

New records of marine Gastrotricha from the French coasts of Manche and Atlantic.

II. Chaetonotida, with descriptions of four new species

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Abstract : Sixteen species of Chaetonotida were found in the region of Roscoff (English Channel) and Arcachon (Eastern Atlantic), four following being new: *Xenotrichula quadritubulata*, *Chaetonotus inaequidentatus* (*Ch. schultzei* species group), *Halichaetonotus atlanticus* and *Heterolepidoderma arenosum*. Two further species, *Chaetonotus* ? *variosquamatus* and *Aspidiophorus* ? *paramediterraneus*, are reported for the first time from French coasts. *Xenotrichula quadritubulata* sp. nov. has showed the presence of two pairs of adhesive tubes; a new species group has been created for this gastrotrich. A large hypostomium in *Halichaetonotus aculifer* and *H. atlanticus* sp. nov. as well as early hermaphroditic phase in *H. aculifer* were observed.

Résumé : Seize espèces de Chaetonotida ont été recoltées dans la région de Roscoff et d'Arcachon, dont les quatre suivantes étaient nouvelles : *Xenotrichula quadritubulata*, *Chaetonotus inaequidentatus* (groupe d'espèces *Ch. Schultzei*), *Halichaetonotus atlanticus* et *Heterolepidoderma arenosum*. Deux autres espèces, *Chaetonotus* ? *variosquamatus* et *Aspidiophorus* ? *paramediterraneus*, ont été trouvées pour la première fois sur les côtes françaises. *Xenotrichula quadritubulata* sp. nov. se caractérise par la présence de deux paires de tubules adhésives ; le nouveau groupe d'espèces a été créé pour ce Gastrotriche. Un grand hypostomium a été trouvé chez *Halichaetonotus aculifer* et *H. atlanticus* sp. nov. et la phase hermaphroditique hâtive a été observée chez *H. aculifer*.

INTRODUCTION

This paper contains the results of a search conducted in summer 1982 at Station Biologique de Roscoff and Station Biologique d'Arcachon for marine gastrotrichs belonging to the Chaetonotida. First part of the results, which concerned methodology and members of the order Macrotrichida, was presented in a previous paper in this series (Kisielewski 1988). The material for this study was sampled from the stations that were described in first paper, though, members of the order Chaetonotida were also found at some other localities as well. On the coast of la Manche, there were baie de Kernic (18 km west of Roscoff) and grève de Goulven, south of Plounéour-Trez village (24 km west of Roscoff), whereas on the Atlantic coast there was Cap Ferret - the station on the open ocean side.

As far as measurement lists for the Chaetonotidae are concerned, the ratios I used (Kisielewski 1981) for characterizing freshwater members of the family have been used again, namely the at : ph ratio, the pharyngeal formula, and the ratio of scale distribution. The at : ph is a ratio of length of naked adhesive tube section (being measured as proposed in the paper cited) to pharynx length. The pharynx formula describes the pharynx shape and consists of three values. The first one is the ratio of maximum width of anterior pharyngeal thickening to pharynx length,

second is the ratio of pharynx width at its mid-length to pharynx length, while the third is the ratio of the maximum width of posterior pharynx thickening pharynx length. The ratio of scale distribution is that of total number of longitudinal rows of scales (counted from a cilia band through lateral and dorsal body sides to another cilia band) to a number of scales in a row. All ratios are expressed in per cent ; \bar{x} denotes mean value, while N indicates the number of measured specimens.

Suborder Multitubulatina d'Hondt, 1971

Family Neodasyidae Remane, 1929

Neodasys chaetonotoideus Remane, 1927a

Localities. La Manche : channel of Ile de Batz - very abundant at MTL, less abundant at MLWNT; baie de Kernic - in small number among fine sand at MTL.

Distribution. Baltic (Roszczak 1939), North Sea (Remane 1927a, Forneris 1961, Schmidt & Teuchert 1969, Mock 1979), Wales (Boaden 1963a, b), Scotland (W.D. Hummon 1976), Northern Ireland (Boaden 1966, 1968), la Manche. French coasts : Roscoff (Lévi 1950, d'Hondt 1970), bassin d'Arcachon (Renaud-Debyser 1964, d'Hondt 1966a), golfe d'Aigues-Mortes (Fize 1963).

Suborder Paucitubulatina d'Hondt, 1971

Family Xenotrichulidae Remane, 1927b

Xenotrichula intermedia Remane, 1934

Localities. Atlantic : bassin d'Arcachon, plage d'Eyrac and Cap Ferret (Camp Americain) - fairly abundant in fine both clean and grey sand at MTL ; the open ocean, Cap Ferret - abundant among clean medium and coarse sand at MTL.

Distribution. Reported from many stations along European coasts including French ones, also found on the Mediterranean coast of Algeria (d'Hondt 1973), Atlantic coast of USA (W.D. Hummon 1967, 1974b, 1975, W.D. Hummon & M.R. Hummon 1977) and in India (Ganapati & Chandrasekhara Rao 1967, Chandrasekhara Rao & Ganapati 1968a). From most of these stations reported under the name of *X. beauchampi* Lévi, 1950, which was considered by Ruppert (1979) as a junior synonym of *X. intermedia*. The discovery of *X. carolinensis* Ruppert, 1979 in USA and *X. c. syltensis* Mock, 1979 in Europe revealed that another species very closely related with *X. intermedia* occurs on the same area, therefore, most previous records of the later species seem to be doubtful.

X. velox Remane, 1927b

Locality. La Manche : Bay of Goulven, south to Plounéour-Trez - abundant among clean medium sand at MTL.

Distribution. Reported from many stations around Europe as well as from Mediterranean coast of Algeria (d'Hondt 1973) and India (Ganapati & Chandrasekhara Rao 1967, Chandrasekhara Rao & Ganapati 1968a, b, Chandrasekhara Rao 1969, 1970, 1980, Chandrasekhara Rao & Clausen 1970). French coasts: Pas de Calais (d'Hondt 1968a), Roscoff (Lévi 1950, d'Hondt 1970), bassin d'Arcachon (Renaud-Debyser 1963a, b, d'Hondt 1966a, 1971, Ruppert 1979), golfe de Gascogne (d'Hondt 1968a) and Marseille (Swedmark 1956b).

In accordance with Ruppert's observations, my specimens had a bidentate hypostomion with "horns" projecting forward. The cephalic tentacles were clearly covered with fine scales.

X. quadritubulata sp. nov. (Fig. 1a-c)

Locality. La Manche - submarine sand-bank Trezen ar Skoden - only two specimens.

Type specimens: Holotype has not been designated. The Nomarski interference optics microphotographs of both specimens are kept in the author's collection (ref. n° 231/82 and 234/82).

Etymology. From the Latin quadri - four, and the Latin tubulus - tubule, referring to the presence of two pairs of adhesive tubes.

Diagnosis. *Xenotrichula* with two pairs of adhesive tubes. The stumpy body about 125 μm in length. A pair of elongate antero-dorsal cephalic cirri and a pair of short lateral ones. Tentacles absent. Dorsal and lateral body sides covered with pedunculated scales arranged in 11 longitudinal rows, about 64 in each. Peduncles with appearance of two separated points when observed from above. A pair of ventro-lateral rows of "hydrofoil" scales. Basal parts of caudal appendages 1.3 times as long as external longer tubes, the former covered with 8 scales along their inner margins. Five cirri per side in posterior group.

DESCRIPTION

The body is about 125 μm long, stumpy and flat. The head is furnished with two pairs of sensory cirri. There is a pair of long (13 μm) antero-dorsal cirri, comprised of cilia of different lengths, and a pair of very short (5 μm) lateral ones. The caudal appendages are short, widely separated and have two adhesive tubes per side. The external tubes, which adjoin to the inner ones, are longer (9-9.5 μm compared with 6-6.5 μm). Both inner tubes of one of the specimens studied were furnished with a thorn projecting laterally (Fig. 1a, c). The caudal base length: external tube length ratio is as 1.3: 1. There are three pairs of dorsal sensory bristles: two pairs are inserted at the end of pharynx and the third at the base of caudal appendages. All locomotory ventral cirri are of similar size, including five per side occurring in the posterior group.

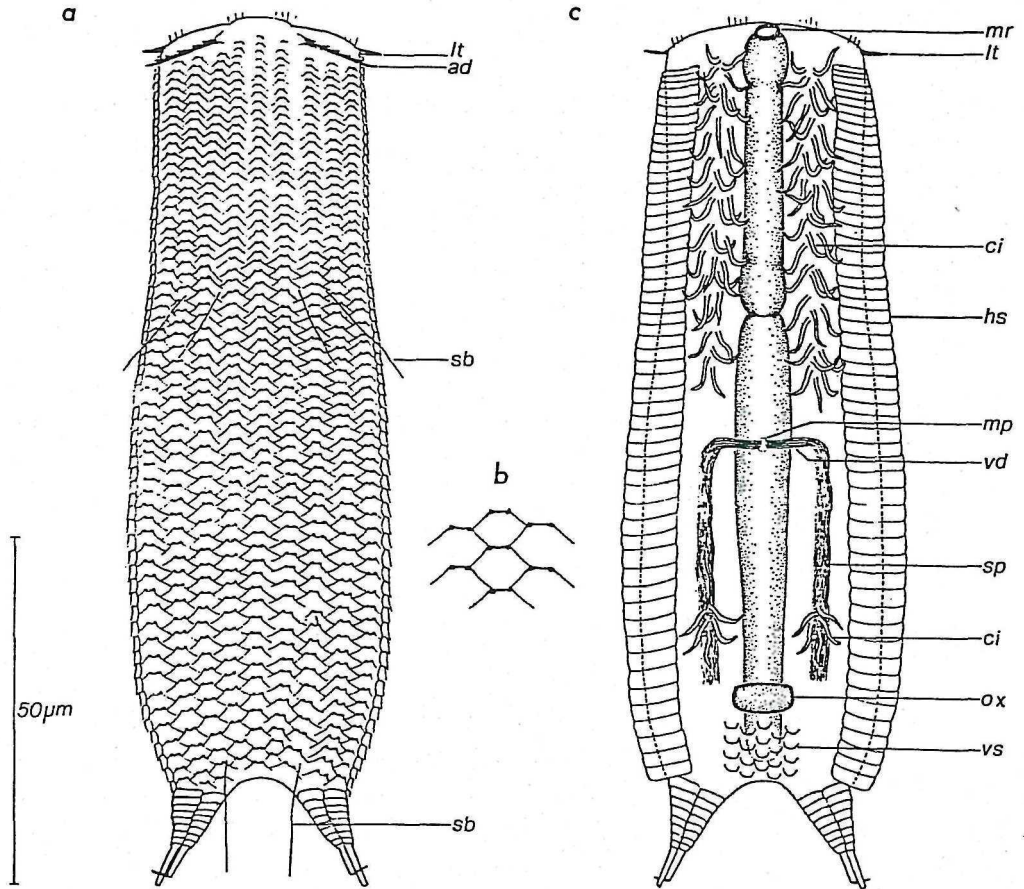


Fig. 1a-c - *Xenotrichula quadritubulata* sp. nov.; a - dorsal view of animal, b - some dorsal pedunculated scales, from above, c - ventral view of animal. ad - antero-dorsal cephalic tentacle, ci - locomotory vental cirri, hs - "hydrofoil" scale, lt - lateral cephalic tentacle, mp - ventral male pore, mr - mouth ring, ox - organ x, sb - sensory bristle, sp - spermatozoa in testicle, vd - vasa deferentia, vs - vental posterior simple scales.

The dorsal and lateral body surfaces are covered with small scales having a peculiar peduncle. The later is 1 μm long and apparently wide and flat, since it is seen from above as two separate points instead of one. The scales are hexagonal being 5.5 μm long (on the mid-trunk region). They are arranged in eleven longitudinal rows, about 64 in each. The ventral cuticular armature consists of a paired longitudinal ventrolateral row of "hydrofoil" scales and a group of large simple scales located on the posterior trunk region. Both the dorsal and ventral surfaces of each proximal furcal branch are covered with two longitudinal rows of eight simple scales.

The mouth ring is narrow and ribbed longitudinally. The pharynx is long (40-41 μm) and has weak anterior and posterior thickenings (7.5 μm wide compared with 6 μm wide middle part). The paired testicle occurs in the middle and posterior trunk region, whereas joint ventral opening of vasa deferentia is located considerably posterior to the pharyngo-intestinal junction. The usual filiform spermatozoa occur in the testes, while the transversally running sections of vasa deferentia are filled with rather thick rod-like structures. The X-organ is almost rectangular in shape and does not seem to be subdivided into lobes.

The animal moves slower than usual among *Xenotrichula*.

DISCUSSION

X. quadritubulata sp. nov. occupies a special position in the genus. First, it has two pairs of adhesive tubes, which has been a feature unknown so far within the whole Xenotrichulidae. The presence of a pair of long cephalic cirri, the occurrence of a pair of short lateral cirri, and the absence of cephalic tentacles is also a distinct character. The dorsal scales show a peculiar peduncle which gives impression of two separate points when observed from above, therefore, they differ from peduncles occurring among all known members of *Xenotrichula* and *Heteroxenotrichula*. Thus, it seems necessary to establish a new species group - *X. quadritubulata*, apart from the groups *X. intermedia* and *X. velox* which have been previously proposed by Ruppert (1979).

Heteroxenotrichula squamosa Wilke, 1954

Localities. Atlantic: bassin d'Arcachon - Pilat dune - abundant in fine clean sand at MTL.

Distribution. North Sea (Mock 1979), Scotland (W.D. Hummon 1976), Eastern Atlantic, Mediterranean Sea (Wilke 1954, Swedmark 1956b, Luporini *et al.*, 1973) and Atlantic coasts of USA (W.D. Hummon 1974b, 1975, Ruppert 1979). French coasts: bassin d'Arcachon (Ruppert 1979) and Marseille (Swedmark 1956b).

The animals found were in full accordance with the Ruppert's (1979) diagnosis of the species. The inner margins of caudal furca were usually covered with ten, but sometimes with eleven scales. Anastomosis of the testis occurred between 3/4 and 4/5 of intestine length.

H. arcassonensis Ruppert, 1979

Localities. Atlantic: Cap Ferret (the open sea side) - abundant in medium and coarse clean sand at MTL; Petit Nice - in fine clean sand at MTL.

Distribution. Described from the region of Arcachon (plage d'Eyrac and Cap Ferret) and not recorded from any other station.

My specimens answered fully the Ruppert's description, including the presence of 13 scales along inner margin of caudal furca. Only the copulatory organ was located a little more posterior than reported by Ruppert (clearly behind the pharyngeointestinal junction).

H. pygmaea (Remane, 1934)

Locality. La Manche : submarine sand-bank Trezen ar Skoden - in small number.

Distribution. Baltic (Remane 1934), North Sea (Mock 1979), la Manche, Eastern Atlantic, Black Sea (Valkanov 1957), Atlantic coasts of USA (W.D. Hummon 1968, Ruppert 1979) and Japan (Sudzuki 1979). French coasts : bassin d'Arcachon (Renaud-Debyser 1963a, b).

A specimen measured was 119 μm long ; its caudal appendages were 36 μm long ; and the length of adhesive tubes amounted to 14.5 μm . The sensory cephalic cirri were 16 μm in length, whereas the lateral "tentacles" which consisted of agglutinated cilia were 5 μm long. The pharynx was 31 μm in length ; it reached 8.5 μm in width at the anterior thickening but was 5.5 μm wide along the remaining part.

Family Chaetonotidae Zelinka, 1889

Chaetonotus atrox Wilke, 1954

Localities. La Manche : Roscoff, channel of île de Batz and bay of Aber - not abundant in fine and medium sand containing organic detritus, between MLWNT and MLWST.

Distribution. Western Swedish coast (Boaden 1960), North Sea (Mock 1979), Wales (Boaden 1963a, b), la Manche, Mediterranean Sea (Wilke 1954, Swedmark 1956b, Luporini *et al.* 1973) and India (Ganapati & Chandrasekhara Rao 1967, Chandrasekhara Rao & Ganapati 1968a). French coasts : Roscoff (Swedmark 1955, 1956a, Dragesco 1960, d'Hondt 1970), Marseille (Swedmark 1956b).

The specimens found are in accordance with the original description and supplementary observations by Luporini *et al.* (1973) and Mock (1979). The only difference should be mentioned here : my animals had the pharynx considerably shorter (31-34 μm in length compared with 49 μm according to Wilke and 42-45 μm according to Mock).

Ch. inaequidentatus sp. nov. (Fig. 2 a-f)

Localities. La Manche : Roscoff, channel of île de Batz and the bay of Aber - abundant among fine, medium and coarse sand, both clean and enriched in organic detritus, between MLWNT and MLWST.

Type specimen : Holotype, a mature specimen collected from the channel of île de Batz on August 2 is deposited with MNHN Paris Collections (ref. n° UC 64).

TABLE 1 - Morphometrical features of *Chaetonotus atrox*

feature	range	\bar{X}	N
body length	121-141 μm	129.0	4
length of caudal appendages	20-28 μm	23.7	3
length of adhesive tubes	13-18.5 μm	15.2	4
at : ph ratio	39.4-54.4 %	46.9	4
pharynx length	31-34 μm	32.5	4
pharynx formula	25.0-28.1 %	26.3	3
	18.8-21.2 %	20.2	3
	25.0-29.7 %	26.8	3
diameter of mouth ring	4-4.5 μm	4.3	3
total number of longitudinal rows of scales	11-12	11.2	4
number of scales in a longitudinal row	14-16	15.0	4
ratio of scale distribution	68.8-78.6 %	75.2	4
length of neck scales	4.5 μm		2
length of trunk scales	5-8 μm	6.7	3
length of dorsal neck spines	7-9.5 μm		2
length of lateral neck spines	10-14 μm	11.7	3
length of dorsal trunk spines	10-11 μm		2
length of lateral trunk spines	13-19 μm	15.1	4
length of rearmost lateral spines	12-13 μm		2

Etymology: from the Latin in - not, Latin aequalis - even, level, and the Latin dens - tooth, referring to asymmetry of double lateral denticle in posterior spines.

Diagnosis. *Chaetonotus* of the *Ch. schultzei* group having body 132-162 μm in length. Scales with three distinct narrow lobes, the former distributed in 19-24 longitudinal rows, 22-25 in each. Spines (including ventro-lateral) with double lateral denticle placed near to their base and with hair-like curved distal part. At least three rearmost dorsal spines with considerably asymmetrical lateral denticles and with a straight and thicker distal part.

DESCRIPTION

The body is elongated and lacks a distinct neck constriction. The front of head is covered with fairly wide cephalion, while the pleurae are presumably absent. The hypostomion is rudimentary. Rather long adhesive tubes are strongly curved ventrally.

The body is covered with spined scales distributed in 19-24 longitudinal alternating rows, 22-25 in each. The scales are rather small (up to 6 μm long) and are distinctly three-lobed in shape. They bear long spines, which are thick and straight only at the base, their distal portions being hair-like and curved. At the junction of thick and hair-like parts a double lateral denticle is placed. While most of denticles tend to be asymmetrical, the clear asymmetry can be always observed on the three rearmost dorsal spines. The denticles are inserted near the spine base, never farther than at 1/2, but sometimes even at 1/5 of the spine length. The length of spines increases considerably from the front of head

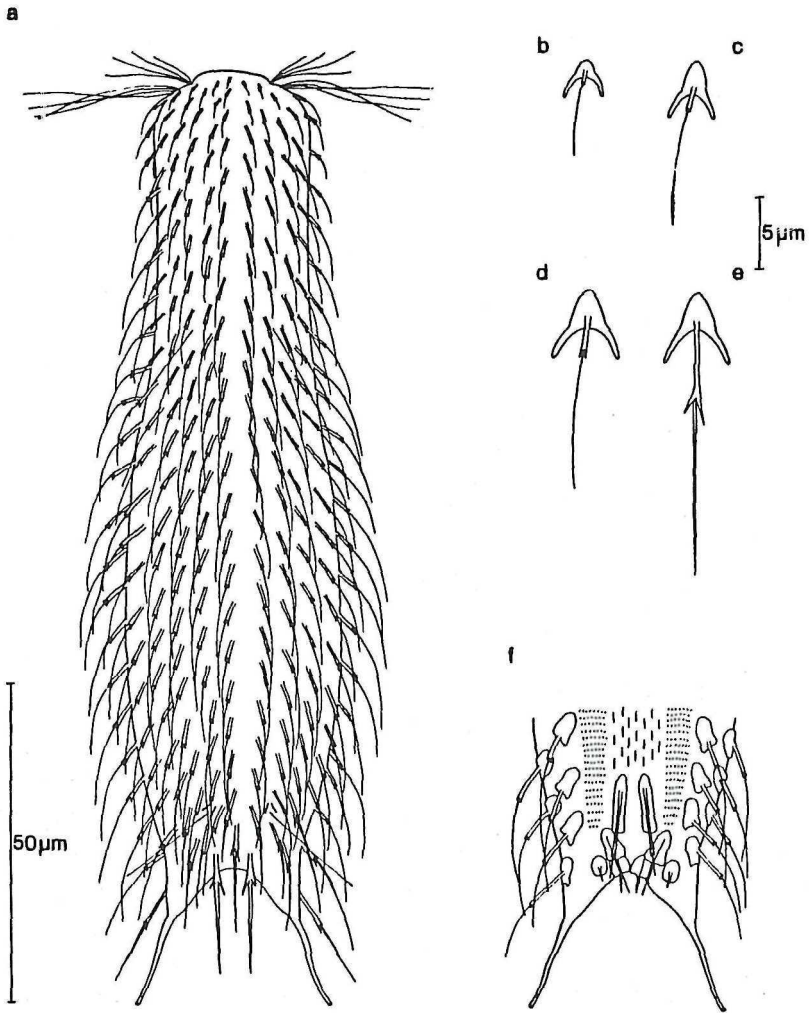


Fig. 2a-f - *Chaetonotus inaequidentatus* sp. nov.; a - general dorsal view, b - dorsal spined scale from head c - dorsal spined scale from neck, d - dorsal spined scale from mid-trunk, e - the posteriormost dorsal spined scale with clearly asymmetrical double denticle, f - ventral view of posterior trunk region (locomotory cilia marked as points).

to the mid-trunk region, whereas posterior spines are of the same length than those from the middle of trunk. Apart from possessing the clearly asymmetrical double denticle, the posterior trunk spines have straighter and thicker distal parts. The ventral field terminates with a pair of elongated keeled scales bearing double-denticle spines, the total scale - spine length being 16-18 μm . The intestinal field region bears short spines arranged in several longitudinal alternating rows. The spines located more posteriorly are usually seen as lines, whereas those which are placed anteriorly give impression of points, like the cuticular armature of *Aspidiophorus* Voigt.

The mouth ring is slightly subterminal. The pharynx is slender, has two indistinct thickenings at both ends, the anterior of them being furnished with a pair of short cuticular rods. The locomotory ventral cilia bands run along the whole body and do not join anywhere. Two pairs of tactile bristles are inserted in typical positions. None of the animals studied showed any male reproductive structures.

TABLE 2 - Morphometrical features of *Chaetonotus inaequidentatus* sp. nov.

feature	range	\bar{X}	N
body length	132-162 μm	144.2	5
length of caudal appendages	20-28 μm	23.4	6
length of adhesive tubes	14-16 μm	15.1	7
at : ph ratio	41.4-47.1 %	44.2	5
pharynx length	31-36 μm	34.2	5
pharynx formula	22.1-29.0 %	25.5	5
	17.1-25.0 %	21.2	5
	22.9-29.0 %	26.4	5
diameter of mouth ring	5-6.5 μm	5.6	6
total number of longitudinal rows of scales	19-24	21.2	4
number of scales in a longitudinal row	22-25	23.3	3
ratio of scale distribution	87-100 %	94.3	3
length of neck scales	2.5-6 μm	4.2	3
length of trunk scales	3.5-6 μm	4.8	4
length of dorsal neck spines	7-10.5 μm	8.8	4
length of lateral neck spines	10-12 μm	11.3	5
length of dorsal mid-trunk spines	10-13.5 μm	11.4	4
length of lateral mid-trunk spines	12-16 μm	13.6	6
length of rearmost lateral spines	13-16 μm	14.9	6

DISCUSSION

The presence of a double lateral denticle on the spines indicates that the species should be classified into the *Ch. schultzei* species group. For none of the nine previously described species belonging to the group was an asymmetry of double lateral denticle reported, whereas this feature may be consistently observed on at least some posterior dorsal spines of *Ch. inaequidentatus*. Moreover, the species from Roscoff differs from the eight remaining marine species belonging to the group by following characters :

- from *Ch. atrox* Wilke, 1954 in having more numerous longitudinal rows of scales (19-24 compared with 13), thinner distal spine parts (compare with microphotograph by Mock 1979, p. 434) as well as in having only one pair (instead three pairs) of ventral posterior spines furnished with double lateral denticles ;
- from *Ch. neptuni* Wilke, 1954 in having a smaller body size (the length 132-162 μm compared with 250 μm) and in lacking a pair of considerably longer lateral spines on the rearmost trunk region ;
- from *Ch. dispar* Wilke, 1954 in lacking a third lateral denticle on its spines ;
- from *Ch. woodi* Thane-Fenchel, 1970 in having different scale shape, in

lacking a pair of considerably longer dorsal spines on the trunk rear as well as in inserting a double denticle near to the spine base ;

- from *Ch. jucundus* Schrom, 1972 in having a considerably smaller body size (the length 132-162 μm compared with 265-282 μm), a more slender body, a cephalion, different scale shape and more numerous longitudinal rows of scales ;

- from *Ch. serenus* Schrom, 1972 in having more numerous longitudinal rows of scales and scales per row, a clear double denticle on the dorsal and ventro-lateral spines, larger scales with distinct postero-lateral lobes, as well as in showing the presence of a cephalion ;

- from *Ch. modestus* Schrom, 1972 in showing a more slender body, more numerous longitudinal rows of scales, larger scales clearly three-lobed in shape, thinner spines with double denticle located near to the base, as well as in having a cephalion ;

- from *Ch. hilarus* Schrom, 1972 in having well developed ventro-lateral spines (with double denticle), larger scales with distinct postero-lateral lobes, the double denticles being placed nearer to the base than the end of spines, as well as by presence of a cephalion.

Ch. ? variosquamatus Mock, 1979 (Fig. 3 a-e)

Localities. La Manche : the île de Callot - abundant among coarse gravel at MTL. Atlantic : Petit Nice - rather not abundant in medium sand, between MTL and HWL.

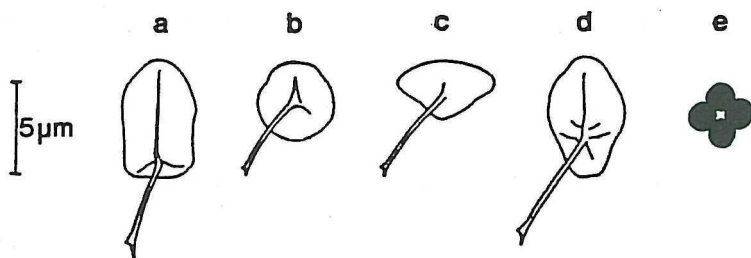


Fig. 3a-e - *Chaetonotus ? variosquamatus* ; a - dorsal spined scale from head, b and c - dorsal spined scales of different shape from neck, d - dorsal spined scale from trunk, e - optical section of spine (enlarged).

Distribution. North Sea (Mock 1979). New for the fauna of France.

Many features of the animals found on the French coasts were in accordance with those of the species described by Mock from Sylt. Both gastrotrichs showed the same body habit, similar shapes of scales in specific body regions (Fig. 3 a-d), short spines having almost terminally placed membranous denticle, a paired longitudinal row of wide ventro-lateral lamellae as well as the same kind of ventral field and ventral posterior trunk covering. The pharynx and mouth ring of compa-

red gastrotrichs were of the same size and presumably similar shape (respective details are lacking in the Mock's description); also a pair of cuticular rods occurred in both cases inside the anterior pharyngeal thickening.

However, my specimens were markedly smaller (the body length 113-115 μm compared with 140-160 μm), had a short but well marked cephalion (which was not mentioned by Mock) and presumably also weakly developed pleurae noticeable only from ventral side. Contrary to the Mock's animals, the French specimens had the anterior tuft cephalic cilia longer than those of posterior tuft. Total number of longitudinal rows of scales (excluding the ventral field covering) was higher in French animals (15-17 compared with 13). Lastly, the dorsal and lateral spines of my specimens were clearly tetragonal in optical section (Fig. 3e), whereas Mock has interpreted them as triangular.

Both the differences mentioned above and lack of some details in the Mock's description (on the number of scales in a longitudinal row, number and size of ventro-lateral lamellae, width of particular pharynx regions) make it a little doubtful whether the French and German specimens belong to the same species.

TABLE 3 - Morphometrical features of *Chaetonotus ? variosquamatus*.

feature	range	\bar{X}	N
body length	113-115 μm		2
length of caudal appendages	21 μm		1
length of adhesive tubes	13-15 μm	14.0	3
at : ph ratio	43.3-46.9 %		2
pharynx length	30-32 μm		2
pharynx formula	30.0 %		1
	18.3 %		1
	28.3 %		1
diameter of mouth ring	5-5.5 μm		2
total number of longitudinal rows of scales	15-17		2
number of scales in a longitudinal row	16-19		2
ratio of scale distribution	78.9-106.2 %		2
length of neck spines	6 μm		2
length of dorsal trunk spines	4.5 μm		1
length of lateral trunk spines	8-8.5 μm		2
number of ventro-lateral lamellae	23		2
length of lamellae	up to 6 μm		1
height of lamellae	5 μm		1

Halichaetonotus aculifer (Gerlach, 1953) (Fig. 4)

Localities. La Manche : submarine sand-bank Trezen ar Skoden - in small number. Atlantic : Petit Nice and Banc d'Arguin - abundant amongst fine sand between MTL and HWL.

Distribution. Reported from many stations around Europe as well as from Atlantic coasts of USA (W.D. Hummon 1967, 1974b). French coasts : Flanders (d'Hondt 1968a), Calvados (Kaplan 1958), Roscoff (d'Hondt 1970), bassin d'Arcachon (Renaud-Mornant & Jouin 1965, d'Hondt 1966a, 1966b, 1971), golfe de Gascogne (d'Hondt 1968b), and Canet-Plage (Delamare Deboutteville 1953, 1954).

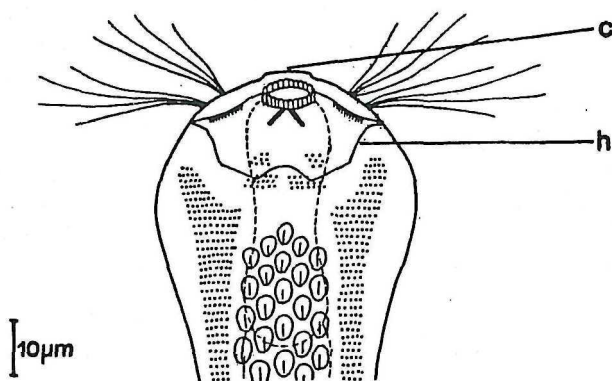


Fig. 4 - *Halichaetonotus aculifer* - ventral view of anterior body region. Locomotory cilia marked as points. c - cephalion, h - hypostomion.

The description of this common species should be supplied with some important details. Apart from a narrow dorsal cephalion, an unusually strong hypostomion occurs on the ventral side of head. It is a polygonal plate 13 μm in length and 31 μm in width, whose anterior top adheres to the mouth ring while the posterior margin is cut and raised (Fig. 4). Rows of points being apparently an implantation of muscle fibres, occur along its antero-lateral edges. The location and appearance of the points mostly resemble those of "kammartigen Zacken" which were described by Remane (1927b) for *Xenotrichula velox* and subsequently observed by Wilke (1954) in *X. cornuta* and by me (Kisielewski 1984) in *X. guadelupense*. Considering this similarity and the presence of well developed hypostomion amongst the *X. velox* group of species (see the description of *X. cornuta* Wilke, 1954), it seems that "kammartigen Zacken" in *Xenotrichula* could be also interpreted as a muscle fibre implantations in the hypostomion edge.

The animals studied had a pair of strong cuticular rods which were obliquely placed inside the anterior pharynx thickening. In one of specimens studied, I have observed a fully developed bilobed X-organ, located ventrally at the trunk rear and having narrow median bridge as well as some densely packed cells occurring bilaterally at the mid-trunk region. A similarity of these structures and their localization in the body to those observed among freshwater members of Chaetonotidae (M.R. Hummon 1984a, b, Kisielewska 1981 & pers. comm.) suggests that the specimen just underwent the early hermaphroditic phase, and its mid-trunk cells were spermatogonia.

TABLE 4 - Morphometrical features of *Halichaetonotus aculifer* (most of measurements was taken from a specimen derived from Trezen ar Skoden; data concerning animals found at other stations are marked with *).

feature	value
body length	190 μm
length of caudal appendages	41 μm
length of adhesive tubes	29 μm
at : ph ratio	69.0 %
pharynx length	42 μm
pharynx formula	31.0 %
	22.6 %
	31.0 %
diameter of mouth ring	8 μm
total number of longitudinal rows of scales (including these consisting of ventro-lateral spined lamellae)	13 (11-16*)
number of scales in a longitudinal row	13 (13-15*)
ratio of scale distribution	100.0 % (73.3-86.7 %*)
length of trunk scale	15-20 μm
width of trunk scale	10 μm

H. paradoxus (Remane, 1927c) (Fig. 5 a-c)

Locality. La Manche: Golf of Goulven, south to Plounéour-Trez - two specimens in medium sand at MTL.

Distribution. Scotland (McIntyre & Murison 1973, W.D. Hummon 1976), Mediterranean Sea (Remane 1927c, Wilke 1954, Swedmark 1956b, Luporini *et al.* 1973). French coasts : Marseille (Swedmark 1956b).

The specimens found answered the Remane's description. The dorsal trunk scales were 10 μm long and had 3.5 μm high keel being slightly protrading beyond the scale end (the total of scale - keel length was 11.5 μm). In accordance with Remane's observations, and contrary to data of Wilke (1954) and Luporini *et al.* (1973), the posterior scale edges were markedly cut. The keels of lateral trunk scales were 4.5 μm high. The ventro-lateral lamellae, originating from rather small and oval-shaped scales, were 8 μm long and 7 μm high. A pair of keeled scales occuring at ventral field end was 11.5 μm in length and 6 μm in width.

a



b

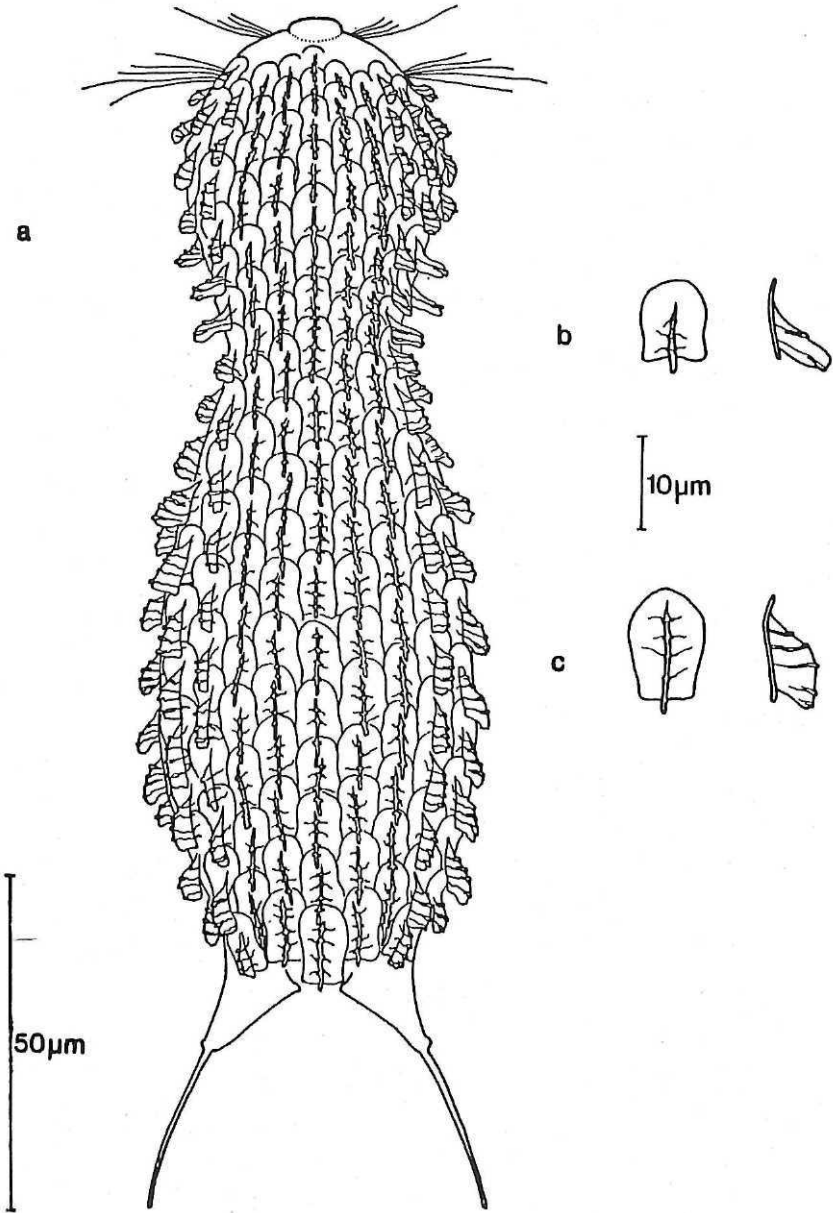


c



Fig. 5a-c - *Halichaetonotus paradoxus*; a - ventro-lateral scales with lamellae, b - dorsal keeled scale from trunk, seen from above, c - the same scale seen semilaterally.

H. atlanticus sp. nov. (Fig. 6 a-f)



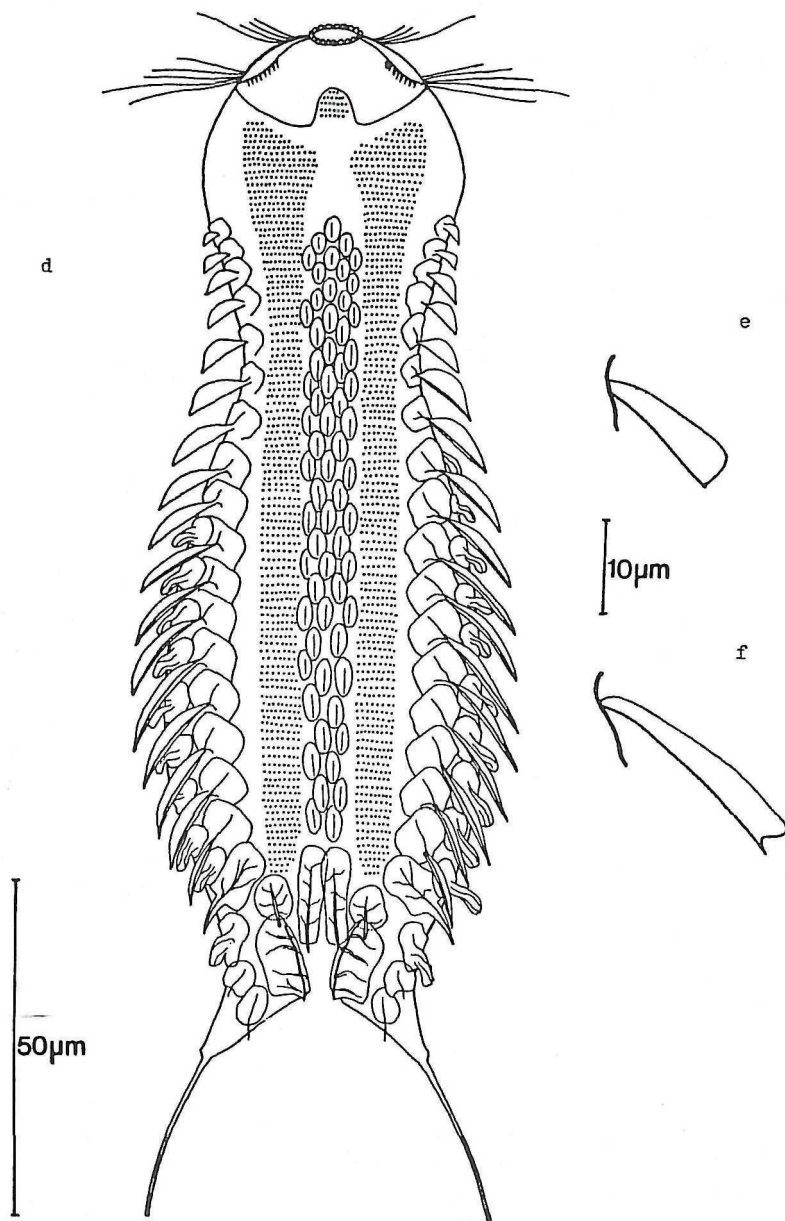


Fig. 6a-f - *Halichaetonotus atlanticus* sp. nov.: a - general view, from dorsal, b - keeled scale from head, dorsal and lateral view, c - keeled scale from trunk, dorsal and lateral view, d - general view, from ventral (locomotory cilia marked as points), e - semilateral view of neck ventro-lateral lamellated scale, f - semilateral view of trunk ventro-lateral lamellated scale.

Localities. Atlantic: Petit Nice and Banc d'Arguin - abundant in fine sand between MTL and HWL.

Type specimens. Holotype, collected from the station at Petit Nice on August, 28, is deposited with MNHN Paris Collections (ref. n° UC 65). Four paratypes are retained in the author's collection.

Etymology: from the geographic name of Atlantic ocean, on eastern coast of which the species has been discovered.

Diagnosis. *Halichaetonotus* with the body 155-168 μm in length. Dorsal and lateral trunk scales 10-12.5 μm in length, with posterior cutting and high keel; both keel and scale surface are transversally ribbed. Some 16-17 pairs of ventro-lateral spined lamellae are present, the trunk ones being 12.5-16 μm long and 3.5-5 μm high. Hypostomion almost as wide as head and deeply cut posteriorly. Small cephalion present. A pair of cuticular rods occurs inside pharyngeal anterior region.

DESCRIPTION

The body is rather slender and has well marked neck constriction. There is a small cephalion, whereas the hypostomion, like that of *H. aculifer*, is unusually large. It is in form of a wide plate whose anterior top encompass laterally and posteriorly the mouth ring, while posterior edge is deeply cut (Fig. 5 d). Like *H. aculifer*, a paired row of muscle fibre implantations occurs on the antero-lateral hypostomion margins. The cephalic cilia of particular specimens were more or less divided into two pairs of tufts. The adhesive tubes are long, pointed and slightly curved interiorly.

The body is covered with scales of diverse character. They are arranged in 13-15 (usually 15) longitudinal alternating rows, 17-20 in each. The first paired ventro-lateral longitudinal row consists of 16-17 (usually 17) spined lamellae, including up to five on the pharyngeal region (first or first two being very small; Fig. 5 d-f). The spined lamellae of the trunk are 12.5-16 μm long and 3.5-5 μm high. The subsequent paired longitudinal row consists of scales which bear protruding lamellae being ribbed longitudinally; the lamellae are 4.5-6 μm long and up to 3 μm high. All remaining scales covering lateral and dorsal body side are elongated and have their end truncate or even slightly cut. A high lamella being transversally ribbed extends along their median and posterior region. The lamella ribs are also continued on the scale surface; this is easiest to detect on the trunk scales, the posteriormost ones in particular (Fig. 5 a-c). These irregular lines crossing the keels and scales give impression of body surface cracks, while the keels seen from above have appearance of twisting cords or plaits. The trunk scales are 10-12.5 μm long and 6.5-9 μm wide whereas their keel is 5-7 μm high. The cephalic scales are of similar shape; however, they are somewhat smaller and have lower keels. The neck scales are much shorter than trunk scales but their keels are

of similar height. The ventral field terminates with a pair of elongated keeled scales, 12.5-15.5 μm in length and showing transverse ribs. The ventral interciary field of the pharyngeal and intestinal regions are covered with oval keeled scales (4.5-5 μm long), distributed in 6-7 longitudinal alternating rows. The inner side of the caudal furca base is covered ventrally with a pair of asymmetrical large keeled scales, which have a short spine at their ends. These scales are also transversally ribbed.

The ventral locomotor ciliary bands run the whole length of the body and do not join anywhere. Apart from them, an unpaired tuft of cilia occurs ventrally at the posterior border of the hypostomion.

The mouth ring is very short. There are two conspicuous terminal pharyngeal thickenings, the anterior one being furnished with a pair of strong cuticular rods. I have observed only parthenogenetic members of the species.

DISCUSSION

Among 16 species of *Halichaetonotus* Remane described so far, a new gastrotrich resembles most of all *H. paradoxus* Remane, 1927c. Both species show large scales having truncate ends and unusually high keels being equally developed on lateral and dorsal scales. However, *H. atlanticus* differs from *H. paradoxus* and other members of the genus in having conspicuous transverse ribs on keel and scale surface.

TABLE 5 - Morphometrical features of *Halichaetonotus atlanticus* sp. nov.

feature	range	\bar{X}	N
body length	155-168 μm	162.3	3
length of caudal appendages	32-38 μm	35.6	4
length of adhesive tubes	26-30 μm	28.0	5
pharynx length	36-40 μm	38.4	4
at : ph ratio	64.2-80.6 %	73.2	4
pharynx formula	29.2-36.4 %	32.2	3
	21.0-26.7 %	22.9	3
	29.6-38.5 %	33.5	3
diameter of mouth ring	6-7 μm	6.5	3
total number of longitudinal rows of scales including these consisting of ventro-lateral lamellae	13-15	14.8	10
number of scales in a longitudinal row	17-20	19.0	9
ratio of scale distribution	75.0-88.2 %	79.1	7
length of trunk scales	10-12.5 μm	11.7	3

Heterolepidoderma arenosum sp. nov. (Fig. 7a-c)

Locality. La Manche : Roscoff, channel of île Batz - only two individuals found in medium clean sand below MLWST.

Type specimens : not distinguished.

Etymology : from the Latin arena - sand, referring to animal habitat.

Diagnosis. *Heterolepidoderma* with body 105-117 μm in length. Head with large "ocellar" granules and two pairs of pleurae, posterior ones markedly protruding laterally. 29-33 longitudinal rows of oval keeled scales, the former running obliquely on the neck and posterior trunk region. Paired cuticular grains and rods inside the anterior pharyngeal thickening.

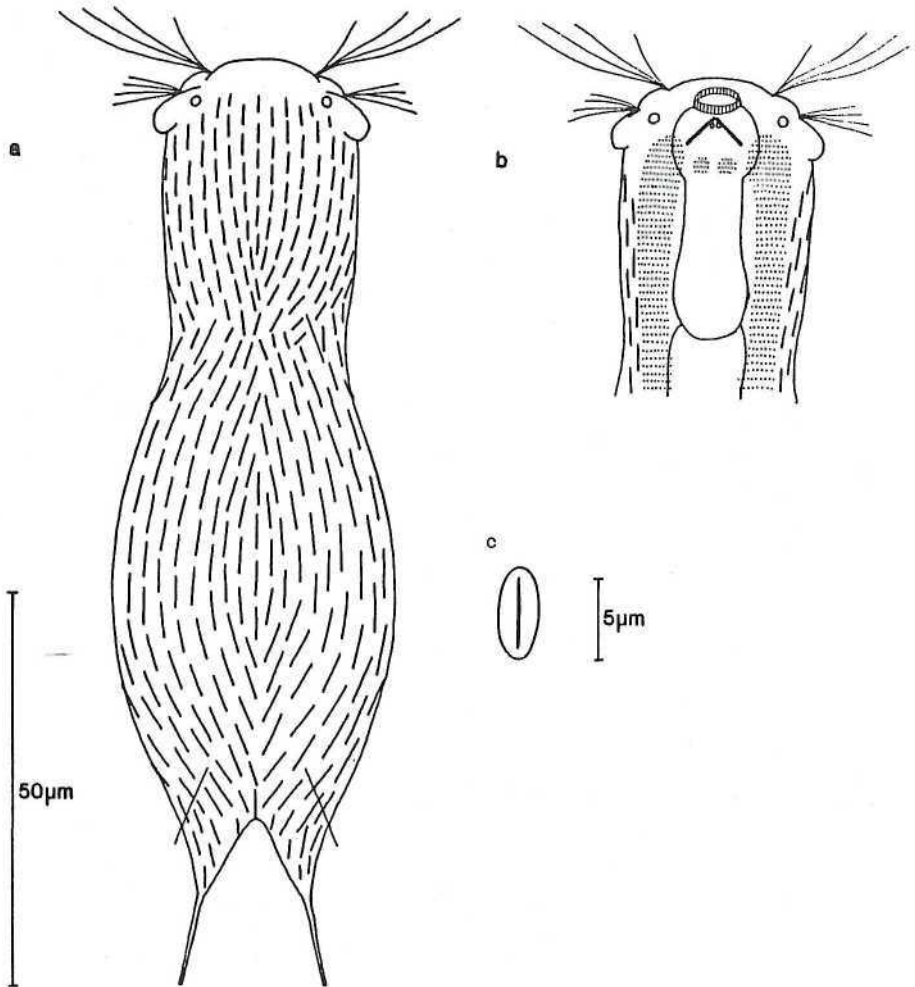


Fig. 7a-c - *Heterolepidoderma arenosum* sp. nov.: a - general view, from dorsal, b - ventral view of anterior body region (locomotory cilia marked as points), c - dorsal trunk scale.

DESCRIPTION

The body is rather elongated and has a weakly marked neck constriction. The head is somewhat flattened frontally and is furnished with cephalion and two pairs of pleurae, the former being the largest and anterior pleurae the smallest. The posterior pleurae are flattened and conspicuously protruding laterally. There are two pairs of cephalic ciliary tufts, the anterior ones consisting of longer and more flexible cilia. A pair of large "ocellar" granules, which are readily seen as light-refracting bodies even under low microscope magnification is present; they occur at the boundary of the anterior and posterior pleurae. The caudal tubes are long, straight and tapered.

The body is covered with keeled scales, which are arranged in 29-33 longitudinal rows, running obliquely on the neck and on the trunk rear. Each of basal part of the caudal appendage is covered dorsally with several keeled scales, which are of similar size to those occurring in the mid-trunk region. The mid-ventral field terminates with a pair of keeled scales 9 μm long. Anteriorly and laterally to them, some smaller keeled scales occur, while the remaining part of field seems to be naked.

The ventral cilia bands run wide by separated beneath the whole length of the body. At their foremost region, a pair of isolated ciliary tufts also occurs (Fig. 7b).

The mouth ring is of rather large diameter. The pharynx has two terminal thickenings, the anterior one being conspicuously larger than posterior. The former is furnished with two pairs of cuticular structures: that of round grains and that of long rods. The intestines of specimens studied were filled with diatoms. Only parthenogenetic specimens have been observed.

TABLE 6 - Morphometrical features of *Heterolepidoderma arenosum* sp. nov. (N = 2)

feature	range
body length	105-117 μm
length of caudal appendages	19-24 μm
length of adhesive tubes	11.5-12.5 μm
at : ph ratio	39.0-50.0 %
pharynx length	25-29.5 μm
pharynx formula	39.0-42.0 %
	23.7-30.0 %
	35.6-36.0 %
diameter of mouth ring	5.5-6 μm
total number of longitudinal rows of scales	29-33
number of scales in a longitudinal row	18-20
keel length in neck scales	2-2.5 μm
keel length in trunk scales	4.5-5 μm

DISCUSSION

Nine from 23 species of *Heterolepidoderma* described so far live in the marine habitat: *H. marinum* Remane, 1926, *H. hermaphroditum* Wilke, 1954, *H. armatum* Schrom, 1966, *H. clipeatum* Schrom, 1972, *H. contectum* Schrom, 1972, *H. istriatum* Schrom, 1972, *H. loricatum* Schrom, 1972, *H. axi* Mock, 1979 and *H. grandiculum* Mock, 1979. For none of them the presence of "ocellar" granules has been reported, whereas this feature is easy to detect in *H. arenosum* sp. nov. Moreover, the species *H. clipeatum*, *H. contectum* and *H. loricatum* show considerably larger and less numerous scales than those of compared species, and *H. contectum* in addition lacks the large protruding posterior pleurae. The last character is also absent in *H. hermaphroditum*, *H. axi*, *H. grandiculum* and *H. istriatum*. *H. arenosum* differs also:

- from *H. marinum* in having smaller number and large-sized keeled scales on the dorsal side of caudal appendage basal parts, as well as in showing oblique disposition of scale rows on posterior trunk region (in respective body part of *H. marinum* the rows run in parallel);
- from *H. armatum* in having terminal scales of ventral field, as well as in lacking keels on the intestinal field region and ventral bristles on inner margin of caudal furca base;
- from *H. istriatum* in lacking small keels on the intestinal region of ventral field and large ventral scale at inner margin of caudal furca base, as well as in having well marked scale edges (the scale edges are not noticeable in *H. istriatum*);
- from *H. axi* in lacking ventro-lateral lamellae and in showing rounded ends of dorsal scales;
- from *H. grandiculum* in having somewhat smaller body size (body length 105-117 μm compared with 130-150 μm), smaller number of longitudinal rows of scales (total of 29-33 compared with 30 only on dorsal side) and smaller number of scales in a row (18-20 compared with 30), as well as in showing presence of terminal ventral field scales that are considerably longer than all neighboring ones.

Among freshwater members of the genus, the "ocellar" granules occur in *H. ocellatum* (Mečnikov, 1865) *sensu* Kisielewski, 1981, *H. tenuisquamatum* Kisielewski, 1981 and *H. macrops* Kisielewski, 1981; however, all these gastrotrichs have smaller anterior pharyngeal thickenings than that of *H. arenosum* and do not show strongly protruding posterior pleurae.

Aspidiophorus marinus Remane, 1926

Localities. La Manche: Roscoff, the Bay of Aber and channel of île de Batz - abundant in fine and medium sand from clean to black, between MTL and MLWST; the île de Callot - in small number amongst coarse gravel at MTL; submarine sand-bank Trezen ar Skoden - in small number.

Distribution. Recorded from many stations along the European coasts including French ones as well as from the Atlantic coast of USA (W.D. Hummon 1967, 1974b, 1975), Japan (Saito 1937, Sudzuki 1976), India (Ganapati & Chandrasekhara Rao 1967, Chandrasekhara Rao & Ganapati 1968a, Chandrasekhara Rao 1969) and Maldives (Gerlach 1961). French coasts: Calvados (Kaplan 1958), Roscoff (Lévi 1950, Swedmark 1950, 1955, 1956a, Dragesco 1960, d'Hondt 1968a, 1970, 1974), bassin d'Arcachon (Renaud-Debyser 1963a, b, d'Hondt 1966a).

DESCRIPTION

The body is rather plump. The head is short, semicircular, without marked pleurae. The cephalic sensory cilia of most specimens were not clearly separated into two pairs of tufts. A pair of "ocellar" granules having appearance of light-refracting bodies have occurred in some animals, of dark amorphous spots in others, or the granules were even lacking at all. The cephalion is short (13.5-16.5 μm in length) and 12-15 μm wide. It raises almost vertically allowing the anterior pedunculated scales to grow right up to the front of the head. The hypostomion is short (3-4.5 μm long) and is 7.5-10.5 μm wide. It does not show any transverse furrow. The neck constriction is almost lacking. The trunk is wider than head in its middle region, whereas its posterior part is narrow. Adhesive tubes are straight, pointed and of medium length.

The body is covered with oval pedunculated scales, having well marked keels, the latter running along the whole length of the scale or even projecting slightly to the rear. The scale edges are hardly detectable in classical light microscopy, though the keels and peduncles are easy to detect. Ventro-lateral, lateral and dorsal scales are arranged in 67-75 longitudinal alternating rows, however, at first glance, they seem to be distributed in transverse rows, on the cephalic region in particular. The pedunculated scales of the mid-trunk region are the largest (3 μm in length), whereas those which occur on head and caudal furca base (both dorsal and ventral ones) are considerably smaller. The scale peduncles are short (1-1.2 μm in length). The mid-ventral field is naked except for a pair of narrow terminal scales having keels usually projecting somewhat to the rear.

Ventral cilia bands run the whole length of the body and are separated from one another. Only in the cephalic region, just behind the hypostomion, are they joined by a transverse band. The mid-ventral field being free from cilia is 6 μm wide in the pharyngeal region and 3.5 μm wide at the rear of the trunk, whereas the total width of both bands amounts 15 μm and 7 μm respectively.

The mouth ring is short (2-3.5 μm long) and of medium diameter (5.5-8 μm), being subterminal and furnished with numerous short bristles. The pharynx is of medium thickness and is weakly narrowed in its middle region. Its anterior thickening shows dorsally the presence of an oval dark area, while its medio-ventral region is furnished with a pair of cuticular rods.

TABLE 7 - Morphometrical features of *Aspidiophorus marinus*

feature	range	\bar{x}	N
body length	121-178 μm	147.8	11
length of caudal appendages	16.5-22 μm	19.3	9
length of adhesive tubes	9.5-13 μm	10.6	10
at : ph ratio	24.4-35.1 %	29.6	9
pharynx length	30-43 μm	36.6	10
pharynx formula	27.0-31.4 %	29.3	8
	17.9-28.3 %	24.4	8
	25.0-31.4 %	29.5	8
diameter of mouth ring	5.5-8 μm	6.4	11
total number of longitudinal rows of pedunculated scales	67-75		2
number of pedunculated scales in a longitudinal row	38-48	42.5	4
ratio of scale distribution	168-170 %		2
length of pedunculated scales on trunk	3 μm		1

DISCUSSION

Remane (1926, 1927c) has described two marine species belonging to the genus *Aspidiophorus* Voigt: *A. marinus* and *A. mediterraneus*. Following features of later species were indicated as differing it from *A. marinus*: the presence of neck and posterior trunk narrowings as well as lack of "ocellar" granules. More recent authors, Schrom (1972) in particular, have stated that characters basing on body shape are of limited use in these species, because of intraspecific variability affected by physiological state of animal. Thus, the main character believed to differ both species is the presence or lack of "ocellar" granules. Many specimens I have studied suggested on the basis of other features that they belong to the same species, however, as far as the presence of "ocellar" granules is concerned, they differed considerably (from the presence of typical light-refracting bodies to lack at all). I have even found a specimen bearing an unpaired well-developed granule. Therefore, this character is also of little diagnostic value. Moreover, my specimens showed a high number of longitudinal rows of pedunculated scales. Even if one considers that data on these respective feature given for *A. mediterraneus* by other authors (Luporini *et al.* 1971, Schrom 1972, Mock 1979) are not fully comparable with mine and do not include a number of lateral and ventro-lateral rows, it seems that the longitudinal rows of scales of *A. mediterraneus* are less numerous than those of *A. marinus*. Only further study of this character as well as more detailed metric data (describing shape of pharynx, cephalion and hypostomion as well as giving length of naked region of adhesive tubes) may solve the question of whether the forms described as *A. marinus* and *A. mediterraneus* actually belong to separate species.

A. ? paramediterraneus W.D. Hummon, 1974a (Fig. 8a, b)

Localities. La Manche : Roscoff, the bay of Aber near the station biologique and channel of the île de Batz - fairly abundant among fine, medium and coarse sand usually rich in organic detritus, between MLWNT and MLWST. Atlantic : bassin d'Arcachon, Eyrac beach - in small number among black fine sand at MTL.

Distribution. Atlantic coasts of USA (W.D. Hummon 1974a, b) and Scotland (W.D. Hummon 1976). New for the fauna of France.

Body was elongated and did not show neck constriction. The head was covered with cephalion being wider and longer than reported by W.D. Hummon (22-28 μm wide and 18-21 μm long) and protruding far forward. This plate consisted of two parts, anterior and posterior, being movably joined, that might be detected when head was straightened and both parts formed an angle (Fig. 8a). There was a pair of small pleurae being in form of narrow "ears" projecting laterally. "Ocellar" granules were absent. The hypostomion was very short (3-3.5 μm in length), slightly wider than in Hummon's specimens (10-11 μm in width) and did not show any transverse furrow. There were two pairs of well-separated tufts of cephalic cilia.

The ventral field between cilia bands was only 2-3 μm wide on pharyngeal region and 2 μm wide on rear of the trunk, while the whole width of cilia bands amounted 15 μm and 7 μm respectively. The bands were joined on the anterior part of pharyngeal region in some animals, however, they never joined on the trunk, as reported by Hummon for the American specimens.

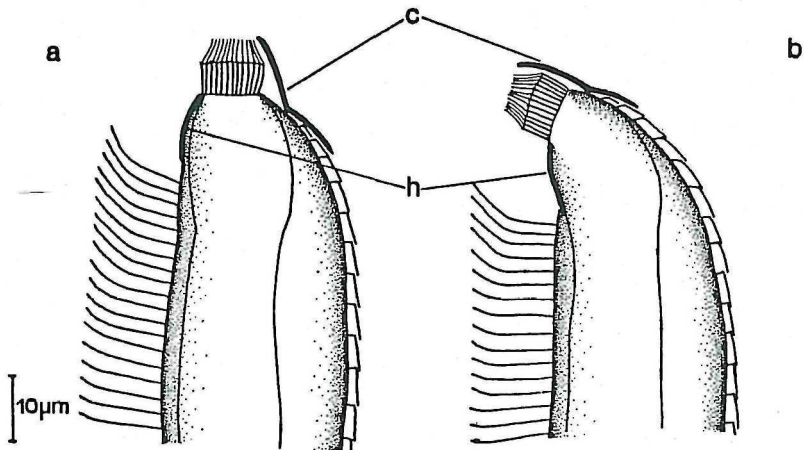


Fig. 8a-b - *Aspidiophorus ? paramediterraneus* - lateral view of anterior body region ; a - the head erect and the cephalion "broken", b - the head and cephalion at typical position. c - cephalion, h - hypostomion.

The body was covered with very numerous pedunculated scales being arranged in 74-93 longitudinal alternating rows, 53-64 in each. In spite of alternating row distribution being common condition amongst Chaetonotidae, the rows seemed to be arranged transversally at first glance. Similarly to American animals, the scales were 3 μm long and their peduncles about 1.5 μm long. In contrast with Hummon's observation, I was not able to detect scale keels. The mid-ventral field was naked except for its rear which bore a pair of long (8 μm) and unusually narrow unkeeled scales. In some specimens, only the internal joined edges of both scales were seen, giving impression of a single long keel.

TABLE 8 - Morphometrical features of *Aspidiophorus ? paramediterraneus*

feature	range	\bar{x}	N
body length	214-288 μm	248.0	5
length of caudal appendages	27-32 μm	29.1	4
length of adhesive tubes	13-15.5 μm	14.0	4
at : ph ratio	21.0-23.2 %	22.3	4
pharynx length	55-70 μm	61.4	5
pharynx formula	25.0-26.1 %	25.4	4
	20.0-24.6 %	21.8	4
	30.4-31.4 %	30.9	4
diameter of mouth ring	9.5-11.5 μm	10.6	4
length of mouth ring	5.5-6 μm		2
total number of longitudinal rows of pedunculated scales	74-93		2
number of pedunculated scales in a longitudinal row	53-64		2
ratio of scale distribution	175.5 %		1

Like American animals, the mouth ring (5.5-6 μm in length and 9.5-11.5 μm in diameter) was almost terminal and covered by the cephalion. The pharynx had a median constriction and a conspicuous posterior thickening. Its anterior region was devoid of cuticular formations.

The description given above shows that the French specimens differ in some features from the American ones, mostly in having wider cephalion as well as in showing presence of small pleurae and narrow ventral field free from cilia on trunk region. In spite of conformity of remaining characters, I am not quite sure whether both forms belong to the same species.

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