done.

DESCRIPTION. The female shell is short, tapered anteriorly, the height greater than half the length. The antero-ventral and postero-ventral corners are rounded; the postero-dorsal corners are formed into short blunt points of equal size (Fig. 61a, g), so that in lateral view this specimen is similar in appearance to the *C. alata* female as figured by Müller (1906a, Pl. XXIX, Fig. 1) and also to the *C.*

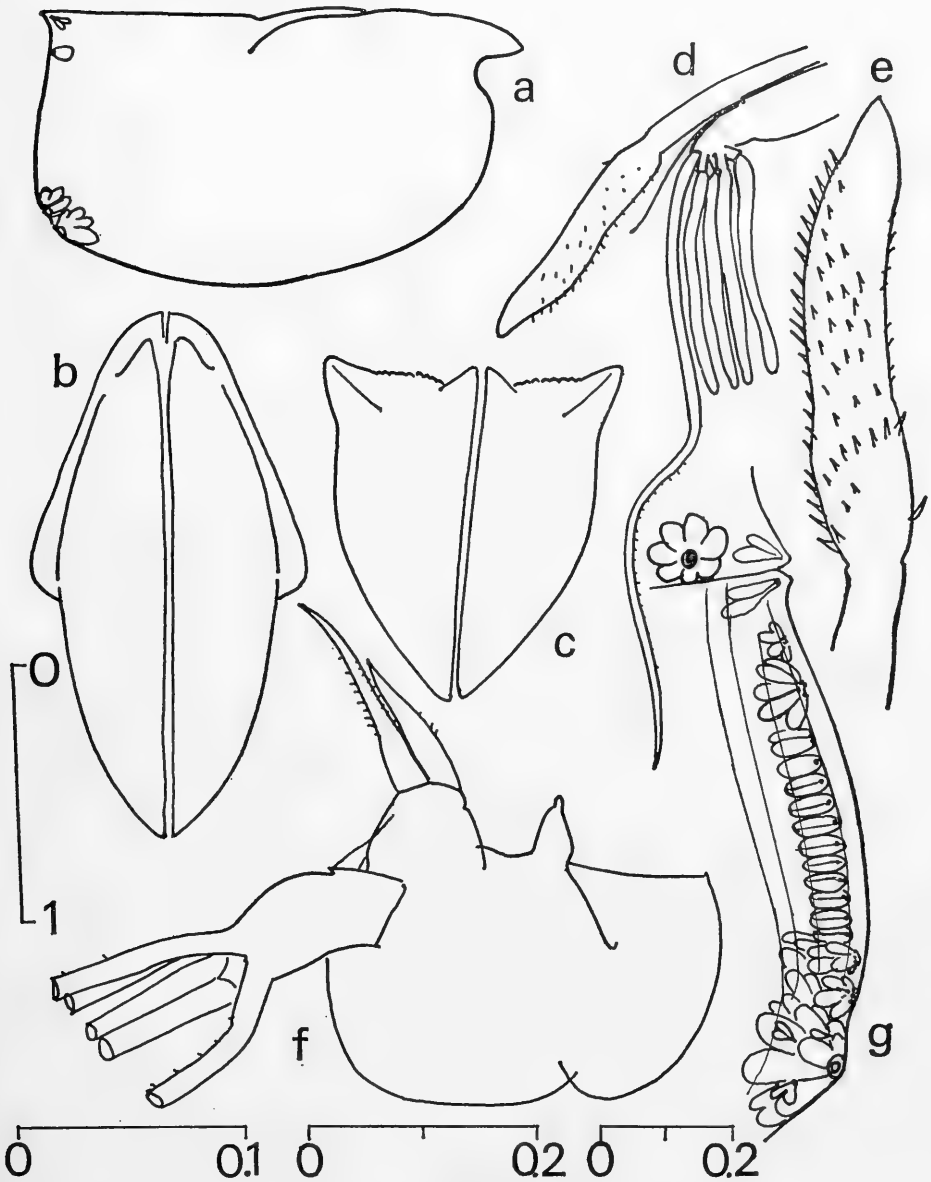


Figure 61. *Conchoecia* sp. a-c, lateral, ventral and posterior views of female. d, frontal organ and first antenna of female. e, capitulum of female frontal organ. f, endopodite of female second antenna (setae and filaments cut off). g, posterior margin of right shell from inside. Scale at left for a-c; at bottom right for g; at bottom center for d; at bottom left for e and f. Scales in mm.

*concentrica* female (Fig. 49a). The shoulder vaults are raised wing-like (Fig. 61c), as in both the *C. concentrica* female (Fig. 49b) and in both sexes of *C. alata*. However, in the *C. concentrica* female the shoulder vaults are more bluntly rounded in posterior view (Fig. 49b) and in *C. alata* the "wings" project laterally at right angles to the dorso-ventral axis of the body. In ventral view the "wings"

are rounded posteriorly (Fig. 61b), whereas in *C. alata* they are pointed at the posterior end (Müller, 1906a, Pl. XXIX, Fig. 2). The asymmetrical glands are in the usual place, but lateral and medial glands are also present on the posterior margin of the right shell of this specimen (Fig. 61g). These appear to be similar in disposition to those illustrated by Müller for *C. alata* (1906a, Pl. XXIX, Fig. 5), but it is not possible to be certain whether there are one or two lateral glands dorsal to the right asymmetrical gland. The glands on the posterior margin of the left shell of this specimen are less readily distinguishable; one lateral gland is present near the postero-ventral corner. In this recently moulted specimen some sculpturing of the shell was discernible and consisted of longitudinal striations running antero-posteriorly dorsally and paralleling the anterior and ventral margins, as in *C. concentrica*.

The capitulum of the frontal organ is pointed at the tip (Fig. 61e), with strong spines over most of the ventral surface and some spinules dorsally. The principal seta of the first antenna has tiny spinules ventrally on the distal half (Fig. 61d). Spinules are also present on the two bristles of the basal segment of the endopodite of the second antenna (Fig. 61f); the processus mammillaris is long, slender and pointed.

LENGTH. Female, 1.95 mm. In size, this specimen is slightly larger than the *C. concentrica* female, and slightly smaller than the *C. alata* female, which according to Müller (1906a, p. 121) varies from 2.1-2.4 mm in length.

COLLECTION DATA. The specimen was obtained in a 0-100 m sample collected on April 28, 1958. The extreme possible temperature range was 18.2-20.2°C.

DISTRIBUTION. 32°N in the Atlantic.

#### GENUS *Euconchoecia* Müller

Members of the genus *Euconchoecia* are distinguished from other Conchoecinae by the following characters: there is no tubercle or processus mammillaris on the basal segment of the endopodite of the second antenna; there are at least 15 sensory filaments on the last two segments of the first antenna; the asymmetrical glands are almost symmetrical and open on the posterior margin near the postero-dorsal corner.

This genus includes four species: *E. chierchiae* Müller, *E. aculeata* (Scott), *E. lacunosa* Müller, and *E. d'Arcy-Thompsoni* Scott. *E. chierchiae* occurred seasonally at Station "S".

#### *Euconchoecia chierchiae* Müller

(Figure 62)

*Euconchoecia chierchiae* Müller, 1890, p. 277, Pl. XXVIII, Figs. 1-10.

*Euconchoecia chierchiae*, Skogsberg, 1920, p. 740, Figs. CXLVIII-CLI.

For synonymy and description, see Skogsberg.

DESCRIPTION. The shell is delicate and elongate; in the male the height is half the length, in the female less than half the length. There is a small spine at the postero-dorsal corner of the right shell. The postero-ventral and antero-ventral corners are rounded. The asymmetrical glands open on both sides on the

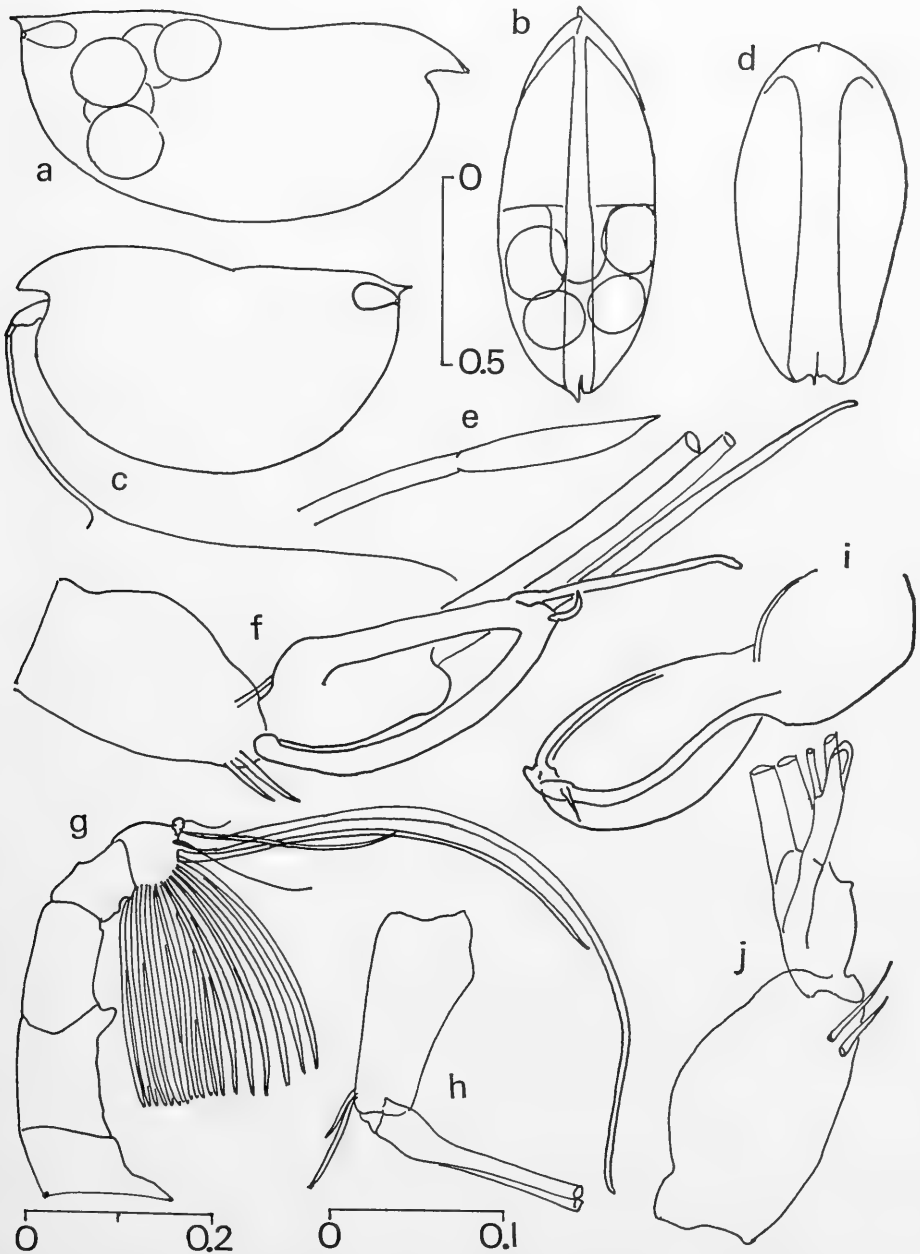


Figure 62. *Euconchoecia chierchiae* Müller. a and b, lateral and ventral views of female. c and d, lateral and ventral views of male. e, female frontal organ capitulum 0.065 mm long. f, endopodite of male right second antenna (setae cut off). g, male first antenna. h, endopodite of female second antenna (setae cut off). i, penis. j, endopodite of male left second antenna (setae and filaments cut off). Scale at top center for a-d; at bottom left for i and g; at bottom center for f, h, j. Scales in mm.

posterior margin, just below the postero-dorsal corner. No other glands have been observed (Fig. 62a, c). In ventral view the left rostrum of the female is pointed and longer than the right rostrum (Fig. 62b). The male rostrum is broadly rounded (Fig. 62d).

The frontal organs of both sexes are slim and undifferentiated (Fig. 62e). The male and female first antennae have over 20 sensory filaments (Fig. 62g). The male endopodites with the clasping organs of the second antennae are illustrated in Figure 62f and j, the female endopodite in Figure 62h. In *Euconchoecia* the shape of the endopodite of the second antenna is quite different from *Conchoecia* and the processus mammillaris is lacking. The longest seta of the endopodite of the male second antenna is considerably longer than the shell (Fig. 62c). The shape of the penis (Fig. 62i) is distinctive. The furca has seven claws.

The female may carry two to eight large eggs, up to 0.25 mm diameter, between the back of the body and the shell (Fig. 62a, b). This also distinguishes *Euconchoecia* from other Halocyprids. *E. aculeata* females also do this, but it has not been observed whether the females of the other species of this genus carry their eggs.

*E. aculeata* is very similar in appearance to *E. chierchiae*, but in *E. aculeata* the height of the male shell is clearly less than half the length. There are spines or points at both postero-dorsal corners in both sexes, the one on the right longer than the one on the left shell. Also, the rostrum has small points on both sides, the one on the left longer than the one on the right.

LENGTH. Females 1.1-1.3 mm, males 1.15-1.25 mm (Skogsberg). At Station "S," females were 1.15-1.25 mm long, males 1.0-1.2 mm long.

COLLECTION DATA. At Station "S", *E. chierchiae* occurred seasonally, from September 1961 to April 1962, in the upper 500 m. It was most numerous from September to December. The extreme possible temperature range was 16.6-27.3°C. Some of Skogsberg's specimens were taken at a temperature of 25.2°C.

DISTRIBUTION. 42°N-20°S in the Atlantic. This species was described from the coast of Brazil. It is the only Halocyprid that has been recorded from inshore waters of the northeastern United States, since it has been taken in Block Island Sound and outside Delaware Bay (Deevey, 1952, 1960).

## QUANTITATIVE DATA

### THE SEASONAL CYCLE IN TOTAL NUMBERS

Estimates for the total numbers of ostracods occurring in the upper 500 m at Station "S" were obtained for the period from March 1961 to April 1962 during a study on the seasonal cycle of the total zooplankton. When these quantitative counts were made, it was not possible to differentiate the species of ostracods. Figure 63C shows the variations in total numbers. No definite seasonal cycle was apparent. Maximal numbers of 36.1/m<sup>3</sup> were noted in March 1962, but there was no comparable increase in numbers in early spring, 1961. In general, smallest numbers of 11-15/m<sup>3</sup> were found in early July and during the period from September to February. The mean number of ostracods obtained for the year was 19.49/m<sup>3</sup>.

As previously noted, excluding the Protozoa, ostracods were third in numerical abundance after copepods and pelagic tunicates. Figure 63B shows the variations

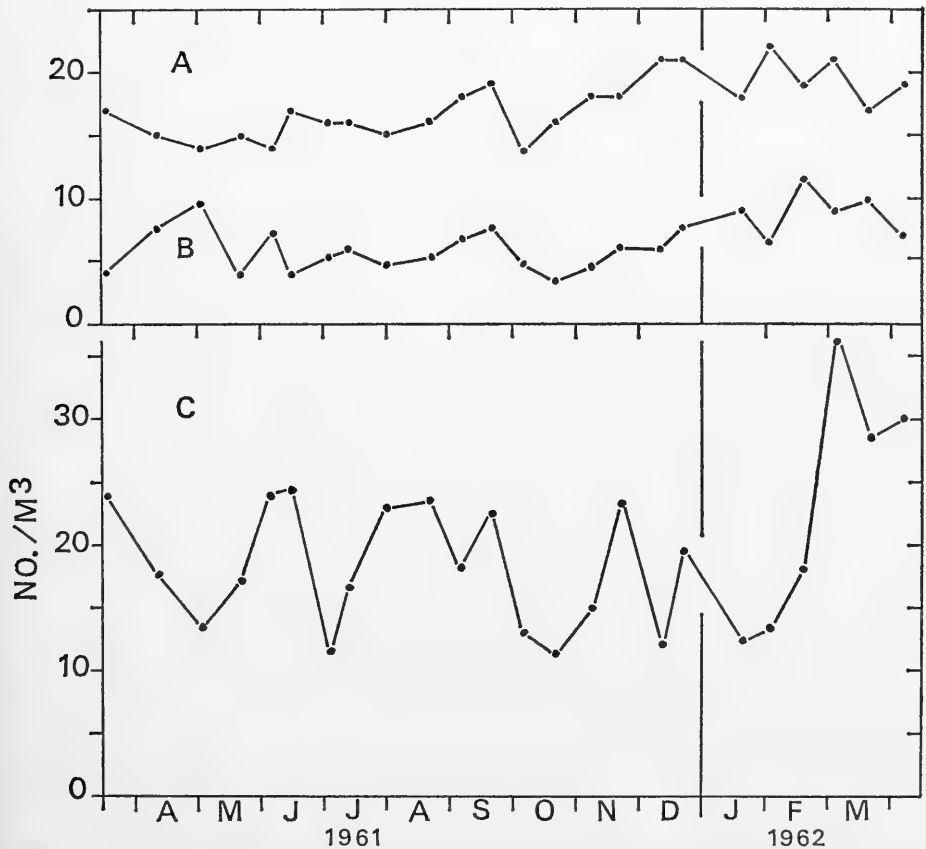


Figure 63. Seasonal variations in: A, the number of species of ostracods per sample; B, the percent of ostracods of the total zooplankton; C, the estimated total numbers of ostracods per cubic meter in the upper 500 m at Station "S", from March 1961 to April 1962.

in percent of ostracods of the total zooplankton, including Protozoa, during the year. In terms of percent of the total zooplankton, ostracods varied from 3.4-11.5%, with the lowest percentages in summer and autumn and higher percentages in winter and spring.

Figure 63A gives the numbers of species of ostracods recorded per sample from the upper 500 m during the year. The smallest number, 14, was noted in May and June and early October. Twenty or more species per sample were recorded in September, December, February and March, so in general more species were taken in the upper 500 m when the water was cooler. The numbers of species were particularly high from December to February, when total numbers of ostracods were relatively low, although over 20 species were present in March, when numbers were maximal.

#### DEPTH DISTRIBUTION

Figure 64 shows the total numbers of ostracods, by actual count, at different

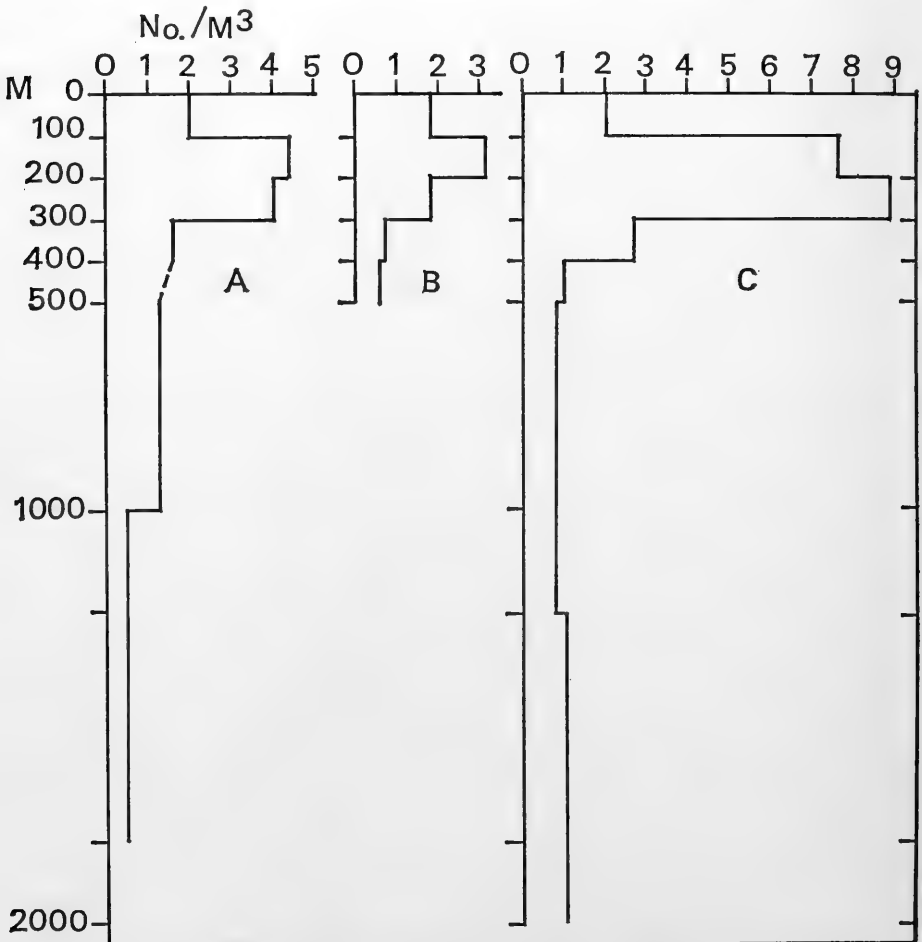


Figure 64. The total numbers of ostracods per cubic meter at different depth ranges on: A, June 23-24, 1959; B, October 9, 1959; C, February 17-18, 1960. Depths in meters.



depth levels down to 2000 m, from samples collected with a meter net with No. 2 nylon, on June 23-26 (Fig. 64A), and Oct. 9, 1959 (Fig. 64B), and Feb. 16-17, 1960 (Fig. 64C). Samples were obtained at 100 m intervals in the upper 500 m; two deeper hauls were made, down to 1800 m in June and 2000 m in February. All the samples were collected during the daytime. In general, highest numbers of ostracods were found in the upper 400 m. In June, numbers decreased from 300 m downwards, but in February slightly higher numbers were found in the 1250-2000 m sample than in the 500-1250 m sample. The majority of the ostracods were between 100 and 300 m in June and February. In October, when fewest ostracods were present, more were found in the 100-200 m sample.

All the ostracods in these samples were removed, counted, and identified insofar as possible. Table 3 lists the numbers per 1000 m<sup>3</sup> of the nine most abundant species for the 100 m depth levels down to 500 m. *C. spirostris* was unquestionably the most numerous species on all three occasions, with highest

TABLE 3. Total numbers/1000 m<sup>3</sup>, by actual count, for 100 m depth intervals, of the nine most numerous species of ostracods in the upper 500 m at station "S", on June 23 and Oct. 10, 1959 and Feb. 17, 1960.

Depth in M	<i>C. spirostris</i>			<i>H. brevirostris</i>			<i>C. parthenoda</i>		
	June	Oct.	Feb.	June	Oct.	Feb.	June	Oct.	Feb.
0-100	1,690	1,340	940	79	76	133	77	248	13
100-200	1,630	893	4,000	47	109	508	525	214	163
200-300	1,210	375	1,520	6	7	341	166	94	14
300-400	316	29	433	3	0	82	107	92	94
400-500	—	3	0	—	0	0	—	24	0
	<i>C. magna</i>			<i>C. curta</i>			<i>C. procera</i>		
	June	Oct.	Feb.	June	Oct.	Feb.	June	Oct.	Feb.
0-100	4	0	7	0	9	33	47	71	7
100-200	198	192	565	146	346	1,130	975	667	170
200-300	400	151	420	1,000	432	4,420	476	226	865
300-400	183	44	191	182	73	874	234	176	362
400-500	—	32	179	—	24	42	—	89	105
	<i>C. spinifera</i>			<i>C. oblonga</i>			<i>C. rotundata</i>		
	June	Oct.	Feb.	June	Oct.	Feb.	June	Oct.	Feb.
0-100	0	0	0	4	7	0	2	5	0
100-200	6	116	3	558	406	73	53	96	57
200-300	348	161	56	182	116	857	106	184	24
300-400	196	84	66	113	77	157	158	51	119
400-500	—	105	231	—	67	63	—	92	178

numbers between the surface and 300 m; very few specimens of this species were taken below 400 m. Two other small species, *C. curta* and *C. procera*, were next in abundance. *C. curta* was most numerous between 200 and 400 m in June and between 100 and 300 m in October and February. *C. procera* was most abundant between 100 and 300 m in June and October and between 200 and 400 m in February. *H. brevirostris* occurred almost entirely in the upper 300 m, whereas *C. spinifera*, *C. rotundata* and *C. oblonga* were rare in the upper 100 m. *C. parthenoda* was usually most numerous between 100 and 200 m.

Figure 65 illustrates the percentage distribution with depth of the nine species

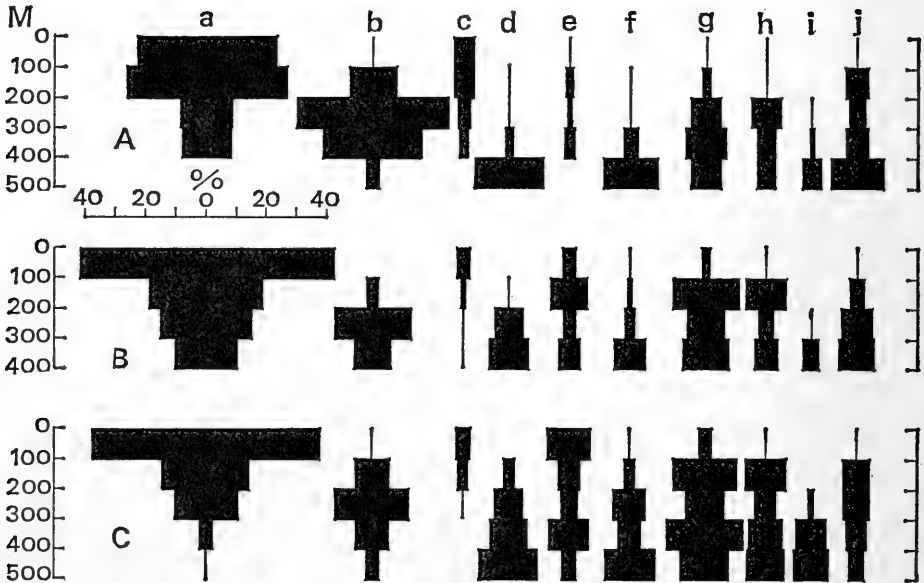


Figure 65. The relative percentages, based on the total numbers of oyster, of the more numerous species of oyster in the upper 500 m at Station "S," over 100 m depth ranges, on: A, February 17, 1960; B, June 23, 1959; C, October 9, 1959. Species a: *C. spirostris*; b: *C. curta*; c: *H. brevisrostris*; d: *C. spinifera*; e: *C. parthenoda*; f: *C. rotundata*; g: *C. procerata*; h: *C. oblonga*; i: *C. imbricata*; j: *C. magna*.

listed in Table 3 plus *C. imbricata* (Fig. 65i). The latter species never occurred above 200 m and increased in numbers with depth. The histograms show clearly how relatively abundant *C. spirostris* (Fig. 65a) was, at least on these three occasions, in the upper several hundred m at Station "S." Aside from *C. spirostris*, only *H. brevisrostris*, *C. parthenoda* and *C. procerata* were ever taken in appreciable numbers in the upper 100 m.

#### COMPARISON OF RESULTS OBTAINED WITH NETS OF DIFFERENT MESH SIZE

On July 10, 1959, zooplankton tows were made simultaneously from 500 to 0 m with No. 2 (aperture 0.366 mm) and No. 20 (aperture 0.076 mm) nets. On Aug. 5, 1959, No. 2 and No. 8 (aperture 0.203 mm) nets were towed simultaneously. Total quantitative counts were made on aliquots of these four samples, then all the oyster were removed from the No. 2 and No. 8 net samples and counted separately. It was impossible to remove the oyster from the No. 20 net sample, since the great majority of the specimens were unidentifiable stage I or II larvae. In the July series, the No. 2 net caught an estimated 1.87 oyster/m<sup>3</sup>, the No. 20 net 11.57/m<sup>3</sup>. From the No. 2 net sample, 923 oyster were removed; by actual count there were 1.78 oyster/m<sup>3</sup>, since 516 m<sup>3</sup> of water had been filtered in collecting the sample. In the August series, the No. 2 net caught an estimated 2.15 oyster/m<sup>3</sup>, the No. 8 net an estimated 9.01/m<sup>3</sup>. From the No. 2 net sample 1165 oyster were removed, giving by actual count total numbers of 1.94 oyster/m<sup>3</sup>. From the No. 8 sample 4610 oyster were removed, which gave by actual count a total number of 7.81 oyster/m<sup>3</sup>. About 65% of

the ostracods caught by the No. 8 net were larvae too small for identification; some were only 0.25 mm long.

TABLE 4. Numbers/1000 m<sup>3</sup>, by actual count, of ostracod species taken in simultaneous tows, 500-0 m, with a No. 8 and a No. 2 net on Aug. 5, 1959.

Species	No. 2 Net	No. 8 Net
<i>Archiconchoecia striata</i> .....	5	145
<i>Halocypris brevirostris</i> .....	161	155
<i>Conchoecia spinirostris</i> .....	727	800
<i>C. parthenoda</i> .....	122	152
<i>C. magna</i> .....	90	95
<i>C. curta</i> .....	126	213
<i>C. procera</i> .....	250	653
<i>C. secernenda</i> .....	56	40
<i>C. spinifera</i> .....	54	108
<i>C. acuminata</i> .....	3	5
<i>C. oblonga</i> .....	106	86
<i>C. daphnoides</i> .....	3	2
<i>C. rotundata</i> .....	103	267
<i>C. imbricata</i> .....	18	17
Total Numbers of Ostracods..	1,940	7,810

Table 4 lists most of the species and the numbers/1000 m<sup>3</sup> obtained by actual count from the August No. 2 and No. 8 net samples. Much larger numbers of the tiniest species, *Archiconchoecia striata*, were caught by the No. 8 net, 86 specimens as against only 3 caught by the No. 2 net, but for many of the species the No. 2 net retained as many identifiable specimens as the No. 8 net. Next to *A. striata*, *C. procera* was retained in appreciably greater numbers by the No. 8 net; 386 specimens were taken, whereas the No. 2 net caught only 158 specimens. *C. curta* and *C. rotundata* were also taken in appreciably greater numbers by the No. 8 net. In the samples collected with No. 2 and No. 8 nets, ostracods constituted 6-7% of the total numbers of zooplankton. In the sample obtained with the No. 20 net ostracods constituted only 2.15% of the total numbers of zooplankton, since many more tiny copepods and copepod nauplii were caught by the No. 20 net. One may conclude, therefore, that a net somewhat finer than a No. 2 is required to collect the smallest species of Halocyprids. Also, it is not necessary to use a net finer than No. 8 to obtain the earliest larval stages.

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