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NOTODELPHYIDAE AND BOTRYLLOPHILIDAE (COPEPODA) FROM THE WEST INDIES

by

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Notodelphyidae and Botryllophilidae are families of cyclopoid copepods, usually associated with Tunicata. Although SARS (1921) considered the families closely related, and placed them together in his suborder Notodelphyoidea, LANG (1946) showed that this group was polyphyletic. The two families are treated here together, simply because both are associated with the same host group.

Through unforeseen circumstances (loss of part of the material while sent out on loan), the publication of this paper was considerably delayed. Certain details that had to be checked, could not be verified owing to the loss of the material involved. In my opinion, however, the available data are still of sufficient interest to warrant publication.

The material covered in this paper comprises:
Notodelphys aurantiaca n.sp., from Curaçao (Figs. 1–2),
Doropygus reductus n.sp., from Puerto Rico (Figs. 3–8),
Pachypygus macer Illg, from Curaçao (Fig. 9),
Doroixys minuta n.sp., from Puerto Rico (Figs. 10–13),
Botryllophilus randalli n.sp., from Puerto Rico (Figs. 14–18), and
Botryllophilus spec., from Puerto Rico.

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Two specimens of *Doropygus reductus* n.sp., described in the sequel, were received from Drs. A. G. HUMES and R. U. GOODING (both at that time of Boston University),

who collected the material during a field trip in 1959, sponsored by the National Science Foundation of the United States. I am indebted to these colleagues for entrustung me this material.

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Family NOTODELPHYIDAE

Members of this family are apparently rare in the region studied. Although a good number of possible tunicate hosts was examined, representatives of only 4 species could be identified, while some immature specimens had to remain unnamed.

Notodelphys aurantiaca n. sp.

(Figs. 1–2)

"Une autre espèce... recueilli[e] aux Antilles"; BOCQUET & STOCK, 1960: 126.

Material. — CURAÇAO: 1 ♀ (holotype) and 1 ♂ (allotype), from the pharyngobranchial sac of *Ascidia interrupta* Heller. Santa Martha Innerbay, behind the Field Station of the Natural Science Study Group; depth 0.1–0.3 m; 8 Oct. 1958. Types in the Zoölogisch Museum, Amsterdam (cat. no. Co. 101.157). – Moreover, 30 specimens from the same locality and host, collected at various dates in 1958 and 1959.

CURAÇAO: Same host. Piscadera Bay, depth 1–2 m; 2 Oct., 28 Oct. and 14 Dec. 1958, every time 1 female.

CURAÇAO: Same host. Fuik Bay, depth 0.3 m; 27 Jan. 1959, 1 ♀ and 1 ♂ from 5 ascidians checked.

Description. – The length of the adult ♀ is about 4.8 mm; the greatest length of the incubatory pouch is 1.60–1.65 mm, its greatest width 0.95–1.00 mm. Spermatophores observed were sausage-shaped, 118 μ long and between 34 and 53 μ wide.

Since the species is obviously closely related to *N. monoseta* Pearse, 1947 (see the redescription of that species in ILLG, 1958), it suffices to mention only the points of difference.

The body (Fig. 1a) is very slender, apparently slenderer than that of *N. monoseta*. The anal operculum is provided with short spinules (Fig. 1b). The terminal setae of the caudal ramus are reduced in length, at most half as long as the length of the ramus.

The eggs in the incubatory pouch are large and not very numerous (Fig. 1a).

The anterior antenna (Fig. 2a) consists of 10 segments, as in *monoseta*, but the new species possesses longer setae on the basal segments (setae shorter than the diameter of segments 1 to 4 in *monoseta*, longer than that diameter in *aurantiaca*). Moreover, the setae are more numerous in *aurantiaca*: segment I–3 setae; II–5 setae; III–12 setae; IV–6 setae; V–5 setae; VI–7 setae; VII–4 setae; VIII–2 setae; IX–2 setae; X–7 setae and 1 aesthete. All setae are plumose.

The tongue-shaped rostrum (Fig. 2b) is similar in both species. Also the posterior antenna (Fig. 2c) does not differ markedly from that of *monoseta*. The mouth-parts and maxilliped are practically identical in the two species.

The first leg (Fig. 1d) offers a number of distinctive features: (1) the first endopod segment is 1½ times as long as wide in *aurantiaca*, versus as long as wide in *monoseta*; (2) the medial seta on the first endopod segment is implanted near the middle of the segment in *aurantiaca*, towards the distal end in *monoseta*; (3) the lateral margin of the basipod bears a well-developed, plumose seta in *aurantiaca*, "a reduced seta" (ILLG, 1958: 500; not illustrated in his fig. 1j) in *monoseta*; (4) exopod segments 2 and 3 bear curiously sinuous rows of small spinules on their surface, not known for *monoseta*.

The 2nd and 3rd legs are mutually nearly identical (Fig. 2d). The chaetotaxis of the 3rd endopod segment of P2 in *aurantiaca* agrees with the information given in ILLG's text (1958: 501) but not with his figure 1k, of *monoseta*.

The 3rd leg of *aurantiaca* (Fig. 2d) is almost identical with the corresponding appendage of *monoseta*, though the curious spiniform processes figured by ILLG (1958, fig. 1l) on the 3rd exopod segment, are lacking in *aurantiaca*.

The 4th legs of both species are nearly identical (Fig. 2e).

The 5th leg of *aurantiaca* is quite distinctive (Fig. 2f). Its basal segment is very elongated. In *monoseta* it shows a rectangular indentation at the insertion of the distal segment, absent in *aurantiaca*. The distance between the lateral prolongation of the basal

segment and the distal segment is much larger in the new species than in *monoseta*. The distal segment in *aurantiaca* is rectangular in outline, it is widest at its base; in *monoseta* this segment is semicircular and much contracted at the base. The distal segment in *aurantiaca* bears (as in *monoseta*) only a single short element; this condition, and the reduced number of segments in the anterior antenna, indicate that *aurantiaca* belongs to the *monoseta*-group of the genus *Notodelphys*.

Male. – The male (length 2275 μ) differs in the usual way from the female. Secondary sexual differences are present in the anterior antenna (which is very similar to that figured by ILLG for *monoseta*, except in having longer and more numerous elements), in the fifth leg (Fig. 2g) (which possesses a row of spinules on the medial side of the basal segment and which has a slightly less produced lateral lobe than in female), in the furca (which is slenderer than in the ♀, and bears less reduced terminal setae, cf. Fig. 1c), and in the anal segment (which lacks marginal cilia, but which bears on its ventral surface 2 triangular pubescent patches, cf. Fig. 1c). The sixth leg of the male is transformed into the usual "genital lobe" (Fig. 2h).

Coloration. – ♀: Body orange, opaque. Incubatory pouch and ovaries golden brown, chocolate brown or lilac brown to lilac black (depending on the state of development of the eggs?). Intestine (in urosome) brown. Eye small, red.

The specific name *aurantiacus* (from Latin *aurum* = gold) alludes to the orange to golden brown color of the body and – in certain cases – of the brood pouch.

Doropygus pulex Thorell, 1860

LANG (1948) has suggested that SCHELLENBERG's concept (1922: 246–247, figs. 26–27) probably embraces several distinct entities. In discussing the *pulex* problem, ILLG & DUDLEY (1961) state, "Evidence begins to accumulate that there are different forms for the families or genera of hosts represented." It is possible, then, that SCHELLENBERG's specimens from Barbados, in a styelid, represent a new taxon and that this may include the material described by ILLG (1958), under *pulex*, from *Styela plicata* (Lesueur) in Florida and Bermuda. From SCHELLENBERG's description, there

is no reason to believe that confusion with the following form could have occurred.

We have not seen West Indian specimens of this species.

Doropygus reductus n. sp.

(Figs. 3–8)

Material. – PUERTO RICO: 4 ♀♀, 4 ♂♂, 7 copepodids and non-adult females, from the branchial sac of 1500 *Ecteinascidia turbinata* Herdman (Ascidiacea: Perophoridae), attached to mangrove roots, west side of cay at N.E. end of Isla Magueyes (17°58′15″ N, 67°02′30″ W), La Parguera, in less than 1 m of water; 12 Feb. 1963. – A female from this lot, with a total length of 2.02 mm is selected as the species holotype; a male becomes the allotype, the remaining specimens being paratypes. The holo- and allotype and 9 paratypes are deposited in the Zoölogisch Museum, Amsterdam (cat.no.Co.100.828 a–c). – Moreover, 2 ♀, same host, same locality, from 208 specimens of the host; 29 July 1959.

PUERTO RICO: 1 young female, from 1000 specimens of the same host, attached to mangrove roots. Near Punta Montalva, W. of Ensenada; 7 Feb. 1963.

Measurements and Figs. 3 a–b were made from entire specimens mounted in lactophenol; the Figs. 3 c, 4 a, 4 b, 4 c, 4 e, 5 c are drawn from a permanent mount in Reyne's modification of Faure's medium of the dissected parts of a 1959 specimen; the remaining female appendages from mounted dissections in the same medium of a 1963 paratype; the male appendages from similar mounts of a 1963 paratype.

The specific name *reductus* (from Latin *reducere* = to reduce) refers to the many structural simplifications from the generalized *Doropygus* pattern.

Female. – The body (Figs. 3a–b) is slender, slightly more compressed than depressed. The length of 4 measured adult females (without furcal setae) was 1.58, 1.82, 1.89, and 2.02 mm. The posterolateral corners of the cephalosome project backwards. The first pedigerous segment is free, but without distinct tergal plates and thus somewhat narrower than the succeeding ones. The segment of leg 4 is expanded and inflated to form the oval incubatory pouch, whose surface is roughened by numerous wrinkles (an artefact due to conservation?). There are 5 urosomal segments, including that bearing the fifth legs, which is only visible in lateral (Fig. 3a) or ventral views. The 2nd urosomal segment carries 2 irregular rows of spinules midventrally: each row is broken into 3 groups, the more anterior lateral pairs having 7–8 (8–9) and 3–4 (9–9) spinules respectively and the median lines 12 and 9 (10 and 12) (the first

figures are from the 1959 female, the figures between parentheses from one of the paratypic females). The anus is dorsal and terminal, with a wide lamella.

The rostrum is triangular, with a rounded apex and basis angles of about 45°.

The first antenna (Fig. 5a) is 7-segmented. Segments 1 and 2 are wide but not exaggeratedly so; segments 3, 4 and 5 diminish successively in diameter; segments 6 and 7 are as wide as 5, and these 3 are cylindrical in shape, being longer than wide, in contrast particularly to segments 3 and 4. The armature is (proximal to distal segments): 3 setae, 17 setae, 9 setae and an aesthete, 3 setae, 2 setae and an aesthete, 4 setae and an aesthete, 7 setae and an aesthete. By comparison, particularly of this armature, with the first antenna in the female *Notodelphys aurantiaca*, it appears that segment 1 is the same in both forms; that segment 2 in *D. reductus* represents a fusion of segments 2 and 3 of *N. aurantiaca*, and segment 3 a fusion of 4 and 5; that segments 4 and 5 in *D. reductus* are equivalent to 6 and 7 in *N. aurantiaca*; that segment 6 in *D. reductus* is a complex comparable to 8 and 9 in *N. aurantiaca*; and that the terminal segments are identical in both species.

The second antenna (Fig. 4a) is 3-segmented. The long basal segment, which shows no trace of subdivision, bears a minute subterminal setule corresponding in position to the 2 long setae in *N. aurantiaca* and thus presumably representing the exopod, but is otherwise smooth. The second segment is unadorned, and about twice as long as wide. The third segment is very slender, about $3\frac{1}{2}$ times as long as wide. Its armature consists of a curved claw, one strong and one very small terminal seta, and two subterminal setae. The homologies of these distal elements are not completely clear; nevertheless, it is tempting to equate the 2 subterminal setae with the most distal of these groups in *N. aurantiaca*, the claw with the same structure, and the terminal two setae with the two setae on the dorsal (posterior) face of that species.

The mandible (Figs. 4b–d) is similar to that of *N. aurantiaca*. The masticatory portion of the coxal incisor process is illustrated in Figs. 4c–d: dorsal to ventral, there are a spinulose seta-like process, a long blade with minute terminal denticulations and a striated face,

then 2 strong teeth, 1 small one and again 2 strong teeth (the dorsal one of this last group with a complex pattern of sclerotisation), and finally, separated by a wide gap, a long, sharp tooth. The width of the gap between the ventral most tooth and the more dorsal teeth is somewhat variable (cf. Figs. 4c and 2d), as is the degree of curving of the tooth itself. In the palp the basis is unarmed; the endopod has 2 segments, the first bearing 2, the second 6 plumose setae; the exopod is indistinctly segmented, and carries 4 plumose setae along its distal edge.

The basic structure of the first maxilla is identical to that of *N. aurantiaca* (Fig. 5c). The coxa bears 2 endites and an epipod. The minor endite is a stout, finger-shaped appendage, with a hirsute distal knob representing the armature. The major endite forms a rounded lobe which, as shown in the figure, bears 8 elements. Three of those have particularly bulbous bases and are barbelated at one side only. One of those elements is much shorter than the others which are mutually about equal in length. The epipod is a subquadrate projection, bearing a long, stout seta and a cone-like hirsute process. The basis is armed terminally with 3 plumose setae. The endopod has a rounded outline, with 2 widely separate plumose setae on the inner side. The exopod is also rounded; it bears 3 strong, plumose setae along the distal edge.

The second maxilla (Fig. 4e) is pentamerous. Eight plumose setae are implanted on segment 1; these are arranged, as in *N. aurantiaca*, on 4 endites, which have (proximal to distal) 3, 1, 2 and 2 setae, respectively. There are 2 setae, similarly plumose, on segment 2, 1 on segment 3, 1 on segment 4 and 3 on segment 5, all of which can be equated with those of the *Notodelphys* pattern.

The maxilliped (Fig. 4f) is unimerous. There are 3 groups of plumose setae: the proximal group on the medial margin comprises 3 setae, the distal group 5, with one seta in each group offset on the anterior face; a long lateral seta completes the armature. We follow ILLG (1958) in considering the lateral seta to represent the reduced armature of an original second segment (although there is no trace of such a segment in *reductus*) and further suggest that the remainder of the appendage may correspond to the basal segment of

the *Notodelphys* pattern. A short line of spinules above the setae on the mesial side forms the only ornamentation.

Legs 1, 2, and 3 (Figs. 6a–c) each have a 3-segmented exopod and a 2-segmented endopod in addition to the protopod. In leg 4 (Fig. 6d) both rami are bimerous. The protopod bears a lateral and a median setule in all legs, in leg 1, moreover, a strong medial spine. The intercoxal plate is narrow in leg 1, wider in legs 2 to 4.

The armature of the legs (elements placed between parentheses are rudimentary) is:

P1 { exp. I-0; I-1; III-I-4 (occasionally III-I-3)
enp. 0-1; 1-6

P2 { exp. I-1; I-1; III-I-5
enp. 0-1; 1-7

P3 { exp. I-1; I-1; III-5
enp. 0-1; 1-6

P4 { exp. (I)-1; (IV)-6
enp. 0-1; 1-5

The lateral seta of the basipod is always very small, the median seta of the coxa somewhat better developed and plumose in all legs. The same trend for anteroposterior reduction of the lateral exopod elements which was noticeable in *N. aurantiaca* and characterizes many *Doropygus* species. Other interesting features in the armament are the reduced number of setae on the second endopod and first exopod segments of leg 1, and in the distal segments of both rami in legs 3 and 4, when compared with the generalized *Doropygus* pattern. Ornamentation occurs mainly on the endopods. There are groups of spinules on the endopod of leg 1, similar groups on the other legs are apparently slightly better developed.

Leg 5 (Figs. 5d–e) is bimerous, consisting of a broad basal part, which is fused with the thoracic segment and that continues between the pair of legs, and an elongated distal segment. The former bears a smooth seta laterally and a medial row of spinules near the base of the second segment. The latter has a straight and smooth lateral margin and a sinuous median edge, which is ornamented with 3 rows of spinules. A row of densely implanted, very small

spinules runs across the dorsal face of this segment; where this row hits the medio-terminal edge of the segment, it turns over to the ventral face, and terminates just before the implantation of the innermost distal long seta. There are also groups of spinules on the ventral face of the second segment: usually 2 groups are present (Fig. 5d), but in one specimen, the left leg has only one group (Fig. 5e), whereas the right leg is normal. Two long setae, whose distal thickening is somewhat annulate but which do not have rows of hairs, form the terminal armature of segment 2. Sixth legs were not seen.

The caudal rami (Figs. 3c–d) are well-developed, over 1½ times as long as the anal segment and 4 times or slightly more than 4 times as long as their diameter. Each ramus is armed with 6 smooth setae: the one on the outer side is conspicuous, situated about 2/5 of the way along the ramus from the base; there are 4 terminal setae, which are about half as long as the ramus; on the dorsal face of the ramus, between the lateral and terminal setae, but nearer to the former, a small seta is found, which is probably homologous with the dorso-terminal seta of other cyclopoids.

Male. – The body (Fig. 7a) is cyclopoid in shape and depressed. The length of 3 measured males was 0.55, 0.60, and 0.60 mm. There are 4 postgenital urosomal segments. The first postgenital segment carries midventrally 2 rows of 6 spinules each (Fig. 7c).

The rostrum is as in female. The first antenna (Fig. 5b) is 9-segmented and the total number of elements is exactly the same as in the female appendage. The first and second segments of the male A1 are identical with the first and second segments of the female; the third segment of the female is represented by four well-separated segments in the male; female segments 4 and 5 correspond fully with male segments 7 and 8; the terminal two segments of the female are homologous with one single male terminal segment. The second antenna of the male is similar to the female appendage. The mouth-parts were difficult to observe, but are probably similar to those of the female.

The legs 1 to 4 show very little reduction; they are biramous, each ramus being trimerous; the trend to transform the elements on the

outer margin of the exopod, so clearly present in the female legs, is entirely absent in the male. The shape, armature and ornamentation of the legs is shown in Figs. 8a–d. The exopod of the third leg (not figured) is constructed as in the fourth; the endopod of the third leg resembles that of the second leg, but lacks the rows of spinules on the distal articulation-lines of segments 1 and 2 (Fig. 8c). The armature of the protopod of legs 1 to 4 is identical to that in the female. The armature of the rami is shown in the following table:

P1	exp. I-0; I-1; III-I-4
	enp. 0-1; 0-1; 1-5
P2	exp. I-1; I-1; III-I-5
	enp. 0-1; 0-2; 1-5
P3	exp. I-1; I-1; II-I-5
	enp. 0-1; 0-2; 1-5
P4	exp. I-1; I-1; II-I-5
	enp. 0-1; 0-2; 1-4

The only element on these legs showing reduction is the median seta of the first exopod segments in legs 2 to 4.

The fifth legs (Fig. 7b) are bimerous, the basal segment being fused with the thoracic segment as in female; a lateral seta, belonging to this basal segment, is well-developed; the 2nd segment is irregularly ovate, without ornamentation; it carries only one distal smooth seta.

The genital segment is provided with 2 posterior, four-angular flaps (the so-called genital lobes); each of the distal corners bears a smooth seta (Fig. 7c).

The anal segment is provided with 2 rows of very minute spinules, just above the implantation of the caudal rami. These rami (Fig. 7d), though 1½ times as long as the anal segment, are only 3 times as long as wide. Their armature is comparable with that of the female furca: there is one plumose lateral seta, 4 plumose terminal setae and a well-developed (smooth?) dorsal seta, implanted about halfway the lateral and terminal setae.

Coloration. – The body of the female is sulphur yellow; the ovaries (seen through the body wall) are olive-green. The eggs in the pouch are olive-green to

green-black (probably depending on their stage of ripeness). The eye is red. The male has a blood-red thorax, whereas the abdomen is colorless. Young females and males are opaque white.

Remarks. – *Doropygus reductus* is thus a distinctive form which may be differentiated morphologically from the other known species of *Doropygus* by the following complex of female characters, all of which are reductions from the generalized *Doropygus* pattern: the 7-segmented first antenna (resulting from fusions of segments 3 with 4, 6 with 7, and 8 with 9 in the 9-segmented structure typical of the genus), the absence of a seta on the mandibular basis, the reduction of elements on the first maxilla, the single seta on the outer side of the 1-segmented maxilliped, the 2-segmented leg 1 endopod, and the 2-segmented leg 4 exopod (3-segmented in all known species, except the first endopod of the imperfectly described *molgulensis* Pearse, 1952), and the armature of the swimming legs (see p. 8). The fifth legs and caudal rami, however, are better developed than in many species. The segmentation of the legs is perhaps the best key character.

Morphologically, although somewhat specialized, *reductus* seems most closely allied to its geographical neighbours (with the exception of *pulex*, as discussed on p. 4): *schellenbergi* Illg, 1958, from off Georgia, and *hummi* Illg, 1958, from the Florida Gulf Coast.

Biological data do not aid in assessing the affinities of the new West Indian species. First, the hosts of *schellenbergi* and *hummi* are not known. Although the incidence of infection is low, the regular occurrence of *reductus* at three different occasions in *Ecteinascidia turbinata*, suggests that this perophorid ascidian is the normal host for *reductus*. If it is, *reductus* would be the first species of *Doropygus* inhabiting regularly perophorid ascidians, and it could be that the distinctive morphology is related to the somewhat isolated position of the Perophoridae Giard within the enterogonous suborder, the Phlebobranchiata Lahille, to which they are currently assigned (Berrill, 1950).

Pachypygus macer Illg, 1958

(Fig. 9)

Pachypygus macer ILLG, 1958: 610, fig. 15.
Pachypygus gibber; WILSON non Thorell, 1927: 162.

Material. – CURAÇAO: From the pharyngo-branchial sac of *Microcosmus exasperatus* Heller. Spanish Water, 3 April 1920, leg. C. J. van der Horst (material examined by C. B. WILSON, 1927), 2 ♀♀.
CURAÇAO: Same host, Piscadera Innerbay, on mangrove roots, 6 Oct. 1958, many specimens.

Remarks. – This species has been described in a satisfactory way by ILLG, 1958. It was already recorded, though under the incorrect name of *P. gibber*, from Curaçao by WILSON. WILSON's material, which has been divided between the U.S. National Museum (Washington) and the Zoölogisch Museum of Amsterdam, has been checked by ILLG and by me, and proves actually to belong to *P. macer*.

Except for the differences in the legs, mentioned by ILLG, the most striking character of *P. macer* is no doubt the 9-segmented A1. Since the generic diagnosis of *Pachypygus* (and ILLG's key on p. 478) speaks of a 7-segmented A1, the diagnosis of the genus needs emendation on this point to make the conception of *P. macer* possible.

We include here some figures of the hitherto unknown male. There is a remarkable sexual dimorphism in the chaetotaxis of legs 2 to 4, as the following table shows:

	♀	♂
P2	exp. I-1; I-0; IV-0	I-1; I-1; IV-4
	enp. 0-1; 0-2; 1-2-3	0-1; 0-2; 1-II-3
P3	exp. I-0; I-0; IV-0	I-1; I-0; IV-2 or IV-3
	enp. 0-1; 0-2; 1-2-3	0-1; 0-2; 1-II-3
P4	exp. I-0; I-0; IV-0	I-0; I-0; IV-2
	enp. 0-1; 0-2; 1-2-2	0-1; 0-2; I-II-2

Coloration. – The female is colorless, translucent; ovaries miniaceous, eggs still brighter (carmine) red; eye light red. The male is colorless with a light red eye.

Doroixys minuta n. sp.

(Figs. 10–13)

Material. – PUERTO RICO: 1 ♀, from *Didemnum* sp., dredged off Mayagüez (67°13'5 W, 18°15' N); depth 40–50 fathoms; bottom muddy sand, 21 Febr. 1963.

This specimen, the holotype, has been dissected; the appendages, mounted on slides in REYNE's (1950) modification of Faure's medium have been deposited in the Zoölogisch Museum, Amsterdam (cat.no.Co.100.825).

Measurements and Fig. 10 a were made from the entire specimen mounted in lactophenol; the remaining figures drawn from the permanent mounts of the dissected parts in Reyne's medium.

The specific name (from Latin *minuta* = small) alludes to the small size of this species, the only member of the genus *Doroixys* Kerschner, 1879 described so far (*D. uncinata* Kerschner, 1879) being at least 3 times as large as *D. minuta*.

Female (holotype). – The body is clearly compressed, in living and preserved state curved, especially so in the metasomal region. It was impossible to measure the total length exactly, but the size taken as indicated in Fig. 10a was 442 μ.

Each posterolateral corner of the cephalosome is produced backwards into a slender, pointed hornlike projection. Although the type species of the genus *Doroixys*, *D. uncinata* Kerschner, has 3 free thoracic segments, no segmentation in the metasomal region of the body was observed in *D. minuta*. It must be admitted, however, that the opacity of the body of the preserved specimen rendered exact observation of this character difficult, so that the absence of segmentation in the metasome must be verified as soon as new material becomes available. The distribution of the few, large eggs, in the incubatory pouch (Fig. 10a) also seems to indicate that not only the fourth, but the second to fourth thoracic segments are involved in its formation. The segment carrying the fifth leg is incorporated in the metasome, as is the genital segment. The urosome is composed of 4 segments, which are smooth except for some fine cilia on the anal segment. The anus is dorsal, with a lamella.

The rostrum is clearly visible in lateral view (Fig. 10a); it is tongue-shaped (Fig. 10b).

The first antenna (Fig. 10b) is 7-segmented. Segments 1 and 2 are wider than the terminal 5 segments, which diminish successively in diameter; segment 2 is as long as wide, segment 7 about twice as

long as its basal diameter, the remaining segments are wider than long. The following approximation of the setal armature (proximal to distal segments) could be made: 2, 16, 6, 4, 4, 3, 10. Aesthetes could not be clearly recognized, but 2 of the setae on segment 7 (marked A in Fig. 10b) might in reality be aesthetes.

The second antenna (Fig. 10c) is 3-segmented; segment 1 is short and unarmed; segment 2 is twice as long as wide, rectangular and likewise unarmed; segment 3 is narrower than segment 2 and slender (about $3\frac{1}{2}$ times as long as wide); it bears 1 seta at about the middle of its inner margin, a terminal, curved claw and 2 subterminal setae.

The mandible consists of an incisor process (Fig. 11a) and a palp (Fig. 11b). The masticatory part of the incisor process is slender; dorsal to ventral there are a seta-like process; a blade with terminal denticulations and a striated face, then 2 small teeth and 3 larger teeth. The basis of the palp is unarmed; the exopod has 2 segments, the first bearing 1, the second 3 plumose setae; the endopod consists of a single segment armed with 5 plumose setae.

The first maxilla is shown in Fig. 11c. It consists of a coxa, bearing one endite and one epipod. The endite is a large, rounded lobe, armed with 8 elements. The epipod is reduced to a plumose seta implanted on a slight rise; its demarcation against the coxa and the basis is not clearly visible. The basis is terminally armed with 1 seta; the exo- and endopod ate more or less fused with the basis; the endopod is about as long as wide and has 3 plumose setae; the exopod is much wider than long and bears 4 plumose setae.

The 2nd maxilla (Fig. 11d) consists of 4 segments; segment 1 has 7 setae, arranged on 4 endites of 1, 2, 2, and 2 setae, respectively; segment 2 has 2 setae, segment 3 has 1, and segment 4 has 3 setae.

The maxilliped is reduced to a unimerous lobe, bearing terminally 5 setae (Fig. 11e).

Legs 1 and 2 (Figs. 12a–b) have both rami 3-segmented; legs 3 and 4 (Figs. 12c, 13a) have a 3-segmented exopod and a 2-segmented endopod. The protopod is 2-segmented in all legs; the 2nd protopod segment is provided with a long plumose lateral seta in leg 1, with a short, rudimentary lateral seta in leg 2, whereas it is unarmed in legs 3 and 4.

A narrow intercoxal plate is present in leg 1 only. Also on leg 1 only occurs a broad spine, on the 2nd protopod segment, near the implantation of the endopod. The 1st endopod shows a characteristic inward curving. The great length of the setae on all legs is also to be noted. The tendency towards a reduction of the endopod is present already in leg 2; endopod segments 1 and 2 are devoid of any armature. In legs 3 and 4, the endopods became 2-segmented; the basal segment is unarmed, the very elongated 2nd segment bears 5 and 4 setae respectively.

The armature of the rami of legs 1 to 4 is:

P1 { exp. I-1; I-1; II-I-4
enp. 0-1; 0-1; 1-3-2

P2 { exp. I-0; I-0; III-I-5 (or 3-1-5)
enp. 0-0; 0-0; 0-3-2

P3 { exp. I-0; I-0; III-6
enp. 0-0; 0-3-2

P4 { exp. I-0; I-0; II-6
enp. 0-0; 0-3-1

The fifth legs are clearly visible in lateral view (Fig. 10a); the left and right legs are connected by an arched chitinous plate (Fig. 13b). Each leg consists of a bifid point, a seta being implanted in the bifurcation, and of a rounded protuberance distally armed with a triangular tooth, laterally with 2 obtuse lobes.

The caudal rami (Fig. 10d) are well-developed, about as long as the anal segment. Each ramus bears 4 smooth terminal setae, the longest of which is about as long as the ramus itself. The lateral and dorsal armature and ornamentation is made up of several setae and cilia; probably the anterior most of these (marked *l* in the figure) represents the lateral seta of the *Notodelphys* furca, whereas the seta marked *d* in the figure might be homologous with the dorsoterminal seta of the *Notodelphys* pattern; the remaining cilia, some of which also occur on the medial margin of the furca, are just ornamentation.

Coloration. – The body of the female is opaque white, the eggs in the pouch are pink.

Remarks. – The present species has the combination of features that characterizes *Doroixys* (see key in STOCK, 1967: 30–31 *)). Apparently, its incubatory pouch has the tendency to extend farther foreward than in *D. uncinatus* Kerschner, 1879 (the type and unique species), but I feel that this character alone should not weigh-out the evident similarity in the appendages.

Apart from the extension of the incubatory pouch, *D. minuta* differs from *D. uncinata* chiefly in the following details: the much smaller size, the better development of the furcal setae, the reduction of the 3rd endopod to two segments, the greater elongation of the 4th endopod and the presence of 2 hooks, instead of one, in the 5th leg.

UNIDENTIFIED NOTODELPHYIDAE

Unidentifyable notodelphyids (copepodids or males) were collected at two occasions.

CURAÇAO: Piscadera Innerbay, from *Symplegma viride* Herdman, on mangrove roots, 6 Oct. 1958, 1 ♂. – Piscadera Innerbay, from *Ascidia interrupta* Heller, dredged at 3 m, 17 Dec. 1958, 2 copepodids.

Family BOTRYLLOPHILIDAE

After a detailed study of European material belonging to the genus *Botryllophilus*, I came to the conclusion that LANG's (1948) simplification, implying the classification of all described *Botryllophilus* taxa into 2 species only, is not tenable. Since a revision of the European species is in preparation, it is not necessary to go into the reasons for this conclusion. It suffices to mention that the structure of the first and second antenna, of the mouth-parts (chiefly mandible and first maxilla) and of the fifth leg provide very useful, and stable, characters for the distinction of the species. It is quite true that, as LANG demonstrated, the structure of the 1st to 4th legs, on which the systematics of the genus was largely based in the past, is rather variable, but even these variations are bound to certain limitations. The number of postgenital segments seems to be a good character as well; in several species, the increase of

*) This key needs correction of a typographical error. In couplet 1 b one should read "Mx_2 4- to 5-segmented" instead of "Mx_2 5-segmented."

this number seems to be a constant phenomenon. Finally, the male (unknown in most species) shows differences at almost generic level, comparable with the situation in the genera *Mytilicola* and *Trochicola* (family Mytilicolidae), where the females are practically indistinguishable, but the males widely different.

Botryllophilus randalli n. sp.

(Figs. 14–18)

Material. – PUERTO RICO: From small compound ascidians, *Eudistoma olivaceum* (Van Name). Isla Magueyes, La Parguera (17°58'15" N, 67°02'40" W), growing on the waterline, on the small pier of the Institute of Marine Biology, in the channel between Isla Magueyes and the coast, 5 March 1963, 3 ♀♀. One female has been selected as the holotype, the 2 remaining females become paratypes; the types are deposited in the Zoölogisch Museum, Amsterdam (cat.no.Co.100.827 a, b).

Measurements and the figure of the entire animal were made from specimens mounted in lactophenol; the remaining figures have been drawn from permanent mounts in Reyne's modification of Faure's medium.

The specific name has been chosen in honour of Dr. JOHN E. RANDALL, Professor in Biology, former Director of the Institute of Marine Biology, University of Puerto Rico, Mayagüez, on whose invitation I could visit Puerto Rico and whose stimulating enthusiasm has facilitated fieldwork to a great extent.

Female. – The length of the 3 specimens collected was 0.85, 0.95, and 1.01 mm. The cephalosome and the pedigerous segments 1, 2, 3, and 4 are all well-articulated and have about the same width. The ovaries extend forward just into the cephalosome (Fig. 14b). The 5th pedigerous segment is nearly as wide, but much less long than the 4th. The 5th legs are transformed to the typical obliquely upward and backward directed horns (Fig. 15a). Ovisacs were not found. The genital segment is slightly wider than long, laterally provided with a rounded lobe, near which on the ventral surface the vulvae are found (Fig. 15d). Facing the concave margin of the vulva, 3 tooth-like processes (*t*) can be distinguished as well as 2 highly refractive bodies (*r* in the figure). The genital segment shows an indistinct trace of subdivision on the level of the lateral lobes. The dorsal surface of the genital segment is, in the midline, provided with a complicated, unpaired array of chitinous bars, etc., the function and exact structure of which are not clear to me. There are 6 postgenital urosome segments; these are articulated with one

another in a kind of telescoping way; the anterior 5 of them are 4 to 5 times as wide as long; only the posteriormost (= the anal segment) is about as long as wide.

The first antenna (Fig. 14a) consists of 4 functional segments, the basal one being by far the largest. It is apparently made up of several fused segments; indications for these disappeared segments can be found in the presence of 3 chitinous thickenings (marked *e* and indicated by punctilated areas in Fig. 14a) in the posterior margin of the first segment; the distal two of these thickenings are in connection with chitinous plates covering part of the surface of the first segment (the limits of these plates are indicated by dotted lines in Fig. 14a); the distalmost thickening is in one specimen associated with a pseudo-articulation (or fold in the exoskeleton). The first segment bears 9 large and 5 smaller smooth setae on its anterior margin; most of the larger setae are implanted on quite large basal protuberances. The second segment is somewhat eccentrically implanted; it has 3 setae. The fourth segment, normally implanted, has a very tapering distal part; it bears one long and strong terminal seta and 6 smaller setae.

The second antenna (Fig. 14b) is trimerous. The first segment is elongated, slightly curved and unarmed; the second segment is small, triangular and likewise unarmed; the third segment, elongated, straight, is shorter than the first; it bears two strong spines on the proximal half of its inner margin, then 1 big, denticulated spine subterminally on the inner margin and further 4 stiff setae of gradually increasing length on the distal margin. From the implantation of the subterminal element to the longest distal element runs a row of small spinules.

The coxal incisor process of the mandible (Fig. 16b) has a clearly demarcated masticatory portion; dorsal to ventral, there are a small seta, a long blade with minute denticulations, 2 short triangular teeth, and finally, separated by a wide gap, a long, sharp tooth. In the palp (Fig. 16a) the basis is unarmed. The exopod is indistinctly articulated with the basis, it is unsegmented, but its armature is arranged in two groups: one feeble seta is implanted far aside, near the proximal articulation of the exopod, whereas 2 strong, plumose setae are implanted terminally. The endopod is 2-segmented; the

1st segment is more or less rectangular in outline and unarmed; the 2nd segment consists of a wide proximal part and a narrower distal part, separated by a distinct constriction; 2 feeble setae are implanted on the boundary of the proximal and distal parts, while 2 strong, plumose setae are implanted subterminally and 2 still stronger plumose setae terminally on the distal part.

The first maxilla (Fig. 16c) can be derived without much trouble from that of *Doropygus reductus*. The coxa bears 1 endite (comparable with the major endite of *D. reductus*) armed with 4 plumose setae; the epipod is reduced to a small triangular lobe (in some species of *Botryllophilus*, e.g., *B. macropus* Canu, 1891, this lobe is setiferous, just as in *D. reductus*). No segmentation lines could be observed between the basis and the endo- and exopod; the inner margin of the basis bears 2 plumose setae (3 in *D. reductus*); the inner-distal lobe represents no doubt the endopod, now fused with the basis – it bears 3 plumose setae; the exopod might be represented by a finger-shaped outer-distal process and 1 plumose and 1 rudimentary seta. In *Botryllophilus macropus*, the outer margin of the basis is provided with a strong, recurved process; instead, we find a smooth, thin seta on the same place in *B. randalli*.

The 2nd maxilla (Fig. 16d) is indistinctly segmented; there is a suggestion of a smooth basal segment, and of a distal portion armed with 4 larger and 1 smaller plumose inner setae, with 2 terminal setae and with 2 spine-like setae, slightly set apart near the bases of the 2nd and 4th plumose inner setae.

The maxilliped (Fig. 16e) is much better developed than in *Doropygus*. It consists of 2 large, tapering segments, each with a row of spinules at the distal margin; the 2nd segment has, moreover, a small spinule at the inner margin; distally there is a large, curved claw, possibly made up of 2 segments: a smooth, trapezoïdal basal segment and the curved tapering distal one. In the middle of the distal segment a spinule is implanted on the inner margin; the sclerotization changes there in properties, giving the impression of another articulation. Distally, the claw is bifid.

The left and right 1st legs are nearly identical (Figs. 17a, b). The 2nd protopod segment bears ventrally, near the implantation of the endopod, an inner row of spinules. This row is also present on the

same place in the legs 2 to 4. However, a lateral seta, usually present on the 2nd protopod segment, was not found in the specimens examined. This seta is present on leg 1 of the following species treated in this paper (*Botryllophilus* sp.), and has been observed as well on legs 2 to 4 of the present species. The first exopod is unimerous on both sides; the right exopod bears 5 strong lateral spines (numbered 1 to 5 in Fig. 17b), 1 subterminal seta and 1 more or less rudimentary inner spine; the left exopod has also 5 lateral elements (but these are more slender, seta-like), and 1 subterminal seta, but an inner element is lacking on the left side. Both right and left first exopods have 3 spiniform projections; the distalmost of these is bifid. The endopods are 2-segmented; the 1st segment bears 2 setae, the 2nd segment 7 (right) or 6 (left) plumose setae. Variation: in another dissected female, the right exopod spines 2, 3, and 4 were somewhat shorter than in the leg illustrated in Fig. 17b.

The left (Fig. 17c) and right (Fig. 17d) 2nd legs are constructed in the same way as leg 1. The right exopod bears 4 lateral spines, 1 subterminal spine, and 1 inner spine; only one spiniform projection (a terminal, bifid one) is present. The left exopod is provided with 1 smooth lateral seta, 3 short lateral spines, and 1 subterminal seta. The endopods are 2-segmented, and armed as illustrated.

The asymmetry between the right and left 3rd legs, is very pronounced (Figs. 18a–b). Both have 2-segmented rami, but the left exopod has elongate segments bearing long setae (1 + 4), the right exopod has short, compact segments provided with spine-like elements only (I + V). The endopods are less dissimilar, though the left one is larger than the right one. Both endopods are 2-segmented, with 1 + 7 setae right and 1 + 6 setae left. Variability: the right 3rd exopod of another female studied, had stronger spiniform processes between the spines on the lateral margin of the 2nd segment.

In the 4th leg (Figs. 18c–d), both endo- and exopod on the right side show a tendency towards elongation of their segments. In the left P4, these segments are elongated. As normal, the right exopod bears spiniform elements (I + V), the left exopod setiform elements (1 + 4). The endopods on both sides bear 1 seta on segment 1, 5 on segment 2.

The 5th leg (Fig. 15c) is a tapering, unimerous structure; dorsally, near its implantation, it bears a setule; there are 1 subterminal short seta, 1 terminal short and 1 terminal long setae. The gap between the two short setae is only a small one.

The anal segment and caudal rami (Fig. 14c) have pubescent patches on their surface, but no row of spinules is present on the anal segment. The caudal rami are divergent; each ramus is longer than wide and has a lateral seta and 4 curved terminal claws, directed outward; a dorsal seta, which is found in certain other species of *Botryllophilus*, might be present, but was not observed in the specimens studied.

Remarks. – The female of *Botryllophilus randalli* is, among other features, characterized by its long 5th legs and by the presence of more than 5 postgenital segments. The only described species agreeing with *B. randalli* in this respect are *B. africanus* Schellenberg, 1922, *B. ruber* Hesse, 1864 (s. str.), and *B. indicus* Sewell, 1949. None of these three species is described in a sufficiently detailed way to make a profound comparison possible.

The scanty illustration of SCHELLENBERG's paper makes it a difficult task to evaluate the difference between *B. africanus* and *B. randalli*. Moreover, one of the most characteristic appendages, the 2nd antenna, was lacking in the unique specimen examined of *B. africanus*. The mouth-parts, which are stated to agree approximately ("annähernd") with those of *B. macropus* Canu, 1891, might furnish some distinguishing characters; this might be especially so for the 1st maxilla, which in *B. randalli* is rather different from that in *B. macropus*. Another difference between *B. africanus* and *B. randalli* is found in the anal segment, which bears ventrally a sinuous row of spinules ("gewundene Zähnchenreihe") in the former, whereas it is unarmed in the latter species.

Botryllophilus ruber Hesse, 1864, was never described in great detail. As mentioned, LANG attributed this name to an assemblage of 14 species, agreeing in size only. I reexamined topotypes of *B. ruber* and found them rather similar to *B. randalli*, but differing, among others, by the 2nd antenna which bears 3 inner spines on the 3rd segment in *ruber*, only 2 in *randalli*. The 5th leg of *B. ruber*

has the same setal armature as that of *randalli*, but the gap between the terminal short setae and the subterminal one is much larger in *ruber*.

B. indicus Sewell, 1949 differs clearly from *B. randalli* in the armature of the 3rd segment of the 2nd antenna. The inner margin of this segment bears 2 flexible, thin setae in *indicus*, 2 strong, robust spines in *randalli*. Another difference might be present in the 5th leg, which is said to bear only 2 distal setae in *indicus* (in *randalli*: 3 distal and 1 proximal setae).

Between *B. randalli* and the three species resembling it (*africanus*, *ruber*, *indicus*) differences exist also in the structure and armature of the legs 1 to 4. Since, however, LANG (1948) demonstrated a great diversity in the structure of these legs in his material, we have refrained from using these differences for the distinction of the new species. It must be remarked parenthetically that we personally never observed such a striking variation within one species; possible explanations might be that the species to which LANG's material belonged is more variable than any species we examined, or that LANG was dealing with more than one, seemingly identical, species.

Botryllophilus spec.

(Figs. 19–21)

Material. – PUERTO RICO: From *Didemnum* spec., dredged off Mayagüez (67° 13'5 W, 180°15' N), in 40–50 fathoms, 21 Feb. 1963, 1♀. The female has been dissected; the mounted appendages have been deposited in the Zoölogisch Museum, Amsterdam (cat. no.Co.100.826).

Description. – Female: In general, the body (Fig. 19a) resembles that of *B. randalli*. The genital segment, however, is subdivided, so that the total number of postgenital segments becomes 8. The total length of the body is 605 μ. The live color is yellowish, opaque; the ovaries are bright pink.

On the middle of the ventral surface of the anal segment (Fig. 19 b) 4 rows of spinules occur (2 rows on each side of the midline). The 2 groups on each side nearly merge into one another. The caudal rami (Fig. 19 b) resemble those of *B. randalli*.

The first antenna is very similar, both in shape and in armature, to the A 1 of *B. randalli*. The only noteworthy difference is that the 2nd seta of the 1st segment (counting from proximal in distal direction), which is long in *B. randalli*, has only one-third of the length of the longer setae in the present specimen.

The second antenna (Fig. 19 e) differs markedly from that of *B. randalli*. The

3rd segment is longer than the first, it has 2 long, slender setae on its inner margin, whereas the distal armature consists of long, curved annulated setae.

The coxal incisor process of the mandible could not be observed in great detail. The palp (Fig. 19 c) is slenderer than in *B. randalli*, but fundamentally constructed in the same way.

The first maxilla (Fig. 19 d) has a slender coxal endite, armed with 5 curved elements; an epipod may occur but could not be observed with certainty. The basis is provided with 2 inner, plumose setae; with a rounded trisetose endopod; with a triangular process; with 2 plumose setae and with 9 long recurved seta.

The second maxilla and maxilliped do not differ markedly from those of *B. randalli*.

The legs 1 to 4 are all asymmetric, especially so in the exopods. The 2nd protopod segment bears a lateral seta in all legs.

In the first legs (Figs. 20 a–b), both endo- and exopod are indistinctly segmented. The right exopod (Fig. 20 b) is armed with 5 lateral, 1 terminal and 1 subterminal element, all of which are robust and spiniform. The left exopod (Fig. 20 a) bears 5 lateral and 1 terminal element, all thin and setiform. On the right exopod, only the terminal spiniform projection is well-developed; on the left exopod, 4 lateral and 1 terminal spiniform projection are visible. The endopods show, by a notch in their inner margin, clearly that they were originally composed of two segments, but an articulation-line could not be found any more. The basal portion bears 1 seta, the distal portion 6 setae.

In the 2nd legs (Figs. 20 c–d), both endo- and exopod show more clearly their bimerous nature. Like in the 1st leg, the right exopod is armed with spiniform elements (4 lateral, 1 terminal, 1 subterminal) and shows only few (2) spiniform processes, whereas the left exopod bears setiform elements (4 lateral, 1 terminal) and more spiniform processes (4). The armature of the left and right endopods is identical: 1 seta on the proximal, 7 setae on the distal segment.

In the 3rd and 4th legs, the asymmetry of the exopods becomes still more evident, since the left exopod differs not only in armature but also in size, being much larger than the right exopods. In the 3rd leg (Figs. 20 e–f) both rami are bimerous on both sides of the body. The right exopod has 1 outer spine on the first segment, 3 outer spines on the 2nd segment; a longer, subterminal element on this segment seems to be homologous with the terminal spine of exopods 1 and 2, whereas a short inner spine may be homologous with the subterminal spine of exopods 1 and 2. There are 4 spiniform projections on the 2nd exopod segment. The right endopod bears 1 + 4 setae. The left exopod consists of an elongate basal and terminal segment, armed with 1 lateral and 3 lateral plus 1 terminal setae, respectively. The 2nd exopod segment has 4 spiniform projections. The left endopod has the same armature as the right one.

The 4th exopod and endopod are bimerous on both sides (Figs. 21 a–b). The right exopod has 1 spiniform element on the 1st segment, 5 spiniform elements on the 2nd. The 2nd segment has only 1 spiniform projection. The right endopod bears 1 + 5 setae. The left exopod is elongated; the 1st segment has 1 outer seta, the 2nd segment 3 outer and 1 terminal setae; there are 3 spiniform projections on this segment. The left endopod is much shorter than the left exopod, but resembles in armature (1 + 5) the right endopod.

The 5th legs show a slight asymmetry in shape: the left leg (Fig. 21 c) is more curved than the right one (Fig. 21 d). Their armature is identical and consists of 1

proximal, inner setule; 1 long, terminal seta, which is only little shorter than the segment carrying it; 1 thin short terminal seta, which has about 1/3 the length of the long seta; and 1 subterminal seta, which is a little longer and thicker than the terminal short seta.

Remarks. – From a number of differences, especially in the 2nd antenna, the 1st maxilla, and the anal segment, it is clear that the present species cannot be identified with *B. randalli*, the only other known West Indian representative of the genus *Botryllophilus*. It belongs, with *B. randalli*, to a group of closely related species characterized by the long 5th leg, and an extra-segmented urosome. This group includes further the species *africanus*, *indicus*, and *ruber* s.str. Of these, *B. indicus* Sewell, 1949, has about the same type of the second antenna: with 2 long setae on the inner margin of the 3rd segment. However, the 5th leg of *indicus* is described as having 2 setae only (4 in the present species) and the illustrations – admittedly insufficient – suggest additional differences in the maxilliped, 1st antenna, and legs 1 to 4.

With *B. africanus* Schellenberg, 1922, the West Indian species agrees in the presence of rows of spinules on the ventral surface of the anal segment. The short description and the absence of adequate figures of *africanus*, makes evaluation of possible differences impossible. If *africanus* has, as the description says, a 1st maxilla similar to that of *B. macropus* Canu, 1891, the present form cannot be identical with it.

From *B. ruber* Hesse, 1864 (s. str.), the West Indian species differs in the armature of the 2nd antenna, in the 5th leg and in the presence of spinules on the anal segment.

Concluding, we may say that the present form is closely related to, but certainly not identical with *B. randalli* and *B. ruber*. It might be identical with either *B. africanus* or *B. indicus*, but our information concerning these two species is too incomplete. Since the present form, as well as *B. africanus* and *B. indicus*, are all known from single specimens, we have refrained from attempting a definite classification of the West Indian material.

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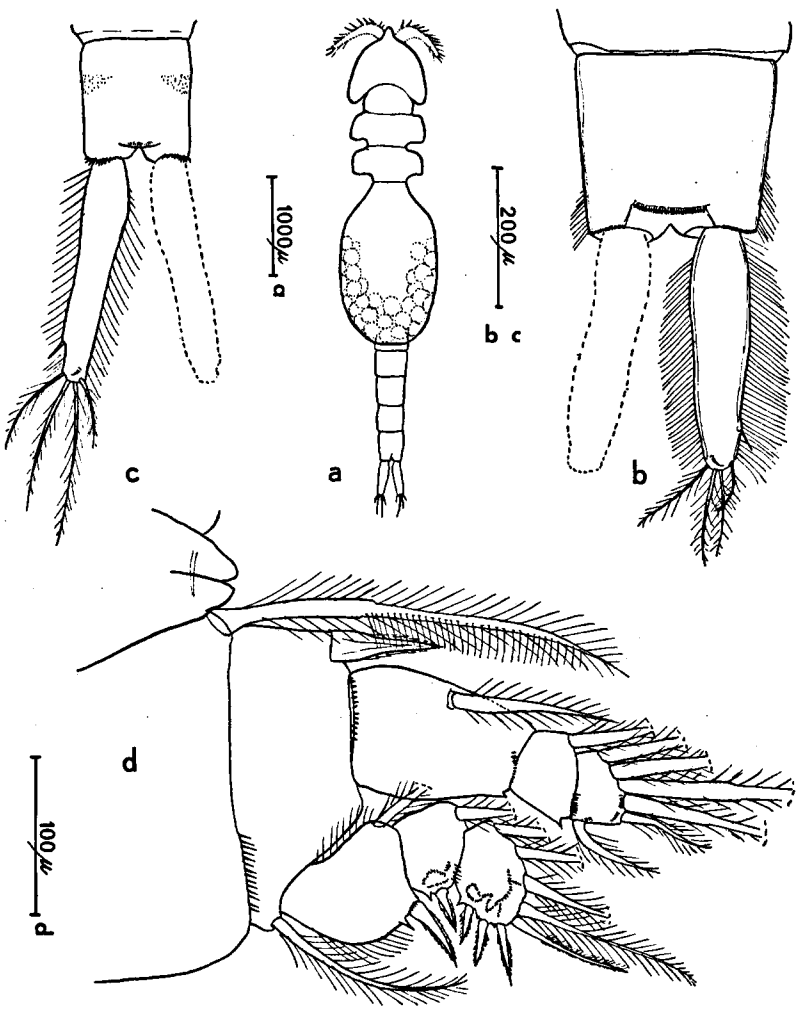

Fig. 1. *Notodelphys aurantiaca* n. sp. — a, female in dorsal view; b, anal segment and caudal ramus, ♀ (dorsal); c, anal segment and caudal ramus, ♂ (dorsal); d, first leg, ♀.

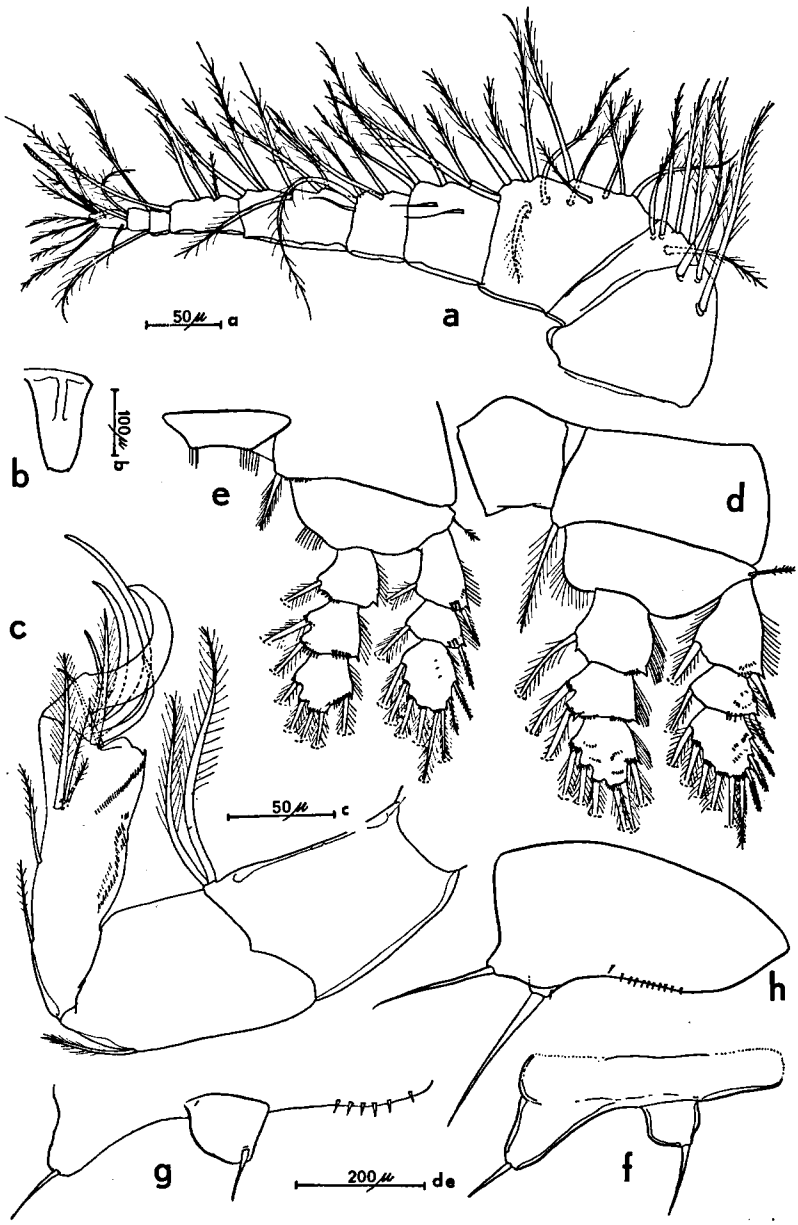

Fig. 2. *Notodelphys aurantiaca* n. sp. — a, anterior antenna, ♀; b, rostrum, ♀; c, posterior antenna, ♀; d, third leg, ♀; e, fourth leg, ♀; f, fifth leg, ♀; g, fifth leg, ♂; h, "genital lobe", ♂.

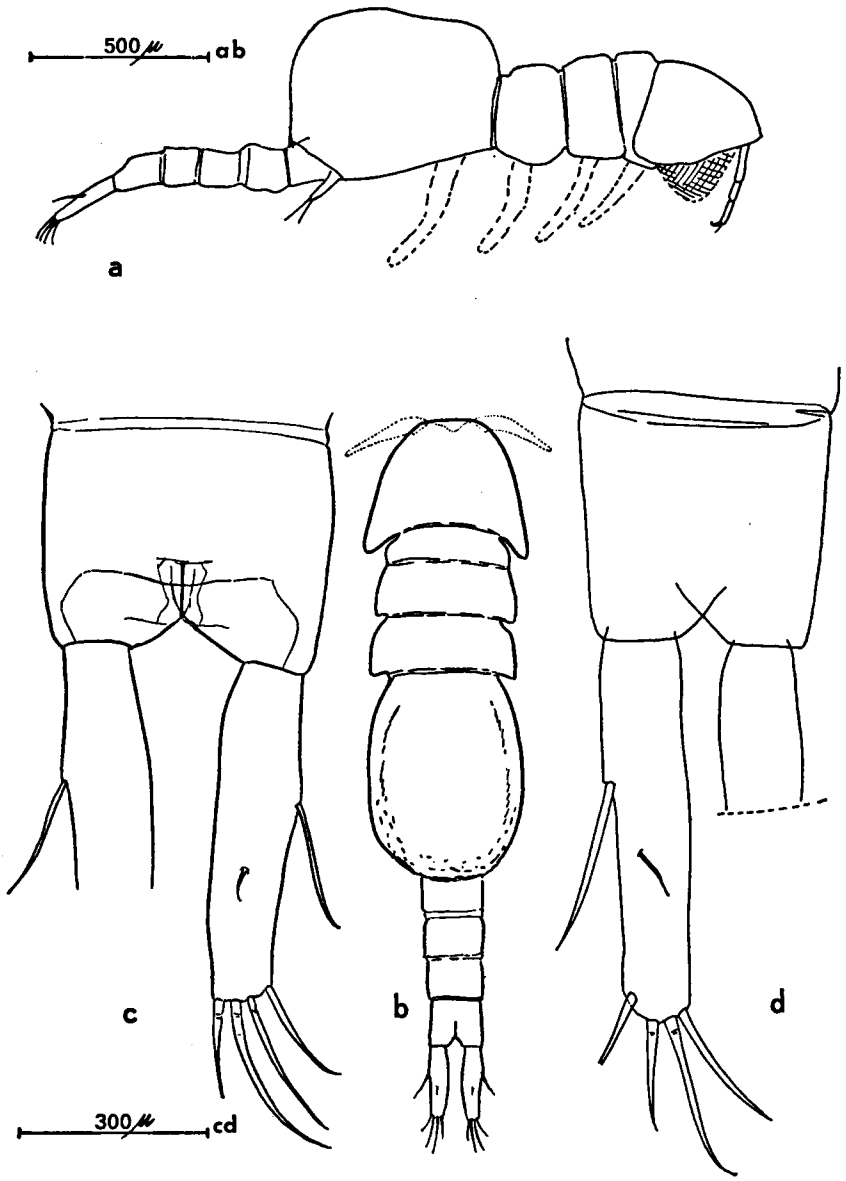

Fig. 3. *Doropygus reductus* n. sp., female. — a, lateral view of the body; b, dorsal view of the body; c, anal segment and caudal rami of the specimen illustrated in Fig. 1 b; d, same of the specimen in Fig. 1 a.

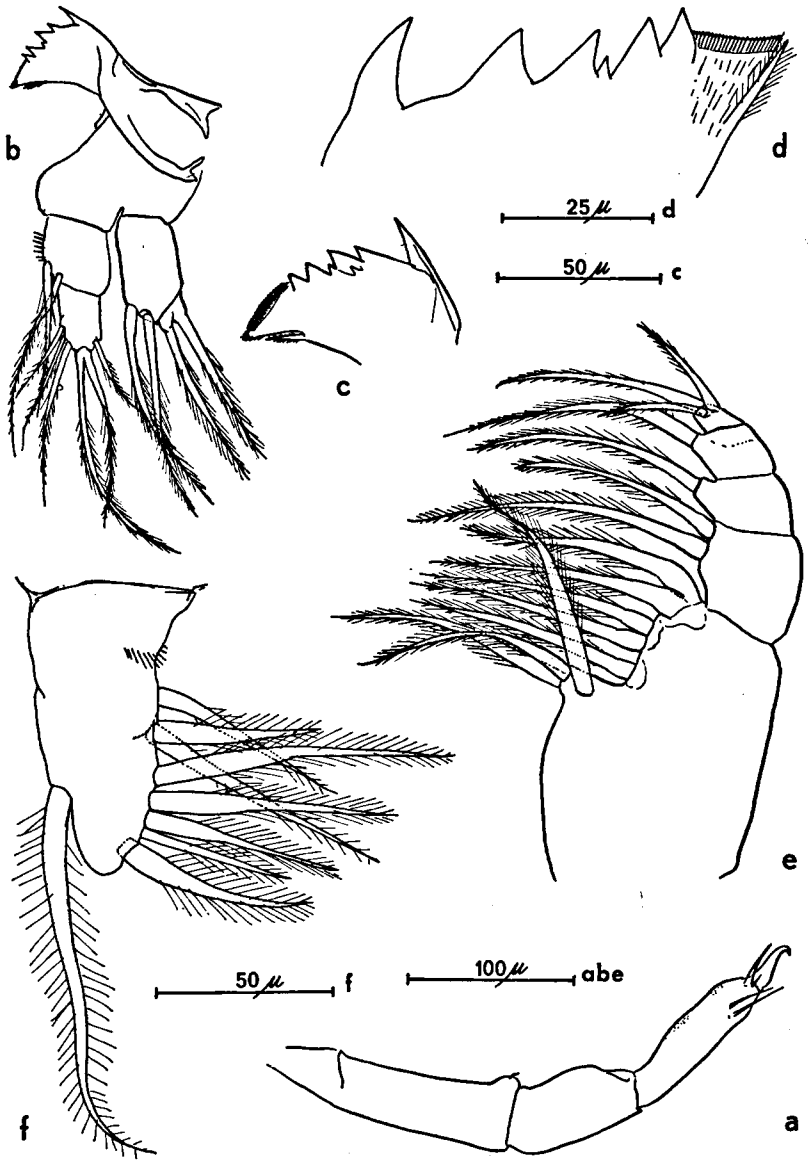

Fig. 4. *Doropygus reductus* n. sp., female. — a, second antenna; b, mandible; c, masticatory part of same, more enlarged; d, masticatory portion of the mandible of another specimen; e, second maxilla; f, maxilliped.

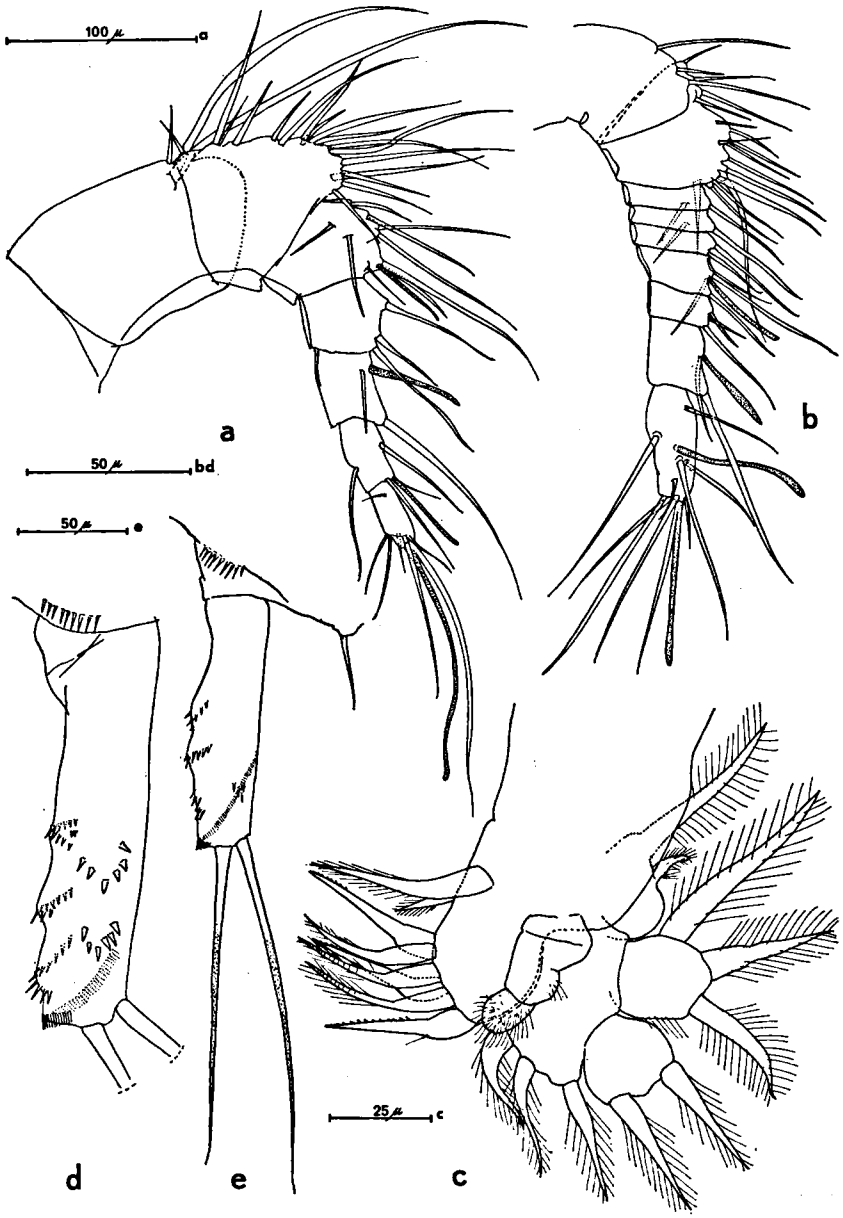

Fig. 5. *Doropygus reductus* n. sp.; b, male; remaining illustrations, female. — a, first antenna; b, same of male; c, first maxilla; d, e, fifth legs.

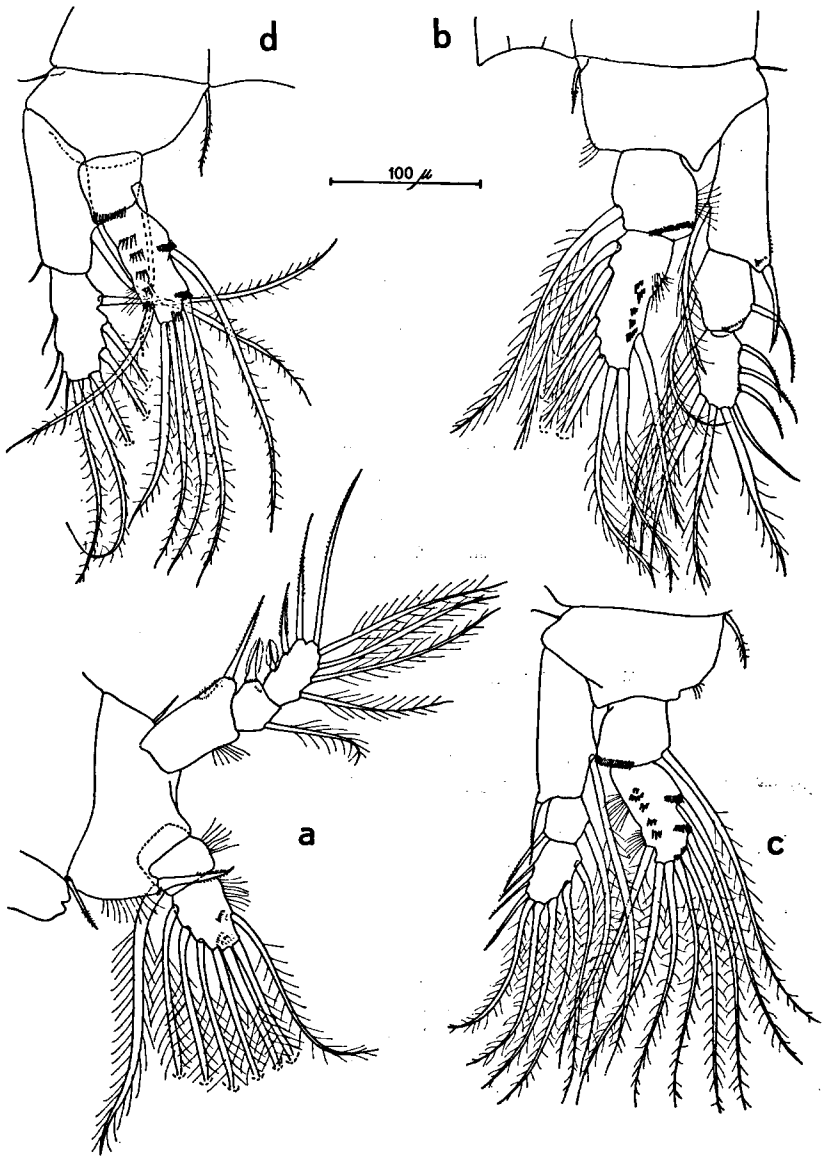

Fig. 6. *Doropygus reductus* n. sp., female. — a, leg 1; b, leg 2; c, leg 3; d, leg 4.

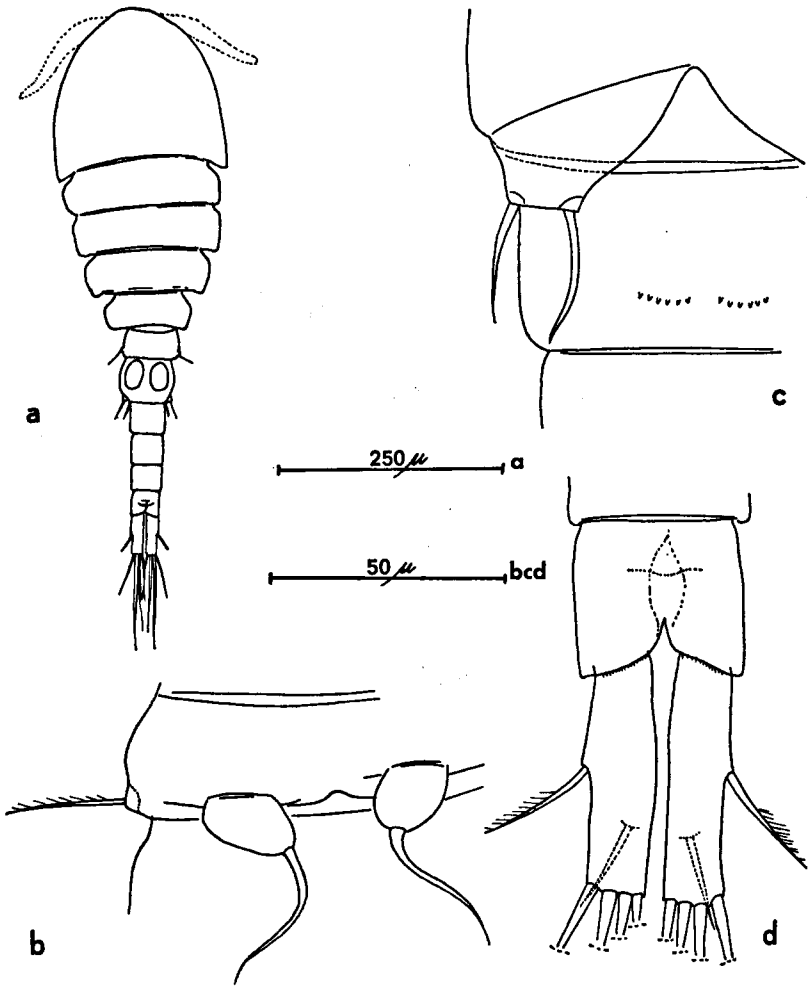

Fig. 7. *Doropygus reductus* n. sp., male. — a, dorsal view of the body; b, fifth leg (ventral); c, second and third urosome segment, with "genital lobe" (ventral); d, anal segment and caudal rami (ventral).

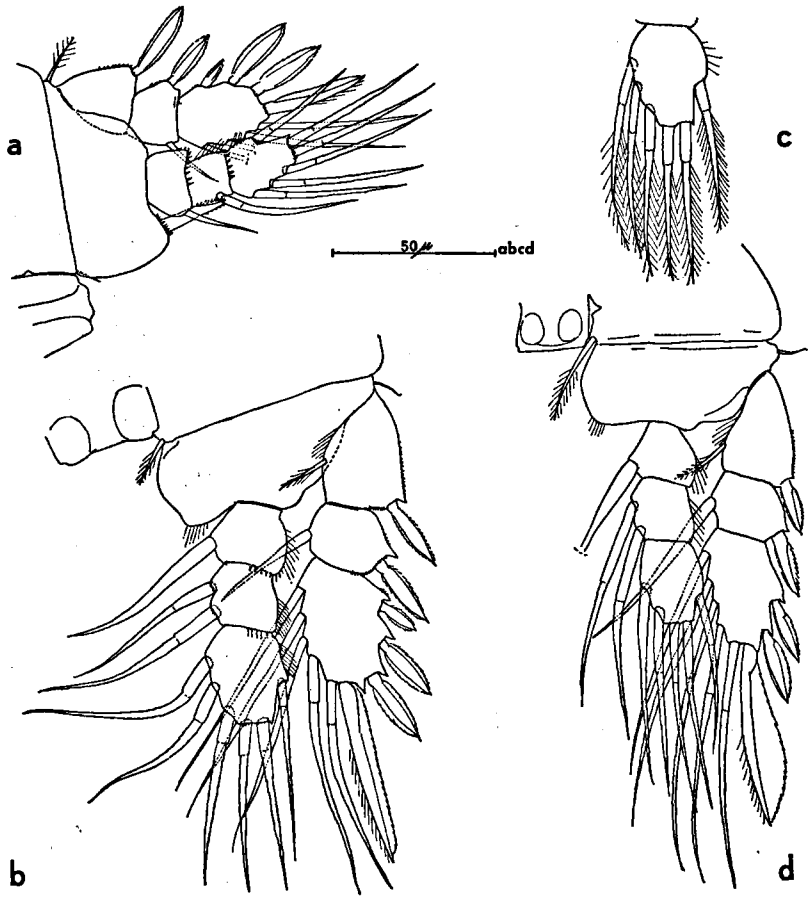

Fig. 8. *Doropygus reductus* n. sp., male. — a, first leg; b, second leg; c, terminal endopod segment of third leg; d, fourth leg (fine ornamentation of most setae omitted in a, b and d).

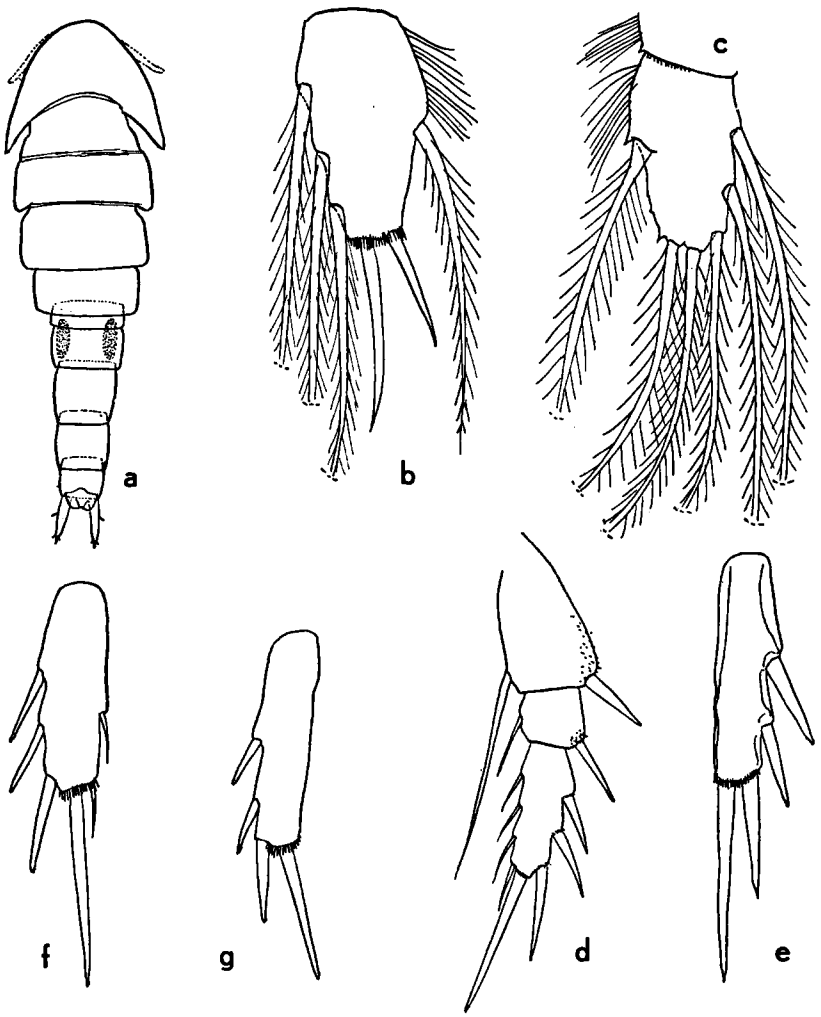

Fig. 9. *Pachypygus macer* Illg, 1958. — a, male in dorsal view; b, third endopod segment of second leg, ♂; c, third endopod segment of second leg, ♀; d, exopod of second leg, ♂; e, third exopod segment of second leg, ♀; f, third exopod segment of fourth leg, ♂; g, third exopod segment of fourth leg, ♀.

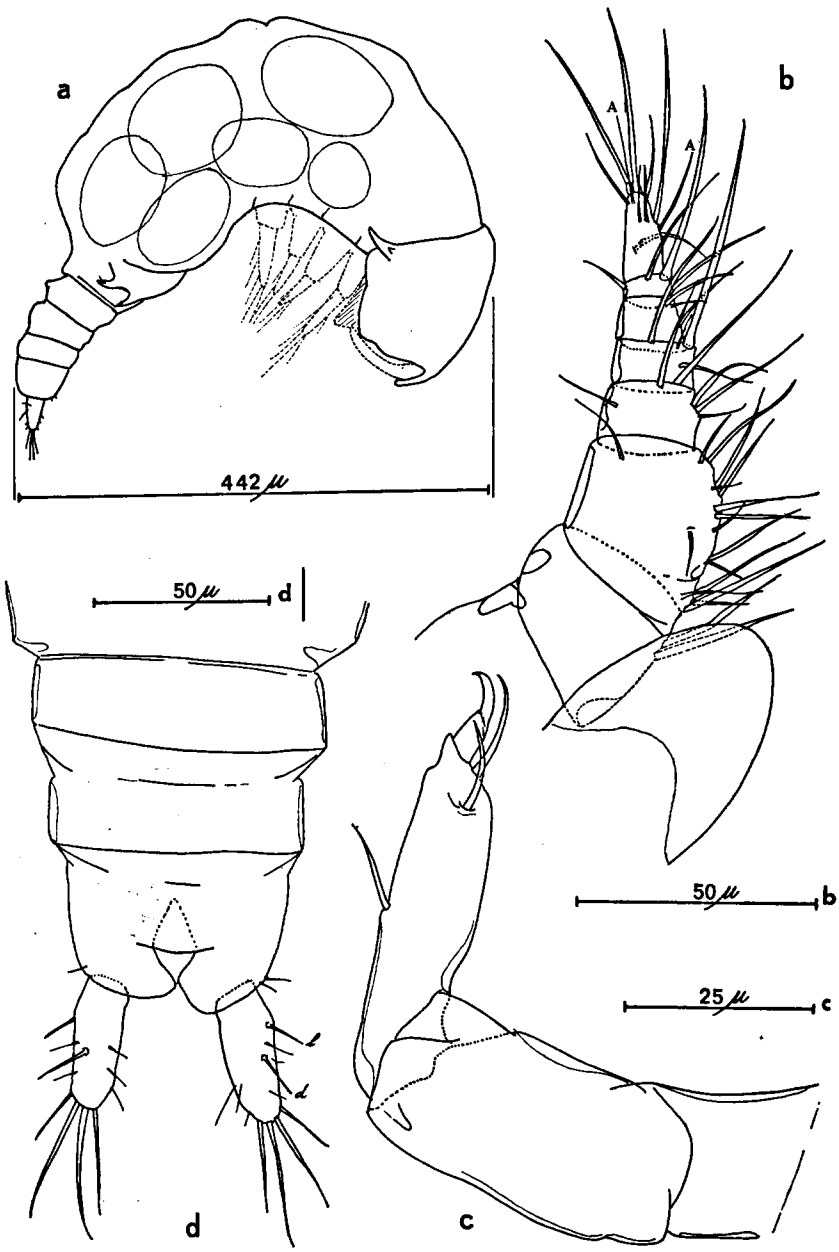

Fig. 10. *Doroixys minuta* n. sp., female, holotype. — a, entire animal from the right side; b, first antenna (dorsal); c, second antenna; d, urosome (dorsal) (*l* = presumed lateral furcal seta; *d* = presumed dorsal furcal seta).

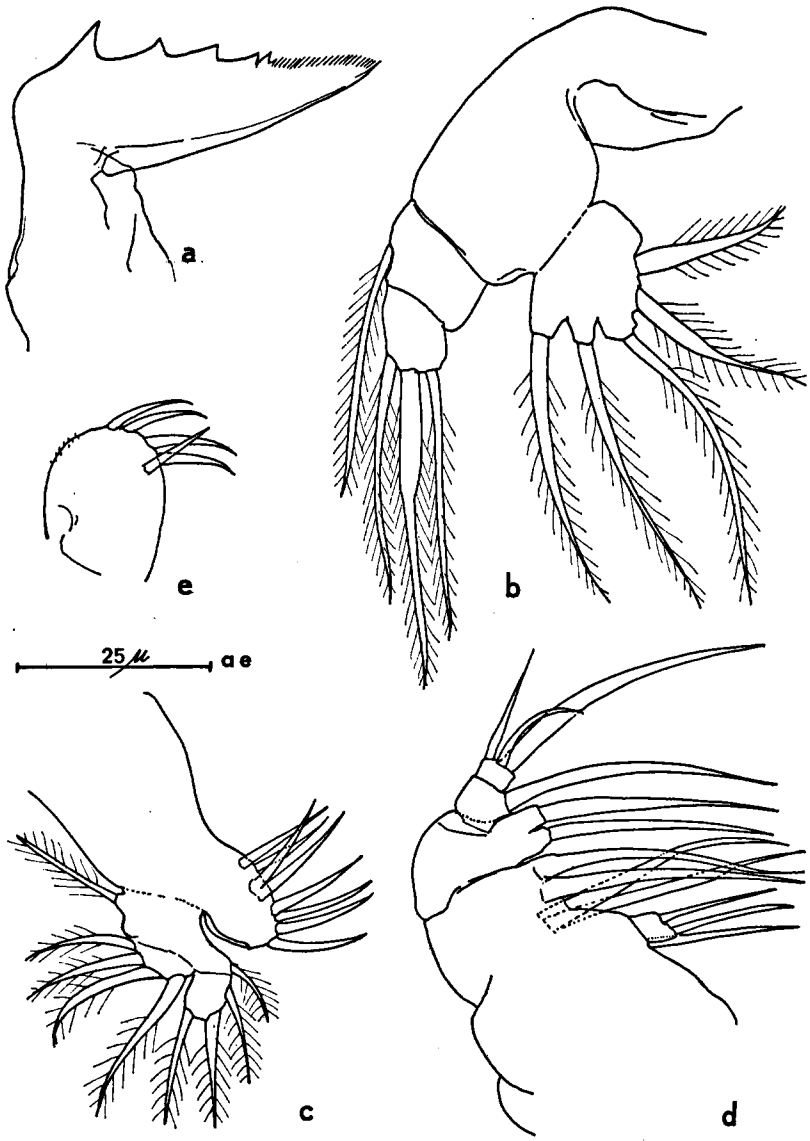

Fig. 11. *Doroixys minuta* n. sp., female, holotype. — a, mandible blade; b, mandible palp; c, first maxilla; d, second maxilla; e, maxilliped (fine ornamentation omitted in d and e).

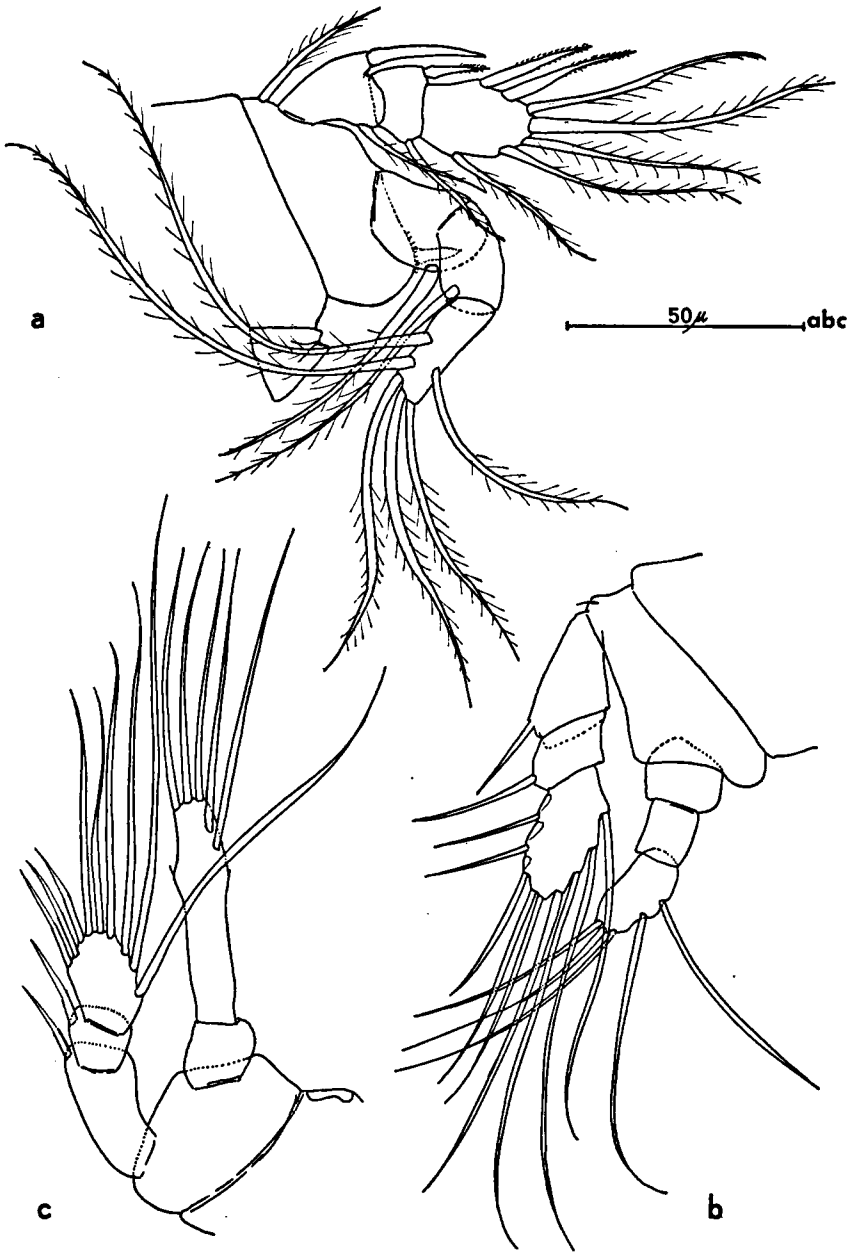

Fig. 12. *Doroixys minuta* n. sp., female, holotype. — a, first leg; b, second leg; c, third leg.

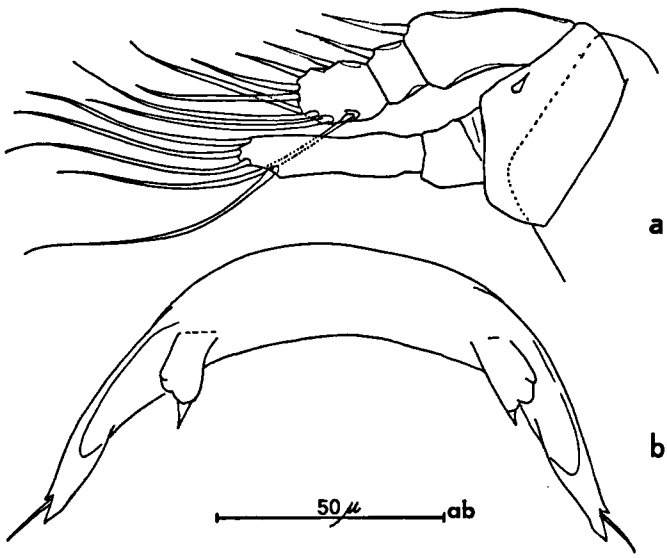

Fig. 13. *Doroixys minuta* n. sp., female, holotype. — a, fourth leg; b, fifth leg.

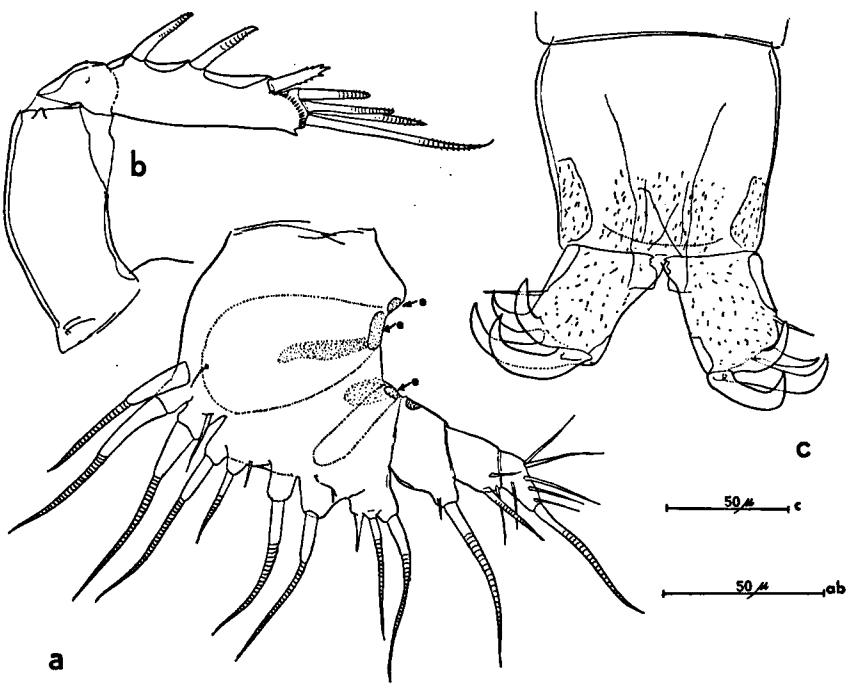

Fig. 14. *Botryllophilus randalli* n. sp., female, paratype. — a, first antenna (e = chitinous thickenings); b, second antenna; c, anal segment and caudal rami (ventral).

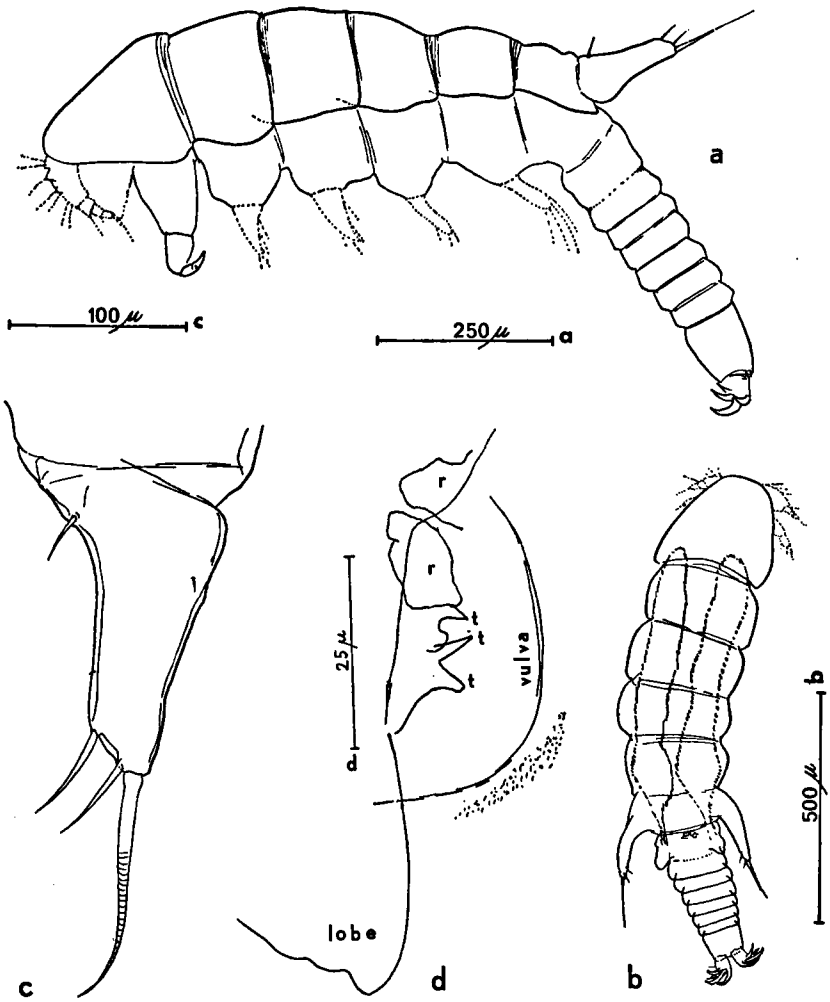

Fig. 15. *Botryllophilus randalli* n. sp., female, paratype. — a, body from the left; b, body in dorsal view; C, fifth leg (dorsal); d, genital area (ventral) (*t* = tooth; *r* = refractive body).

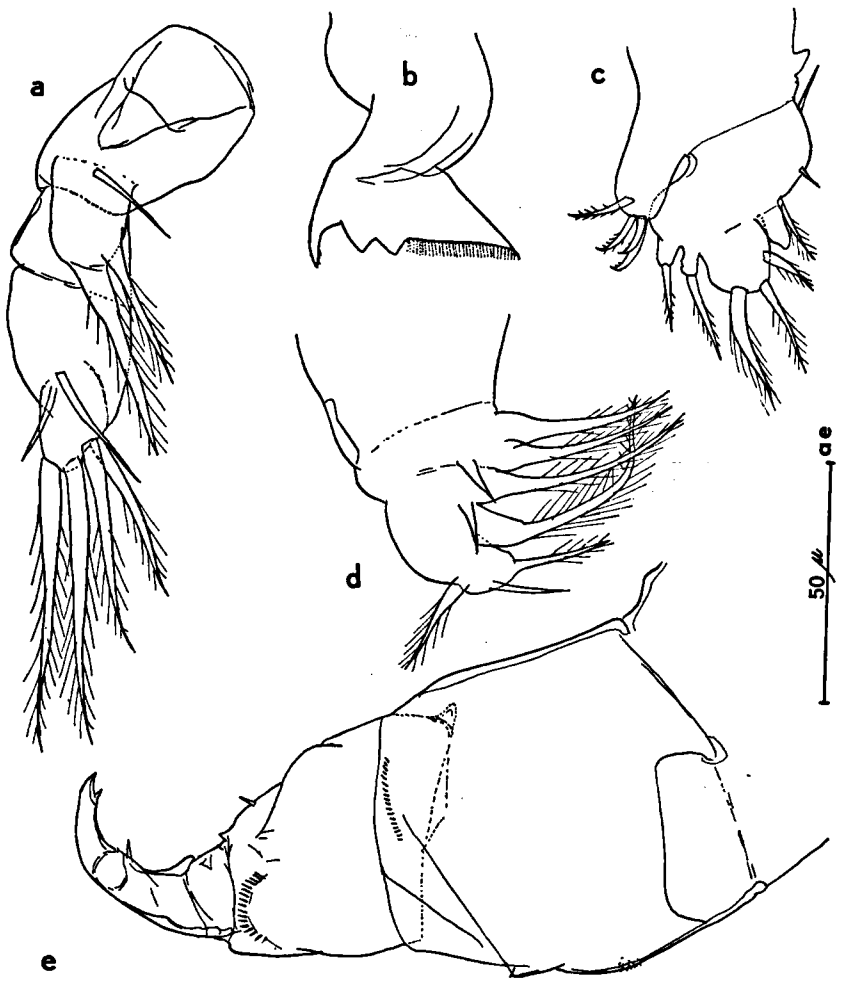

Fig. 16. *Botryllophilus randalli* n. sp., female, paratype. — a, mandible palp, b, coxal incisor process; c, first maxilla; d, second maxilla; e, maxillipéd.

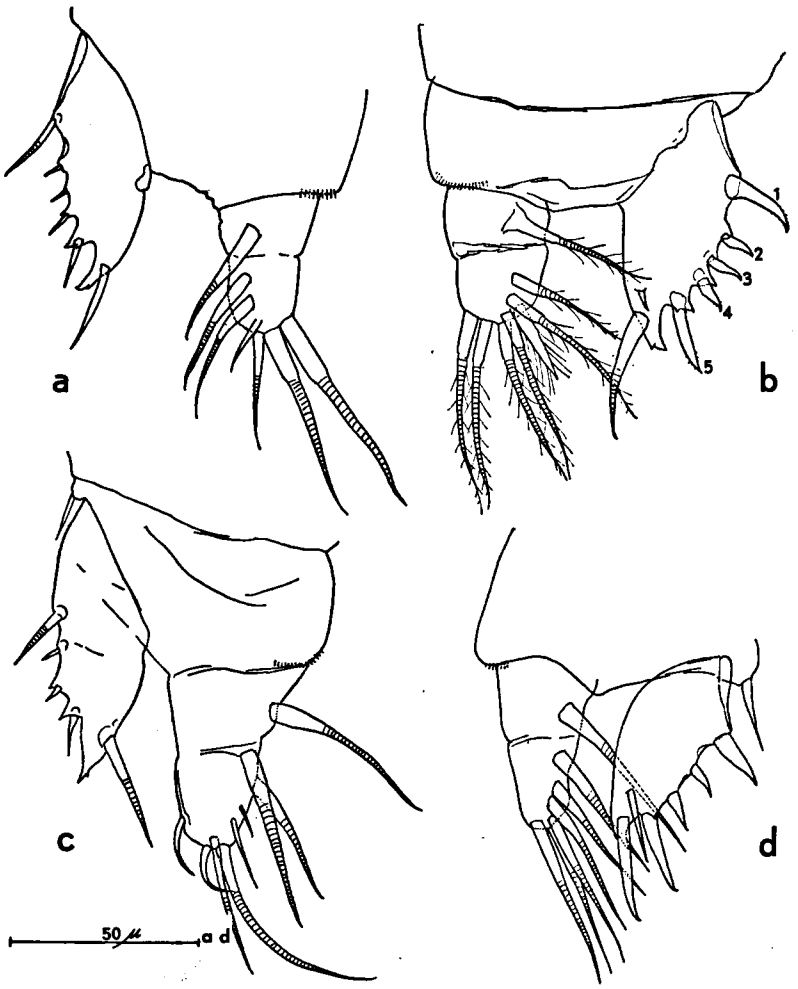

Fig. 17. *Botryllophilus randalli* n. sp., female, paratype. — Left column: left legs; right column: right legs. a–b, first legs; c–d, second legs (fine ornamentation of the elements omitted, except in b).

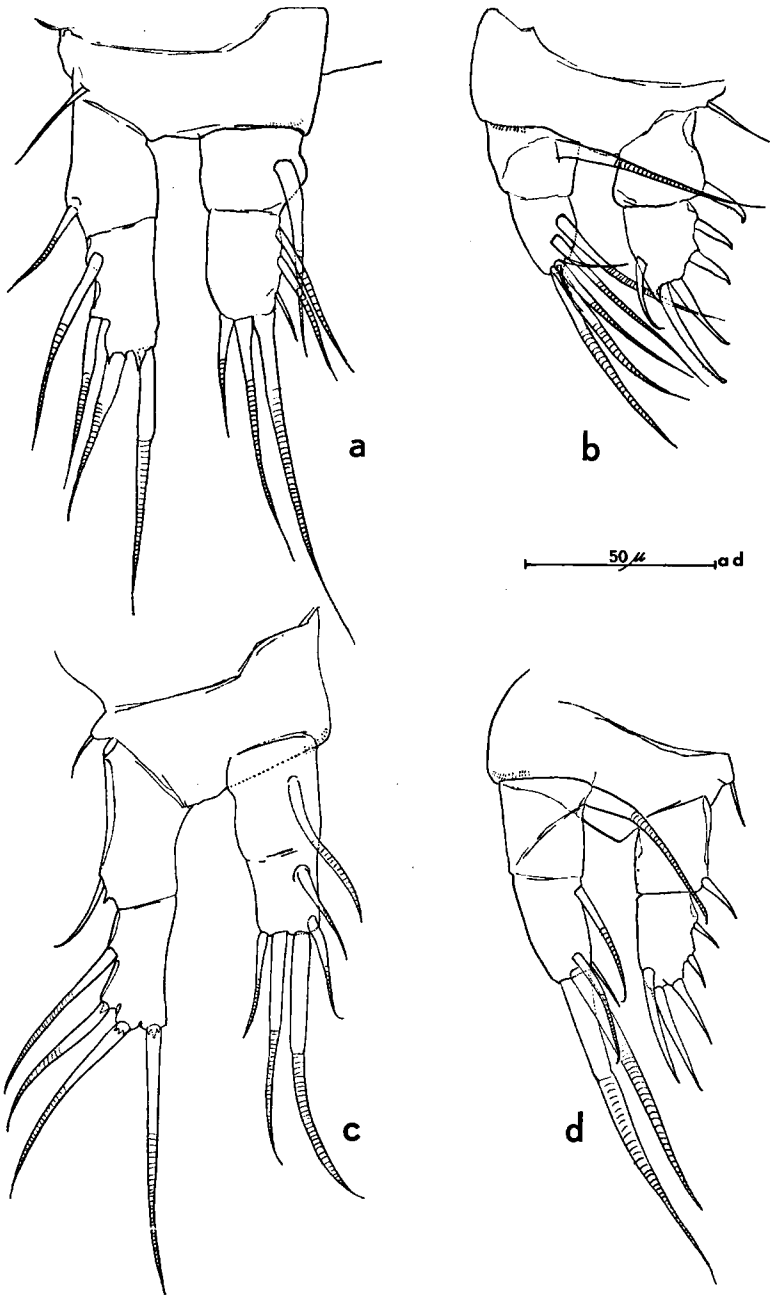

Fig. 18. *Botryllophilus randalli* n. sp., female, paratype. — Left column: left legs; right column: right legs. a–b, third legs; c–d, fourth legs (fine ornamentation of the elements omitted).

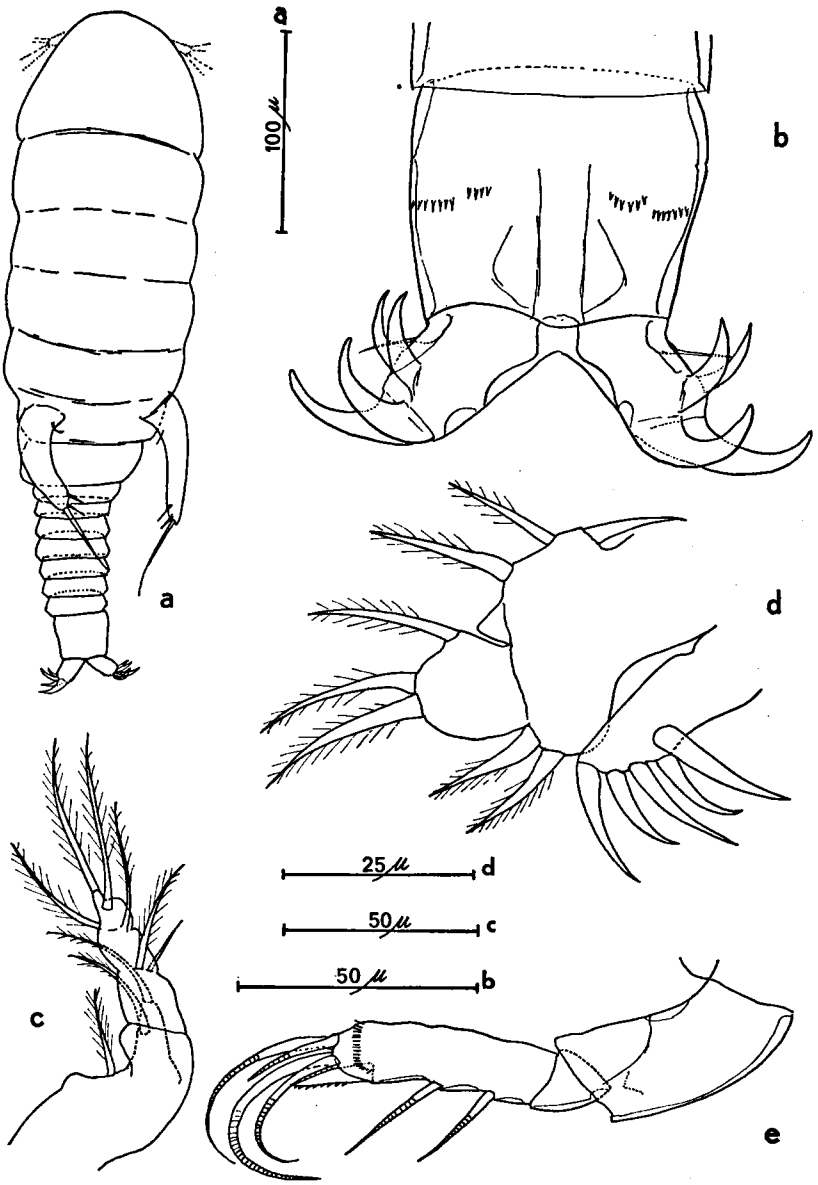

Fig. 19. *Botryllophilus* sp., female. — a, dorsal view of the body; b, anal segment and caudal rami (ventral); c, mandible palp; d, first maxilla (ornamentation of elements on endite omitted); e, second antenna.

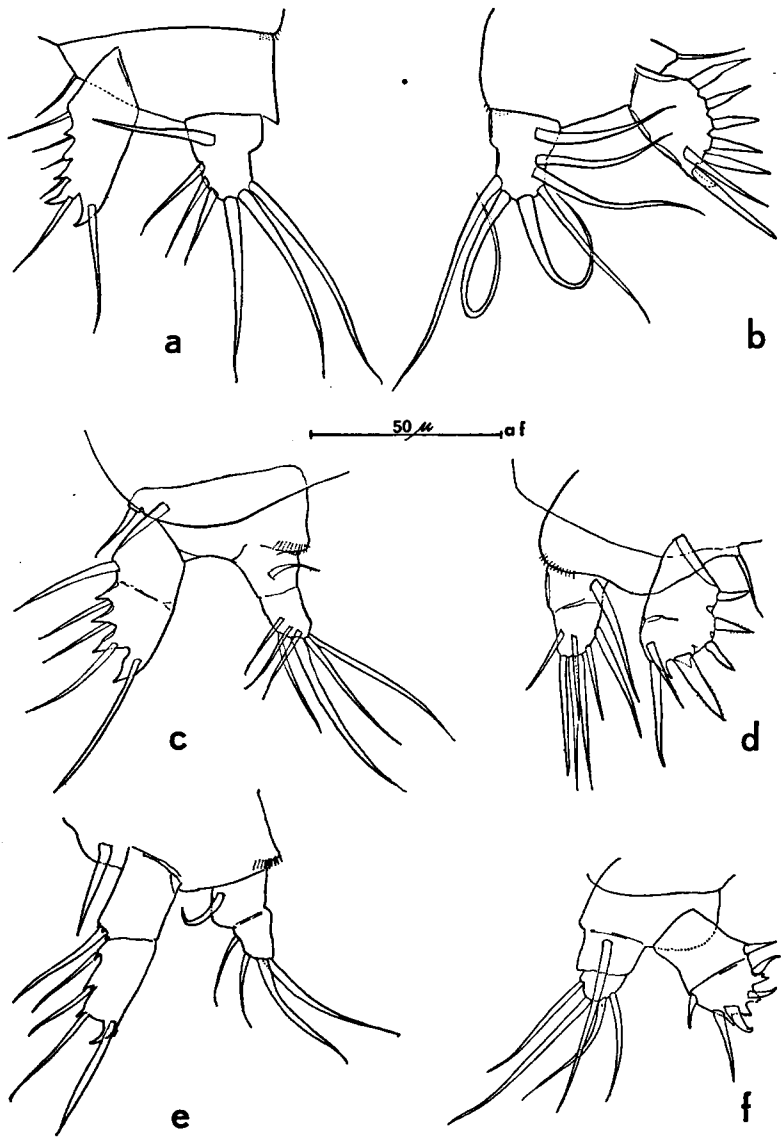

Fig. 20. *Botryllophilus* sp., female. — Left column: left legs; right column: right legs. a, b, leg 1; c, d, leg 2; e, f, leg 3.

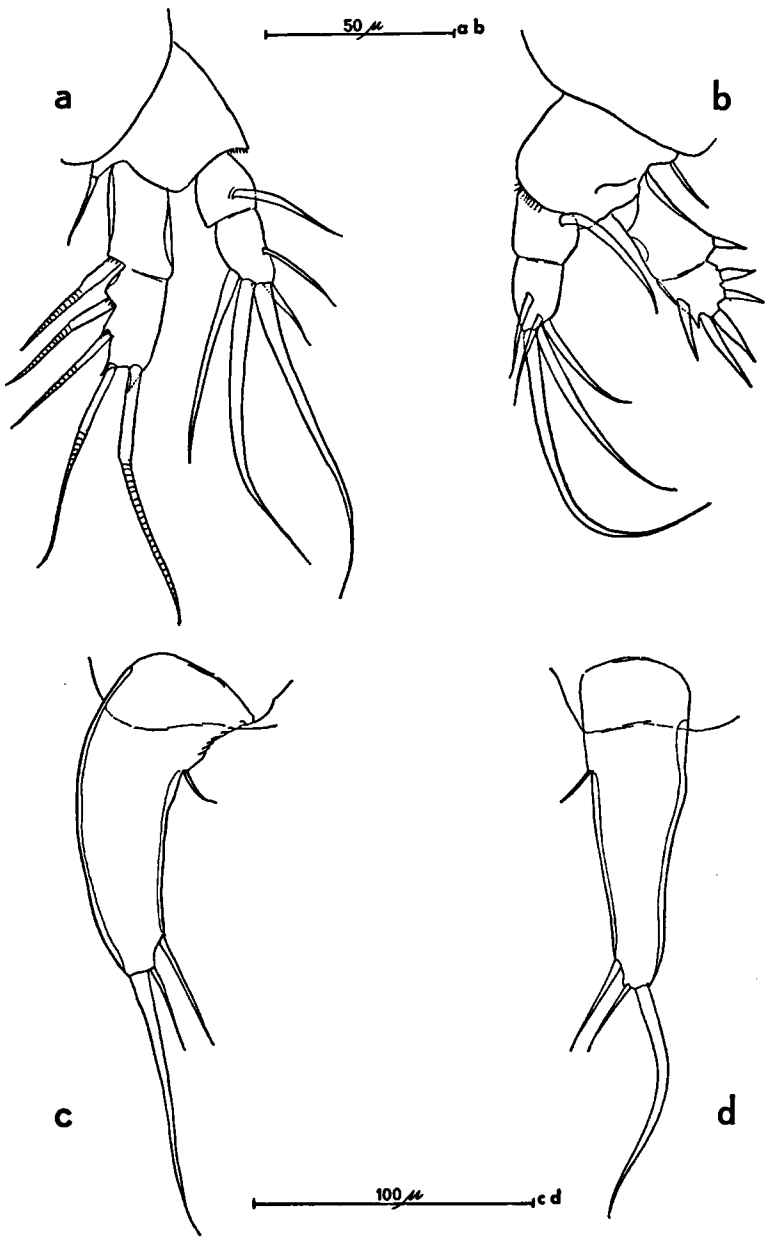

Fig. 21. *Botryllophilus* sp., female. — Left column: left legs; right column: right legs. a, b, leg 4; c, d, leg 5.