

19. The mesoblast cells now retreat from the periphery of the egg into the cleavage cavity. The hypoblastic cells also sink in toward the centre, and the formation of a gastrula is thereby brought about. The figure shows the gastrula stage in horizontal optical section.
20. Gastrula at a somewhat earlier stage, in longitudinal optical section. Owing to the small size of the cleavage cavity, and the large size of the hypoblast cells, the gastrulation is slow and difficult. When the (now eight) lateral and anterior hypoblast cells begin to sink, the four central hypoblast cells also sink a little, but as the former sink deeper, they compress the latter in such a way that they present the appearance shown in the figure. *ec*, epiblast.
21. Gastrula seen from the side. The epiblast is seen in optical section. *gm*, gastrula mouth.
22. Later stage. The gastrula mouth is closing up. Later it disappears entirely. That this side answers to the later ventral side is highly probable.
23. Stage when the second pair of antennæ, II (the first appendages to appear), have begun to appear. Optical cross-section. The other two pairs of nauplius appendages soon follow. The œsophagus of the nauplius arises from an invagination of the epiblast.
24. Nauplius just hatched, seen from below. The intestine (*i*) as yet has no anal opening. Under the bilaterally disposed ectoderm cells, at the posterior extremity of the body, are seen the primitive mesoblast cells (*pms*). From these are developed the mesodermic structures of the later-formed somites. The duration of the egg-development is about twenty-four hours.
NOTE.—In the nauplius of *Cyclops serrulatus* and *Ergasilus Sieboldi*, Grobben detected the presence of a dorsal organ equivalent to that in *Phyllopora*, &c. See *Arbeiten Zoolog. Inst. Wien*, II, p. 262, Taf. XVI. figs. 61, 62, 1879.
25. Later stage, lateral view. In the posterior part of the body, the rudiment of the genital system (*gen*) has already appeared. The intestine is now furnished with an anus (*an*).
26. A little older metanauplius larva, lateral view. The fourth pair of appendages (maxillæ) have appeared. *n*, brain. *n'*, secondary brain, a thickening of the ectoderm, interpreted by Grobben as a rudimentary organ representing the compound eyes of *Phyllopora* and their ganglia, which do not develop further in the *Copepoda*.
27. Anterior portion of the same stage, seen from below. *oes*, œsophagus. *ocl*, eye.
28. A little older metanauplius than that represented by Fig. 26, from below. The anterior and posterior maxillipeds (V, VI) have now made their appearance, as well as the first pair of swimming-feet (VII). Under the cuticle is also seen the second pair of swimming-feet (VIII), which become free at the next moult. According to Claus and Grobben the so-called two pairs of maxillipeds of *Copepoda* really represent but one pair of appendages, the anterior pair being the outer branches, the posterior pair the inner branches. Both together will then represent the second pair of maxillæ of other Crustacea, and the first pair of swimming-feet will be the homologue of the first maxillipeds of *Decapoda*. Assuming this view to be correct, the reader must bear in mind that, in the figures of *Copepoda* on this plate, the Roman numerals higher than V must be lessened by one.
29. First Cetoichilus stage, from ventral side. The third pair of swimming-feet (IX) has appeared. *mt*, metastoma or paragnathite. At subsequent moults, new thoracic segments and appendages are developed, until the adult state is attained.

PLATE V.

a.	Anus.	o v.	Ovary.
b r.	Gill.	p c.	Polar cell ?
d p.	Deutoplasm.	st.	Stomach.
e p.	Epiblast.	v m.	Egg membrane.
g e n.	Genital cells.	α.	Adductor muscle of the shell.
g m.	Gastrula mouth.	β.	Antennary muscle.
h.	Heart.	γ.	Shell gland.
h y.	Hypoblast.	δ.	Muscular impression.
i.	Intestine.	ε.	Chitinous support of the caudal fork.
l.	Liver.	ζ.	Threads (nervous ?) connected with the setæ of the shell.
l b.	Labrum.	η.	Cephalic plate.
m.	Mouth.	θ.	Maxillary somite.
m s.	Mesoblast.	ι.	Rudiment of sensory seta.
m t.	Metastoma.	κ.	Shell.
n'.	Primary brain.	λ.	Dorsal organ.
n''.	Secondary brain.	μ.	Inner membrane of fold over the eye.
o c.	Compound eye.	ν.	Seta.
o c l.	Simple eye.	ν'.	Olfactory setæ.
o e s.	Esophagus.	ξ.	Caudal fork.

The Roman numerals denote the appendages of the body in their consecutive order.

1 - 12. *Development of OSTRACODA (Cypris). Figures from CARL CLAUS, Beiträge zur Kenntniss der Ostracoden. I. Entwicklungsgeschichte von Cypris. Schriften Gesellsch. Beförd. gesamt. Naturwissensch. Marburg, IX., Taf. I., II., 1868.*

1. First larval (nauplius) stage of *Cypris ovum*. Differs from the typical nauplius form in having a bivalve shell, and in the second and third pairs of appendages not being biramous. α, adductor muscle of the shell. β, antennary muscle. st, stomach. i, intestine.
2. Third appendage of the same stage, locomotive in function. At its base is seen the rudiment of the future mandible. The appendage terminates in a hooklike seta.
3. Second stage of *Cypris fasciata*. Two new pairs of appendages have appeared, viz. the first pair of maxillæ (IV) and the first pair of feet (VI). The fifth pair of appendages (second maxillæ, "maxillipeds" of some authors) are not developed till later. The first pair of feet (VI) bear a terminal claw for adhering. The masticatory part of the mandible (III) is well developed. III', mandibular palpus. m t, metastoma.
4. Third stage of *Cypris fasciata*. V, rudiment of second maxilla. The first maxilla (IV) has acquired its large setose appendage (IV').
5. Fourth stage of *Cypris fasciata*.
6. Fifth stage of the same. The second maxillæ (V) have developed into ambulatory appendages, terminated by a hook similar to that borne during the previous stages by the sixth pair of appendages. The latter have lost their hook. γ, shell gland. l, liver. δ, muscular impression on the shell.
7. Second maxilla (V), first foot (VI), and caudal fork (ξ) of the same stage.
8. Sixth stage of the same. All the appendages of the adult are now present, the second pair of feet (VII) having appeared. The second maxillæ (V) are beginning to lose their ambulatory function, and become converted into masticatory organs through the enlargement of their cutting blades and reduction of the palp. The hook at the end of these appendages has disappeared, and one reappears at the end of the first pair of feet (VI). ξ, abdomen or caudal fork. ε, chitinous support of the caudal fork.
9. First foot of the same, sixth stage.
10. Caudal fork of the same, sixth stage.
11. Seventh stage of the same. All the appendages have practically acquired their permanent form. I, first antenna. II, second antenna. II', basal segment of second antenna. III, mandible with four-jointed palpus. IV, first maxilla with gill-plate. V, second maxilla with jaw-process and leg-like palpus. At the base of the latter there is a small gill-plate, not seen in the figure. VI, first leg. VII, second leg. Both pairs of legs are now jointed. o v, rudiment of the ovary.
12. Adult female of the same. ζ, network composed of groups of cells from which fine threads proceed to the setæ of the cuticle.

The marine genera of *Ostracoda* have an abbreviated metamorphosis.

13 - 24. *Development of CLADOCERA. Figures from CARL GROBBEN and G. O. SARS.*

- 13 - 22. *Development of the summer egg of Moina rectirostris. From Grobben, Die Entwicklungsgeschichte der Moina rectirostris. Arbeiten Zoolog. Inst. Univ. Wien, II., Taf. XI. - XIV., 1879.*

The summer eggs are parthenogenetically developed within the brood-cavity of the parent.

13. Egg during the cleavage process. The cleavage is superficial. *pc*, a body supposed to be a polar cell, although its origin from the germinative vesicle was not ascertained. It is present at the time the egg is laid.
14. Gastrula stage in longitudinal optical section. *gm*, gastrula invagination. The gastrula mouth seems to close completely at a later stage. *hy*, hypoblast. *ep*, epiblast. *ms*, mesoblast. The mesoblastic cells are withdrawn from the surface of the blastosphere into the interior just before the gastrula invagination takes place. *gen*, two of the four cells which subsequently are split into eight and pass into the interior of the embryo, take a position under the hypoblast, and develop into the genital organs. These genital cells were distinguishable before the cleavage was completed. *dp*, deutoplasm. η , cephalic plate, from which the supra-oesophageal ganglion and eye are developed.
15. Embryo in the nauplius stage, ventral view. I, anterior antennæ. II, posterior antennæ. These first appeared in an earlier stage as simple buds, before the first and third pairs of appendages began to form. They are now two-branched. III, Mandible. The mouth (*m*) and oesophagus (*oes*) are forming from an invagination of the epiblast. The oesophagus is short and abuts blindly against the intestine (*i*).
16. Later stage, ventral view. Behind the mandibles is seen a maxillary segment (ϑ), although no trace of the maxillæ has yet appeared. Behind the maxillary segment are two thoracic segments with slight rudiments of their appendages (VI, VII). η , cephalic plate in optical section. *z*, mid-gut, the product of the hypoblastic germ-layer. The oesophagus (*oes*) is longer, but still terminates blindly. The place where the rectum is to arise is indicated by a thickening of the body-wall at the posterior extremity.
17. Later stage from ventral side. Four pairs of feet (VI-IX). The two maxillary segments are united, and show no appendages yet. On the outer side of the second antennæ is a protuberance (*u*) connected with the development of a sensory seta which occupies the corresponding part in the adult. The genital cells have divided into a right and left portion. The shell (κ) begins to appear as a fold of the dorsal integument in the maxillary region.
18. The next stage, from below. The fifth foot (X) has appeared. The four anterior feet are becoming differentiated into an inner branch, outer branch, and branchial appendage (in the third foot, these parts are indicated by the characters VIII, VIII', and *br''*). The first maxilla (IV) has appeared.
19. Embryo in the next following stage, lateral view. Observe the dorsal flexure of the body. *lb*, labrum. The second antennæ (II) begin to show segmentation in both their branches. The second maxilla (V) has now made its appearance. This is commonly said to be wanting in the adult *Daphniidæ*, but persists in a rudimentary condition in adult *Moina*, according to Grobben. All five pairs of feet have outer branches, except the first (VI), the single branch here corresponding to the inner branch of the other legs. Near the origin of the shell there is seen a group of cells (λ) higher than their neighbors and furnished with larger nuclei. These go to form the dorsal organ. γ , shell gland, as yet unprovided with an outlet, and probably developed from the mesoblast. The cephalic plate, at a period earlier than this, separated into an anterior portion (*n'*) and a posterior portion (*n''*). The former develops into the brain proper (in the stage figured it has not yet become freed from the integument), the latter forms the retina of the eye. This has already separated from the surrounding epiblast which closes over it and develops into the compound eye. This eye is a paired structure at its first appearance. *a*, anus opening into the invagination of the epiblast which forms the rectum. π , rudiment of the large posterior sensory seta.
20. Next stage, from below. The mandible (III) now shows a division into a palp and masticatory portion.
21. Later stage, from below. ν , primary sensory seta on first antenna. The pigment is forming in the eye. In the median line is seen a furrow, widening posteriorly, formed by an invagination of the epiblast which makes the nerve-cord. The mandible (III) has lost its palp.
22. Embryo shortly before hatching, lateral view. The embryo has now essentially the characters of the adult, excepting the secondary sexual characters. ν' , olfactory setæ. *h*, heart. About two days and a half are consumed in the development of the embryo. The dorsal organ is become reduced to a rudiment at the time of hatching, and is not found in the adult *Moina rectirostris*. In *M. paradoxu*, on the contrary, it persists throughout life.
23. Young *Sida crystallina* at the time of quitting the brood-cavity of the mother, lateral view. λ , provisional dorsal organ. This is the homologue of the dorsal organ in other *Cladocera*. λ' , unpaired horseshoe-shaped dorsal organ. λ'' , paired dorsal organ. γ , shell gland. ν , primary sensory seta. ν' , olfactory setæ. From Grobben, *Ibid.*, Taf. XVI, fig. 56.
24. *Leptodora hyalina*. Larva just escaped from the winter egg, seen from below. The body shows no trace of segmentation. I, first pair of antennæ. II, second pair of antennæ (only the basal portion is represented on the left-hand side of the figure). III, third pair of appendages, representing the mandibular palpi. In the adult the mandibles are destitute of a palpus, as in other *Cladocera*. Behind the third pair of appendages are seen the rudiments of the six pairs of feet of the adult in the form of small buds. *ocl*, ocellus, which persists in the adult. The adult form is gradually attained after the third moult. While the young developed from the winter eggs thus undergo a postembryonal metamorphosis, the summer eggs develop without metamorphosis, as is the case with most *Cladocera*. No ocellus is present at any stage in the development of the summer eggs. From G. O. Sars, Om en dimorph Udvikling samt Generationsvexling hos *Leptodora*. Forhandl. Vidensk.-Selsk. Christiania, Aar 1873, Tab. I. fig. 1.

PLATE VI.

<i>a.</i> Anus.	<i>ri.</i> Inner branch of appendage.
<i>ap.</i> Appendage.	<i>sd.</i> Stomodæum, or fore-gut.
<i>bl.</i> Blastoderm.	<i>a.</i> Five anterior thoracic somites.
<i>br.</i> Gill.	<i>β.</i> Antennal gland.
<i>cp.</i> Carapace.	<i>γ.</i> Shell gland.
<i>ep.</i> Epiblast.	<i>δ.</i> Papilla through which the shell gland opens.
<i>f.</i> Frontal sensory papilla.	<i>ε.</i> Outer egg-membrane.
<i>h.</i> Heart.	<i>ζ.</i> Inner egg-membrane.
<i>hy.</i> Hypoblast.	<i>η.</i> Contour of body.
<i>i.</i> Intestine.	<i>θ.</i> Cellular membrane.
<i>l.</i> Liver.	<i>ι.</i> Muscular wall of intestine.
<i>lb.</i> Labrum.	<i>κ.</i> Epithelium of intestine.
<i>m.</i> Mouth.	<i>λ.</i> Dorsal organ.
<i>ms.</i> Mesoblast.	<i>μ.</i> Appendage connected with sexual function.
<i>mt.</i> Metastoma.	<i>ν.</i> Larval membrane.
<i>n.</i> Nerve.	<i>ξ.</i> Caudal fork.
<i>oc.</i> Paired eye.	<i>π.</i> Rudiment of dental apparatus in stomach.
<i>ocl.</i> Unpaired eye.	<i>ρ.</i> Communication between liver and intestine.
<i>pd.</i> Proctodæum, or hind-gut.	<i>σ.</i> Hypodermis.
<i>re.</i> Outer branch of appendage.	

The Roman numerals indicate the appendages of the body in their consecutive order.

1-10. *Development of PHYLLOPODA (Apus cancriformis). Figures from CARL CLAUS, Zur Kenntniss des Baues und der Entwicklung von Branchipus stagnalis und Apus cancriformis. Abhandl. Königl. Gesellsch. Wissensch. Göttingen, XVIII., Taf. VI.-VIII., 1873.*

1. Nauplius larva, on its escape from the egg, from the ventral side. Behind the mandibles (III) is seen the beginning of the formation of the five anterior somites. *ocl.*, ocellus. The darker portion is the intestine.
2. The same larva seen from above, the appendages removed. *cp.*, rudiments of dorsal shield or carapace. *i.*, intestine. *l.*, liver. *a.*, five anterior thoracic somites. *λ.*, dorsal organ.
3. Second larval stage, from ventral side. IV, first maxilla. *f.*, frontal sense papilla. New thoracic somites have been added posteriorly. VI, VII, VIII, appendages of three anterior thoracic somites. *ξ.*, caudal fork.
4. The same, from dorsal side.
5. Third larval stage, from below. 1 mm. long. The mandibles have developed a powerful cutting blade at their base. The rudimentary second maxillæ (V) have appeared, and four new thoracic appendages. *β.*, antennal gland, probably homologous with the "green gland" of *Malacostraca*.
6. Fourth larval stage, from below. 1 to 1¼ mm. long. New somites continue to form at the hinder end of the body, and appendages to arise from the somites already formed. There are now seventeen pairs of appendages, including the three pairs of nauplius limbs, formed or in the process of formation. Behind the unpaired eye the paired eyes are beginning to be formed. The so-called liver forms three diverticula on each side of the head. *γ.*, shell gland. The dorsal shield has grown backward so as to cover the four anterior thoracic somites. III, mandible. III', mandibular palp. *lb.*, labrum.
7. Fifth larval stage, from below. 1½ mm. long. The appendages have begun to appear as far back as the nineteenth (XIX), and about six somites are marked off by transverse segmentation back of this. The mandibular palp is now much reduced. *oc.*, paired eye.
8. Mouth parts of the same stage. III, mandible. III', mandibular palp. IV, first maxilla. V, second maxilla. *δ.*, papilla in which the shell gland opens.
9. Foot of the twelfth pair from a female larva with dorsal shield 2 mm. long. *ri.*, ramus internus, comprising six joints or lobes. *re.*, ramus externus. *br.*, branchial sac or epipodite.
10. Foot of the first pair from a larva with dorsal shield 2½ mm. long. Letters as in the last figure. Through successive moults the nauplius appendages become atrophied, the second antennæ being especially reduced in size, and the mandibular palp disappearing altogether.

11-21. *Development of ISOPODA. Figures from ANTON DOHRN, HEINRICH RATHKE, and N. BOBRETZKY.*

- 11-18. *Asellus aquaticus*. From Dohrn, Die embryonale Entwicklung des *Asellus aquaticus*. Zeitschr. wissensch. Zool., XVII., Taf. XIV., XV., 1867.
11. Segmented egg. ϵ , outer egg-membrane, chorion. According to Dohrn an inner membrane lies close upon the yolk.
12. The blastoderm (*bl*) now envelopes the whole food-yolk.
13. The blastoderm has become thickened on what will become the ventral side of the embryo.
14. The inner egg-membrane (ζ) has separated from the yolk. αp , rudiments of the two first-formed appendages, referred by Dohrn (correctly?) to the two pairs of maxillæ.
15. Embryo twelve hours later than fig. 14. η , contour of the median portion of the body. λ , dorsal organ. Rudiments of the two pairs of antennæ (I, II), mandibles (III), two pairs of maxillæ (IV, V), maxillipeds (VI), and the six anterior pairs of thoracic legs (VII-XII) have appeared.
16. The embryo lies coiled within the egg, the *dorsal* flexure being so strong that the end of the abdomen and back of the head are in contact. The abdominal part of the body is now well developed and bears four pairs of appendages, the three anterior of which are rudiments of the gills, the fourth (XIX) being the terminal appendage of the adult. VII-XII, six pairs of thoracic legs. μ , appendage developed between the sixth pair of legs and the first pair of gills, later connected with sexual functions. The metastoma (*mt*) is now present. l , liver. a , anus.
17. Later stage. The abdominal appendages are now bilobed. Previous to this stage the chorion has been cast off. The former inner membrane (ζ) now becomes the outer egg-membrane. The blastoderm at a stage much earlier than this has shed a cuticle (ν) which now, as a larval membrane, forms a sac enveloping the embryo up to the time of hatching.
18. Mouth parts of young before leaving the brood-sac of parent. lb , labrum. III, mandible. III', mandibular palp. *mt*, metastoma. IV, first maxilla. V, second maxilla. VI, VI', VI', maxilliped. Within the transparent cuticle of the appendages are seen the setiferous appendages of the next stage.
19. Young *Asellus aquaticus* before leaving the brood pouch of parent. The seventh thoracic somite and its appendages are not yet developed. Beneath the abdomen are seen three pairs of gills and the terminal appendages (XIX). From Rathke, Abhandlungen zur Bildungs- und Entwicklungs-Geschichte des Menschen und der Thiere, Erster Theil, Taf. I. fig. 17, Leipzig, 1832.
- 20, 21. *Oniscus murarius*. From Bobretzky, Zur Embryologie des *Oniscus murarius*, Zeitschr. wissensch. Zool., XXIV., Taf. XXII., 1874.
20. Longitudinal section through embryo. sd , fore-gut, or stomodæum. pd , hind-gut, or proctodæum. ep , epiblast. ms , mesoblast. hy , hypoblast cells. According to Bobretzky these cells originate from the blastoderm and pass into and gradually absorb the food-yolk, increasing until they occupy the whole of the yolk space. n , thickening of the epiblast along the median ventral line of the embryo from which is developed the nerve cord. n' , thickening of the epiblast which goes to form the brain. s , cellular membrane lying within the inner egg-membrane. This membrane, which partially engirdles the embryo at this stage, originates as a heap of thickened epiblastic cells on the dorsal side of embryo. These cells become attached to the inner egg-membrane (which seems to be made up of vitelline membrane and a larval skin together), spread and separate from the embryo excepting at one point where the connection persists by means of a short neck (λ). This structure is homologous with the dorsal organ of *Asellus*, *Moina*, &c.
21. Longitudinal section through an embryo at a much later stage. The invaginated portion of the epiblast which forms the stomodæum is becoming differentiated into oesophagus and stomach. π , rudiment of masticatory apparatus in the stomach. From the hypoblast cells have been formed the epithelial lining of the liver (l) and the mid-gut, or mesenteron. The mesenteron is not in communication with the stomach, and there is no line of demarkation between it and the epiblastic proctodæum. m , mouth. a , anus. i , intestine. lb , labrum. Below the mouth the section passes through the lower lip or metastoma. h , heart, arising in the mesoblastic tissue. κ , epithelium of intestine. ι , muscular outer coat of intestine, derived from the mesoblast. The outer part of the wall of the liver is also formed at the expense of the mesoblast, and below the stomach is seen a mass of mesoblast cells out of which is developed at a later stage the muscles which move the masticatory apparatus of the stomach. ρ , communication between liver and intestine. The nervous system (n, n') has become separated from the outer epiblast which now covers it in (σ).

PLATE VII.

<i>a.</i> Anus.	<i>o c.</i> Eye.
<i>ap.</i> Appendage.	<i>oc l.</i> Ocellus.
<i>bl.</i> Blastoderm.	<i>a.</i> Larval skin.
<i>dp.</i> Deutoplasm.	<i>β.</i> Egg-membrane.
<i>ep.</i> Epiblast.	<i>δ.</i> Amœboid cell.
<i>i.</i> Intestine.	<i>ε.</i> Segmentation cleft.
<i>ms.</i> Mesoblast.	<i>ζ.</i> Yolk sphere.
<i>n.</i> Nerve.	<i>λ.</i> Dorsal organ.
<i>nc.</i> Nucleus.	

The Roman numerals indicate the appendages of the body in their consecutive order.

1-10. *Development of AMPHIPODA. Figures from B. ULIANIN and ADOLPHE DE LA VALETTE ST. GEORGE.*

1-7. *Orchestia.* From Ulianin, Zur Entwicklungsgeschichte der Amphipoden. Zeitschr. wissenschaft. Zool., XXXV., Taf. XXIV., 1881.

1. Egg with four cleavage spheres. *β*, chorion. The cleavage is superficial. In each of the four cleavage products is a nucleus surrounded by protoplasm (*δ*) which sends amœboid processes out into the investing deutoplasm. These nuclei with the investing layer of protoplasm are the "amœboid cells" of Ulianin. They afterwards increase by division, come to the surface of the yolk, and from them is formed the blastoderm.
2. Section through one of the cleavage spheres of the same. *δ*, amœboid cell, not yet transported to the surface.
3. Section of egg at later stage. The "amœboid cells" (*δ*) have migrated to the periphery of the egg, divided, and from them has been formed the blastoderm (*bl*).
4. Later stage, superficial view. The blastoderm has largely increased at the expense of the "amœboid cells."
5. Section of an egg a little younger than the one represented in Fig. 4, to show the formation of the mesoderm cells by division of the blastoderm cells.
6. Section of egg at later stage, passing through the dorsal organ or "micropyle apparatus." *ep*, epiblast. *ms*, mesoblast. *λ*, micropyle apparatus, arising as a patch of thickened epiblastic cells.

NOTE. — Ulianin homologizes the dorsal organ of Crustacea with the shell gland of Mollusca.

7. Section through embryo after the appearance of the appendages. *λ*, dorsal organ. The cells have become invaginated so as to form a sac. *dp*, deutoplasm. *ζ*, yolk sphere. *nc*, nucleus of yolk sphere, with protoplasmic investment.
- 8-10. *Gammarus pulex.* From La Valette St. George, Studien über die Entwicklung der Amphipoden. Abhandl. naturforsch. Gesellsch. Halle, V., 1860.
8. Egg from brood-pouch of parent, showing the enclosed embryo. All the limbs are formed before the embryo quits the egg. Note the ventral flexure of the embryo compared with the dorsal flexure of the Isopod embryo (Pl. VI.). *λ*, dorsal organ, connecting the embryo with the first larval skin which surrounds the whole embryo. *dp*, food-yolk.
9. Portion of the dorsal surface of the same, more highly magnified, to show the connection of the embryo with the larval skin through the dorsal organ. After the epiblastic invagination is formed, as shown in Fig. 7, the whole surface of the epiblast secretes a thin structureless cuticula (larval membrane), which separates from the underlying epiblast at all points excepting within the invagination. Here the cuticula remains attached to the epiblast until the atrophy of the dorsal organ. *β*, egg-membrane. *a*, larval skin. *λ*, dorsal organ.
10. Portion of the upper half of the body. *oc*, eye. *dp*, remains of food-yolk. *a*, larval skin with the so-called micropyle (*λ*) torn away from the sac of the dorsal organ (*λ'*) which lies in fourth segment of the body.

11-19. *Development of STOMATOPODA. Figures from WALTER FAXON, CARL CLAUS, and W. K. BROOKS.*

11. Youngest known stage of Stomatopod larva of the *Erichthus* type of development (*Erichthoidina*), seen from below. The line on the left of the figure indicates the length of this larva. The body consists of an anterior unsegmented portion bearing an ocellus (*oc l*), a pair of stalked eyes (*oc*), two pairs of simple antennæ (I, II), a pair of mandibles (III) without palpi, and two pairs of maxillæ (IV, V). From the dorsal side of this head portion is developed a large shield or carapace produced into a rostrum in front, and extending backward so as to cover most of the middle or thoracic region of the body, but entirely free from the underlying segments back of the head. Behind the head is a region composed of eight segments, the five anterior of

which are provided each with a pair of two-branched swimming appendages, the three posterior being destitute of limbs. The five pairs of swimming legs represent the five pairs of grasping legs or maxillipeds of the adult stomatopod. (These are homologous with the three pairs of maxillipeds and two anterior pairs of legs of the *Decapoda*.) The three following segments, which are without limbs, are the three posterior thoracic somites of the adult, which are destined to bear the three pairs of ambulatory limbs. The posterior, broad, unsegmented tail represents the long segmented abdomen of the adult. The specimen here figured was on the point of moulting and within the anterior part of the tail plate are seen two abdominal segments which will become free after the moult. The posterior border of the tail of the next stage is also seen through the transparent cuticle. *a*, anus. On either side of the anus is seen a cœcal, glandular body. From a sketch by Faxon, made at Newport, R. I., August 23, 1876.

12. Part of the border of the tail fin of the same, more highly magnified. In the next stage known, the two abdominal somites seen within the telson in Fig. 11 become free, and the anterior one develops a pair of rudimentary bilobed appendages. These appendages are the first abdominal. The first pair of antennæ become two-branched. As the development proceeds the inner branch of the second pair of maxillipeds increases in size and acquires a terminal claw, while the outer branch is aborted. The abdominal somites and appendages develop gradually in succession from before backwards.
- 13-16. From Claus, *Die Metamorphosen der Squilliden*. Abhandl. Königl. Gesellsch. Wissensch. Göttingen, XVI., Taf. II., III., 1871.
13. Older Erichthoid larva (*Erichthoidina spinosa*) of 7 mm., lateral view. Both pairs of antennæ are now furnished with a lateral branch. The first and second maxillipeds (VI, VII) have lost their external branch and approximate the form of the same parts in the adult. Gill-plates have developed from the basal joint of each (not shown in the figure). The three following pairs of limbs have become much reduced in size. The abdomen now consists of the full number of somites, each with its pair of appendages (XIV-XIX). The last pair (XIX) is very small.
14. Older stage (*Erichthoidina armata*), seen from the ventral side. 9 mm. long. The three posterior pairs of maxillipeds (VIII-X) have undergone atrophy, being now reduced to mere rudiments. The three posterior thoracic segments are still without a trace of appendages. *n*, abdominal nerve-cord.
15. Still older form, or Erichthus stage (*Erichthus Edwardsi*), 16 mm. long, from the Indian Ocean. The three posterior pairs of maxillipeds (VIII-X) have again grown out in their permanent shape, and behind them each of the three posterior segments of the thorax has developed a pair of small buds (XI-XIII), the first rudiments of the three pairs of ambulatory appendages of the adult. The third flagellum of the first antenna is present. VII, gill-plate attached to base of the large grasping leg (VII).
16. Later or Squillerichthus stage (*Squillerichthus triangularis*) of a Stomatopod from Zanzibar. The three pairs of ambulatory appendages are much enlarged and two-branched. On the five anterior pairs of abdominal limbs are seen the rudiments of gills. The sixth abdominal appendage has now outgrown the others and has its permanent form.

From Claus's observations it is probable that the larvæ of the Erichthoid type of development belong to the genus *Gonodactylus*.

- 17-19. Development of *Squilla empusa*, from Beaufort, N. C., to illustrate the *Alima* type of Stomatopod development. From Brooks, *The Larval Stages of Squilla empusa* Say. Chesapeake Zoological Laboratory, Scientific Results of the Session of 1878, Pl. IX., X., 1879. The outline of Fig. 18 is corrected after a drawing of the same stage by Alexander Agassiz.
17. Youngest stage observed, magnified about 75 diameters; seen from below. This is probably the stage in which the larva leaves the egg. (Cf. Paul Mayer, *Mittheil. Zoolog. Stat. Neapel*, II. p. 219, who has seen an *Alima* larva come out of the egg of a *Squilla*, probably *S. mantis*.) This stage corresponds in a general sense to the stage in the development of the *Erichthus* type where the three posterior pairs of maxillipeds have atrophied (fig. 14). There are no two-branched swimming-feet on the thorax, and no thoracic limbs of any kind back of the great grasping legs or second maxillipeds (VII), although three free somites are present. The three posterior thoracic somites are represented by a long unsegmented region. The abdomen has five segments and the terminal fin, the four anterior segments carrying swimming-feet (XIV-XVII), represented only on one side of the figure. *n*, nerve-cord. *ocl*, ocellus.
18. Next stage observed, ventral view. All the thoracic segments are now present.
19. Older stage, ventral view. The ocular segment has become marked off at the front end of the body. The six posterior pairs of thoracic limbs (three posterior pairs of maxillipeds and the three ambulatory limbs of the adult) have begun to form as minute buds (VIII-XIII). The fifth pair of abdominal limbs (XVIII) is present in a very rudimentary condition, and the nerve-ganglion of the sixth abdominal somite is seen, although the somite itself is not yet freed from the telson.

PLATE VIII.

<i>a.</i>	Anus.	<i>n.</i>	Nerve ganglion.
<i>ab.</i>	Abdomen.	<i>oc.</i>	Eye.
<i>br.</i>	Gills.	<i>ocl.</i>	Ocellus.
<i>cp.</i>	Carapace.	<i>pp.</i>	Protoplasm.
<i>ct.</i>	Cuticle, larval skin.	<i>r.</i>	Rostrum.
<i>dp.</i>	Deutoplasm.	<i>α.</i>	Contour of body
<i>f.</i>	Frontal sense-organ.	<i>β.</i>	Larval skin.
<i>i.</i>	Intestine.	<i>γ.</i>	Chorion.
<i>l.</i>	Liver.	<i>ε.</i>	Place of attachment of branchial apparatus.
<i>lb.</i>	Labrum.	<i>ζ.</i>	Abdominal muscles.
<i>mt.</i>	Metastoma.	<i>λ.</i>	Dorsal organ.

The Roman numerals denote the appendages of the body in their consecutive order

1-4. *Development of STOMATOPODA, continued. Figures from W. K. BROOKS and WALTER FAXON.*

1. Larva of *Squilla empusa*, older than the one represented on Plate VII. fig. 19. Ventral view. The antennular segment has become marked off at the anterior end of the body, and the third flagellum of the adult antennule is present. The second antenna has a rudimentary three-jointed inner branch or flagellum. The six posterior thoracic appendages have acquired essentially their permanent form. The sixth abdominal somite has become free and bears a pair of large swimmerets (XIX) similar in form to those of the adult. The abdominal appendages of the left side are omitted in the figure. From Brooks, *Ibid.*, Pl. XI.
2. Still older stage of the same, dorsal view. Length 17 mm. The abdominal appendages are not shown in the figure, excepting the last pair (XIX). From a sketch by Faxon, made at Newport, R. I., August 24, 1876.
3. The specimen represented in fig. 2, moulted on the 25th of August, assuming the form shown in fig. 3, from the lower side. It is now 19 mm. long, and has the characters of the adult *Squilla empusa*. All the abdominal limbs are present, but are omitted in the figure with the exception of the last pair (XIX) and the right one of the first pair. From a sketch by Faxon.
4. Part of the border of the telson of the same, more highly magnified.

5-8. *Development of CUMACEA. Figures from ANTON DOHRN, Untersuchungen über Bau und Entwicklung der Arthropoden. I. Ueber den Bau und die Entwicklung der Cumaceen. Jenaische Zeitschr., V., Taf. II., 1870.*

5. Early stage in the development of the embryo of *Cuma Goodsiri*. *α*, contour of the body. *β*, larval skin. *γ*, chorion. *λ*, dorsal organ. Behind the dorsal organ a deep fold gives the embryo a marked dorsal flexure. Through this dorsal flexure and dorsal organ the embryo exhibits a striking resemblance to the embryo of Isopods. Cf. Plate VI. The sixth pair of appendages, however, unlike the corresponding pair in the Isopod embryo, at this early stage is two-lobed and resembles the six following pairs of appendages. Rudiments of all the appendages are present from the first to the twelfth. *cp*, carapace commencing as a fold in the region of the maxillæ. *l*, liver.
6. Later stage of the same. The outer membrane has been cast off. The caudal appendages (XIX) are present.
7. Later stage. The embryo now approaches the Decapod type. The larval skin has been shed, the dorsal organ has disappeared, and the dorsal flexure is exchanged for a ventral one. The bulk of the first maxilliped (VI) is formed from the exopodite while the similar second maxilliped (VII) represents the endopodite alone, the external branch having entirely disappeared. X', XI', rudimentary exopodites of the tenth and eleventh pairs of appendages. The twelfth pair is now devoid of external branch.
8. Larva ready to leave the brood-sac. *ε*, place of attachment of the branchial apparatus. The last pair of thoracic legs has not yet developed, nor the appendages of the abdomen except the last pair (XIX). The abdominal appendages are never developed in the female. The eyes, which are not shown in the figures, are developed on each side of the head, and coalesce at a later period to form the median sessile eye of the adult.

9-17. *Development of NEBALIA GEOFFROYI. Figures from ELIAS METSCHNIKOFF, ИСТОРИЯ РАЗВИТІЯ NEBALIA. ЗАПИСОКЪ ИМП. АКАДЕМІИ НАУКЪ, XIII, САНКТПЕТЕРБУРГЪ, 1868 [Development of Nebalia. Mem. Imper. Acad. Sci., XIII., St. Petersburg, 1868].*

9. Early stage showing partial segmentation (telolecithal). 7^{f} .
10. Later stage. The blastoderm cells now form a cap over one pole of the egg. 7^{f} .
11. So-called nauplius stage of the embryo. The rudiments of the two pairs of antennæ and mandibles are present (I, II, III). *a b*, abdomen.
12. Later stage in the development of the embryo. The seven anterior pairs of appendages are now present. *l b*, labrum. *a*, anus.
13. Still older phase. The dotted line from VIII passes a little forward of its proper place in the figure.
14. Embryo at the time of leaving the egg. Most of the appendages are present. The body is still enveloped in a larval skin, *c t*, and the abdomen is bent upwards. 7^{f} .
15. Older larva after the larval skin has been cast off. *IV'*, external branch of first maxilla. *o c*, eye. *c p*, carapace. 7^{f} .
16. Later stage. *r*, rostrum. *IV'*, appendage of the first maxilla extending backwards over the branchial feet. VI-XIII, branchial feet. Behind these are four pairs of abdominal swimming-feet. *a b*^s, eighth somite of abdomen bearing the two terminal styliform appendages (ξ). 7^{f} .
17. One of the phyllopod appendages. 1, inner branch. 2, middle branch. 3, outer branch. 15^{o} .

18-22. *Development of SCHIZOPODA. Figures from ELIAS METSCHNIKOFF and CARL CLAUS.*

18. Nauplius of *Euphausia*, just hatched. A mouth opening is seen between the bases of the third pair of appendages, but there is no anal orifice. From Metschnikoff, Ueber den Naupliuszustand von *Euphausia*. Zeitschr. wissenschaft. Zool., XXI., Taf. XXXIV., 1871.
19. Later stage of the same. *o c l*, ocellus. *l b*, labrum. *m t*, metastoma or lower lip. *IV*, rudiment of first maxillæ. *V*, second maxillæ. *VI*, first maxilliped. The carapace is now present. The specimen figured was about to moult, and within the third pair of nauplius appendages are seen the mandibles of the next stage, when the function of these appendages becomes masticatory. From Metschnikoff, *op. cit.*
20. Later stage (protozoëa) of a *Euphausia* larva from the Atlantic Ocean, seen from the ventral side. $1\frac{1}{2}$ mm. long. The hind body (thorax and abdomen) has now acquired great length. The segmentation of the body is beginning in the region back of the first maxillipeds, i. e. in the thoracic region, the hinder or abdominal portion being yet uninvaded by segmentation. *f*, frontal sense-organ, similar to that shown on previous plates in larvæ of *Cirripedia*, *Apus*, &c. Grobben (Arbeiten Zoolog. Inst. Wien., II. p. 262, Taf. XVII. figs. 74-76, 1879) has shown that the larva of *Euphausia* also has a "dorsal organ" equivalent to that which we have seen in the embryos of many of the lower Crustacea. *i*, intestine. *a*, anus. ζ , longitudinal muscles of the abdomen. From Claus, Untersuchungen zur Erforschung der Genealogischen Grundlage des Crustaceen-Systems, Taf. I., 1876.
21. Still later stage (zoëa) of the same, lateral view. $2\frac{3}{4}$ mm. long. The thoracic region behind the first maxilliped (*VI*) is divided into its full number of seven somites, although they are extremely short. The abdomen is also divided into six somites. The telson is not yet separated by a suture from the sixth segment. Underneath the cuticle of the anterior portion of the terminal segment are the rudiments of the posterior pair of abdominal appendages (not seen in the lateral view). The larva, unlike the typical zoëa, lacks the second pair of maxillipeds, and the antennæ are still large swimming-organs. As the development proceeds, the thoracic and abdominal appendages develop as two independent series from before backwards, the abdominal series being completed before the thoracic series. *o c*, eye. From Claus, *loc. cit.*
22. Second and third maxillipeds (*VII*, *VIII*) and the first and second ambulatory appendages (*IX*, *X*) of a *Euphausia* $4\frac{1}{2}$ -5 mm. long. *VII'*, etc., outer branches of appendages. *b r*, gills. From Claus, *loc. cit.*