

XXXIV.—*On the Young Stages of a few Annelids.*

BY ALEXANDER AGASSIZ.

Read June 25, 1866.

THE study of immature animals has become so important that, before proceeding to my subject, it may be of some interest to those engaged in investigating marine animals, to know how the young may be collected. Johannes Müller was the first who successfully employed surface dredging with a fine gauze hand-net; he has been followed with eminent success by many of his pupils, and now scooping the surface of the sea in search of diminutive animals, scarcely to be recognised with the naked eye, is one of the most profitable sources of supply for recent investigators at the sea-shore. Baur* has introduced fishing with the gauze net by sinking it to any desired depth, and this promises to be a fruitful mode of finding what cannot be reached with a hand net. Meyer and Möbius,† in their investigations of the Fauna of the Bay of Kiel, have even attempted, with remarkable good fortune, to pump up from the vicinity of the bottom any animals there abounding.

As a rule, the habits of the young marine animals are so utterly different from those of the adult, that we cannot expect to find them together, and must not search for the young in the retreats where lie concealed the adult Crustacea, in the mud-flats or sandy beaches where are buried Annelids and Mollusca, along the rocky shores where so many Gasteropods abound, or under sea-weeds and stones, the hiding-places of both Annelids and Mollusks, as well as Crustacea. We must not look in

* BAUR, A. Beiträge zur Naturgeschichte der *Synapta digitata*; in Verhandl. der K. L. C. D. Akad. 1864.

† MEYER, H. A. u. MÖBIUS K. Fauna der Kieler Bucht.

rocky pools frequented by Starfishes, Sea-urchins, and the like, for young Echinoderms; the young Polyps are not always to be found growing up by the side of their parents; neither can we expect to find the young Cod, Goose-fish, Lump-fish, Flounder, Cottoids, and Perches, on the feeding-grounds frequented by the fishermen in search of the adult. The young fishes abound close in shore, along sandy flats heated by the sun, seeking to avoid the dangers which would beset them in deeper waters, and they can scarcely be recognised for what they really are except by the most practised eye. Thus the earlier stages of most marine animals are passed under circumstances totally different from those of the adult. When the adults are sedentary in their habits, and capable of very limited motion, the young are almost always endowed with corresponding freedom, leaving them entirely at the mercy of the winds and currents. On the contrary, in the class where we have the greatest freedom of movements and least sedentary habits, we find the young, for the most part, fixed to the ground and incapable of any motion. What greater contrast can there be in this respect than the early stages of Hydroid Medusæ, when, plant-like, they remain for ever attached to one spot, giving rise to Medusæ endowed with the most varied and graceful movements, and often carried about helpless by the wind and tide.

The young of many of our Annelids present a similar contrast to the adult, the latter passing their existence buried in tubes sunk in the mud or sand, while in their early stages they are free and nomadic, and swarm near the surface of the sea. Who would have thought of looking for young Echinoderms among those erratic beings which perform such a conspicuous part in the phosphorescence of the sea, until the wonderful researches of Müller led the way to a field of investigations which has revealed changes of the most astonishing nature! The young Crustacea, until quite advanced, find their way to the top of the water, where they swim about in company with

embryo Mollusks, both very different in appearance and in their habits from the adults.

From the few complete embryologies we possess of the lower marine animals, it is apparent that there has not been, up to this time, any systematic method of working. Artificial fecundation can do much towards adding to our knowledge of the early stages of marine animals, but any one who has lived at the sea-shore and endeavored to keep alive these tiny creatures, will soon find in this method insurmountable obstacles to pursuing his investigations beyond very narrow limits. The only way is to go to the fountain head at once, to make oneself familiar with the currents at all hours of the tide and under all possible influences of wind; to notice the place where opposite currents meet, and throw into long bands the wealth of animal life they have swept along; to become so perfectly familiar with what you may expect to find under certain conditions, that no time shall be lost in looking for the most favorable spot which otherwise you would only stumble upon accidentally. The habitat of the adult animals should be carefully observed, so that by surface dredging with the fine gauze hand-net in the vicinity of their abodes, and by a close attention to the direction which the currents take from these places, at the time of breeding, we can often obtain specimens at all ages and of all sizes, till they have ceased to be nomadic or have assumed the habits they retain in their adult condition.

According to the nature of each locality spots are easily found where the currents which skirt along the shores are compelled to pass. Projecting points of land are barriers during certain hours of the day, and everything brought floating with the tide along their shores will accumulate, until it forces its way round or over the obstacles. Narrow passages between islets and the shore, through which the tide rushes with great rapidity, will give us a synopsis as it were of all that can be found in the vicinity. When the wind blows constantly from the same direction, it will heap up on the lee shore anything

floating on the surface, so that frequently the examination of a few rods will give us at once what otherwise we should find only after a protracted search.

Violent storms which throw upon the beaches masses of seaweed, furnish a rich harvest of small animals, attached to the fronds, or concealed between the roots, only to be found in hiding-places inaccessible at other times. The roots of *Laminaria* are the resort of thousands of young Echinoderms, Annelids, Crustacea, and Mollusks, after they have ceased to swarm near the surface of the water, and have assumed somewhat the habits of the adult. Not even the dredge will root these up, and we must snatch at the favorable chances an opportune storm throws in our way.

I have already shown in my different papers on the Embryology of Echinoderms* and *Acalephs*,† how useful knowledge of this kind proved in order to complete missing links in the history of their development. In the following pages will be given some of the results obtained for a few Annelids by a similar mode of procedure.

PLANARIA.

Before the observations of Müller‡ on the development of Planarians, the embryos had not been found to differ materially

* AGASSIZ, ALEXANDER. On the Embryology of *Astracanthion berylinus*, Ag. . . . ; in Proc. Am. Acad. April 14, 1863.

AGASSIZ, ALEXANDER. On the Embryology of Echinoderms; in Mem. Am. Acad. IX. 1864.

AGASSIZ, ALEXANDER. Embryology of the Star-fish; in Vol. 5 of Agassiz's Cont. Nat. Hist. of U. S. 1865.

† AGASSIZ, ALEXANDER. North American *Acalephæ*; No. 2 of Illustrated Catalogue of Museum of Comparative Zoölogy. 1865.

‡ MÜLLER, JOHANNES. Ueber eine eigenthümliche Wurmlarve aus der Classe der Turbellarien u. aus der Familie der Planarien; in Archiv f. Anat. u. Phys. 1850. p. 485. Plate XII-XIII.

from the adult; according to Siebold,* Schmidt,† and Quatrefages,‡ they differed principally in size, and no trace of metamorphosis could be seen; similar results have been obtained by Van Beneden,§ Keferstein and Ehlers,|| and Claparède.¶ Müller's observations first showed the existence of a metamorphosis in Panaria, while Leuckart and Pagenstecher** subsequently proved beyond doubt the existence of still more striking changes in Pilidium, of a sort of alternate generation giving rise to Nemertes, as previously suggested by the observations of Müller,†² Busch,‡² Gegenbaur,§² Wagener,||² and Krohn;¶²

* SIEBOLD, K. T. v. Wirbellose Thiere; in *Siebold u. Stannius Vergleichende Anatomie*, p. 171.

† SCHMIDT, E. O. Die Rhabdocœlen Strudelwürmer des Süßenswassers, beschrieben u. abgebildet. 1848.

‡ QUATREFAGES, A. de. Mémoire sur quelques Planaires marines; in *Ann. Seien. Nat.* 3me. Ser. 1845. IV.

§ VAN BENEDEN, P. J. Recherches sur la Faune littorale de la Belgique. Turbellariés de la côte d'Ostende. 1860.

|| KEFERSTEIN, W. u. EHLERS, E. Zoologische Beiträge gesammelt im Winter 1859-60, in Neapel u. Messina. 1861.

¶ CLAPARÈDE, A. R. E. Beobachtungen ueber Anatomie u. Entwicklungsgeschichte wirbelloser Thiere, an der Küste von Normandie angestellt. Leipzig, 1863.

** LEUCKART, R. u. PAGENSTECHEER, AL. Untersuchungen ueber niedere Seethiere. Pilidium die Larve einer Nemertine; in *Arch. f. Anat. u. Phys.* 1858. p. 569, Pl. XIX.

†² MÜLLER, J. Ueber verschiedene Formen von Seethieren: in *Arch. f. Anat. u. Phys.* 1854. p. 81.

MÜLLER, J. Bericht ueber einige neue Thierformen der Nordsee; in *Arch. f. Anat. u. Phys.* 1846. Pl. V.

‡² BUSCH, W. Beobachtungen ueber Anatomie u. Entwicklung einiger Wirbelloser Thiere. Berlin. 1851.

§² GEGENBAUR, C. Bemerkungen ueber Pilidium gyrans, Actinotrocha branchiata und Appendicularia; in *Zeitschr. f. Wiss. Zool.* 1853. V. p. 346.

||² WAGENER, R. Ueber die Mesotrocha sexoculata v. Willh. Busch; in *Arch. f. Anat. u. Phys.* 1847. p. 187.

¶² KROHN, A.; in *Archiv f. Anat. u. Phys.* 1856. p. 78.

KROHN, A.; Ueber Pilidium u. Actinotrocha; in *Archiv f. Anat. u. Phys.* 1858. p. 289.

changes reminding us of a somewhat similar process in the development of an Echinoderm from a Pluteus. To these evidently dissimilar modes of development I still have to add the transformations of Nareda, as shown in a subsequent part of this paper, resembling the usual mode of development of Annelids; also a sort of retrograde development of a species of Planaria quite analogous to that more fully described in Nareda, where we have a gradual extinction, with advancing age, of very distinct articulate features of the young. As in Nareda, we find in this Planaria plainly marked articulations when young, which become less and less distinct with advancing development, a striking contrast to the evolution shown to exist in Planarians by Müller, and to the usual mode of growth in this family where the young so early resemble the adult.

On examining a string of eggs, mistaken at first for those of some naked Mollusk, I was surprised to find young Planariae in different stages of growth with a ramifying digestive cavity, somewhat similar to that of adult specimens, but showing besides one distinct articulation for each spur of the digestive cavity. The eyes were well developed, and when the young became free, the articulations were still distinct, and the ramifications of the digestive cavity sufficiently advanced to enable me to determine with tolerable certainty the species to which these young belonged; probably the *Planaria angulata* MÜLL.*

In the youngest specimen observed, Fig. 1, the spurs of the digestive cavity were quite prominent, eleven in number (the first trace of the ramifications of the adult); each spur was placed in a distinctly marked transverse ring. The two anterior and posterior rings were much larger than the others. In this stage the young Planaria scarcely answers to its name; it is almost cylindrical, and only slightly compressed. In Fig. 2, the processes are larger and more distinctly developed, and the young worm has become considerably flattened. It seems

* MÜLLER, O. F. *Zoologia Danica.*

scarcely necessary to refer to the opinion advanced by Girard,* that the Planarians are naked Gasteropods.

ON THE ADULT OF LOVÉN'S ANNELID LARVA.

(*Nareda Gir.*) ††

Although Lovén was the first to publish observations on the development of Annelids proper, as early as 1842,‡ when he traced the development of an Annelid, supposed at the time to be the larva of some Nereis-like animal, yet up to the present day, his observations have not been confirmed in spite of the many memoirs we now possess on the metamorphosis of several families of true Annelids. Milne Edwards, who followed closely upon Lovén with a most exhaustive history of the development of *Terebella*,§ laid the foundation of generalizations on the mode of formation and norm of succession of rings in the young Annelids, which subsequent observations have completely confirmed; these were somewhat different from what would seem to be logically deduced from the observations of Lovén, so that it is of considerable interest to have the observations of the latter repeated, to show that the development of this larva does not differ very materially from the general mode of evolution observed in other Annelids.

The large disk of the anterior extremity in Lovén's larva was

* GIRARD, CH. Recherches upon Nemerteans and Planarians. I. Embryonic Development of *Planocera elliptica*; in Jour. Acad. Nat. Sciences. Phil. 1854.

GIRARD, CH. On the Development of *Planocera elliptica*; in Proc. Bost. Soc. N. H. III. p. 348.

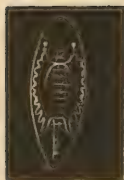
† GIRARD, CHAS.; in Synopsis of Marine Invertebrates of Grand Manan, by W. Stimpson; in Smithsonian. Cont. 1853.

‡ LOVÉN, S. L. Jakttagelse öfver metamorfos hos en Annelid; in K. Vet. Akad. Handl. Stockholm. 1840. p. 93.

LOVÉN, S. L. The same, translated by W. Peters, in Archiv f. Naturg. 1842. I. p. 302; also in Ann. d. Scien. Nat. 2me. Ser. 1842. XVIII. p. 288.

§ EDWARDS, H. MILNE. Observations sur le développement des Annélides; in Ann. d. Scien. Nat. 1845. III. p. 145.

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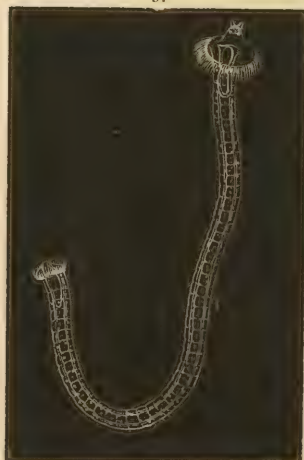
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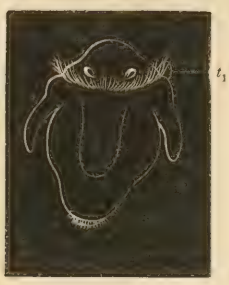
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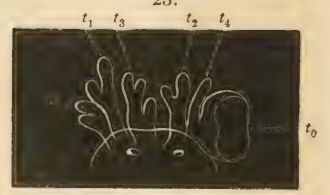
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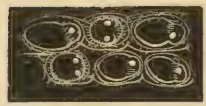
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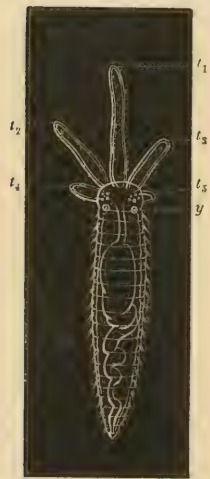
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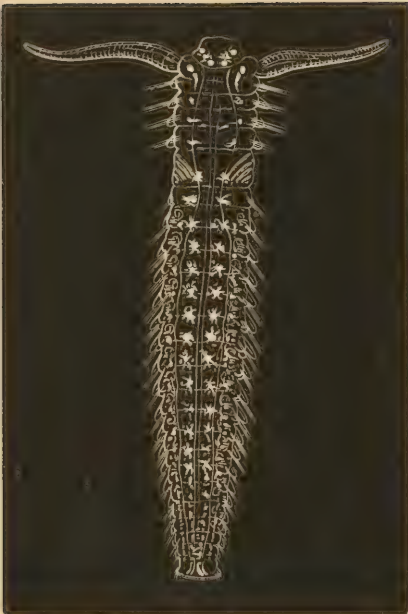
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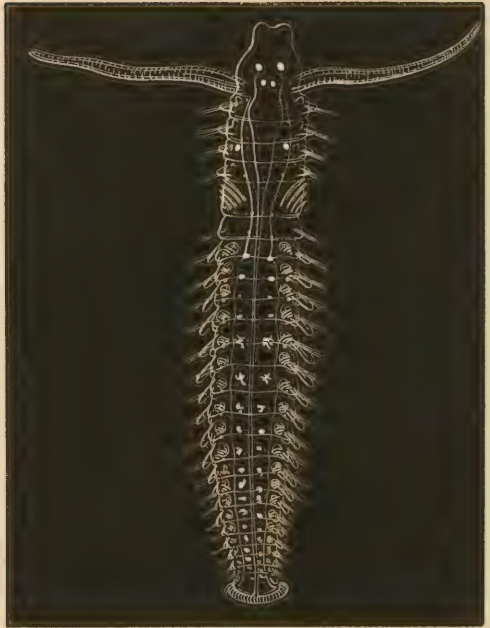
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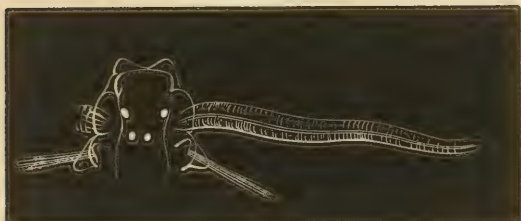
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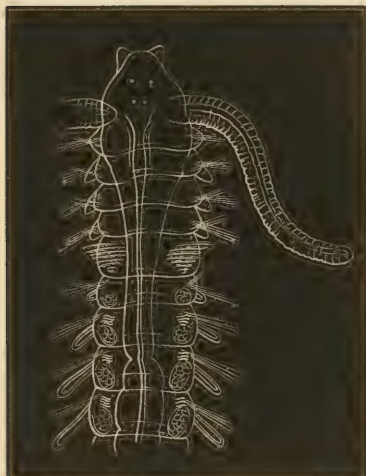
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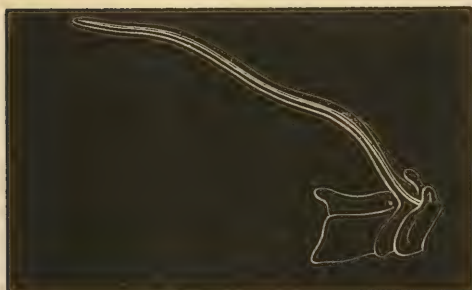
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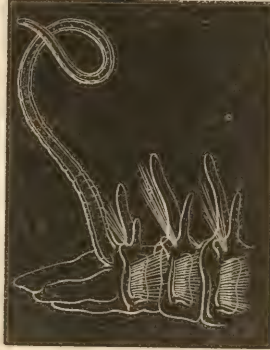
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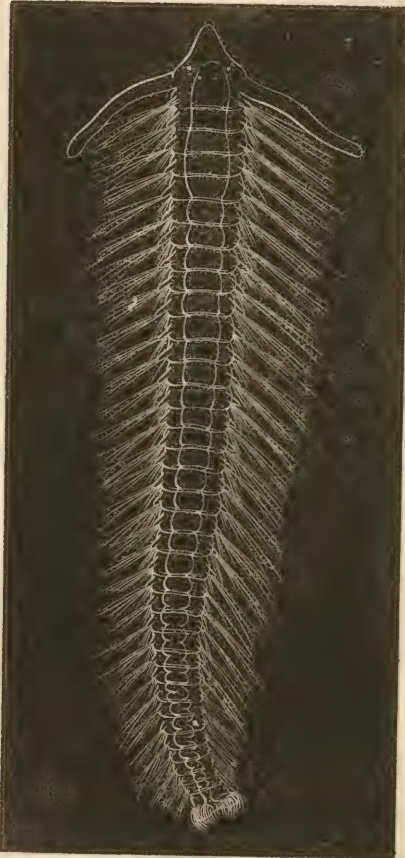
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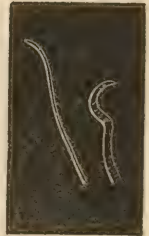
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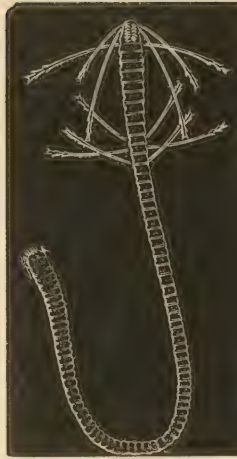
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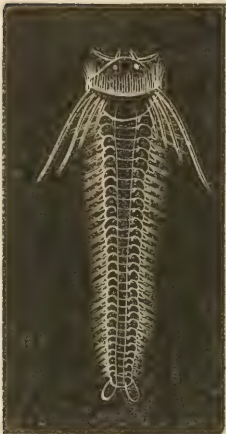
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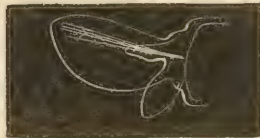
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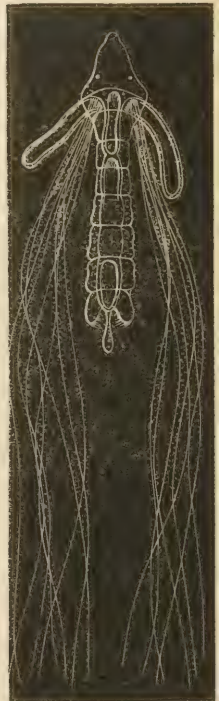
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