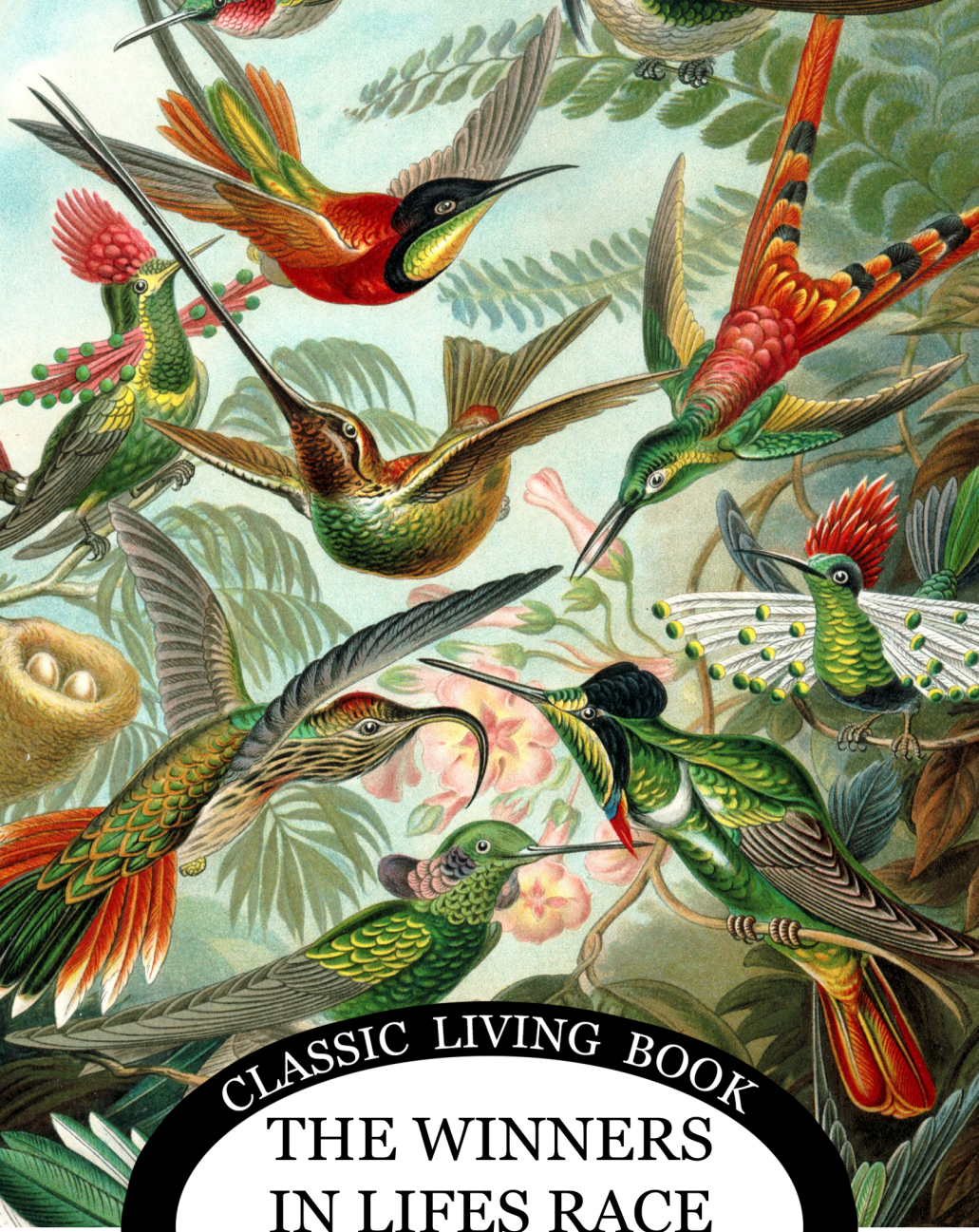

CLASSIC LIVING BOOK

THE WINNERS IN LIFES RACE

Arabella Buckley

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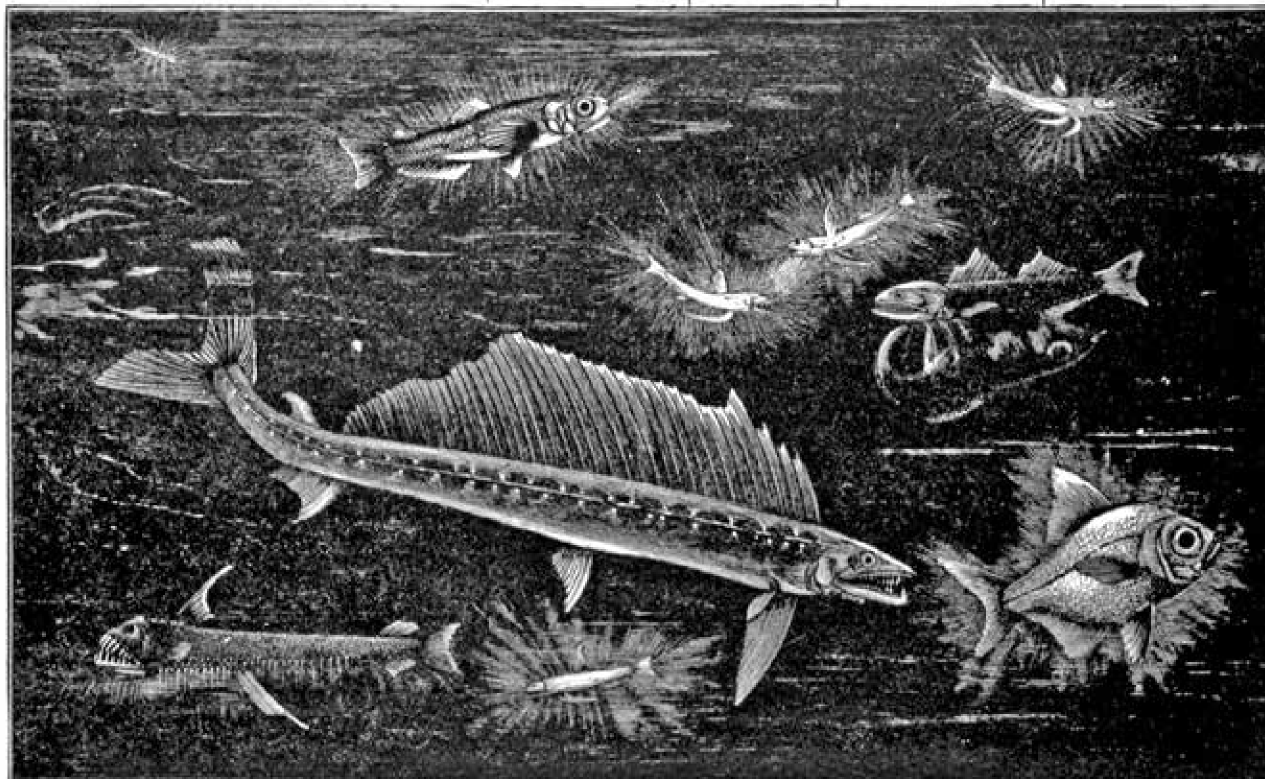
The Winners in Life's Race

or the Great Backboned Family

by

Arabella B Buckley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PREFACE.

Although the present volume, as giving an account of the *vertebrate* animals, is a natural sequel to, and completion of, my former book, *Life and her Children*, which treated of *invertebrates*, yet it is a more independent work, both in plan and execution, than I had at first contemplated.

This arises from the nature of the subject. The structure and habits of the lower forms of life are sufficiently simple to be treated almost without reference to geological history. When, however, I began to sketch out the lives and structure of the vertebrate animals, which are so closely interlinked one with another and yet so sharply separated into groups, I soon found that I must carry my readers into the past in order to give any intelligible account of the present.

I have therefore endeavoured to describe graphically the early history of the backboned animals, so far as it is yet known to us, keeping strictly to such broad facts as ought in these days to be familiar to every child and ordinarily well-educated person, if they are to have any true conception of Natural History. At the same time I have dwelt as fully as space would allow, upon the lives of such modern animals as best illustrate the present divisions of the vertebrates upon the earth; my object being rather to follow the tide of life, and sketch in broad outline how structure and habit have gone hand-in-hand in filling every available space with living beings, than to multiply descriptions of the various species. If my younger readers will try and become familiar

with the types selected, either alive in zoological gardens or preserved in good museums, they will, I hope, acquire a very fair idea of the main branches of the Backboned Family.[1]

In order to treat so vast a subject simply and within narrow limits, it has often been necessary to pass lightly over new and startling facts. I trust, however, it will not be inferred that such passages have been lightly or carelessly written, for in all cases I have sought, and most gratefully acknowledge, the assistance of some of our best authorities; and I have endeavoured that what little is said upon difficult subjects shall be a true foundation for wider knowledge in the future.

Among the many friends who have rendered me valuable assistance, I cannot sufficiently express my obligations to Professor W. Kitchen Parker for his unwearying kindness in explaining obscure points of anatomical structure, and to my friends Mr. Alfred R. Wallace, Professor A. C. Haddon of Dublin, and Mr. Garnett of the British Museum, for constant suggestion and encouragement. I am also indebted to Mr. J. P. Anderson of the British Museum for aid in the arrangement of the Index.

The geological restorations given as picture-headings (some of which are here attempted, I believe, for the first time) have been most carefully considered, though the exact forms of such strange and extinct animals must necessarily be somewhat conjectural. My thanks are due to the artist, Mr. Carreras, jun., for the patience and care with which he has followed my instructions regarding them, and also to Mr. Smit for his masterly execution of the frontispiece.[2]

1 Almost every animal mentioned in this book is to be found alive in the London Zoological Gardens, or stuffed in the British Museum.

2 The Figures in the text, which, with exception of about twenty, have all been

I have been asked why, in this and the former work, I have not given genealogical tables to help the reader to follow the relations of the various groups. My reason is, that it is impossible to construct tables of this kind without giving a false idea of the fixity of natural divisions and of the extent of our knowledge. To men of science, who know how provisional such tables are, they have a certain value, but they would be positively harmful in a work of this kind, which will have fully accomplished its purpose if it only awakens in young minds a sense of the wonderful interweaving of life upon the earth, and a desire to trace out the ever-continuous action of the great Creator in the development of living beings.

Arabella B. Buckley.

London, *September 1882.*

drawn expressly for this book, are the work of the above-mentioned artists, together with Mr. Coombe and Miss Suft.

CHAPTER I.

THE THRESHOLD OF BACKBONED LIFE.

LIFE, life, everywhere life! This was the cry with which we began our history of the lowest forms of Life's children, and although we did not then pass on to the higher animals, is it not true that before we reached the end we were overwhelmed with the innumerable forms of living beings? The microscopic lime and flint builders, the spreading sponges, the hydras, anemones, corals, and jelly-fish filled the waters; the star-fish, sea-urchins, crabs, and lobsters

crowded the shores; the oysters, whelks, and periwinkles, with their hundreds of companions, struggled for their existence between the tides; while in the open sea thousands of crustaceans and molluscs, with cuttle-fish and terribly-armed calamaries, roamed in search of food. Upon the land the snails and slugs devoured the green foliage, while the vast army of insects filled every nook and cranny in the water, on the land, or in the air. Yes! even among these lower forms we found creatures enough to stock the world over and over again with abundant life, so that even if the octopus had remained the monarch of the sea, and the tiny ant the most intelligent ruler on the land, there would have been no barren space, no uninhabited tracts, except those burning deserts and frozen peaks where life can scarcely exist.

Yet though the world might have been full of these creatures, they would not have been able to make the fullest use of it, for all animal life would have been comparatively insignificant and feeble, each creature moving within a very narrow range, and having but small powers of enjoyment or activity. With the exception of the insects, by far the greater number would, during their whole lives, never wander more than a few yards from one spot, while, though the locust and the butterfly make long journeys, yet the bees and beetles, dragon-flies and ants, would not cross many miles of ground in several generations.

What a curious world that would have been in which the stag-beetle and the atlas-moth could boast of being the largest land animals, except where perhaps some monster land snail might bear them company; while cuttle-fish and calamaries would have been the rulers of the sea, and the crabs and lobsters of the shores! A strangely silent world too. The grasshopper's chirp as he rubbed his wings together,

the hum of the bee, the click of the sharp jaws of the grub of the stag-beetle, eating away the trunk of some old oak tree, would have been among the loudest sounds to be heard; and though there would have been plenty of marvellous beauty among the metallic-winged beetles, the butterflies, and the delicate forms of the sea, yet amid all this lovely life we should seek in vain for any intelligent faces,—for what expression could there be in the fixed and many-windowed eye of the ant or beetle, or in the stony face of the crab?

These lower forms, however, were not destined to have all the world to themselves, for in ages, so long ago that we cannot reckon them, another division of Life's children had begun to exist which possessed advantages giving it the power to press forward far beyond the star-fish, the octopus, or the insect. This was the Backboned division, to which belong the fish of our seas and rivers; the frogs and toads, snakes, lizards, crocodiles, and tortoises; the birds of all kinds and sizes; the kangaroos; the rats, pigs, elephants, lions, whales, seals, and monkeys.

Is it possible, then, that all these widely different creatures, which are fitted to live not only in all parts of the land, but also in the air above, and the seas and rivers below, and which are, in fact, all those popularly known as "animals," only form one division out of seven in the real animal kingdom?

Can it be true that while the chalk-builders have one division all to themselves, the sponges forming a transition group, the lasso-throwers another division, the prickly-skinned animals a third, the mollusca a fourth, the worms a fifth, and the insects a sixth, yet the innumerable kinds of birds and beasts, reptiles and fishes, are all sufficiently alike to be included in one single division—the seventh? It

seems at first as if this arrangement must be unequal and unnatural; but let us go back for a moment to the beginning, and we shall see that it is not only true, but that quite a new interest attaches to the higher animals when we learn how wonderfully life has built up so many different forms upon one simple plan.

Starting, then, with the first glimmerings of life, we find the minute lime and flint builders, without any parts, making the utmost of their little lives, filling the depths of the sea, and wandering in pools and puddles on the land; acting, in fact, as scavengers for such matter as is left them by other animals. But here their power ends; to take a higher stand in life a more complicated creature is needed, and the sponge-animal, with its two kinds of cells and its numerous eggs, is the next step leading on to the curious division of lasso-throwers. These, in their turn, do their utmost to spread and vary in a hundred different ways. Possessed of a good stomach, of nerves, muscles, powerful weapons, and means for producing eggs and young ones, they fill the waters as hydras, sea-firs, jelly-fish, anemones, and corals. But here they too find their limit, and, without advancing any farther, continue to flourish in their lowly fashion. Meanwhile the tide of life is flowing on in two other channels, striving ever onwards and upwards. On the one hand, the walking star-fish and sea-urchin push forward into active life under the sea, forming, with their relations, a strange and motley group, but one which could scarcely be moulded into higher and more intelligent beings. On the other hand, the oyster and his comrades, with their curious mantle-working secret protect their soft body within by a shelly covering, and by degrees we arrive at the large army of mollusca, headed by the intelligent cuttle-fish. And here this division too ceases

to advance. The soft body in its shelly home does not lend itself to wide and great changes, and it was left for other channels to carry farther the swelling tide of life. These take their rise in the lowly, insignificant division of the worms, which may, perhaps, have had something to do with the earliest forms even of the star-fish and mollusca, but which soon shot upwards, on the one hand along a line of its own, while, on the other, we have seen[3] how, in its many-ringed segments, each bearing its leg-like bristles and its line of nerve-telegraph, the worm foreshadowed the insects and crustacea, or the *jointed-footed* animals of sea and land, forming the sixth division.

Here surely at last we must have reached animals which will answer any purposes life can wish to fulfil. We find among them numberless different forms, spreading far and wide through the water and over the land, and it would seem as if the sturdy crab and fighting lobster need fear no rival in the sea, while the intelligent bee and ant were equal to any emergency on dry ground. But here the tide of life met with another check. It must be remembered that the jointed-footed animals, whether belonging to land or water, carry their solid part or skeleton *outside* them; their body itself is soft, and cased in armour which has to be cast off and formed afresh from time to time as they grow. For this reason they are like men in armour, heavily weighted as soon as they grow to any size, while the body within cannot become so firmly and well knit together as if all the parts, hard and soft, were able to grow and enlarge in common. And so we find that large-sized armour-covered animals, such as gigantic crabs and lobsters, are lumbering unwieldy creatures, in spite of

3 Life and her Children.

their strength, while the nimble intelligent insects, such as the ant and bee, are comparatively small and delicate.

It would be curious to try and guess what might have happened if the ant could have grown as large as man, and built houses and cities, and wandered over wide spaces instead of being restricted to her ant-hills for a home, and few acres for her kingdom; but she too has found the limit of her powers in the impossibility of becoming a large and powerful creature. Thus it remained for Life to find yet another channel to reach its highest point, by devising a plan of structure in which the solid skeleton should be—not a burden for the soft body to carry, as in the sea-urchins, snails, insects, and crabs—but an actual support to the whole creature, growing with it and forming a framework for all its different parts.

This plan is that of the backboned animals. They alone, of all Life's children, have a skeleton within their bodies embedded in the muscular flesh, and formed, not of mere hardened, dead matter, but of bones which have blood-vessels and nerves running through them, so that they grow as the body grows, and strengthen with its strength. This is a very different thing from a mere outer casing round a soft body, for it is clear that an animal with a living growing skeleton can go on increasing in size and strength, and its framework will grow *with* the limbs in any direction most useful to it.

Here, then, we have one of the secrets why the backboned animals have been able to press forward and vary in so many different ways; and especially useful to them has been that gristly cord stretching along the back, which by degrees has become hardened and jointed, so as to form that wonderful piece of mechanism, the *backbone*.

Look at any active fish darting through the water by

sharp strokes of its tail,—watch the curved form of a snake as it glides through the grass, or the graceful swan bending his neck as he sails over the lake,—and you will see how easily and smoothly the joints of the backbone must move one upon the other. Then turn to the stag, and note how jauntily he carries his heavy antlers; look at the powerful frame of the lion, watch an antelope leap, or a tiger bound against the bars of his cage, and you will acknowledge how powerful this bony column must be which forms the chief support of the body, and carries those massive heads and those strong and lusty limbs.

Nor is it only by its flexibility and strength that this jointed column is such an advantage to its possessors; the backbone has a special part to play as the protector of a most valuable and delicate part of the body. We have already learnt in *Life and her Children* to understand the importance of the nerve-telegraph to animals in the struggle for life. We found its feeble beginnings in the jelly-fish and the star-fish; we saw it spreading out over the body of the snail; we traced it forming a line of knots in the worm, with head-stations round the neck, which became more and more powerful in the intelligent insects. But in all these creatures the stations of nerve-matter from which the nerves run out into the body are merely embedded in the soft flesh, and have no special protection, with the exception of a gristly covering in the cuttle-fish. We ourselves, and other backboned animals, have unprotected nerve-stations like these in the throat, the stomach, and the heart, and cavity of the body. But we have something else besides, for very early in the history of the backboned animals the gristly cord along the back began to form a protecting sheath round the line of nerve-stations stretching from the head to the tail, so that

this special nerve-telegraph was safely shut in and protected all along its course.

A careful examination of the backbone of any fish, after the flesh has been cleared off, will show that on the top of each joint (or *vertebra*) of the backbone is a ring or arch of bone; and when all the joints are fastened together, these rings form a hollow tube or canal, in which lies that long line of nervous matter called the *spinal cord*, which thus passes, well protected, all along the body, till, when it reaches the head, it becomes a large mass shut safely in a strong box, the skull, where it forms the brain.

Here, then, besides the unprotected nerve-stations, we have a much more perfect nerve-battery, the spinal cord, carried in a special sheath formed of the arches of the backbone, which is at once strong and yielding, so that the delicate telegraph is safe from all ordinary danger. Now when we remember how important the nerves are,—how they are the very machinery by which intelligence works, so that without them the eye could not see, the ear hear, nor the animal have any knowledge of what is going on around it,—we see at once that here was an additional power which might be most valuable to the backboned division. And so it has proved, for slowly but surely through the different classes of fish, amphibia (frogs and newts), reptiles, birds, and mammalia, this cord, especially that larger portion of it forming the brain, has been increasing in vigour, strength, and activity, till it has become the wonderful instrument of thought in man himself.

We see, then, that our interest in the backboned or *vertebrate* animals will be of a different kind from that which we found in the boneless or *invertebrate* ones. There we watched Life trying different plans, each successful in its

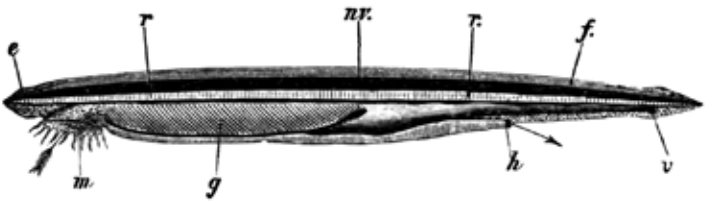
way, but none broad enough or pliable enough to produce animals fitted to take the lead all over the world. Now we are going to trace how, from a more promising starting-point, a number of such different forms as fish, reptile, bird, and four-footed beast, have gradually arisen and taken possession of the land, the water, and the air, pressing forward in the race for life far beyond all other divisions of animal life.

On the one hand, these forms are all linked together by the fact that they have a backbone protecting a nerve-battery, and that they have never more than two pair of limbs; while every new discovery shows how closely they are all related to each other. On the other hand, they have made use of this backbone, and the skeleton it carries, in such very different ways that out of the same bones and the same general plan unlike creatures have been built up, such as we should never think of classing together if we did not study their structure.

What the lives of these creatures are, and what they have been in past time, we must now try to understand. And first we shall naturally ask, Where did the backboned animals begin? Where should they begin but in the water, where we found all the other divisions making their first start, where food is so freely brought by passing currents, where movement from place to place is much easier, and where there are no such rapid changes as there are on the land from dry to damp, from heat to cold, or from bright leafy summer, with plenty of food, to cold cheerless winter, when starvation often stares animals in the face?

It is not easy to be sure exactly how the backboned animals began, but the best clue we have to the mystery is found in a little half-transparent creature about two inches long, which is still to be found living upon our coast. This

Fig. 1.



The Lancelet, the lowest known fish-like form.

m, mouth. *e*, eye-spot. *f*, fin. *r*, rod or notochord, the first faint indication of a backbone. *nv*, nerve cord. *g*, gills. *h*, hole out of which water passes from the gills. *v*, vent for refuse of food.

small insignificant animal is called the "Lancelet,"[4] because it is shaped something like the head of a lance, and it is in many ways so imperfect that naturalists believe it to be a degraded form, like the acorn-barnacle; that is to say, that it has probably lost some of the parts which its ancestors once possessed. But in any case it is the most simple backboned animal we have, and shows us how the first feeble forms may have lived.

Flitting about in the water near the shore, eating the minute creatures which come in his way, this small fish-like animal is so colourless, and works his way down in the sand so fast at the slightest alarm, that few people ever see him, and when they do are far more likely to take him, as the naturalist Pallas did, for an imperfect snail than a vertebrate animal. He has no head, and it is only by his open mouth (*m*), surrounded by lashes with which he drives in the microscopic animals, that you can tell where his head ought to be. Two little spots (*e*) above his mouth are his feeble eyes, and one little pit (*n*) with a nerve running to it is all he has to smell with. He has no pairs of fins such as we find in most fishes, but only a delicate flap (*f*) on his back

4 Amphioxus lanceolatus (*amphi* both, *oxus* sharp).

and round his tail; neither has he any true breathing-gills, but he gulps in water at his mouth, and passes it through slits in his throat into a kind of chamber, and from there out at a hole (*h*) below. Lastly, he has no true heart, and it is only by the throbbing of the veins themselves that his colourless blood is sent along the bars between the slits, so that it takes up air out of the water as it passes.

But where is his backbone? Truly it is only by courtesy that we can call him a backboned animal, for all he has is a cord of gristle, *r r*, pointed at both ends, which stretches all along the middle of his body above his long narrow stomach, while above this again is another cord containing his nerve-telegraph (*nv*.) All other backboned animals that we know of have brains; but, as we have seen, he has no head, and his nerve-cord has only a slight bulge just before it comes to a point above his mouth. Now when the higher backboned animals are only just beginning to form out of the egg, their backbone (which afterwards becomes hard and jointed) is just like this gristly rod or *notochord* (*r r*) of the lancelet, with the spinal cord (*nv*) lying above it; so that this lowest backboned animal lives all his life in that simple state out of which the higher animals very soon grow.

This imperfect little lancelet has a great interest for us, because of his extremely simple structure and the slits in his throat through which he breathes. You will remember that when we spoke of the elastic-ringed animals in *Life and her Children*, we found that the free worms were very active sensitive creatures, whose bodies were made up of segments, each with a double pair of appendages; the whole being strung together, as it were, upon a feeding tube and a line of nerve-telegraph, but without any backbone. Now among these worms we find many curious varieties; some

have the nerve-lines at the sides instead of below, and one sea-worm, instead of breathing by outside gills like the others, has slits in its throat through which the water can pass, and so its blood is purified.

You may ask, What this has to do with backboned animals? Nothing directly, but these odd worms are like fingerposts in a deserted and grass-grown country, showing where roads may once have been. The lancelet, like the worm, has a line of nerve-telegraph and a feeding-tube, only with him the nerve-telegraph lies above instead of below. He has also slits in his throat for breathing, only they are covered by a pouch. Thus he is so different from the worms that we cannot call them relations; but at the same time he is in many ways so like, that we ask ourselves whether his ancestors and those of the worms may not have been relations.

But you will say he is quite different in having a gristly cord. True—but we shall find that even this does not give us a sharp line of division. By looking carefully upon the seaweed and rocks just beyond low tide, we may often find some curious small creatures upon them, called Sea-Squirts or Ascidians (B, Fig. 2).[5] These creatures are shaped very like double-necked bottles, and they stand fixed to the rock with their necks stretching up into the water. Through one neck (m) they take water in, and after filtering it through a kind of net so as to catch the microscopic animals in it and taking the air out of it, they send it out through the other neck, thus gaining the name of sea-squirts. So far, they are certainly boneless animals. But they were not always stationary, as you see them fixed to the rock. In their babyhood they were tiny swimming creatures with tails (A and a), and in the tail was a gristly cord (*r*), with

5 For this drawing, and also those of Figures 1 and 4, I am indebted to Professor A. C. Haddon; the larval form A is the young of Clavelina, found at Torquay.

Fig. 2.

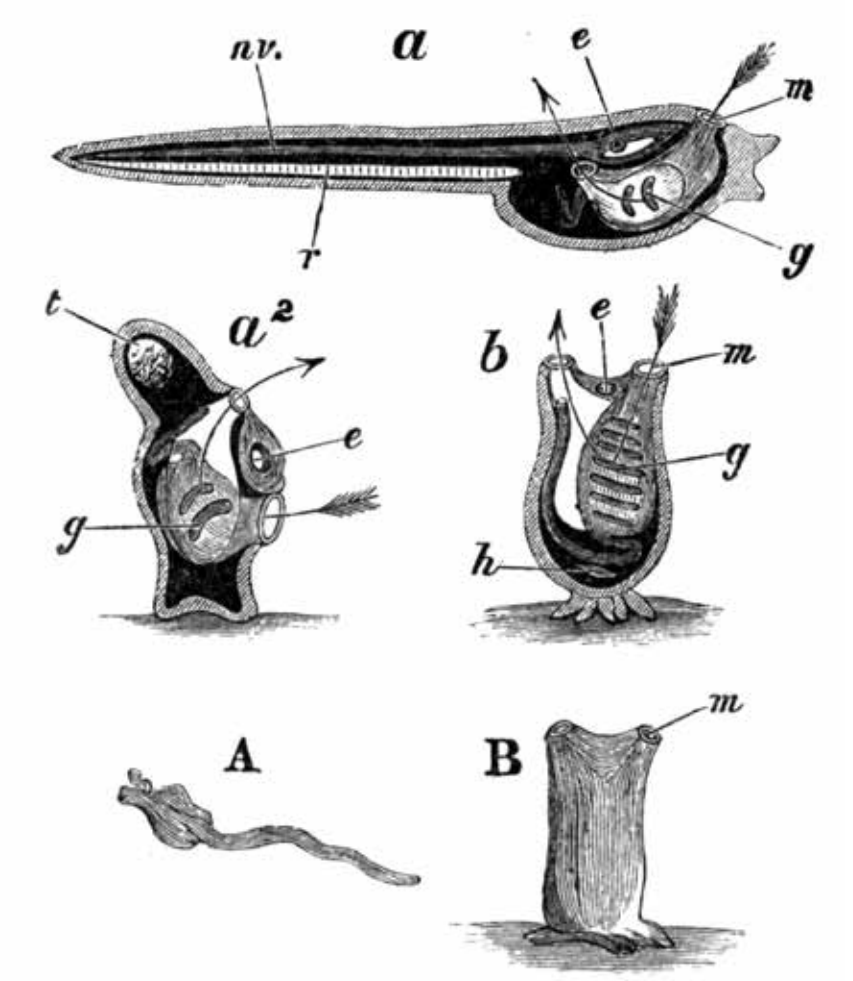


Diagram of the growth of a Sea-Squirt or Ascidian.
A *a*, Young free swimming stage. a^2, Intermediate stage when first settling down. B *b*, Full-grown Sea-Squirt.
m, mouth; *e*, hollow brain with eye; *g*, gill slits; *h*, heart; *r*, rod of gristle in free swimming form; *nv*, nerve cord in same; t, tail in process of absorption in intermediate form.

a nerve cord (*nv*) above it, like those we find in the lancelet. For this reason we were obliged to pass them by among the lower forms of life, because, having this cord (*r*), they did not truly belong to the animals without backbones; and yet now we can scarcely admit them here, because when they are grown up they are not backboned animals. They belong, in fact, to a kind of "No Man's Land," behaving in many ways like the lancelet when they are young, as if they had once tried to be backboned; and yet they fall back as they grow up into invertebrate animals.

So we begin to see that there may have been a time when backbones had not gained quite a firm footing, and our lancelet, with his friends the sea-squirts, seems to lie very near the threshold of backbone life.

And now that we are once started fairly on our road, let us turn aside before beginning the history of the great fish-world and pay a visit to a little creature whose name, at least, we all know well, and which stands half-way between the lancelet and the true fish. This is the Lamprey, represented by two kinds; the large Sea-Lamprey, caught by the fishermen for bait as it wanders up the rivers to lay its eggs, and the true River-Lamprey or Lampern, which rarely visits the sea.

What country boy is there who has not hunted in the mud of the rivers or streams for these bright-eyed eel-like fish, with no fins, and a fringe on back and tail? If you feel about for them in the mud they will often come up clinging to your hand with their round sucker-mouth, while the water trickles out of the seven little holes on each side of their heads. The small river-lampreys do not hurt in the least as they cling, though the inside of their mouth is filled with small horny teeth. But the larger sea-lamprey uses these teeth as sharp weapons, scraping off the flesh of fish for food as he clings to them.

Fig. 3.

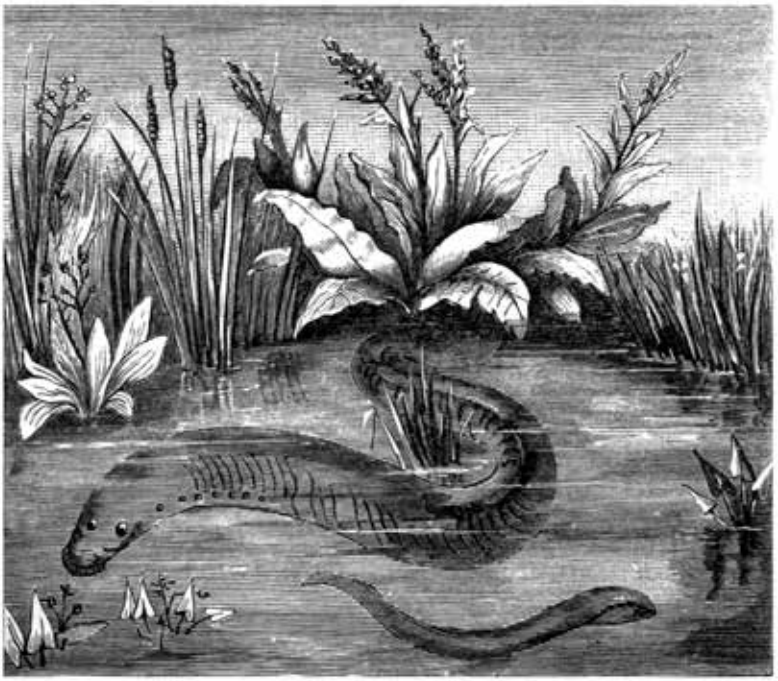


Figure of a full-grown Lamprey[6] and of the young Lamprey, formerly called Ammocœtes.

Showing the seven holes through which it takes in water to breathe.

These Lampreys, together with some strange creatures, the "Hags" or "Borers,"[7] belong to quite a peculiar family, called the Round-mouthed fishes,[8] and, though they stand much higher in the world than the lancelet, yet they are very different from true fish. Like the lancelet they have only a gristly cord for a backbone, but this cord has begun to form arches over the nerve battery, and it swells out at the end into a gristly skull covering a true brain. They have

6 Petromyzon (*petra*, stone; *myzo*, to suck).
7 Myxine.
8 Cyclostomata (*cyclos*, circle; *stoma*, mouth).