BERGENS MUSEUMS AARBOK
1912

AVHANDLINGER OG AARSBERETNING

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BERGENS MUSEUM

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JENS HOLMBOE
MUSEETS DIREKTØR

BERGEN
A/S JOHN GRIEGS BOKTRYKKERI
1913

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The Glass Shrimps *(Pasiphæa)* in Northern Waters.

By

Oscar Sund.

With 3 plates and 9 figures in the text.

While engaged in the working up of the decapod material from the cruises of "Michael Sars" I was struck by the fact the glass shrimps which are so commonly caught along our coast evidently included more species than was hitherto supposed, for at the present time only two species are recognized, viz. *Pasiphœa tarda* and *Pasiphœa sivado.*

Accordingly I sought to secure as many examples as possible of *Pasiphœa*[1]) from Northern Waters, and through the kindness of the zoologists at our various museums,—Mr. Dons of Tromsø, Mr. Nordgaard of Trondhjem, Messrs Brinkmann and Bjerkan of Bergen, and Mr. Wollebæk of Kristiania,—I received all their preserved material, and during a short stay at Copenhagen in July this year I had, through the kindness of Messrs Bøving and Lundbeck, access to the ample collections from the very extended danish expeditions in home and arctic regions.

As a result of my investigations, I found that the fauna of the Scandinavian waters included four species of *Pasiphœa*, viz.:

1. *Pasiphœa multidentata* Esmark (= *P. tarda* autorum)
2. *P. principalis* n. sp. (= *princeps* Kemp)
3. *P. tarda* Krøyer
4. *P. sivado* Savigny

to which the following is a key:—

I. Telson forked

A. "Rostrum" cuneiform, ascendant, projecting *P. multidentata* Esmark

(Long spine on scaphocerite, base of 2nd pereiopod with 7 to 12 spines. Size up to 11 cm.).

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[1]) According to Krøyer (1845), Savigny, who created the genus, wrote the name as above. Whether etymologically right or wrong, I think it should be spelt as its autor spelt it.

B. "Rostrum" a horizontal crest, sinuous anteriorly, not reaching beyond the front margin .... *P. principalis* n. sp.
(Short spine on scaphocerite, base of 2nd pereiopod with only 2 to 5 spines. Size up to 16 cm.).

C. "Rostrum" spearshaped, deflected, projecting much beyond the frontal margin........................ *P. tarda* Krøyer.
(Spine on scaphocerite short, base of 2nd pereiopod with 1 to 4 spines. Size up to 15 cm.).

II. Telson not forked .... *R. sivado* Risso.

Pasiphæa multidentata Esmark 1865.

P. norvegica M. Sars 1868.
P. tarda G. O. Sars 1877.
P. norvegica Faxon, 1895.
By all subsequent writers the species has been called *P. tarda.*

In accordance with the rules of nomenclature the above name must be used, though it is very unjust to M. Sars, who first published an accurate description with admirable figures (1868), but in 1865 Esmark published a short note with a latin "definition of specific characters", rather indefinite I may be permitted to say, and without figures. Still an examination of his single mutilated type specimen shows me that the species he intended to describe is really the same as Sars' *P. norvegica.* Esmark's diagnosis runs as follows:

"*Pasiphæa multidentata* n. sp. cephalo-thorace compresso, supra carinato, carina antice parum adscendente in fine truncata vel subemarginata; articulo tertio pedum primiparis dentibus acutis undecim, secundeparis vigintiquatuor armato; postabdominis articulo ultimo sive lobo medio caudæ supra per totam longitudinem profunde canaliculato, apiceque bifurcato. Long. 80 mm."

The specimen preserved in the University Museum of Christiania is not however, 80 but about 110 mm. in length. I believe the figure to be a misprint, as the specimen is from Namsos and bears on the table the name of the collector (Mosling) from whom Esmark obtained his specimen. Moreover the "state of mutilation" of Esmark's specimen, which Sars describes very drastically (1865) agrees perfectly with the condition of the specimen examined by me, so there can be little doubt that Esmark actually had before him a specimen of "the common glass prawn", as it may be called by way of distinction from *P. tarda* and *P. principalis*, which have only been caught on a few occasions in our waters.

As may be seen from the chart fig. 1 *P. multidentata* has been taken on the coast of the United States, south of the Færøes, on

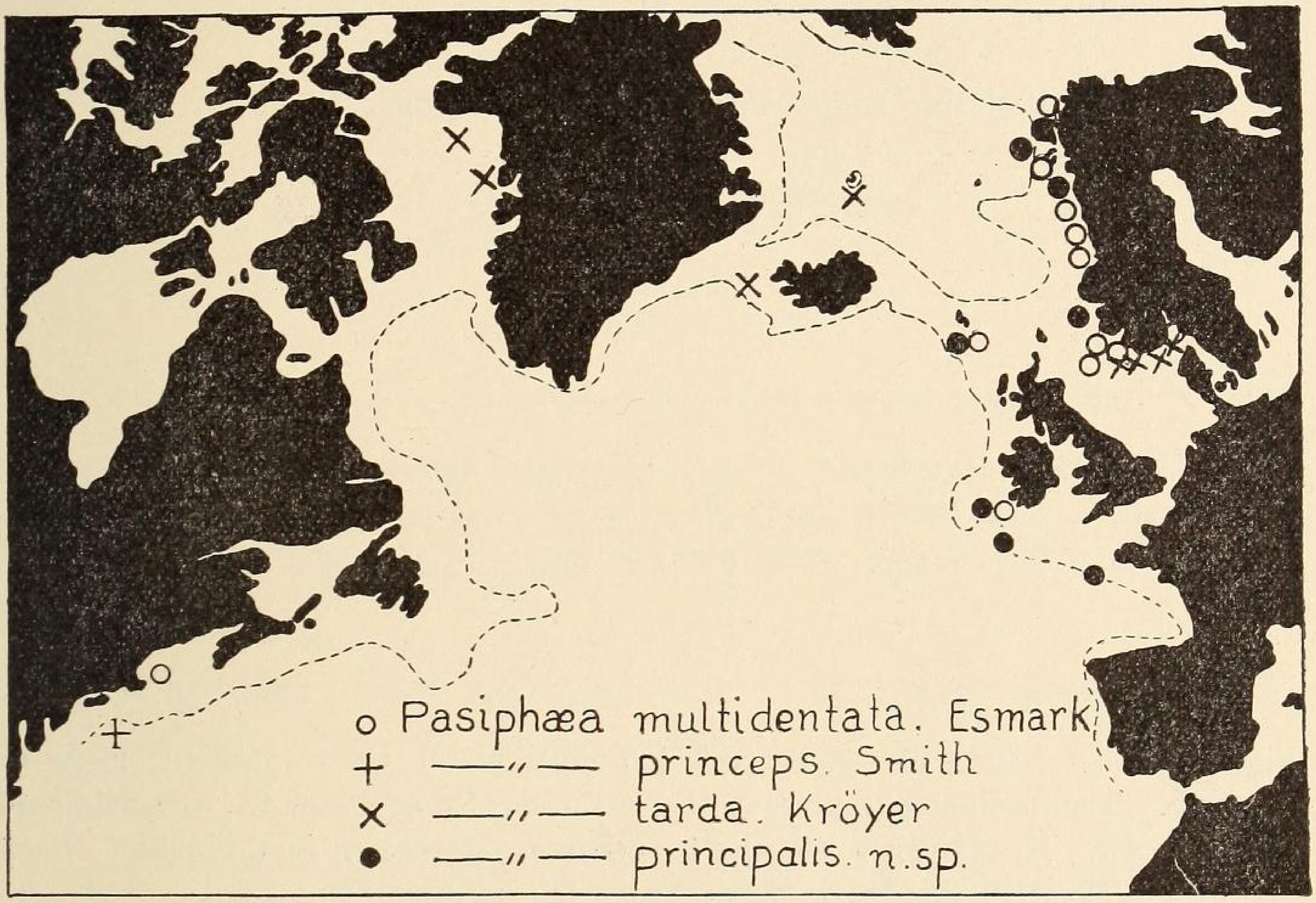

Fig. 1.

Tampen bank in the North Sea, in the Skagerack, and in the Norwegian fjords up to Malangen (near Tromsø).

The specific identity of the specimens from America is beyond doubt, as evidenced by Smiths figures (pl. X, fig. 1, Smith 1879).

From the data regarding vertical distribution it seems that *P. multidentata* lives nearer towards the surface than the two other species. This may be connected with the fact that it is almost devoid of pigment while *P. principalis*, according to Kemp (1910), is "of a vermilion red", and the specimens of *P. tarda* collected by the "Michael Sars" in the Skagerack in 1910, were thus referred to by dr. Hjort in the ship's journal:—"— — — several giant *Pasiphaë* of a blood-red colour."

Pasiphæa principalis, nomen novum.

P. tarda Nordgaard, 1905.
P. tarda H. J. Hansen, 1908.
P. princeps Kemp., 1910.
P. tarda Stephensen, 1912.

This species was confounded with "*P. tarda*" (really *P. multidendata*) so far as regards the specimens caught on this side of the Atlantic, until KEMP (1910) made clear the differences between

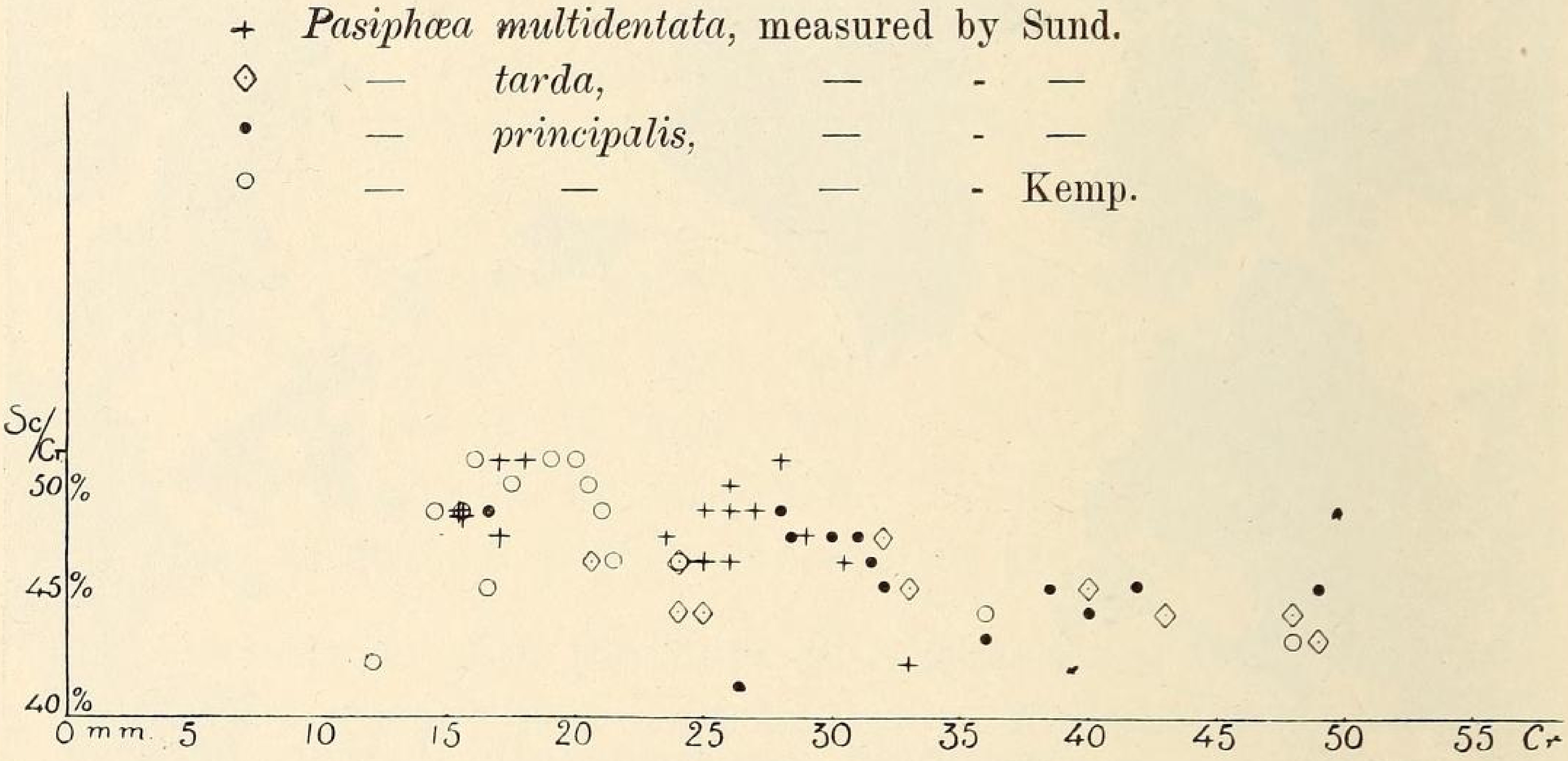

Fig. 2. Sc. = length of scaphocerite (antennal plate), Cr. = median length of carapace. The ordinates represent the ratio Sc : Cr as $^0/_0$ of Cr, the abscissae represent Cr. No evidense of specific difference is shown in this ratio. Each spot in the diagram represents one measured specimen.

them. I cannot however agree with KEMP in regarding the ratios between the length of the antennal scale and that of the carapace, and between the length of the carapace that of the abdomen as distinctive of the two species. In fact, as will be seen from the accompanying diagrams figs 2 and 3, both these ratios vary according to size. Moreover the second ratio especially is very difficult to determine with certainty, at it is impossible to stretch the abdomen of specimens preserved in alcohol quite straight. But if we only consider the adult individuals it holds true that the antennal scale is shorter and the abdomen longer in proportion to the length of the carapace in *P. principalis* than in *P. multidendata*, because the last named species is adult when perhaps only two-thirds the length of *P. principalis*.

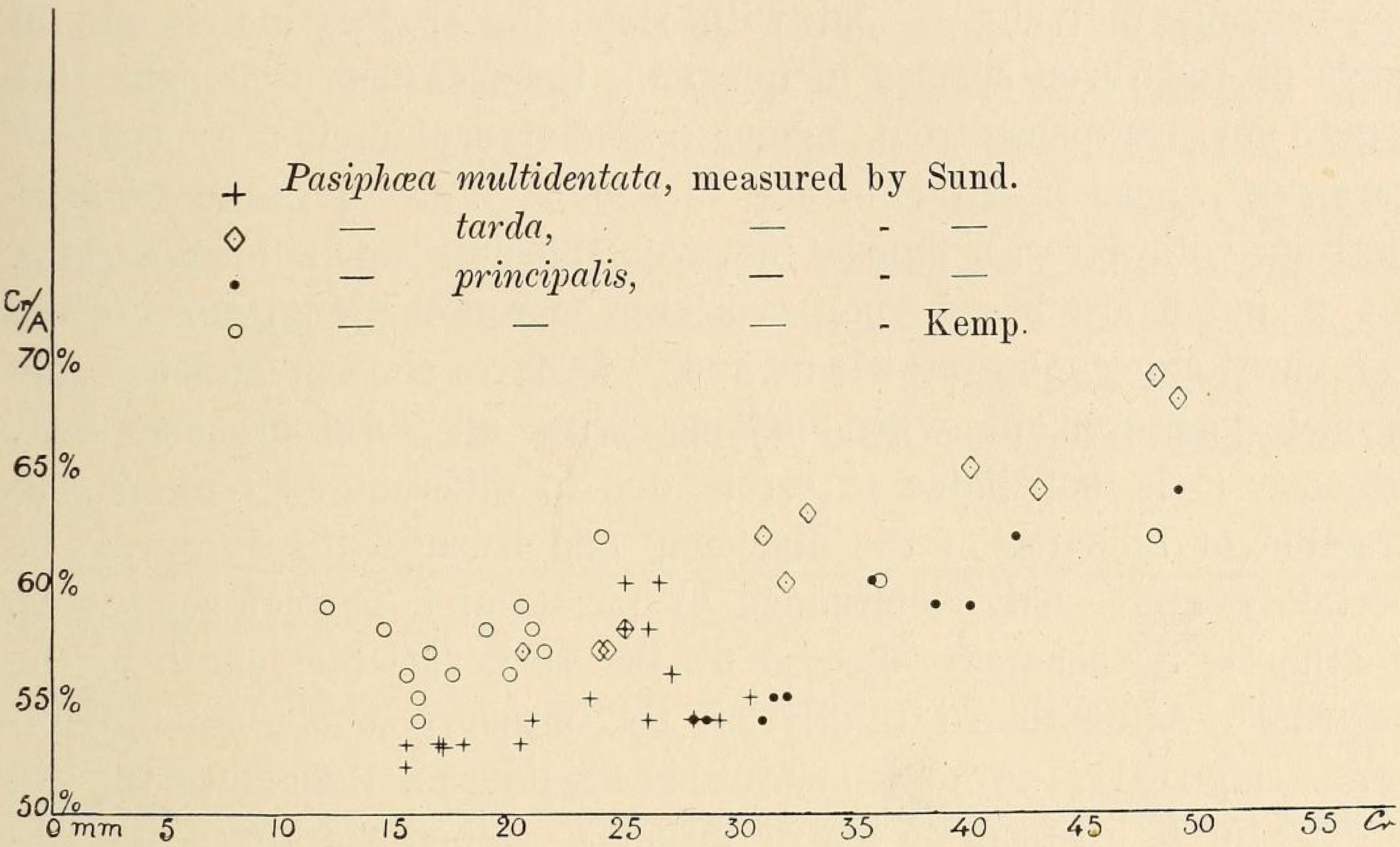

Fig. 3. Cr = median dorsal length of carapace, A = dorsal length of abdomen excluding telson. The ordinates represent the ratio Cr : A as $^0/_0$ of A, the abscissae represent Cr. The carapace grows longer with age.

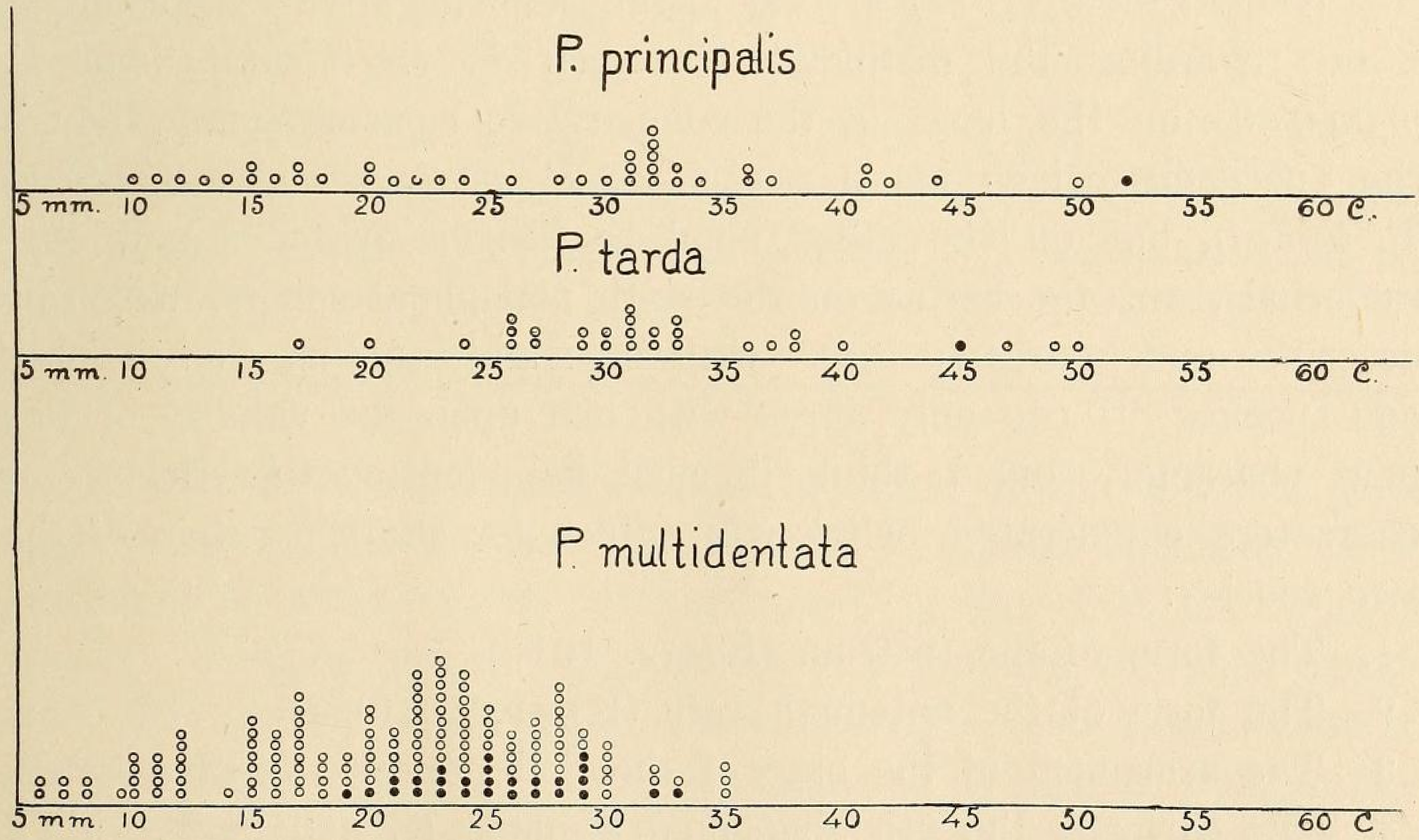

Fig. 4. Each black spot denotes an egg-bearing individual, each ring denotes an individual without eggs. The abscissae represent lateral length of carapace (C) in millimetres.

In the diagram (fig. 4) I have indicated with black spots the egg-bearing individuals, and with rings the eggless individuals, of each of the three species in question, the measure used being the length of carapace from hinder edge of ocular sinus to edge of carapace along a horizontal line (C). For the sake of comparison with KEMP's figures however the data upon the diagrams, fig. 2 and 3 are based upon measurements of the length (Cr) of the carapace along the median line. I have chosen, and use, the former measurement when dealing with all sorts of "macrura", because it is not liable to errors due to different degrees of contraction or inflexion of the abdomen, and because it may always be certainly and easily determined by means of a pair of compasses. Neither is its accuracy affected by the very variable length of the rostrum. Altogether I think that this measure much better represents the real size of a macrurous crustacean, than does the old „from tip of rostrum to tip of telson". When working with lobsters I found that the weight of the animals corresponded more nearly with the dimension C than with the entire length, and of course, the determination of the latter is more liable to errors than the former.

STEPHENSEN (1912) arrives at the same negative conclusion as I do regarding the distinction between *P. multidentata* and *P. principalis* on the basis of the comparative measurements (though the specimens which he measured as *P. principalis* were in fact *P. tarda!*), but on the other hand he has discovered a new characteristic, viz. the carina on the sixth abdominal somite, which he describes and figures (p. 68). Still he maintains that there is only one species. I can only agree with him upon the validity of this new character, and I think it must be admitted that the set of characters enumerated below will suffice for the separation of the two species:

1. The form of the rostrum (KEMP, 1910).
2. The form of the antennal scale (KEMP, 1910).
3. The armament of the base of the 2nd periopod (KEMP, 1910).
4. The carinaon the 6th abdominal segment (STEPHENSEN, 1912).
5. The form of the outer urapod (se fig. 7).
6. The form of the telson (KEMP, 1910).
7. The colour.

Regarding the character derived from the number of spines on the basis of the 2nd pereiopod, STEPHENSEN (p. 68) argues that it is of restricted value because it is not found in small individuals at all, and because it is inconstant in more advanced stages. The first objection has not much weight, as it is a very common thing for the young of very different species to resemble each other. Regarding the second objection it is true that the number of spines varies, but as shown by the table below, the limits of variation do not touch each other as far as concerns *P. multidentata* on the one hand and *P. principalie* and *P. tarda* on the other, though the two lastnamed can not be individually separated by means of this characteristic.

P. multidentata			*P. principalis*			*P. tarda*		
Size	Spines		Size	Spines		Size	Spines	
(C. mm.)	Right	Left	(C. mm.)	Right	Left	(C. mm.)	Right	Left
32	12	10	52	4	5	50	3	3
30	10	9	44	3	3	49	3	2
30	12	12	42	2	2	45	3	4
30	11	12	41	3	3	40	3	3
29	7	9	41	5	5	33	1	2
29	10	12	34	3	4	33	4	4
29	12	11	33	3	3	32	1	1
27	8	9	33	2	2	31	3	3
27	10	11	32	4	5	26	2	2
26	7	8	31	2	4	26	3	4
25	9	8	31	3	4	25	3	3
21	7	8	—	—	—	22	3	3

Number of spines on base of 2nd perciopod of *P. multidentata* from the Kristianiafjord, of *P. principalis* from the Færø Bank, and of *P. tarda* from the Skagerack.

Stephensen also remarks that the form of the antennal plate may cause difficulties, as he has seen a typical specimen of *P. multidentata* whose right antennal plate is like that in *P. principalis* I have had an opportunity of examining the same specimen, but failed to recognise the similarity. The scaphocerite in question had a rather abnormal appearance. If such an isolated fact had any significance at all it would perhaps point towards the phylogenetic derivation of *P. multidendata* from *P. principalis* or a species closely allied to it. In a species of *Sergestes* I found the left 3rd maxilliped closely resembling that of another distinct, though nearly related species.

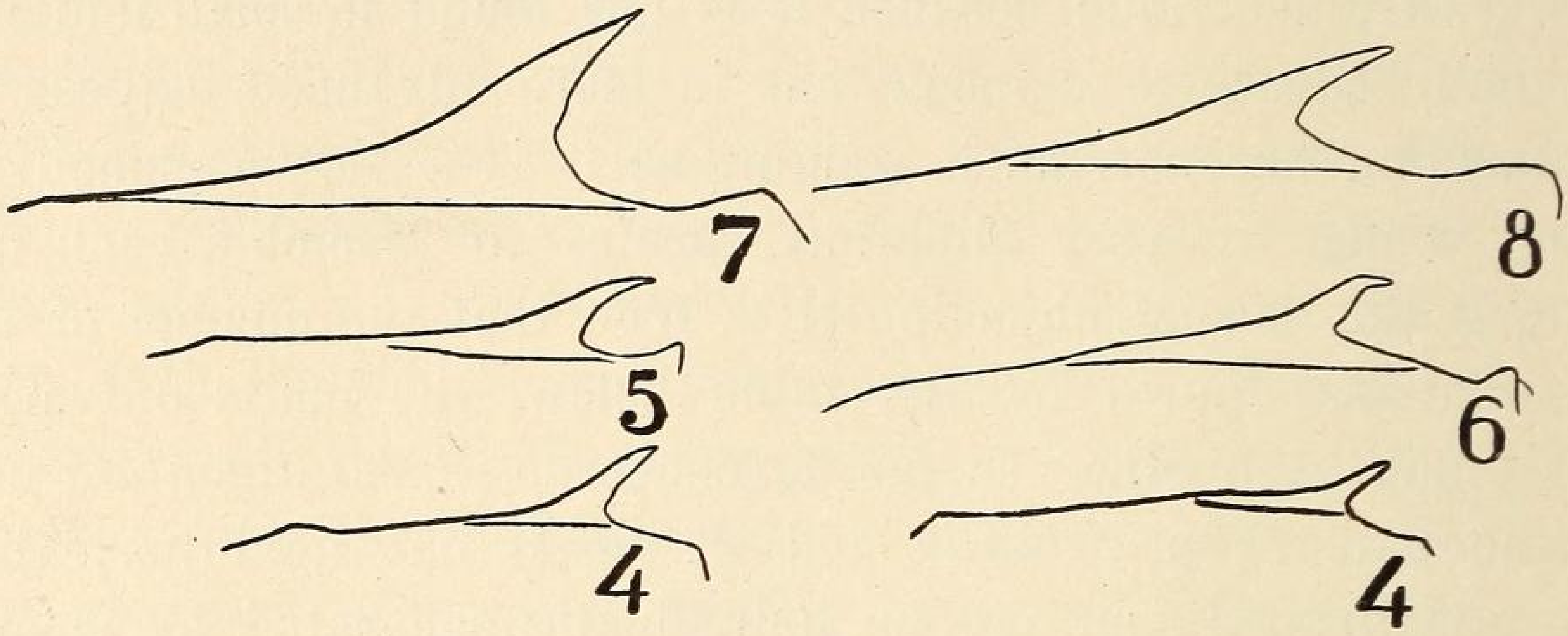

Fig. 5. Left row: rostra of *Pasiphœa* from Sulen fiord, depth 400 metres. Right row: rostra of *Pasiphœa* from the Faroe Bank, depth 700—1700 metres. The figures denote length of carapace in each of the specimens. Enl. $^{11}/_{1}$.

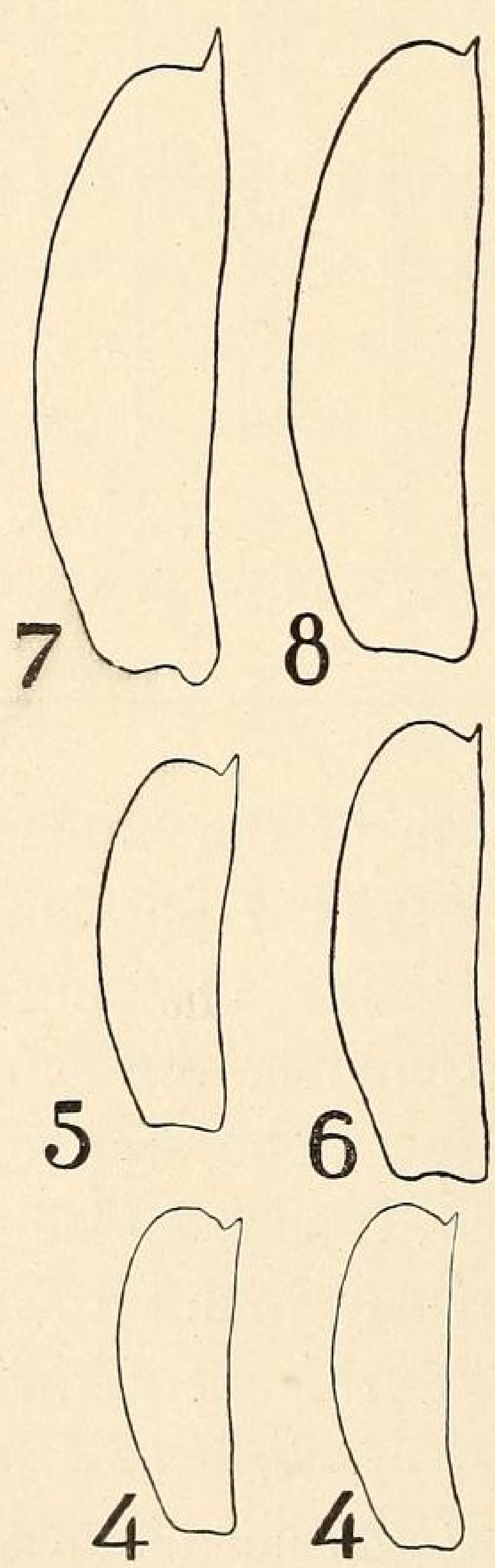

Fig. 6. Scaphocerite.
(For explanation see fig. 5).

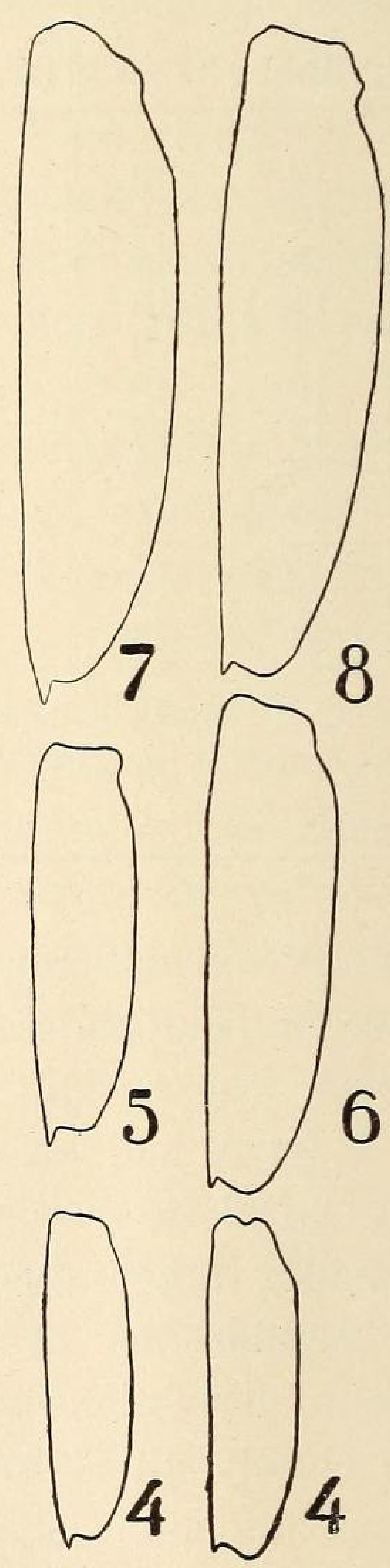

Fig. 7. Outer uropod.
(For explanation see fig. 5).

It is possible to distinguish *Pasiphœa principalis* and *P. multidentata* from another even in specimens which are so small that no spines are developed on the pereiopods, by means of the shape of the rostrum, of the scaphocerite and of the outer uropod.

It is true that great changes take place during growth, but still typical differences remain, which became evident to me while examining a good number of young specimens from two localities where the one or the other of the two species dominated, as far as could be concluded from the adult. In the figs. 5, 6 and 7 are reproduced camera drawings (an enlargement of $^{35}/_{1}$ was used) from six specimens, three taken in deep water on the South Faroe Bank and three in somewhat shallower water in Sulen fiord, about 100 km. north of Bergen.

From these drawings it will be seen that the two species may be kept apart with certainty by means of the rostrum or the scaphocerite down to a size of 5 or 6 mm. (C), by means of the outer uropod even at a size of 4 mm., lack of smaller specimens preventing me from carrying the comparison further. These sizes of carapace correspond to a total length of about 20, resp, 14 mm. and as the larva of *P. multidentata,* according to Björck (1911) leaves the the egg when about 9 mm. long, it would appear to be possible to distinguish this species from the other at almost every stage of development.

There is a marked correspondence in the shape of the scaphocerite and of the outer uropod, the thin portion of both these appendages protruding more apically and the spine being shorter in *P. principalis* than in *P. multidentata.*

Kemp (1910, p. 42) seems to doubt the specific identity between the European and American specimens of "*P. princeps*" still he holds that the difference is only a racial one. An examination of Smith's description (1884, p. 382 [38]) shows several points in which they do not agree, arguing, I think, against applying the same specific name to both.

1. The eggs of Smith's species are very large, measuring 4 by 5 mm., while the eggs of the European species measure only 2 by 3 mm.
2. The base of the 2nd pereiopod carries no spines in the American species according to Smith's description, while all the specimens of the present species longer than about 60 mm.

which I have seen carry at least 2 and sometimes as many as 5 spines.

3. The comparative lengths of the joints of the 4th and 5th pereiopod in SMITH's species do not correspond with those found in the present species.

Therefore I think it is not justifiable to use the name *P. princeps* for the European species, for which I propose the name *P. principalis* having regard of the great similarity between the two forms.

The distribution of *P. principalis* is shown on the chart fig. 1. The occurrences in Sognefjord and also at Øxsund (E. of the Lofoten isles, about 67½° N.) are indicated outside the coast only to make the signs distinct from the black land-colour.

From West Greenland (65° 14′ N, 55° 42′ W), from the Iceland ridge (61° 44′ N, 27° 0′ W) and from Denmark Straits (64° 42′ N, 26° 40′ W) I have seen single small specimens (C = 17, 10 and 14 mm. respectively), but from considerations which will be set forth under the next species I regard it as extremely doubtful whether they should be referred to that or to the present species. The same may be said with regard to the other small specimens enumerated above in which the carapace (C) is shorter than 20 mm. but as they were captured in areas where no specimens of *P. tarda* have been caught, it may be reasonable to ascribe them to *P. principalis.*

KEMP (1910, p. 46) states that according to the available information *P. principalis* is restricted to the bottom, but this is not always the case, for the Danish and Norwegian catches were often made in midwater. Even the two specimens from the Sognefjord were taken by the "Michael Sars" in pelagic appliances. This shrimp seems to lead a pelagic life in depths of 250 metres and more, perhaps down to 1000 metres. But the records are still too few to form any definite opinion on the matter. From its colour one might perhaps infer that it frequents the same water-layers as other red animals in our seas, for instance, the Norway Haddock which is known from the investigations of the "Michael Sars" to live pelagically in the Norwegian Sea between 50 and 400, mostly 100 and 200 metres.[1]) A similar blood-red colour is found in the pelagic

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[1]) See MURRAY and HJORT: "The Depths of the Ocean". London 1912 Page 646—648.

Distribution of *Pasiphæa principalis*.

Caugth by	Locality	Position	Depth metres	Date	Number	Length of carapace (C) (mm.)	
						♀ with eggs	Others
„Thor"	S. of the Færøes	61° 16′ W. 9° 35′ W.	350 850	22/5 04	23	—	16—4 (?)
„	„	59° 49′ N. 8° 58′ W.	600	30/5 05	1	—	37
„M. S."	„	61° 7′ N. 9° 33′ W.	—	14/8 02	6	—	$\frac{1}{36}$ $\frac{3}{32}$ $\frac{1}{31}$ $\frac{1}{29}$ [1]
„	„		—	14/8 02	12	52	$\frac{1}{44}$ $\frac{1}{42}$ $\frac{2}{41}$ $\frac{1}{34}$ $\frac{2}{33}$ $\frac{1}{32}$ $\frac{2}{31}$ $\frac{1}{18}$
„	„	59° 23′ N. 7° 50′ W.	1100	12/8 02	1	—	17
„Tjalfe"	E. of Labrador	63° 54′ N. 53° 15′ W.	988—1400	8/6 09	1	—	20
Nordgaard......	Øxsund	—	600	17/9 99	1	—	16
„M. S."	N. of Andenes	—	250 450	12/7 01	2	—	12, 5
„	W. of Lofoten	69° 13′ N. 10° 40′ E.	400	13/8 00	3	—	26, 24, 23
„	„	„	1000-0	„	3	—	32, 15, 13
„	„	68° 57′ N. 12° 48′ E.	—	13/4 01	5	—	28, 22, 21, 20, 15
„	Sognefjord	—	650 750	22/5 11	2	—	36, 11
„	SW. of Ireland	49° 38′ N. 11° 35′ W.	923	10/4 10	2	—	about 50, about 30

[1] The denominators signify the length of carapace (c), the enumerators the number of specimens.

shrimps of the Atlantic, for instance, *Acanthephyra,* living in depths below 500 metres, owing to the greater intensity of light in the upper water-layers compared with that in more northern seas.[1])

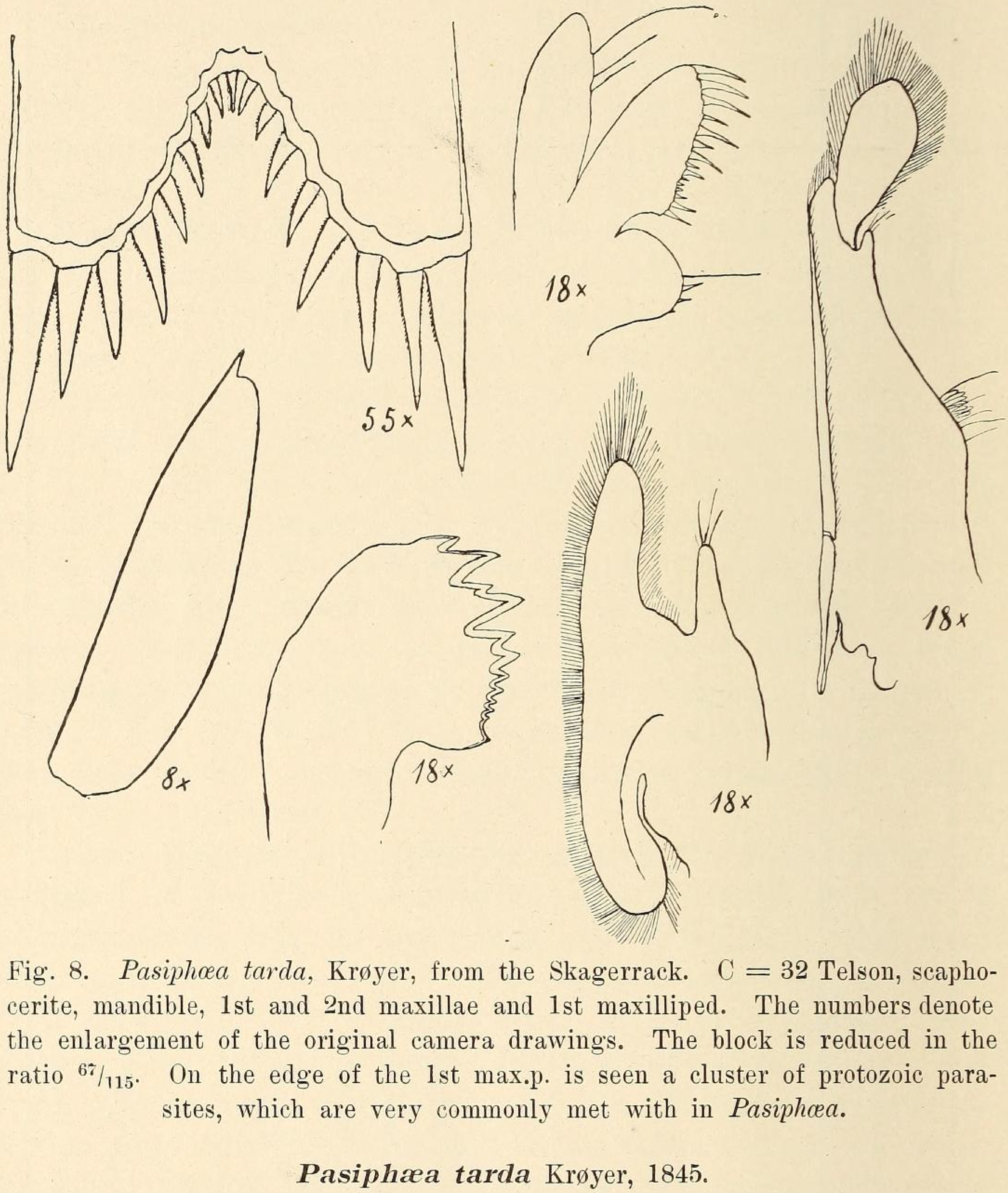

Fig. 8. *Pasiphœa tarda,* Krøyer, from the Skagerrack. C = 32 Telson, scaphocerite, mandible, 1st and 2nd maxillae and 1st maxilliped. The numbers denote the enlargement of the original camera drawings. The block is reduced in the ratio $^{67}/_{115}$. On the edge of the 1st max.p. is seen a cluster of protozoic parasites, which are very commonly met with in *Pasiphœa.*

Pasiphæa tarda Krøyer, 1845.

Pasiphœa tarda Krøyer, 1846. (In "Gaimards Voyage").
— — M. Sars, 1868.
— — H. I. Hansen 1908 (sc. *multidentata).*
— — Wollebæk, 1908 (sc. *multidentata).*
— *princeps* Kemp, 1910.
— — Stephensen, 1912.
— *tarda* Stephensen (sc. *multidentata).*

[1]) Ibidem, p. 624.

This species was described by KRØYER in 1845, and was apparently not recaptured until about 11 years ago, when the "Michael Sars" took several specimens in the Skagerack, which agree well with KRØYER's description and with the figures drawn from KRØYER's specimens in Gaimards "Voyage". This summer I had the opportunity of examining the single survivor of these specimens and was not able to detect any important difference between it and the Skagerack specimens, nor between these and the specimens caught by the Danish vessels "Ingolf" and "Tjalfe" in the seas around Greenland and Iceland.

The separation of this form from *P. multidentata* needs no apology, as proved by the figures which I take the liberty of reproducing here as pl. II, III from the rare and textless work, Gaimards "Voyage en Scandinavie etc.", and also the drawing by WOLLEBÆK (1908) from a large Skagerack specimen, pl. I.

Fig. 8 gives some details from a Skagerack specimen about 10 cm. in length (C = 32 mm.).

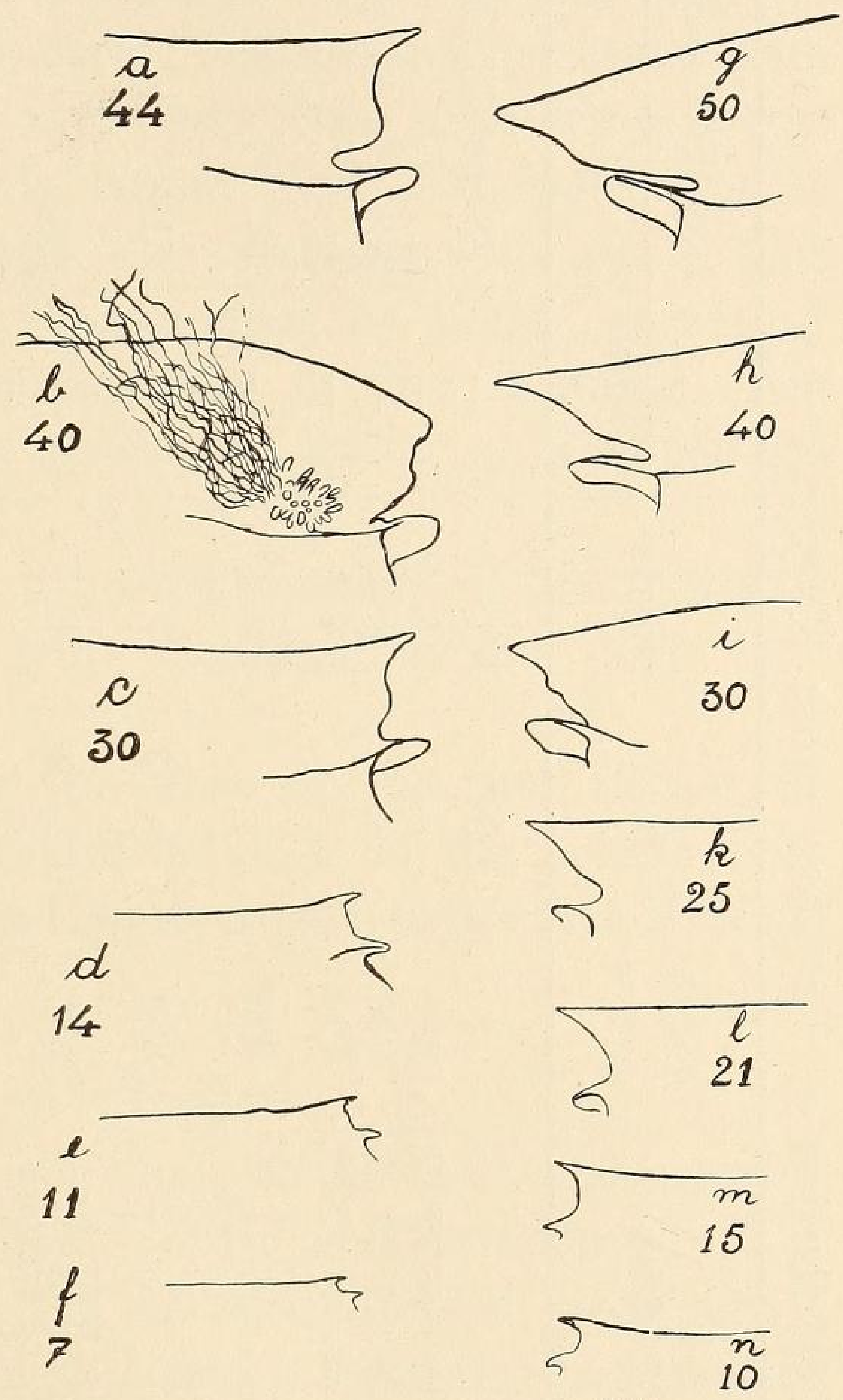

Fig. 9. a—f *Pasiphœa principalis,* g—n *P. tarda.* The figures inscribed below the letters denote the size of the specimen (C, i. e.: lateral length of carapace) in mm.

Much closer are the relations between this species and *P. principalis.* The chief distinctions depend upon the form of the rostrum and upon the relative size of the abdomen, as will be noticed from an inspection of the digram fig. 3.

The two forms agree in the shape of the scaphocerite, though the apical spine is as a rule more developed in *P. tarda;* they also agree in the armament of the 2nd pereiopod. It would seem therefore that there is little ground for establishing two species, but that is the only way to do justice to the differences which do

Distribution of *Pasiphæa tarda* Krøyer.

Caught by	Locality	Position	Depth metres	Date	Number	Length of carapace (C) ♀ with eggs	Length of carapace (C) Others
Jørgensen	S. Greenland	?	?	1842	1	—	38 one of Krøyer's type specimens
„Ingolf" st. 97, 116, 126	Danmark str.	67° 19', 15° 52' W.	550	—	1	—	32, 30, 29, 27, 26, 20
	Danmark str.	65° 28', 27° 39' W.	900	—	1	—	
	Jan Mayen	70° 5', 8° 26' W.	700	—	4	—	
„Ingolf" st. 28..	Davis straits	65° 14' N. 55° 42' W.	800	—	2	—	31, 27
„Tjalfe"	„	64° 14' N. 55° 55' W.	839	$^{2}/_{6}$ 09	1	—	31
„Thor"	Skagerak	34' NW. by N. of Høien	(535)	$^{17}/_{3}$ 04	1	—	26
„	„	44' NW. by N. of Høien	(660)	$^{14}/_{10}$ 04	2 (12)	—	47, 17 and ten small (uncertain)
„	„	58° 3' N. 9° 20' E.	(500—550)	$^{7}/_{3}$ 03	2 (22)	—	38, 24 and twenty small, either *tarda* or *principalis*
„	„	18' S. of Oxø lighthouse	(510)	$^{28}/_{5}$ 07	5	—	37, 36, 33, 31, 26
„	„	57° 52' N. 8° 1' E.	150	$^{6}/_{9}$ 05	1	—	29
„	„	58° 32' N. 4° 18' E.	280	$^{30}/_{4}$ 03	1	—	30
„M. S."	„	58° 10' N. 9° 53' E.	300—430	$^{9}/_{9}$ 01	8	45 (?)[1]	50, 49, 40, 33, 33, 32, 31
„	„	58° 14' N. 9° 55' E.	430—515	„			

[1]) The eggs are lying at the bottom of the bottle, so that I am not quite sure to which of the animals they belong.

in fact exist. Turning first to the form of the rostrum, this feature is very different in large individuals as shown by the outline drawings fig. 9, but there is less difference in young animals below 20 mm. (C)[1]. These small individuals were determined as either *P. principalis* or *P tarda* by means of the form of the scaphocerite and the armament of the 2nd pereiopod. I suppose each set belongs to the respective species merely because the specimens were caught in areas where only one of the two forms is known to occur.

The abdomen is comparatively larger in *P. principalis,* but as will be seen from fig. 3, the ratio $^{Cr}/_{A}$ increases with age. This latter faet seems not to have been noticed by Kemp, because I think, most of his small specimens were in fact *P. tarda.* See fig. 3. The rostrum which he figures as fig. 5, pl. IV, belongs undoubtedly to that form.

In the table on p. 16 I have collected together all the av ailable data about the specimens of *P. tarda* examined by me.

The depths within brackets are Soundings, and it may be that the appliances were not towed actually on the bottom. As mentioned before it appears from Kemps paper (1910) that *P. tarda* also occurs SW of Ireland.

Pasiphæa sivado Risso.

This species is so characteristic that, so far as I am aware, it has never been confounded with any other northern forms. It is very rare in our waters. From the Kristianiafjord I have seen 4 specimens, C = 20, 19, $5^1/_2$ and $5^1/_2$ mm. From the Langesundsfjord (on the East-coast) depth 200 m. one, C = 11 mm. Four specimens, probably from Mosterhavn (N. of Stavanger) measure (C) $7^1/_2$, $7^1/_2$, $6^1/_2$ and $5^1/_2$ mm.

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[1]) C = length of carapace from ocular sinus to posterior edge.

List of references.

1845. Henrik Krøyer: Karcinologiske bidrag. *Pasiphaë tarda.* Naturhistorisk tidsskrift, 2. række, 1. bind, p. 453. The illustrations (drawn by Thornam) are given in Gaimards Voyage en Scandinavie etc. 1846 Crustacées tab. 6, fig. 1.

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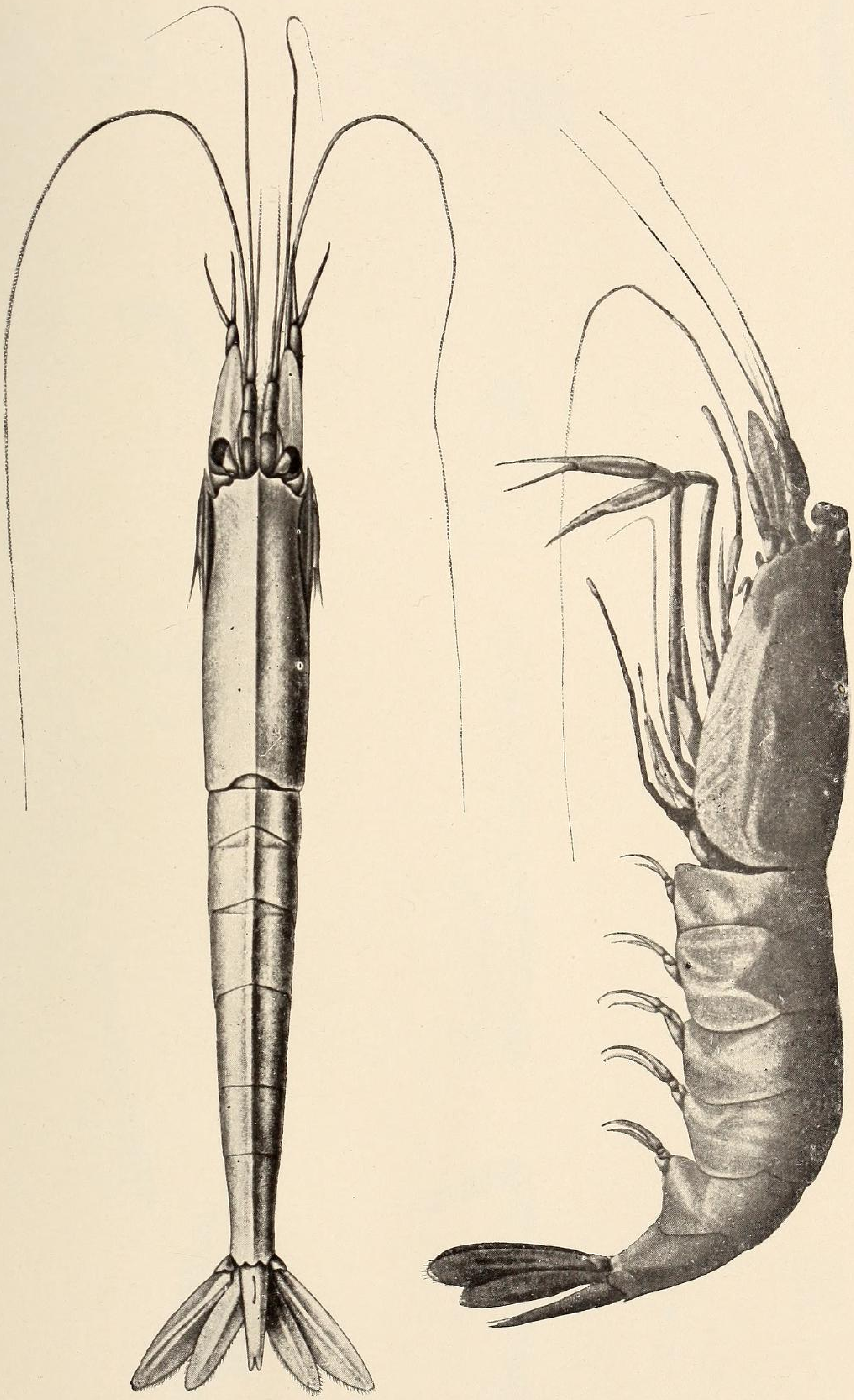
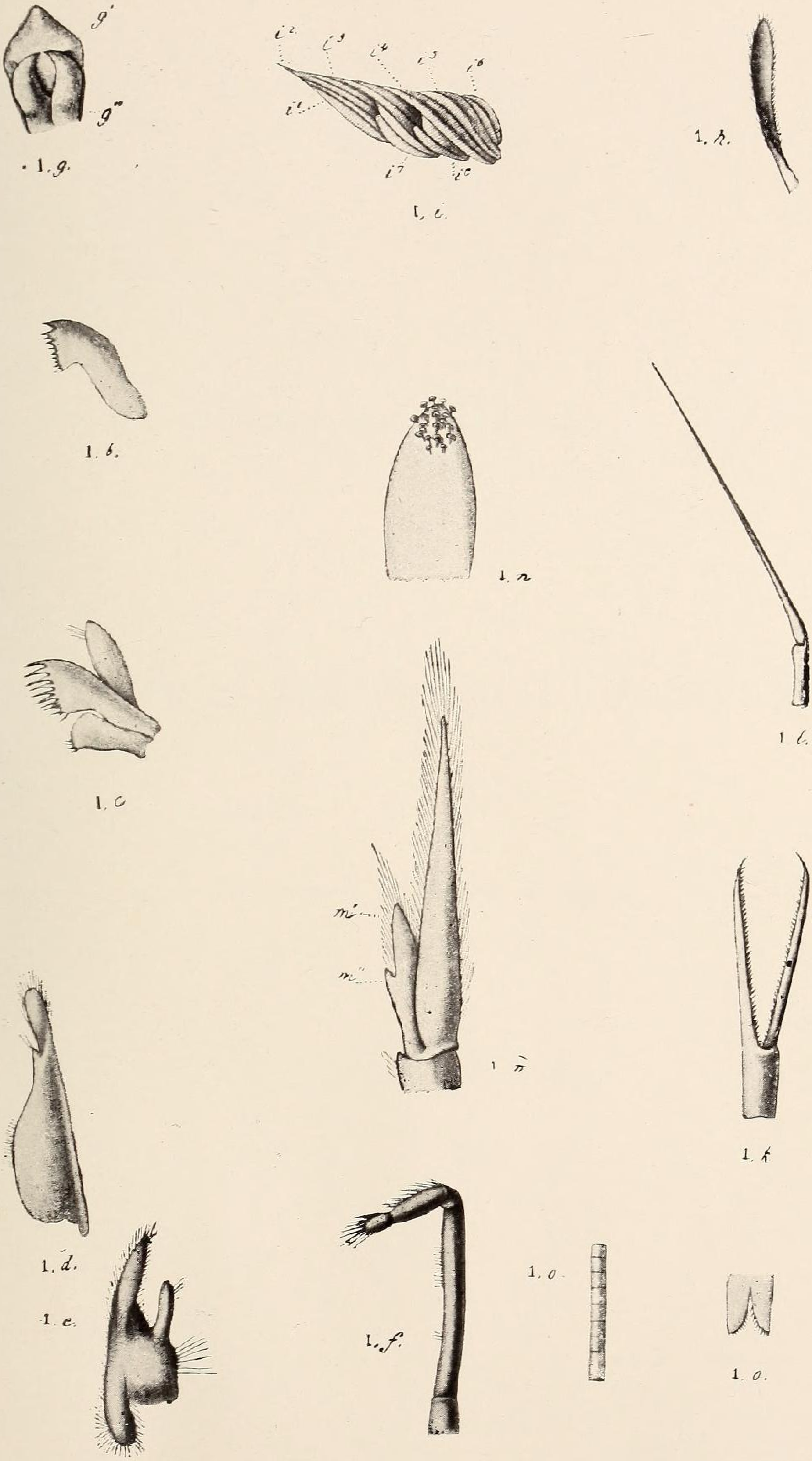


Pasiphœa tarda Kr. (S. Greenland 1842). From Gaimards "Voyage", drawn for KRØYER by THORNAM.



Pasiphœa tarda Kr. (S. Greenland 1842). From Gaimards "Voyage", drawn for Krøyer by Thornam.