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NOTES ON SOME DECAPOD CRUSTACEA OF BERMUDA.—II. THE SPECIES OF HIPPOLYTE AND THEIR LARVÆ.

By ROBERT GURNEY, D.Sc., F.Z.S.

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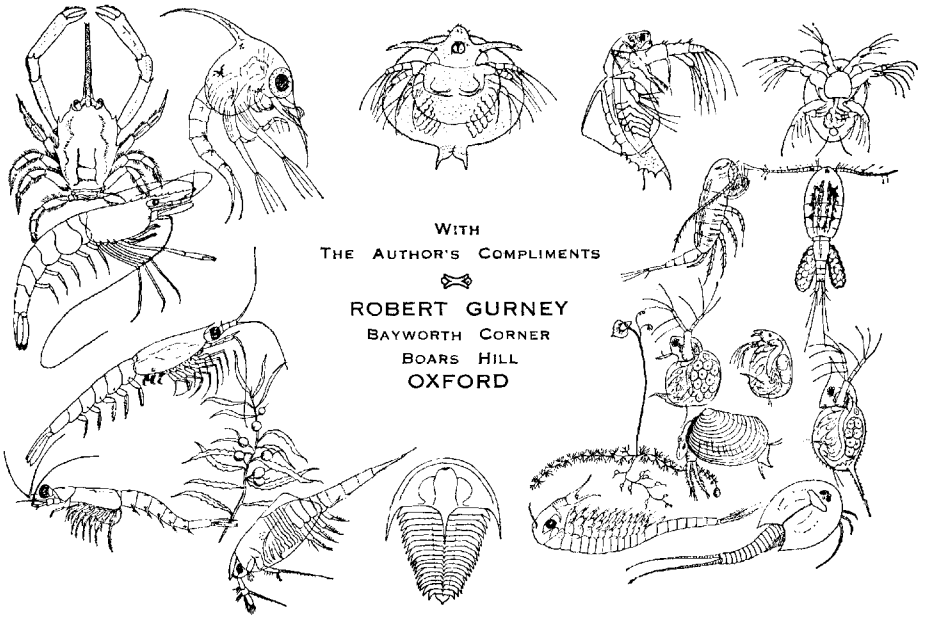

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Notes on some Decapod Crustacea of Bermuda.—II. The Species of *Hippolyte* and their Larvæ.

By ROBERT GURNEY, D.Sc., F.Z.S.

(Plates I.–V.*)

Verrill records from Bermuda only one species of *Hippolyte* (*H. acuminata* Dana), but another small species was found to be common on a *Zostera*-bed in Walsingham Bay, on the west of Castle Harbour, and also in *Sargassum* growing on rocks at Tobacco Bay on the north shore. It was not found on the *Zostera* in shallow water in the Reach, but this may be due to the fact that the *Zostera* here appeared to be almost entirely dead.

I have found it most difficult to identify this *Hippolyte*, since the published descriptions of species are generally brief, dealing mainly with the form of the rostrum, and I am much indebted to Dr. W. Schmitt for providing me with specimens of *H. pleuracantha* Stimpson and *H. zostericola* Smith for comparison.

These two Atlantic species are very closely related. *H. zostericola* differs from *H. pleuracantha* in the much more slender form of leg 2, in having usually five spines on the merus of legs 3 and 4 instead of four, and in the greater number and smaller size of the spines on the dactylus of legs 3–5. Otherwise the differences are hardly appreciable.

Table showing Numbers of Spines on Outer Face of Merus.

	H. varians	*H. acuminata.*	*H. zostericola.*	*H. pleuracantha.*	*H. pleuracantha bermudensis.*	*H. proteus.*	*H. ventricosus.*	*H. prideauxiana.*
Leg 3	*2	1	5	4	*2	1	2	†6
,, 4	1	1	4/5	4	1	1	1	4/5
,, 5	0	1	1	1	0	0	0	1

* Number usually found.
† In this species there is also a row of marginal spines on legs 3 and 4.

The Bermuda form differs from both species in the number of spines on the merus of legs 3–5 and in the relatively longer segment 3 in the peduncle of the antennule. It agrees in other respects so closely with *H. pleuracantha* that it could not well be separated from it. The number of spines on the merus of legs 3–5 may prove to be a useful specific character, although it is not quite constant. The following table shows the arrangement of these

* For explanation of the Plates, see p. 31.

spines in such species as I have been able to examine, but in most cases the figures are taken from a single specimen, and cannot therefore be relied upon very much. To show the range of variation I give also the results of examination of fifteen specimens of *H. varians* from Millport.

It appears that there are either three species, separated by very slight differences, or one species with three distinguishable forms. I am very reluctant

Table showing Numbers of Spines on Outer Face of Merus.

	H. varians (Millport).			*H. pleuracantha bermudensis.*		
	Leg 3.	Leg 4.	Leg 5.	Leg 3.	Leg 4.	Leg 5
1	2	1	0	2	1	0
2	2	1	0	4	1	0
3 R	5	1	0	2	1	1
L	3	1	0	1	1	1
4	2	1	0	1	0	0
5	3	3	0	1	2	1
6	2	1	0	2	1	0
7	4	2	0			
8	2	1	0			
9	3	3	0			
10	2	2	0			
11	2	1	0			
12	2	1	0			
13	2	1	0			
14	4	3	0			
♂ 15	1	1	0			

	H. pleuracantha (U.S.A.).	*H. pleuracantha bermudensis.*	*H. zostericola.*
Rostrum (usually)	2/2	2/3	2/3
Rostrum, length : width	6·5 : 1	6·8 : 1	7 : 1
Antennule, segments of peduncle.	6 : 2 : 1	3·3 : 1·6 : 1	4·9 : 2·15 : 1
Outer flagellum, thick segments.	7	7	7
Antennal scale, length : width.	3·3 : 1	3·3 : 1	3·1 : 1
Leg 2, carpal segments	1·47 : 1 : 2·62	1·58 : 1 : 1·8	1·3 : 1 : 2
Number of spines on dactyl of legs.	9	9–11	16

to treat the Bermuda form as a distinct species, but it cannot very well be simply referred to *H. pleuracantha*. It is therefore treated here as a subspecies. Whether *H. zostericola* should also be regarded as a subspecific form is a question which may be left to those who have the opportunity to compare a richer material of the two American forms. It may be a convenience to give a fairly full description of the two Bermudan species.

HIPPOLYTE PLEURACANTHA BERMUDENSIS, subsp. n.

Female.—Length 14–17 mm.

Rostrum narrow, a little shorter than the carapace and not reaching end of scale ; with 1 or 2 dorsal spines and 2 to 4 ventral, of which one is quite near the apex. Usual number 2 above and 3 below. The carapace bears large supraorbital and antennal spines (Pl. I. fig. 7). Telson nearly three times as long as wide, with 2 lateral and 6+6 distal spines. I have seen one specimen (Pl. I. fig. 9) with 5 lateral pairs and 9 terminal spines. Segment 1 of antennule about three times as long as segment 3, without spine at distal inner angle ; outer flagellum about as long or shorter than peduncle, consisting of 7 (rarely 8) thick segments and 3 thin ones. Antennal scale three times as long as wide.

Maxillipede 3 dactylus nearly six times as long as wide, with 8 to 10 terminal spines. Leg 1 stout, dactylus and palm about equal. Leg 2 chela as long as first two segments of the carpus ; carpal segments rather stout, proximal segment the longest (average of five specimens 1·65 ; 1 ; 1·58). Legs 3 to 5, dactylus with 9–11 spines, the distal ones very long ; carpus with one spine on outer face near base ; merus with usually 2 . 1 . 0 spines on outer face, exceptionally with 4 on leg 3. Pleopods 1 to 3 bearing eggs. Endopod of pleopod 1 nearly as long as exopod, with ovigerous setæ (Pl. II. fig. 15) ; in pleopods 2 and 3 apparently the eggs are borne on ovigerous setæ attached to the basis only ; coxa of pleopods 2 and 3 greatly elongated in egg-bearing females.

Male.—Length 10–12 mm.

Rostrum more slender than in female and supraorbital spine larger. Dactylus of maxillipede 3 more slender than in female. Legs 3 and 4 with propodus widened beyond the middle and dactylus bent downwards. Pleopod 2 with *appendix masculina* about 2/3 as long as *appendix interna*, bearing a group of stout spines at end.

Colour.—The majority of specimens from Castle Harbour were bright green, but a few were pale grey. Those taken from *Sargassum* on the north shore were dark olive-brown, matching the colour of the weed.

HIPPOLYTE ACUMINATA Dana, 1855.

Syn. *H. bidentatus* Bate, 1888.

Female.—Length 12·8 mm.

Rostrum a little shorter than carapace and than scale, with one tooth above and one below, or lacking one or other of these teeth. Carapace with large supraorbital spine, very small antennal spine, and with hepatic spine close to anterior margin of carapace. Pleura of abdominal somite 2 very large, bending inwards to form a brood-pouch. Abdominal somites 5 and 6 with large downturned spinous process on either side. Telson four times as long as wide, with two pairs of small dorso-lateral spines and 6 or 8 apical spines.

Segment 1 of antennular peduncle nearly four times as long as segment 3, with strong spinous process at outer distal angle ; outer flagellum shorter than peduncle, consisting of ten thick segments and a single slender terminal segment. Antennal scale three times as long as wide.

Maxillipede 3, dactylus about five times as long as wide, with about 8 stout marginal spines. Leg 1, dactylus equal to palm, the latter about same length as carpus. Leg 2, first and third segments of carpus nearly equal and about twice length of middle segment. Legs 3–5, dactylus with 9 stout

spines ; carpus and merus each with one spine on their outer face. Pleopods 1–3 with ovigerous setæ ; pleopod 1, endopod oval, much shorter than exopod.

Male.—Length 13 mm.

Propodus of legs 3 and 4 modified as in other species of *Hippolyte*, but not so much widened as in *H. pleuracantha*. On pleopod 2 the *appendix masculina* is a small papilla, less than half the length of the *appendix interna*, with a number of stiff setæ at end.

It cannot be doubted that this is the species described by Dana and by Bate, but it is remarkable that Dana and Verrill have emphasized the absence of an hepatic spine, and Bate states that there is no spinous process on the sixth abdominal somite. Kingsley (1899), in his key to the North American Caridea, uses the absence of an hepatic spine to distinguish this species from the other two species of *Hippolyte*. Verrill did not himself take this species at Bermuda, but records a single specimen found on the north shore. During my stay it was taken in some numbers in floating *Sargassum*, but only outside the reef. While *Latreutes fucorum* was always common and *Leander tenuicornis* generally present in small numbers, *H. acuminata* was sometimes absent from the patches of weed examined and was never found in weed drifted inside the Reach.

The coloration is remarkable. The body is banded with brownish yellow in such a way that it seems to be broken up into two parts, each of which looks very like a vesicle of *Sargassum* (Pl. V.).

Larval Development.

Miss Lebour (1931) has summarized present knowledge of the development of the genus *Hippolyte*, and has fully stated the generic larval characters taken from the development of *H. varians*, *H. prideauxiana*, and *H. proteus* (=*orientalis*). In view of the striking differences between the larvæ of these species and those of *Spirontocaris*, a genus which has hitherto been regarded as very closely allied to *Hippolyte*, there is, I think, some value in describing the development of another species of *Hippolyte* which conforms exactly to the characters established for the genus. It is worth noting that whereas specific differences in the larvæ of *Caridion* and *Spirontocaris* may be quite striking, in *Hippolyte* the structure is almost identical in all species—in fact, apart from colour there is practically nothing to distinguish them. Miss Lebour draws attention to the fact that all larvæ of *H. varians* from Plymouth have a pair of spines on abdominal somite 5 *, whereas it is not mentioned by Sars nor shown in his figures. I find it impossible to believe that Sars could have overlooked these spines, which are present in all stages in other species, and it must for the present be accepted that the Norwegian form differs in this respect, or is really a different species.

First-stage larvæ, which were subsequently proved to belong to *H. pleuracantha*, were taken in night plankton in the Reach on February 20. Adults with eggs were trawled on February 21 in Castle Harbour, and from these larvæ were hatched on February 24. The later stages were obtained in plankton from Castle Roads, where they were abundant throughout March. With the exception of two postlarval specimens none of the later stages were found in plankton in the Reach or in Castle Harbour itself.

Of the stages separated here nos. 1–3 are, as always, perfectly distinct and clearly marked by important changes, but subsequent stages are less easy to separate. Among the many specimens examined two groups, called here stages 4 and 6, can be distinguished clearly from stage 3 and each other,

* These spines are present in larvæ of *H. varians* hatched at Millport (Pl. IV. fig. 47).

but there are a few individuals which do not fit easily into either of the other groups, and for these I have postulated a stage 5. This group is, I believe, formed of abnormal specimens intermediate between the other two stages. It is probable that they are more vigorous individuals which have skipped stage 4. It is not easy to test such a point. The few larvæ which moulted to post-larval in the laboratory were not sufficiently carefully examined, and their moulted skins are too much damaged to be certain if they were in stage 5 or 6. While, therefore, six stages are here distinguished, I am of opinion that there are actually only five normal stages. Sars described five stages in *H. varians*, and I was only able to find four in *H. proteus*, though it is very likely there were really five. Miss Lebour tells me that she finds *H. varians* at Plymouth to have a long series of stages like *Spirontocaris* and other genera.

Even in stages 4 and 6 there is some variation in the degree of development of legs 1 and 2 and of the pleopods, but it is possible that these rudimentary appendages, which cannot be rigid, change to some extent with the growth of the new limb within them.

As will be seen from the measurements given the variation in size causes considerable overlap, and it is impossible to separate stages by size alone. The possibility that this overlap in size and form may be accounted for by a mixture of the larvæ of two species cannot be altogether excluded, since the fauna of Bermuda is not completely known, but it is very unlikely, especially as the larvæ were examined alive, and any specific difference would probably have been revealed by a marked difference in colour.

Stage I.—Length 1·5 mm. (Pl. III. figs. 34–37.)

General colour dark olive-brown ; chromatophores as shown in figs. 34, 35 (Pl. III.). There is no chromatophore in the antennule, a character which was sufficient to distinguish this species from a very similar larva of another genus in the plankton.

Rostrum, long, down-turned ; carapace with postrostral tubercle and three marginal teeth. Fifth abdominal somite with a pair of lateral spines. Telson slightly indented, the middle one of the three inner spines longer than the other two.

Antennal scale with two faintly marked terminal segments and two outer setæ ; nine inner and apical setæ, of which the proximal one is turned backwards and the ninth is a small hair. There is indication of a segment at the fifth seta, and it is possible that the ninth may really be an outer seta belonging to this segment. Inner branch nearly as long as scale, with spine-like end.

Maxilla with 5 setæ on exopod. Maxillipedes 1–3, exopods with 3 terminal setæ *. Leg 1 present as a very small rudiment.

Stage II.—Length 1·8 mm.

Rostrum widening at base but without supraorbital teeth. Telson unchanged except for additional inner pair of spines. Antennule stem with segment 3 separated. Antenna unchanged, but segmentation of scale difficult to trace. Exopods of maxillipedes with 4 terminal setæ. Leg 1 a large rudiment, followed by a lobe which seems to contain traces of legs 2 and 3.

Stage III.—Length 1·9–2·0 mm. (Pl. III. figs. 38, 39.)

Rostrum broad at base, with a pair of small supraorbital teeth. Telson separated from somite 6, slightly narrowed (length to width 1·36 to 1). Outermost of the spines now lateral. Antennule with rudiment of endopod

* There are three terminal setæ instead of the normal four in *H. varians* and *H. proteus* (=*orientalis*). Mrs. Needler's figures (1933) show the same arrangement in *H. californiensis* and *Spirontocaris paludicola*.

segment 3 with 3 ventral setæ ; base enlarged, but without outer spinous process. Antenna, endopod unchanged, but scale unsegmented, with terminal spine and 12 setæ. Maxilla, exopod with 10 setæ. Leg 1 with setose exopod and small unsegmented endopod. Legs 2–5 rudimentary. Pleopods absent. Uropods present ; exopod with 7 setæ and endopod quite small, not jointed, with 2 small apical setæ. Anal spine absent.

Staye IV.—Length 2·2–2·56 mm. (Pl. III. figs. 40, 41.)

Antennule as in stage 3, but with 4 ventral setæ on segment 3 ; basal segment with small ventral spine and rudiment of stylocerite. Antennal scale with 13 setæ and apical spine ; endopod still pointed, shorter than scale. Exopod of maxilla with 11 setæ. Legs 1 and 2 with setose exopods ; endopods small, unsegmented, swollen at end and sometimes showing first trace of incipient chelæ. Legs 3–5 small, without exopods. Pleopods either altogether absent or present as small simple buds. Uropods much shorter than telson ; exopod with 10, endopod with 7 (or rarely 8) setæ, both branches jointed to basis. Anal spine present. Telson narrowed, rather more than twice as long as wide, with one pair of lateral spines and 6+6 terminal spines.

Stage V.—Length 2·35–3·12 mm.

Endopod of antennule about 2/3 length of exopod. Antennal scale with 14 setæ ; endopod as long as scale, pointed, but not tapering. Exopod of maxilla with 12 setæ. Legs 1 and 2 with small incipient chelæ, unsegmented. The exopods in this and the next stage bear only 6 setæ. Pleopods small, bilobed, variable in size. Telson nearly or quite two and a half times as long as wide, with two pairs of lateral spines and 6+6 terminal spines. Branches of uropods with many setæ, nearly as long as telson.

Stage VI.—Length 2·82–3·01 mm. (Pl. IV. figs. 42–44.)

Antennule, segment 1 with beginning of ventral ridge ; stylocerite larger ; segment 3 with 4 ventral setæ, the three inner ones long, the outer one small and slender ; endopod about half as long as exopod. Antennal scale with 16 setæ ; endopod with basal segment marked off, longer than scale and blunt at end ; basis with small outer and inner spine. Exopod of maxilla with 13 setæ. Legs 1 and 2 with distinct chelæ, but segmentation not well marked. Legs 3 to 5 long, unsegmented, without setæ, and without exopods. Pleopods long, biramous, bent forwards. Uropods, exopod with 14, endopod with 10 setæ. Telson about two and a half times as long as wide, with spines as before.

Larvæ of Stages V. or VI. moulted in the laboratory to postlarval, but I have seen a single specimen of 3·35 mm. which is distinctly more advanced and represents a possible additional stage. It differs from Stage VI. in having the telson about four times as long as wide and the legs much more developed, the chelæ being large and fully formed but the carpus of leg 2 undivided. Having regard to the abundance of stage VI. and the fact that only the single more advanced specimen was found, it seems that larval development normally ends at Stage VI.

Post-larval Stage I.—Length 2·76–3 mm. (Pl. IV. fig. 45.)

Rostrum as in larva, short, very broad at base, with small supraorbital spines. Carapace without spines. Pleura of abdominal somite 5 rounded. Telson narrow, length to width 2·65 to 1, with spines as in larva. Antennule without otocyst, stylocerite small ; outer flagellum consisting of 3 thick and 1 thin segment ; inner flagellum of 3 segments. Mouth-parts of adult form.

Maxillipede 2, exopod without setæ. Legs 1 and 2 with large vestigial exopods, chelate; carpus of leg 2 divided into 3 segments. Legs 3 to 5, dactyl with 6, 6, 5 spines; no spines on outer surface of carpus and merus. Pleopods large, setose, the *appendix interna* present only on pleopods 4 and 5. Gills small, not foliated; none seen on leg 5.

This stage was obtained too late during my visit for the moult to stage 2 to be observed, and the only specimens of later stages seen were two taken in plankton at night. These measured 4·7 and 7 mm., and both were males with the *appendix masculina* well developed (Pl. IV. fig. 46).

The smallest of these had the rostrum straight, slender, bifurcated at tip, but without dorsal spines. The carapace had small supraorbital spines, but no antennal spines.

Outer flagellum of antennule with 4 thick and 2 thin segments; inner flagellum with 5 segments. Exopod of maxillipede 3 with 6 outer, 4 apical, and 1 inner setæ. Dactylus of legs 3–5 with 7 spines; carpus with one small outer spine; merus of leg 3 only with one distal spine.

This is probably Stage III., and it is likely that a sexual difference in pleopod 2 is appreciable in Stage II., as it is so well marked here.

HIPPOLYTE ACUMINATA Dana.

Stage I.—Length 1·87 mm. (Pl. IV. figs. 48, 49.)

General form as in *H. pleuracantha*, but stouter.

Telson broadly triangular and rather more deeply incised. Antennal scale more distinctly segmented, with a distinct line of division traceable from seta 6 to the outer terminal hair. Maxillipedes as in *H. pleuracantha*. Exopods with 3 terminal setæ. No trace of leg 1.

Body almost colourless, the only chromatophores seen being a postocular pair, a very small pair at base of antennæ and maxillæ of a greenish-brown colour, and a small one at base of telson.

I was unable to keep any of these larvæ until the moult to Stage II., and no larvæ were found in plankton which could be referred to this species, which could probably be easily distinguished by its relatively large size and absence of colour.

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EXPLANATION OF THE PLATES.

PLATE I.

Figs. 1–3. *Hippolyte pleuracantha* Stimpson. From U.S. National Museum.

Fig. 1. Rostrum. Port Macon.
2. Antennule. Port Macon.
3. Leg 3, ischium and merus. Beaufort.

Figs. 4–21. *Hippolyte pleuracantha bermudensis*, subsp. n.

Fig. 4. Leg 3.
5. Female, after hatching young and moulting.
6. Rostrum, usual form, female.
7. Rostrum, exceptional form, female.
8. Antennule, female.
9. Part of telson with abnormal number of spines, female.
10. Part of telson, usual form, female.
11. Leg 1, female.
12. Dactylus of leg 5, female.

PLATE II.

Fig. 13. Leg 2, female.
14. Dactyl of maxillipede 3, female.
15. Pleopod 1. Ovigerous setæ shown in black.
16. Part of leg 3, male.
17, 18. Rostrum, male.
19. Pleopod 2, endopod with *appendix masculina*, male.
20. Pleopod 1, endopod, male.
21. Maxillipede 3, dactylus, male.

Figs. 22–27. *Hippolyte zostericola* Smith. Naushon. From U.S. National Museum.

Figs. 22, 23. Rostrum.
Fig. 24. Antennule.
25. Leg 1.
26. Leg 2.
27. Dactylus of leg 4.

Figs. 28–33. *Hippolyte acuminata* Dana.

Fig. 28. Rostrum.
29. Antennule.
30. Dactylus of leg 5.
31. Dactylus of maxillipede 3.

PLATE III.

Fig. 32. Part of leg 3, male.
33. Part of endopod of pleopod 2, male.

Figs. 34–46. Development of *Hippolyte pleuracantha*

Fig. 34. Stage I. Dorsal.
35. ,, Lateral.
36. ,, Antenna.
37. ,, Maxilla.
38. Stage III. Dorsal.
39. ,, Lateral.
40. Stage IV. Legs 1 and 2.
41. ,, Telson.

PLATE IV.

Fig. 42. Stage VI. Lateral.
43. ,, Telson, in moult to postlarval.
44. ,, Legs 1 and 2.
45. Postlarval I. Lateral.
46. Postlarval III ? Pleopod 2 of male.

Hippolyte varians (from Millport).

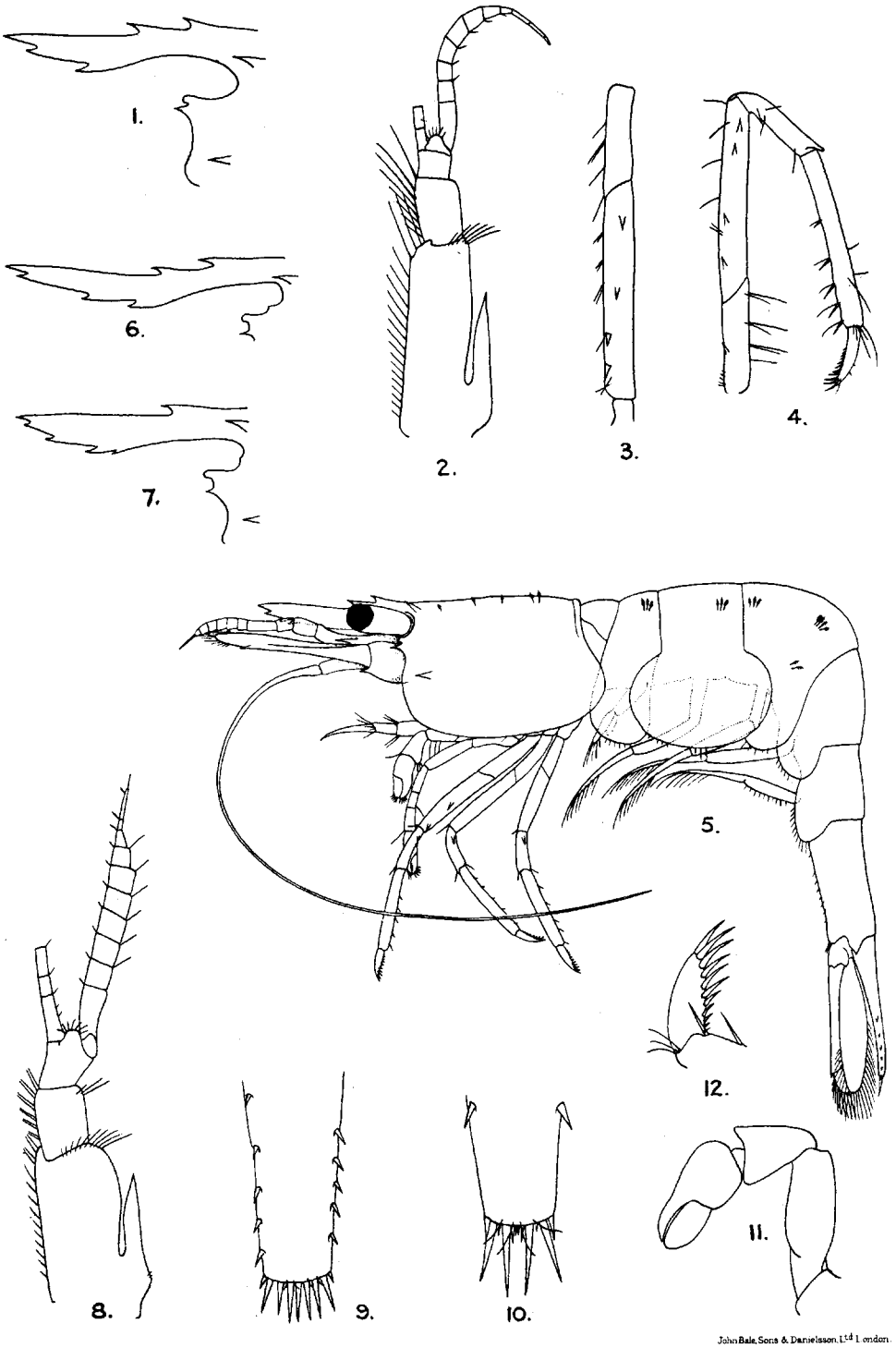
Fig. 47. Stage I. Dorsal.
47 *a*. Part of antenna.

Hippolyte acuminata.

Fig. 48. Stage I. Dorsal.
49. ,, Lateral.

PLATE V.

Three specimens of *Hippolyte acuminata* in natural surroundings to show close resemblance to the vesicles *of Sargassum*. Drawing by Miss O. F. Tassart.



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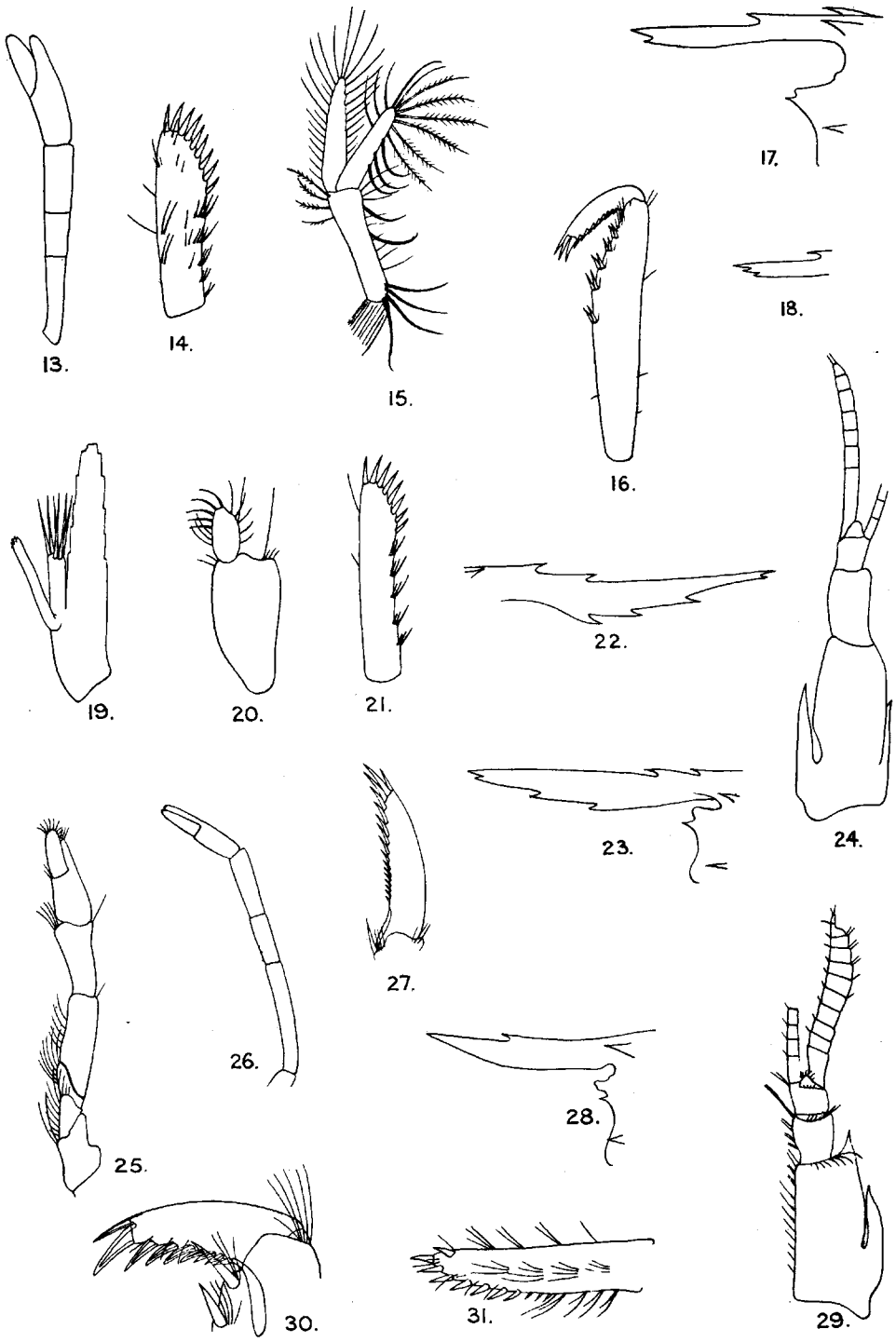

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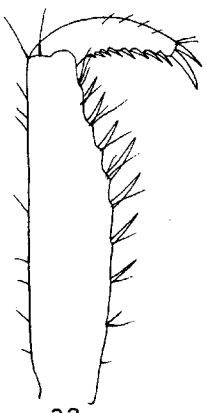

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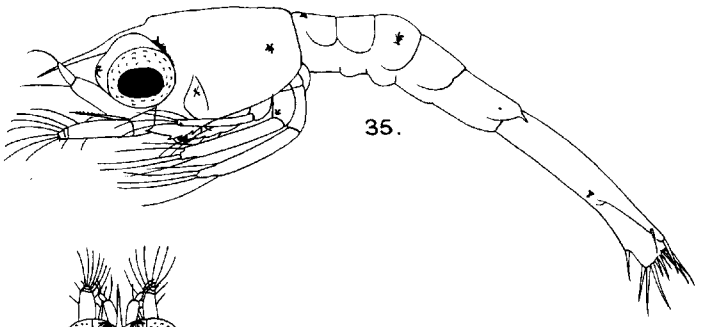

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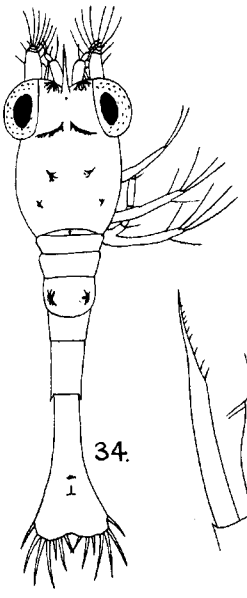

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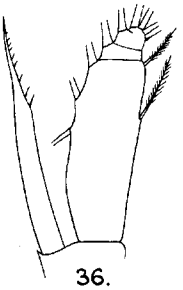

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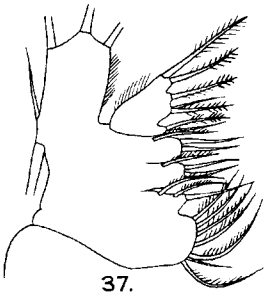

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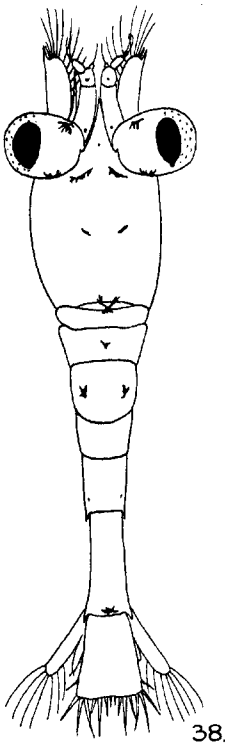

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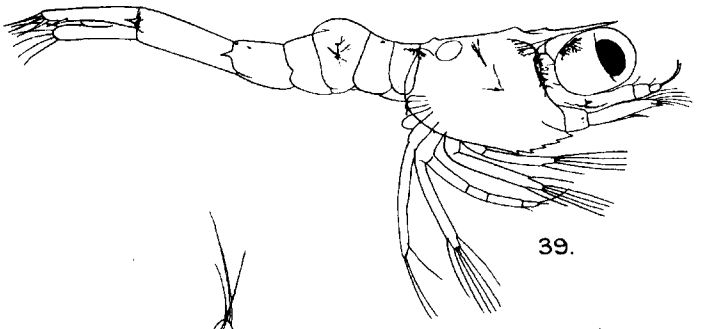
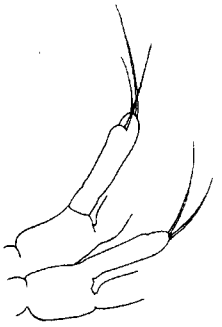


39.



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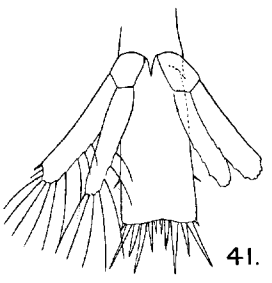

41.

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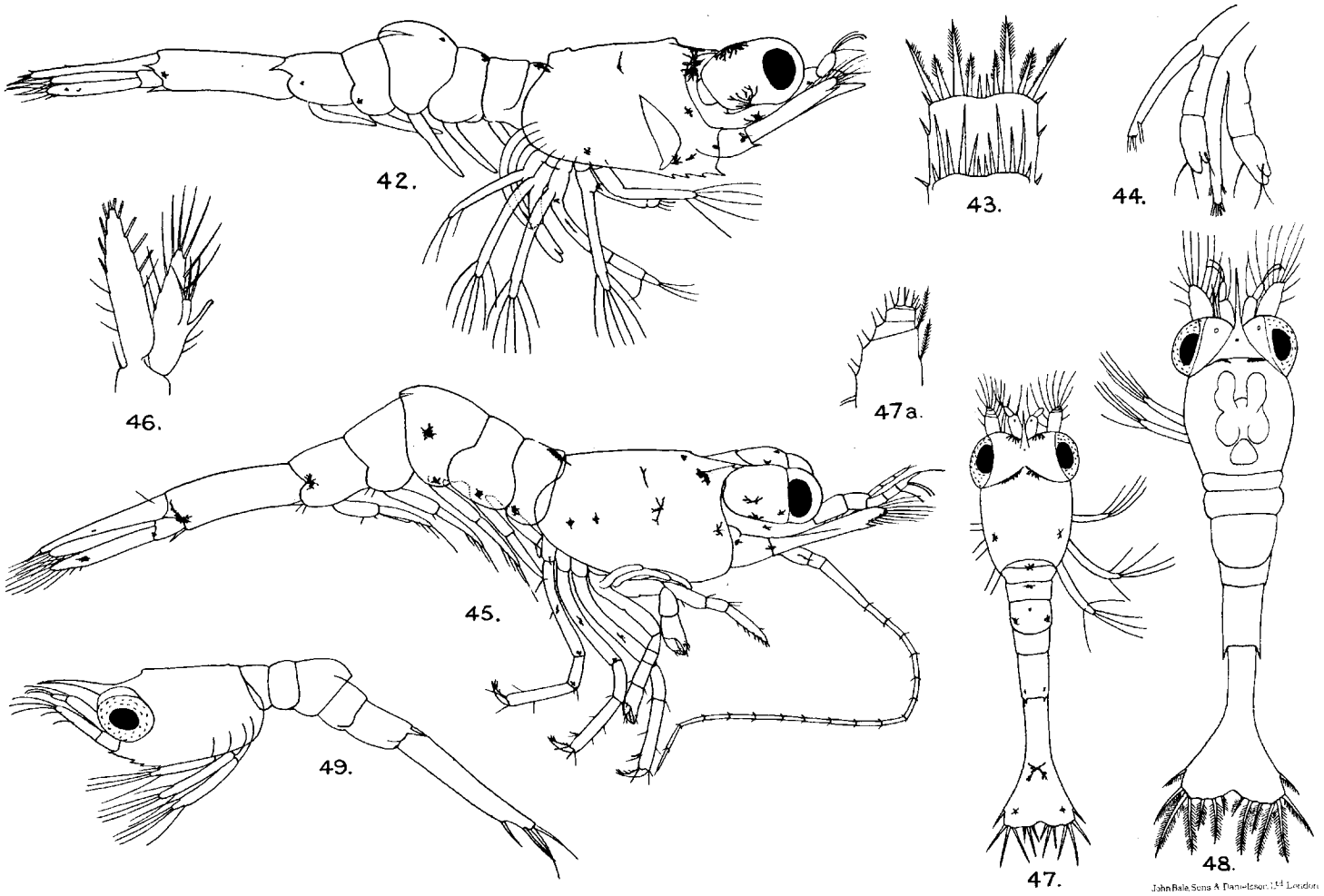
DECAPOD CRUSTACEA OF BERMUDA. SPECIES OF *HIPPOLYTE* AND THEIR LARVAE.



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THREE SPECIMENS OF *HIPPOLYTE ACUMINATA* IN NATURAL SURROUNDINGS TO SHOW RESEMBLANCE TO THE VESICLES OF *SARGASSUM*.