

CONSEIL INTERNATIONAL POUR L'EXPLORATION DE LA MER

Zooplankton.
Sheet 70.

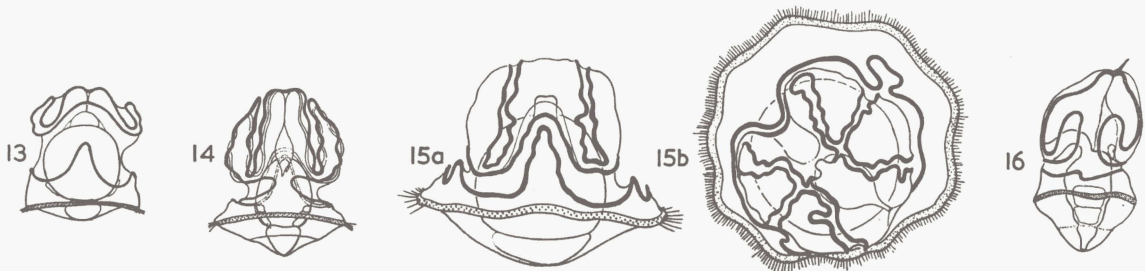
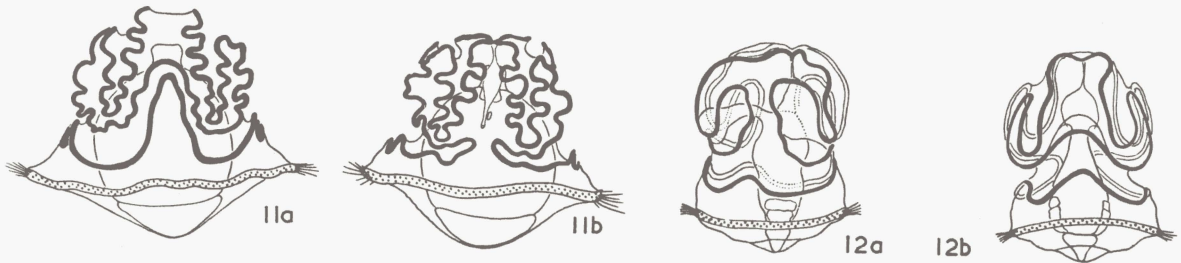
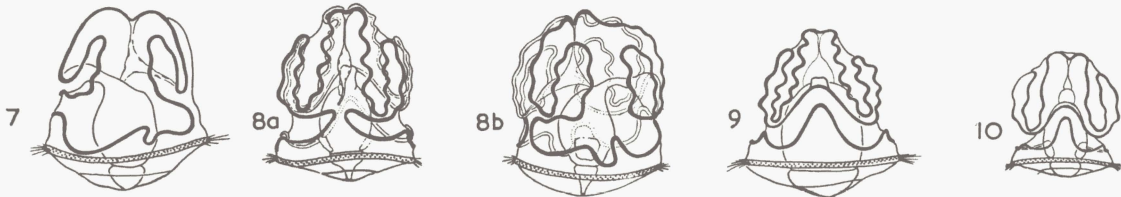
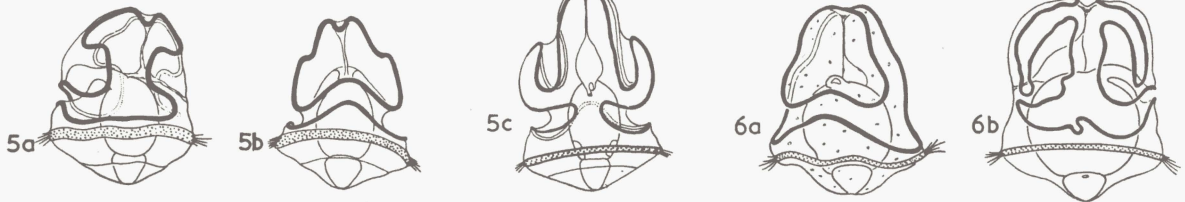
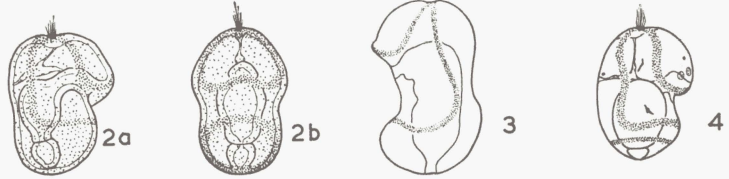
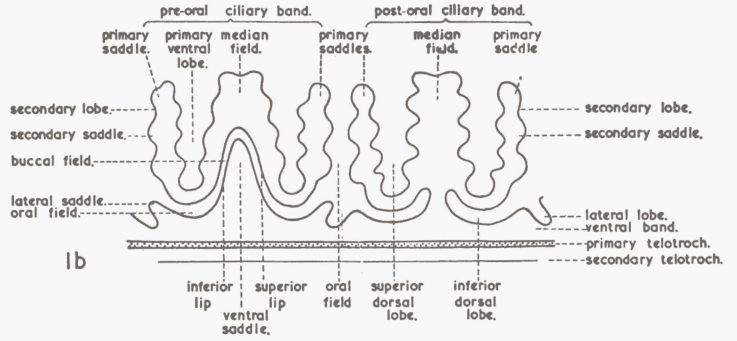
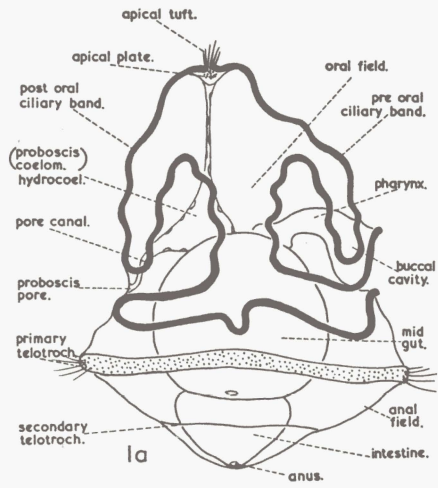
HEMICHORDATA
ENTEROPNEUSTA
Family: Ptychoderidae
TORNARIA LARVAE
(By C. Burdon-Jones)¹⁾
1957

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For identification and population analysis it is convenient to sub-divide the various Tornariae into 6 age-groups or stages of development as follows:

1. Müller (Figs. 2, 3) newly hatched, with pre- and post-oral ciliary bands.
 2. Heider (Fig. 4) as for Müller, with primary telotroch but devoid of primary lobes and saddles.
 3. Metschnikoff (Figs. 5—7) with developing or fully developed primary lobes and saddles.
 4. Krohn (Figs. 8—11) with developing or fully developed secondary lobes and saddles and secondary telotroch; maximum size.
- At this stage the specific features of the tornaria can be identified with certainty.
5. Spengel (Figs. 12—15) with regression of secondary lobes and saddles, and diminution in size.
 6. Agassiz (Fig. 16) advanced regression of all ciliary tracts, elongated longitudinally, metamorphosis imminent.

All these stages are planktonic and lecithotrophic, with the probable exception of late Agassiz larvae.

Balanoglossus clavigerus (S. de Chiaje, Stiasny, 1914 a and b) is the only North Atlantic species for which all the six developmental stages are known. The specificity of all other North Atlantic Tornariae is based on the characteristics of their Krohn stages.

Their identification with an adult species is tentative and based primarily on their relative geographic distribution:

Tornaria bournei is probably the larva of *Glossobalanus sarniensis*

Tornaria mielcki is probably the larva of *G. marginatus* Meek

Tornaria meeki — adult unknown.

Stage I. Müller	<i>B. clavigerus</i> (Fig. 2)	<i>T. bournei</i> (Fig. 3)	Stage II. Heider	<i>Balanoglossus clavigerus</i> (Fig. 4)
Size in mm.	0.5—1.0	ca. 0.3	Size in mm.	ca. 0.75
Form	dumb-bell shaped, slightly compressed laterally	similar	Form	ovoid
Ciliary bands	broad	narrow	Ciliary bands	broad
Pre-oral field	completely arched, very prominent	incompletely arched, not prominent	Primary telotroch	present, and narrower than ciliary bands
Oral field	small, broadly arched apically	large, narrowing apically	Pre-oral field	strongly arched and prominent
Dorsal lobe	absent	rudimentary	Dorsal lobe	rudimentary
Hydrocoel	present	absent		

Müller stages have not been described for
Tornaria meeki and *T. mielcki*.

Heider stages have not
been described for any
other Tornariae.

Fig. 1, Typical *Tornaria* larva, a. general anatomy, b. Mercator projection and nomenclature of ciliary tracts.

Müller Stage:

Fig. 2, *B. clavigerus*, a. lateral, b. ventral.

Fig. 3, *T. bournei*, lateral.

Heider Stage:

Fig. 4, *B. clavigerus*, lateral.

Metschnikoff Stage:

Fig. 5, *B. clavigerus*, a. young stage, lateral, b. ventral,
c. advanced stage, dorsal.

Fig. 6, *T. bournei*, a. young stage, ventral, b. advanced stage,
lateral.

Fig. 7, *T. meeki*, advanced, lateral.

Advanced Krohn Stage:

Fig. 8, *B. clavigerus*, a. dorsal, b. lateral.

Fig. 9, *T. bournei*, ventral.

Fig. 10, *T. meeki*, ventral.

Fig. 11, *T. mielcki*, a. ventral, b. dorsal.

Spengel Stage:

Fig. 12, *B. clavigerus*, a. lateral, b. ventral.

Fig. 13, *T. bournei*, ventral.

Fig. 14, *T. meeki* (Spengel-Agassiz stage), dorsal.

Fig. 15, *T. mielcki*, a. ventral, b. apical.

Agassiz Stage:

Fig. 16, *B. clavigerus*, lateral.

(Figures not all to same scale)

Figs. 2, 4, 7, 10, 12, 13, 14, 16 after G. W. and G. Stiasny, 1925; Figs. 3, 6, after G. C. Bourne, 1889.

Young Stage III. Metschnikoff	<i>B. clavigerus</i> (Figs. 5a, b)	<i>T. bournei</i> (Fig. 6a)	Advanced Stage III. Metschnikoff	<i>B. clavigerus</i> (Fig. 5c)	<i>T. bournei</i> (Fig. 6b)	<i>T. meeki</i> (Fig. 7)
Size in mm.	0.75—1.25	ca. 0.33—1.0	Primary lobes	well developed	well developed	well developed
Pre-oral field	arched	flattened	Primary saddles	well developed	well developed and broad	well developed
Pre-oral ciliary band	distinctly tri-lobed	very rudimentary lobes	Secondary lobes	absent	rudimentary	rudimentary
Post-oral ciliary band	rudimentary primary lobes and saddles	primary lobes and saddles absent	Lateral lobes	absent	smaller than saddle	smaller than saddle
Lateral lobes and saddles	very rudimentary	absent	Lateral saddle	absent	dorsally directed	dorsally directed
Ventral saddle	arched mid-ventrally	broadly arched latero-ventrally	Ventral band	moderately wide laterally	very narrow laterally	very narrow latero-ventrally
Ventral band	long and narrow	short, broadening ventrally	Inferior dorsal lobes	narrow	narrow	broad
Anal field	broadly arched	conical	Anal field	broadly arched	conical	broadly arched
Primary telotroch	not prominent or flanged	prominent and flanged	Coelomic sacs	rudimentary	absent	absent
Heart vesicle	absent	rudimentary	Hydrocoel	small	large	medium
			Heart vesicle	rudimentary	absent	absent?

No Metschnikoff stages have been described for *Tornaria mielcki*, and only advanced stages of *T. meeki*.

Stage IV. Krohn	<i>B. clavigerus</i> (Figs. 8a, b)	<i>T. bournei</i> (Fig. 9)	<i>T. meeki</i> (Fig. 10)	<i>T. mielcki</i> (Figs. 11a, b)
Size, height in mm.	1.5—2.0	1.25—2.0	1.5—1.75	1.5—2.0
Diameter of telotroch	less than height	less than height	less than height	2.25—2.5
Median pre- and post-oral field	4 secondary moderately deep lobes and saddles	5 moderately deep	3, median one broad, all shallow	5 or more broad and deep saddles
Primary saddles	narrower than median field, 3 secondary lobes	narrower than median field, 3—4 secondary lobes	narrower than median field, 2 shallow secondary lobes	almost equal to median field 4, very deep secondary lobes internally, 2—3 deep lobes externally
Ventral saddle	as broad as high, apex mid-ventral or posterior	as in <i>B. clavigerus</i>	higher than broad, apex about mid-ventral	higher than broad, apex anterior to mid-ventral point, lobed
Inferior dorsal lobe	curved apically	only slightly curved apically	not curved apically	very strongly curved apically

Stage V. Spengel	<i>B. clavigerus</i> (Figs. 12a, b)	<i>T. bournei</i> (Fig. 13)	<i>T. meeki</i> (Fig. 14)	<i>T. mielcki</i> (Figs. 15a, b)	Stage VI. Agassiz	<i>B. clavigerus</i> (Fig. 16)	<i>T. meeki</i> (Fig. 14)
Size in mm.	2	2	1.75	2	Shape	elongated, with annular constriction	slightly more elongate than Krohn stage
Secondary lobes and saddles	rudimentary or absent	rudimentary or absent	present, but very shallow	reduced, regression advanced	Anal field	markedly conical	conical
Lateral lobes	reduced or absent	reduced	reduced	reduced	Primary saddles	very reduced, devoid of secondary lobes and saddles	well developed, with reduced secondary lobes and saddles
Lateral saddles	present	present	reduced	reduced	Buccal cavity	flexed postero-ventrally	some flexure
Ventral saddle	broadly arched	narrow, anteriorly extended	narrow, anteriorly extended	narrow slightly lobed, anteriorly extended	Hydrocoel	very large	large
Ventral band	broad	broad	narrow	narrow	Coelomic sacs	2 pairs	2 pairs
Median fields	broader than primary saddles	very much broader than primary saddles	very much broader than primary saddles	equal to primary saddles	Mid-gut	elongated and cylindrical	globular — ovoid
Mid-gut	narrow, cylindrical	massive, spherical	ovoid, but not large	massive, spherical	Intestine	elongated and conical	conical
Intestine	elongated and conical	globular	sub-conical and short	globular and flattened	<p>The Agassiz stage is only known for <i>B. clavigerus</i>.</p> <p>The details given for <i>T. meeki</i> are for the transitional stage Spengel-Agassiz.</p>		
Coelomic sacs	2 pairs	1 pair	1 pair	1 pair			
Oral field	narrow	very broad, expanded	narrow	very narrow			
Inferior dorsal lobe	no regression	very broad	no regression	no regression			

Distribution of larvae

B. clavigerus — English Channel.

T. bournei — English Channel (Eddystone, Falmouth, Plymouth Sound); Ireland (Valencia Harbour); Irish Sea (Port Erin); North Sea (Dogger).

T. meeki — North Sea (St. Andrews, Longstone, Helgoland).

T. mielcki — North Sea (Longstone); Celtic Sea.

Tornaria sp. incert. — Off west coast of Ireland; Skagerak.

Distribution of adults

B. clavigerus — English Channel (French coast).

Glossobalanus sarniensis (= *T. bournei*?) — English Channel (Channel Is., Scilly Is., Plymouth); S. W. and North Ireland; North Sea; Kattegat.

G. marginatus (= *T. mielcki*) — North Sea (Farne Is.); Kattegat.

Further Information on Identification

a. Larvae.

i. General: Stiasny-Wynhoff & Stiasny, 1926, 1927.

ii. *B. clavigerus*: Heider, 1909, pp. 695—704, Figs. 9—14. Stiasny, 1914a, p. 62, Figs. W & X, Pl. IV, Figs. 12, 13, Pl. V, Figs. 14—21; 1914b, Pl. 6, Figs. 1—7. Stiasny-Wynhoff & Stiasny, 1927, pp. 132—37, Figs. 50—58.

iii. *T. bournei*: Bourne, 1889, Pl. 7, Figs. 1, 4, Pl. 8, Fig. 13. Johnstone *et al.*, 1924, Pl. VII, Fig. 10. Stiasny, 1921, pp. 127—29, Fig. 6; 1926, pp. 157—65, Figs. 8—15. Stiasny-Wynhoff & Stiasny, 1927, pp. 145—49, Figs. 61—63, pp. 155—57, Figs. 69, 70, pp. 161—63, Figs. 75—77.

iv. *T. meeki*: Meek, 1922, pp. 591—93, Fig. 14. Stiasny, 1925, pp. 435—47, Figs. 1—6. Stiasny-Wynhoff & Stiasny, 1927, pp. 152—54, Fig. 67, pp. 157—59, Figs. 71—73.

v. *T. mielcki*: Peacock, 1923, pp. 136—39, Fig. 2. Stiasny, 1926, pp. 149—57, Figs. 1—7. Stiasny-Wynhoff & Stiasny, 1927, pp. 154—55, Fig. 68, pp. 160—61, Fig. 74.

b. Adults.

i. General: Horst, 1927—39.

ii. *B. clavigerus*: Chiaje, 1929.

iii. *Glossobalanus sarniensis*: Burdon-Jones, 1953.

iv. *G. marginatus*: Meek, 1922.

c. General Biology.

Horst, 1927—39, 1925, 1932.
Burdon-Jones, 1956.

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— 1921. Vid. Medd. Dansk. Naturh. Foren., Copenhagen, **73**,
— 1925. Z. wiss. Zool., **125**, 435—47.
— 1926. Zool. Anz., **68**, 149—57.
Stiasny-Wynhoff, G., & Stiasny, G., 1926. Zool. Anz., **68**, 159—65.
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