SOME NEW AND RARE SPECIES OF CALANOID COPEPODS FROM THE NORTHEASTERN ATLANTIC

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Pp 295–372 ; 33 *Text-figures*

BULLETIN OF
THE BRITISH MUSEUM (NATURAL HISTORY)
ZOOLOGY Vol. 28 No. 7
LONDON: 1975

THE BULLETIN OF THE BRITISH MUSEUM (NATURAL HISTORY), *instituted in* 1949, *is issued in five series corresponding to the Scientific Departments of the Museum, and an Historical series.*

Parts will appear at irregular intervals as they become ready. Volumes will contain about three or four hundred pages, and will not necessarily be completed within one calendar year.

In 1965 *a separate supplementary series of longer papers was instituted, numbered serially for each Department.*

This paper is Vol. 28 *No.* 7 *of the Zoology series. The abbreviated titles of periodicals cited follow those of the World List of Scientific Periodicals.*

World List abbreviation :
Bull. Br. Mus. nat. Hist. (Zool.)

ISSN 0007–1498

TRUSTEES OF
THE BRITISH MUSEUM (NATURAL HISTORY)

Issued 5 *November*, 1975 *Price* £4·75

SOME NEW AND RARE SPECIES OF CALANOID COPEPODS FROM THE NORTHEASTERN ATLANTIC

By H. S. J. ROE

SYNOPSIS

One new genus, nine new species, and nineteen undescribed males of known species of calanoid copepods are described. A further eighteen rare or poorly known species are described or commented upon. Five existing species are transferred to the new genus; new synonymies are proposed for six species, and two species are recorded as *incertae sedis*. All the specimens were taken from vertical series of closing net hauls made in the northeastern Atlantic.

INTRODUCTION

For some years the Institute of Oceanographic Sciences has been investigating the vertical distributions and migrations of zooplankton and nekton in the northeastern Atlantic. These investigations have been based largely upon a series of vertical hauls made with horizontally towed opening and closing net systems. The calanoid copepods have now been analysed from two of these series. The results of the first, the RRS 'Discovery' SOND cruise in 1965, have been given previously (Roe, 1972*a*, *b*, *c*, *d*). The SOND series was taken with a modified Indian Ocean Standard Net (the N113H), fitted with a catch dividing bucket, in a position off Fuerteventura in the Canary Islands. Details of the sampling methods used in this series are given by Foxton (1969), Angel (1969) and Roe (1972*a*).

The second series was made in 1969 in a position centred on 18°N 25°W near the Cape Verde Islands. A day and a night series of hauls was made with an acoustically controlled net system. This comprises two rectangular midwater trawls, one of 8 m² mouth area and mesh of 4·5 mm (RMT 8), the other of 1 m² mouth area and mesh 0·32 mm (RMT 1), combined within the same frame. This net system, designated the RMT 1+8, is described by Baker, Clarke & Harris (1973). The series was taken at 1250–0 m depth and was fished in the manner described by Baker *et al.*

Both these series contained a number of very rare calanoid copepods, several undescribed sexes of known species and some new species. These specimens are all described below. The geographical positions given for each species are approximate; more accurate positions are listed at the Institute of Oceanographic Sciences.

TAXONOMY

Family SPINOCALANIDAE

The RMT 1 collections contain females of the following species of *Spinocalanus*: *S. abyssalis* Giesbrecht, 1888; *S. magnus* Wolfenden, 1904; *S. spinosus* Farran, 1908; *S. horridus* Wolfenden, 1911; *S. angusticeps* Sars, 1920; *S. brevicaudatus*

Brodsky, 1950; *S. parabyssalis* Park, 1970; *S. hoplites* Park, 1970; *S. usitatus* Park, 1970; *S. pteronus* Park, 1970. These females all agree with previous descriptions and all except *S. angusticeps* fit Park's (1970) partial key to the genus. Together with these females were the males of five species. Three of these are more or less tentatively identified as *S. abyssalis*, *S. brevicaudatus* and *S.* sp. Grice & Hulsemann, 1967, but the remaining two could not be attributed to any known species. Since the males of many species of *Spinocalanus* are unknown and as the present specimens are all incomplete they are not considered here to be new species.

***Spinocalanus* ? *abyssalis* Giesbrecht, 1888**

MATERIAL EXAMINED: 56 males from 13 RMT 1 hauls made at 1020–300 m depth in a position 18°N 25°W, between 12 and 16 November 1969. 44 specimens deposited at the British Museum (Natural History), reg. no. 1974: 462–482.

DESCRIPTION. Male (Fig. 1a–j): Body length 1·06–1·22 mm with a mean of 1·14 mm (35 specimens). The cephalothorax is stout and 1·7 times as long as the 5-segmented abdomen. In lateral view the cephalothorax is arched dorsally. The head and 1st thoracic segment are completely fused and thoracic segments 4 and 5 are partially so. The 3rd thoracic segment has protruding corners in dorsal view. There is no rostrum. The anal segment is very short and telescoped into the 4th abdominal segment. The 1st antenna has 19 free segments and reaches to about halfway along the 2nd abdominal segment; the basal eight segments have large flattened sensory filaments; the 1st segment has a small group of spines. The remaining mouthparts and legs are as shown. A satisfactory preparation of the 1st maxilla was not obtained but it appears to be similar to that of *S* ? *brevicaudatus* (p. 300). The 2nd maxilla and maxilliped are weakly chitinized and have small feeble setae. The swimming legs of all specimens are damaged. The 5th pair of legs reaches back to the hind edge of the 2nd abdominal segment; the right endopod and the terminal spine of the left exopodite are broken off in all the dissected specimens.

REMARKS. Brodsky (1950) and Park (1970) discussed the synonomy of this species. The present males do not fit the description of any known *Spinocalanus* male. They were taken at depths where the most abundant spinocalanids were females of *S. abyssalis* (2022 specimens), *S. spinosus* (336), *S. magnus* (111), *S. brevicaudatus* (73) and *S. angusticeps* (50). *S. magnus*, the male of which is described by Tanaka (1956), and *S. angusticeps* are larger species, and the presumed male of *S. brevicaudatus* is described below. According to Brodsky (1950) the male of *S. abyssalis* is unknown, although Vervoort (1946) mentioned a male of *S. abyssalis* var. *pygmaeus* measuring 1·14 mm. Presumably the males listed by Vervoort (1957) and that described by Bradford (1971*a*) are too large (1·7–2·2 mm) to be *S. abyssalis*. The males of all species in which the female has a spiny cephalothorax are also unknown. The present specimens seem to be the right size to be the males of *S. abyssalis* – the females of this species here average 1·04 mm in length (1055 measured specimens), whereas those of *S. spinosus* are larger (1·79 mm from 156 specimens). They are

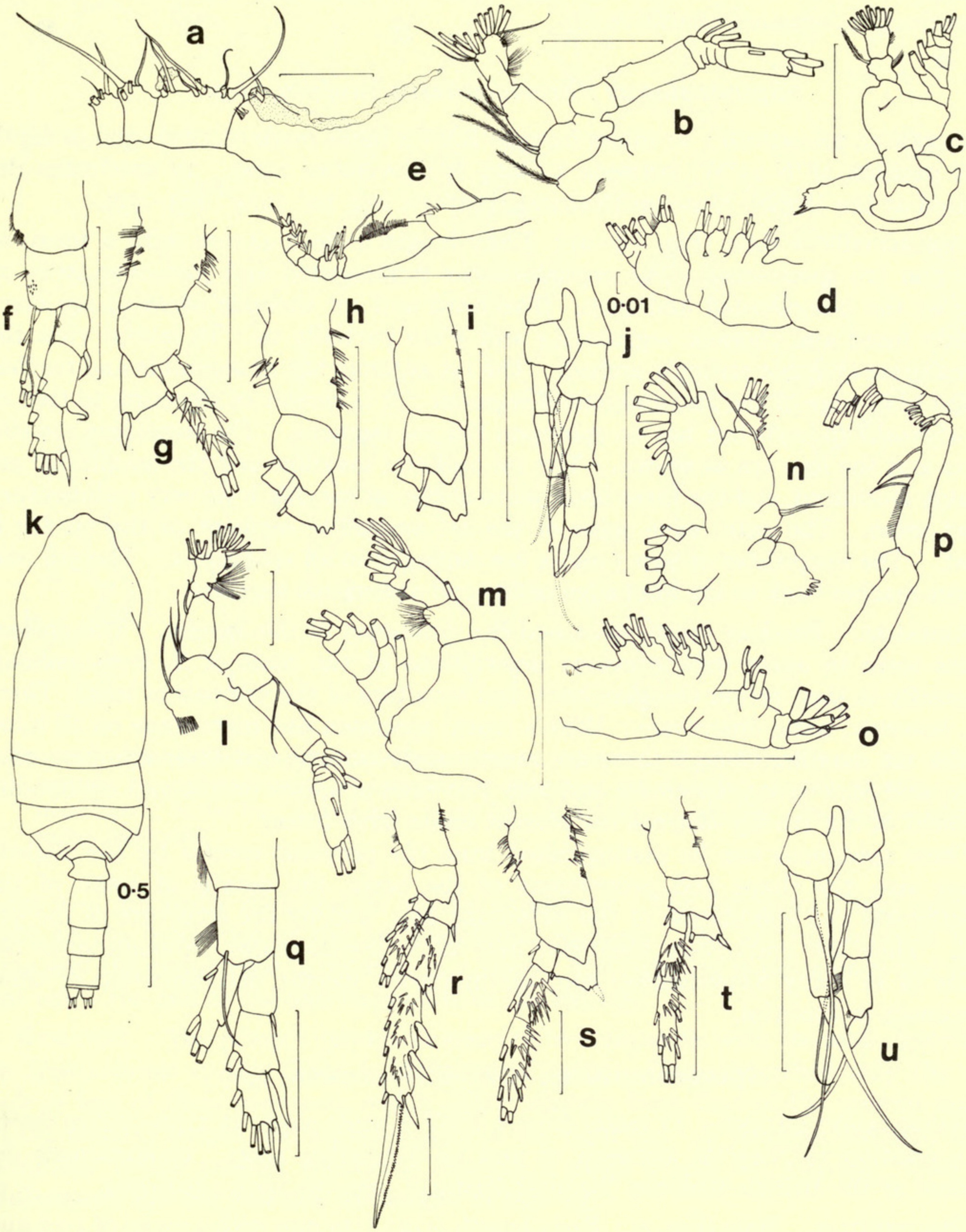

FIG. 1. a–j, *Spinocalanus* ? *abyssalis* ♂. a, base of 1st antenna ; b, 2nd antenna ; c, mandible ; d, 2nd maxilla ; e, maxilliped ; f, 1st leg ; g, 2nd leg ; h, 3rd leg ; i, 4th leg ; j, 5th leg ; k–u, *Spinocalanus* ? *brevicaudatus* ♂. k, body, dorsal ; l, 2nd antenna ; m, mandibular palp ; n, 1st maxilla ; o, 2nd maxilla ; p, maxilliped ; q, 1st leg ; r, 2nd leg ; s, 3rd leg ; t, 4th leg ; u, 5th leg. Bar scale 0·1 mm unless indicated.

recorded here as *S. abyssalis* although in the absence of complete animals this identification remains tentative.

***Spinocalanus* ? *brevicaudatus* Brodsky, 1950**

Material examined : 21 males from 10 RMT 1 hauls made at 1250–300 m depth in a position 18°N 25°W, between 12 and 17 November 1969. 17 specimens deposited at the British Museum (Natural History), reg. no. 1974 : 483–493.

Description. Male (Fig. 1k–u) : Body length 1·29–1·44 mm with a mean of 1·38 mm (16 specimens). The cephalothorax is elongated and just over twice as long as the 5-segmented abdomen. The head and 1st thoracic segment are completely fused and thoracic segments 4 and 5 are partially so. In lateral view the cephalothorax is not strongly arched. The 1st antenna has 22 segments and reaches to the hind edge of the 2nd abdominal segment ; it is similar in structure to that of *S* ? *abyssalis* (p. 298) but has no spines on the 1st segment. The remaining mouthparts and the legs are as shown. The 1st and 2nd maxillae and the maxilliped are weakly chitinized, and the three inner lobes of the 1st maxilla bear very rudimentary short setae. The outer edge spine of the 1st exopodite segment of the 1st leg is short. The exopodites of legs 3 and 4 are damaged in all specimens. The 5th pair of legs reaches back to the hind edge of the 2nd abdominal segment.

Remarks. Brodsky (1950) discussed the synonomy of this species. The present males seem to agree with previous descriptions of the male of *S. brevicaudatus*, especially in their rather elongate body and structure of the 5th pair of legs. There are, however, some differences : With's (1915) specimen had more setae on all lobes of the 1st maxilla, though these are mostly rudimentary and their numbers may vary, and Sars' (1903) specimen had only two rows of spines on the 2nd endopodite segment of the 4th leg whereas the present males have three.

These specimens can be distinguished from the previous species by the slightly larger size, the shape and proportions of the body, the details of some of the mouthparts and spinulation of the swimming legs, and by the structure of the 5th legs. They are tentatively identified here as *S. brevicaudatus* although since the males of so many *Spinocalanus* spp. are unknown specific determination of these specimens is doubtful.

***Spinocalanus* sp. Grice & Hulsemann, 1967**

Material examined : 11 males from 5 RMT 1 hauls made at 1250–800 m depth in a position 18°N 25°W, between 12 and 18 November 1969. 10 specimens deposited at the British Museum (Natural History), reg. no. 1974 : 494–504.

Description. Male (Fig. 2) : Body length 1·22–1·29 mm with a mean of 1·25 mm (7 specimens). The cephalothorax is 3 times as long as the 5-segmented abdomen. The head and 1st thoracic segment are fused but thoracic segments 4 and 5 are separate. The 1st antenna has 19 segments and reaches to the hind edge of the 1st abdominal segment ; the 1st segment has no group of spines. The remaining mouthparts are as shown ; the maxillae and maxilliped are weakly chitinized.

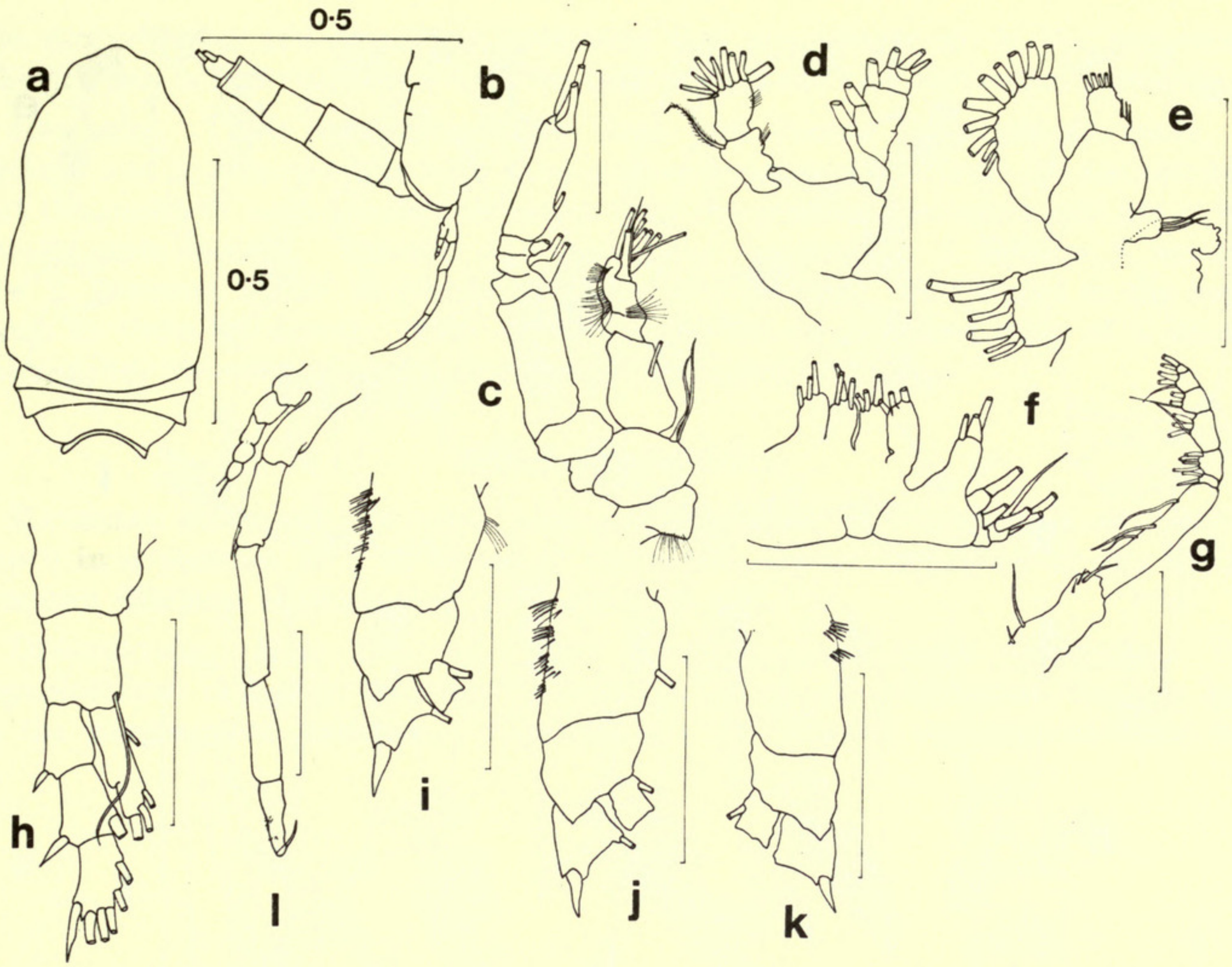

FIG. 2. *Spinocalanus* sp. ♂. a, cephalothorax, dorsal; b, abdomen and 5th legs, lateral; c, 2nd antenna; d, mandibular palp; e, 1st maxilla; f, 2nd maxilla; g, maxilliped; h, 1st leg; i, 2nd leg; j, 3rd leg; k, 4th leg; l, 5th leg. Bar scale 0·1 mm unless indicated.

Legs 2–4 are badly damaged in all the specimens. The 5th pair of legs extends back to the hind edge of the 3rd abdominal segment: the left exopodite is very long and the endopodite is reduced to a spine; the right leg is uniramous and does not reach the end of the 2nd basipodite of the left leg.

REMARKS. The present specimens seem to be conspecific with the male described as *Spinocalanus* sp. by Grice & Hulsemann (1967). They described only the 5th pair of legs of their specimen, which differs slightly from that of the present males in the relative length and segmentation of the right leg. *S. longipes* Tanaka, 1956 is similar to the present specimens but has a much longer left 5th leg. Grice & Hulsemann did not describe the length of this leg.

Spinocalanus sp. A

MATERIAL EXAMINED: 14 males from 7 RMT 1 hauls made at 1220–610 m depth in a position 18°N 25°W, between 13 and 18 November 1969. Deposited at the British Museum (Natural History), reg. no. 1974 : 505–515.

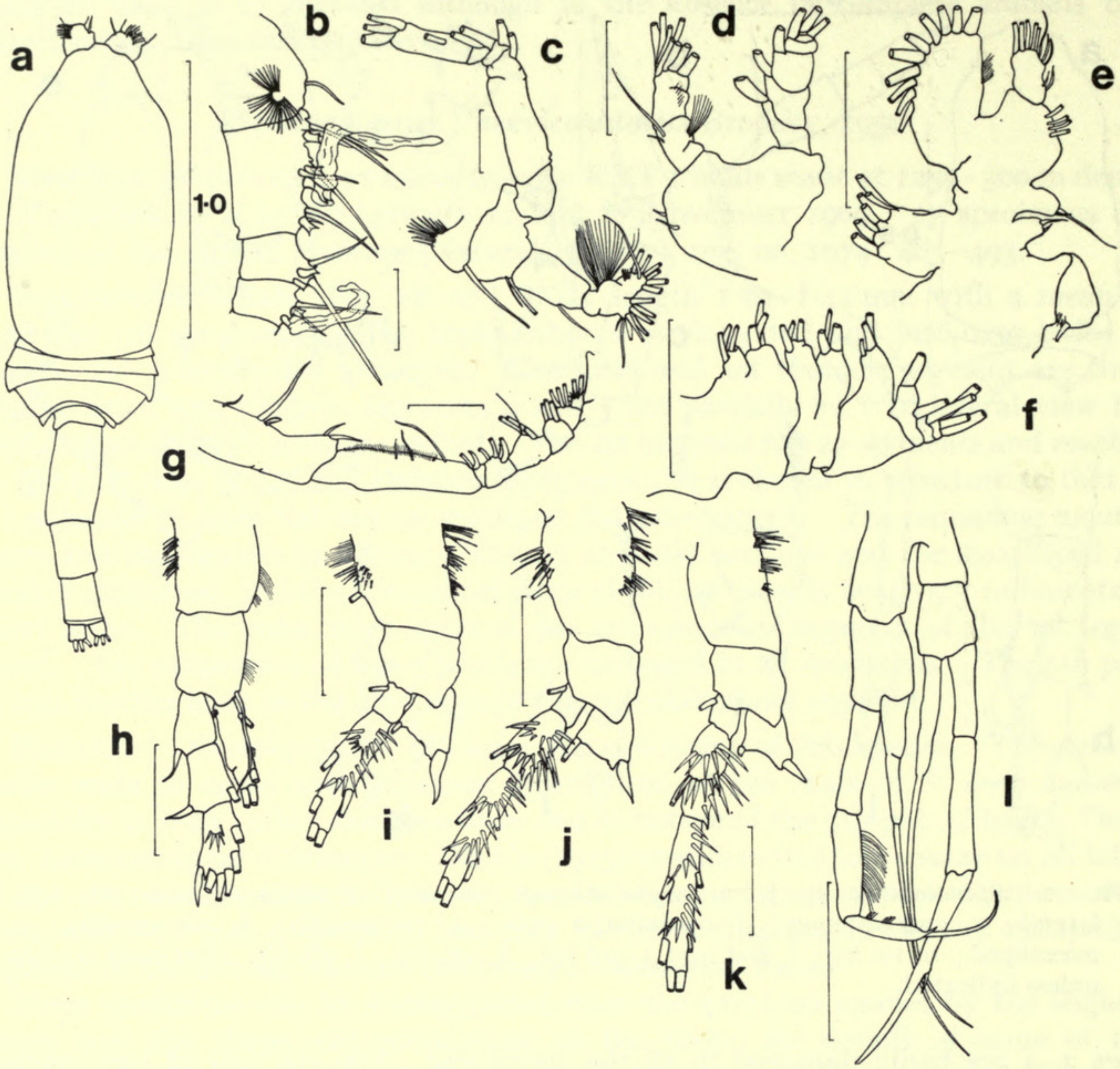

FIG. 3. *Spinocalanus* sp. A ♂. a, body, dorsal ; b, base of 1st antenna ; c, 2nd antenna ; d, mandibular palp ; e, 1st maxilla ; f, 2nd maxilla ; g, maxilliped ; h, 1st leg ; i, 2nd leg ; j, 3rd leg ; k, 4th leg ; l, 5th leg. Bar scale 0·1 mm unless indicated.

DESCRIPTION. Male (Fig. 3) : Body length 1·75–2·20 mm with a mean of 1·91 mm (11 specimens). The cephalothorax is 1·6 times as long as the 5-segmented abdomen. The head and 1st thoracic segment are fused but thoracic segments 4 and 5 are separate. The cephalothorax is slightly arched in lateral view. The anal segment is very short and telescoped into the 4th abdominal segment. The 1st antenna has 19 segments and reaches to the hind edge of the 2nd abdominal segment ; the 1st segment has a stellate group of spines on the dorsal surface and the first eight segments have large flattened sensory filaments. The remaining mouthparts and the legs are as shown. The 1st and 2nd maxillae and the maxilliped are weakly chitinized ; the terminal segment of the maxilliped has a group of spines. The 3rd exopodite segment of the 1st leg has a patch of fairly large surface spines ;

the exopodites of the remaining swimming legs are missing in all the specimens. The 5th pair of legs reaches back to the hind edge of the 2nd abdominal segment.

REMARKS. These specimens differ from any known *Spinocalanus* male. *S. stellatus* and *S. dorsispinosus* both have stellate bundles of spines on the 1st antenna, but the males of both species are larger than the present specimens and are structurally quite distinct. Females of *S. horridus, S. angusticeps, S. hoplites, S. usitatus* and *S. pteronus,* for all of which the males are unknown, were found in the same hauls as these specimens. Since they may be the undescribed male of a known species they are not considered here to be a new species.

Spinocalanus sp. B

MATERIAL EXAMINED: 2 males taken in an RMT 1 haul made at 1220–1000 m depth in a position 18°N 25°W on 18 November 1969. Deposited at the British Museum (Natural History), reg. no. 1974 : 516 and 517.

DESCRIPTION. Male (Fig. 4): Body length 2·05 mm (both specimens). The cephalothorax is slightly distorted in both specimens and is about 2·6 times as long as the 5-segmented abdomen. The head and 1st thoracic segment are fused but

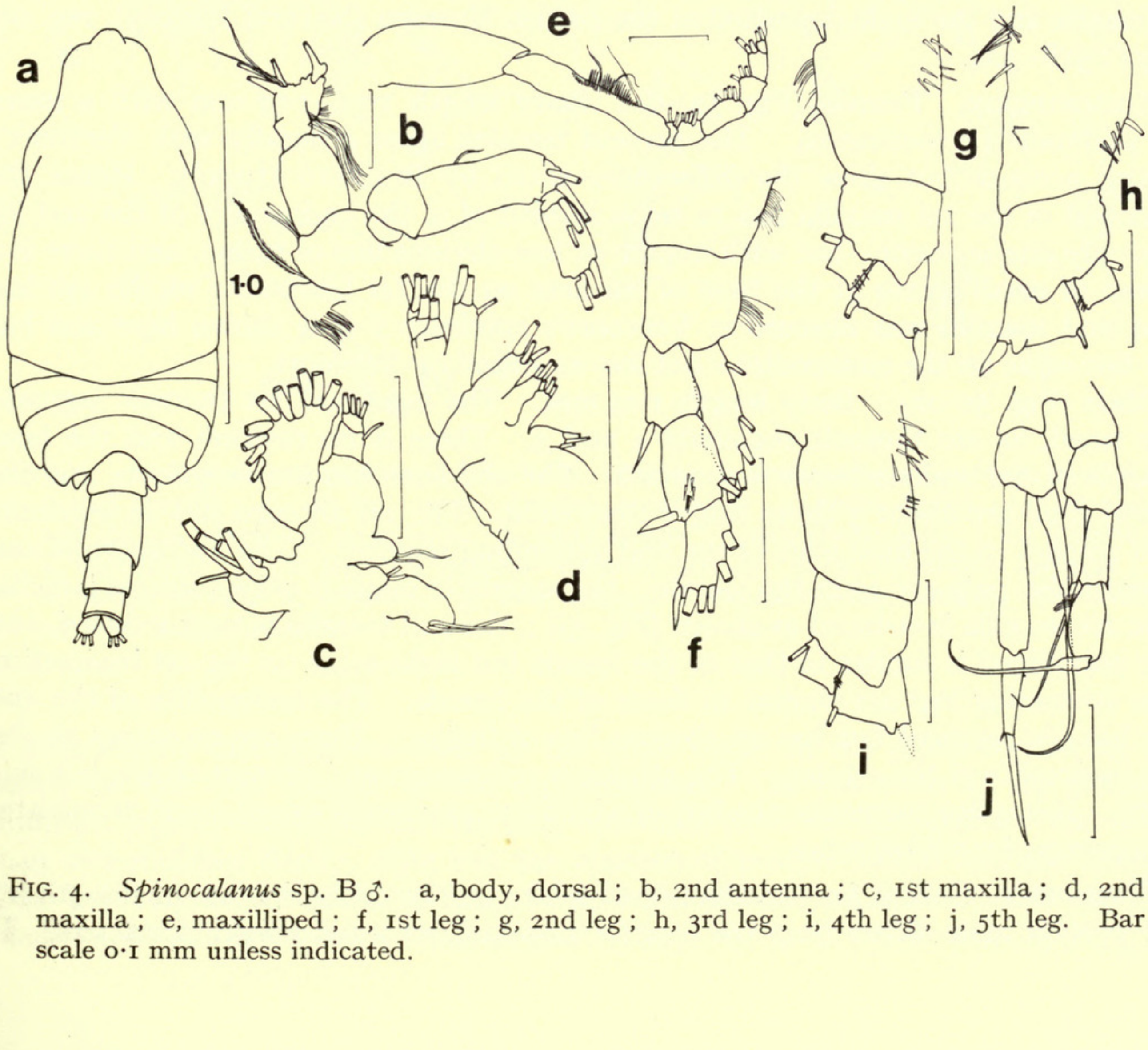

FIG. 4. *Spinocalanus* sp. B ♂. a, body, dorsal; b, 2nd antenna; c, 1st maxilla; d, 2nd maxilla; e, maxilliped; f, 1st leg; g, 2nd leg; h, 3rd leg; i, 4th leg; j, 5th leg. Bar scale 0·1 mm unless indicated.

thoracic segments 4 and 5 are separate. The forehead has a distinct dorsal protrusion. The 1st antennae are broken on both specimens; the 1st segment has no spines. The mandible is similar to that of the preceding species, and the remaining mouthparts are as shown. The 1st leg has a group of spines on the surface of the 2nd exopodite segment; legs 2–4 are badly damaged in both specimens. The 5th pair of legs reaches back to the hind edge of the 3rd abdominal segment.

REMARKS. These relatively large specimens do not agree with the description of any known *Spinocalanus* male. They were taken in a haul containing females of *S. horridus*, *S. hoplites*, *S. usitatus*, *S. angusticeps* and *S. abyssalis*. Since they may be the undescribed male of a known species they are not considered here to be a new species.

Family **AETIDEIDAE**

Aetideus arcuatus (Vervoort, 1949)

Snelliaetideus arcuatus Vervoort, 1949: 3–7, fig. 1; Park, 1970: 475; Bradford, 1971*b*: 32.

MATERIAL EXAMINED: 14 females and 1 male taken in 4 RMT 1 hauls made at 790–610 m depth in a position 18°N 25°W, between 12 and 14 November 1969. 6 females and the male deposited at the British Museum (Natural History), reg. no. 1974: 518–524.

DESCRIPTION. Female (Fig. 5a–d): Body length 1·52–1·67 mm with a mean of 1·60 mm (12 specimens). The present females agree generally with Vervoort's (1949) account but show the differences noted by Bradford (1971*b*). Hence the endopod of the 1st maxilla has 12 setae instead of 9, the endopodite of the 2nd leg has only one segment – but with a more or less obvious line of fusion, and there is a group of small spines at the base of the seta on the 1st basipodite of the 4th leg. The 2nd maxilla was obscure in Vervoort's specimen; it is shown here and has six fine setae on the endopodite – not five as stated by Vervoort.

Male (Fig. 5e–m): Body length 1·22 mm. The head and 1st thoracic segment are fused, as are thoracic segments 4 and 5. There is no rostrum and the hind margin of the cephalothorax is rounded. The abdomen has four segments, and the furcal rami are about 3 times longer than wide. The 1st antenna has 20 segments and reaches to the hind edge of the 2nd abdominal segment. The 2nd antenna and mandibular palp are as in the female; the mandible blade is only a simple lamella. The 1st maxilla is reduced as shown (Fig. 5j); the 2nd maxilla is very reduced, and the maxilliped is similar to that of the female but lacks setae on the 1st basipodite. The swimming legs are similar to those of the female. The endopodite of the 2nd leg has one segment but has an obvious line of fusion. There are no spines on the 1st basipodite of the 4th leg. The 5th leg is uniramous and present on the left side only. It has five segments, the last of which has patches of spinules and terminates in a group of modified setae.

REMARKS. Except for the absence of spines on the 1st basipodite of the 4th leg the present male differs from the females only in the normal sexual characters. It

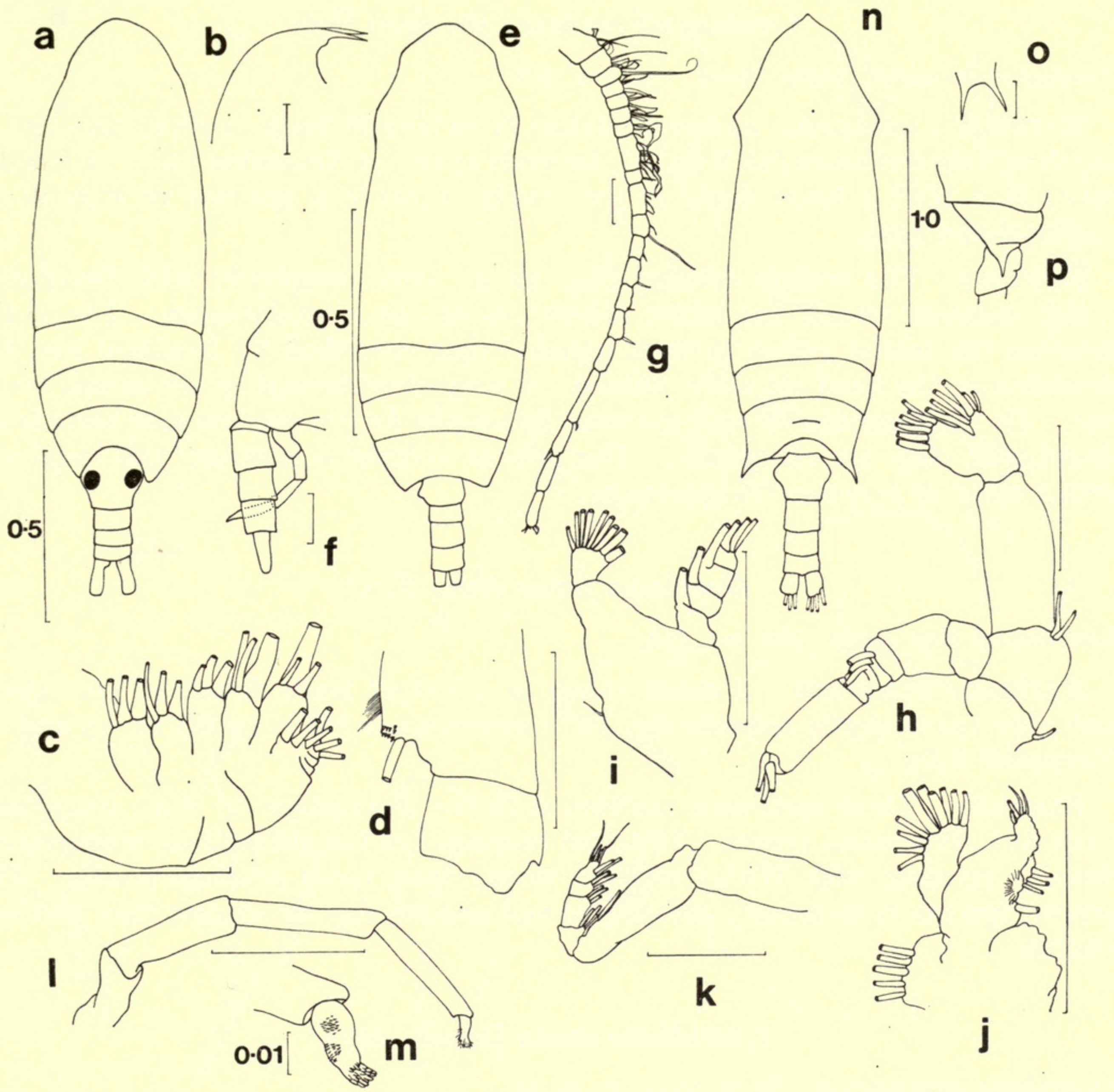

FIG. 5. a–d, *Aetideus arcuatus* ♀. a, body, dorsal; b, forehead and rostrum, lateral; c, 2nd maxilla; d, 4th leg. e–m, *Aetideus arcuatus* ♂. e, body, dorsal; f, abdomen and 5th leg, lateral; g, 1st antenna; h, 2nd antenna; i, mandibular palp; j, 1st maxilla; k, maxilliped; l, 5th leg; m, terminal segment, 5th leg. n–p, *Aetideopsis carinata* ♀. n, body, dorsal; o, rostrum; p, hind margin of cephalothorax, lateral. Bar scale 0·1 mm unless indicated.

is immediately distinguished from all the other males in the genus by having no points on the hind margin of the cephalothorax. On the basis of the females Bradford (1971*b*) concluded that the only difference between *Snelliaetideus* Vervoort, 1949 and *Aetideus* Brady, 1883 was the absence of postero-lateral thoracic points. This discovery of the male confirms Bradford's opinion and *Snelliaetideus* should, I believe, be amalgamated with *Aetideus*.

Aetideopsis carinata Bradford, 1969

Aetideopsis carinata ? ; Roe, 1972*a* : 294, 302, 308.

MATERIAL EXAMINED : 14 females taken in 10 N113H hauls made at 940–450 m depth off Fuerteventura (28°N 14°W), between 15 and 27 November 1965. 2 females taken in 2 RMT 1 hauls made at 500–410 m depth in a position 18°N 25°W on 16 November 1969.

REMARKS. The present females (Fig. 5n–p) agree completely with Bradford's (1969) account except for slight differences in the cephalothorax. The notch between the rostral points is more rounded than described by Bradford and the shoulders on the head are more pointed – in some specimens they are almost hook-like. Dr Bradford kindly sent me some specimens for comparison and there is no doubt that they are conspecific. The present specimens measure 2·66–2·96 mm with a mean of 2·79 mm (16 specimens).

Gaetanus ferox With, 1915*

Gaetanus sp. Roe, 1972*a* : 286, 302, 308.

MATERIAL EXAMINED : 2 males taken in 2 N113H hauls fished at 510–450 m and 300–240 m depth respectively, off Fuerteventura (28°N 14°W) on 15 and 16 November 1965.

REMARKS. These specimens conform with the descriptions of With (1915) and Grice and Hulsemann (1967). The right exopodite of the 5th leg has two segments thereby agreeing with With's account rather than Grice & Hulsemann's. The present specimens measure 3·12 and 3·27 mm and are slightly smaller than previous records.

Chiridiella ovata Deevey, 1974

? *Chiridiella macrodactyla* ; Scott, 1909 : 79, pl. 36.

MATERIAL EXAMINED : 1 female taken in an RMT 1 haul made at 1200–1000 m depth in a position 18°N 25°W on 18 November 1969.

REMARKS. I was preparing to describe this specimen as a new species until Dr G. B. Deevey kindly sent me a copy of her then unpublished manuscript on *Chiridiella* (Deevey 1974). The present female (Fig. 6) agrees almost completely with her description of *C. ovata*. The 1st maxilla, however, is variable. On the left side (Fig. 6f) the 3rd inner lobe is absent – contrasting with Deevey's specimens, and the exopodite has three setae ; on the right (Fig. 6g) the 3rd inner lobe is present and has one seta, but the exopodite has only two. The 1st maxilla of Scott's (1909) specimen differs from both this and Deevey's account. The 2nd lobe of the 2nd maxilla is very small in the present specimen, and the seta on the 1st

* Park has recently concluded that *G. ferox* is the male of *Gaetanus miles*, Giesbrecht 1888. (Park, T. S. 1975. Calanoid copepods of the genera *Gaetanus* and *Gaidius* from the Gulf of Mexico. *Bull. mar. Sci.* **25** : 9–34.)

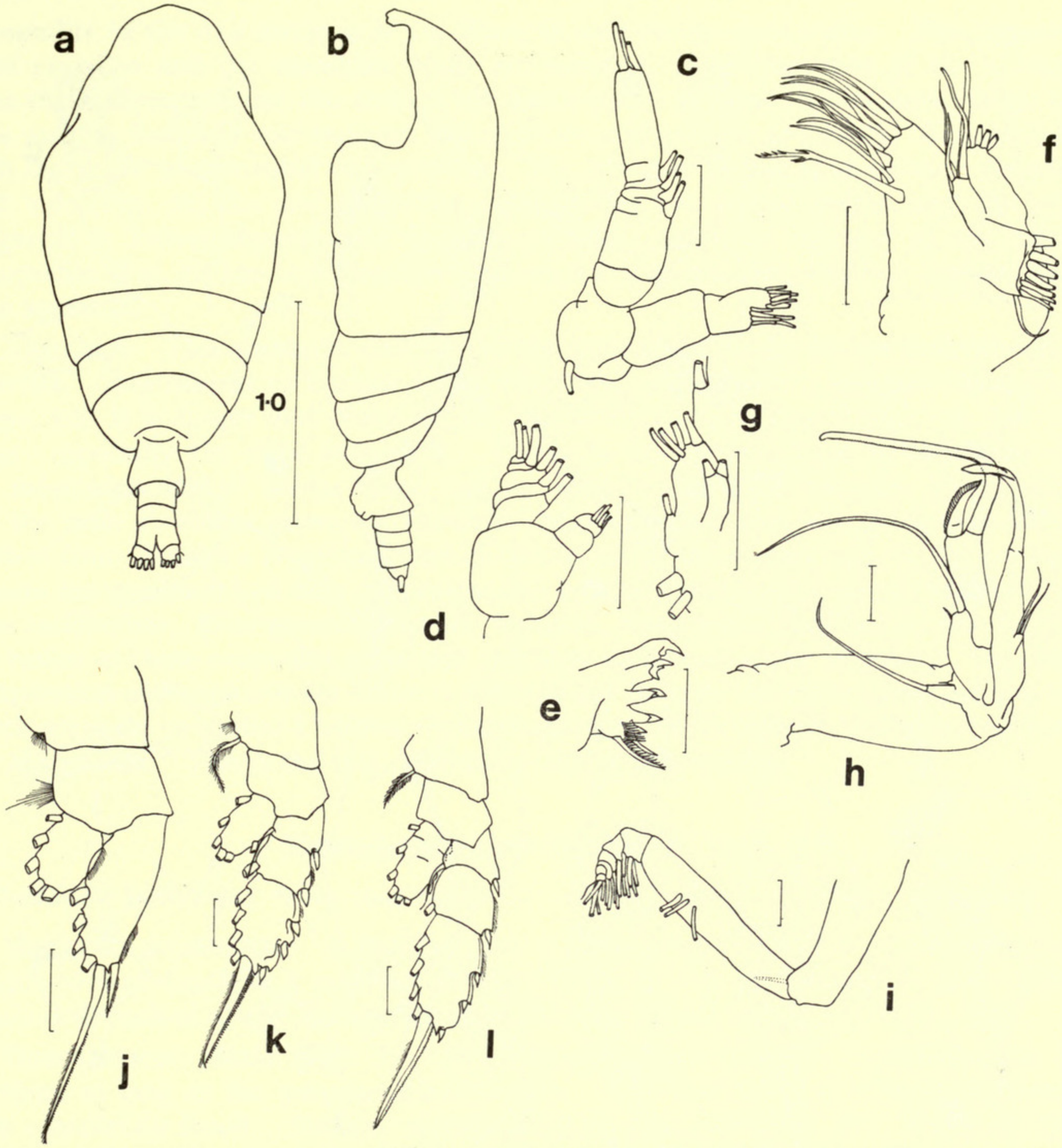

FIG. 6. *Chiridiella ovata* ♀. a, body, dorsal; b, body, lateral; c, 2nd antenna; d, mandibular palp; e, mandible blade; f, 1st maxilla, left; g, 1st maxilla, right; h, 2nd maxilla; i, maxilliped; j, 1st leg; k, 2nd leg; l, 4th leg. Bar scale 0·1 mm unless indicated.

basipodite of the maxilliped is present on one side only. The endopodites of the 3rd and 4th legs have only one segment but the lines of fusion are clearly visible.

Pseudochirella tuberculata Tanaka, 1957

MATERIAL EXAMINED: 4 females and 1 male taken in 4 RMT 1 hauls made at 1250–700 m depth in a position 18°N 25°W, between 12 and 17 November 1969. The male is deposited at the British Museum (Natural History), reg. no. 1974 : 525.

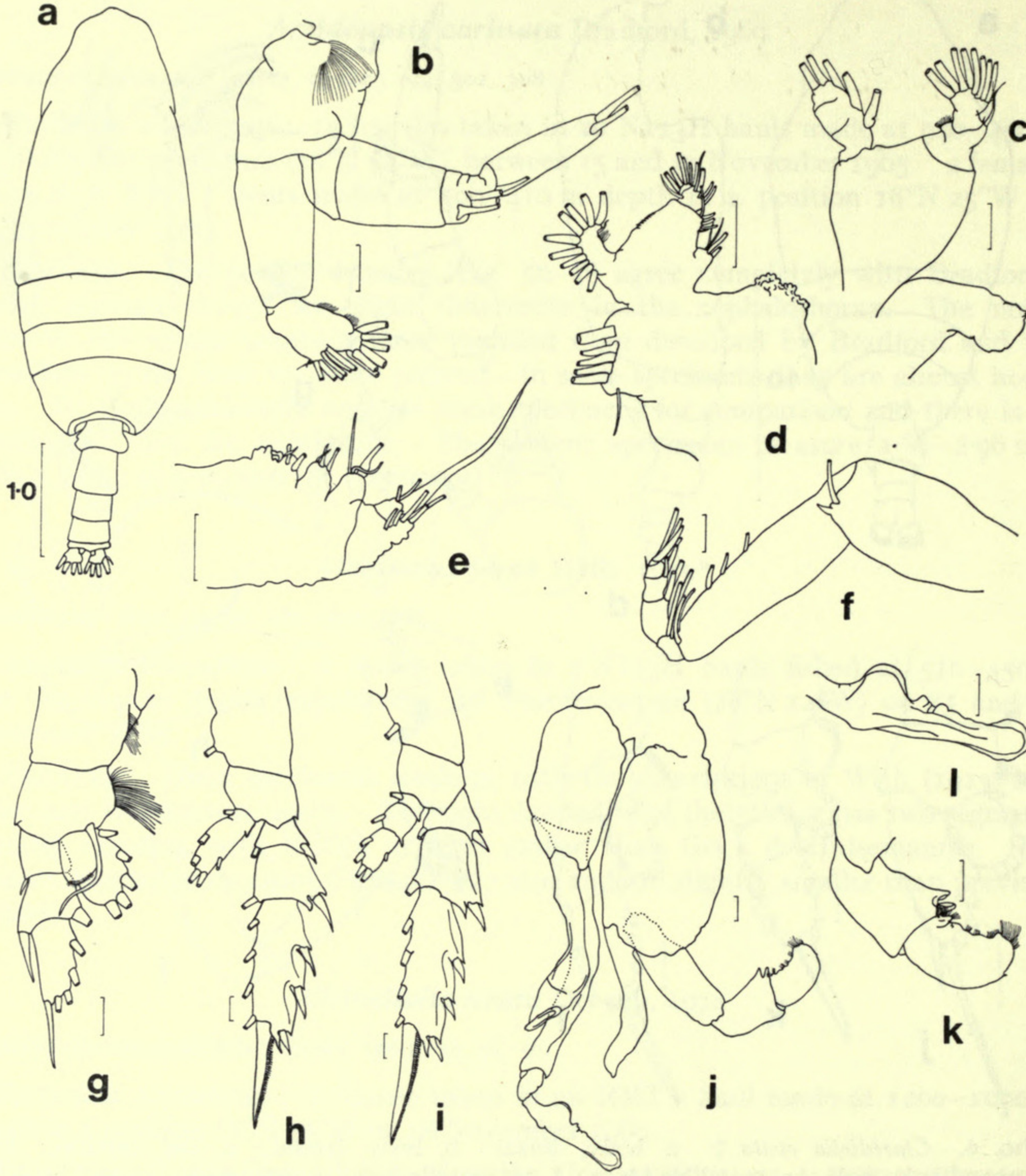

FIG. 7. *Pseudochirella tuberculata* ♂. a, body, dorsal ; b, 2nd antenna ; c, mandible ; d, 1st maxilla ; e, 2nd maxilla ; f, maxilliped ; g, 1st leg ; h, 2nd leg ; i, 4th leg ; j, 5th leg ; k, 5th leg, left exopodite ; l, 5th leg, right 3rd exopodite segment. Bar scale 0·1 mm unless indicated.

DESCRIPTION. Male (Fig. 7) : Body length 5·76 mm. The cephalothorax is robust and oval ; it is 3·1 times as long as the 5-segmented abdomen. The head and 1st thoracic segment are fused. Thoracic segments 4 and 5 are separate ; the 5th segment is rounded laterally and has no spines. The rostrum is a single spike directed ventrally. The 1st antenna has 21 segments and reaches to the hind edge of the 3rd abdominal segment. The remaining mouthparts are as shown. The exopodite of the 2nd antenna is 1·4 times as long as the endopodite. The 1st and 2nd maxillae and the mandible blade are reduced. The exopodite of the 1st leg has three segments and the endopodite has a comb of spines. The endopodite of the 2nd leg has only one segment but with an evident line of fusion; the 3rd and 4th legs have 3-segmented endopodites. The 5th pair of legs is as shown: on the left side (Fig. 7k) the 2nd exopodite segment has two strong points, and the 3rd segment is kidney-shaped with bunches of hairs; the 3rd segment of the right exopodite (Fig. 7l) has two lamellae – one on a central swelling and one terminating the segment.

REMARKS. This specimen does not fit the description of any known male *Pseudochirella*. It is nearest to Tanaka & Omori's (1969) account of *P. polyspina* Brodsky, 1950, but it is larger and differs in the detail of the mouthparts and 5th pair of legs – especially the right exopodite. It was found in association with females of *P. tuberculata* and *P. obtusa* (Sars, 1905). It does not agree with the description of the male *P. obtusa* given by Vervoort (1949). Apart from sexual characters, it differs from Tanaka's (1957) account of the female *P. tuberculata* only in the 1st leg, where his specimen had only two exopodite segments and had no comb of spines on the endopodite. The present females, however, show some variation in the degree of fusion of these exopodite segments and they do have a comb of spines. Specific attribution of *Pseudochirella* males is difficult but because the structures common to both sexes are so similar I believe that this specimen is the hitherto unknown male of *P. tuberculata*. This is the first Atlantic record of this species.

Valdiviella minor Wolfenden, 1911

? *Valdiviella brevicornis*; Scott, 1909: 78, pl. 22; Brodsky, 1950: 223, fig. 137 (male only).

MATERIAL EXAMINED: 2 females and 1 male from 2 RMT 1 hauls made at 1250–1000 m depth in a position 18°N 25°W on 17 and 18 November 1969. The male is deposited at the British Museum (Natural History), reg. no. 1974: 526.

DESCRIPTION. Male (Fig. 8): Body length 4·96 mm. The cephalothorax is 3 times as long as the 5-segmented abdomen. The head and 1st thoracic segment are completely fused; thoracic segments 4 and 5 are partially so. The head has prominent shoulders and the rostrum has two short spikes. The hind margin of the cephalothorax is rounded laterally and has no spines. The 1st antennae are both broken off. The remaining mouthparts are identical to those described by Sewell (1929) for the male *V. insignis*. The legs are as shown. The 1st leg has three exopodite segments but the 2nd, 3rd and 4th legs have only two. The 2nd leg has a single endopodite segment and legs 3 and 4 have two endopodite segments. The exopodites and endopodites of legs 2–4 all show signs of fusion between segments. The 5th pair of legs is typical of the genus. The basipodite segments are much longer on the left side than on the right, but conversely the left endopod is much shorter than the right. The 1st and 2nd exopodite segments of the left leg each have a small spine. The 1st and 2nd exopodite segments of the right leg are partially fused and are drawn out into a long curved point.

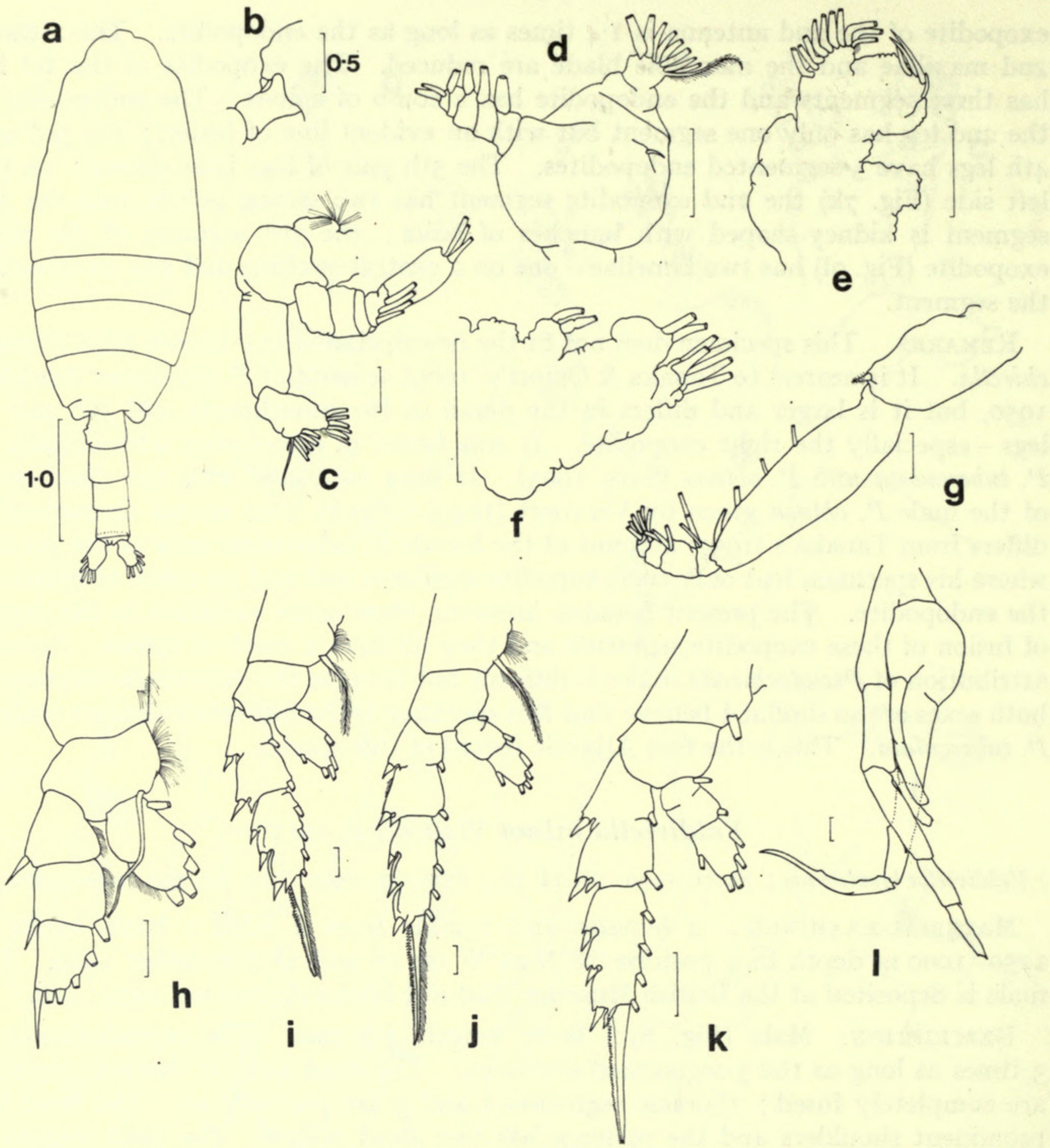

FIG. 8. *Valdiviella minor* ♂. a, body, dorsal ; b, forehead and rostrum, lateral ; c, 2nd antenna ; d, mandibular palp ; e, 1st maxilla ; f, 2nd maxilla ; g, maxilliped ; h, 1st leg ; i, 2nd leg, j, 3rd leg ; k, 4th leg ; l, 5th leg. Bar scale 0·1 mm unless indicated.

REMARKS. This male was found with two undoubted females of *V. minor*. Both the females have the very characteristic chitinous ridge on the dorsal side of the genital segment and are identical to the descriptions of Wolfenden (1911) and Sewell (1929). They both measure 5·44 mm and are thus slightly larger than previous records. The present male is distinguished both in structure and size from males of *V. insignis*, *V. oligarthra* and *V. ignota*. Of the three smaller species, *V. imperfecta* is very poorly known, but females of *V. brevicornis* and *V. minor* can be identified easily. Scott (1909) described a male which he doubtfully attributed to *V. brevicornis*. Sewell (1929) also described a male as *V. brevicornis* and noted slight differences between his specimen and Scott's. Vervoort (1957) stated that Sewell's specimen(s) were 'undoubted males of *V. brevicornis*'. The present male is very similar to that described by Scott. As far as can be seen from his description it differs only in having the 4th and 5th thoracic segments and the 1st and 2nd exopodite segments of the right 5th leg partially fused instead of completely so. Sewell's specimen had a short spine on the posterior thoracic margin and a 3-segmented exopodite in the 2nd leg. I believe that Scott's male and the present specimen are conspecific. If the differences between them and Sewell's specimen of *V. brevicornis* are of specific value they may well be the hitherto undescribed male of *V. minor*, especially in view of the present association with females of this species.

Family **PHAENNIDAE**

Xanthocalanus agilis Giesbrecht, 1892

MATERIAL EXAMINED: 1 male taken in an RMT 1 haul made at 200–110 m depth in a position 18°N 25°W on 16 November 1969. Deposited at the British Museum (Natural History), reg. no. 1974 : 527.

REMARKS. The present male (Fig. 9a–d) measures 2·58 mm and agrees with Giesbrecht's (1892) description except for the 5th pair of legs. Giesbrecht described only the elongate left leg but it is not clear from his account whether the absence of the right leg was accidental or not. Giesbrecht & Schmeil (1898) said that the right leg is absent. Other than restatements of Giesbrecht's original account I know of no other description of the male *X. agilis*. The general appearance of the present male is so similar to that of the female *X. agilis* that there can be no doubt that they are conspecific. The right leg of the 5th pair has five segments and is very short, reaching only to the end of the 1st segment of the left leg. I believe that Giesbrecht's description is incomplete and that the male *X. agilis* has a pair of 5th legs in common with other males of this genus.

Family **SCOLECITHRICIDAE**

Several authors have commented on the difficulties in classifying species within this large and complex family. Most recently, Bradford (1973) partially reviewed both the Phaennidae and the Scolecithricidae, redefining both families and some of their genera. Within the Scolecithricidae she found apparently consistent differences in the setation of the 1st maxilla of various genera, although the number of species which she examined was rather small. She was, however, unable to place definitely a large number of species into her redefined genera, either because of their structure or, presumably, because their descriptions are inadequate and many of their males unknown. It is therefore impossible, at the moment, to verify her narrower generic definitions for many species in this family. Re-examination of more species will clarify the acceptable limits for each genus.

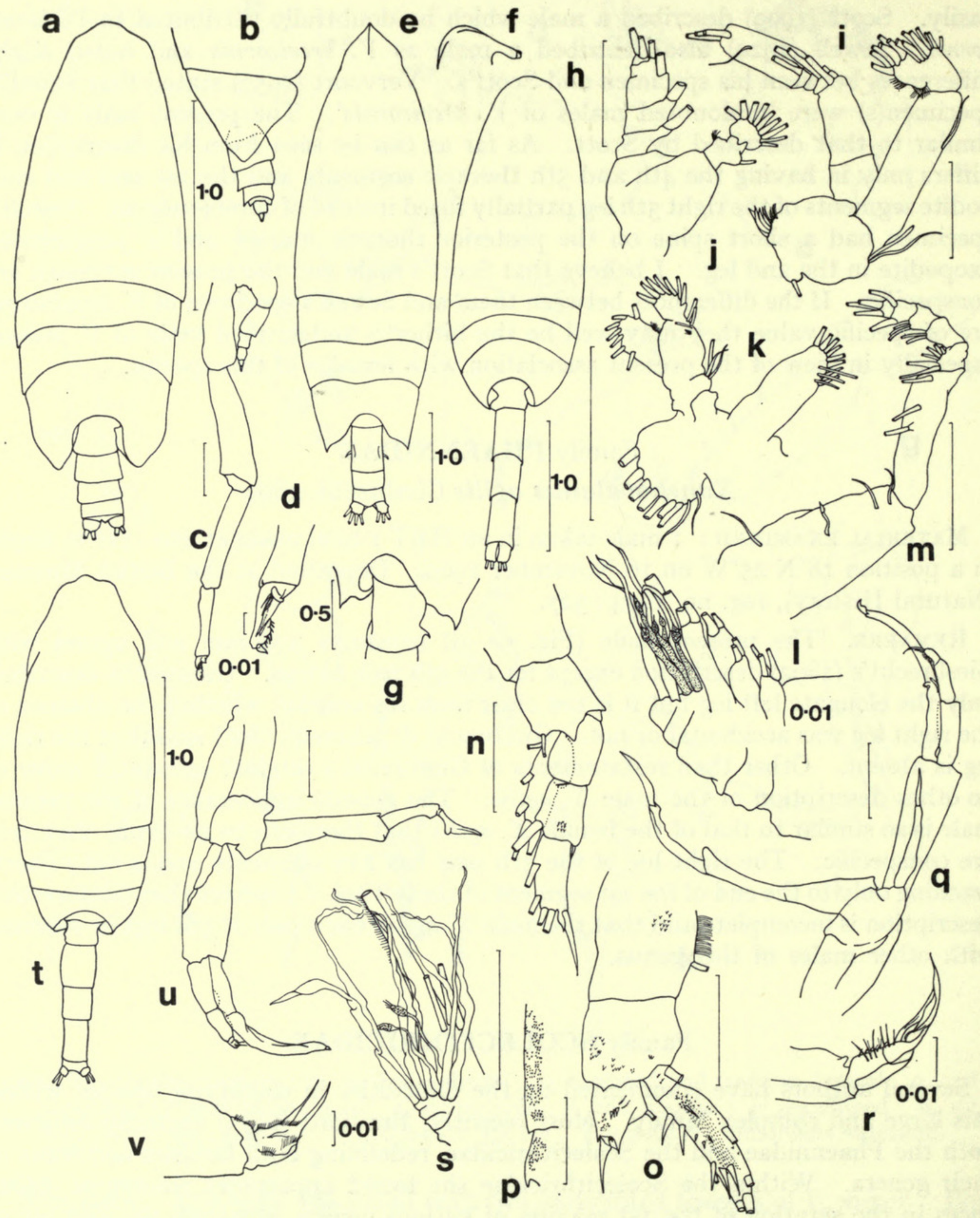

FIG. 9. a–d, *Xanthocalanus agilis* ♂. a, body, dorsal; b, last thoracic segment and abdomen, lateral; c, 5th leg; d, 5th leg, terminal segment left leg. e–g, *Scottocalanus thomasi* ♀. e, body, dorsal; f, forehead and rostrum, lateral; g, genital segment, half lateral. h–r, *Scaphocalanus* sp. ♂. h, body, dorsal; i, 2nd antenna; j, mandibular palp; k, 1st maxilla; l, 2nd maxilla; m, maxilliped; n, 1st leg; o, 2nd leg; p, 4th leg, basipodite segments; q, 5th leg; r, 5th leg, 3rd exopodite segment left leg. s, *Scolecithricella laminata* ♀, 2nd maxilla endopod. t–v, *Scolecithricella laminata* ♂. t, body, dorsal; u, 5th leg; v, 5th leg, 3rd exopodite segment left leg. Bar scale 0·1 mm unless indicated.

The present collections contain several rare and new scolecithricid species. Some of these agree well with Bradford's generic definitions but some do not. A new genus is described for some of the latter species but others are maintained within existing genera pending further study of the variation within these.

Scottocalanus thomasi Scott, 1909

? *Scottocalanus backusi* Grice, 1969 : 451, figs 16–34.

MATERIAL EXAMINED : 3 females and 1 male taken in 3 RMT 1 hauls made at 500–210 m depth in a position 18°N 25°W, between 12 and 16 November 1969.

REMARKS. The present females (Fig. 9e–g) agree with Grice's (1969) description of *S. backusi* which is, in turn, very similar to *S. thomasi*. The females of these two species apparently differ only in the structure of their genital segment where *S. backusi* has a pair of spine-like protrusions. Sewell (1929), however, described the genital segment of *S. thomasi* as having 'a finger-like backwardly directed projection near the posterior margin a little to the left of the middle line'. Scott (1909) made no mention of this. (Sewell's description of three endopodite segments on the 1st maxilla of *S. thomasi* may be atypical since Scott described this as being 'nearly similar' to that of *S. securifrons* which has only two endopodite segments.) I have examined a female specimen of *S. thomasi* in the collections of the British Museum (Natural History), which was taken at 'Investigator' Station 670 and presumably identified by Sewell. It has two spine-like projections on its genital segment exactly as shown here (Fig. 9e, g). These projections are not always conspicuous, especially if they are bent back alongside the genital segment, and they can be easily overlooked, as they apparently were on this specimen. For this reason I think it probable that *S. backusi* and *S. thomasi* are conspecific. The present female specimens measure 5·92–6·08 mm and the male 5·92 mm.

Lophothrix latipes (T. Scott, 1894)

MATERIAL EXAMINED : 5 females and 12 males taken in 7 N113H hauls made at 800–90 m depth off Fuerteventura (28°N 14°W), between 13 and 28 November 1965. 13 females and 28 males taken in 9 RMT 1 hauls made at 700–49 m depth in a position 18°N 25°W, between 13 and 16 November 1969. 7 males are deposited at the British Museum (Natural History), reg. no. 1974 : 528–535.

DESCRIPTION. Male (Fig. 10) : Body length 2·96–3·19 mm with a mean of 3·05 mm (26 specimens). The cephalothorax is 3·4 times as long as the 5-segmented abdomen. The head and 1st thoracic segment are fused ; thoracic segments 4 and 5 are separate. The head has a low crest and the forehead is angular in lateral view. The rostrum has two thick filaments. The head has prominent shoulders. The hind margin of the 1st thoracic segment is undulating and the ventro-lateral margin of the 5th thoracic segment is abruptly cut off. The 1st antenna has 20 segments and reaches to the end of the cephalothorax. The remaining mouthparts are as shown. The mandible blade, 1st and 2nd maxillae and the maxilliped are reduced.

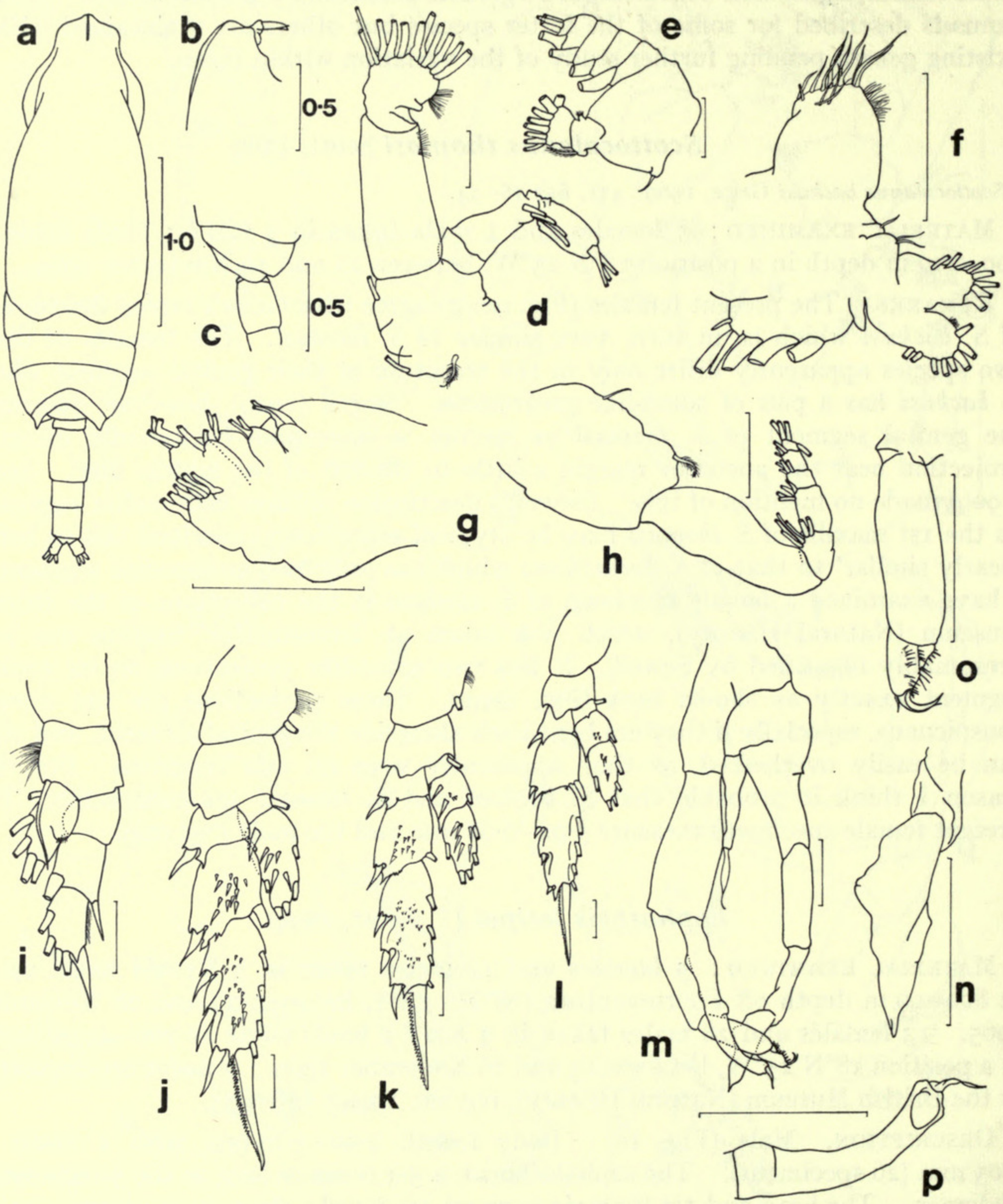

FIG. 10. *Lophothrix latipes* ♂. a, body, dorsal ; b, forehead and rostrum, lateral ; c, thoracic segments 4 and 5, lateral ; d, 2nd antenna ; e, mandibular palp ; f, 1st maxilla ; g, 2nd maxilla ; h, maxilliped ; i, 1st leg ; j, 2nd leg ; k, 3rd leg ; l, 4th leg ; m, 5th leg ; n, 5th leg, last exopodite segment right leg ; o, 5th leg, terminal exopodite segments left leg ; p, 5th leg, last endopodite segment left leg. Bar scale 0·1 mm unless indicated.

The endopod of the 2nd maxilla has six sensory setae, none of which are brush-like. The first four pairs of legs are identical to those of the female. The 5th pair of legs are asymmetric and reach back to the hind edge of the 3rd abdominal segment. In the right leg, the exopodite has four segments, the last of which is flattened and roughly triangular in shape ; the endopodite is short and has two segments. The left leg has longer basipodite segments, the exopodite has three segments and the endopodite has two ; the last exopodite segment has two wide setae and numerous spines ; the endopodite terminates in a ribbon-like seta.

REMARKS. Wilson (1950) described a male as *L. latipes* which differs in many respects from the present specimens, particularly in its mouthparts, which were described as 'like those of the female', and in its 5th pair of legs. There is some confusion between Wilson's description and his figures. His figure of the lateral view of the complete animal shows a distinct crest on the forehead, but he described this as 'evenly rounded with no trace of a crest'. The same figure shows a prominent spine on the posterior margin of the last thoracic segment ; this is described as 'smoothly rounded' in the text. The present males are so similar to the females in all structures common to both sexes that I have no doubt that they are conspecific. The mouthparts are typically reduced but the cephalothorax, particularly the characteristic low crest and last thoracic segment, and the swimming legs, are identical to those of the female.

Scaphocalanus difficilis sp. nov.

MATERIAL EXAMINED : 64 females from 8 RMT 1 hauls made at 700–210 m depth in a position 18°N 25°W, between 12 and 17 November 1969. The holotype was caught between 600 and 515 m on 14 November 1969. Deposited at the British Museum (Natural History), holotype reg. no. 1974 : 536, paratypes reg. no. 1974 : 537–557.

DESCRIPTION. Female (Fig. 11) : Body length 1·29–1·44 mm with a mean of 1·38 mm (44 specimens). The holotype measures 1·37 mm. The cephalothorax is elongate and is 3·5 times as long as the 4-segmented abdomen. The head and 1st thoracic segment are fused as are thoracic segments 4 and 5. The rostrum has two tapering filaments. The hind margin of the cephalothorax is flattened in lateral view. The abdominal segments and furcal rami have the following proportional lengths :

Seg. 1+2	3	4	5	F. rami	
30 :	19 :	19 :	13 :	19	= 100

The furcal rami are twice as long as wide. The 1st antenna is broken in all specimens ; the near-basal segments are flattened and typical of the genus. In the 2nd antenna the endopodite is 1·4 times longer than the exopodite. In the 1st maxilla the 1st inner lobe has only two surface setae and the 3rd inner lobe has only three setae. The endopod of the 2nd maxilla has five brush-like setae, of which two are enlarged, and three flattened worm-like setae. The 1st pair of legs has no external spine on either the 1st or 2nd exopodite segments. The outer spine

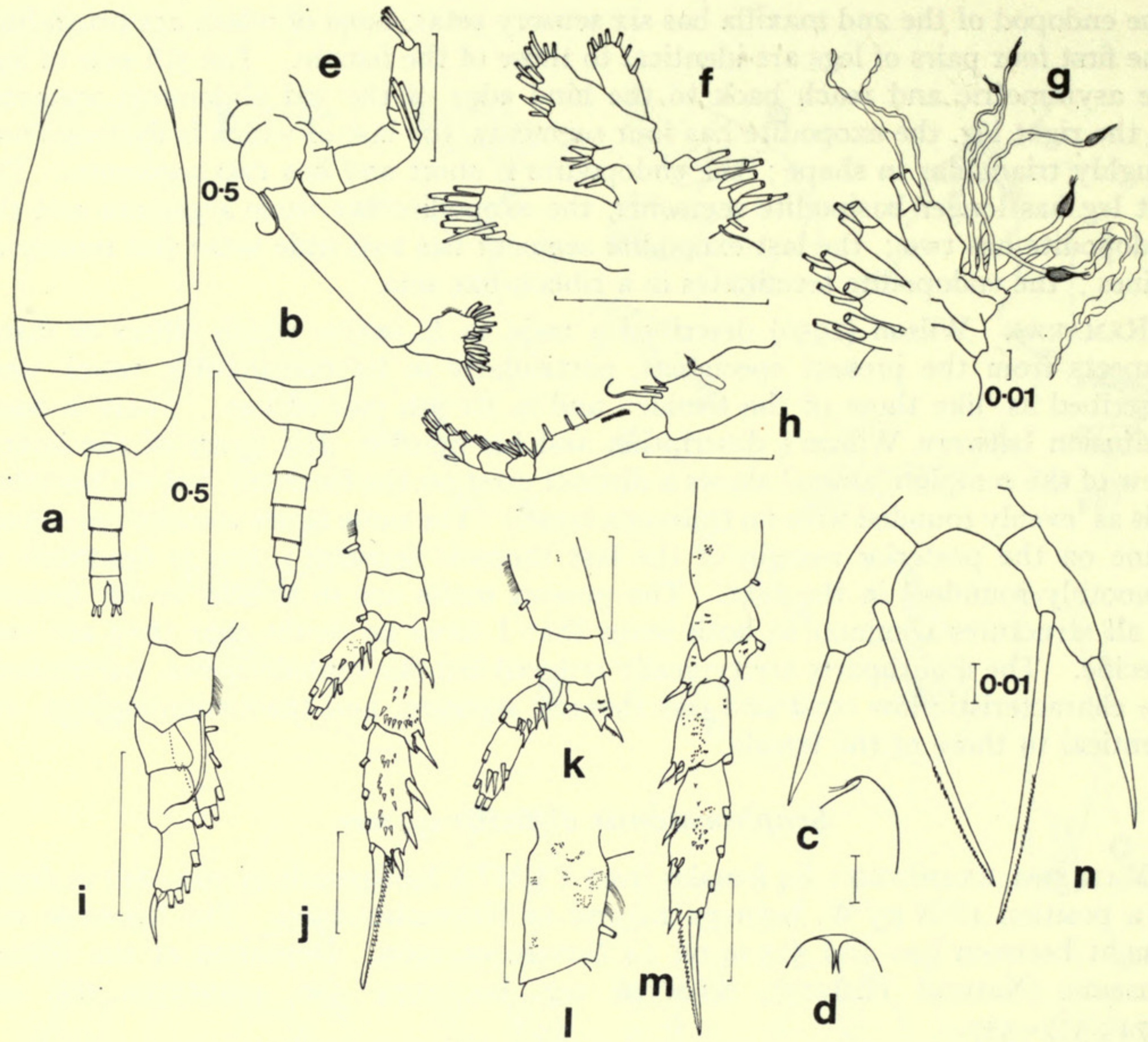

FIG. 11. *Scaphocalanus difficilis* ♀. a, body, dorsal ; b, abdomen and last thoracic segment, lateral ; c, rostrum, lateral ; d, rostrum, ventral ; e, 2nd antenna ; f, 1st maxilla ; g, 2nd maxilla ; h, maxilliped ; i, 1st leg ; j, 2nd leg ; k, 3rd leg ; l, 3rd leg, 1st basipodite segment (paratype) ; m, 4th leg ; n, 5th leg. Bar scale 0·1 mm unless indicated.

on the 1st exopodite segment of the 2nd leg is short. The basipodite segments of the 3rd and 4th legs have varying numbers of small surface spines. The 5th leg has a single segment on each side carrying two spines ; the inner spine is 1·8 times longer than the terminal one.

REMARKS. The small size of the present species distinguishes it from all other *Scaphocalanus* species which have a well-developed 5th pair of legs. *S. longifurca* (Giesbrecht, 1888) is only slightly larger (♀ 1·48–1·90 mm – limits from Tanaka, 1961, and Grice & Hulsemann, 1965). The present species differs from Giesbrecht's (1892) description of *S. longifurca* in the following characters : (a) the endopod of the 2nd antenna longer than the exopod, (b) a relatively shorter abdomen, (c) different proportional lengths of the abdominal segments, (d) no outer spine on the 2nd exopodite segment of the 1st leg, (e) a more or less straight outer spine on the 1st exopodite segment of the 2nd leg, and (f) different proportional lengths of the spines on the 5th leg. Giesbrecht (1892), Vervoort (1951) and Tanaka (1961) all described spines on the basal segments of legs 2–4 in *S. longifurca*. Vervoort said that these form a 'dense covering' on the 3rd leg and according to Tanaka these same joints are 'coarsely covered'. Without illustrations it is difficult to decide on the degree of spinulation in these descriptions. The present specimens have a varying number of small spines on these basal segments but they are relatively few in number. Tanaka's (1961) specimens of *S. longifurca* have the endopod of the 2nd antenna longer than the exopod, and the cephalothorax is 3·5 times as long as the abdomen. They differ from the present females, however, in the proportional lengths of the abdominal segments and in the shape of the hind margin of the cephalothorax.

S. subbrevicornis (Wolfenden, 1911) is very similar, if not identical, with *S. longifurca* (Farran, 1929; Vervoort, 1951; Tanaka, 1961). In some of the slight differences between these two species – the proportions of the rami of the 2nd antenna, the straight outer spine of the 1st exopodite segment of the 2nd leg of *S. subbrevicornis*, and the degree of spinulation of the basal joints of legs 2–4 – *S. subbrevicornis* is structurally more similar to the present species. Moreover, the relative length of the abdomen and the proportional lengths of the abdominal segments are also similar to the present females (Tanaka, 1961). *S. subbrevicornis* is, however, larger, females measuring 1·60–2·10 mm (extremes from Vervoort, 1957, and Grice & Hulsemann, 1965) and there are differences in the 1st and possibly also the 5th pair of legs.

Whether or not these slight differences merit separation into three species is questionable. It may be necessary to amalgamate two or all of them in future but for the moment at least they can remain separate. The 1st maxilla of *S. difficilis* differs from Bradford's (1973) definition of the genus in having only two surface setae on the 1st inner lobe and three setae on the 3rd inner lobe. This last character is shared with other scaphocalanids, however, e.g. *S. similis* and *S. invalidus* (Hure & Scotto di Carlo, 1968), and the general structure of the present species is so similar to *Scaphocalanus* that there can be no doubt that it belongs to this genus.

Scaphocalanus sp.

MATERIAL EXAMINED: 3 males taken in 2 RMT 1 hauls, one at 900–800 m depth and the other at 500–410 m, in a position 18°N 25°W on 14 and 16 November 1969. Deposited at the British Museum (Natural History), reg. no. 1974 : 558–560.

DESCRIPTION. Male (Fig. 9h–r): Body length 1·98–2·13 mm with a mean of 2·05 mm (3 specimens). The cephalothorax is 1·9 times as long as the 5-segmented abdomen. The head and 1st thoracic segment are completely fused, thoracic segments 4 and 5 are partially so. The rostrum has two thickened filaments. The abdominal segments and furcal rami have the following proportional lengths:

Seg.	1	2	3	4	5	F. rami	
	13 :	26 :	21 :	29 :	3 :	8	= 100

The 1st antenna has 20 segments and reaches back to the hind edge of the 2nd abdominal segment; the first eight segments have long sensory setae. The remaining mouthparts are as shown. The swimming legs are damaged in all specimens. The outer spine on the 1st exopodite segment of the 2nd leg is moderately long and straight. The basipodite segments of legs 2–4 are covered with small surface spines which are particularly dense on legs 3 and 4. The 5th pair of legs reaches back to the end of the abdomen. On the left side the exopodite is much shorter than the endopodite; the last exopodite segment has some coarse setae and a lamella, and the endopodite has no marked swelling along its length.

REMARKS. These specimens cannot be identified with any of the known *Scaphocalanus* males. The abdomen, with an unswollen 2nd segment, is similar to that described for *S. echinatus* by Tanaka (1961) but the present males are larger and have a different 5th pair of legs. As the males of several *Scaphocalanus* species are unknown and as these specimens are all damaged they cannot be described as new species.

Scolecithricella obscura sp. nov.

MATERIAL EXAMINED: 10 females taken in 3 RMT 1 hauls made at 1250–800 m depth and 1 female taken in an RMT 1 haul at 500–410 m. The holotype was taken at 1250–1000 m on 16 November 1969. All hauls were made in a position 18°N 25°W, between 14 and 18 November 1969. Deposited at the British Museum (Natural History), holotype reg. no. 1974 : 561, paratypes reg. no. 1974 : 562–570.

DESCRIPTION. Female (Fig. 12): Body length 1·82–2·13 mm with a mean of 2·04 mm (10 specimens). The holotype measures 1·90 mm. The cephalothorax is an elongated oval, and is 5·9 times as long as the 4-segmented abdomen. The head and 1st thoracic segment and thoracic segments 4 and 5 are fused. The rostrum has two thick filaments. The hind margin of the cephalothorax is indented laterally. The genital segment is as long as the combined length of the two subsequent segments. The furcal rami are about as long as wide. The 1st antenna is broken in all specimens. The remaining mouthparts are as shown. The endopod of the 2nd maxilla has five brush-like setae, two of which are much larger than the others, and three flattened worm-like setae. In the maxilliped the 1st basipodite is about two-thirds the length of the second, and carries one brush-like and two worm-like setae. The legs are as shown. There is no external spine on the 1st exopodite segment of the 1st leg. All the outer edge spines on the exopodite segments of the 2nd leg are long. The 5th pair of legs is uniramous and symmetrical. On each side there is a single segment, incompletely divided into three, having a small external spine – which is absent on one side of one of the paratypes, a longer terminal spine and a long stout internal spine garnished with teeth.

REMARKS. This species agrees generally with *Scolecithricella* as defined by Bradford (1973). It can be distinguished from all others in the genus by its 5th pair of legs, which are more like those found in *Amallothrix* and are very similar to those of ? *Amallothrix valens* (Farran, 1926). The great development of two of the

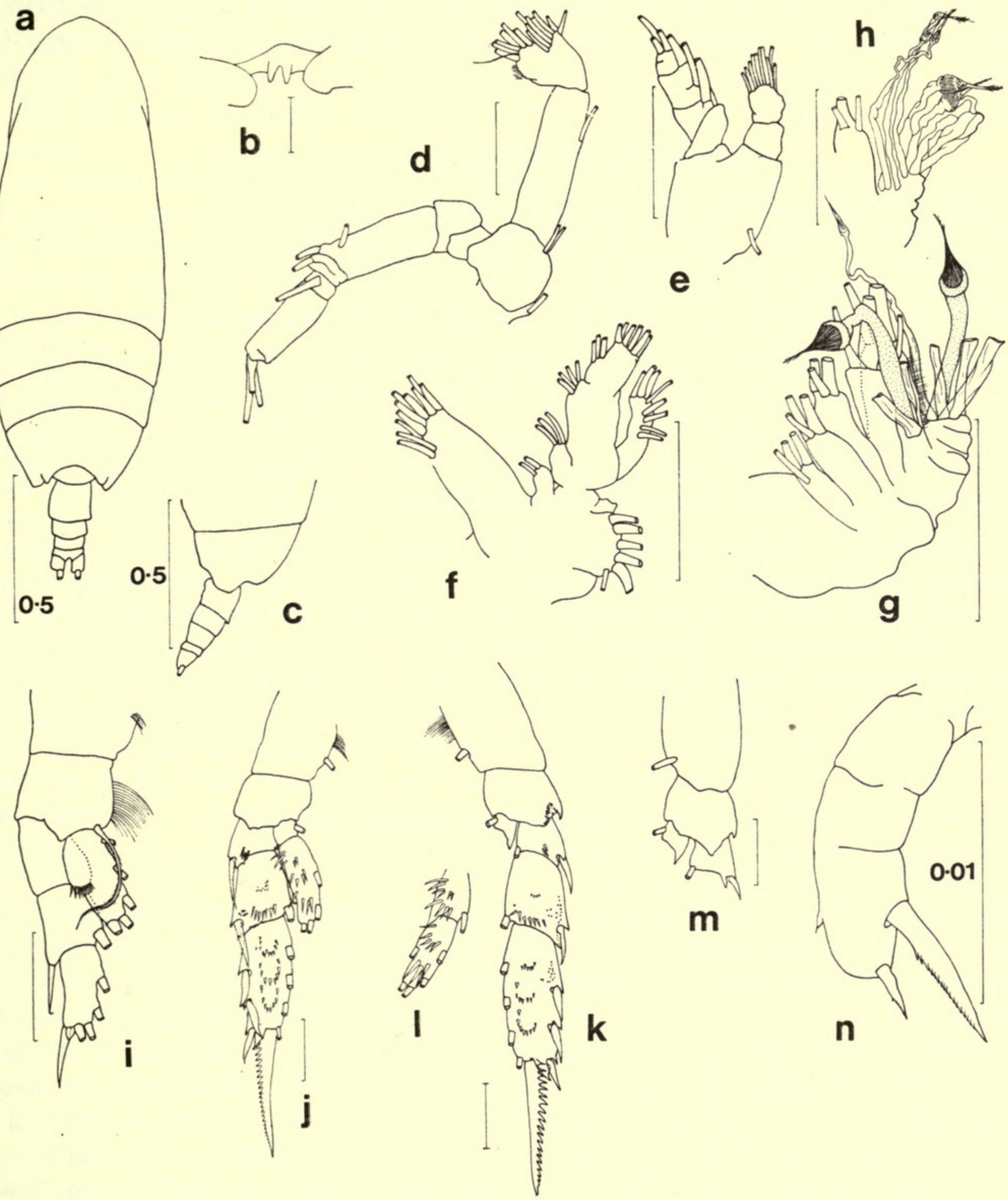

FIG. 12. *Scolecithricella obscura* ♀. a, body, dorsal ; b, rostrum, ventral ; c, last thoracic segment and abdomen, lateral ; d, 2nd antenna ; e, mandibular palp ; f, 1st maxilla ; g, 2nd maxilla ; h, 2nd maxilla endopod (paratype) ; i, 1st leg ; j, 2nd leg ; k, 3rd leg, exopodite ; l, 3rd leg, endopodite segments 2–3 ; m, 4th leg ; n, 5th leg. Bar scale 0·1 mm unless indicated.

brush-like setae of the 2nd maxilla approaches the condition seen in *Amallothrix altera* (p. 331). Few authors have figured these setae in detail in *Scolecithricella* but in some species two of the brush-like setae are shorter and thicker than the others, though not, apparently, to the extent seen here (for example, see Rose, 1942).

Scolecithricella laminata (Farran, 1926)

Scolecithrix laminata Farran, 1926 : 265, pl. 8 ; Bradford, 1973 : 143, 145.
Scolecithricella laminata ; Grice & Hulsemann, 1965 : 239, figs 14g–m, 15a–j ; 1967 : 16 ; Park, 1960 : 476 ; Wheeler, 1970 : 8 ; Roe, 1972*a* : 304, 310 ; 1972*c* : 540.
S. lamellifer Tanaka, 1962 : 78, fig. 146.
? *Amallothrix profunda* Brodsky, 1950 : 263, fig. 172 ; Bradford, 1973 : 144.

MATERIAL EXAMINED : 3 females and 1 male from an N113H haul made at 960–800 m depth off Fuerteventura (28°N 14°W) on 25 November 1965. 15 females and 3 males from 5 RMT 1 hauls made at 1250–700 m depth in a position 18°N 25°W, between 12 and 18 November 1969. 3 females and the males are deposited at the British Museum (Natural History), reg. no. 1974 : 571–577.

DESCRIPTION. Female (Fig. 9s) : Body length 1·82–2·28 mm with a mean of 1·94 mm (14 specimens). Redescription of these females is unnecessary as they generally agree with Farran's (1926) account but have the modifications described by Grice & Hulsemann (1965) and Tanaka (1962). The structure of the 1st and 2nd maxillae, however, seems in need of clarification. The 1st maxilla has the following number of setae : 5 large and 2 small on the 1st outer lobe, 8 on the exopod, 5 on the fused 2nd and 3rd endopodite segment, 2 on the 1st endopodite segment, 6 on the 2nd basipodite, 4 on the 3rd inner lobe, 2 on the 2nd inner lobe and 13 on the 1st inner lobe – of which 4 are on the surface as opposed to the edge. The 2nd maxilla (Fig. 9s) has 8 sensory setae on the endopodite of which only 2 are short and brush-like and 6 are long and worm-like.

Male (Fig. 9t–v) : Body length 2·20–2·43 mm with a mean of 2·35 mm (3 specimens). The cephalothorax is 2·3 times as long as the 5-segmented abdomen. The head and 1st thoracic segment and thoracic segments 4 and 5 are fused. The rostrum has two stout filaments. The hind margin of the cephalothorax is smoothly rounded. The 1st antenna has 19 segments and reaches to the end of the furcal rami. The remaining mouthparts are generally slightly smaller and more weakly chitinized than in the female ; their setation patterns are identical to those of the female except in the following respects. The basipodite of the mandibular palp has no setae ; in the 1st maxilla the 1st outer lobe has six large and two small setae, the exopodite has nine and the 2nd basipodite has five setae. The endopodite of the 2nd maxilla is as in the female with six long filaments and two shorter brush-like setae. In all the specimens the 2nd and 3rd exopodite segments of legs 2–4 are missing but the remainder of the swimming legs are identical to those of the female. The 5th pair of legs are asymmetrical and resemble those of *Scaphocalanus*. In the right leg the exopodite has three segments, the last of which is roughly triangular in shape. In the left leg the exopodite is much shorter than the 2-segmented endopodite ; the 3rd exopodite segment has bunches of fine hairs and two large setae.

REMARKS. Apart from the normal sexual characters these males are so similar to the females that there is no doubt that they are the same species. Brodsky's (1950) description of *A. profunda* is incomplete but the structure of the 5th pair of legs, especially the short exopodite of the left leg, is very similar to that of the present specimens.

In her review of the Scolecithricidae, Bradford (1973) could not place this species into a genus. She suggested that it may belong to *Amallothrix* or to an unnamed group typified by *Scolecithrix auropecten* Giesbrecht, 1892. The combination of six worm-like and two brush-like setae on the endopod of the 2nd maxilla would exclude this species from the Scolecithricidae as defined by Bradford. However, this definition of the 2nd maxilla would also exclude *Parascaphocalanus* Brodsky, 1955 although Bradford admits this genus to the family. In other respects the present species is a typical scolecithricid. The combination of the 2nd maxilla, a *Lophothrix*-type 1st maxilla with four surface setae on the 1st inner lobe, well-defined rostral filaments, a spine on the 1st exopodite segment of the 1st leg, and, in the male, relatively unreduced mouthparts and a *Scaphocalanus*-type 5th pair of legs, excludes this species from those genera defined by Bradford and from those not described by her. As mentioned earlier (p. 311), she had difficulty in definitely assigning a large number of species to genera, and rather than create a new monotypic genus for the present species it seems better to place it into *Scolecithricella* as defined by Sars (1902), until examination of more species clarifies the limits of any narrower generic definitions.

Scolecithricella aspinosa sp. nov.

MATERIAL EXAMINED : 9 females taken in 2 RMT 1 hauls – one fished at 1250–1000 m depth on 17 November 1969 and the other (containing the holotype) at 1220–1000 m on 18 November 1969. Both hauls were made at 18°N 25°W. Deposited at the British Museum (Natural History), holotype reg. no. 1974 : 578, paratypes reg. no. 1974 : 579–586.

DESCRIPTION. Female (Fig. 13) : Body length 3·19–3·65 mm with a mean of 3·36 mm (8 specimens). The holotype measures 3·19 mm. The cephalothorax is oval and robust, and is 3·6 times as long as the 4-segmented abdomen. The head and 1st thoracic segment are completely fused, thoracic segments 4 and 5 are partially so. The forehead is rounded in lateral view ; the rostrum has two filaments with thick sausage-shaped bases. The hind edge of the cephalothorax is slightly indented. The genital segment is longer than the combined length of the three subsequent segments. The furcal rami are about as long as wide. The 1st antenna has 23 segments and reaches to the end of the furcal rami. The remaining mouthparts are as shown. The exopod of the 1st maxilla has a group of spines. The endopod of the 2nd maxilla has five brush-like setae and three worm-like setae. In the holotype the worm-like setae are very wrinkled but this may

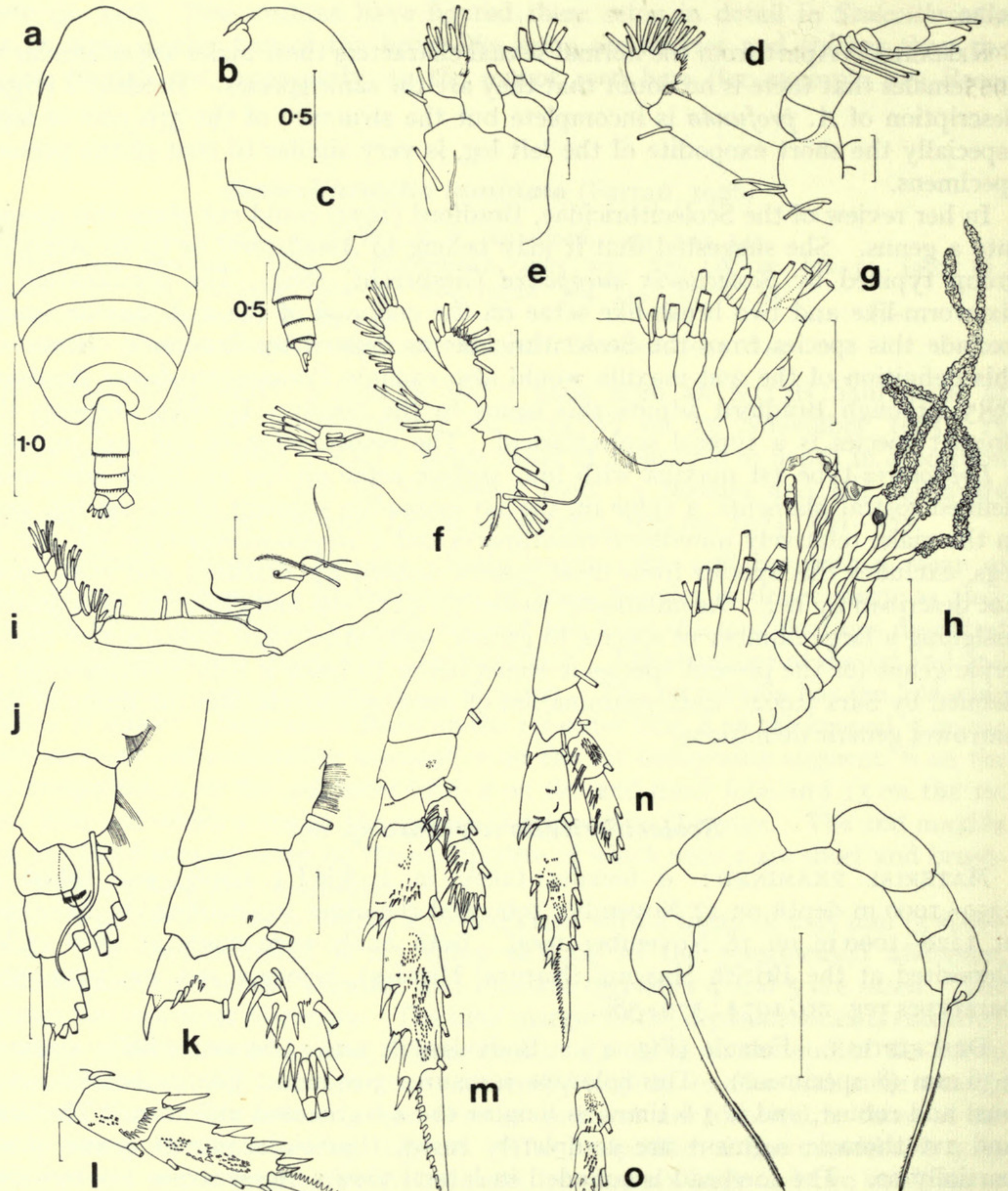

FIG. 13. *Scolecithricella aspinosa* ♀. a, body, dorsal ; b, forehead and rostrum, lateral ; c, last thoracic segment and abdomen, lateral ; d, 2nd antenna ; e, mandibular palp ; f, 1st maxilla ; g, 2nd maxilla, exopod ; h, 2nd maxilla, endopod ; i, maxilliped ; j, 1st leg ; k, 2nd leg ; l, 2nd leg, exopodite segments 2–3 (paratype) ; m, 3rd leg ; n, 4th leg ; o, 4th leg endopod anterior surface ; p, 5th leg. Bar scale 0·1 mm unless indicated.

be an artifact of preservation as in one of the paratypes these setae are simple flattened filaments. The basal segment of the maxilliped has one brush-like and two worm-like setae. The legs are as shown. The 1st leg has no outer spine on either the 1st or 2nd exopodite segment. In the 2nd leg the external spine of the 1st exopodite segment is short, and the 2nd endopodite segment has a raised lobe carrying four spines. The endopods of legs 2–4 all have long spines on their posterior surfaces ; their anterior surfaces generally have small spines but those on the 4th leg are fairly large. The 5th leg is symmetrical and uniramous. On each side there are two segments with the second having a distinct line of fusion and carrying a short terminal spine and a very long internal spine.

REMARKS. *Scolecithricella aspinosa* and the following species are distinct in having no external spines on the 1st and 2nd exopodite segments of the 1st leg. Discussion of the affinities of both these species follows the description of *Scolecithricella canariensis* on p. 325.

Scolecithricella canariensis sp. nov.

Scolecithricella sp. 3 Roe, 1972*a* : 304, 310 ; 1972*c* : 540.

MATERIAL EXAMINED : 2 females from 2 N113H hauls made at 960–825 m depth off Fuerteventura (28°N 14°W) on 25 and 27 November 1965. 9 females from 6 RMT 1 hauls made at 1220–610 m depth in a position 18°N 25°W, between 12 and 18 November 1969. The holotype was taken at 790–700 m on 12 November 1969. Deposited at the British Museum (Natural History), holotype reg. no. 1974 : 587, paratypes reg. no. 1974 : 588–597.

DESCRIPTION. Female (Fig. 14) : Body length 3·12–3·42 mm with a mean of 3·30 mm (11 specimens). The holotype measures 3·19 mm. The cephalothorax is elongate and 5·1 times as long as the 4-segmented abdomen. The head and 1st thoracic segment are fused, as are thoracic segments 4 and 5. The forehead is somewhat angular in dorsal view. The rostrum has two fairly long filaments. The hind margin of the cephalothorax is indented laterally. The genital segment is a little longer than the subsequent segment ; the furcal rami are slightly longer than wide. The 1st antenna has 23 segments, the last of which extends past the furcal rami. The remaining mouthparts are as shown. The endopod of the 2nd maxilla has three ribbon-like setae and four brush-like setae. The basal segment of the maxilliped has two worm-like and one brush-like seta. The legs are as shown. The 1st leg has no external spine on either the 1st or 2nd exopodite segment. The 2nd leg has a short outer edge spine on the 1st exopodite segment and a distinct raised lobe bearing six spines on the 2nd endopodite segment. The 5th pair of legs is symmetrical and uniramous. On each side there is a single segment, which bears traces of fusion, attached to a common basal segment. Each terminal segment has a short end spine and a longer robust internal spine armed with short teeth.

REMARKS. *Scolecithricella canariensis* and *S. aspinosa* are closely related. Both have (a) no trace of an external spine on the 1st and 2nd exopodite segments of the 1st leg, (b) a *Lophothrix*-type 1st maxilla, (c) uniformly small heads to the brush-like

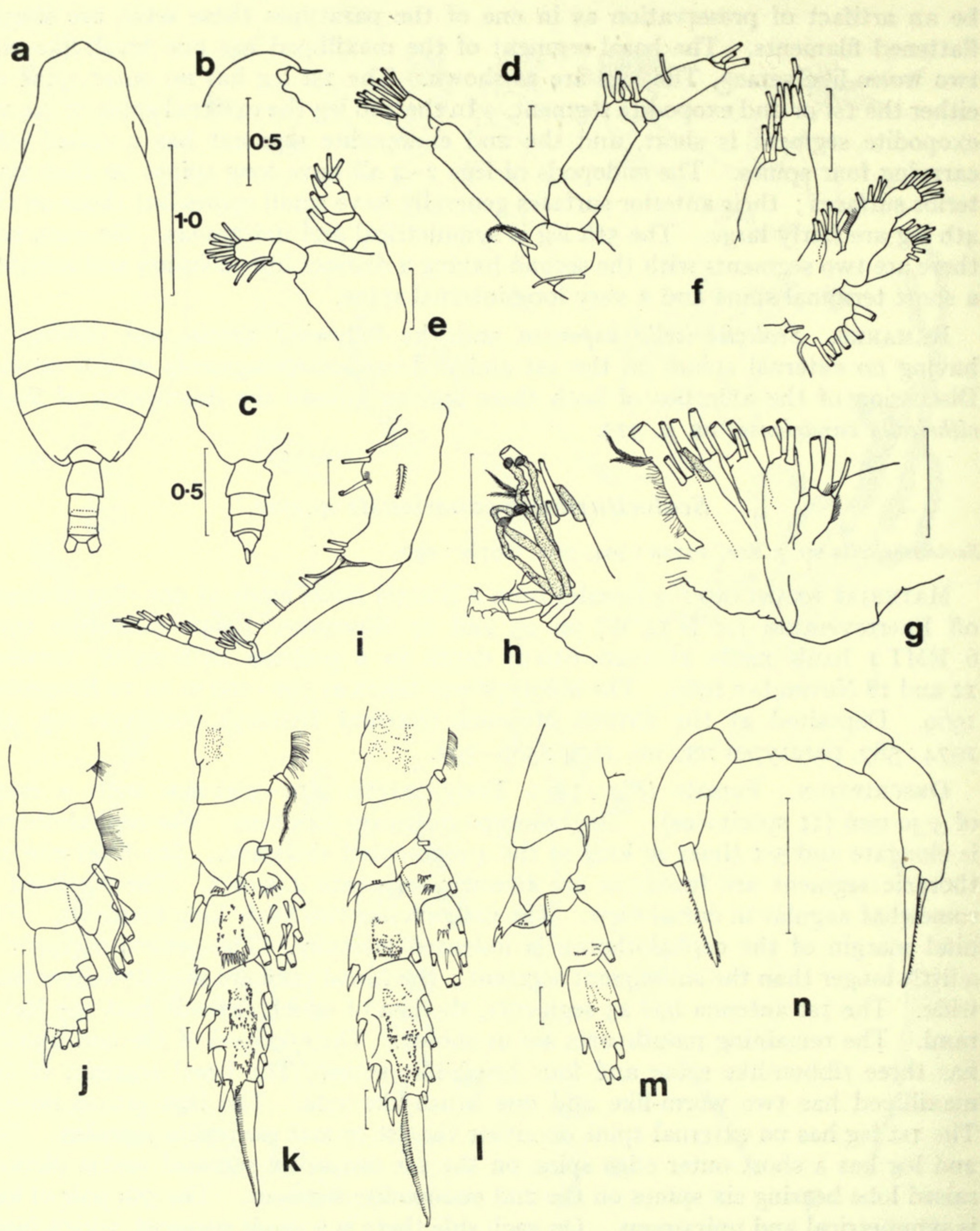

FIG. 14. *Scolecithricella canariensis* ♀. a, body, dorsal; b, forehead and rostrum, lateral; c, last thoracic segment and abdomen, lateral; d, 2nd antenna; e, mandibular palp; f, 1st maxilla; g, 2nd maxilla, exopod; h, 2nd maxilla, endopod; i, maxilliped; j, 1st leg; k, 2nd leg; l, 3rd leg; m, 4th leg; n, 5th leg. Bar scale 0·1 mm unless indicated.

setae of the 2nd maxilla (*S. canariensis* apparently only has four of these setae), (d) a similar-shaped maxilliped, and (e) a short external spine on the 1st exopodite segment of the 2nd leg and, in the same limb, a raised lobe on the 2nd endopodite segment. The two species are clearly distinct, however, differing from each other in body shape, the detailed setation of the 1st maxilla and the structure of the legs. They both show similarities with *Scaphocalanus bogorovi* Brodsky, 1955. The exopodite of the 1st leg is identical (see Grice & Hulsemann, 1965), and the maxilliped and the endopod of the 2nd maxilla are also very similar. There are differences, however, in the structure of the 1st maxilla and in the legs. *S. bogorovi* seems at best a very peculiar *Scaphocalanus* and should probably be removed from this genus.

As with *S. laminata* (p. 321) it is impossible to place either of the two present species into any of the scolecithricid genera defined by Bradford (1973), or into any of the remaining genera in this family. Both have some affinity to *Lophothrix* but also show a general resemblance to *Amallothrix*. The peculiar structure of their 1st leg, however, is constant in all the present specimens and it may be necessary to establish a new genus for these species and also perhaps for *S. bogorovi*. Pending the discovery of the males and determination of the acceptable limits within each genus both species are temporarily placed within *Scolecithricella* Sars, 1902.

Amallothrix falcifer (Farran, 1926)

Scolecithrix falcifer Farran, 1926 : 262, pl. 8 ; Bradford, 1973 : 143.
Scolecithricella sp. 2 Roe, 1972*a* : 296, 304, 310 ; 1972*c* : 540.

MATERIAL EXAMINED : 11 females and 2 males taken in 10 N113H hauls made at 960–510 m depth off Fuerteventura (28°N 14°W), between 24 and 28 November 1965. 10 females and 7 males taken in 7 RMT 1 hauls made at 1250–700 m depth in a position 18°N 25°W, between 12 and 17 November 1969. One female and 5 males are deposited at the British Museum (Natural History), reg. no. 1974 : 598–603.

DESCRIPTION. Female (Fig. 15a–m) : Body length 1·82–2·20 mm with a mean of 2·00 mm (20 specimens). The cephalothorax is oval and robust ; it is 3·8 times as long as the 4-segmented abdomen. The head and 1st thoracic segment are fused, as are thoracic segments 4 and 5. The forehead is rounded, the two rostral filaments are thickened over most of their length. The hind margin of the cephalothorax is slightly indented. The genital segment is almost as long as the combined length of the three subsequent segments. The furcal rami are only slightly longer than wide. The 1st antenna has 23 segments and reaches back to the anal segment. The maxilliped has a sensory seta in the middle of the 1st basipodite. The remaining mouthparts are as shown. The 2nd maxilla has five brush-like setae on the endopodite and at least two ribbon-like setae. The legs are as shown. The internal edge of the 2nd basipodite of the 2nd leg has a characteristic group of spines. The surfaces of legs 2 and 3 are heavily ornamented with spines.

Male (Fig. 15n–r) : Body length 1·98–2·81 mm with a mean of 2·50 mm (9 specimens). The cephalothorax is 3 times longer than the 5-segmented abdomen.

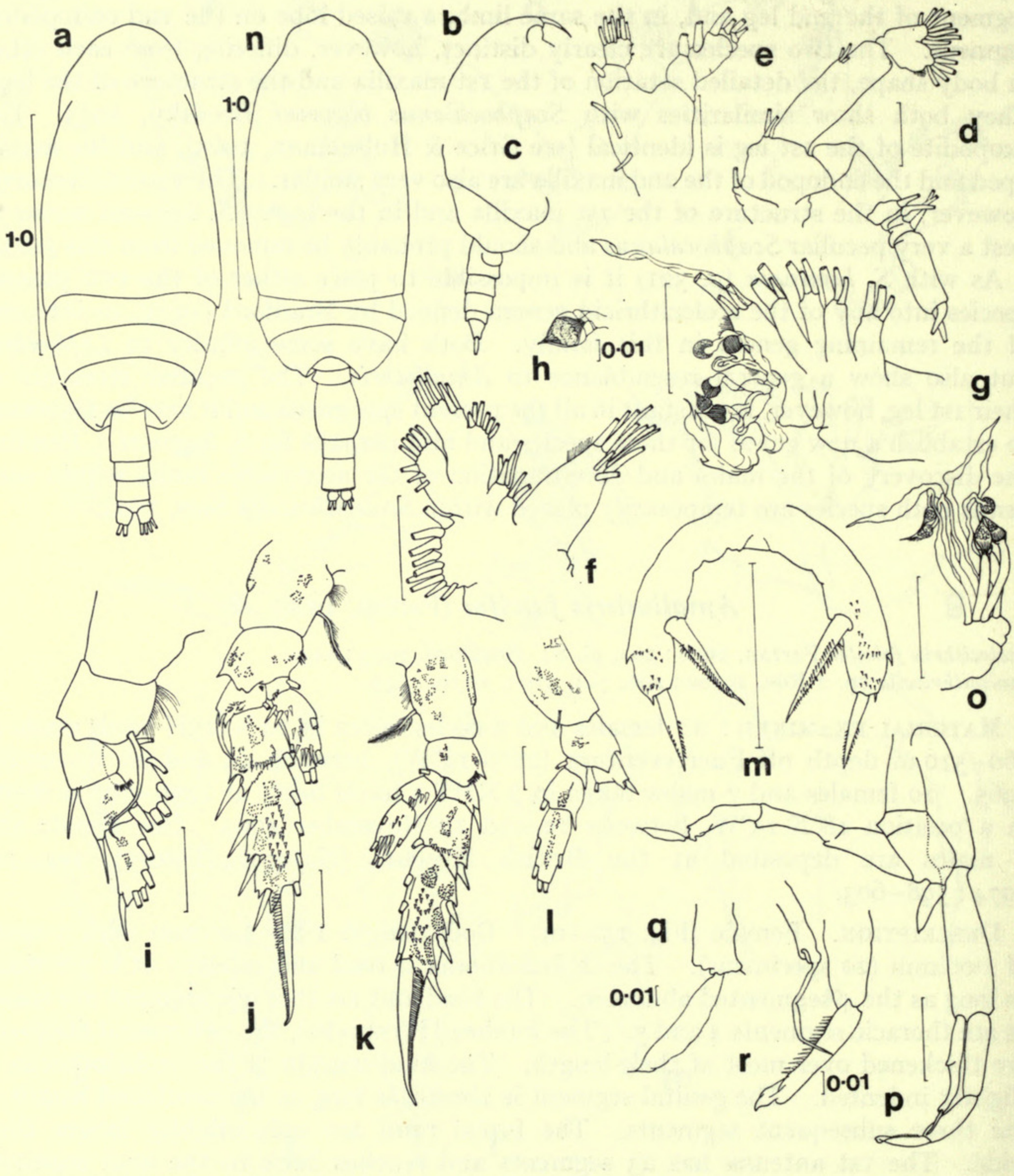

FIG. 15. a–m, *Amallothrix falcifer* ♀. a, body, dorsal ; b, forehead and rostrum, lateral ; c, last thoracic segment and abdomen, lateral ; d, 2nd antenna ; e, mandibular palp ; f, 1st maxilla ; g, 2nd maxilla ; h, 2nd maxilla, brush-like seta head ; i, 1st leg ; j, 2nd leg ; k, 3rd leg ; l, 4th leg ; m, 5th leg. n–r, *Amallothrix falcifer* ♂. n, body, dorsal ; o, 2nd maxilla, endopod ; p, 5th leg ; q, 5th leg, last exopodite segment right leg ; r, 5th leg, terminal segments left leg. Bar scale 0·1 mm unless indicated.

The head and 1st thoracic segment and thoracic segments 4 and 5 are fused. The anal segment is very short. The 1st antenna has 19 segments and reaches back to the hind edge of the 3rd abdominal segment. The setation of the mouthparts is identical to that of the female except in the following respects. In the 2nd antenna the exopodite has three terminal setae and the 1st endopodite segment has a bunch of hairs. The 1st maxilla is slightly variable; in one specimen the 1st outer lobe has eight setae, in another the 3rd inner lobe has three, and in both the 2nd basipodite has five and the 1st endopodite has three setae. In the 2nd maxilla lobes 2–5 each has an enlarged seta typical of other *Amallothrix* males and the endopodite has five brush-like setae and three ribbon-like setae. Two of the brush-like setae are short and one of these is conspicuously larger than the others. The swimming legs are identical to those of the female. The 5th pair of legs reaches back to the end of the abdomen. On the right leg the endopod is a short single segment and the last exopodite segment is leaf-shaped. On the left leg the endopod ends in a flagellum and the 3rd exopodite segment has a row of setae and a lamella.

Remarks. *A. falcifer* is difficult to recognize from Farran's (1926) account and apart from Wilson's (1950) figure of the female 5th legs it has never been redescribed. I have compared the present material with the type specimen held in the British Museum (Natural History). The 1st maxilla of the type is not mounted and the endopodite of the 2nd maxilla is rather obscure – it does, however, have at least four brush-like setae and three ribbon-like setae. In all other respects the present females are identical to the type. The 2nd leg of Farran's specimen has the characteristic group of spines on the 2nd basipodite although this is neither described nor figured by him. Apart from sexual characters and the slightly variable setation of some of the mouthparts the males are identical to the females. They have the distinct group of spines on the 2nd basipodite of the 2nd leg. There are, apparently, two size groups in the males. Two specimens each measured 1·98 mm but the remaining seven were between 2·58 and 2·81 mm in length. There are no structural differences between the large and small specimens and both are considered to be conspecific. *Scolecithricella denticulata* Tanaka, 1962 has a similar group of spines on the basipodite of the 2nd leg but its 5th pair of legs differs from the present males. Bradford (1973) could not definitely place *A. falcifer* into *Amallothrix* following her revision of the Scolecithricidae. The present specimens are in complete agreement with her definition of this genus.

Amallothrix sp.

Material examined: 6 males from 5 RMT 1 hauls made at 1220–610 m depth in a position 18°N 25°W, between 12 and 18 November 1969. Deposited at the British Museum (Natural History), reg. no. 1974 : 604–609.

Description. Male (Fig. 16): Body length 2·05–2·81 mm with a mean of 2·43 mm (5 specimens). The cephalothorax is 2·5 times as long as the 5-segmented abdomen. The head and 1st thoracic segment and thoracic segments 4 and 5 are fused. The rostrum has two stout filaments. The 1st antenna has 19 segments and reaches to the hind edge of the 2nd abdominal segment. The remaining mouthparts

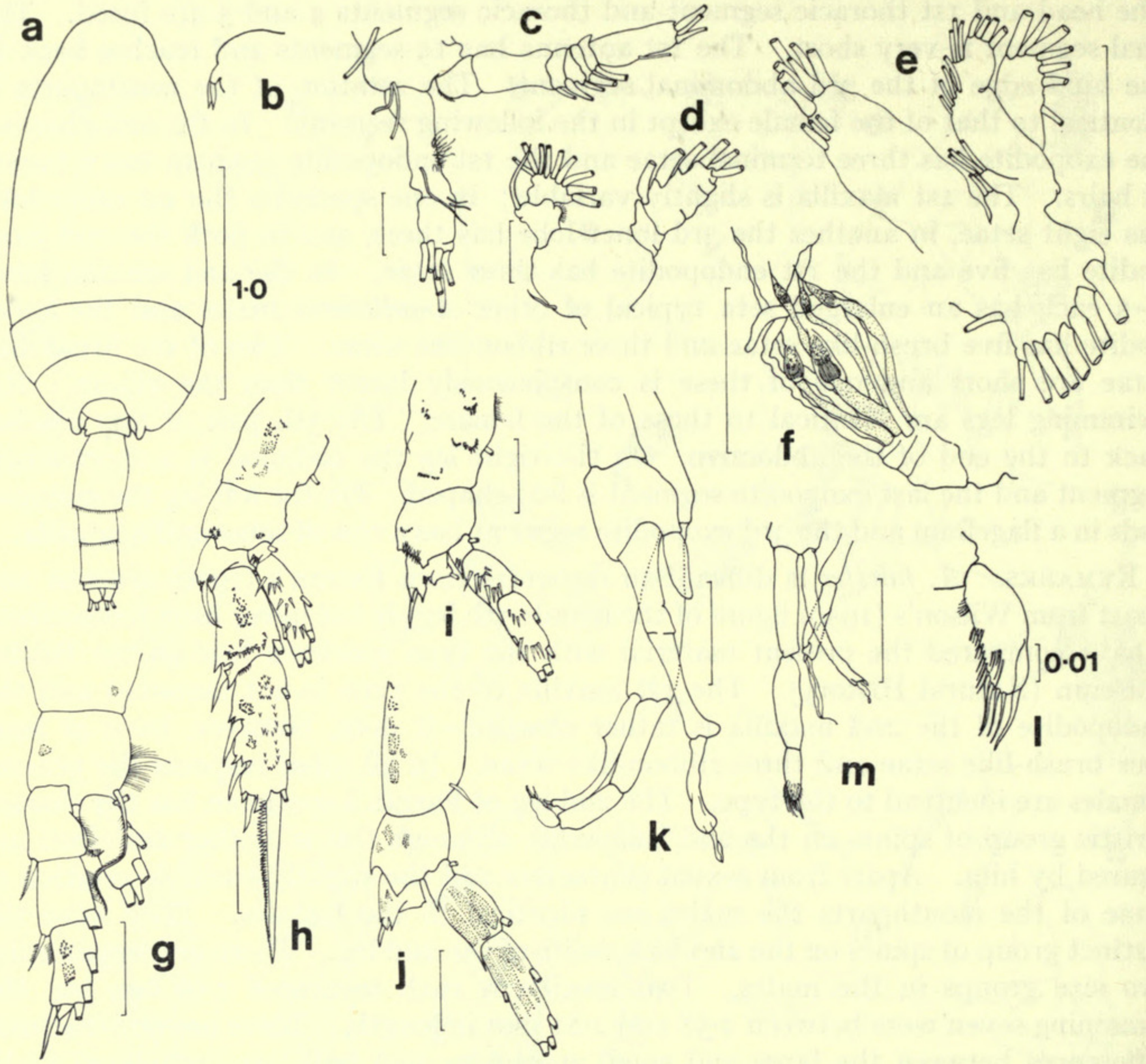

FIG. 16. *Amallothrix* sp. ♂. a, body, dorsal ; b, forehead and rostrum, lateral ; c, 2nd antenna ; d, mandibular palp ; e, 1st maxilla ; f, 2nd maxilla, endopod ; g, 1st leg ; h, 2nd leg ; i, 3rd leg ; j, 4th leg ; k, 5th leg ; l, 5th leg, last exopodite segment left leg ; m, 5th leg, terminal segments (different specimen). Bar scale 0·1 mm unless indicated.

are as shown. There is some slight variation in setation of the 1st maxilla where one specimen has nine setae on the exopodite. The swimming legs are incomplete in all specimens. The 3rd exopodite segment of the 1st leg has surface spines ; the 1st exopodite segment of the 2nd leg has a long curved outer spine. The basipodites of legs 2–4 are covered with surface spines. The 5th pair of legs reaches back about half the length of the abdomen. On the left side the exopodite is slightly longer than the endopodite and the last exopodite segment has a lamella and groups of coarse setae.

REMARKS. I cannot definitely identify these specimens with any of the known males of *Amallothrix*. They show a general similarity to the male of *Amallothrix* *propinqua,* described by Tanaka (1962), but differ in the spinulation of the swimming legs and in the structure of the 5th pair of legs. They agree with Bradford's (1973) redefinition of *Amallothrix,* but as they may be the undescribed male of a known species they are not considered here to be a new species.

Amallothrix lobophora (Park, 1970)

Scolecithricella lobophora Park, 1970 : 511, figs 188–201.

MATERIAL EXAMINED : 11 females and 4 males taken in 8 RMT 1 hauls made at 785–300 m depth in a position 18°N 25°W, between 13 and 17 November 1969. 2 females and the males are deposited at the British Museum (Natural History), reg. no. 1974 : 610–615.

DESCRIPTION. Male (Fig. 17) : Body length 1·44–1·67 mm with a mean of 1·56 mm (4 specimens). The cephalothorax is 2·8 times as long as the 5-segmented abdomen. The head and 1st thoracic segment and thoracic segments 4 and 5 are fused. The forehead is flattened anteriorly in dorsal view ; the rostrum has two large swollen filaments. The hind margin of the cephalothorax is bluntly triangular in lateral view. The anal segment is very short and is telescoped into the 4th abdominal segment. The 1st antenna has 19 free segments and reaches to the hind end of the abdomen ; the proximal segments have large sensory filaments. The mandible blade is similar to that of the female but smaller. The 2nd maxilla has five exopodite lobes but two have been omitted in Fig. 17h for clarity ; the endopodite has five brush-like setae, two of which have enlarged heads, and three worm-like setae. The other mouthparts and the legs are as shown. The external spine on the 2nd exopodite segment of the 1st leg varies slightly in length ; in another specimen it is longer than shown here. The 5th pair of legs is biramous and reaches back to the end of the abdomen. It is similar to that found in *Scaphocalanus* with the left endopodite longer than the exopodite. The left exopodite terminates in a lamella, which is broken in the illustrated specimen, and the last endopodite segment is knobbled. In the right leg the last exopodite segment is roughly triangular in shape.

REMARKS. These males were taken in the same hauls as several female *A. lobophora.* The present females agree with Park's (1970) description except that the 1st inner lobe of the 1st maxilla has three surface setae and not two. Some of the male mouthparts are reduced but the characteristic rostrum and the swimming legs are identical to those of the female.

Bradford (1973) transferred this species from *Scolecithricella* Sars, 1902 to *Amallothrix* Sars, 1925. The present specimens differ from her redefinition of *Amallothrix* in having a *Scaphocalanus*-type 1st maxilla with three surface setae on the 1st inner lobe. The 5th legs of both sexes also seem to be atypical of this genus and are very similar to those of *Amallothrix auropecten* (Giesbrecht, 1892). A discussion of the possible affinities of these two species is given after the account of *A. auropecten* on p. 334.

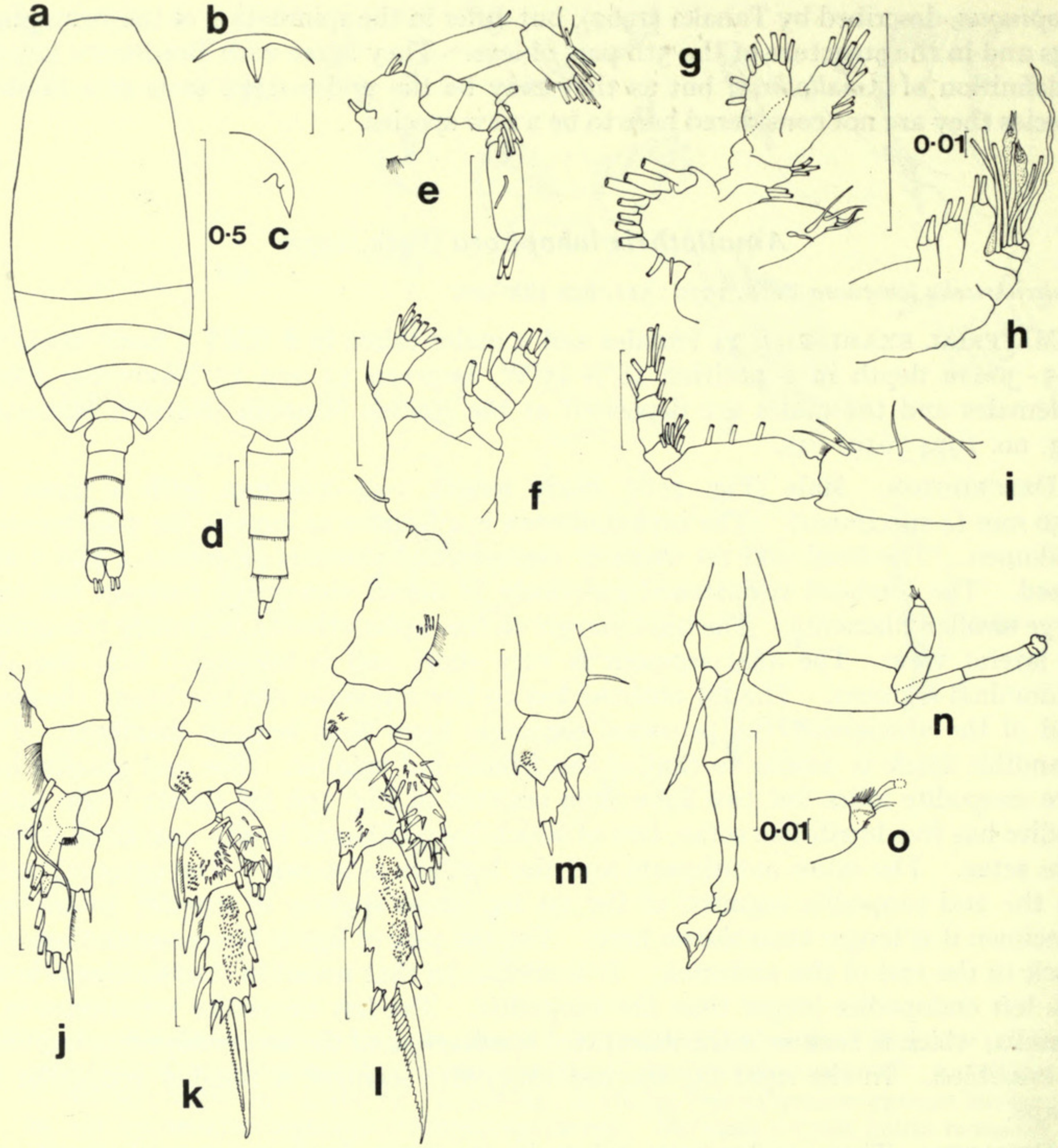

FIG. 17. *Amallothrix lobophora* ♂. a, body, dorsal ; b, rostrum, ventral ; c, rostrum, lateral ; d, last thoracic segment and abdomen, lateral ; e, 2nd antenna ; f, mandibular palp ; g, 1st maxilla ; h, 2nd maxilla, lobes 4 and 5 omitted ; i, maxilliped ; j, 1st leg ; k, 2nd leg ; l, 3rd leg ; m, 4th leg ; n, 5th leg ; o, 5th leg, last exopodite segment left leg. Bar scale 0·1 mm unless indicated.

Amallothrix altera (Farran, 1929)

Amallophora altera Farran, 1929 : 252–4, fig. 19 ; Tanaka, 1960 : 102.
Scolecithricella sp. 1 (part) Roe, 1972*a* : 304, 310 ; 1972*c* : 540.
? *S.* (*Amallothrix*) *altera* ; Vervoort, 1965 : 69–73, figs 14–16.
? *S.* (*Amallothrix*) *auropecten* ; Vervoort, 1951 : 101–3, fig. 54.
not *Amallophora altera* ; Vervoort, 1957 : 94–95, figs 77–79 ; Bradford, 1973 : 134, 136, 141, 144–5, figs 2–3.

MATERIAL EXAMINED : 1 female from an N113H haul fished at 700–550 m depth off Fuerteventura (28°N 14°W) on 24 November 1963. 3 females from 2 RMT 1 hauls fished at 600–410 m depth in a position 18°N 25°W on 15 and 16 November 1969. Deposited at the British Museum (Natural History), reg. no. 1974 : 616–619.

DESCRIPTION. Female (Fig. 18) : Body length 1·98–2·20 mm with a mean of 2·09 mm (4 specimens). The cephalothorax is 4·1 times as long as the 4-segmented abdomen. The head and 1st thoracic segment are fused ; thoracic segments 4 and 5 are separate. The rostrum is large and has two filaments which are thickened

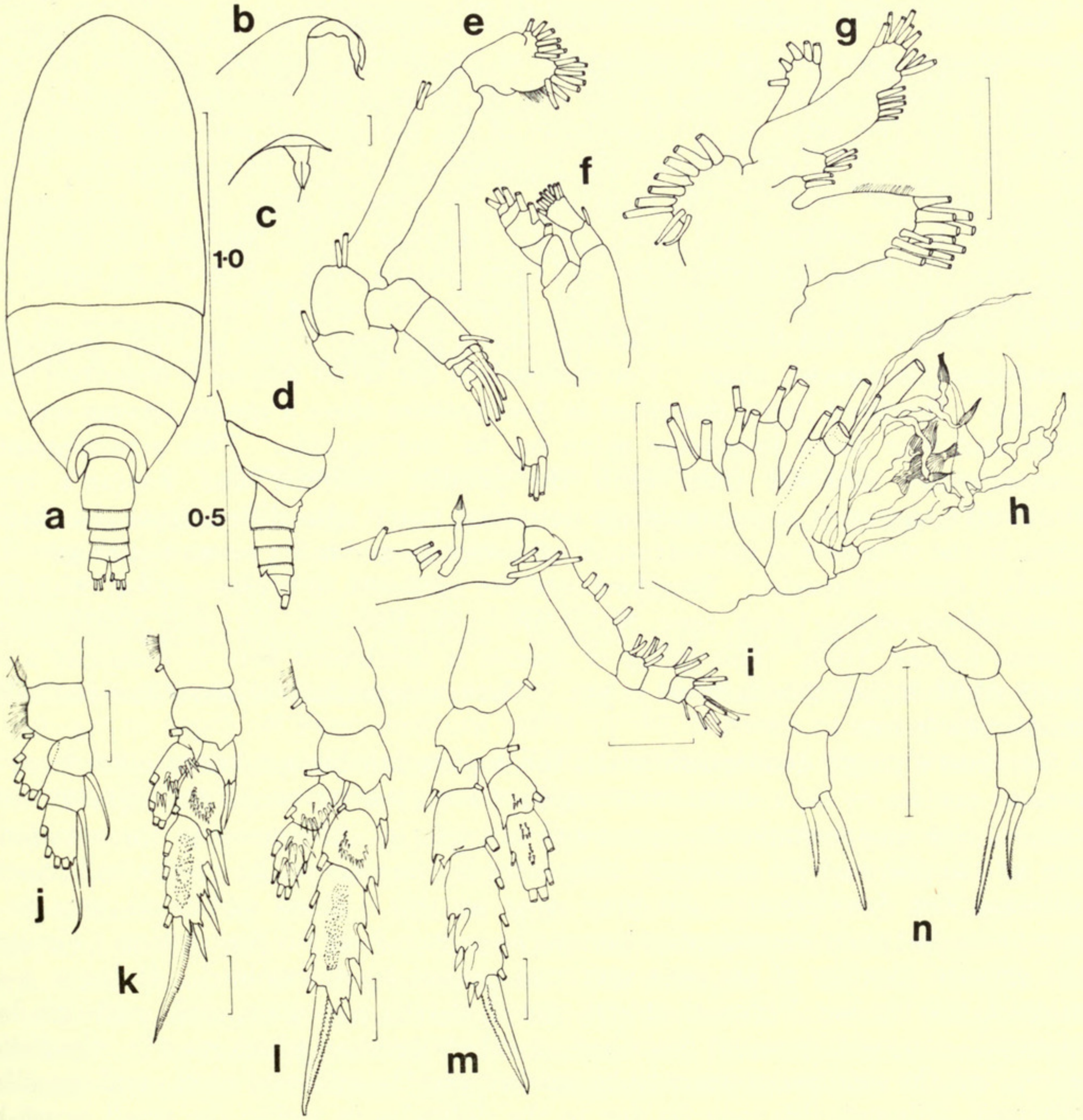

FIG. 18. *Amallothrix altera* ♀. a, body, dorsal ; b, rostrum, half lateral ; c, rostrum, ventral ; d, last thoracic segment and abdomen, lateral ; e, 2nd antenna ; f, mandibular palp ; g, 1st maxilla ; h, 2nd maxilla ; i, maxilliped ; j, 1st leg ; k, 2nd leg ; l, 3rd leg ; m, 4th leg ; n, 5th leg. Bar scale 0·1 mm unless indicated.

basally. The last thoracic segment protrudes laterally. The genital segment is slightly longer than the combined length of the three subsequent segments. The furcal rami are about 1¼ times as long as wide. The 1st antenna has 24 segments (the last is very small), and reaches to the hind edge of the genital segment. The remaining mouthparts are as shown. The endopodite of the 2nd maxilla has five brush-like setae, of which two are enlarged, and three flattened worm-like setae. The maxilliped has a large brush-like seta on the 1st basipodite. The legs are as shown. The endopodite of the 1st leg has no lobe and no surface spines. The 5th leg has three segments on each side.

REMARKS. The present females have been compared with the type specimens of *Amallophora altera* held in the collections of the British Museum (Natural History). They are smaller than Farran's types but are structurally identical except that the holotype has two setae on the basipodite of the mandibular palp and no apparent segmentation line between endopodite segments 4 and 5 of the maxilliped. Farran (1929) could not ascertain the structure of the sensory setae of the 2nd maxilla. However, both holotype and paratype are identical to the females described here and have two large brush-like setae and three smaller ones. There is no doubt that the present females are conspecific with *Amallophora altera* Farran.

The identity of this species is confused and it has been mixed up with *Amallothrix auropecten* (Giesbrecht, 1892). For comparison the latter species is described below (p. 333). Bradford (1973) described as *Amallophora altera* a species having one very large and four small brush-like setae on its 2nd maxilla. This arrangement is conspicuously different from both the present material and Farran's types. Bradford's specimen is incompletely described but it also differs from *Amallothrix altera* in the structure of its rostrum, its 1st maxilla and in its 1st and 5th legs. It is clearly a different species. Bradford used her specimen to typify a group containing *Amallophora smithae* Grice, 1962, *Scolecithrix vorax* Esterley, 1911 and *Xanthocalanus typicus* Farran, 1908. This group of species is considered here to comprise a new genus which is described later on p. 335. The true *Amallothrix altera* does not belong in this new genus.

Vervoort's (1957) description is also incomplete but his specimens differ from the present species by (a) a short outer edge spine on the 1st exopodite segment of the 2nd leg, (b) an incompletely segmented 5th leg, (c) differences in the setation of the 1st maxilla and (d) apparent differences in the endopodite of the 2nd maxilla, although the description is not very clear on this. These specimens may be *A. auropecten* but their identification cannot be certain from his description. Similarly the definite identity of his 1951 specimen cannot be determined. It has a 3-segmented 5th leg but Vervoort (1957) stated that it was conspecific with his later material. In 1965 Vervoort described a further specimen which may be *Amallothrix altera*, but the rostrum appears to be smaller and the endopod of the 2nd maxilla is different, although this may be due to the difficulty in seeing the small brush-like heads.

A. altera is generally similar to *A. auropecten* (Fig. 19) but differs in the following respects, (a) the rostrum of *A. altera* is larger and of a different shape, (b) the setation of the 1st maxilla is different, especially of the exopodite, (c) the endopodite of the

2nd maxilla has two of the five brush-like setae enlarged in *A. altera* but not in *A. auropecten*, (d) the 1st basipodite of the maxilliped has a large brush-like seta in *A. altera* but not in *A. auropecten*, (e) the endopod of the 1st leg has a comb of surface spines in *A. auropecten* but not in *A. altera*, and (f) the 5th leg has three segments in *A. altera* but is incompletely segmented in *A. auropecten*. This last difference may be variable but all the examined specimens of *A. altera* have a completely segmented 5th pair of legs whereas those of *A. auropecten* are normally 2-segmented or incompletely divided into three (Fig. 19 and see Giesbrecht, 1892 ; Rose, 1942 ; Wilson, 1942, 1950 ; Park, 1968 ; Bradford, 1973). One of the present specimens of *A. auropecten* has an abnormal 5th pair of legs similar to that figured by Park (1968, pl. 9, fig. 3).

In 1965 Vervoort transferred Farran's *Amallophora altera* to *Amallothrix*. The main apparent difference between the species and Bradford's redefinition of *Amallothrix* is its *Scaphocalanus*-type 1st maxilla with three surface setae on the 1st inner lobe. This character is shared with *A. lobophora* (p. 329) and *A. auropecten* (p. 334) and discussion of the affinities of all three species follows on p. 334. The enlargement of two of the brush-like setae in the present species is not, by itself, a generic character and it is shown by several other species and genera within the Scolecithricidae (see, for example, *A. falcifer*, p. 325, *Scolecithricella obscura*, p. 318, *Scaphocalanus difficilis*, p. 315, and *Scopalatum dubia*, p. 338).

Amallothrix auropecten (Giesbrecht, 1892)

Scolecithrix auropecten Giesbrecht, 1892 : 266, pl. 13, figs 8, 18, 22, 27, pl. 37, figs 3, 10.
Scolecithricella auropecten ; Rose, 1933 : 158–9, fig. 175.
S. sp. 1 (part) Roe, 1972*a* : 296, 304, 310 ; 1972*c* : 540.
? *Amallophora altera* ; Vervoort, 1957 : 94–5, figs 77–79.
? not *Scolecithricella* (*Amallothrix*) *auropecten* ; Vervoort, 1951 : 101–3, fig. 54.

Material examined : 2 females and 21 males taken in 11 N113H hauls made at 950–475 m depth off Fuerteventura (28°N 14°W), between 24 and 28 November 1965. 6 females and 6 males taken in 7 RMT 1 hauls made at 785–300 m depth in a position 18°N 25°W, between 13 and 16 November 1969.

Description (Fig. 19) : Body length of the females is 1·9–2·05 mm with a mean of 1·96 mm (7 specimens) ; of the males it is 2·20–2·51 mm with a mean of 2·28 mm (21 specimens). The present females agree with the descriptions of Giesbrecht (1892) and Rose (1942). They are figured here for comparison with *A. altera* (p. 330) where their structure is commented upon. The endopod of the 2nd maxilla has five brush-like setae, all with small heads, but only four could be seen in the specimen illustrated. The males agree with Rose's account and redescription is unnecessary. The male described by Wilson (1950) as *Scolecithricella auropecten* is not of this species.

Remarks. Rose (1942) transferred *Scolecithrix auropecten* to *Amallothrix*. Bradford (1973) omitted it from her redefined *Amallothrix* and considered that it should typify an unnamed group, together with *Scolecithrix laminata* Farran, 1926

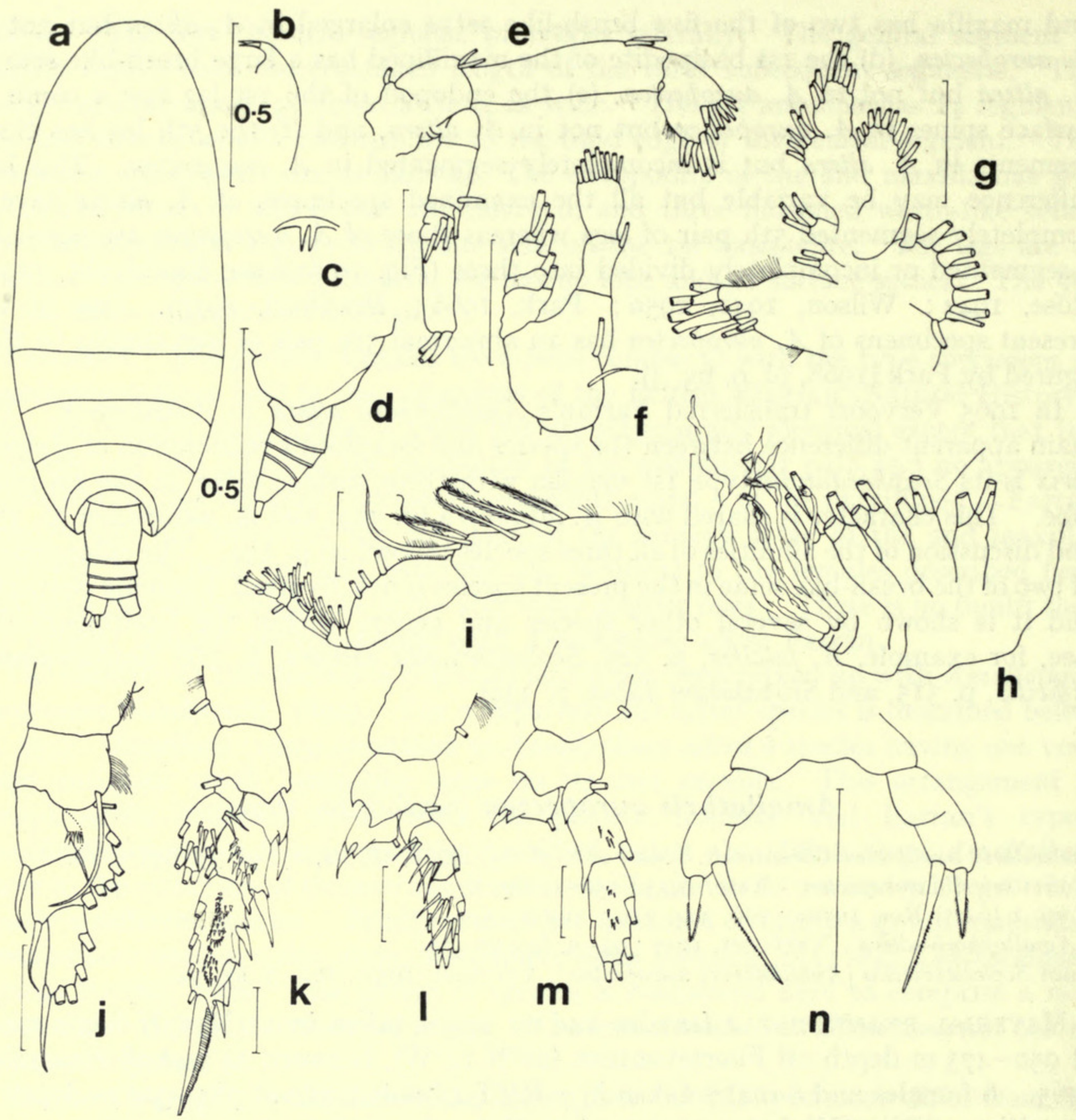

FIG. 19. *Amallothrix auropecten* ♀. a, body, dorsal ; b, rostrum, lateral ; c, rostrum, ventral ; d, last thoracic segment and abdomen, lateral ; e, 2nd antenna ; f, mandibular palp ; g, 1st maxilla ; h, 2nd maxilla ; i, maxilliped ; j, 1st leg ; k, 2nd leg ; l, 3rd leg ; m, 4th leg ; n, 5th leg. Bar scale 0·1 mm unless indicated.

and *Scolecithricella modica* Tanaka, 1962. *Scolecithrix* (= *Scolecithricella*) *laminata* differs in many respects from the present species (see p. 320) and is not, in my opinion, closely related. *A. altera* and *A. lobophora*, however, do seem to be related to the present species. All three differ from Bradford's *Amallothrix* in having a *Scaphocalanus*-type 1st maxilla (p. 329). The female 5th legs of all three species and the male 5th legs of *A. lobophora* and *A. auropecten* are also atypical of this genus. There are, however, differences between these three species. *A. altera* and *A. auropecten* are distinct (p. 332), and *A. lobophora* differs from both by lacking an outer edge spine on the 1st exopodite segment of the 1st leg and by having spines on the 1st basipodite of the 3rd leg. The rostrum of *A. lobophora* is similar to that of *A. altera* but the structure of its 5th legs (both sexes), the spiny lobe on the endopod of the 1st leg, and the uniformly small brush-like setae on the female 2nd maxilla are all more like *A. auropecten.* Whether or not these three species are sufficiently alike and sufficiently distinct from others to stand as a separate genus within the Scolecithricidae is not yet clear. Discovery of the male of *A. altera* and determination of the acceptable generic limits, especially regarding the 1st maxilla, will clarify their position. Meanwhile all three species can conveniently remain within *Amallothrix.*

SCOPALATUM gen. nov.

DIAGNOSIS. *Head* and 1st thoracic segment fused; thoracic segments 4 and 5 fused or separate. *Rostrum* with two filaments. *1st antenna* with 23 segments in the female, 20 in the male; there are large sensory filaments on the proximal segments of the male 1st antenna. *2nd antenna* exopod slightly longer than the endopod. *1st maxilla* with two posterior surface setae on the 1st inner lobe, two setae on the 2nd inner lobe and four on the 3rd inner lobe; in the female the endopod is ornamented with spinules. *2nd maxilla* endopod with five brush-like setae and three flattened worm-like setae; in the female one of the brush-like setae is greatly enlarged; in the male two are enlarged. *Maxilliped* with one brush-like seta on the 1st basipodite. The male mouthparts are weakly chitinized and slightly reduced.

1st leg has a 3-segmented exopod and a single endopodite segment: all three exopodite segments have an outer spine; the endopod has a lobe carrying small spines. *2nd leg* has a 3-segmented exopod and a 2-segmented endopod; the outer edge spines on all exopodite segments are large; the 2nd and 3rd exopodite segments and the 2nd endopodite segment carry prominent surface spines. *3rd leg* has a 3-segmented exopodite and endopodite: the 1st basipodite segment has a group of long spines; the 2nd and 3rd exopodite and endopodite segments have surface spines. *4th leg* has a 3-segmented exopodite and endopodite: the 1st basipodite may have a group of long spines; the 2nd and 3rd endopodite segments have very few small surface spines; the exopodite segments have no surface spines. *Female 5th leg* is uniramous; on each side there are two segments, which may be fused, attached to a common basal segment; there are 1–3 spines. *Male 5th leg* similar to that of *Scaphocalanus*: left exopod is shorter than the endopod; right exopod is much longer than the endopod.

Scopalatum gibbera sp. nov. is nominated as the type species of the genus.

The name *Scopalatum* is derived from the Latin *scopae* – a broom and *latum* – carried; it refers to the sensory setae of the 2nd maxilla.

DISCUSSION. T. Scott (1894) described a new subgenus, *Amallophora,* for a male copepod, *A. typica,* having a peculiar enlarged sensory seta on its 2nd maxilla. Giesbrecht (1892) had previously described a similar structure in the male of *Xanthocalanus* and considered that *Amallophora* was a junior synonym of *Xanthocalanus* (Giesbrecht & Schmeil, 1898). Farran (1908) named a female which he believed to be conspecific with Scott's male as *X. typicus.* Recently, Bradford

(1973) separated these two specimens, reiterating Giesbrecht's opinion that Scott's male is a xanthocalanid but transferring Farran's female to the Scolecithricidae. She placed this, as *X. typicus* Farran, into a group together with *Amallophora smithae* Grice, 1962, *Scolecithrix vorax* Esterley, 1911 and *Amallophora altera* Farran, 1929. Her inclusion of *A. altera* in this group however is erroneous, see p. 332 ; Bradford's specimen of *A. altera* is not conspecific with Farran's, which belongs to an entirely different group. Nevertheless, I believe she was correct in collecting together her specimen of '*A. altera*' and the other three species into a distinct group within the Scolecithricidae.

Bradford briefly characterized this group but did not name it as a separate genus. The discovery of a female of a new species which clearly belongs in this group (see below) and the redescription of what, in my opinion, is a male of this group (p. 338) lead me to believe that this collection of species should be given generic status within the Scolecithricidae. This new genus is defined above (p. 335). The genus *Scopalatum* at present contains *S. farrani* sp. nov., *S. vorax* (Esterley, 1911), *S. smithae* (Grice, 1962), *S. dubia* (T. Scott, 1894) and *S. gibbera* sp. nov. It also includes the species '*Amallophora altera*' wrongly identified by Bradford (1973) which should be further described and named. Grice's (1962) account of *S. smithae* is complete and also conforms with the new genus. The descriptions of *S. vorax* (Esterley, 1911) and '*A. altera*' of Bradford (1973) are incomplete, however, particularly regarding the swimming legs. The present generic definition may have to be modified when these latter two species are fully described. Details of *S. gibbera* sp. nov., *S. farrani* sp. nov. and *S. dubia* (T. Scott, 1894) are given below.

Scopalatum agrees in all respects with Bradford's (1973) redefinition of the Scolecithricidae. The combination of characters given on p. 335, especially those of the 1st and 2nd maxillae and the legs, distinguishes this new genus from all others in the family. It is related to *A. altera*, *A. auropecten* and *A. lobophora*, see p. 334. These three species may have to be removed from *Amallothrix* but they differ from the present genus in the structure of their 1st maxilla and, in the females, of the 2nd maxilla. The 2nd maxilla of the male *A. auropecten* is also distinct, and both this species and *A. altera* are further distinguished by having no basipodite spines on either their 3rd or 4th legs. *A. lobophora* has a similar 2nd maxilla in the male to *Scopalatum* and both sexes have a group of spines on the 1st basipodite of the 3rd leg. They do not, however, have an external spine on all exopodite segments of the 1st leg.

Scopalatum gibbera sp. nov.

Amallophora sp. Roe, 1972*a* : 295, 309.

MATERIAL EXAMINED : 1 female in an N113H haul fished at 310–240 m depth off Fuerteventura (28°N 14°W) on 13 November 1965. 2 females in 2 RMT 1 hauls fished in a position 18°N 25°W ; one (the holotype) caught at 300–210 m depth on 12 November 1969 and the other at 400–305 m depth on 17 November 1969. Deposited at the British Museum (Natural History), holotype reg. no. 1974 : 620, paratypes reg. no. 1974 : 621–622.

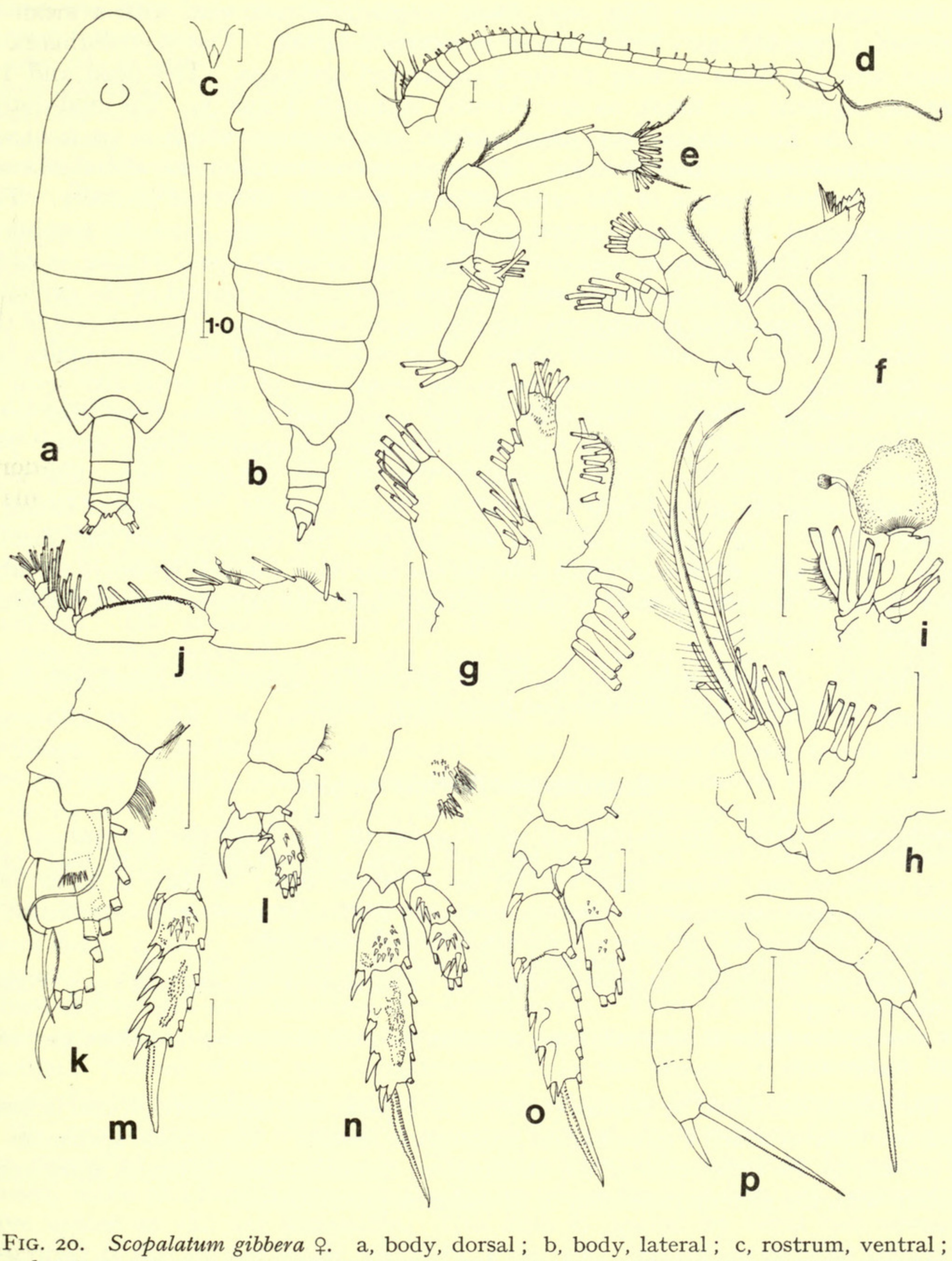

FIG. 20. *Scopalatum gibbera* ♀. a, body, dorsal ; b, body, lateral ; c, rostrum, ventral ; d, 1st antenna ; e, 2nd antenna ; f, mandible ; g, 1st maxilla ; h, 2nd maxilla, exopod ; i, 2nd maxilla, endopod ; j, maxilliped ; k, 1st leg ; l, 2nd leg ; m, 2nd leg, exopodite segments 2–3 (paratype) ; n, 3rd leg ; o, 4th leg ; p, 5th leg. Bar scale 0·1 mm unless indicated.

DESCRIPTION. Female (Fig. 20): Body length 2·58–2·81 mm with a mean of 2·73 mm (3 specimens). The holotype measures 2·81 mm. The cephalothorax is robust and 3·9 times as long as the 5-segmented abdomen. The head and 1st thoracic segment are fused, as are thoracic segments 4 and 5. The mid-dorsal region of the head has a very characteristic protuberance which is particularly conspicuous when seen from the side. The rostrum has two filaments with thickened bases. The hind margin of the cephalothorax is deeply indented laterally. The genital segment has a slight ventral protrusion and is longer than the combined length of the three following segments. The furcal rami are about as long as wide. The 1st antenna has 23 segments and does not quite reach the end of the cephalothorax. The remaining mouthparts and the legs are as shown. The endopod of the 1st maxilla is covered with small spines. The endopodite of the 2nd maxilla has five brush-like and three flattened worm-like setae, one of the brush-like setae is greatly enlarged. The 1st basipodite of the maxilliped has one brush-like seta. The 1st basipodite of the 3rd leg has two conspicuous groups of long spines. The terminal spines on legs 2–4 have laminae. The 5th pair of legs is uniramous with two fused segments on each side attached to a basal segment; the line of fusion is clearly visible. The terminal segment on each side has one long and one shorter spine. There is an additional small spine on one side only, but this is clearly variable since in one of the paratypes it is about halfway down the outside edge of the fused 2nd and 3rd segments.

REMARKS. *S. gibbera* has all the female characters defined for the genus on p. 335. A discussion of its affinities has been given earlier.

Scopalatum farrani sp. nov.

Xanthocalanus typicus; Farran, 1908: 47–48, pl. 4, figs 15–17; Bradford, 1973: 145.
Amallophora typica; Sars, 1924: pl. 38, figs 8–18; 1925: 140–142 (part); Rose, 1933: 134–135 (part), fig. 129; Wilson, 1942: 170–171, fig. 1; Wilson, 1950: 159 (part), pl. 20, fig. 275; Vervoort, 1957: 94–95 (part); Tanaka, 1960: 102 (part); Vervoort, 1965: 27–28 (part); Binet & Dessier, 1971: 430, 453; Bradford, 1973: 138–139 (part).
? *Amallophora typica*; Grice & Hulsemann 1965: 221, 223; Harding, 1972: 58.
not *Xanthocalanus typicus*; Giesbrecht, 1897: 254; Giesbrecht & Schmeil, 1898: 50; Wolfenden, 1908: 35.
not *Amallophora typica* T. Scott, 1894: 54, pl. 3, figs 39–46, pl. 6, figs 1–4; A. Scott, 1909: 85, pl. 36, figs 1–8.

The female described by Farran (1908) as *X. typicus* was misidentified and belongs to a new species which I have named *Scopalatum farrani*. The female specimens of *S. farrani* in the collections of the Institute of Oceanographic Sciences agree completely with the generic definition of *Scopalatum* given earlier.

Scopalatum dubia (T. Scott, 1894)

Amallophora dubia T. Scott, 1894: 55, pl. 4, figs 10–18.
Scolecithrix scotti Giesbrecht, 1897: 254; Giesbrecht & Schmeil, 1898: 46; Wolfenden, 1911: 250.

Heteramalla dubia ; Sars, 1907 : 17 (part) ; A. Scott, 1909 : 86–87 (part) ; Sars, 1925 : 142–144 (part) ; Rose, 1933 : 135 (part) ; Alzamora, 1940 : 6 ; Wilson, 1942 : 189 (part) ; Vervoort, 1965 : 28–30 (part).
Heteremalla dubia ; Rose, 1929 : 26.
Hetermalla dubia ; Roe, 1972*a* : 303, 309.
? *Heteramalla dubia* ; Wilson, 1950 : 239 ; Grice & Hulsemann, 1967 : 16.
not *Heteramalla dubia* ; A. Scott, 1909 : pl. 33, figs 1–9 ; Sars, 1924 : pl. 39 ; Rose, 1933 : fig. 130 ; Grice & Hulsemann, 1965 : 221, 223, 235.

MATERIAL EXAMINED : 1 male in an N113H haul made at 660–510 m depth off Fuerteventura (28°N 14°W) on 26 November 1965. 8 males taken in 5 RMT 1 hauls made at 900–305 m depth in a position 18°N 25°W between 12 and 17 November 1969. 7 males deposited at the British Museum (Natural History), reg. no. 1974 : 623–629.

DESCRIPTION. Male (Fig. 21) : Body length 2·36–2·74 mm with a mean of 2·48 mm (9 specimens). The cephalothorax is 2·7 times as long as the 5-segmented abdomen. The head and 1st thoracic segment are fused ; thoracic segments 4 and 5 are separate. The rostrum has two filaments attached to a common base. The hind margin of the cephalothorax has a slight lateral indentation. The 1st antenna reaches to the hind edge of the 2nd abdominal segment ; both 1st antennae have 20 segments and the proximal 12 segments on each side carry large flattened sensory filaments. The mouthparts and legs are as shown. The endopod of the 2nd maxilla has five brush-like setae and three flattened worm-like setae ; the heads of three of the brush-like setae are small whereas two are greatly enlarged – one of them especially so. All the 'brush' heads consist of fine threads ending in rounded swellings. The 1st basipodite of the 3rd leg has two groups of long narrow spines. The 5th pair of legs is similar to that of *Scaphocalanus* and reaches back to the end of the furcal rami. On the right leg the exopodite terminates in a claw-like segment. On the left leg the exopodite is shorter than the endopodite ; the 3rd exopodite segment is covered with hairs and has a terminal lamella.

REMARKS. I have compared the present males with the type specimens of *Amallophora dubia* T. Scott, 1894 held in the collections of the British Museum (Natural History). The type material consists of several slides on which are mounted the mixed appendages and abdomens of two specimens. There is only one example of most appendages – including the 2nd maxilla, and there is no specimen of the 1st maxilla. Neither of the two cephalosomes is in the Museum's collection. The material is very faded and it is impossible to ascertain the detailed structure of some of the appendages. An attempt to remount some of the specimens failed because the mountant would not dissolve. The only observable difference between the present males and Scott's type is in the 3rd leg where the type does not, apparently, have spines on the 1st basipodite. This limb is figured by Scott but wrongly described as the 4th leg (Scott, 1894 : Pl. 4, fig. 16). According to Scott the right 1st antenna has 18 joints and is indistinctly geniculate and the left 1st antenna has 23 joints. There are three 1st antennae in the type collection ; one has 19 segments but the others are very faded and have, I believe, 20 and 21 segments respectively. None of these antennae are in any way geniculate and their segmentation agrees

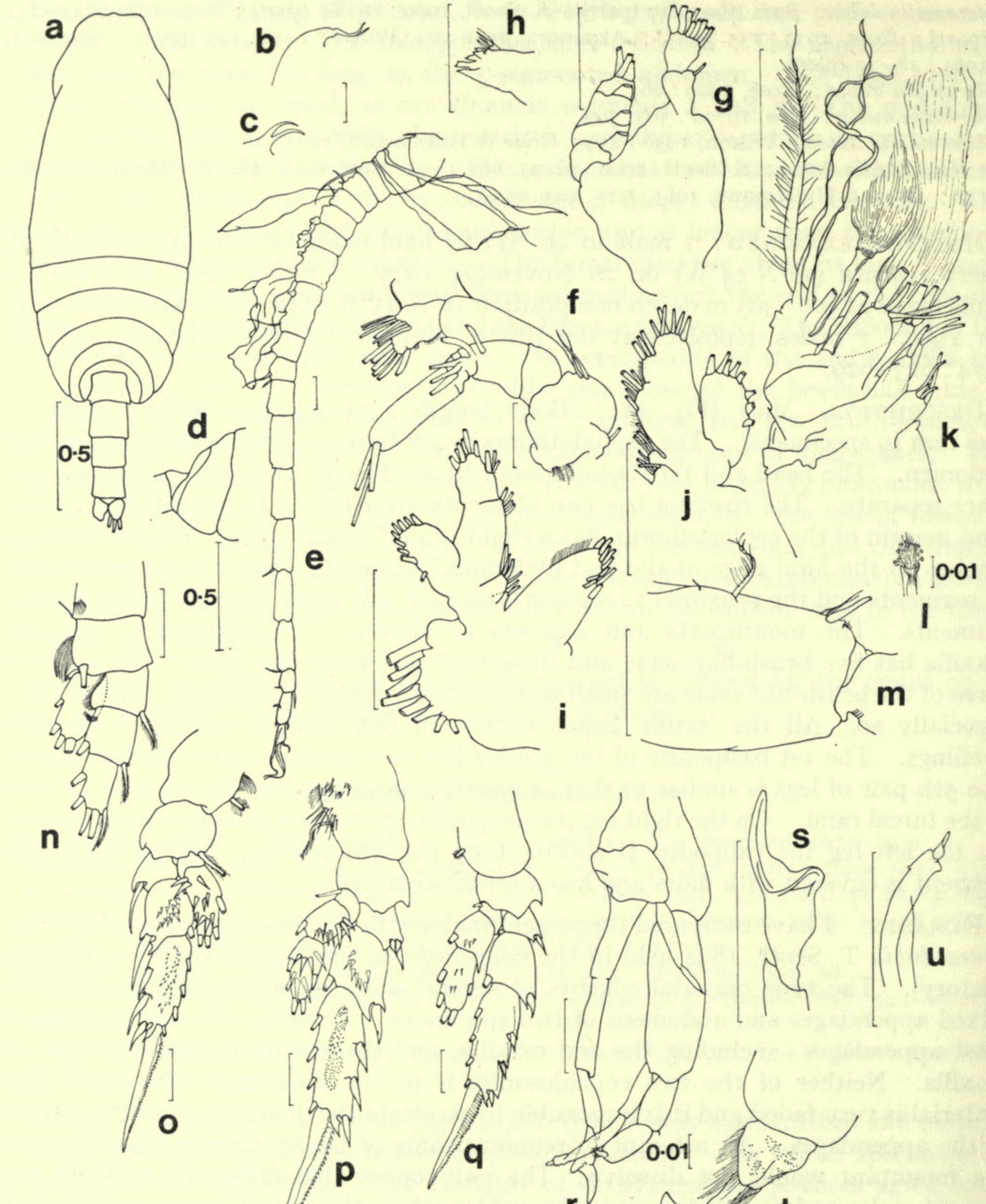

FIG. 21. *Scopalatum dubia* ♂. a, body, dorsal; b, rostrum and forehead, lateral; c, rostrum, ventral; d, last thoracic segment, lateral; e, 1st antenna; f, 2nd antenna; g, mandibular palp; h, mandible blade; i, 1st maxilla; j, 1st maxilla (different specimen); k, 2nd maxilla; l, 2nd maxilla, head of small brush-like seta; m, maxilliped, basal segment (different specimen); n, 1st leg; o, 2nd leg; p, 3rd leg; q, 4th leg; r, 5th leg; s, 5th leg, last exopodite segment right leg; t, 5th leg, last exopodite segment left leg; u, 5th leg, last endopodite segment left leg (different specimen). Bar scale 0·1 mm unless indicated.

better with the present male's antennae, which have 20 segments on each side, than with Scott's description. The type material of the 2nd maxilla is in very poor condition and it is impossible to see any structure except the general presence of two large brush-like setae. Despite the possible difference in the 3rd leg I believe that the present males are conspecific with Scott's *Amallophora dubia*.

Sars (1907) erected a genus, *Heteramalla*, for a female which he believed was conspecific with Scott's male. In 1925, however, he expressed doubts as to the correctness of his assumption, and in 1965 Vervoort also mentioned the possibility that Sars' females and Scott's male were not the same species. Further male specimens have been recorded by Wolfenden (1911) and by Rose (1929) but they were not described.

Bradford (1973) transferred *Heteramalla* from the Phaennidae to the Scolecithridae. The present males are clearly scolecithricids according to her redefinition of the family. I have examined female specimens of *H. dubia* Sars, 1907 taken at 1020–800 m depth in a position 18°N 25°W. These specimens agree with Sars' (1924, 1925) description except that they have no 5th pair of legs (thereby conforming with Grice & Hulsemann's (1965) specimen), and there is no seta on the 2nd inner lobe of the 1st maxilla. The endopod of the 3rd leg has two segments only. These females also agree with Bradford's definition of the Scolecithricidae. I believe, however, that Sars was mistaken in identifying his female with Scott's male. Apart from the normal sexual differences they differ in the following respects: (a) the rostrum of ♀ *H. dubia* is strong and plate-like, in the male it has two filaments, (b) the 1st maxilla of the males has two setae on the surface of the 1st inner lobe, two on the 2nd inner lobe and four on the 3rd inner lobe; the corresponding number of setae in the female are 1, 0 and 3, (c) the 1st leg of ♀ *H. dubia* has a 2-segmented exopod with no external spine on the 1st exopodite segment; the endopod has no lobe and has a group of large spines; in the male the 1st leg has three exopodite segments, all with outer spines, and the endopod has a lobe with a comb of small spines only, (d) ♀ *H. dubia* has no surface spines on the exopodites of legs 2–4 – these legs are heavily spinulated in the male, and (e) the 3rd leg of the ♀ *H. dubia* has a 2-segmented endopod and has no spines on the 1st basipodite segment; the 3rd leg of the male has three endopodite segments and two groups of spines on the 1st basipodite.

I agree with Bradford (1973) that the genus *Heteramalla* Sars, 1907 belongs to the Scolecithricidae. It is at present a monospecific genus known only from the female (see p. 342). Scott's male is here considered to belong to the new genus *Scopalatum* described on p. 335.

The most striking difference between *S. dubia* and the females of *Scopalatum* is in the development of the sensory setae of the 2nd maxilla. The females have one brush-like seta much enlarged but the male has two. Enlargement of one or two of these setae is, however, common to the males of many species and genera of the Scolecithricidae (see, for example, *Amallothrix falcifer*, p. 325, and *Scolecithricella* dentata (Rose, 1942: 55). I believe that the increased size of one seta in the present males is a sexual character. Apart from the normal sexual differences in the 1st antenna and more weakly chitinized and slightly reduced mouthparts, the appendages of these males are very similar to those of the female *S. gibbera* sp. nov., *S. farrani* sp. nov. and *S. smithae* Grice, 1962. They are so similar to *S. gibbera* that these two species may be conspecific. They differ in the length of the outer edge spines of the exopodite of the 1st leg, and the males do not have the curious dorsal swelling of the female. In addition to these differences *S. farrani* has groups of spines on the 1st basipodite of the 4th leg. *S. smithae* and *S. vorax* are much smaller species.

Heteramalla sarsi sp. nov.

Heteramalla dubia ; Sars, 1907 : 17 (part) ; A. Scott, 1909 : 86–87 (part), pl. 33, figs 1–9 ; Sars, 1924 : pl. 39 ; 1925 : 142–144 (part) ; Rose, 1933 : 135 (part) fig. 130 ; Wilson, 1942 : 189 (part) ; Grice & Hulsemann, 1965 : 221, 223, 235 ; Vervoort, 1965 : 28–30 (part).
? *Heteramalla dubia* ; Wilson, 1950 : 239 ; Grice & Hulsemann, 1967 : 16.
not *Heteramalla dubia* : Alzamora, 1940 : 6.

The female described by Sars (1907) as *H. dubia* was misidentified and belongs to a new species which I have named *H. sarsi*. The validity of this species is considered earlier together with the discussion of *Scopalatum dubia* (T. Scott).

Family **METRIDIIDAE**

Metridia alata sp. nov.

Material examined : 6 females and 6 males taken in 6 RMT 1 hauls made at 1220–700 m depth in a position 18°N 25°W, between 12 and 18 November 1969. The holotype (female) and allotype (male) were caught on 18 November 1969 at 1220–1000 m. Deposited at the British Museum (Natural History), holotype reg. no. 1974 : 630, paratypes reg. no. 1974 : 631–641.

Description. Female (Fig. 22) : Body length 8·64–10·24 mm with a mean of 9·09 mm (5 specimens). The holotype measures 9·12 mm. The cephalothorax is 1·2 times as long as the 3-segmented abdomen. It is very robust and in lateral view the anterior part of the head protrudes sharply from the hind part. The right lateral margin of the head is produced into a very conspicuous wing ; this wing protrudes both laterally and ventrally and is present on the right side only. The head and 1st thoracic segment are separate ; thoracic segments 4 and 5 are fused. The rostrum has two strong spikes pointing ventrally. The hind edge of the cephalothorax is smooth and rather abruptly rounded. The genital segment is swollen both laterally and ventrally and is longer than the combined length of the two subsequent segments. The furcal rami are 0·36 times the length of the abdomen and are 6 times longer than wide. The 1st antenna is slightly longer than the body : it has 25 segments, segments 7 and 8 are partially fused and the last segment is small ; the 1st segment has three hooks and the 2nd, 4th and 5th segments each have a single hook. The remaining mouthparts and legs are as shown. The endopodite of the mandibular palp has a group of large spines on the 1st segment and many small spines on the 2nd. The mandible blade has numerous small spines in addition to the large teeth. The

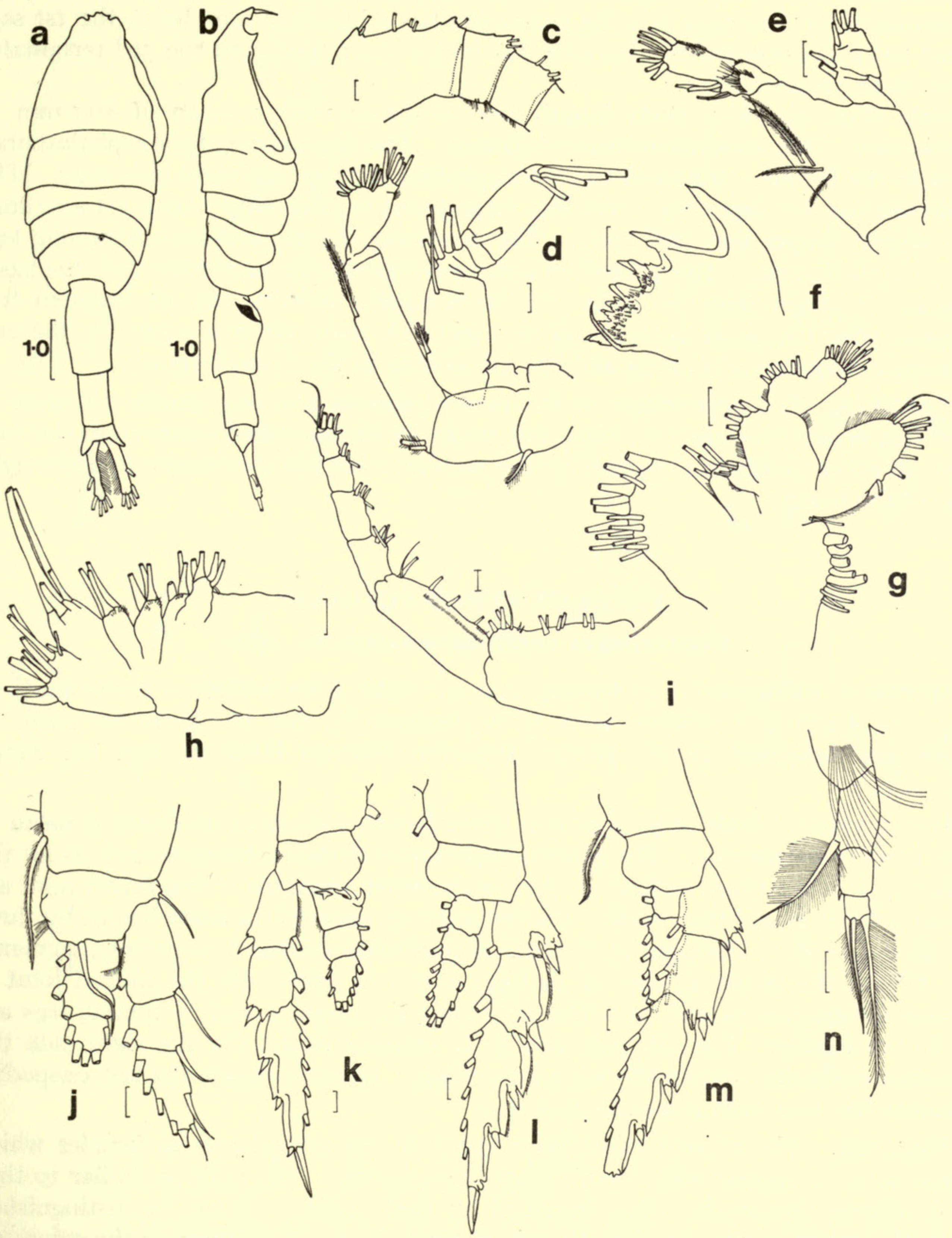

FIG. 22. *Metridia alata* ♀. a, body, dorsal ; b, body, lateral ; c, 1st antenna, basal segments ; d, 2nd antenna ; e, mandibular palp ; f, mandible blade ; g, 1st maxilla ; h, 2nd maxilla ; i, maxilliped ; j, 1st leg ; k, 2nd leg ; l, 3rd leg ; m, 4th leg ; n, 5th leg. Bar scale 0·1 mm unless indicated.

1st endopodite segment of the 2nd leg has three strong claws. The 5th pair of legs is symmetrical; on each side the basipodite has a bunch of long hairs, the 1st segment has a plumose outer edge seta, the 2nd a short spine and the 3rd terminates with three plumose setae.

Male (Fig. 23a–b): Body length 8·00–8·64 mm with a mean of 8·51 mm (6 specimens). The allotype measures 8·64 mm. The appearance of the cephalothorax is as in the female; the head has a conspicuous wing on the right side only. The abdomen has five segments. The left 1st antenna is geniculate; both 1st antennae are slightly longer than the body. The remaining mouthparts and swimming legs are as in the female. The 5th pair of legs is asymmetrical: on the left side, the basal segment is longer than the right and has a bundle of hairs, the 4th segment terminates with two small spines; on the right side there are five segments, the 2nd bearing a long curved process and the 5th ending in three small spines.

REMARKS. The appendages of the present species are very similar to those of *Metridia princeps* Giesbrecht, 1892, but it can be distinguished easily from this and from all other species in the genus by the peculiar wing-like development of the right side of the head.

Family **CENTROPAGIIDAE**

Centropages caribbeanensis Park, 1970

MATERIAL EXAMINED: 43 females and 21 males from 6 RMT 1 hauls made at 194–0 m depth in a position 18°N 25°W, between 15 and 18 November 1969. 5 males are deposited at the British Museum (Natural History), reg. no. 1974: 642–646.

DESCRIPTION. Male (Fig. 23c–e): Body length 1·82–2·13 mm with a mean of 1·95 mm (15 specimens). The general appearance of the cephalothorax is as for the female; it is 2·2 times as long as the 5-segmented abdomen. The furcal rami are about 3 times longer than wide. The 1st antenna exceeds the body length by three or four segments. The right 1st antenna is geniculate and has 22 segments, segments 17, 18 and the proximal part of 19 have a row of fine teeth, the hinged joint is between segments 18 and 19. The remaining mouthparts and swimming legs are as in the female. The 5th pair of legs is asymmetrical. On the right side the terminal exopodite segment forms a large chela; on the left side the last exopodite segment has two large spine-like processes.

REMARKS. The present males were found in the same hauls as females which agree in every respect with Park's (1970) description. The male is similar to that of *C. elegans* Giesbrecht, 1895 described by Park (1968). It can be distinguished from this latter species by the 5th pair of legs. In *C. caribbeanensis* the spines on the terminal segment of the left exopodite are longer than in *C. elegans* and are not pitted distally. The shorter arm of the chelate right exopodite is pointed in *C. caribbeanensis* and rounded in *C. elegans*. The present specimens are only the second record of this species and the first from the eastern north Atlantic.

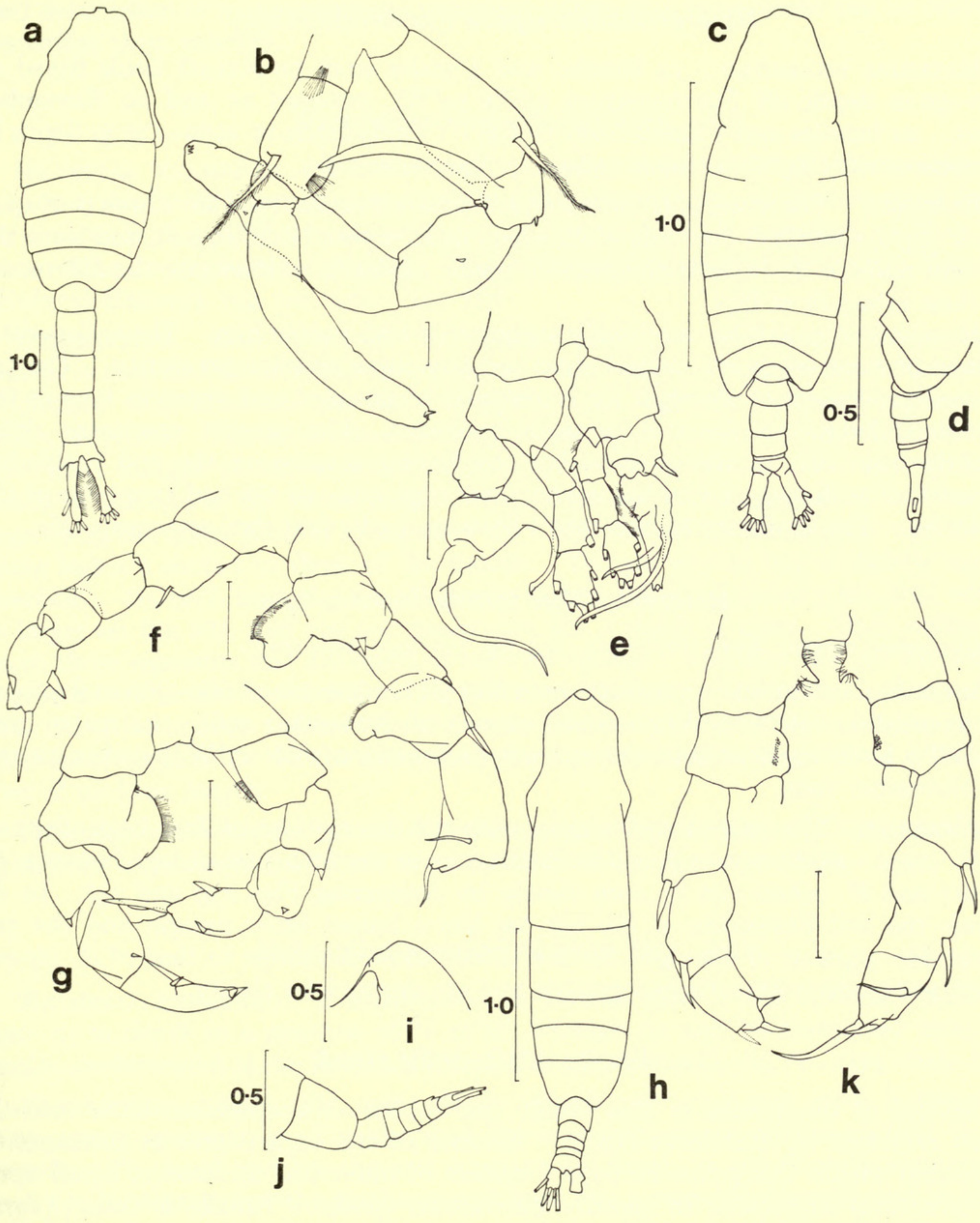

FIG. 23. a–b, *Metridia alata* ♂. a, body, dorsal; b, 5th leg. c–e, *Centropages caribbeanensis* ♂. c, body, dorsal; d, last thoracic segment and abdomen, lateral; e, 5th legs. f, *Heterorhabdus vipera* ♂ 5th legs. g, *Heterorhabdus tenuis* ♂ 5th legs. h–k, *Haloptilus angusticeps* ♂. h, body, dorsal; i, forehead and rostrum, lateral; j, last thoracic segment and abdomen, lateral; k, 5th legs. Bar scale 0·1 mm unless indicated.

Family HETERORHABDIDAE

Heterorhabdus vipera (Giesbrecht, 1892)

MATERIAL EXAMINED: 14 females and 4 males from 12 N113H hauls fished at 590–90 m depth off Fuerteventura (28°N 14°W), between 11 and 26 November 1965. 22 females and 3 males from 12 RMT 1 hauls made at 1250–110 m depth in a position 18°N 25°W between 12 and 17 November 1969.

REMARKS. The males of *H. vipera* and *H. tenuis* Tanaka, 1964 have been confused. Park (1970) described the male of *H. tenuis* as *H. vipera* (Roe, 1972*d*), and since the present material includes both species it seems advisable to illustrate the differences in their fifth pair of legs.

H. vipera (Fig. 23f) has a strongly asymmetric fifth pair of legs. The endopodites consist of three segments on both sides and have been omitted for clarity. The 3rd exopodite segment of the right leg is abruptly terminated and about as long as the combined length of the two previous segments. The present specimens differ slightly from that of Giesbrecht (1892) by having a spine on the 2nd basipodite segment of both legs, and by having an outer edge spine on the 2nd exopodite of the right leg. The similarity is such that I have no doubt that they are conspecific.

Heterorhabdus tenuis Tanaka, 1964

Heterorhabdus vipera; Park, 1970: 523–525, figs 250–252 (male only).

MATERIAL EXAMINED: 7 males from 5 N113H hauls made at 660–460 m depth off Fuerteventura (28°N 14°W), between 11 and 26 November 1965. 14 males from 6 RMT 1 hauls made at 600–210 m depth in a position 18°N 25°W, between 12 and 16 November 1969.

REMARKS. The present males agree with the descriptions of Tanaka (1964) and Park (1970 – as *H. vipera* ♂). The differences in the fifth pair of legs between *H. tenuis* and *H. vipera* can be seen clearly by comparing Figs 23g and 23f. In *H. tenuis* the 2nd basipodite of the left leg has a haired inner margin and the 3rd exopodite segment of the right leg is a totally different shape to that of *H. vipera*. Both endopodites have three segments and are omitted for clarity.

Family AUGAPTILIDAE

Several of the genera in this family, particularly *Euaugaptilus*, have recently been reviewed by Matthews (1972). Because of the high degree of intraspecific variation within this genus he used a system of numerical taxonomy, based upon 35 structural characters, to identify the various species. Tanaka & Omori (1974) also used a similar list of 21 characters to identify the *Euaugaptilus* spp. off Izu, Japan. These latter authors also recognized the great variation within species in this genus but retained a normal diagnostic key for their identification.

Several species of *Euaugaptilus* are described here, and all of them show marked intraspecific variations. This variability emphasizes the difficulties in recognizing or describing species based upon single specimens. Some *Euaugaptilus* species are so similar to one another (see, for example, Matthews, 1972 : 66), that the discovery and description of more specimens is needed before firm conclusions can be reached regarding their validity.

Haloptilus angusticeps Sars, 1907

MATERIAL EXAMINED : 2 males and 7 females from 5 N113H hauls made at 625–0 m depth off Fuerteventura (28°N 14°W), between 17 and 26 November 1965. 12 females from 5 RMT 1 hauls made at 700–305 m depth in a position 18°N 25°W, between 14 and 17 November 1969. The males are deposited at the British Museum (Natural History), reg. no. 1974 : 647–648.

DESCRIPTION. Male (Fig. 23h–k) : Body length 3·04–3·12 mm. The cephalothorax is long and slender and slightly more than 4 times as long as the 5-segmented abdomen. The head and 1st thoracic segment are separate ; thoracic segments 4 and 5 are fused. The rostral base is rounded and bears two fine fairly long filaments. The hind margin of the cephalothorax is smoothly rounded. The 1st antennae reach to the end of the furcal rami ; the left 1st antenna is geniculate and has 20 segments, the hinge joint is in segment 18. The remaining mouthparts and swimming legs are similar to those of the female. The 5th pair of legs is slightly asymmetrical. On each side, the 1st basipodite segment has a pointed projection which is larger on the left, and the 2nd basipodite has a patch of hairs. Both endopods have three segments and are omitted here for clarity. The 2nd and 3rd exopodite segments are almost fused and only a faint line of separation remains. On the left side the 3rd exopodite segment has three small spines (the outer one is missing on the illustrated specimen) ; on the right the 3rd exopodite has one long curved spine and two of medium length.

REMARKS. Except for sexual differences these males agree so closely with the female *H. angusticeps* that there is no doubt that they are conspecific.

Haloptilus paralongicirrus Park, 1970

MATERIAL EXAMINED : 8 males and 160 females from 7 RMT 1 hauls made at 400–55 m depth in a position 18°N 25°W, between 12 and 16 November 1969. 5 males are deposited at the British Museum (Natural History), reg. no. 1974 : 649–653.

DESCRIPTION. Male (Fig. 24) : Body length 1·67–2·20 mm with a mean of 1·87 mm (6 specimens). The shape of the cephalothorax is similar to that of the female. The head and 1st thoracic segment are fused, as are thoracic segments 4 and 5. In dorsal view the forehead is shaped like a rounded triangle, and in some specimens it is more rounded than shown here. The rostral filaments are fairly long and have swollen bases. The hind margin of the cephalothorax is smoothly rounded. The abdomen has five segments, the furcal rami are about twice as long as wide. The 1st antennae are longer than the body. The left 1st antenna is geniculate and has 21 segments ; the proximal 12–13 segments have long sensory setae, segments 16, 17 and 18 have an undulating lamella, and segment 18 contains

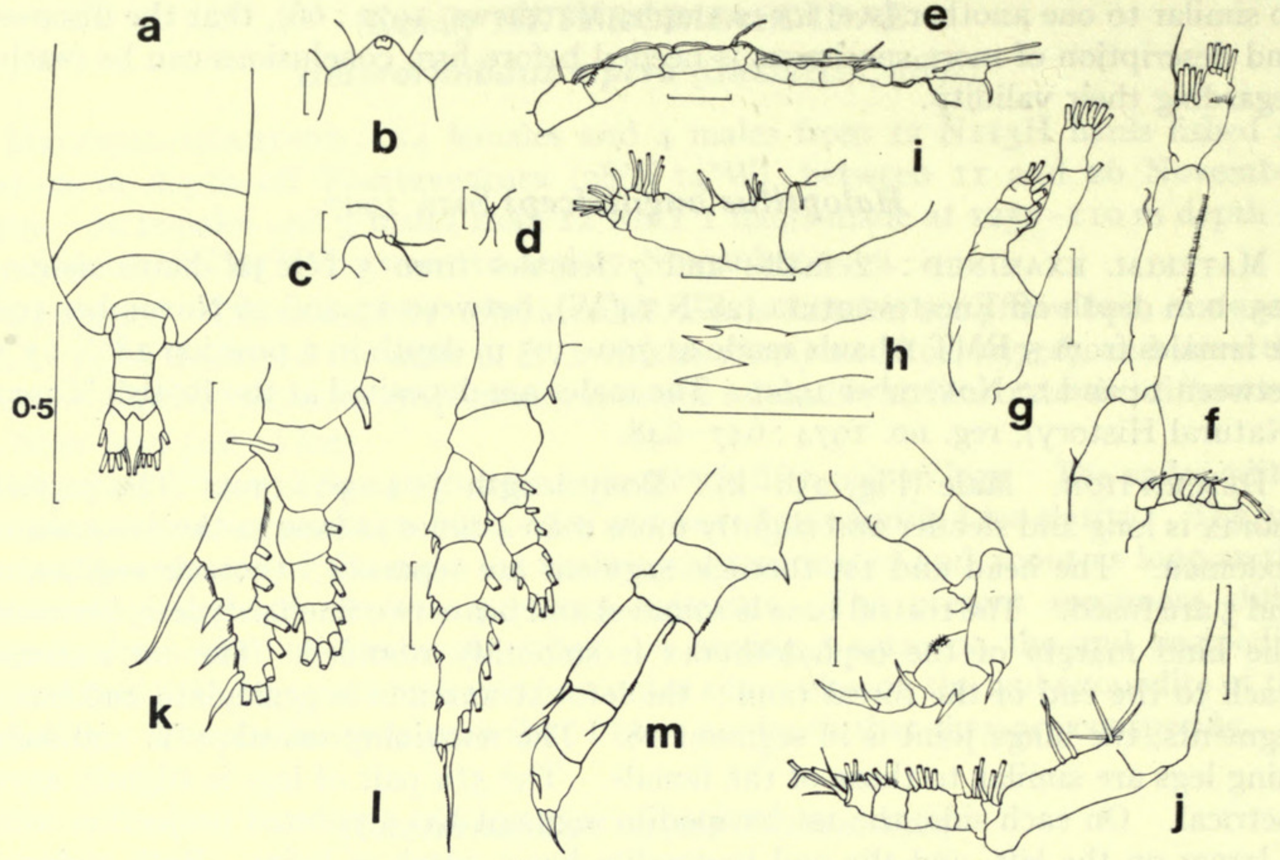

FIG. 24. *Haloptilus paralongicirrus* ♂. a, thorax and abdomen, dorsal; b, head, dorsal (different specimen); c, rostrum, lateral; d, rostrum, ventral; e, 1st antenna, segments 15–20; f, 2nd antenna; g, mandibular palp; h, mandible blade; i, 2nd maxilla; j, maxilliped; k, 1st leg; l, 2nd leg; m, 5th legs (different specimen). Bar scale 0·1 mm unless indicated.

the hinge joint. (The last segment is missing in the figure.) The remaining mouth-parts are very feebly chitinized and are similar in structure to those of the female. A satisfactory preparation of the 1st maxilla could not be made. The 2nd, 3rd and 4th pairs of legs are similar. The 5th pair of legs is slightly asymmetrical; the pointed projection on the 1st basipodite is larger on the left side, and the 2nd exopodite segment of the right leg bears a small haired lobe. Both endopodites have three segments and are omitted here for clarity.

REMARKS. *Haloptilus paralongicirrus* was described from the female (Park, 1970) and is closely related to *Haloptilus longicornis* (Claus, 1863) and *H. longicirrus* Brodsky, 1950. The females of the present species differ from those of *H. longicirrus* only in the shape of the forehead and their smaller size. Park suggested that these very slight differences may only be variations caused by differences in their vertical distributions – *H. longicirrus* living deeper than *H. paralongicirrus*. The present collections contain females of all three species and the males of two (that of *H. longicirrus* is unknown). *H. longicornis* was the shallowest of the three and *H. longicirrus* the deepest. The mean body lengths of *H. longicornis* were 2·14 mm (females) and 1·18 mm (males), of *H. paralongicirrus* they were 2·59 mm (females) and 1·87 mm (males), and of *H. longicirrus* 3·08 mm (females). All three species were non-migrants. These results agree with those of Park (1970). The present males were found in association with female *H. paralongicirrus* and since their structure, body size and depth distribution accord with those of the female I believe that they are conspecific.

Euaugaptilus atlanticus sp. nov.

MATERIAL EXAMINED : 7 females and 2 males from 2 RMT 1 hauls made in a position 18°N 25°W ; one, containing the female holotype, at 400–305 m depth on 17 November 1969 and the other, with the male allotype, at 400–300 m depth on 13 November 1969. Deposited at the British Museum (Natural History), holotype reg. no. 1974 : 654, paratypes reg. no. 1974 : 655–662.

DESCRIPTION. Female (Fig. 25a–g) : Body length 2·81–2·96 mm with a mean of 2·92 mm (7 specimens). The holotype measures 2·89 mm. The cephalothorax is long and slender and about 3·5 times as long as the 3-segmented abdomen. The head and 1st thoracic segment are separate but thoracic segments 4 and 5 are fused. In dorsal view the head protrudes slightly and is rounded. The rostrum has two fine short filaments. The hind margin of the cephalothorax is smoothly rounded. The genital segment is elongated and over twice as long as the combined length of the remaining two segments ; it is slightly swollen laterally and more distinctly so ventrally. The furcal rami are about twice as long as wide ; the inner furcal setae are almost as long as the cephalothorax.

The first antenna has 25 segments, the last five of which extend past the end of the body. The remaining mouthparts are as shown. The mandible blade has the same structure on both the right and left side. The swimming legs are identical in both sexes. The base of each external spine on the exopodite of the 1st leg has a conspicuous comb of curved spines. The terminal exopodite spine on the 2nd, 3rd and 4th leg is long and bears numerous small spinules. The 5th pair of legs is symmetrical. The 2nd basipodite has a very long seta which is longer than the remainder of the leg. The 2nd exopodite segment has a massive internal spine, carrying many coarse teeth, but no external spine. The endopodite has three segments.

Male (Fig. 25h–m) : The allotype is slightly crushed and could not be measured ; the other male is 2·58 mm long. The general appearance is as for the female. The abdomen has five segments. The left 1st antenna is geniculate but broken in both specimens, the right 1st antenna reaches to the end of the furcal rami. The mouthparts are identical to those of the female except that the exopodite of the 2nd antenna has three terminal setae not two, and the mandible blade on the right side has a minute extra tooth. The swimming legs are as shown, the 4th leg is similar to the 3rd. The 5th pair of legs is slightly asymmetrical. The 1st exopodite segment of the left leg has no outer spine and the 3rd exopodite segment of this leg has a short claw and a long curved spine. On the right leg the second exopodite segment has a haired lobe on its inner edge, and the terminal segment has three spines. On both legs the inner corner of the 2nd basipodite bears a curious structure shaped like a segmented hemisphere. The endopodites of both legs have three segments.

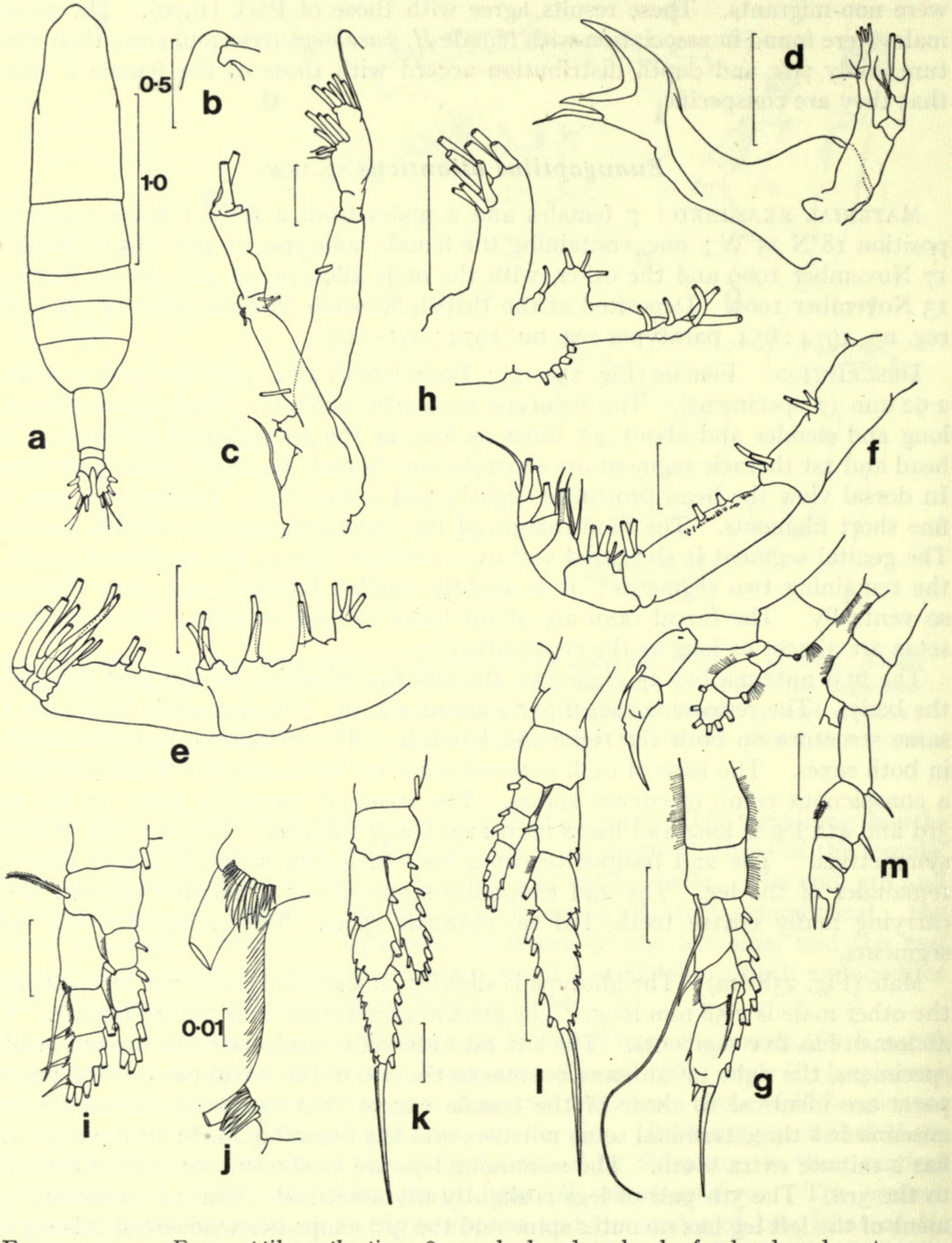

FIG. 25. a–g, *Euaugaptilus atlanticus* ♀. a, body, dorsal ; b, forehead and rostrum, lateral ; c, 2nd antenna ; d, mandible right side ; e, 2nd maxilla ; f, maxilliped ; g, 5th leg. h–m, *Euaugaptilus atlanticus* ♂. h, 1st maxilla ; i, 1st leg ; j, 1st leg, outer edge of exopodite segments 1 and 2 ; k, 2nd leg ; l, 3rd leg ; m, 5th legs. Bar scale 0·1 mm unless indicated.

REMARKS. The female of *E. atlanticus* resembles that of *E. longiseta* Grice & Hulsemann, 1965. I have examined the type specimen of this latter species at the British Museum (Natural History) and it differs from *E. atlanticus* in the structure of the mandible blade, the 1st leg and the 2nd exopodite segment of the 5th leg. The male of *E. longiseta* is smaller than the present species and has a different 5th pair of legs. The copepodite *E.* sp. 1 Tanaka & Omori, 1974, is also similar to the present species but it is larger and differs in the structure of the 1st maxilla and mandible blade.

Euaugaptilus fecundus Tanaka & Omori, 1974

Euaugaptilus sp. 3 Grice & Hulsemann, 1967 : 37, figs 231–240 ; Matthews, 1972 : 45.

MATERIAL EXAMINED : 1 female from an RMT 1 haul made at 1250–1000 m depth in a position 18°N 25°W on 17 November 1969. Deposited at the British Museum (Natural History), reg. no. 1974 : 663.

DESCRIPTION. Female (Fig. 26a–h) : Body length 6·40 mm. I was preparing to describe and name this specimen until I saw the recent account of *E. fecundus.* The present female differs from Tanaka & Omori's specimen only in the following minor details, (a) the endopod of the 2nd antenna is about 4 times longer than the exopod, instead of 2·6 times, (b) there are 24 setae on the endopod of the 2nd maxilla instead of 19, and (c) the 3rd endopodite segment of the 2nd leg has seven setae instead of six. The setation of the distal segments of the maxilliped is slightly obscure in the present female but in all other respects it is identical to *E. fecundus.*

REMARKS. I believe that this species is the female of the male described as *Euaugaptilus* sp. 3 by Grice & Hulsemann (1967). Except for the 1st antenna and 2nd maxilla the mouthparts of the present female are identical to those of the male. The 1st lobe of the 2nd maxilla bears a single seta in both the present female and that of Tanaka & Omori ; this is not shown by Grice & Hulsemann but it is easily damaged when the appendage is dissected off the body. The endopod of the 2nd maxilla in the present specimen has more setae than either the male or Tanaka & Omori's female. The proportions of the rami in the 2nd antenna are similar in the present female and the male. The endopodite of the 1st leg has three segments in the male but only two in both females ; the remaining swimming legs of the male are not described in detail by Grice & Hulsemann.

Except for normal sexual differences the only real difference between the females and the male is in the segmentation of the 1st leg. Intraspecific variation occurs in *Euaugaptilus,* however, both in the setation of the mouthparts and in the segmentation of the 1st leg (Matthews, 1972). Grice & Hulsemann (1967) and Matthews (1972) were unable to refer the male to a known species but pointed out similarities with *E. rigidus* (Sars, 1907). The true male of *E. rigidus* is described below (p. 357), and the agreement between the present female and the male *E.* sp. 3 is so good that I have no doubt that they are conspecific.

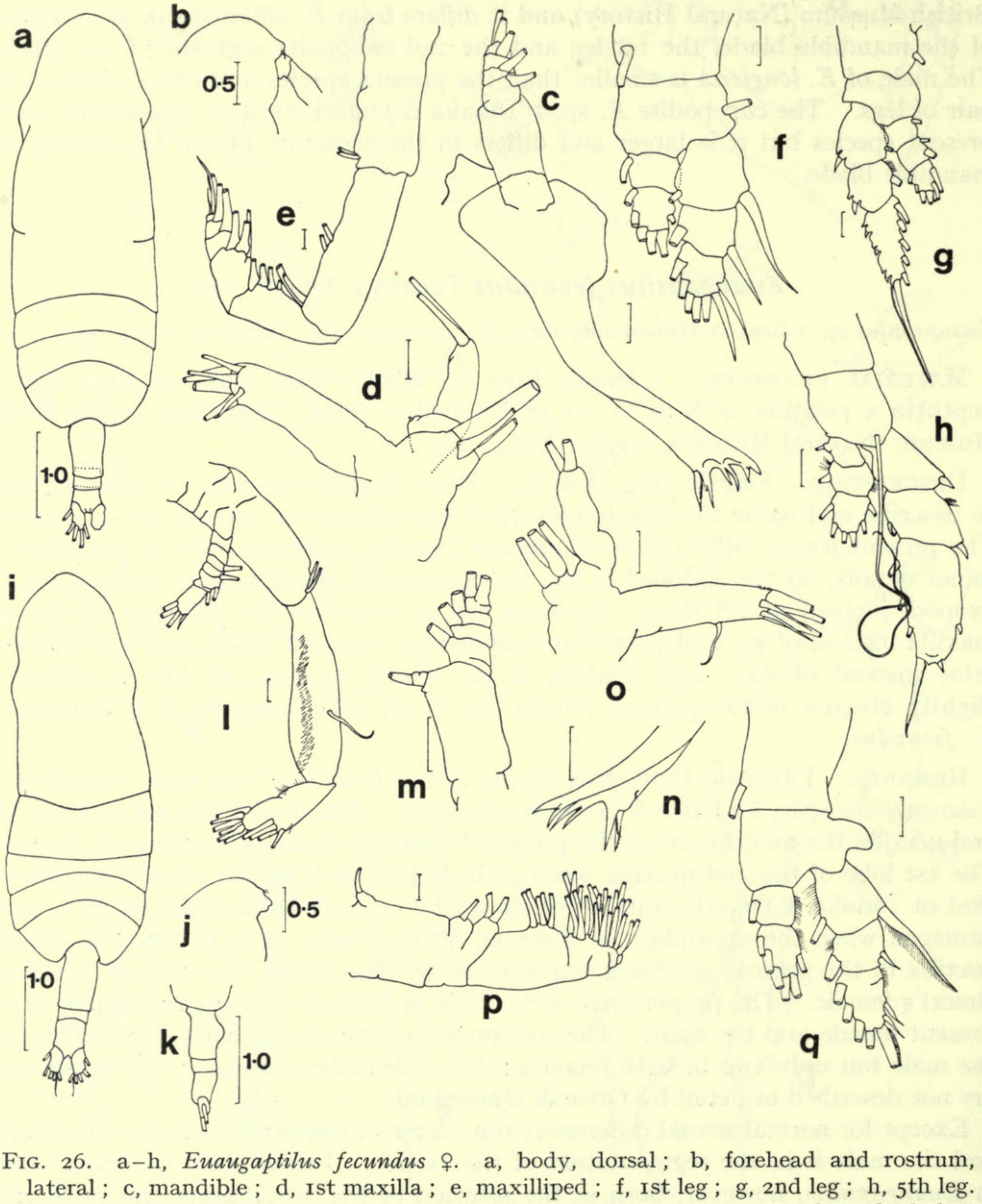

FIG. 26. a–h, *Euaugaptilus fecundus* ♀. a, body, dorsal ; b, forehead and rostrum, lateral ; c, mandible ; d, 1st maxilla ; e, maxilliped ; f, 1st leg ; g, 2nd leg ; h, 5th leg. i–q, *Euaugaptilus latifrons* ♀. i, body, dorsal ; j, forehead and rostrum, lateral ; k, last thoracic segment and abdomen, lateral ; l, 2nd antenna ; m, mandibular palp ; n, mandible blade ; o, 1st maxilla ; p, 2nd maxilla ; q, 1st leg. Bar scale 0·1 mm unless indicated.

Euaugaptilus latifrons (Sars, 1907)

MATERIAL EXAMINED : 2 females from 2 N113H hauls made at 800–475 m depth off Fuerteventura (28°N 14°W) on 26 November 1965. 3 females from 2 RMT 1 hauls made at 700–505 m depth in a position 18°N 25°W, between 14 and 15 November 1969.

DISCUSSION. The present females (Fig. 26i–q) agree generally with the descriptions of Sars (1924, 1925), Sewell (1932) and, particularly, Tanaka & Omori (1974). There is tremendous variation in the number of setae on the 2nd maxilla in this species. Tanaka & Omori discussed this in relation to their specimen and those of Sars, Sewell and Vervoort (1965). The present females have the following numbers of setae on the various lobes of the 2nd maxilla :

<table>
<tr><th rowspan="2">Station no. of specimen</th><th colspan="7">Lobes of 2nd maxilla</th><th rowspan="2"></th></tr>
<tr><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>Endopod</th></tr>
<tr><td>7089 no. 16</td><td>1</td><td>0</td><td>1</td><td>2</td><td>5</td><td>6</td><td>16</td><td>(fig. 26p)</td></tr>
<tr><td>no. 16 (2nd specimen)</td><td>1</td><td>0</td><td>1</td><td>2</td><td>2</td><td colspan="2">14</td><td></td></tr>
<tr><td>no. 17 } same specimen</td><td>1</td><td>0</td><td>1</td><td>2</td><td>3</td><td>5</td><td>12</td><td>(right side)</td></tr>
<tr><td>no. 17 } same specimen</td><td>1</td><td>0</td><td>1</td><td>2</td><td>5</td><td colspan="2">17</td><td>(left side)</td></tr>
<tr><td>5825 no. 4</td><td>1</td><td>0</td><td>1</td><td>2</td><td>3</td><td colspan="2">17</td><td></td></tr>
<tr><td>no. 1</td><td>1</td><td>0</td><td>1</td><td>2</td><td>2</td><td>4</td><td>8</td><td></td></tr>
</table>

In the 2nd maxilla of some of these females lobe 6 and the endopod cannot be distinguished, and in one specimen there is some variation between the left and right side. The present specimens measure 4·96–6·72 mm with a mean of 5·63 mm.

Euaugaptilus maxillaris Sars, 1920

MATERIAL EXAMINED : 3 females from 3 N113H hauls made at 960–550 m depth off Fuerteventura (28°N 14°W), between 24 and 28 November 1965. 3 females and 2 males from 3 RMT 1 hauls made at 785–610 m depth in a position 18°N 25°W, between 13 and 14 November 1969. 5 females and the males are deposited at the British Museum (Natural History), reg. no. 1974 : 664–670.

DESCRIPTION. Female (Fig. 27a–g) : Body length 3·27–5·76 mm with a mean of 5·11 mm (6 specimens). The cephalothorax is long and narrow and just over 3·5 times as long as the 3-segmented abdomen. The head and 1st thoracic segment are separate. The forehead and hind margin of the cephalothorax are rounded. The genital segment is 1·8 times as long as the combined length of the two subsequent segments. The 1st antenna has 25 segments and exceeds the body length by 4–5 segments. Except for the 1st maxilla the remaining mouthparts are as figured by Sars (1924). The distal setae of the 2nd maxilla and maxilliped have very small 'buttons'. The 1st maxilla (Fig. 27e, f) differs from the descriptions of Sars (1924, 1925) and Tanaka & Omori (1974) in the development of the endopodite. Both Sars' and Tanaka & Omori's specimens had a single endopodite segment with five setae. One of the females illustrated here has two endopodite segments bearing

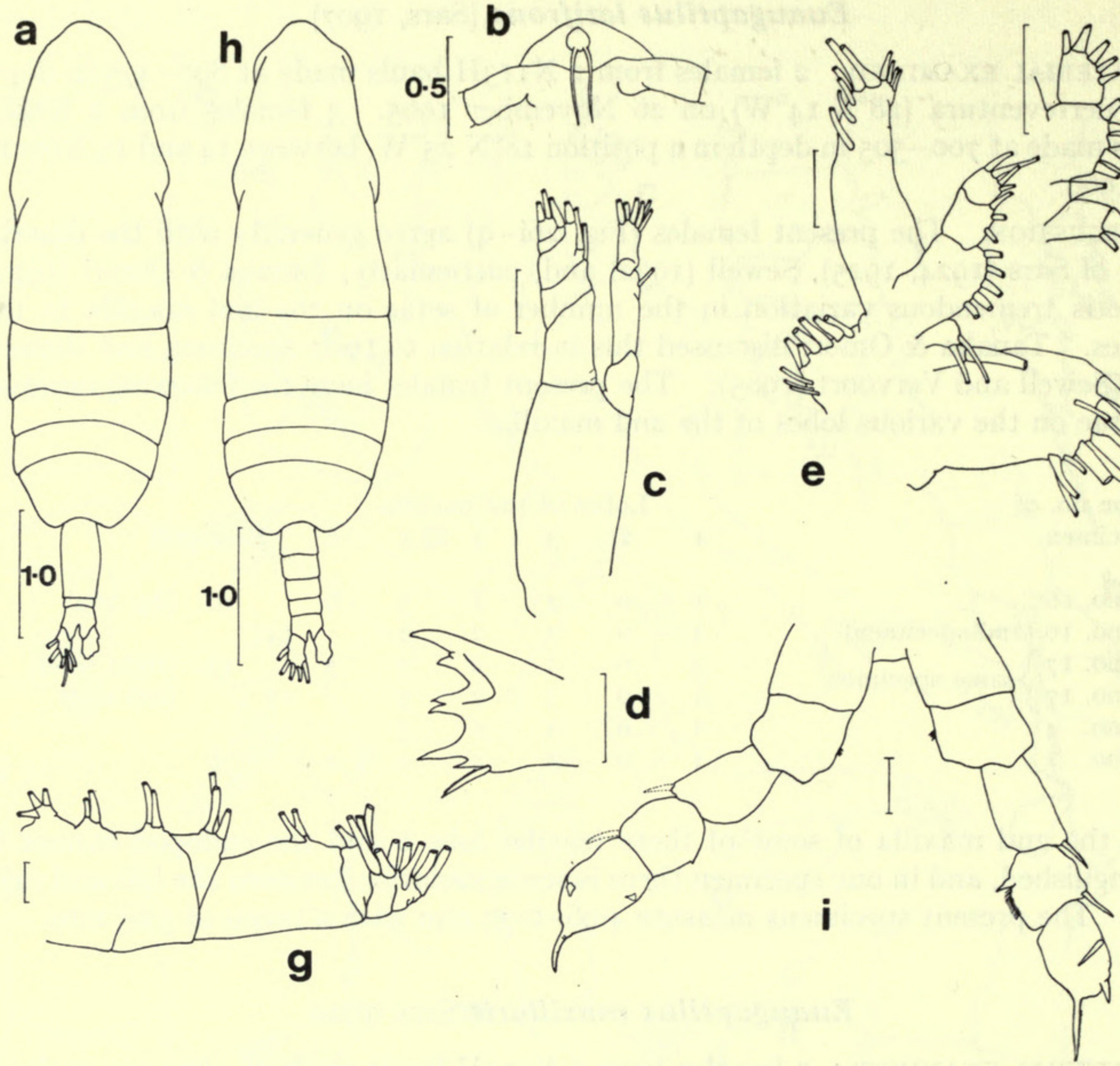

FIG. 27. a–g, *Euaugaptilus maxillaris* ♀. a, body, dorsal ; b, rostrum, ventral ; c, mandibular palp ; d, mandible blade ; e, 1st maxilla ; f, 1st maxilla, small specimen ; g, 2nd maxilla. h–i, *Euaugaptilis maxillaris* ♂. h, body, dorsal ; i, 5th legs. Bar scale 0·1 mm unless indicated.

three and four setae (Fig. 27e). Both the segmentation and setation of this endopodite are subject to variation however, since two other specimens have only a single segment with six and seven setae respectively. The endopodite of the 1st maxilla of the smallest female (3·27 mm, Fig. 27f) agrees with Sars' account but the 2nd and 3rd endites have two and one setae respectively – the converse of the arrangement in both previous accounts and in the other specimens here. The swimming legs are as described by Sars.

Male (Fig. 27h, i) : Body length 5·12 mm (both specimens). The cephalothorax is 3·5 times as long as the 5-segmented abdomen. The head and 1st thoracic segment are separate ; thoracic segments 4 and 5 are fused. In dorsal view the forehead protrudes more than in the female ; the rostrum has two fairly long filaments. The furcal rami are twice as long as wide. The left 1st antenna is presumably geniculate but is broken in both specimens ; the right 1st antenna has 25 segments and exceeds the body length by five segments. The remaining mouthparts are identical to those of the present females. Both specimens have only a single endopodite segment in the 1st maxilla, carrying seven and eight setae respectively ; otherwise this appendage is as shown in Fig. 27e.

The swimming legs are the same as in the female. The 5th pair of legs is slightly asymmetrical. The external exopodite spines on the left leg are missing in the illustrated specimen but present in the other. The 2nd basipodite segment of both legs has a small patch of spines. The endopodites are 3-segmented on both sides and are omitted here for clarity.

REMARKS. The female of *E. maxillaris* has only been described and figured by Sars (1924, 1925) and by Tanaka & Omori (1974). The male has hitherto been unknown. The present female specimens agree with these descriptions and I have no doubt that they are conspecific. The variation in structure of the 1st maxilla accords with the intraspecific variations noted in *Euaugaptilus* by Matthews (1972) and by Tanaka & Omori (1974). Similar differences are also present in several of the species described here.

Euaugaptilus* ? *longicirrhus (Sars, 1905)

MATERIAL EXAMINED : 1 female taken in an N113H fished at 800–680 m depth off Fuerteventura (28°N 14°W) on 26 November 1965. 3 females and 1 male from 2 RMT 1 hauls made at 500–410 m depth in a position 18°N 25°W, between 22 and 24 November 1969. 3 females and the male are deposited at the British Museum (Natural History), reg. no. 1974 : 671–674.

DESCRIPTION. Female (Fig. 28a–c) : Body length 4·18–4·56 mm with a mean of 4·31 mm (4 specimens). The general appearance of the body is as shown by Sars (1924). The rostral filaments are very long. Except for the 2nd maxilla the mouthparts of the present females are the same as those of the male, and fit Sewell's (1947) description better than Sars'. The mandibular palp is very reduced with the exopod having four and the endopod two setae ; the blade has two more teeth than either Sars' or Sewell's specimens. The 1st maxilla is reduced and agrees with Sewell's description. The 2nd maxilla has 3 (2 long and 1 spike), 1, 2, 3, 2 and 3 setae on lobes 1–6 respectively, whereas Sars' specimen had –, 1, 2, 3, 3, 3 setae and Sewell's 2, –, 2, 3, 2 and 3. The legs all have 3-segmented exopods and endopods – the 1st pair thereby agreeing with Sewell's account rather than Sars'.

Male (Fig. 28d–h) : Body length 3·42 mm. The cephalothorax is similar in shape to the female but has slightly more conspicuous shoulders. It is 3·7 times as long as the 5-segmented abdomen. Thoracic segments 4 and 5 are fused and the hind margin of the cephalothorax is rounded. The rostral filaments are very long. The left 1st antenna reaches to the end of the abdomen ; it is geniculate and has 21 segments. The right 1st antenna is broken. The mouthparts are as shown and are identical to the female except that the 1st lobe of the 2nd maxilla has only one seta. The swimming legs are the same as in the female. The 5th pair of legs are slightly

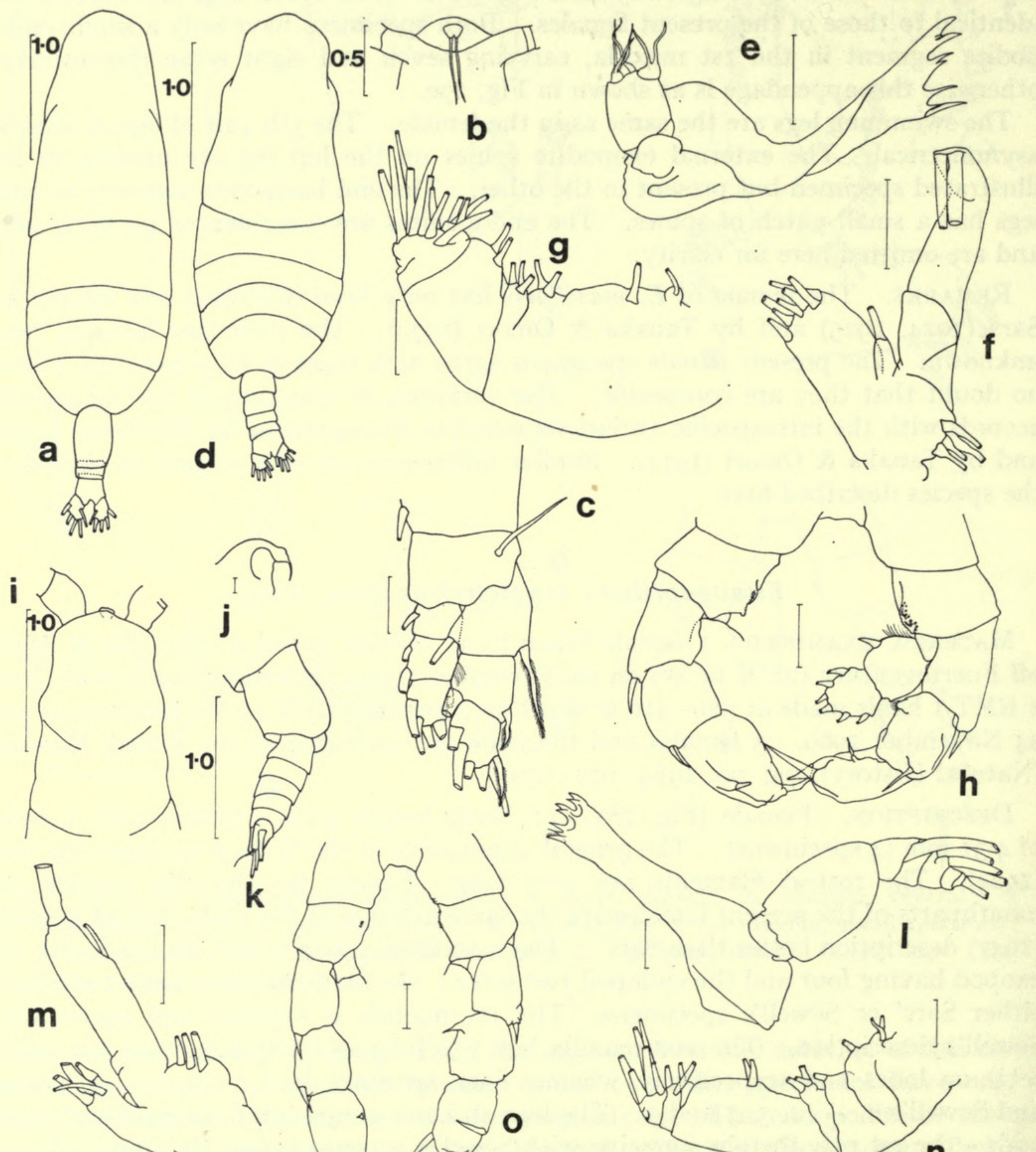

FIG. 28. a–c, *Euaugaptilus longicirrhus* ♀. a, body, dorsal ; b, rostrum, ventral ; c, 1st leg. d–h, *Euaugaptilus longicirrhus* ♂. d, body, dorsal ; e, mandible ; f, 1st maxilla ; g, 2nd maxilla ; h, 5th legs. i–o, *Euaugaptilus rigidus* ♂. i, head, dorsal ; j, forehead and rostrum, lateral ; k, last thoracic segment and abdomen, lateral ; l, mandible ; m, 1st maxilla ; n, 2nd maxilla ; o, 5th legs. Bar scale 0·1 mm unless indicated.

asymmetrical. The 2nd exopodite segment of the right leg has a small haired lobe ; the 2nd basipodite segment of both legs has a patch of raised spots on its internal edge. The endopods of both legs are 3-segmented.

REMARKS. *E. longicirrhus* was described by Sars (1924, 1925) from an adult female. The only other description is by Sewell (1947) who attributed a stage V female copepodite to this species. Matthews (1972) agreed with Sewell and kindly identified the present female taken off Fuerteventura (Roe, 1972*d*). The appendages of Sewell's specimen differ from those of Sars' in several respects – the exopodite of the 1st pair of legs has three segments not two, and the mandibular palp and 1st and 2nd maxillae differ in details of their setation. The present specimens show almost complete agreement with Sewell's account and if his copepodite is *E. longicirrhus* then the specimens described here are also this species.

Euaugaptilus rigidus (Sars, 1907)

MATERIAL EXAMINED : 2 females from 2 N113H hauls made at 590–450 m depth off Fuerteventura (28°N 14°W), between 15 and 26 November 1965. 1 female and 1 male from 2 RMT 1 hauls made at 785–300 m depth in a position 18°N 25°W, between 13 and 14 November 1969. The male is deposited at the British Museum (Natural History), reg. no. 1974 : 675.

DESCRIPTION. Male (Fig. 28i–o) : Body length *c.* 4·3 mm but as the cephalothorax was fractured accurate measurements are impossible. The general appearance of the body, especially the shape of the head and hind margin of the cephalothorax, are as for the female. The head and 1st thoracic segment are separate but thoracic segments 4 and 5 are fused. The rostrum has two filaments of medium length. The abdomen has five segments ; the furcal rami are about 1·5 times as long as wide. The 1st antenna are broken off on both sides. Except for the 2nd maxilla the other mouthparts are identical to the female described by Sars (1924, 1925). On the present specimen the first six lobes of the 2nd maxilla bear 2, 1, 1, 3, 2 and 1 setae respectively ; whereas Sars' female had 1, 1, 1, 2, 2 and 1 setae on these lobes. Slight variation in the setation of this appendage occurs, however, since the female described by Tanaka (1964) had 2, 1, 1, 3, 2 and 2 setae and the present females have 2, 1, 1, 3, 2, 1 (two specimens) and 2, –, 1, 3, 2, 1 setae respectively. The first four pairs of legs are identical to the female. The 5th pair of legs is slightly asymmetrical. The 2nd exopodal segment of the right leg has a pointed lobe on its inner margin ; the outer spine of this segment is missing and apparently broken off. The 2nd basipodite segment of both legs has a small corrugated patch. The endopodite on both sides has three segments and is omitted for clarity.

REMARKS. The agreement between this specimen and the female is so good that I have no doubt that they are conspecific. The slight variation in setation of the 2nd maxilla is not surprising since Matthews (1972) found a considerable degree of intraspecific variation in this genus. Vervoort (1965) reported a damaged male of this species, measuring 4·30 mm, but it has hitherto been undescribed. The male *E.* sp. 3 of Grice & Hulsemann (1967) has been discussed earlier (p. 351).

Euaugaptilus mixtus (Sars, 1907)

Euaugaptilus propinquus Sars, 1920 : 17 ; 1924 : pl. 102 ; 1925 : 297 ; Rose, 1933 : 221, 230, fig. 283 ; Vives, 1970 : 554–555 ; 1972 : 221–222 ; Matthews, 1972 : 39 ; Tanaka & Omori, 1974 : 193, 197, 199, 200, 248–250, figs 3h, 26.

MATERIAL EXAMINED : 2 females in 2 N113H hauls made at 960–750 m depth off Fuerteventura (28°N 14°W), between 25 and 28 November 1965. 5 females taken in 5 RMT 1 hauls made at 900–410 m depth in a position 18°N 25°W, between 12 and 16 November 1969. 6 females are deposited at the British Museum (Natural History), reg. no. 1974 : 676–681.

DESCRIPTION. Female (Fig. 29h–o) : Body length 3·50–3·80 mm with a mean of 3·65 mm (7 specimens). The general appearance of the body is as shown by Sars (1924), Hulsemann (1967) and Tanaka & Omori (1974). The cephalothorax is 2·6 times as long as the 3-segmented abdomen. The head and 1st thoracic segment are separate ; thoracic segments 4 and 5 are fused. The forehead is rounded and the rostrum has two filaments of medium length. The hind margin of the cephalothorax is rounded in dorsal view but slightly angular when seen laterally. The genital segment is about 1·5 times as long as the combined length of the two subsequent segments. The furcal rami are twice as long as wide. The 1st antenna has 25 segments and exceeds the body length by 2–3 segments. The remaining mouthparts are as shown but there is slight variation in the setation of both the 2nd antenna and 1st maxilla, and in the number of mandibular teeth. The 2nd antenna was examined in three specimens, two of which had nine large setae on the endopodite and the 3rd (Fig. 29j) had eight. The 1st outer lobe of the 1st maxilla has six large and one small setae in three specimens, six large in one, five ? large in one, and five large and one small in another (Fig. 29m). The mandibular teeth are in groups of 2, 2 and 3 in four specimens (Fig. 29l), but in two of these four examples the second tooth of the middle group is minute and could easily be overlooked ; a further specimen has 2, 2 and 2 teeth, and another 2, 1 and 3. The distal setae of the 2nd maxilla and maxilliped have well-developed 'buttons'. The legs agree with previous descriptions.

REMARKS. *E. mixtus* was described briefly by Sars in 1907 from 'Princesse Alice' station 1794. It does not, however, appear in the list of copepods taken at this station in Sars (1925). The only other record of this species is by Lysholm & Nordgaard (1945). This specimen was probably identified by Sars and was redescribed by Hulsemann (1967). *E. propinquus* was described briefly by Sars in 1920 and more fully in 1924 and 1925. It was recorded by Vives (1970, 1972) and a further description has recently been given by Tanaka & Omori (1974). Sars listed his specimens as coming from 'Princesse Alice' stations 1781, 2738 and 3021. I have borrowed a female specimen of *E. propinquus* from the Oceanographic Museum, Monaco, which was caught at station 1768 in 1904. This specimen is not mentioned by Sars and it is not on his list of species taken at this station.

Hulsemann (1967) pointed out the similarity between *E. mixtus* and *E. propinquus* and said that they could be distinguished by (a) a slightly different shaped forehead, (b) the mandibular tooth arrangement is 2, 1 and 3 in *E. mixtus* and 2, 2 and 2 in

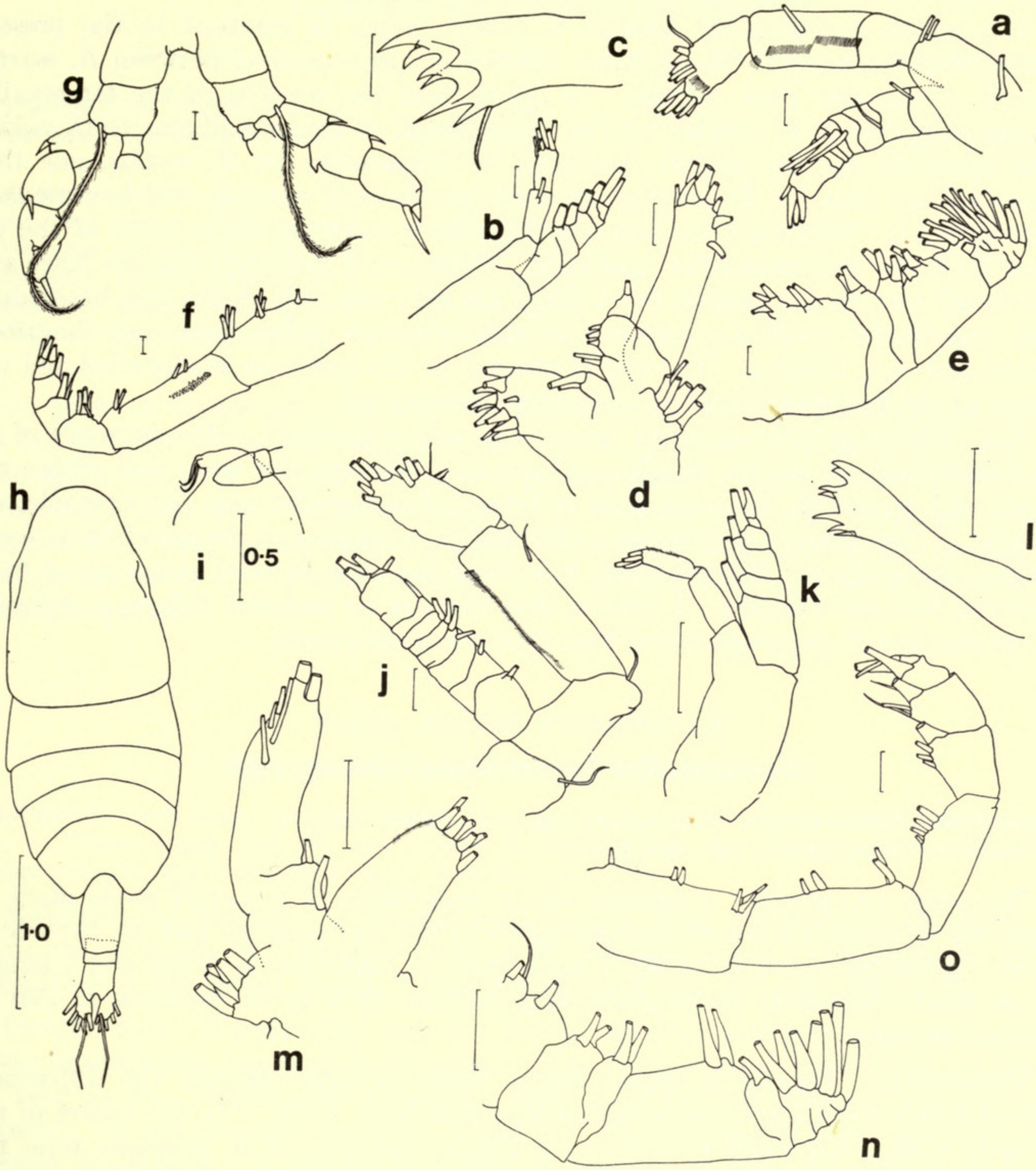

FIG. 29. a–g, *Euaugaptilus hyperboreus* ♂. a, 2nd antenna ; b, mandibular palp ; c, mandible blade ; d, 1st maxilla ; e, 2nd maxilla ; f, maxilliped ; g, 5th legs. h–o, *Euaugaptilus mixtus* ♀. h, body, dorsal ; i, forehead and rostrum, lateral ; j, 2nd antenna (different specimen) ; k, mandibular palp ; l, mandible blade ; m, 1st maxilla ; n, 2nd maxilla ; o, maxilliped (different specimen). Bar scale 0·1 mm unless indicated.

E. propinquus, and (c) the 1st maxilla of *E. mixtus* has one seta on the 2nd basipodite and six large setae on the exopodite, whereas these segments in *E. propinquus* have two setae and five large and one small seta respectively.

The female described by Tanaka & Omori (1974) is identical to the present 'Discovery' specimens. These latter females are intermediate between *E. mixtus* and *E. propinquus* (Roe, 1972*d*). In all of them the setation of the 1st maxilla agrees with that of *E. mixtus* but the arrangement of the mandibular teeth varies. One specimen has the pattern described by Hulsemann for *E. mixtus*, one that described by Sars for *E. propinquus*, and four have a varying and intermediate arrangement. Without dissection it is difficult to ascertain the setation of the 1st maxilla of the 'Princesse Alice' specimen. However, it definitely has five large and one small seta on the exopod but I could see only one seta on the 2nd basipodite. The mandibular tooth arrangement of this specimen differs from any described above and is 1, 1 and 4. The cephalothorax of this specimen is distorted and the shape of the forehead cannot be accurately determined.

The differences between these two species are very slight. The presence of an additional seta on the 1st maxilla and one of a different size seem well within the range of intraspecific variation seen in several *Euaugaptilus* spp. (for example, see p. 355). The shape of the forehead may well be variable and the mandibular tooth pattern certainly is. Furthermore, it is clear that the detailed structure of Sars' material was not uniform. I believe that there is no essential difference between *E. mixtus* and *E. propinquus* and that they are synonymous.

Euaugaptilus hyperboreus Brodsky, 1950

Euaugaptilus hyperboreus ? ; Roe, 1972*a* : 299, 311 ; 1972*d* : 1035.
E. elongatus ; Roe, 1972*a* : 299, 306, 311.

Material examined : 2 females and 1 male taken in 3 N113H hauls made at 950–600 m depth off Fuerteventura (28°N 14°W), between 26 and 28 November 1965. 2 females taken in 2RMT 1 hauls made at 1220–800 m depth and 1 female in an RMT 8 fished at 1020–910 m in a position 18°N 25°W, between 14 and 18 November 1969.

Discussion. Tanaka & Omori (1974) have recently clarified the differences between this species and *Euaugaptilus elongatus* (Sars, 1905). In the course of the present work I borrowed a male and a female specimen of *E. elongatus* from the Oceanographic Museum, Monaco, both of which were taken at 'Princesse Alice' station 1781 on 21 August 1904. These specimens and the present 'Discovery' material confirm the differences in the setation of the 1st and 2nd maxillae observed by Tanaka & Omori. These differences are shown in Table 1.

Slight variation occurs in the setation of the 1st maxilla endopodite of *E. hyperboreus*, but none of the present specimens, nor those examined by Tanaka & Omori, have three setae on this lobe. Some differences are also present in the setation of the 2nd basipodite of the 1st maxilla, where the 'Discovery' male (Fig. 29a–g) has

TABLE 1

The number of endopodite setae on the 1st and 2nd maxillae of *Euaugaptilus hyperboreus* and *E. elongatus*

Specimen	Species	1st maxilla	2nd maxilla
'Princesse Alice' Station 1781 ♀	*E. elongatus*	3	8
'Princesse Alice' Station 1781 ♂	*E. elongatus*	3	8 (right) 9 (left)
'Discovery' station 5825 no. 7 ♀	*E. hyperboreus*	2	15
'Discovery' station 5827 no. 3 ♀	*E. hyperboreus*	2	15
'Discovery' station 5827 no. 4 ♂	*E. hyperboreus*	1	15
'Discovery' station 7089 no. 12 ♀	*E. hyperboreus*	1	15
'Discovery' station 7089 no. 14 ♀	*E. hyperboreus*	1	14
'Discovery' station 7089 no. 34 ♀	*E. hyperboreus*	2	14

three setae on the left side (Fig. 29d) but four on the right. Similar variation occurs on the endopod of the 2nd maxilla of the male *E. elongatus* from Monaco (Table 1). The specimens of *E. hyperboreus* have a spinous ridge at the base of the external exopodite spines of the 1st leg as described by Tanaka & Omori. Although closely related, these two species show consistent differences, especially in the number of endopodite setae on the 2nd maxilla. They should, I believe, be maintained as separate species.

Family **BATHYPONTIIDAE**

Bathypontia sarsi Grice & Hulsemann, 1965

Bathypontia minor Sars, 1907 : 27 ; 1924 : pl. 127 ; 1925 : 360 ; Lysholm & Nordgaard, 1945 : 42 ; Wilson, 1950 : 171, fig. 303 ; Owre & Foyo, 1964*a* : 343 ; 1964*b* : 367 ; 1967 : 100, figs 720–722, 724–726 ; 1972 : 494 ; Tanaka, 1965 : 379.

MATERIAL EXAMINED : 2 females and 3 males from 5 RMT 1 hauls made at 1250–700 m depth in a position 18°N 25°W, between 14 and 18 November 1969. Deposited at the British Museum (Natural History), reg. no. 1974 : 682–686.

DESCRIPTION. Female (Fig. 30a–i) : One specimen is 3·04 mm in length and the other is too badly damaged to measure. The cephalothorax is oval and 2·9 times as long as the 4-segmented abdomen. The head and 1st thoracic segment are separate, as are thoracic segments 4 and 5. The rostrum is large, rounded and curved downwards ; it has no filaments or points. The last thoracic segment is symmetrical with ventrally directed points. The 2nd and 3rd abdominal segments have small spines on their hind margins. The furcal rami are slightly longer than wide. The 1st antenna has 23 segments and reaches to the hind edge of the genital segment. The remaining mouthparts are as shown. The mandible blade has a large tooth (Fig. 30d). The left 2nd maxilla has only five large hooked setae (Fig. 30f), but the right one has seven. Swimming legs 1–4 are similar to those of the male. The external exopodite spines on the 2nd pair of legs are symmetrical. The 5th pair of legs is uniramous with three segments on each side ; the terminal segment

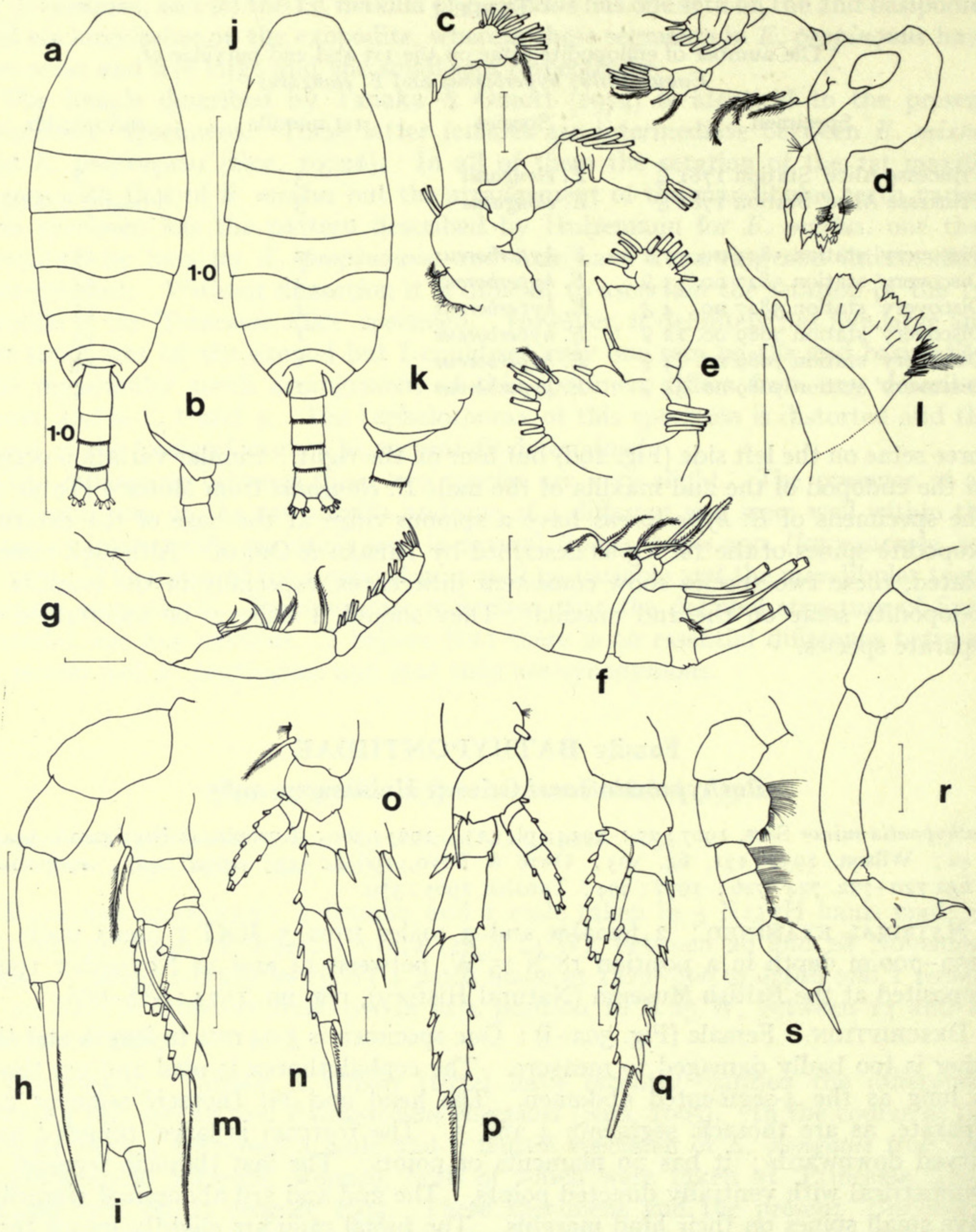

FIG. 30. a–i, *Bathypontia sarsi* ♀. a, body, dorsal ; b, last thoracic segment, lateral ; c, 2nd antenna ; d, mandible ; e, 1st maxilla ; f, 2nd maxilla, left ; g, maxilliped ; h, 5th leg ; i, 5th leg, other specimen. j–s, *Bathypontia sarsi* ♂. j, body, dorsal ; k, last thoracic segment, lateral ; l, mandible blade ; m, 1st leg ; n, 2nd leg, left ; o, 2nd leg, outer edge of right exopodite ; p, 3rd leg ; q, 4th leg ; r, 5th leg, right ; s, 5th leg, left. Bar scale 0·1 mm unless indicated.

has one long and one short spine. The arrangement of these spines is slightly asymmetric in one specimen (Fig. 30i), but in the other both sides are as shown in Fig. 30h.

Male (Fig. 30j–s): Body length 2·74–3·04 mm with a mean of 2·91 mm (3 specimens). The general appearance of the body is the same as the female. The abdomen has five segments. The 1st antenna reaches to the end of the cephalothorax. The right 1st antenna is geniculate and has 20 segments. The remaining mouthparts are identical to those of the female but the right 2nd maxilla has seven large setae and the left only six. The swimming legs are as shown. The external spine on the 2nd exopodite of the 2nd pair of legs is slightly larger on the left side. The 5th pair of legs is uniramous and completely asymmetrical. The right leg (Fig. 30r) is longer than the left and has four segments; the last segment is roughly triangular in shape, terminates in two unequal spines, has a central pore and has a small lamella in the distal corner. The left leg (Fig. 30s), has five segments of which segments 2–5 have bundles of hairs of varying length; the 5th segment terminates in one long and one short spine.

REMARKS. *B. sarsi* is a very rare species which has never previously been fully described or figured. Sars (1924, 1925) gave the most complete account, and to verify the identification of the present specimens I borrowed a female and a male *B. sarsi* from the collections of the Oceanographic Museum, Monaco. The female was taken at 'Princesse Alice' station 1871 in 1904, but this specimen is not mentioned by Sars, nor is station 1871 included in his station list. The male has no station number or date but it was probably taken on a cruise to the Azores in 1904–5 (G. Testa, pers. comm.). These omissions add to the existing confusion surrounding Sars' station listings for this species (Owre & Foyo, 1964*b*).

The present 'Discovery' specimens differ from Sars' description in the shape of the last thoracic segment and possibly in the structure of the mandible blade. The 5th thoracic segment of these specimens has a fairly blunt ventrally directed point, whereas Sars figures this as being very sharp and directed straight back. In the 'Princess Alice' male, however, this point is identical to that of the 'Discovery' specimens (Fig. 30k), and in the 'Princess Alice' female it is also blunt but does go straight backwards. Sars described the mandible blade as having an external tooth which is only a little larger than the two following teeth. This tooth on the present 'Discovery' specimens seems to be larger than described by Sars but it is difficult to be certain. Owre & Foyo's (1967) photograph of the mandible blade shows no external tooth. It is impossible to see the mandible blade on either of the 'Princess Alice' specimens without dissection. The remaining mouthparts and the swimming legs of *B. sarsi* have never been described. In these 'Discovery' specimens they are very similar to those of *B. similis* Tanaka, 1965. The female 5th pair of legs agrees with previous accounts. Their asymmetry in one specimen approaches the condition seen in *B. intermedia* Deevey, 1973. *B. sarsi* and *B. intermedia* differ in several other respects, however, and presumably the slight asymmetry seen here is merely a variation similar to that shown in the setation of the 2nd maxilla. The 'Discovery' male's 5th pairs of legs are identical to that of the 'Princess Alice' male. All differ from Sars' figure in the shape of the last segment of

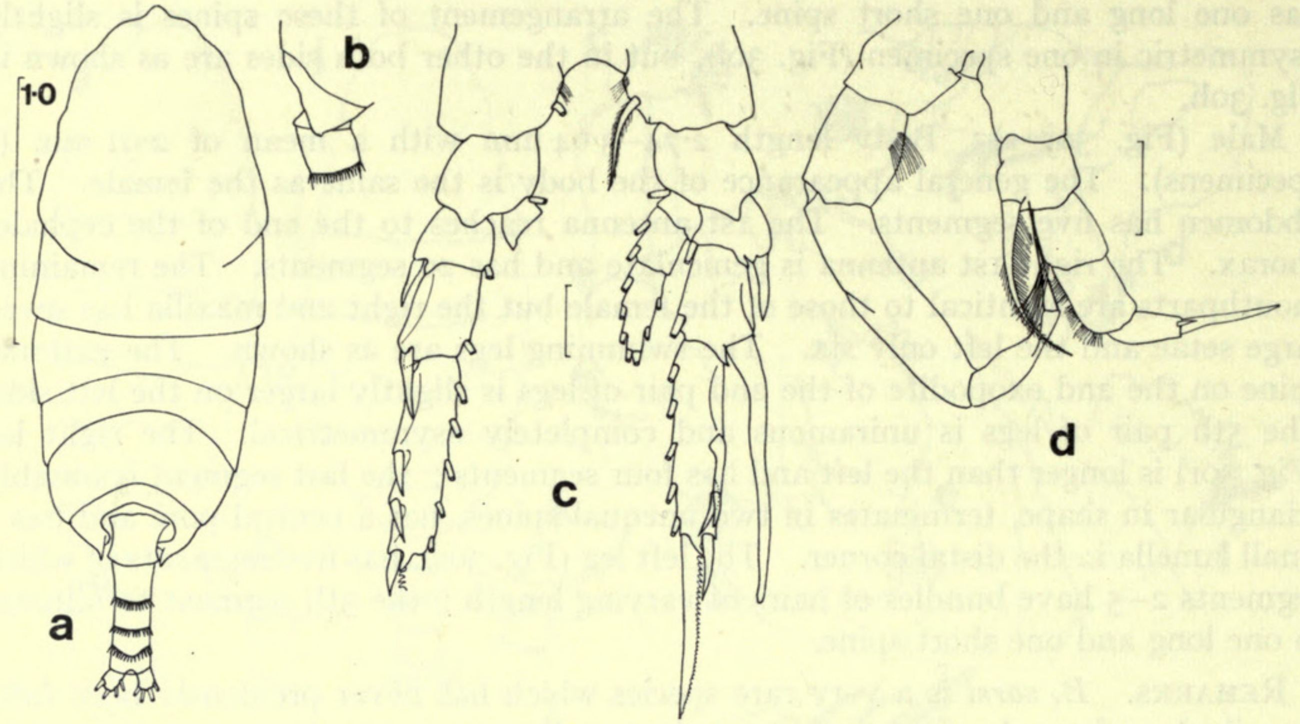

FIG. 31. *Bathypontia spinifera* ♂. a, body, dorsal ; b, last thoracic segment, lateral ; c, 2nd legs ; d, 5th legs. Bar scale 0·1 mm unless indicated.

the right leg, but this is probably due to a difference in the angle at which Sars' figure was drawn.

Bathypontia spinifera A. Scott, 1909

Bathypontia sarsi ; Wheeler, 1970 : 12, figs 77–90.

MATERIAL EXAMINED : 1 male taken in an RMT 1 fished at 700–610 m depth in a position 18°N 25°W on 14 November 1969.

DESCRIPTION. Fig. 31 shows the very characteristic 2nd pair of legs and the 5th pair of legs of the male *B. spinifera*.

REMARKS. Deevey (1973) pointed out the overall similarity between *B. spinifera* and *B. similis* Tanaka, 1965. Dr Tanaka kindly sent me some specimens of *B. similis*, the male of which can easily be distinguished from *B. spinifera* as it does not have the very long spine on the right 2nd leg. The present specimen measured 2·66 mm.

Incertae sedis

'Xanthocalanus' paululus Park, 1970

? *Amallothrix robustipes* Grice & Hulsemann, 1965 : 239, fig. 13f–k ; 1967 : 26 ; Bradford, 1973 : 147.

MATERIAL EXAMINED : 23 females and 2 males taken in 4 RMT 1 hauls made at 1250–800 m depth in a position 18°N 25°W, between 12 and 18 November 1969.

9 females and the males are deposited in the British Museum (Natural History), reg. no. 1974 : 687–697.

DESCRIPTION. Female (Fig. 32a–n) : Body length 1·14–1·29 mm with a mean of 1·22 mm (19 specimens). The cephalothorax is oval and 4·8 times as long as the 4-segmented abdomen. The head and 1st thoracic segment are almost completely fused but the 4th and 5th thoracic segments are separate. The head is characteristically helmet-shaped ; there are no apparent rostral filaments. The 5th thoracic segment protrudes laterally and is indented. The genital segment is longer than the combined length of the three subsequent segments. The furcal rami are about twice as long as wide. The 1st antenna reaches to the hind edge of the genital segment. In the 2nd maxilla, lobes 4 and 5 each have a large curved seta armed with teeth, and the endopodite has six setae of which at least two are plumose but none, as far as can be seen, are brush-like. The remaining mouthparts and the legs are as shown.

Male (Fig. 32 o–r) : Body length 1·29–1·37 mm. The cephalothorax is 3·2 times as long as the 5-segmented abdomen. The head and 1st thoracic segment are separate, as are thoracic segments 4 and 5. In lateral view the head is the same shape as in the female ; there are no rostral filaments. The 1st antenna has 22 segments and exceeds the body length by 2–3 segments. Some of the mouthparts are reduced as follows. The mandible blade is smaller than that of the female. The 1st maxilla has fewer setae on almost all lobes – 5 on the 1st outer lobe, 2 on the exopod, and 1, 1 and 3 on the 3rd, 2nd and 1st inner lobes respectively. All the setae except those on the outer lobe are very small and feeble. The 2nd maxilla has small, weak setae on all five lobes with a single larger seta on the 5th lobe ; the endopod has six sensory seta, all of which are, apparently, worm-like. The 1st basipodite of the maxilliped has fewer setae than in the female. Legs 1–3 are identical to those of the female ; the 4th pair of legs is broken in both specimens. The 5th pair of legs is asymmetrical and reaches back to the middle of the abdomen. The right leg has a 2-segmented exopodite and one short endopodite segment. In the left leg the endopodite is also only a single segment but it is almost as long as the 3-segmented exopodite ; the 2nd exopodal segment has a lamella which partially overlaps the 3rd segment ; this last segment bears clusters of hairs of varying length.

REMARKS. Despite the reduction in their mouthparts the present males are so similar to the females in the curious shape of the head and the structure of the swimming legs that I believe that they are conspecific. The present females differ from Park's (1970) description in only a few details. Park's specimens had one more seta on the 1st maxilla, two more on the endopod of the 2nd maxilla, longer 1st antennae and two fine rostral filaments. I could see no rostral filaments on the present specimens but this, together with the differences in setation, may be due to the difficulties in accurately observing these. Overall agreement is so good, however, that there is little doubt that they are the same species.

X. paululus is very similar to *Amallothrix robustipes* Grice & Hulsemann, 1965. I have examined the type of this latter species in the British Museum (Natural History). The shape of the cephalothorax is the same as that of the present females but unfortunately the slide(s ?) of the appendages is not in the Museum's collection.

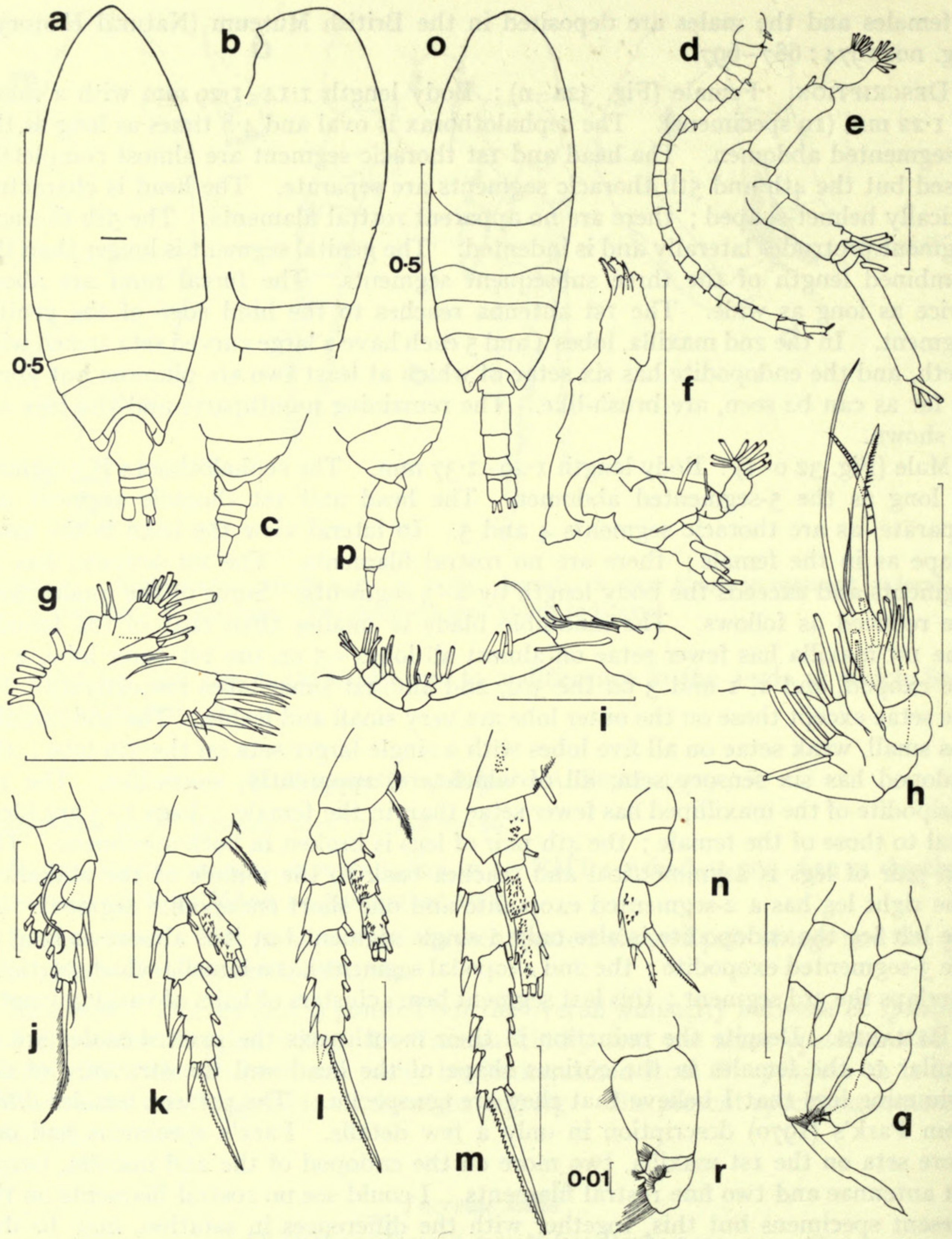

FIG. 32. a–n, *'Xanthocalanus' paululus* ♀. a, body, dorsal ; b, head, lateral ; c, last thoracic segment and abdomen, lateral ; d, 1st antenna ; e, 2nd antenna ; f, mandible ; g, 1st maxilla ; h, 2nd maxilla ; i, maxilliped ; j, 1st leg ; k, 2nd leg ; l, 3rd leg ; m, 4th leg ; n, 5th leg. o–r, *'Xanthocalanus' paululus* ♂. o, body, dorsal ; p, last thoracic segment and abdomen, lateral ; q, 5th leg ; r, 5th leg, exopodite segments 2 + 3 left leg. Bar scale 0·1 mm unless indicated.

Of the mouthparts of *A. robustipes* only the 1st antenna and the 1st maxilla have ever been described (Grice & Hulsemann, 1965, 1967). The 1st maxilla is very similar to that of the present species, and the swimming legs are apparently identical except for the absence of small spines on the endopod of the 2nd leg. The 5th leg differs in having the terminal spine longer than the internal spine. Without a description of the remaining mouthparts, however, especially the 2nd maxilla, it is impossible to ascertain whether or not *A. robustipes* and *X. paululus* are synonymous.

At the moment it is not possible to place this species into any of the four families which have sensory setae on the endopod of the 2nd maxilla. Bradford (1973) was unable to assign either *A. robustipes* or *X. paululus* to either the Phaennidae or the Scolecithricidae. This discovery of the male *X. paululus* confirms her opinion. This species differs from both these families (as defined by Bradford) in the following respects : (a) the endopod of the 2nd maxilla apparently lacks any brush-like setae, (b) there are no large spines on the posterior surfaces of the swimming legs, and (c) the male 5th pair of legs are biramous and have symmetrical basipodites. The presence of enlarged setae on lobes 4 and 5 of the 2nd maxilla further distinguishes it from the Scolecithricidae. It is distinct from the Diaixidae and Tharybidae in having reduced mouthparts in the male. It is further distinguished from the Diaixidae by the female possessing a 5th pair of legs and by the relatively simple nature of the male 5th legs.

This species is apparently closest to the Tharybidae but pending a revision of this family in relation to the three others mentioned here it seems advisable to record it as *incertae sedis*. To avoid any future additional synonomy I have retained the generic name *Xanthocalanus* for this species although it is certainly not of this genus, nor, if *A. robustipes* is synonymous, of *Amallothrix* either.

Species 1

MATERIAL EXAMINED : 2 females taken in 2 RMT 1 hauls made in a position 18°N 25°W ; one at 1010–900 m depth on 13 November 1969 and the other at 900–800 m on 14 November 1969. Deposited at the British Museum (Natural History), reg. no. 1974 : 698–699.

DESCRIPTION. Female (Fig. 33) : Body length 1·29 mm and 1·44 mm. The cephalothorax is oval and about 5 times longer than the 4-segmented abdomen. The head and 1st thoracic segment are separate, as are thoracic segments 4 and 5. The rostrum is a curved spike containing a central groove – presumably it is formed of two more or less fused filaments. The last thoracic segment is slightly produced laterally. The 1st antennae are broken in both specimens. The other mouthparts are as shown. The illustrated 1st maxilla (Fig. 33f) has a damaged 1st outer lobe ; the other 1st maxilla of the same specimen has seven large and two small setae on this lobe. In the 2nd maxilla all the lobes are at the distal end of the appendage. Lobe 4 has three large curved setae, furnished with many small spines, lobe 5 has two such setae and two small ones. The endopodite has eight long thin filaments which, as far as can be seen, all taper to a fine point ; none of them is brush-like. The 1st leg has a long curved spine on the outer edge of each exopodite segment.

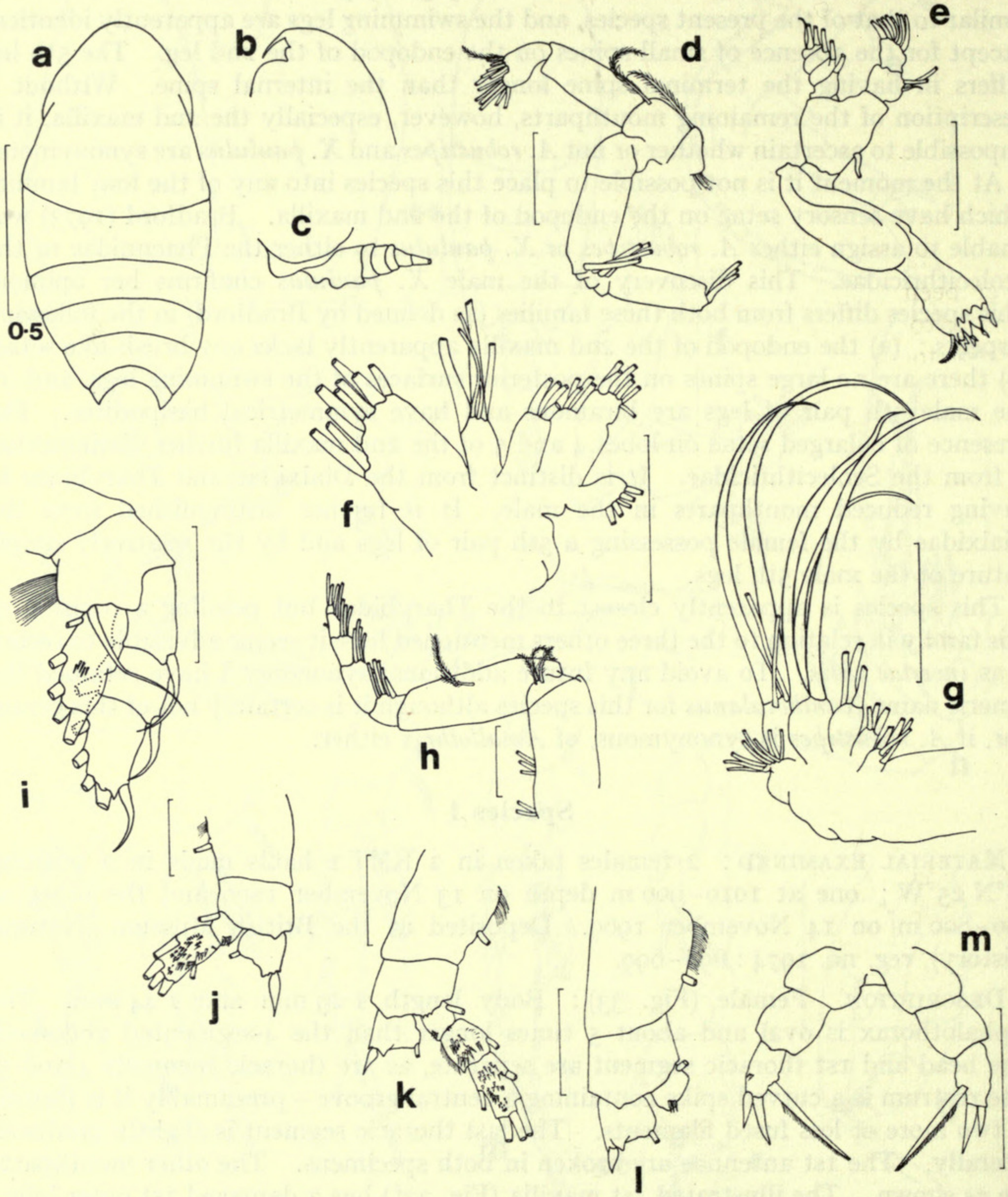

FIG. 33. Species 1 ♀. a, body, dorsal ; b, forehead and rostrum, lateral ; c, last thoracic segment and abdomen, lateral ; d, 2nd antenna ; e, mandible ; f, 1st maxilla ; g, 2nd maxilla ; h, maxilliped ; i, 1st leg ; j, 2nd leg ; k, 3rd leg ; l, 4th leg ; m, 5th legs. Bar scale 0·1 mm unless indicated.

Legs 2 to 4 are incomplete but the endopodites of legs 2 and 3 are covered with fairly large spines. The 5th pair of legs is small and uniramous. Each side has three segments, the third having a long internal spine and two shorter stout spines ; on one side the surface of the 3rd segment has two small spines.

REMARKS. As with the preceding species I am unable to identify these females with any of the four families having sensory setae on the 2nd maxilla endopod. These setae are all simple and worm-like in the present specimens, thereby excluding them from either the Phaennidae or Scolecithricidae according to Bradford (1973). The presence of a 5th pair of legs distinguishes them from the Diaixidae. They may be members of the Tharybidae but as their legs are incomplete it is impossible to be certain. It seems best to record them as *incertae sedis* until complete specimens are found.

ACKNOWLEDGEMENTS

I wish to thank Dr J. M. Bradford of the New Zealand Oceanographic Institute, Dr A. L. Rice, then of the British Museum (Natural History), Dr O. Tanaka, c/o Ocean Research Institute, Japan, and Dr G. Testa of the Oceanographic Museum, Monaco, for the loan of specimens used in this work ; also Dr G. B. Deevey of the Florida State Museum, who very kindly sent me a copy of her manuscript on *Chiridiella* ; and Mrs C. Darter who prepared the drawings for reproduction.

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