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A FAMILIAR HISTORY

OF THE

MOLLUSCS INHABITING THE BRITISH ISLES.

BY

GEORGE BRETTINGHAM SOWERBY, F.L.S.,

AUTHOR OF 'MANUAL OF CONCHOLOGY,'

'CONCHOLOGICAL ILLUSTRATIONS,' 'THESAURUS CONCHYLIORUM,' ETC.

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PREFACE.

In the following pages, the writer has attempted to convey to his readers some of the most striking and interesting facts in the natural history of the Molluscous animals living in and about our own country. The pleasures of a sea-side or country ramble must be greatly increased by an acquaintance with shell-bearing tribes met with among the rocks on the beach, the ponds and lakes and running streams dotting and intersecting the land, and the hedge-rows parting the fields.

This knowledge is sought to be given in language easily understood, and as little burdened as possible with technical phraseology.

An extensive work, by two gentlemen of the highest authority, having recently appeared, fully describing every species of British Mollusca, the present writer has thought

it best to adopt, sometimes even without inquiry, their arrangement of the Classes, Orders, and Genera, as far as such questions come within the scope of his little volume.

Although the principal design has been to familiarize the lover of Nature with the general character and habits of these little-observed animals, it is also hoped that the descriptions, with the help of the Plates, will be sufficient to enable an intelligent observer, even if no conchologist, to recognize the *genus* to which any specimen may belong.

Many of the *species* even, which happen to be distinguished from each other by well-marked peculiarities, may be made out, or at least guessed at, from the very short mention we have made of each species in nearly all the genera.

Some readers may find a pleasure in learning, for the first time, the interesting facts mentioned in this work; others may find these facts awakening in them a desire to pursue the subject further than it will take them. In either case the writer will be gratified, and his design fulfilled.

LIST OF PLATES.

Plate I.

TUNICATÆ, OR LEATHER-BAG MOLLUSCA.

1. *Pelonaia corrugata*, floating or living in the sand.
2 *a*. *Cynthia aggregata*, attached in groups when full grown.
2 *b*. The same in a young state, when free like *Pelonaia*.
3. *Aplidium fallax*, many individuals enclosed in each bag.
4. *Clavellina lepadiformis*, individuals attached to each other by a basal thread.
5. *Ascidia mentula*, attached to the rock singly.
6. *Botryllus polycyclus*, individuals united in star-like bodies.

Plate II.

PHOLADIDÆ, OR BORERS.

1. *Pholas dactylus*, imbedded in the rock.
2. Valves belonging to the back of the hinge, termed accessory valves; they are formed, in many species of *Pholas*, after the animal has attained maturity.

3. *Teredo navalis*, or Ship-worm, in a piece of timber which has been perforated by many other individuals. The white tube is broken, to show the worm-like animal, with the pallets inserted at the upper end, where it is divided into the two canals. At the lower end the valves are shown, and the little sucker-like foot, supposed to be a chief agent in excavating the wood.
4. One of the separated pallets of *T. navalis*.
5. One of the horny, pen-shaped pallets of *T. bipennata*.
6. Valves or shell of *T. Norvegica*.

PLATE III.

BORERS AND BURROWERS.

1. *Xylophaga :* like a *Teredo*, but without a tube. The boring has been effected *across* the grain of the wood.
2. *Gastrochæna modiolina*, valves and animal.
3. Valves of the same alone.
4. Tube or case made of pebbles, sand, etc. agglutinated, containing the valves and animal inside.
5. *Saxicava arctica*.
6. *Pholadidæa papyracea*, or Paper Pholas, with a horny cup at the end of the valves.
7. *Petricola lithophaga ;* literally, "rock-inhabiting stone-eater."

PLATE IV.

1. *Neæra cuspidata*, showing the shell with the foot and tubes of the animal.

2. *Venerupis Irus*, a rock-boring bivalve.
3, 4. *Corbula nucleus.*
5. *Pandora obtusa.*
6. *Pandora rostrata.*
7. *Lyonsia Norvegica.*

Plate V.

MUD BURROWERS.

These live in mud and sand, with the ends of their tubes sometimes protruding above the holes; at other times so deeply immersed as to leave only an indication on the surface.

1. *Lutraria elliptica.*
2. *Mya truncata.* This bivalve has a spoon-shaped process in the hinge of one valve.
3. *Panopæa Norvegica*, found about the northern coasts of Scotland as well as in Norway.

Plate VI.

RAZOR-SHELLS.

1. *Solecurtus candidus*, covered with a dark greenish epidermis, and differing from the true Solens in having a central hinge.
2. *Solen ensis*, the true Razor-shell, having the hinge at one end.
3. *Ceratisolen legumen*, with a singularly shaped foot.

Plate VII.

1. *Psammobia tellinella.*
2. *Tellina crassa*, or Thick Tellen.

3. *Donax anatinus*, or Duck's-bill Wedge.
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5. *Tellina Donacina*, so named from its resemblance to the *Donax*.

Plate VIII.

1. *Mactra stultorum*.
2. *Mactra elliptica*, with the animal having united tubes and a long bent foot.
3. *Tapes virginea;* the hinge having three compressed central teeth.
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5. *Cytherœa Chione;* hinge with central teeth and one anterior tooth.

Plate IX.

1. *Lepton squamosum*, enlarged, showing the cilia, tubes, and foot of the animal.
2. *Cyclas cornea*, a fresh-water bivalve.
3. *Pisidium amnicum*, also fresh-water.
4. *Cyprina Islandica;* coated with epidermis, no sinus in the impression of the mantle.
5. *Artemis lincta:* teeth resembling *Cytherœa;* impression of the mantle with a deep angular sinus.
6. *Astarte Danmoniensis* or *Scotica*.

Plate X.

1. *Cardium edule*, or eatable Cockle.

2. *Cardium lævigatum*, or Smooth Cockle.
3, 4. *Isocardia cor.*

Plate XI.

1. *Arca tetragona.*
2. *Læda caudata;* differing in shape from *Nucula*, but the hinge having two rows of sharp, angular teeth, and a central pit, as in that genus.
3. *Nucula nucleus;* interior of one valve.
4. *Pectunculus pilosus;* having an arched hinge, with two rows of angular teeth, and the ligament placed on an external area.
5. Young and striped specimen of *Mytilus edulis*, or the common eatable Mussel, showing the narrow, white foot, and the byssal cords attaching the bivalve to the rock.
6. *Dreissina polymorpha;* having a septum across the interior at the small end.

Plate XII.

1. *Lima*, showing the cilia and foot of the animal outside the valves.
2. *Anomia ephippium.* The small figure shows the bony button passing through an opening in the lower valve, by which the *Anomia* is fixed to the rock.
3. *Pecten niveus*, or White Scallop; showing the ocelli, or eye-like spots, and cilia.
4. *Anodonta cygnea.*
5. *Terebratula caput-serpentis;* attached to a rock by means of

a byssal cord, passing through a hole in the beak of the upper valve.

Plate XIII.

1. *Dentalium entalis*, or Tooth Shell.
2. *Chiton emarginatus*, Coat of Mail, as attached to the rock.
3. *Hyalæa trispinosa;* showing the wing-shaped flaps for swimming.
4. *Avicula tarentina*, as attached by byssus.
5. *Pinna pectinata*, with its silky beard or byssus.
6. *Fissurella reticulata*, Key-hole Limpet.

Plate XIV.

1. *Ianthina communis;* showing the gelatinous float, with the egg-bags hanging underneath.
2. *Haliotis tuberculatus*, or Ear-shell.
3. *Phasianella pullus*, "Pheasant."
4. *Trochus cinerarius.*
5, 6, *Patella vulgaris*, or common Limpet.

Plate XV.

1, 2. *Littorina littorea*, Periwinkle of the shore.
3. Its operculum.
4. *Lacuna vincta;* showing its divided foot.
5. *Paludina vivipara.*
6. *Eulima nitida;* showing the eyes of the animal through the glassy shell.
7. *Scalaria Trevelyana.*

Plate XVI.

1. *Aporrhais pes-pelicani;* so named from the resemblance of the outer lip to the webbed foot of a bird.
2. *Turritella communis.*
3. *Cæcum trachea.*
4. *Buccinum undatum*, or common Whelk.

Plate XVII.

1. *Mangelia septangularis.*
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3. *Trichotropis borealis.*
4. *Murex erinaceus.*
5. *Natica monilifera.*
6. *Purpura lapillus.*
7. *Natica Alderi;* showing the mentum and fold of the foot partly enveloping the shell.

Plate XVIII.

1 *a*. *Cypræa Europæa*, or European Cowry; the shell enveloped, excepting the dorsal ridge, by the mantle of the animal, as in walking.

1 *b*. Shell of the same, as when the animal is enclosed.

2 *a*. *Fusus Berniciensis.*

3. Rudimentary shell of *Fusus Turtoni.*
4. Egg-bag of the same.
5. *Bulla lignaria.*

Plate XIX.

1. *Doris planata:* has no shell, but the breathing apparatus external.

2. *Achatina acicula.* *Achatina* has a notch at the end of the columella, thus differing from *Bulimus.*
3. *Testacella Haliotoidea;* a slug, with a small shell at its back.
4. *Helix pomatia;* a large snail.
5. *Cyclostoma elegans;* a land-shell with an operculum.
6. *Succinea putris.*
7 *a.* *Aplysia hybrida*, with the shell entirely enveloped.
7 *b.* Shell of the same.

Plate XX.

WATER-SNAILS.

1. *Physa hypnorum.*
2. *Limnæus stagnalis.*
3. *Planorbis vortex.*
4. *Ancylus fluviatilis;* the animal resembling those of *Physa* and *Limnæus*, notwithstanding the difference of the shells.

CEPHALOPODA, OR CUTTLE-FISH.

5. *Rossia macrosoma.*
6. Internal bone or shell of the *Sepia officinalis.*

POPULAR

BRITISH CONCHOLOGY.

CHAPTER I.

SEA-SIDE PLEASURES.—LEATHER-BAGS AND STARS.—TUNICS OF THE 'TUNICATA.'—COMPOUND AND SIMPLE ASCIDIANS.—APLIDIUM.—EARLY ACTIVITY OF THE ASCIDIANS.—CLASSIFICATION.—PATIENCE NOT ALWAYS REWARDED.

TUNICATA.

A PLEASANT and healthy recreation is that of wading among the low rocks and seaweeds of the beach, regardless of shoes sopped in salt water, and occasional slips into ugly holes. Then is the time to decide whether we have "eyes or no eyes," or whether we can *perceive*, as well as see, the interesting, the beautiful, the grand: the grand, in the towering cliffs on either hand and the expanse before us; the interesting and beautiful, in the several forms of active and passive

life at our feet. Here, in the grotto-like hollows, are the little branching corallines and many-coloured seaweeds, spreading out their floating threads and ribbons to the light, and forming many a mimic landscape by their fanciful grouping; there, the larger algæ hang in clusters over the rough blocks and tablets, sheltering perhaps some small mollusca, or some valorous crab who hides his body under it, all but the one claw with which he tries to terrify the intruder.

If we turn up some of the stones, or look under the projecting ledges, we shall sometimes find, among other things, certain oddly shaped bodies having a leathery or fungus-like look about them; and, looking a little more carefully, we may meet with others transparent and star-like, all growing, as it were, on the rocks or surfaces of large weeds. These belong to an order of *shell-less* mollusca (if indeed they are rightly so classed) called "*Tunicata*."

It would not be consistent with the pretensions of this little book to enter very deeply into the consideration of this order, however well it might repay our attention. Many clever men, who have spent years in examining these animals, have concluded that they come nearer to polypes than to molluscs. Yet they breathe and digest their food in the same way as the latter; but their circulation and method of

multiplication is different, and the coverings of their bodies, although analogous to the shells of shell-fish, are not shells in their composition and structure. My readers must therefore be content with a general notice of them, by way of introduction to the true molluscs.

The *Tunicata* are so named because the body is wrapped up in a kind of tunic or mantle, which is thus graphically described by Aristotle, in his work on the History of Animals:—"They are the only kind (of mollusca) whose whole body is enclosed in the shell, and that shell of a substance between true shell and leather: it may be cut like dry leather." The "Father of Natural History" further remarks, "They are attached to rocks by their shells, and have two separate openings, which are very small and difficult to notice, the one to take in, the other to eject the water."

As these creatures stand among others on the confines of the animal kingdom, it has even been a question whether they belong to it, they seem so very *lifeless*, and look so much like fungi growing on stones and weeds. Dr. Schmidt indeed found some cellular tissue within them, like that of vegetables; but this turns out to be only the result of the vegetable substances on which they live, entering into their circulation.

Of the Compound Ascidians, or *Botryllidæ*, in which a number of animals group together, so as to form one compact mass enclosed in one bag, I may give two instances:— First, the *Aplidium fallax* (Pl. I. fig. 3), which looks like an irregularly shaped bag fastened down at the open end, and is found on examination to contain a number of individuals placed in a circular row within the mass: each individual has a mouth, with a six-rayed breathing apparatus, and each an opening for ejection. Then, a *Botryllus* (*B. polycyclus*, Pl. I. fig. 6) is beautifully described in a letter by Dr. Schlosser, published in the 'Philosophical Transactions' nearly a hundred years since, an extract from which may give some idea of the pleasurable excitement attending the intelligent pursuit of nature. "The first time the fishermen hauled in the dredge, I discovered a most extraordinary sea production surrounding the stem of an old fucus; it was of a hardish but fleshy substance, and more than an inch thick, of a light brown or ash colour, and the whole surface was covered over with bright yellow shining and star-like bodies, which induced me to believe it to be an undescribed species of *Alcyonum*. I put it immediately into a basket of sea-water, expecting every moment the polypes, which I thought were lodged in these little stars, would extend and show

themselves; . . . but after more than half an hour's attention, the vessel lying very quiet all the time, I did not perceive the least appearance of any of these polypes; upon which I brought them to the shore in sea-water, and then, by means of my microscope, I discovered every one of those stars to be a true animal, and much more beautiful than any polype, but quite of a different structure, which I shall now describe." Then follows a description of the "little radiating bodies, with their contracting and expanding mouths, and the little tender fibres moving at the bottom." And then the writer proceeds: "By comparing and examining all the various pieces I had collected of this fleshy substance, with its shining stars, I observed that the size and colour, as well as the very figure of the stars, varied greatly; but the structure of the leaf-like radii, and that of their mouths and their motions, were perfectly the same in every individual."

The simple Ascidians, or "*leather-bag*" Tunicata, are more independent and unsocial in their way of living. The rudely-formed case, clinging to the weed or rock, and sometimes encrusted with stones, shells, and corallines, is found to compose the outer covering of a single animal, whose principal duty in life appears to be that of sitting still with

open mouth, ready to suck in any microscopic food which the currents may chance to bring within reach. If these creatures were endowed with the gift of memory however, each one might recall a time in his existence when he was much more active and bright, for, like all his tunicated brethren, he began life as a merry tadpole, frisking about with tail and arm-like projections, his body light and transparent, and his motions free; but alas!

"The light of other days is faded;"

for one day he seized a rock or a weed with his arms, and did not let go till they became rooted to the surface; then throwing off his tail as no longer of use, he assumed his present state of *otium cum dignitate*, and a new shape altogether.

The smooth, bright orange species of *Cynthia*, figured in both states (Plate I. fig. 2 *a*, *b*), will present one of the very various forms contained in this section.

The *Tunicata* are divided into the following five families:—

1. Botryllidæ. Several animals enclosed in one body. Ex. *Aplidium fallax*, Plate I. fig. 3; *Botryllus polycyclus*, Plate I. fig. 6.
2. Clavellinidæ. Several animals with independent bodies

united by a root-like base. Ex. *Clavellina lepadiformis*, Plate I. fig. 4.

3. Ascidiadæ. Each animal complete in itself and independent. Ex. *Ascidia mentula*, Plate I. fig. 5.
4. Pelonaiadæ. Each animal independent and unattached; apertures on the same level; living in mud. Ex. *Pelonaia corrugata*, Pl. I. fig. 1.
5. Salpidæ. Solitary and aggregate in alternate generations.

I cannot leave this very slight notice of the *Tunicata* without a passing tribute to the memory of one who spent a great part of his life in searching into their nature. M. Jules César Savigny, taking the word "Patientia" for his motto, followed up the minute history of these little masses of jelly, bags of leather, and conglomerations of living stars, day by day, year by year, with the dredge, the forceps, the eye, and the lens, till the continued strain upon the eye at last deprived him of sight, and shut out the whole world of wonders from his view.

CHAPTER II.

THE SHIP-WORM.—ANCIENT ACCOUNTS.—MISCHIEFS.—ATTEMPTS TO CHECK IT.—TRUE DESCRIPTION.—MANNER OF BORING.—SPECIES.—CHAMBERS IN THE TUBE OF TEREDO NORVEGICA.

PHOLADIDÆ.

THESE are bivalved mollusca, with long-shaped bodies, with a siphonal tube divided at the end into two hairy openings. They all bore into stone, clay, wood, or other substances.

TEREDO.

There was known among the ancients a formidable kind of "worm" with a long body, a forked tail, a round head, with a most formidable pair of jaws, which voraciously gnawed its way into wood under water, and lived in the hole which it had thus scooped out for its dwelling. Multitudes of these worms attacked not only floating, useless timber, but the submerged parts of piles and breakwaters,

1. Pelonaia corrugata. 2 Cynthia aggregata 3. Aplydium fallax.
4. Clavellina lepadiformis. 5 Ascidia mentula. 6. Botryllus polycyclus.

as well as the woodwork of ships, as they lay in the docks or floated on the waves. At one time it threatened destruction to the marine bulwarks which the Hollanders had erected, with much industry, to protect their low-lying lands from the sea. Many have been the contrivances by which it was hoped to check the ravages of the relentless animal, but hitherto in vain. In fact, a history of unsuccessful attempts to get rid of Teredos might be written, and entitled 'A century of warfare between the worm and the man, in which the man was defeated, and the worm remained master;' for even to this day the breakwaters of our coasts can only be maintained by renewing the timber from time to time, again to become a prey to the voracious worm. If dissecting, anatomizing, and exposing in huge volumes of learned lore would have exterminated the common enemy, it would have been done by Dutchmen. If the citation of "respectable witnesses" would have shamed the criminal out of the dock, he would have been so served by the erudite Sellius, who cited no fewer than two hundred authors to attest his misdeeds, and afterwards went mad, perhaps with the excitement of the contest. But it was not to be. Man, as was observed by a certain Emperor known to modern history, can conquer

many enemies, but not his destiny. As it was in the days of Ovid, when he compared the shipworm in the wood to grief gnawing at his heart, so it is now; with a very slight accommodation of the words of a living poet, we may still say—

> "The stoutest bulwark man can raise,
> Is the ship-worm's food at last."

But it will be asked, What have we to do with a *worm* in a book about *shells?* We shall see, on examination, it turns out that this destructive creature is a true mollusc; that in the "round head" is contained the greater part of the body, and that the dreadful "jaws" are nothing but the two valves of a fragile shell.

Pieces of wood are found pierced like the piece represented (Plate II. fig. 3), with a number of long tubular holes; some of these holes will be lined with a shelly tube, which being taken out resembles, and has been taken for, a *Serpula* (the shell of a true worm). Within this tube, occupying its whole length, is a soft worm-like lining, containing the alimentary canals; at the smaller, which is generally the upper end, is a gristly ring, in which are inserted two shelly or horny pieces, in some species like a pair of paddles (Plate II. fig. 4) in others like pens (Plate II.

fig. 5). After this, the tube is carried on a little further, till it is separated into two smaller tubes, each ending in an orifice, and the shelly tube will be found, if perfect, to be divided correspondingly. These two openings are all the means of communication possessed by the animal with the world of waters around him; for the larger end is quite buried within the block into which he has found his way. At this larger end is the body, which is round, and partly covered by the bivalve shell. The shell opens in front, and between its angular edges is seen a portion of fleshy mantle, with a little hole, out of which protrudes the sucker, or tongue-shaped foot.

It is a difficult question, not yet satisfactorily determined, how this creature manages to make its way into its hard bed. The ancients felt no difficulty about this; the thing to them was perfectly clear. There was the bullet-headed monster, and there was the pair of cutting teeth, and he had nothing to do but to go head foremost, and eat his way in. After a time however it became evident that the solution was not so easy as supposed, for when the truth began to appear, it was found that the valves could no more bite the wood than the mollusc could eat it. Adanson, who made great advances in a knowledge of the true character of this

and many other mollusca, speaks of rows of very minute teeth or rasp-like processes on the valves, and supposes the hollowing out to be caused by the motion of the valves in the hole rasping against its sides. We cannot however discover these rasping points in the shells, but only crossed striæ. On the whole, the evidence of the *Teredo* is against the rasping theory; but of this we must speak again when the character of *Teredo* comes before us.

The British species of *Pholas* are :—

1. *T. Norvegica:* valves nearly as broad as long; pellets paddle-shaped. Plate II. fig. 6.
2. *T. navalis:* valves extended laterally by auricles; pellets paddle-shaped, forked at the base. Plate II. fig. 3, 4.
3. *T. Megotara:* valves distinguished by very wide and horizontally spread auricles; pellets spade-shaped.
4. *T. bipennata:* valves with wide auricles; pellets long, pen-like. Plate II. fig. 5.
5. *T. malleolus:* valves narrow; pellets shelly, mallet-shaped.
6. *T. palmulata:* valves like those of *navalis;* pellets short, plumose.

The *Teredo Norvegica,* imported from the North, and naturalized among us, notwithstanding the partly success-

ful efforts of Government to extirpate it, is still at its work undermining British stabilities. In the little harbour of Port Patrick it is now busy destroying the piles which support the pier. The tubes of this species, although seldom seen in collections more than nine to twelve inches long, are yet sometimes met with in the Irish piles as long as two and a half feet. It is remarkable for the chambered structure of its larger end, where the animal seems, after completing its work, to have desired to come nearer the opening, and for this purpose has removed a little at a time, at each stage building behind it a wall to sustain the body in its position.

The gigantic shell named *Septaria* by Lamarck, consisting of a tube some six or seven feet long, belongs in all probability to this genus.

The boring or piercing of the wood is generally performed in the direction of the grain, and proceeds pretty evenly, until the borer becomes sensible of another tube lying in his way, when he alters the direction of his work, and thus carefully avoids invading his neighbour's territory. Thus, in a piece of wood lying five or six years under water, there may be hundreds of holes so close as to leave in some places the thinnest possible space between them, and yet,

in scarcely a single instance, will the party-wall be cut through. The wood, when thus pierced by a large company of these sappers and miners, is perfectly light and buoyant, rather unfortunately for Ovid's aforesaid simile about grief nibbling at his heart; for we are accustomed to associate lightness of heart with freedom from grief.

CHAPTER III.

TEREDINES IN LONDON CLAY.—PRE-ADAMITE HISTORY.—THE 'WOOD-EATER.'—ATTACKS ON THE GATES OF ARDROSSAN.—PREVENTIVES.—GOING AGAINST THE GRAIN.

TEREDINA.

Connected with the history of our recent shipworms, is a geological fact which will illustrate the manner in which the study of living nature throws light on the history of the past. In the beds of clay on which our metropolis stands, there are found buried deep blocks of timber pierced through by the *Teredina*, an extinct genus of borers, which must have been an animal of similar nature; and, as Sir Charles Lyell observes, there must have been a period when this wood, now many feet below the foundations of a large city, floated on the water, and again we are carried back to the time when the tree was living. With this block in our hands, then, what a history of by-gone time can be traced!

First, the sapling, rising from the seed, gradually attaining the maturity of a full-grown tree, blossoming and flourishing for years, until, uprooted by some mighty land-torrent, it has been drifted down a river into the ocean. The germs of the *Teredinæ* have settled on the floating mass; they riddle its substance, and line the holes with their shelly tubes. From generation to generation they live, reproduce, and die; then some check occurs, or the bay becomes silted up with marine mud, in which the wood, with its colony, is buried. By a subsequent chemical action the mass is changed into *stone;* season after season fresh marine deposits are laid upon it, till at length the clay-bed is upheaved, ocean recedes, acres of dry land appear; by processes incredibly slow, this dry land becomes fit for the habitation of man: London is then built, and in the parks and gardens trees are planted, where they flourish for ages, perhaps destined one day, by similar catastrophes, to begin the same story over again.

XYLOPHAGA, OR "WOOD-EATER."

The younger part of my readers must make some allowance for the scientific names they may meet with, and not, for instance, run away with the notion that this "wood-eater" actually devours the wood which he penetrates,

merely because Dr. Turton, who first described the genus, called it "*Xylophaga*." This *Xylophaga* is a little mollusc resembling the *Teredo* in many respects. Like the latter, it penetrates wood that has been immersed in salt water for any length of time. It does not make a long hole, because its tube, containing the alimentary canals, is very short, and it only makes an oval hollow to live in. The shell is only open in front, not in front and back, as in *Teredo*, and it has not the curved bones under the beaks which are seen in other Pholads. The beaks or umbos of the valves are protected by two little plates, which are called *accessory valves*. The pallets are pen-like, and the hole is never lined with any shelly tube. The first specimens of *Xylophaga dorsalis* were obtained by Dr. Turton, from the fragments of a wreck which had been submerged nearly fifty years ago, near Berry Head, Torbay; and in the 'Annals of Natural History' for 1847, an interesting account is given of another locality, by Mr. Thompson, whose notice gives an excellent idea of the nature and haunts of the species.

"Early in the month of May last, Major Martin of Ardrossan, in Ayrshire, a gentleman well known as a lover of natural history and as a successful collector of objects of zoological and botanical interest, sent me a piece of wood

perforated by *Xylophaga dorsalis*, and labelled as from the dock-gates, Ardrossan. Not having heard of this animal before attacking the *fixed* timber of our harbours (it has been found in driftwood, or portions of vessels cast ashore), I made immediate inquiry respecting it. The piece of wood sent was a portion of the dock-gates. The *Xylophaga* has been known to be consuming them since the docks were opened, in March, 1844. It has been known for a very considerable time along this coast, where there is no fresh water. It attacks timber of all kinds; for instance, the wooden pier (the supporters of which are nearly destroyed) and other timbers that are under water about the quays, and have been placed there without any preservative coating. It appears to prefer black birch to any other timber, but does not like African or American oak. The only successful preventive made use of for preserving the dock-gates against the *Teredo, Xylophaga*, etc., is Muntz's patent yellow metal sheathing, which is put on to the height of thirteen feet; it lasts for ten or twelve years. The timber that is perforated is always covered by water. The depth of water in the docks is from sixteen to eighteen feet. It may give some idea of the frequency of the *Xylophaga's* perforations in the different pieces of wood, to mention, that on an ave-

rage at least one-half is occupied by its burrows; the *Xylophaga* has never, like the *Teredo*, been observed by my correspondent to form a testaceous tube or lining to its shell. Many of the chambers of the *Xylophaga* before me are one inch and a half in length, thus exceeding by one-half the longest noticed by Turton. The shells of my largest specimens are $5\frac{1}{2}$ lines in length: the two valves joined at the hinge occupy a space of $5\frac{1}{2}$ lines in diameter. This species differs from *Teredo navalis* by boring *against* the grain of the wood (all of which is pine) in a diagonal manner."

The habit last alluded to may remind us of certain *cross-grained* natures which, always boring their way against the grain, delight in creating obstacles in order to overcome them, and love a position of antagonism for the excitement it produces. But how much better is it to work, if possible, like the *Teredo, with the grain*, and be the better prepared to meet and overcome all difficulties.

CHAPTER IV.

HOME OF THE PHOLAS.—CHARACTERS.—SHELL.—SUPPLEMENTARY CONTRIVANCES.—LIGHT FROM DARKNESS.—BRITISH KINDS.—CUP-BEARING PHOLAS.—GROWTH AND HABITS.

PHOLAS.

On the low rocks of our coasts near low-water mark may be found, snugly ensconced in close-fitting holes, leaving very small openings at the surface, specimens of a long-shaped mollusc with a pair of colourless shells. You cannot get at them without breaking open the chalk, red sandstone, lias, or decayed wood in which they are imbedded; and, when first intruded upon, they are very apt to spurt out a jet of water from the fleshy tube. The *Pholas* lies head downwards in the cell, which fits his body, and into which he made his way when very young. The two valves of the shell are generally oval or cylindrical, and the front or lower part of them is covered by sharp points, arranged

in oblique rows. The cartilage which unites the valves at the back is quite different from the *ligament* of other bivalves, so that when the animal is removed they fall apart. The edges do not meet all round, but are open in front to admit the passage of the food or sucker, and at the hinder or upper end to give room for the tube to pass through the upper part of the hole. There are no hinge-teeth, but from under the place in each valve where the teeth usually appear, a curved flattened free rib protrudes, which is characteristic of nearly all the *Pholadidæ*. The mantle of the animal is entire, excepting where the foot protrudes. A remarkable circumstance in the shells of this family is the peculiarity and variety of their *accessory* valves or plates, or other parts. When the animals are young, and the work of excavation is going on, the shells are quite simple, and have no supernumerary contrivances of the kind; but afterwards, when they are full-grown and intend to retire from active life, they seem to find their retreats rather too large for their comfort and safety. They find, in parts of their dwelling, room for unpleasant currents, which might not only still further increase its size, but also damage their shells and disturb their repose. To avoid these evils, the various species of *Pholas* in every part of the world set to work by

various means to secure and protect their bodies and their shells, and make their holes fit them by filling up the interstices. Some species will protect the umboes and dorsal edges of the valves by one, two, or more shelly plates; others, by horny coverings in back and front; others, by extending the edges of the shells themselves, so as to fill up the parts which were gaping. In a new genus of *Pholadidæ*, which I have recently described under the name of *Triomphalia*, the right valve increases in length at the *hinder end*, so as partly to fill up the narrower part of the tube, while near the hinge of the left valve commences, in what I call a *third umbo*, an inflated shelly covering, which joins the gaping edge of the valve, and overlaps the other valve in front. In the *Pholas papyracea* and some other species, there commences at the posterior end of the shell, an invention for filling up part of the hollow where the tubes of the animal pass, which consists of a kind of *cup* or the beginning of a tube. In some species this is of shell, in others it is pure horn, and there are one or two species where it is prolonged into a distinct shelly tube. I may also mention in this place the specimen of *Ph. calva* figured in the Proceedings of the Zoological Society, in which, besides a very large proportion of the usual muniments, the upper part of the hole is

lined by layers of the decomposed but reunited rock in which it is bored. These varieties in structure, all with one object evidently in view, rendered my task in preparing figures and descriptions of all the species of *Pholas* one of no ordinary pleasure. These animals are said to have the remarkable property of throwing off a phosphorescent light, of a bluish-white hue, which is believed to proceed from a luminous mucus like that of the *Medusa*. It is given out into the surrounding currents, so that we have the phenomenon of a stream of light issuing from a hermit's darkened cell.

We have not met with any persons who have tasted our British *Pholades;* but the *Pholas costata*, a West Indian species of some size, is much coveted as food, and sold in the markets for the purpose.

The species of British *Pholas* are as follows:—

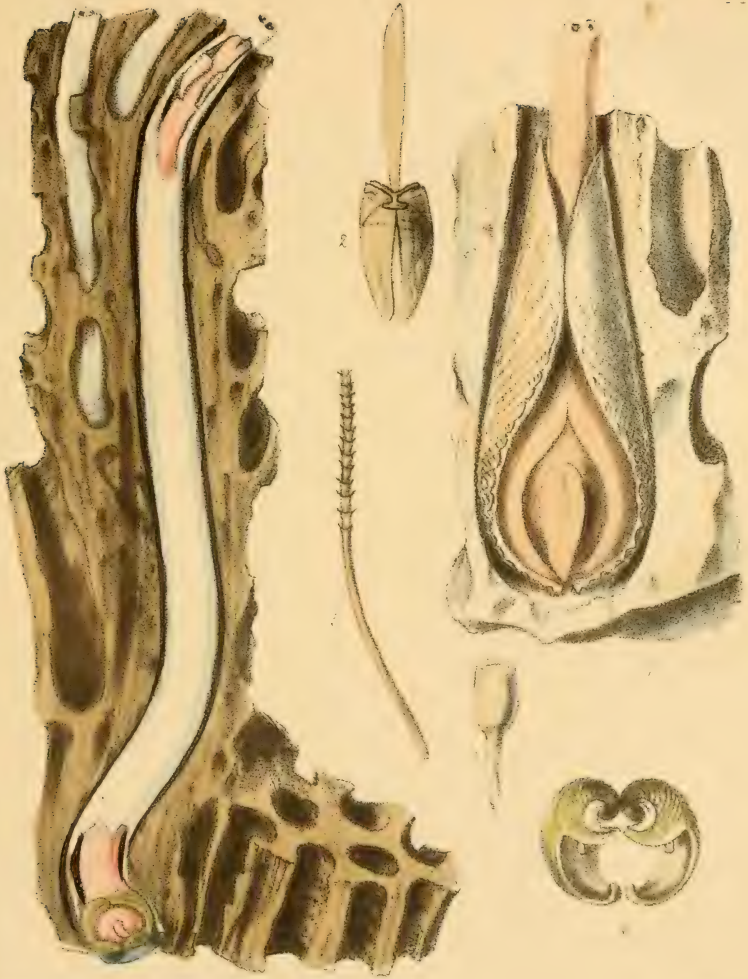
1. *P. dactylus:* the large long kind, which has two long and one cross accessory valves on the hinge, and one long and narrow between the edges below. It is common on the southern coasts of England. Plate II. fig. 1, 2.
2. *P. crispata:* with very short, broad, wide and gaping valves, and scarcely any dorsal plate. It is often preserved with a coriaceous covering for the canals.

3. *P. parva:* shaped something like *P. dactylus,* but having *one* narrow dorsal plate.
4. *P. candida:* more oval than *P. parva,* with a broader dorsal plate.
5. *P. striata:* rather conical, closed by extended edges, and by a squarish dorsal plate, as well as by a longitudinal narrow plate back and front. Found on the coasts of Great Britain and various parts of the Atlantic, in floating wood, particularly mahogany. Mr. Cuming also found specimens of apparently the same species on the shores of the Philippine Islands.

PHOLADIDÆ.

(PHOLAS PAPYRACEA, the Paper Pholas, Pl. III. fig. 7.)

This is the British representive of the *cup* or tube-forming *Pholades.* It is a beautifully delicate shell, and so different in its young state to its more natural condition that it has been distinctly named as a separate species. When young it is similar in form to *P. crispata,* but of a much lighter texture. The two parts of the surface are divided by an oblique line, on the anterior side of which there are numerous prickly points, and on the hinder side only smooth ridges. The opening in front, or the "anterior gape," is



1.Pholas dactylus in stone. 2 Dorsal plates of the same. 3.Teredo navalis in wood
4 Pallet of Teredo navalis. 5 Pallet of Teredo bipennata.
6 Valves of Teredo Norvegica.

very wide, and the dorsal edge is turned back over the umboes: such is the state of shell, which is far from covering the animal, while it continues to grow and to bore, the latter operation implying some sort of motion. Whether this motion be rotatory or not, we shall not now stay to inquire; but it certainly must cease when the adult stage is attained, because at that period the shell begins to be shaped so as to fit the hole exactly. A transformation in general appearance then takes place; the reflected dorsal edge before spoken of becomes thickened and expanded, and a pair of joints or articulations are added, which stand for rudimentary accessories; the wide front hiatus is closed by a thin, paper-like inflated extension of the edges, and, still more remarkable, a portion of the hollow at the upper end of the burrow is filled up by a completely formed, protruding, cup-like appendage, which is like the commencement of a tube at the thinner end of the shell.

The *Pholas papyracea* is not very easily procured in a perfect state. Mr. Hanley observes that it "must be considered not only a very local shell, but one difficult to procure even at most of the spots from whence only it can be obtained. It is met with at very low tides imbedded in reddish sandstone at Exmouth, Teignmouth, Torquay, and

other towns on the South Devon coast; but its extreme fragility renders its safe extraction, and subsequent removal of animal matter, a work of very delicate manipulation." Considering the similitude of the young shell to that of most of the *Pholades*, and the great variety of means by which the species of the family enclose and protect their shells, it may reasonably be questioned whether it is worth while to make a separate genus of the cup-making *Pholas*.

CHAPTER V.

EXCAVATIONS IN STONE, WOOD, WAX.—SUMMARY OF OPINIONS.—THE 'RASPING' PROCESS DESCRIBED.—DIFFICULTIES IN EVERY THEORY.—VIEWS OF THE WRITER, AND A HOMELY EXPERIMENT.

THE BORING POWER OF PHOLADIDÆ.

The great peculiarity from which this family of mollusca derives its name, is the astonishing power possessed by all the species, of scooping out dwelling-holes in various kinds of stone, wood, sand, hard mud, and even wax. These holes invariably correspond to the size of the creature which makes them, and when the latter is quite mature, the hole generally fits it so closely as to leave it no room to move. The way in which this close fitting is effected is probably by means of various supplementary growths on the edges or back, or end of the shell. But the grand difficulty has always been to account for the power of perforating in the hard substances which they burrow.

Professor Forbes thus ably sums up the various theories which have been promulgated on this very interesting and difficult point. "They may all be classed under five conclusions: 1st. That the boring mollusca perforate by means of the rotation of the valves of their shells, which serve as augers. 2nd. That the holes are made by rasping, effected by siliceous particles studding the substance of certain parts of the animals. 3rd. That currents of water, set in action by the motions of vibratile cilia, are the agents. 4. That the animal secretes a chemical solvent, an acid, which dissolves the substance into which it bores. 5. That the combined action of a secreted solvent and rasping by the valves effects the perforations."

The most plausible account in favour of the first of these theories is that given by Mr. Ostler, who describes the young animal first fixing itself by its foot, raising itself almost perpendicularly, and pressing the prickly part of the shell against the stone in a half-rotatory motion, and thus adapting its motions to its advancing age, the size of the opening, and the progress of the work. Mr. Ostler goes on to say, "The particles rubbed off, and which in a short time completely clog the shell, are removed in a very simple manner." When the projected siphon is distended with water, the *Pholas*

closes the orifices of the tubes, and retracts them suddenly. The water which they contained is thus ejected forcibly from the opening in the mantle; and the jet is prolonged by the gradual closure of the valves, to expel the water contained within the shells. The chamber occupied by the animal is thus completely cleansed; but as many of the particles washed out of it will be deposited before they reach the mouth of the hole, the passage along which the *Pholas* projects its siphon is constantly found to be lined with a soft mud.

In further apparent support of the idea of the holes being made by the mechanical action of the valves, it has been noticed that some of them are marked by rough grooves, such as might be produced in that manner. On the other hand however, it may be observed that the 'rasping' points on the surface of the valves are never worn down, which must be the case if they were constantly employed on hard substances, as suggested; that in some of the species the shells are externally quite smooth, and that the holes, instead of being quite cylindrical, are fitted to the shells in such a manner as, at least when adult, to deprive them of the power of lateral action.

The second theory, namely, that which endeavours to ac-

count for the wearing away of the rock by the rubbing of flinty atoms in the foot of the animal, has this important difficulty to encounter; namely, that after the most anxious microscopic researches no such siliceous particles have been found in the *Pholas*, although they do exist in some other families of boring molluscs.

The third theory may be good as far as it goes, but is inadequate by itself to account for the whole result. No doubt, currents of sea-water between the shell and the walls of its habitation must materially aid, not only in clearing away the particles when dislodged, but also to some extent in dislodging them.

As to the fourth, and perhaps on the whole the most popular notion,—that of a chemical solvent secreted by the animal,—it would probably puzzle the acutest chemist to find or invent a solvent which would act equally on wood, clay, sandstone, chalk, and wax.

The fifth theory, or that of the combined action of rasping and solution, combines the difficulties of both.

Now, it may seem presumptuous on my part, after so many learned opinions have been cited, and the question left still undecided in the latest and most careful treatises, to venture on anything like a judgment of my own. "Who

shall decide when doctors disagree?" but I must confess that it does not seem difficult to imagine the *Pholas* making its way into its stony bed by the simple process of *licking* a hole. M. Réaumur observed, that when he removed the living animal from its place, and put it on soft clay, it quickly before his very eyes buried itself in that substance. Although the stones in which some of the species burrow are certainly harder than the clay described, yet it must be remembered that the clays in cabinet specimens are much harder than when under water; and that this sucking and licking, and rubbing with the foot, which is certainly of stouter material than the rest of the animal, would be powerfully aided by the action of salt water. We see, in the caves below cliffs, how water can excavate hard rocks when acting in circular currents, and we can easily imagine how it would act in enlarging a cavity already begun. In fact, we see, in the case of deserted holes of boring bivalves, instances of the enlarging power of small currents. If Réaumur's specimens could so easily perforate the soft clay during the progress of a mere experiment, how shall it be difficult to understand perforation, by the same simple means, of a harder substance during the gradual growth of the animal? While thinking on this matter, it occurred to me to try a very

simple experiment, by procuring from the kitchen a piece of hearthstone,—which the servant, by the way, observed was a very hard piece. With some salt water to assist me, I rubbed the surface with my finger, of course keeping to the same spot, and in a very few minutes' time I had made a very sensible impression in the stone. I had not patience to carry the experiment any further; but as far as it went, it left no doubt on my mind that with the foot alone, *without* siliceous particles, *without* a chemical solvent, and *without* using the rasping powers of the shell, our little animal could easily execute his self-pronounced sentence of solitary confinement for life.

CHAPTER VI.

SOFT BEDS AND SAFE RETREATS.—MYA, FOOD FOR FISH AND MEN.—FRESH WATER AND DEFORMITY.—PANOPÆA, AND THE PLEASURES OF DREDGING.

MYADÆ, OR GAPERS.

As the *Pholadidæ* for the most part live in holes which they have excavated in stones and wood, so the *Myadæ*, or Gapers, bury themselves in gravel, sand, or mud. The shells are widely open in front; hence the popular name of "gapers."

The genera *Mya* and *Panopæa* represent this family in the British seas.

MYA.

Mya truncata is a coarse, brown-skinned, and broad-shelled mollusc, of a squarish-oblong form in the body, and with a very rough and wrinkled cover to its long, rather

broad tube. At the end of the cover is a fringe, beyond which projects the unequally-divided tube. The opening for reception is wide and fringed, while that for rejection is small and smooth. As in the preceding families, the mantle opens in front to admit the passage of the foot, which, in this case, is long and tapering, and admirably adapted for the work of cutting and making way through the mud. The hiding-places occupied by these creatures are indicated far above them on the surface of the sand or mud by the holes which lead down to their retreat. The valves are broad, rather flat in the middle, inflated anteriorly, and, as it were, cut square at the posterior end, where it joins the tube. The ligament is contained in a wide spoon-shaped projection of the hinge-margin.

The species is found in deep sea, and at a distance from the shore, as well as in parts of the beach only covered by the high tides. It occurs at various localities on the British, Irish, and Scotch coasts. It is said to be a favourite food of cod-fish at Newfoundland, and is boiled and eaten for food by the inhabitants of Zetland, under the name of "Smurslin."

Mya arenaria differs from *M. truncata* chiefly in the more oval form of the shell, which is rather pointed than

truncated at the hinder part. It sometimes attains the size of four inches long and two and a half broad. The animal burrows to the depth of a foot or more, communicating with the surface of the sand or gravel by means of a hole, through which, when disturbed, it will throw out a jet of water in seeming fury. The following remarks on the deformity and degeneration occasioned in some specimens of this species by a change in the element by which they are surrounded is found in Forbes and Hanley's 'History of British Mollusca:'—"The *Mya arenaria* is occasionally found in brackish water, and is there subject to dwarfing and distorting. Such is the condition of the specimens in the Loch of Stennis, in Orkney, famous for the part it plays in the scenery of Scott's admirable novel of 'The Pirate.' In that lake we find *Limnei*, *Neritinæ*, and other fresh-water molluscs, along with the *Myæ*, which now however appear to be nearly if not altogether extinct. Before they became so, they had greatly diminished in size, and become variously distorted. In this instance, the cause is to be sought for in a very recent elevation of the land, which has gradually converted what was originally an arm of the sea into a brackish pool, only occasionally flooded with salt water, and probably destined eventually to become a fresh-water

lake. In Mr. Cuming's collection are some remarkably distorted *Myæ* of this species from the sluices of Ostend, where their deformities are most likely also due to the pernicious influence of the fresh water. To the same cause we may attribute the numerous and singular varieties of this shell, such as the so-called species *M. lata* and *pullus*, found in the mammaliferous crag of the east of England, a formation in which many of the mollusca are deformed: the melting of the icebergs which then chilled our region doubtless furnished the disturbing medium. These dangerous and disastrous consequences of too great an imbibition of the 'pure element' present a timely warning to the votaries of teetotalism."

For my part, although no "teetotaller," I confess that the above remarks have failed to inspire me with any very great dread of pure water; and I can only hope that the learned authors of the 'History' will themselves avoid the "dangerous and disastrous consequences" alluded to by mixing a sufficient quantity of *salt* with the water they drink.

PANOPÆA.

The shell of the *Panopæa Norvegica* is not unlike that of *Mya truncata;* it is however more solid, and has no spoon-

shaped process in the hinge, both parts of the ligament being in one piece, and placed outside the shell.

In a little work entitled 'Arran,' by the Rev. D. Landsborough, where the pleasures of dredging excursions are warmly dwelt on in many repeated instances, that gentleman says: "A cruise is rather an anomalous event in the life of a sober country minister; and a dredging excursion is what seldom falls to the lot of even zealous naturalists. Few have at their command the vessel, the sailors, and the dredging apparatus; and most of us are thankful if we can find time for an occasional ramble for a few hours in a wild glen, or on the mountain-side, or on the teeming shore of the bountiful sea. Great, then, was my delight at being invited to spend a few days in dredging along with Mr. Smith, of Jordan Hill, in his nice little yacht the Raven. . . . We afterwards rowed to the shore in a boat, and landed near Balnacoolie, where Mr. Smith and Mr. Sowerby, from London, some years ago had discovered a rich newer pliocene deposit. We had not been long ashore till we discovered two or three specimens of *Panopæa Bivonæ* (*Norvegica*), a rare subfossil shell which we were in search of, as it had been found for the first time in Scotland by Mr. Smith and Mr. Sowerby." It has however since been taken *living* at Scarborough,

as stated in the following account by Mr. Bean :—"To some of the fishermen of our coast it appeared to be well known by the name of the 'Bacca Box,' from a fancied resemblance. The specimens were taken by the hook, and rescued from destruction in a singular manner. The first, from which our figure was taken, was destined for a tobacco-box; the second had the honour of holding the grease belonging to the boat establishment; and the third, after amusing them (the members of a philosophical society) by squirting water to the ceiling, was at last seen by a learned friend, purchased for a trifle, and generously placed in our cabinet. The animal we have not seen, but its colour is black."

A large species (*P. Australis*) is found on the coast of South Africa; it makes known its presence by the hole through which its tube protrudes, but resists all the efforts of the sailors to take it, by withdrawing its tube, just as the earthworm does; and if its persecutors are relentless enough to follow up the pursuit, they can only do so by digging in the mud for it.

CHAPTER VII.

THE UNEQUAL-VALVED CORBULA.—THE TAPERING SPHÆNIA.—THE GRACEFUL NÆRA.—THE UNPRETENDING POROMYA.—THE PEARLY PANDORA.—THE IRIDESCENT LYONSIA.—THE RUDE THRACIA, AND THE SPOON-HINGED COCHLODESMA.

CORBULIDÆ, PANDORIDÆ, ANATINIDÆ.

The genera of small bivalved mollusca composing these two families are perhaps scarcely different enough to be separated; they are all distinguished from the preceding families by the shortness of their siphons. The genera composing the three families may be thus enumerated:—

CORBULIDÆ.

I. Corbula.—The animal is short and small, with short united siphonal tubes, both fringed at the openings. The mantle, which is at once the outer coating of the body and the lining of the shell, is closed except-

ing where the foot protrudes. The ejecting siphon has a white membranous tube projecting beyond the fringe; and the only colour, excepting pale yellow, about the little creature consists of a red edge to the openings of the siphons. The shell is oval; it has one very deep curved valve, and one smaller and flatter; the front side is rounded, the hinder side is truncated. All the sorts have the beaks prominent, and the surface ridged in the direction of the lines of growth. The hinge has a pit for part of the ligament, and one strong *curved* tooth in one or both valves. The species of *Corbula* found in Great Britain are—

C. nucleus: which is not uncommonly hauled up in the dredge, but is not very often met with by those who can only conchologize on the beach.

C. rosea is not likely to trouble the collector, but if he *should* be fortunate enough to find a specimen, he may know it by the rosy hue of its tips, and the comparative equality and smoothness of its valves.

C. ovata: admitted with doubt among the British fauna.

II. Sphænia.—The animal resembles that of *Corbula*, but is apt to burrow, in which case irregularity of form, and extension of the hinder end, take place. The shell is

y del. et lith.

Vincent Brooks Imp.

Xylophaga dorsalis. 2. Gastrochæna modiolina. 3, 4. Valves and tube of the same. 5. Saxicava arctica. 6. Pholadidea papyracea. 7. Petricola lithophaga.

not so inequivalve as that of *Corbula;* it is oblong, and rather square at both ends. When the valves are seen without the green epidermis which covers them, they look very much like those of a *Saxicava*. The only species is *S. Binghami*.

III. Neæra.—All the species of this beautiful genus are elegantly formed, presenting the graceful curved lines of the pear or fig; the tubes are short and divided, and surrounded at the sides by long cirrhi, or threads, ending beyond the orifices by little divided paddles; the foot is curved and pointed; the shell is pyriform, and has a spoon-shaped pit for the internal part of the ligament. The British species are—

N. cuspidata: shell smooth, delicately brown outside, pinkish inside, about three-quarters of an inch long, very bulky in front, and with an elegantly curved beak at the back: found in deep water far from land, at Cape Clear, Firth of Forth, Northumberland, Zetland, etc.

N. abbreviata: very small; the beak or rostrum short, with a rib before it: in deep water at Loch Fyne.

N. costellata: small, more decidedly rostrated, with two or three ribs radiating from the umbo between the rostrum and the swelled part of the shell: dredged by

Professor Forbes and Mr. M'Andrew in forty fathoms water, at Loch Fyne.

IV. Poromya.—The shell is equivalve, nearly colourless, roundish, with an external ligament, and a kind of tooth or excrescence in the hinge of one valve, entering a pit in the other.

Mr. Jeffreys dredged a specimen of the only species, *P. granulata*, in fifty fathoms' depth of water, off the island of Skye.

PANDORIDÆ.

As the genera *Pandora* and *Lyonsia* contain the only British representatives of this family, and as I do not think these genera very well united, it will be better to say the little that is to be said on them under their respective names.

I. Pandora.—In this mollusc, besides the narrow space in which it is confined, we find no great departure from the preceding families. The siphons are rather short, divided, with the openings fringed and tinted with pink and yellow; the foot, which is rather large, three-cornered, and pointed, protrudes through the usual opening in the mantle. The shell is thin, very flat, and exquisitely pearly; one valve is rather deeper

and larger than the other, which has a long diverging rib or tooth, fitting into an opposite burrow; the ligament is long and internal.

Bright rainbow tints, suggestive of *hope*, may have given the name to this peculiar genus; but if Pandora's box, so full of evils, were as flat as the shell, the contents would soon be exhausted, and the bright boon at the bottom soon be seen. The British species are—

P. rostrata: very elegantly formed, with a curved ventral line, and posterior rostrum or beak.

P. obtusa: much shorter, broader at the hinder part, and more truncated.

Dr. Carpenter, whose researches into the microscopic construction of the substances of different shells are so valuable, finds in the *Pandora* the "exact prismatic arrangement of cellular tissue," which would fully account for the gem-like beauty of the pearly surface.

II. Lyonsia.—Instead of hinge-teeth in the shell of this genus, there is a movable shelly ossicle united to the valves by a cartilage just under the hinge, which is external. In *Pandora* one valve is flat, and the other slightly convex; but in *Lyonsia* both valves are convex, although by no means equally so; the same pearly

texture, but in less degree, ornaments the surface. The siphonal tubes of the animal are rather longer; they are straight and ciliated; the foot as in *Pandora*. The British species is *L. Norvegica*.

ANATINIDÆ.

The shell of the genus from which this family takes its name is one of the most beautiful of bivalves. The *Anatina*, in form like *Lyonsia*, but much more gracefully curved, more inflated and equivalve, is exquisitely delicate and transparent, as well as beautifully pearly: the same cannot be said of the only two genera which will come under our notice in this work as containing British species.

I. Thracia.—We still have to repeat the oval shape and nearly closed mantle, with the tongue-shaped foot passing through it; the siphons are rather long, separated close to the body, fringed at their openings; the shell is oval, rather flat, thin, with one valve rather deeper than the other; it is of a dull pale-brownish tint, and the animal is quite colourless; the hinge has a thick swelling called a fulcrum, with a partly internal ligament and a little free bony plate attached to it by cartilage. The British species are—

T. convexa: large, brownish, much swelled anteriorly, rather angular, and square posteriorly; very inequivalve.

T. pubescens: much the same form, but whiter, smaller, less inequivalve, and more square.

T. phaseolina: thin, white, rather long, oval, oblique.

T. villosiuscula: shorter than *phaseolina*, not oblique.

T. distorta: short and squarish; although not a borer, often mistaken for one, through its habit of getting into crevices when young, and shaping its shell according to the irregularities of its position; hence it becomes distorted: its beaks are sometimes tinged with purple.

II. Cochlodesma.—The only British species of this, *C. prætenuis*, is white, shaped like a *Thracia*, but is equivalve, and has in each valve a spoon-shaped process jutting from the hinge.

CHAPTER VIII.

THE RAZOR-SHAPED SHELL.—HAUNTS OF THE ANIMAL.—FOOD, 'FAUTE DE MIEUX.'—CAUGHT BY CRAFT, OR TAKEN BY ASSAULT.—MOTION.—KINDS ON THE BRITISH COASTS.—CERATISOLEN AND SOLECURTUS.

SOLENIDÆ, OR RAZOR-SHELLS, AND SOLECURTIDÆ.

WITHOUT entering into the question whether the genus *Solen* is rightly regarded as the single representative of a family, or whether other genera might rightly be connected with it, it may be remarked that no other shells so nearly resemble in form the true *Solenes*, as to be difficult to distinguish from them. The very peculiar tube-like appearance of the two valves when placed in opposition, the closeness of the hinge ligament to the anterior extremity, and the long triangular area leading to the truncated hinder end, are so peculiar, as to make the *Solen* stand alone. The structure of the animal, and its habits, are no less curious and interesting. The animal of course partakes the cylindrical shape of

the shell. The mantle is entire for a portion of the length, but separates where the large, thick, long foot protrudes. The end of this foot is flattened underneath, and forms a sucker-like disc. The siphons are short, united, and fringed at their openings. The razor-fishes are much sought after in some places and circumstances as an article of food. They are said to be the most delicious of shell-fish, if well cooked; as such, they are broiled and eaten in many parts of Britain. Adanson, however, in his 'Voyage du Senegal,' mentions a species which is found on that coast, and says that the Negroes of Senegal make no use of the animal, because they can get at plenty of other fish which are infinitely superior. Quite a realization of the proverbial saying about having "other fish to fry"!

From Aristotle, and afterwards from Réaumur, as well as from the knowledge of living naturalists, we find that the razor-fish buries itself perpendicularly in the sand, with its great foot downwards, to a depth of two feet or more. It can rise to the top of its hole, and sink again at pleasure; but rarely leaves its dwelling. The hole is shaped like a key-hole, corresponding with the shape of the siphons. Now and then the creature rises a little way out, perhaps to enjoy the ripple of the receding tide, or to ascertain if any enemies

may be near. When the tide is quite out, down he sinks into his briny reservoir. Who has not seen the picture of the stupid-looking boy going warily out with a box of salt, having been gravely informed by some village wag that if he would only just drop a pinch of salt on the birds' tails, he would be sure to catch them? We are all familiar enough with this venerable joke, but not so with its successful application in another case. This time it is the fisherman, instead of the village boy, who carries the box. He cautiously slips a little salt into the hole, which irritates the ends of the siphons, and makes the *Solen* come quickly out to see what is the matter, and to clear itself of the painful intrusion. The fisher, on the alert, must quickly seize his prey, or else it will dart back again into its retreat, whence no amount of salting or coaxing will bring it out again. When a *Solen* is taken out of its hole, and laid on the sand, it will, like the *Pholas*, try at once to pierce a hole with its foot, so well adapted to the purpose, and very soon succeeding, buries itself again. The *Solen* seldom voluntarily changes his locality; but when he wishes to do so, he has a clever knack of rising from his hole, and swimming by leaps from place to place, till he finds the ground soft enough to burrow in. By suddenly contracting his shell and ejecting

the water previously drawn between the folds of the mantle, he obtains an impulse which jerks him forward a foot or two at a time.

In places where *Solens* are sought as food by the common people, the children are very successful in drawing them out by means of bent wires pushed into the hollows.

The species of *Solen* found on our British coasts are—

S. marginatus, commonly called *S. vagina:* the straightest of all the species, and the most square at the ends; sometimes exceeding four and a half inches in length; the front termination is edged by a kind of groove; hinge quite at the end, with one small jutting tooth in each valve.

S. siliqua: not quite so straight in outline; rather more round at the forward end, where it has *not* a *groove,* but an expansion.

S. ensis: narrower than *S. marginatus,* terminating like *S. siliqua,* and *arched.*

S. pellucidus: a small arched species, which has the front end rounded out considerably beyond the hinge. The mantle of the animal is so transparent that the flesh-coloured body can be seen through it.

SOLECURTIDÆ.

While the *Solenidæ* have short united siphons, the *Solecurtidæ* have them longer, and separated. The *Solenidæ* have long straight shells, with terminal hinges; but the *Solecurtidæ* have shorter and more rounded shells, with hinges nearly central. The genera of British *Solecurtidæ* are—

I. Ceratisolen, or Pod-shaped Solen.

C. legumen ("*Solen legumen*" of authors) is long, flat, greenish, smooth, with the hinge rather more posterior than anterior. The valves are rather broader and more square at the front side. The external ligament is placed upon a thickened fulcrum, and the teeth are three in each valve, rather irregular. The siphonal tubes of the animal are of a brownish-red colour; they are rather long, divided, unequal, and fringed. The foot is of the same colour, very broad, thick, and large, with a flattish disc underneath. The mantle is opened in front, with the edges of the opening fringed.

II. Solecurtus.—The shell, although still transversely oblong, is much shorter than the preceding; the valves are compressed, equal, and gaping at both ends, with the hinge nearly central. The mantle of the animal

is closed only in the middle. Through the front opening protrudes a very thick and large pointed foot; and through the hinder gap are jutted out the thick, uneven, unequal, divided siphons with fringed openings. The British species are—

S. coarctatus: animal white; shell covered with a dark green epidermis, and slightly strictured in the middle.

S. candidus: shell similar in shape, but marked with oblique striæ. Animal of bright orange-colour, and very large, compared with the shell.

CHAPTER IX.

THE BEST OUTSIDE.—GENERA AND SPECIES.—PSAMMOBIA, DIODONTA, TELLINA, SYNDOSMYA, SCROBICULARIA.

TELLINIDÆ.

The shells of this extensive family are many of them so remarkable for the beauty and brilliancy of their colouring, that one would be led to expect some corresponding brightness in the animals which they adorn; but it unfortunately happens that in their case "beauty is only *shell* deep," for nearly all the animals are of a colour just sufficiently removed from white to make them sordid. Even the *Psammobia vespertina*, the rich purple tints and rayed markings of which have given it the appropriate name of "the setting sun," and the splendid pink-rayed *Tellina crassa* and *T. donacina*, present little of beauty in the animal, and no colour, but sometimes a squalid stain. It is thus we are apt to be

disappointed when we are first attracted by outward specialities, and afterwards become acquainted with the insides of things.

The genera including British species belonging to this family are—

I. PSAMMOBIA.—Shell of a flat, oval form, rounded at the front, and rather squared at the hinder end; hinge near the middle, external, and placed on a thickened fulcrum; teeth two and one; a very deep sinus in the impression of the mantle. Animal white, with broad, pointed foot, and long narrow siphonal tubes, which are quite divided, hairy at the sides, and scalloped at the orifices; mantle *open* all along and fringed. The *Psammobiæ* live buried in sand or mud. The British species are—

P. vespertina, or "setting sun:" shell smooth, clouded with rich purple inside, with light rays; outside marked with wavy bands in rays; about an inch and a quarter long.

P. Ferroensis: shell slightly ridged, longer in form, with an angle and slight contraction behind it; marked with delicate pink, even rays; an inch and a half long.

P. Tellinella: shell smooth, oval, orange, with linear rays of pink; three-quarters of an inch long.

P. costulata: shell narrow, curved, ribbed behind, orange, rayed with red; three-quarters of an inch long.

II. Diodonta *fragilis* has one long and one short siphon, both fringed; the mantle open the whole length and fringed. The shell is oval, thin, pale brown, striated and angular at the back; hinge with two teeth in one valve to one double-tooth in the other; ligament external; muscular impression strong, with a deep sinus in the impression of the mantle. It is taken near Dublin, in Ireland, and near Tenby, in Wales.

III. Tellina.—Among many similar genera, the *Tellinæ* may be known by a kind of fold in the hinder part of the shell, which is shown by a curve in the line dividing the two valves in the ventral margin; the ligament is external; teeth one or two central, generally two lateral; muscular impressions not quite equal; pallial impression with a sinus. The animal has very long siphons, quite separate and nearly equal, with plain openings; the fringed mantle is entirely open. These molluscs live in sand or mud, quite under the surface, some distance from the shore. The British species are—

T. crassa: almost as broad as long, thick, and ribbed in the direction of lines of growth; pinkish, with pink rays,

and touches of bright red about the hinge; a broad anterior lateral tooth.

T. balustina: very round, with narrow bright-red rays.

T. donacina: rather long and oblique, with the posterior side very short and truncated; colours pink and yellow, very brightly rayed with red.

T. pygmæa: very similar to *T. donacina*, but small and more obtuse.

T. incarnata: slightly striated, oblong, beaked at the hinder side, and flesh-coloured.

T. solidula: red, thick, round, nearly as broad as long, slightly beaked, and with a strong fold behind.

T. tenuis: smooth, flat, oval, small, slightly beaked behind, flesh-coloured.

T. fabula: small, brownish in the middle, rounded anteriorly, and rather contracted and beaked behind.

T. proxima: small, round, nearly white, with an epidermis. It differs not very widely from *T. solidula*.

IV. Syndosmya.—The principal difference between this genus and *Tellina* is, that the elastic part of the ligament is received in a spoon-shaped pit within the shell; there are lateral teeth in one valve. The animal is very similar to that of *Tellina*, and, like that genus, its habits are to burrow in sand or mud; the foot, having a

posterior angle, is *boot-shaped*. The shells are thin, and for the most part without colour. The British species are—

S. intermedia: rather long, beaked; apex nearly central.

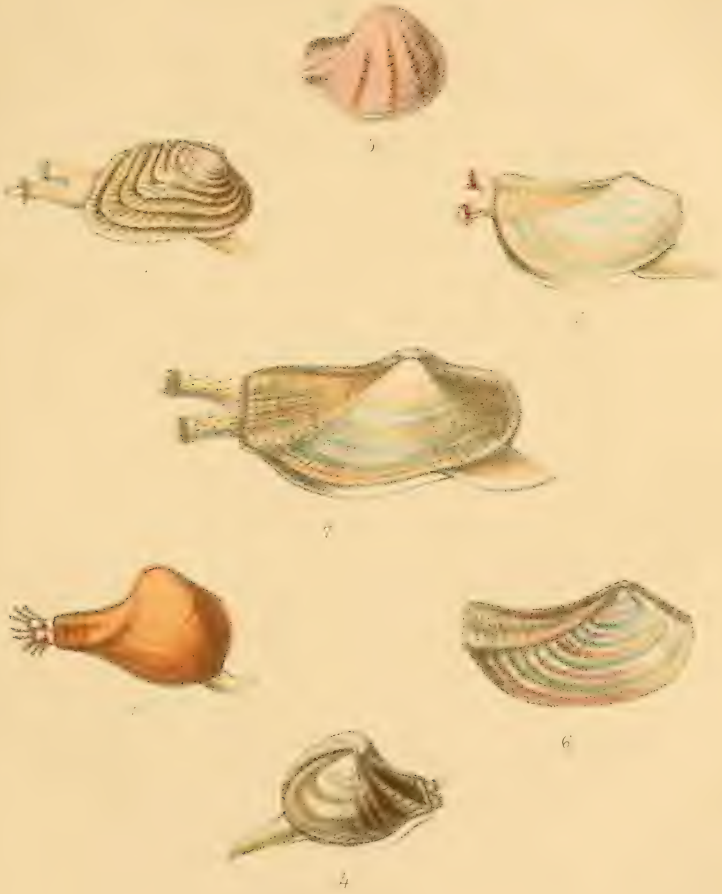
S. tenuis: short, nearly as broad as long, slightly coloured.

S. alba: white, like all except *tenuis*, very inequilateral, with a fold and slight beak at the back.

S. prismatica: iridescent like the rest, longer than *S. intermedia*, with the apex more on one side.

V. Scrobicularia.—Like *Syndosmya*, this genus has a pit in the hinge for the inner part of the ligament, and small narrow teeth at the sides of it; but it has *no lateral teeth*. The animal has remarkably long siphonal tubes with plain openings; the mantle fringed and open, and the foot broad, tongue-shaped, and pointed.

The shell of *S. compressa* is flat, shaped like the broader species of *Tellina*, and of a very pale yellowish colour. "Chiefly found at the mouths of rivers or inlets not remote from fresh water; and though never beyond the flux of the tide, yet it delights in situations where the fresh water is occasionally flowing over. It principally inhabits sludge or muddy places, buried to the depth of five or six inches." (*Montagu.*) Found at Scarborough, Liverpool, Cork, Frith of Forth, etc.



by dd. a lith. Vincent Brooks Imp.

1 Nucula cuspidata . 2 Venerupis Irus . 3 . 4 Corbula nucleus . 5 . Pandora obtusa 6 Pandora rostrata . 7 Lyonsia Norvegica .

CHAPTER X.

THE BEAUTIFUL AND THE DULL.—TREASURE THEM ALL.—THE PRETTY DONAX.—THE PLAIN ERVILIA.—MESODESMA.—MACTRA.—LUTRARIA.—MACTRA EDULIS AT PORT FAMINE.—A FRIEND IN NEED.

DONACIDÆ AND MACTRIDÆ.

These families present nothing very interesting to general readers, either as to the animals or their shells. To conchologists they are important as links to connect other families together by means of those gradations of character which render systematic arrangement so difficult. Every earnest collector will, if possible, possess a specimen of each genus, even if the shell should be ugly enough to spoil the appearance of a drawer. There are however hardly any shells, or animals either, that do not present beauties of some kind to a careful observer.

I. Donax.—The above general remarks will not apply to this genus, as the shells it contains are really very

beautiful (even the British examples fine, some of the foreign kinds splendid). They are more or less wedge-shaped, having one side short and truncated, the others long. Ligament external; teeth two; no lateral teeth. Inside edge of the valves beautifully toothed all round. The animal has a tongue-shaped, pointed foot; open mantle; rather short, unequal siphons; that for ejection, the smaller, simply fringed with ten lobes; the other larger, with the lobes branched. All the species live buried in sand. The British species are—

D. anatinus: so called from its likeness in shape to a duck's-bill, has the shell decussated at the hinder part with cross striæ. On the outer surface of the valves may be seen, through the shining yellowish epidermis, radiating shades of the same bright purple which is seen in its full, unclouded glory within.

D. politus: rather longer and straighter than *D. anatinus*, and *quite smooth*. From the apex to the ventral margin of the shell radiates a band of light, on either side of which are arranged streaks of clouded purple, which show more brightly at the point or apex, where the thin epidermis is not sufficient to veil its beauty.

II. Ervilia *castanea* is a little oval, light-brown shell, with no outer ligament, and a triangular pit, with a little tooth on each side in the hinge.

III. Mesodesma *cornea* is a small, thick, white, striated shell, with strong lateral teeth, doubtfully introduced into the British fauna.

IV. Mactra has a long, tongue-shaped foot, a mantle open and fringed as far as the siphons, which are rather long, *united*, and fringed; shell more or less triangular, with three-cornered ligament-holding pit; two strong lateral teeth in the hinge. Of the British species,

M. solida has thick, strong valves, uncoloured except by greenish-brown epidermis, and rather sharply angular at each side.

M. subtruncata has also colourless valves, with the front side much shorter than the other.

M. stultorum: thin, light, less angular than the preceding, generally tinted, and *rayed*.

M. elliptica has a small, oval, equilateral, and white shell.

M. truncata has a rather solid light-brown shell, as broad as long, with rather straight sides.

The species frequent our sandy coasts, generally keeping near land, and burrowing in the soil.

V. LUTRARIA is a rather large burrowing mollusc, with a long foot protruding through the otherwise closed mantle, and the siphons united into a very rugged, thick, double tube, with stellated orifices, and a long or oval bivalve shell, with triangular pits in the hinge; ligament partly external, but the elastic part contained in the pit within.

L. elliptica has a large, broad, brownish shell, covered with a dark olive-green epidermis.

L. oblonga or *Solenoides* has the shell narrow, *curved*, and rather truncated at the ends. The same as *L. elliptica* as to colouring and epidermis.

In their burrowing, these *Lutrariæ* rather choose soft mud than clean sand. In an interesting paper by Captain King, describing some mollusca collected by the officers of the 'Beagle,' the following circumstance is related of the *Mactra edulis*:—"This shell was found in abundance on the flat of sandy mud which fronts the west shore of Port Famine, and proved a valuable article of food to the ship's company, particularly during the winter months, when sea-birds and game were not to be procured, and the fish had deserted us. I have named it, in allusion to its affording us a grateful, as well as seasonable, supply of fresh food."

CHAPTER XI.

ELEGANCE OF THE SHELLS OF THE VENUS TRIBE.—THE BORING VENUS OR TAPES.—DIFFERENT HABITS AMONG THE SAME SPECIES.—CYTHEREA.—VENUS.—ARTEMIS.—LUCINOPSIS.

VENERIDÆ.

Although, as a general rule, our mollusca partake of the same quiet, sober hues which characterize the greater part of our native productions, and it is rarely permitted us to feast upon the gorgeous tints which adorn the littoral inhabitants of warmer and more sunny climes, yet the sterner rules are now and then relaxed in our favour, and in the *Venus* tribe we meet with several shells on our own coasts of great beauty. And if even these do not equal in splendour the inhabitants of southern seas, we often see the want of more showy colours made up by the exquisite delicacy of some tints, and the harmonious arrangement of others.

The animals of *Veneridæ* are in general much alike;

their shells present great variations in shape and sculpture, but all have the hinge external. Not only the species of different genera, but even the individuals of the same species, as we shall presently see, differ from each other in their habits of life. The genera are as follows :—

I. Tapes—has two moderate-sized fringed siphons, divided half-way; a large, compressed, tongue-shaped foot, with a groove in which a byssus is fixed, so that the animal, when not in motion, or when not sufficiently fixed in his cavity, can secure himself by *anchoring* himself to any localities he may affect. The shell is oval, and, like the *Venus*, has two or three teeth in each valve, close to the apex. Many of the *Tapes* are found in holes of rocks, in which they have lived, and have become very irregular in their growth, so much so, that it is in many cases difficult to say, with regard to individuals, whether they belong to *Venus* or *Venerupis*. This genus is represented in our seas by the following species :—

Tapes Pullastra or *Venus perforans:* shell rather oval or oblong, squarish at the ends, very finely striated in both directions, and sometimes with strong ridges, or laminæ, at the hinder end.

This species shows how difficult it is to found arrangements on any one peculiarity, for no distinction would seem to be more important between two *species* or *genera*, or even *families*, than that which would result from contrary habits of the animals; and yet such contrary habits exist, and are shown by contrary characters of the shells, even in different *individuals* of the same species. The following interesting observations on the instance before us are by the authors of the 'History of British Mollusca.'

"We are compelled by the force of facts to come to the conclusion that the two are identical; and though the shells of each seem to present greater differences than their animals, still the principal form and outline of both, with their striæ of growth and decussations, are essentially of the same character; the variations are mere modifications of similar elements dependent on habitat, deprivation of light, or exposure to it; for when the shells are imbedded in the cavities of rocks they are subject to variations of form, and being deprived of light, they are usually colourless and without markings; and not being rubbed by the action of the waves amongst the shingly beaches, their striæ are sharper and more foliaceous. Amongst shingle, where they are free, or, if the current be strong, attached by their filaments to stones,

and exposed to light and the action of the sea, they are of regular form, often beautifully coloured, with smoother striæ and decussations. In the former case they are the *Venus perforans,* in the latter the *Venus Pullastra* of authors."

T. virginea: generally regular, oval, rather pinkish, only ridged concentrically, prettily marked with brown zigzag lines, a delicate pink *blush* within.

T. aurea: like *T. virginea,* but shorter, yellowish within, and more swelled at the lower edge.

T. decussata is a favourite article of food in many parts of the Continent. The specimens taken in the Mediterranean are of considerable size. The shell is *strongly* and coarsely striated in both directions.

II. Cytheræa.—*C. Chione* is the only representative of this genus in British seas, and it really is a magnificent creature. The shell is large, smooth, oval, of a delicate white within, of a pinkish colour without, finely rayed with rich brown; the hinge has the small lateral tooth near the two cardinal teeth, but at a different angle, which distinguishes the shells of this genus from those of *Venus.* The animal is of a reddish-orange colour, with open mantle, beautifully scalloped; it has a large, thick, pointed, tongue-shaped foot, and siphons

united, except near the openings, which are fringed. It has not, like *Tapes*, a byssus for *anchoring*.

III. VENUS.—The *Venus* has *not* a separate lateral tooth in the hinge of its shell, but three diverging cardinal teeth. The shells vary considerably in shape and colouring.

The larger and more beautiful *Veneres* belong to tropical climates, but we have several on our own coasts which are very pretty in their way. Their habits vary very much, particularly in respect to the greater or lesser depths of ocean under which they live, some being almost littoral, and others living in the deep recesses of the sea: those that lie furthest out of sight are, however, destitute of colour.

V. verrucosa has a thick, round shell, with strong, coarse concentric ridges, the ridges crossed by oblique dissecting lines, which cut them up into knobs or "warts" on each side. Animal pale yellowish-white.

V. cassina: shell flatter, but round; ribs rounded in front, *flattened* or laminated behind, and *not* dissected when young; it is delicately rayed.

V. striatula: shell rather triangular, sometimes marked by zigzag lines, with concentric ridges numerous, more or less flattened at the back, with fine brown lines on the flattened dorsal area. Plentiful on our sandy coasts.

V. fasciata has the shell rather thick, small, flat, and round, with broad, flattened ribs; sometimes nearly white, with interrupted rays of dark brown; sometimes pinkish, with rich chestnut rays, irregularly edged by red lines.

V. ovata: shell small, oval, with numerous radiating ribs, crossed by very minute concentric striæ. This species as well as the last has a preference for gravelly sand.

IV. Artemis.—Round, flat, with mantle open; tubes long, united, with the edges of their openings fringed; foot "semilunar;" valves of the shell flat, round, with a very deep angular sinus in the impression of the mantle pointing upwards. This last character forms the principal distinction of this genus.

A. exoleta: shell squarish-round, coarsely ribbed, coloured with purplish-pink, and marked with rays of brown and zigzag lines.

A. lincta: more round, colourless, with the concentric ribs more delicately fine than in *A. exoleta*.

V. Lucinopsis *undata* has a light brown, thin, inflated, round shell, with characters which seem to place it very near, if not in, the genus *Artemis*. The siphonal tubes however are *divided*, which is not the case with *Artemis*. It is rather rare, inhabiting sandy ground.

CHAPTER XII.

SIPHONS.—THE ARCTIC CYPRINA.—THE LITTLE CIRCE.—ASTARTE.—ISOCARDIA COR.—THE PRISONER.

CYPRINIDÆ.

Hitherto we have spoken of the siphonal tubes being long or short, divided or united, fringed or plain; but, in the present family, the tubes are hardly properly so called, for they do not (or scarcely) protrude beyond the body: some of them are mere openings. This is connected with a character in the shell. The impressed line, which passes from one muscular impression to the other, is in the preceding families more or less curved at the back into a *sinus;* but in this family it has no such curve. In proportion to the length of the siphons, is the depth of sinus in the impression of the mantle; and when the siphons do not at all protrude, the sinus is not there. This character, although one of degree,

seems to unite the following genera with some propriety, although, in many respects, they do not form a group that would seem natural to the eye.

I. Cyprina *Islandica*.—Only separated from the genus *Venus* by the above distinction; delights in northern seas; his shell is thick, and covered with a thick coating of brown epidermis, as if to keep him comfortable in those icy regions, where he abounds more than on our own coasts.

II. Circe *minima* has a prettily scalloped mantle, a foot with a kind of heel to it, and a small, flat, roundish shell, very variously coloured, and concentrically ridged, with the hinge-teeth of a *Cytheræa;* he lives in sand or mud on the Mediterranean shores, where his colours are even more varied and bright than under our quiet skies.

III. Astarte has a thick shell, well coated with a thick, smooth epidermis, and having the teeth of *Venus;* the mantle and siphonal openings are edged with a bright orange line. Specimens of *Astarte* are found undigested in the stomachs of cod-fish, which seem to be fond of them. Of the British species, speaking of the shells, *A. Scotica*, including *A. Danmoniensis*, is rather square in outline, strongly ridged.

A. triangularis is very small, and triangular.

A. compressa is flattish, finely grooved, more or less rounded or triangular.

A. elliptica is longer than *A. Danmoniensis*, and is generally smooth towards the edge.

A. crebricostata is more nearly triangular than *A. Danmoniensis*, with the grooves much more numerous and regular; of very rare occurrence.

A. arctica: large, rounded, and smooth.

IV. Isocardia *cor.*—Using the term in a conventional rather than in a natural sense, the shell of this fine *Irish* mollusc is not inappropriately described as "heart-shaped," for it may be held in such a position as to present a figure like nothing else in nature, but remarkably like the article so commonly seen in shop windows during February, painted red, and having some sort of connection with an undressed urchin in its vicinity. It is very full and rounded, and has large spirally-curved umboes or beaks.

Following the example of others, whose powers of originality are unquestionable, I cannot help transcribing from the 'Zoological Journal' the very interesting account given of this animal by the Rev. James Bulwer.

"On being placed in a vessel of sea-water, the valves of the shell gradually opened to the extent represented in the drawing. The feelers, or ciliated fringe of the upper orifice of the mantle, moved slowly, as if in search of animalcules. Having remained in this situation about ten minutes, water was ejected with considerable force from the lower orifice, which till now had remained motionless. The expulsion of the water seemed to be effected by a sudden contraction of the muscles, because this was never done without the valves nearly closing at the same instant. After a few seconds the valves gradually returned to their open position, and remained quiescent as before till the water was again ejected with a jerk. This alternating process was repeated at unequal intervals during the whole time my specimens were under examination, but at shorter intervals on receiving fresh supplies of sea-water, when I suppose food (its quality I could not ascertain) was more abundant.

"The animal appears to be insensible both to sound and light, as the presence or absence of either did not at all interrupt its movements; but its sense of feeling appeared to be very delicate; minute substances being dropped into the orifice of the mantle instantly excited the animal, and a column of water strongly directed expelled from the shell.

With so much strength was the water in some instances ejected, that it rose three inches above the surface of the superincumbent fluid. Animal, small in proportion to its shell, occupying when dead barely a third of the space enclosed in the valves. Its mantle is slightly attached to the shell, and to the epidermis at the margin, and appears to be kept distended, and in contact with the interior of the valves, by the enclosed water.

"The valves fit so closely that the animal can remain two days or more without permitting a single drop of fluid to escape.

"Locomotion very confined; it is capable, with the assistance of its foot, which it uses in the same manner (but in a much more limited degree) as the *Cardiacea*, of fixing itself firmly in the sand, generally choosing to have the umboes covered by it, and the orifices of the tubes of the mantle nearly perpendicular.

"Resting in this position on the margin of a sand-bank, of which the surrounding soil is mud, at too great a depth to be disturbed by storms, the *Isocardia* of our Irish sea patiently collects its food from the surrounding element, assisted in its choice by the current it is capable of creating by the alternate opening and closing of its valves."

CHAPTER XIII.

GASTRONOMIC CRITICISM.—FOOD FOR THE POOR.—COCKLES.—SPECIES.—ADAPTATIONS.—LUCINA.—DIPLODONTA.

CARDIACEA AND LUCINIDÆ.

CARDIUM, or *Cockle*.—The writer of a book like this should not only be something of an epicure in a general way, so as to have some discriminating appreciation of various flavours, but should have especially made it his business to taste the various kinds of eatable shell-fish, to give a critical opinion of their respective merits. In both these respects, the present writer feels his deficiency. Oysters and periwinkles (besides having once suffered severely from mussels) constitute the utmost amount of his experience in matters of malacological *taste*. He is ignorant of scallops and razor-fish; and as to cockles, none have ever passed his lips, either hot or cold, roasted, boiled, or raw, and he can only say, that in

1 Lutraria elliptica . 2 Mya truncata 3 Panopæa Norvegica

every condition they are *considered* most savoury and delicious.

Still, however, it is pleasant to know that many a time have the cockles of our coast afforded a good substantial meal in some humble cottage, whose inhabitants might have perished with hunger but for this providential supply; and even in ordinary times, the utility of the esculent is attested by heaps of emptied shells near the tenements of the poor. This is the case in many parts of our coast, especially among the northern islands of Scotland.

All the Cockles have a very large geniculated foot, which they are said to use with great dexterity in making enormous leaps; the siphons are very short and fringed, and the mantle freely open. The shells present great variety of form and sculpture; they are all more or less ribbed in a radiating direction,—at least, those few species which are not distinctly so still show linear traces without, and tooth-like terminations within, of the same character. In many cases the ribs are ornamented with beads or striæ, or spines. The finest and most numerous species abound in tropical climates, but still the genus has a wide range; and although our species cannot boast of much or very brilliant colouring, the ornamentation is not to be despised. The British *Cardia* are—

C. aculeatum: shell large, light, inflated, with about twenty ribs adorned by prickles, the interstices of which are smooth.

C. echinatum: shell more solid, with fewer ribs, and the interstices cross-ribbed.

C. rusticum, generally called *tuberculatum:* shell thick, solid, coloured by cross-bands of rich brown; ribs thick, cross-ribbed, with little sharp tubercles.

C. edule: the common cockle, so frequently used as food; has a rather obliquely oblong shell with furrowed ribs, and almost always with a patch of dark colour inside at the hinder part, and about the hinge. The animal inhabits sands at low water in numbers together. Among the Orkney Islands, during the late failure of the potato-crop, many of the poorer people subsisted almost entirely on cockles.

C. nodosum: shell small, rather square, with little oblong seed-like tubercles on the close-set ribs.

C. Suecicum: a delicate, small, white, flattish species.

C. fasciatum: small, obliquely oval, banded with brown.

C. pygmæum: like *nodosum,* but with little *round* tubercles on the ribs.

C. Norvegicum or *lævigatum:* rather large, flattish, smooth.

A remarkable circumstance noticed with regard to the *Cardia* is, that those which inhabit sheltered localities have much thinner shells than those which lie in coarse sands, exposed to tidal currents; the covering strengthens in proportion to the amount of protection required, just as a well-known long-eared and patient quadruped is assisted in bearing the violence to which he is exposed, by being provided with a remarkably thick skin; or as some among mankind, having to encounter much rough treatment in the world, are mercifully guarded by an extra degree of obtuseness, an outer coating of hardiness, suited to their state.

LUCINIDÆ.

I. LUCINA, the genus from which the family is named, has generally a round form, with a remarkably long foot, capable of being contracted within the mantle, which is open and fringed; the siphons are "sessile," that is, not protruding. The shell is generally white, rounded, has no sinus in the impression of the mantle, but a curious elongation of the anterior muscle. Of the British species,—as to the shells,

L. borealis is the largest; it is round and regularly ridged in a circular direction.

L. leucoma (known as *lactea*): smaller, without sculpture; ligament internal.

L. flexuosa: small, white, with folds at the sides.

L. divaricata: still smaller, with striæ meeting at the centre, and diverging towards the sides of the shell.

L. ferruginosa: minute, brown, heart-shaped.

II. Diplodonta *rotundata* is the only remaining British mollusc of this group. It burrows in sand on our southern shores, thence ranging to the Mediterranean. The foot is pearly white, rather flat, and neither siphonal tubes nor orifice could be found by Mr. Clark, who examined it very carefully. The shell is very like a *Lucina*, of a round shape, smooth, with a broad, shining, unsinuated pallial impression.

CHAPTER XIV.

KELLADIÆ, SPECIES AND HABITS; MONTACUTA, TURTONIA, KELLIA, GALEOMMA, LEPTON.—OBSERVATIONS ON A LIVING CAPTIVE.—CYCLADIDÆ, CYCLAS AND PISIDIUM.

KELLADIÆ AND CYCLADIDÆ.

ALTHOUGH compelled by our limits to pass quickly over the little creatures composing these two groups, they are by no means without interest. This is saying no more than might be said of the smallest thing that has life; but we shall find among these tiny shell-fish instances of beauty in form and nicety of adaptation.

The KELLADIÆ are marine, and have only one siphonal opening; their foot has a little groove, in which is inserted a little hairy byssus; the valves of the shell are thin and oval.

I. MONTACUTA has no tubes, only one opening, a large triangular-pointed foot, exserted forwards. The light, thin

shell has a cartilage-pit in the hinge, two broad diverging teeth, and no external ligament. The shell of
M. ferruginosa is *really* white, long, oval, smooth;
M. bidentata, white, rather squarish-oblong;
M. substriata, small, brown, striated obliquely, short.

The latter species is generally found attached to the spines of the purple *Spatangus*, or "sea-urchin." By means of its byssus, or cable, it is fixed so firmly in its position, that it is difficult to remove without breaking the delicate shell; yet in spite of this power of firm adherence, the *Montacuta* could not take the motto "always at home," for its powers of locomotion are remarkably great for so minute a creature, and are doubtless exercised often. When on the move, it stretches out the rounded point of its foot, and taking firm hold, draws itself up, and rapidly repeating the act, gets quickly over the ground.

II. Turtonia *minuta* has one thin siphonal tube at the short end, and the foot long and sharp, exserted from the opposite. The shell is very small, oval, brown, with the ligament outside, and two minute teeth in the front part of the hinge within. "It inhabits pools and crevices of rocks between tide-marks," sometimes adhering to little corallines.

III. Kellia has one very short siphon at the back and

a curiously tubular elongation, communicating by open edges with the foot in front. The shell of

K. nitida is white, rather square, and flat, with one very sharp cardinal and two broad lateral teeth in each valve;

K. suborbicularis, yellowish, similar in form, with a partly internal ligament, no cardinal teeth, two short lateral teeth in one valve;

K. rubra, very minute, tinged with red, rounded in front, squarish behind, hinge nearly as in *K. suborbicularis.*

The *Kelliæ,* sometimes among rocks and shells and sometimes hiding under seaweeds, sometimes attached by their byssus and at other times free, have doubtless their own means of enjoyment unobserved in their quiet retreats.

IV. LEPTON is so called from the square, flat, *scale*-like form of its small, white shell. The following extracts from Mr. Alder's account of the animal will be read with pleasure.

"When lately dredging in Fowley's harbour, I fortunately met with a living individual of this rare genus, the *Lepton squamosum,* which I kept alive for a fortnight, and am thus enabled to supply some account of its characters and habits. It is of a transparent white, the mantle is very large, and

when fully extended, is at least one-third larger than the shell, passing considerably beyond it in the free part, which is thin and transparent, with a smooth, undulating margin. Between this and the shell there is a fringe of filaments, extending completely round to the umboes, but largest and most conspicuous on the back. There is however a single filament much stouter and longer than the rest, which, when the animal is crawling, is waved to and fro, like a tentacle, apparently feeling the way as it goes. The other filaments are comparatively motionless, floating loosely in the water, though capable of being thrown out or withdrawn at pleasure. The mantle is open for about three-fourths of its circumference, being united for a short space before and behind; in the latter part it forms a short siphon, with a single aperture. The foot is very large, rather thick and tapering in front, with a slight nipple-like termination; behind, it extends into a long, pointed heel, with thin margins, which are divided for about half the length of the base, forming, in that part, a kind of disc, the edges of which can be either closed or expanded, as in the foot of the *Nuculæ*. As may be imagined from the size of the foot, it has the power of crawling about very freely, and sometimes it also swims inverted on the surface of the water, in the manner

of the gasteropods, the hinder part of the foot being then unfolded into a disc; but its favourite position is that of repose, suspended freely in a perpendicular position, with the umboes downwards, by three or four threads, so fine that they cannot be seen by the naked eye, and even with a magnifier can only be observed in certain positions of light."

It must be curious to see all this beautiful apparatus of large foot, mantle spreading out widely beyond the shell, and siphon and fringe of filaments suddenly withdrawn and enclosed within the two flat little valves.

The shell of *L. convexa* is smaller, less square, and less flat.

V. Galeomma *Turtoni* has an oval, white, toothless shell, with a very wide opening between the valves; the foot is rather cylindrical, and the mantle is studded with curious tubercles. Mr. Clark having with some difficulty detached a specimen from the rock, to which it was attached by the byssus, kept it alive in a saucer for twenty-four hours, during which time it attached and detached itself several times, in one case making a new byssus, by pouring out a green glutinous matter, which became a firm thread in a few minutes. "When detached, it opened its valves, laying them nearly flat, and marched across the saucer by means of its foot, with such rapidity that scarcely ten could be counted."

The CYCLADIDÆ are small *fresh-water* molluscs, with more or less oval shells of a horny structure, having cardinal and lateral teeth in each valve. By the sides of rivers, in ponds and ditches, buried in the mud, live these little bivalve shell-fish, bringing forth their young from eggs *within* the parent shell.

I. CYCLAS has a long foot and divided siphon. The shell of

C. vivicola is oval, inflated, and striated; that of

C. cornea is more rounded and smooth; while that of

C. caliculata has a peculiar cup-shaped prominence on the umbo.

II. PISIDIUM has the siphonal tube *single*. While in *Cyclas* the hinge of the shell is placed on the longer side, that of *Pisidium* is on the shorter. The British species are—*P. obtusale, P. pusillum, P. cinereum, P. nitidum, P. pulchellum, P. Henslowianum, P. amnicum,* with differences too minute to be otherwise than technical.

CHAPTER XV.

THE BUCKLER OF PEARLS.—THE FISHERIES.—ORIENTAL PEARLS.—THE DIVER.—A REPLY.—NATURE OF PEARLS.—ARTIFICIAL HELPS.—FRESH-WATER MUSSELS.—UNIO ANODONTA.—SALT-WATER MUSSELS.—MYTILUS EDULIS SOUGHT FOR FOOD, BAIT, AND PEARLS.—DREISSENA AT HOME.—MODIOLA CREVELLA.

UNIONIDÆ AND MYTILIDÆ.

SALT AND FRESH WATER MUSSELS.

THE famous shield, covered by British pearls, and dedicated to the Goddess of Beauty by Cæsar, could scarcely have been worthy of its shrine, unless it were for the great pains and expense incurred by the warrior in procuring the gems. Supposing even that his pearls were the produce of *Unio margaritiferus*, or "pearl mussel," they would, in comparison with "oriental tear-drops," compose but a dull surface of tiny beads, with here and there a spark of nacreous glitter. But if, as perhaps was the case, they were from the common

eatable mussel, they would be poor indeed for the trophy of a conqueror, or a compliment to celestial charms. If, indeed, the fame of these gems attracted the notice of Julius Cæsar to our Isles, he must have been, as far as they were concerned, disappointed at the result, for there really is little beauty or richness in the pearly productions of our own clime.

Still, we have had our "pearl-fisheries" in various parts of the kingdom. Multitudes of poor people have been employed from time to time in fishing the *Unios* for pearls, taking the opportunity when the rivers were low, when they could easily take them as they lay protruding their great fleshy foot, or follow them with sticks and tongs where they burrowed in the soil; but many mussels must be fished before one pearl would be found, and out of many pearls one or two only would be worth any attention either for size or clearness. This is still more the case with the Salt-water Eatable Mussel, among which it is still more rare to find a "gem of first water." In the aggregate, however, the fisheries of both kinds are productive of large sums, and afford profitable employment to the poor in many places.

The more gorgeous pearls are taken from the Pearl-oyster of the Indian Seas, where they are fished by divers, whose

perils and sufferings have been the theme of many a dissertation. The death of one of these men in pursuing his occupation, gave rise to the following truly poetical stanzas. Introducing the pearl as adorning a lady's head-dress, the poet says:—

"There it lies,
A lily pale and bright.
Yet what doth all avail,—
All its beauties, all its grace,
All the honour of its place?
He who pluck'd it from its bed,
In the far blue Indian Ocean,
Lieth without life or motion,
In its earthly dwelling, *dead*.
And his children, one by one,
As they look upon the sun,
Curse the toil by which he drew
That treasure from its bed of blue.
Gentle bride, no longer wear
Such a spoil; it is not fit
That thy tender soul should sit
Under such a cursed gem:
Needest *thou* a diadem?
Oh! sweet lady, cast aside
With a noble, gentle pride,
All that is to pain allied."

As no pain, sorrow, or danger is however associated with British pearl-fishing, we may venture to reply, in lines as

far short of the above in poetry, as our pearls are of the beauty of oriental specimens in beauty :—

> But yet the glittering dew-drop drawn
> From shores or streams of British Isles,
> With flowers of *heartsease* might be worn,
> And lustre give to beauty's smiles.
> No luckless diver's heaving breast
> For useless ornament oppress'd,
> But cheerful labour, free from pain,
> Has sought the prize for honest gain.

All kinds of mollusca whose shells are lined with pearly coating, are apt to produce pearls under some condition. The coating of the shell of pearl-oyster, for instance, is thick and iridescent; it is usually called "mother-of-pearl," and produces its offspring thus :—if any little bit of sand gets intruded within the mantle, it causes such irritation to the animal that an extra quantity of the nacreous secretion is exuded suddenly in or near the spot surrounding the object. If the latter be not removed, it will form the nucleus of many layers of the secretion, successively hardening round it, and so will become a jewel. If the shell is closely attached to its bed, the pearl will remain fixed to the surface; but if it be "riding at anchor," attached only by the long hairs of its byssus, the oyster will roll about, and contrive to shake

out the intruder at a more or less advanced stage; so that it will be found round and free, perhaps hidden among the fibres of the beard.

The iridescent lining of our *Unio* is not so thick, nor that of our *Mytilus* so bright, as the oriental oyster, which of course suggests a less rapid and pure secretion of the fluid, and accounts for the inferior quality and size of their *calculi*.

From this account it may be easily understood how the Chinese manage to make pearls by keeping the shell-fish alive, and introducing irritating substances through their shells: they have even inserted images of baked clay, which, in due time, have been covered with the enamel.

The Unionidæ, or Fresh-water Mussels, are remarkable for the large size of their tongue-shaped, compressed foot, so peculiarly adapted for cutting their way rapidly through the mud of the rivers in which they make their bed. I remember, many years since, seeing a number of men, women, and boys, with pots and pans, collecting specimens of *Anodon* from the pond in the Green Park, opposite Piccadilly. The water was all drawn off, and the people were knee-deep in the mud, following the diagonal traces of the active creatures' retreat. It was a most exciting and really

curious chase. The mantle of the animal is plain, and freely open; the lips of the anal siphon form a tube-like projection; and the branchial opening is fringed by filaments: the shells are pearly within, and covered by a thick, horny, smooth, brown or green epidermis without.

I. Unio has a thick oval shell, with teeth on the hinge: the soft parts of many of the magnificent species of foreign rivers are used for food.

U. tumidus has an oval, obliquely angular shell, with wavy tubercles at the umboes.

U. pictorum is much longer, and less oblique.

U. margaritifera, or Pearl-bearing *Unio*, has the shell long, arched, with a black epidermis. In the Conway, the Firth, the Tay, and other rivers, are found the haunts of these animals, where they are sought for their pearly products, occasionally, at rare intervals, rewarding the seeker with a prize worth a pound or two.

II. Anodonta is represented by one species among our Islands, the *A. cygnea:* the shell is light and thin, of a varying, but generally oblique oval shape; the hinge *without* teeth, and the outer surface covered with a glossy transparent epidermis, brightly rayed with green.

The Mytilidæ are true mussels, generally inhabiting the

1. Solenicurius [illegible]. 2. Solen ensis. 3. Solen siliqua
4. [illegible]ratisolen legumen.

sea: they have a slender foot, at the base of which is a byssal groove.

I. Mytilus *edulis*, or the Common Eatable Mussel, has a very prettily fringed open mantle, and a long slender foot, from which it spins a very strong byssus. It is collected in great numbers for three distinct purposes, namely, for food, for bait, and for pearls.

"As bait, the consumption is very large in some places; so much so, that the beds, which in many cases are private property, and yield large incomes, are becoming exhausted. In Newhaven alone there are four large deep-sea fishing-boats, which generally go out three times a week, and fish for about thirty weeks in the year, excluding Sundays and bad weather. Each of these large boats carries eight men, with eight lines of eight hundred yards in length, which, at a low calculation, take twelve hundred mussels to bait, each time they are so used; so that each large boat will use 28,800 mussels per week, equal to 864,000 per annum. But there are about sixteen other smaller boats, which go out daily, or rather at twelve o'clock every night, for about the same number of weeks in a year. Each carries four men, with four lines, eight hundred yards long; their consumption of mussels will come to 3,456,000: the total con-

sumption of mussels for bait annually in Newhaven alone may be reckoned at 4,320,000." (*Dr. Knapp*, in Forbes and Hanley). "Mussels are kept in many places in artificial beds, to be used when required for bait. At Anstruther, in Fifeshire, we have seen these little mussel-gardens, as they are called—little plots of sea-shore, between tide-marks, edged in by stones, and held as private property." (*Forbes and Hanley.*)

As food, mussels are well known. When in good condition they are esteemed nutritious and pleasant; but their consumption is not unattended with danger; for it sometimes happens that after taking them persons have been seized with a peculiar illness, for which it is impossible to account, although the symptoms have been accurately described, and treatises have been written on the subject. Until the precise state of the mussels (or of the patient) which induces the disorder be known, it will be impossible to know whether in a dish of them you are taking wholesome food or poison.

For pearls, such as they are, the mussel is sought in its haunts by multitudes who obtain a livelihood by it. The following account of the fishery in the river Conway, from the 'Magazine of Natural History,' is very interesting:—

"When the tide is out they (the natives) go in several boats to the bar at the mouth of the river, with their sacks, and gather as many shells as they can before the return of the tide; the mussels are then put into a large kettle over a fire to be opened, and the fish taken out singly from the shells with the fingers, and put into a tub, into which one of the fishers goes barefooted, and stamps upon them until they are reduced to a sort of pulp; they next pour in water to separate the fishy substance, which they call *solach*, from the more heavy parts, consisting of sand, small pebbles, and the pearls, which settle at the bottom. After numerous washings, until the fishy part is entirely removed, the sediment, if I may so term it, is put out to dry, and each pearl separated on a large wooden platter, one at a time, with a feather; and when a sufficient quantity is obtained, they are taken to the overseer, who pays the fisher so much an ounce for them. The price varies from 1*s.* 6*d.* to 4*s.* There are a number of persons who live by this alone, and where there is a small family to gather the shells and pick out the fish, it is preferable to any other kind of daily labour." About the destiny or use of these pearls there is some mystery, and the same writer says, "There have been some curious and fanciful surmises which may not be thought worth

mentioning. Some suppose that the pearls are sent abroad to be manufactured into seed-pearls; others, more gravely, that they are exported to India to be dissolved in the sherbet of the Nabobs."

Who knows but that another '*buckler*' may be preparing, to grace the triumphs of another *Cæsar*, who modernizes the title by a different mode of spelling!

II. Dreissena *polymorpha* has recently been introduced into this country, and is a naturalized mollusc. The shell is very angular, and is painted with zigzag markings. Inside it has a kind of plate, or septum, across the beaks. It was first noticed in the Commercial Docks, attached in abundance to shells and timber, by my relative, Mr. J. Bryant, who used the animal as bait for perch. The animal differs from *Mytilus* in having the mantle closed: it propagates rapidly, and is now common. It is difficult to account for its introduction into our river; for, on the supposition that it came attached by its byssus to the bottoms of ships, it must have passed through miles of salt water, and if it came on timber from Wisbeach, as believed to be the case, it must have lived during the journey without water. Whatever might have been the perils and dis-

comforts of the voyage to the country of his adoption, the *Dreissena* is now contented and happy, and feels himself quite at home among us.

III. Modiola.—In *Modiola* the front of the shell protrudes a little beyond the apex, and forms a *rounded* termination, in this respect differing from *Mytilus*. The shell of

M. modiolus is large, full, covered with a brown epidermis, not rayed; of

M. tulipa is smaller, narrower with rays of colour; of

M. phaseolina, small, oval, with a fringed epidermis;

M. barbata, larger, with a fringed epidermis.

IV. Crenella differs from *Modiola* in the shell, which is more oval, has a crenulated hinge-margin, and is radiately grooved before and behind. The shell of

C. nigra is rather flat, an inch long, and black; of

C. costulata, large at the back, with strong radiating grooves at each end, and marbled with zigzag lines; of

C. rhomba, small, almost three-cornered; of

C. decussata, small, nearly square, crossed with striæ;

C. marmorata, oblong, nearly straight, marbled, smooth in the middle; of

C. discors, like *marmorata*, but oblique; not marbled.

CHAPTER XVI.

THE 'SWALLOW' MUSSEL.—AVICULA.—PINNA AND ITS BEARD.—THE FABLE.—SHARP-TOOTHED NUCULA.—LEDA.—ARCA.—PECTUNCULUS.

AVICULIDÆ AND ARCADÆ.

In the first of these families we boast *one* Avicula and *one* Pinna.

Avicula *Tarentina* is also known as *Mytilus hirundo*, from a fancied resemblance in the graceful form of its shell to that of a swallow in flight. Mr. Hanley compares it to a mussel placed obliquely, with a long wing-shaped appendage attached horizontally to its apex. The hinge and medial disc within is beautifully iridescent, as might be expected from its affinity to the pearl-oyster of the orientals; the outside of the shell is of a loose scaly texture, almost as much so as that of the oyster; the foot, or locomotive organ, of the *Avicula* being small, the byssus, or means of anchorage, is proportionately large.

PINNA *pectinata* is a pleasing example of a very noble tribe of bivalves. The *Pinnæ* are something like enormous mussels with the end open. Some of the species attain a size of two feet long and one foot broad at the broader end, for they are broad at one end and taper to the other end, which is the apex. Although our species only attains, even in extreme cases, twelve inches in length, it is still the largest bivalve of our seas. The vital part of the inside is lined with thin pearl. In the bed of *Pinnæ* at Salcombe Bay, discovered by Montagu, they were all fixed with the small end downwards, and attached so firmly by the large strong byssus of silky threads, that it was no easy task to separate them. They are said to be used as food, but require a great deal of cooking to make them even tolerably tender.

In the British Museum there are not only specimens of pearls taken from *Pinnæ*, but also of gloves woven from their byssus. The latter however are by no means elegant in appearance, and it is not very likely that *Pinna* gloves and stockings will ever be a manufacture in demand.

Those who have watched the general fondness of little crabs on our shores for getting into nooks and crevices of every kind for shelter, will easily understand how some of them would find a comfortable asylum between the flaky

folds of the sedentary *Pinna's* shell. They will thus be able to account for their existence in such a situation, without resorting to the curious old fable about the crustacean providing food for the mollusc, as a rental for his apartments in the shelly tenement, and the "*entente cordiale*" between them.

THE ARCADÆ

crawl on the expanded surface of the foot, which, when not in action, has its two sides wrinkled up so as to form a groove; an open mantle; and a shell which, however different in form, always has on the hinge a *row of interlocking teeth.*

I. NUCULA has the disc of the foot sharply notched; the pretty little shells are very bright and pearly, with two half-circular rows of sharp teeth on the hinge; a very sober drab-coloured epidermis without. The shells of the British species are—

N. decussata: rather oval, finely striated; dorsal area sculptured.

N. radiata: smooth, more oblique, rayed.

N. tenuis: thin, smooth, inner edge not crenated.

N. nucleus: rather triangular, smooth, blunt at the hinder end; epidermis dull.

N. nitida: rather triangular, tapering at the hinder end; epidermis shining.

II. LEDA differs from the other animals of the genus in having distinct siphonal tubes. The shell differs from that of *Nucula* in having the hinder end lengthened. That of *N. pygmæa* is smooth and short; that of *N. caudata* is longer and ridged.

III. ARCA is so named from the broad, flat disc of the hinge of the united valves, which has been likened to the deck of a vessel. The animal of our typical species spins a byssus; it is called

A. tetragona now, but more commonly known as *A. Noæ.* It is found in many localities, generally attached by its byssus, in crevices of rocks, or in hollows of empty shells. It is not so fine a shell as the foreign *A. Noæ;* it has a very broad area.

A. lactea is small, white under the hairy epidermis, and with a small area.

A. raridentata is quite a minute shell, rather short, with only three or four teeth on each side of the hinge.

IV. PECTUNCULUS has a thick, round, equilateral shell, with the teeth arranged on each side of the hinge in a half-moon; the muscular impressions are very strongly

marked, and the edge has very even, flat teeth all round.

Our British species, *P. glycimeris*, is beautifully marked with brown, especially when young. From the hairy epidermis it has been called *P. pilosa*.

CHAPTER XVII.

INCONGRUITIES.—LIMA.—ITS WOVEN NEST.—PECTEN.—ITS OCELLI.—ITS MOVEMENTS.—SPECIES.—OSTRÆA.—'ONLY ONCE A YEAR.'—OYSTER-BEDS.—ANOMIA.

OSTRÆADÆ.

Scallops and Oysters! The most active and most sedentary of molluscs: the smart and merry Pecten, with the grave and placid Oyster, the time-honoured symbol of all that is heavy, dull, and inanimate! One would suppose that the only excuse for grouping them together would be, that both are articles of food. The animals of one are *free*, of the other are *attached*, by their shells *growing on to* each other and the rocks. The one has a foot and a circle of tentacles, while in the other the foot is wanting and the mantle is without ornaments; the shell of the one is regular, while that of the other is rough and uneven. Yet there are species and genera which, in one character or another, form

connecting links between them, and only serve to show how impossible it is to seize any characters sufficiently permanent and absolute, to form any distinct line of demarcation between one group and another in nature. In the 'History of British Mollusca' the following characters are given, for the purpose of uniting the different groups under one family:—"All the tribe have the mantle freely open, no tubes, a small or obsolete foot, probably capable in some stage of the animal's existence of spinning a byssus, and constantly doing so in some species, united adductor muscles, leaving a single impression in the shells, and a ligament wholly or partly interior, lodged in a cardinal groove and sometimes accompanied by teeth."

The two adductor muscles of other bivalves, being in the *Ostræadæ* united into one, and producing one impression in the shell, is the most important character of the family.

PECTENS, OR SCALLOPS.

I. LIMA.—"Oh, here is the *Lima's* nest!" is the delighted cry of Miss Alder, when, dredging with her papa and the Rev. D. Landsborough, she reaches a little cluster of broken fragments of coral bound together in a mass; and opening the lump, there is the *Lima* snugly ensconced in the

middle. The *Lima* itself is a most beautiful creature, with a double-frilled orange or pink mantle lining its delicately-white, ribbed shell, and rows of long, ringed tentacula; it has a narrow tongue-shaped foot and an anal siphon. It is most commonly seen swimming through the water with very great quickness, by means of suddenly opening and shutting its valves, all its bright orange or vermilion tentacula in motion. At other times it is found at anchor, fixed to the rocks by its fine-spun byssus; and it is only occasionally that it adopts the hermitage, formed of loose substances, called its *nest*.

A description of this nest, from the pen of the reverend gentleman above named, is found in his delightful book, 'Arran.'

"The coral nest is curiously constructed, and remarkably well-fitted to be a safe residence for this beautiful animal. The fragile shell does not nearly cover the mollusc,—the most delicate part of it, a beautiful orange fringe-work, being altogether outside of the shell. Had it no extra protection, the half-exposed animal would be a tempting mouthful, quite a *bonne bouche* to some prowling haddock or whiting; but He who tempers the wind to the shorn lamb, teaches this little creature, which he has so elegantly formed, curious arts of self-preservation. It is not contented with hiding

itself among the loose coral, for the first rude wave might lay it naked and bare. It becomes a marine mason, and builds a house or nest. It chooses to dwell in a coral grotto; but, in constructing this grotto, it shows that it is not only a mason, but a rope-spinner, and a tapestry weaver, and a plasterer. Were it merely a mason, it would be no easy matter to cause the polymorphous coral to cohere. Cordage, then, is necessary to bind together the angular fragments of the coral, and the cordage it spins; but it spins it as one of the secrets of the deep. Somehow or another, though it has no hands, it contrives to intertwine this yarn, which it has formed among the numerous bits of coral, so as firmly to bind a handful of it together. Externally this habitation is rough, and therefore better fitted to elude or to ward off enemies; but though rough externally, within all is smooth and lubricous, for the fine yarn is woven into a lining of tapestry, and the interstices are filled up with fine slime, so that it is as smooth as plaster-work, not unlike the patent Intonaco of my excellent, ingenious friend, Mrs. Marshall. Not being intended, however, like her valuable composition, to keep out damp or bid defiance to fire, while the intertwining cordage keeps the coral walls together, the fine tapestry, mixed with smooth and moist plaster, hides all as-

perities, so that there is nothing to injure the delicate appendages of the enclosed animal. Tapestry, as a covering for walls, was once the proud and costly ornament of regal apartments; but ancient though the art was, I shall answer for it, that our little marine artisan took no hint from the Gobelins, nor from the workmen of Arras, nor from those of Athens, nor even from the earliest *tapissiers* of the East. I doubt not, that from the time Noah's Ark rested on the mountain of Ararat, the forefathers of these beautiful little *Limas* have been constructing their coral cottages, and lining them with well-wrought tapestry, in the peaceful Bay of Lamlash.

"When the *Lima* is taken out of its nest, and put into a jar of sea-water, it is one of the most beautiful marine animals you can look upon. The shell is beautiful, the body of the animal within the shell is beautiful, and the orange fringe-work outside of the shell is highly ornamental. Instead of being sluggish, it swims about with great vigour. Its mode of swimming is the same as that of the scallop. It opens its valves, and suddenly shutting them expels the water, so that it is impelled onwards or upwards; and when the impulse thus given is spent, it repeats the operation, and thus moves on by a succession of jumps. When moving through

the water in this way, the reddish fringe-work is like the tail of a fiery comet. The filaments of the fringe are probably useful in catching its prey. They are very easily broken off; and it is remarkable that they seem to live for many hours after they are detached from the body, twisting themselves like so many worms."

The *Limæ* of Great Britain are—

L. hians, the shell of which is oblique, about an inch long, and open on both sides.

L. Loscombii has a fuller shell, *closed,* and oblique.

L. subauriculata is nearly straight, and equilateral.

II. Pecten.—The large eatable Scallops, with one flat and the other convex valve, are too well known to require description, and they represent a large section of the genus having unequal valves, but not sufficiently different from the others to make a distinct genus, as some have desired. The *Pectens* are exquisitely beautiful: the shells are generally ribbed with great regularity; they are nearly equal-sided, and have an expansion at each side of the beaks called an *auricle.* The animal is furnished with fringes of tentacula as his mantle, and black tubercles, or *ocelli,* supposed, however doubtfully, to represent organs of vision. The author of 'Arran' must again be heard:—"The scal-

...verby del. et lith. Vincent Brooks Imp.

1. Mactra stultorum. 2. Mactra elliptica. 3. Tapes virginea 4. Venus fasciata.
5. Cytherea Chione.

lops, or *Pectens,* are a beautiful tribe, and both the shell and its inhabitant show forth the praises of the Lord. Are any disposed to think the scallop must lead a joyless life, lying inert in the dungeons of the deep? The *Pecten,* let me tell them, is a happy, active creature. It can raise itself to the surface, and, though unaided by fins, can skim cleverly through the waves. I have seen a little fleet of them skipping about most merrily, as if engaged in some frolicsome dance. On watching their zigzag evolutions, I found that their valves were to them in water what wings are to the bird in the air. Every time they opened and shut their valves, they were rapidly propelled several yards; and they had only to repeat the operation, and their sportive movement was continued. Others will say, 'What a pity, poor things, that they are blind!' Your pity is again misplaced."

The shells of our British *Pectens* may be thus characterized:—

P. varius: equal-valved, longer than broad; valves equal; auricles unequal; ribs numerous, raised, with spines; colours, bright orange or purple, beautifully mottled.

P. niveus: white, with more ribs than *P. varius.*

P. striatus: rather rounded, smooth or slightly scaled; more or less transparent; variously mottled or marked.

P. tigrinus: either without ribs, or two or three very broad ones; one auricle very small, the other large and strongly ribbed; variously coloured.

P. Danicus: rather triangular, with auricles both small; very variable in sculpture.

P. similis: minute, smooth, expanded at one side, longer than broad.

P. maximus (the great eatable Scallop): nearly equal-sided; one valve flat, strongly ribbed; the other valve white, deeply concave, overlapping it; colours in festooned patches over the ribs.

P. opercularis, the equal-valved, variable shell, so often pierced and used as pincushions. It is rounded, broad, with finely-serrated angular ribs, and auricles not so unequal as *P. varius.* From a bright red to yellow, orange and brown, brilliantly painted and mottled, this interesting shell presents every shade of variation, of which one of great beauty is that of a delicately-white surface, with a bright red line on each rib. Commonly called *P. lineatus.*

P. pusio: with the characters of a *Pecten,* this species has, in advanced life, the habit of an oyster. Free when very young, it soon settles down to a sedentary exist-

ence by attaching itself to submarine objects, and growing to them. The shell becomes irregular, throwing out in its growth any leaflets which may be required to secure it in its place. Thus we pass to

III. OSTRÆA.

Most of us are familiar with the flavour and appearance of the eatable Oyster, as well as with its shell; for the flat valve is brought to table, and the deep valve is presented imploringly to us oftener than we like in August by the grotto boys and girls. Although at first sight the animal presents an unimposing appearance, excepting to the eye of an epicure when plump, the construction is very pretty when more closely examined. The delicate breathing apparatus, seen by cutting open the upper part of the pulpy body, and the double-fringed mantle, with its rows of tentacles, are by no means without a beauty of their own. The shell, too, is sometimes very beautifully foliated, and even in some instances, when young, brightly rayed; the animal has one hinder opening and no foot; the valves are drawn together by a strong, large, round muscle, which forms the delicious gristle, thought by some to be the most delicate morsel of the whole, and makes a strong mark on both shells.

The spat, or spawn, of the oyster is cast in the month of May, and consists of a pulpy substance, described as resembling a drop of tallow; it adheres to the stones, shells, etc. on which it drops at the bottom of the sea; when thus fixed, it is not many hours unclothed, for soon a shell begins to be formed, which thickens and expands until arrived at maturity. In two or three years' time it presents the strong, heavy, beautifully lined, protecting case with which we are so familiar.

There are natural and artificial *oyster-beds*. In the former the oysters live and breed much more flourishingly than in the latter; but the stock is obliged to be guarded by stringent rules, to prevent its exhaustion by eager fishermen. The latter, particularly at Colchester and at the mouth of the Thames, are made by taking the spat and laying it down among rocks and stones in a sheltered place; or by gathering very young shells among stones and sand, and depositing them in the guarded enclosures.

"The life of an oyster" is a phrase used to express all that is dull, senseless, and monotonous in existence; yet even this sedentary creature fulfils, not without some sensations, the purposes of his existence; one of which is, perhaps, to feed some beings who, disdainfully as they think of his

position, would do well if they could imitate him by doing as little mischief and as much good.

IV. ANOMIA.—The attachment of the *Anomiæ* is by means of a kind of button fixed to the object, and locking through a hole in the lower or flat valve. The shells are very irregular, some of them very bright and pearly within; they are remarkably apt to take their form and sculpture from that of the objects to which they are fixed.

A. ephippium is the common species, so variable in its form and sculpture as to have received, in its various conditions, the names *electrica, squamula, cepa, flexuosa, cylindracea, patellæformis,* etc.

A. striata: regularly and minutely striated.

A. patellæformis, with a cavity on the under valve, beneath the hinge.

A. aculeata, with radiating prickles.

CHAPTER XVIII.

TEREBRATULA PSITTACEA, OR PARROT'S BEAK.—MEGATHYRIS.—CRANIA, OR THE MASK.—HYALÆA AND SPIRALIS.

TEREBRATULIDÆ, CRANIADÆ, PTEROPODA.

Our British representatives of the order *Brachiopoda* are not numerous, either as to species or individuals. They are distinguished from other orders by the spiral fringed arms which spring from the margins of the mouth; they have no power of locomotion, but are attached by means of a horny cord passing through part of the shell. The British *Terebratulidæ* are—

I. Hypothyris *psittacea*, or *Terebratula psittacea*, so named from the curious resemblance in the slate-coloured valves to the beak of a parrot, the apex of one bending in a produced point over the other. The byssal cord passes through an opening under the beak,

but the shell is not perforated; two curious bent processes jut out from under the shorter or lower beak.

II. Terebratula *caput-serpentis*, or *Serpent's head*, from a certain flatness and tapering form; the valves are striated; inside, the long ciliated arms are supported on an arched and looped appendage attached to the lower valve; the byssal cord passes through a perforation in the beak of the larger.

T. cranium has the shell smooth.

III. Megathyris *cistellula:* small, broad, with a straight dorsal edge, a triangular opening through the disc on the larger valve.

CRANIADÆ.

Crania *anomala* was first found adhering to stones from deep water in Zetland; it has since been taken in other places: it is like the *Terebratulæ* in some respects, but the lower valve grows on the stone to which it has been fixed, and the upper is something like a square *limpet*. The peculiar arrangement of the four muscular impressions gives, in some species, the appearance of a mask.

PTEROPODA.

The Hyalæa *trispinosa* and the Spiralis *Flemingii*,

Macandrei, and *Jeffreysii* are all that we can show in our ungenial seas of that numerous class of little molluscs, which abound in warmer regions, and with their glassy shells sparkle near the surface of the water. The shells of the two genera are perfectly distinct, that of the *Hyalæa* resembling a bivalve, with the edges glued down, and that of the *Spiralis* being like a lengthened snail; but notwithstanding these differences, and others still greater, in other members of the order, as to the glassy or horny test, the animals are very similar, each having a pair of swimming paddles likened to wings, giving them the name "Pteropoda," or *wing-footed*, and causing a distinguished naturalist to term them "Neptune's bees and butterflies."

CHAPTER XIX.

A WALK ON THE BEACH.—CHITONS.—LIMPETS.—THE FINNY TRIBES DISTINGUISH SPECIES.—ACMÆA.—PILIDIUM.—DENTALIUM.—PILEOPSIS.—CALYPTRÆA.—FISSURELLA.—PUNCTURELLA.—EMARGINULA.

THE LIMPET TRIBE.

CHITONIDÆ, PATELLIDÆ, DENTALIADÆ, CALYPTRÆADÆ, FISSURELLIDÆ.

We find life in some places where it is little expected. Where all is quiet and seeming inanition, one who looks closely into nature may discover forms of vitality unknown to a casual observer. You walk down to the sea-beach, when the receding waves have left bare a portion of the strand, and the rays of the setting sun are illuminating the distant hazy region, where sea and sky appear to meet. You are alone: you see nothing but the expanse above and below and the rugged rocks at your feet, you hear nothing but the roaring of the restless waves against them. In the

hollows you see pebbles and corallines; on the surfaces not covered by seaweeds you see uneven crustings and green mosses, and for a moment you feel as if you were the only living thing within sight or sound. But it is not so. The disturbance of an overhanging *alga* will cause a commotion among innumerable little crustaceans, who will scamper away to hide in the nearest cover; a blow of the barest rock will lay open the dwellings of sea-worms and shell-fish; the polypi will be seen, "all hands" at work, seizing and devouring prey. A closer glance at the crusty surfaces of the blocks will show the tiny *barnacles*, busy throwing out their feathery cirrhi in rapid strokes. In some instances nature is so economical of space in packing her vital treasures, that you may take up an old shell and find almost every hair's-breadth of its substance crowded with perforating worms and mollusca, and every quarter-inch of its surface covered with serpules, limpets, and barnacles. On examining the surfaces of the low rocks you will frequently find crowds of convex shells, fixed by their flattened bases; they are not only motionless when your busy eyes are upon them, but look as if they were incapable of motion. You see nothing but shell, or shelly skin, forming a conical excrescence; you try to remove it by the finger and thumb, but it will not stir

until a knife, or something thin, is inserted under the rim, and it is gradually prized up. When you have it in hand, and turn it over, it appears filled with a living creature; not, indeed, remarkable for activity, but by no means powerless or senseless. The greater part of the flat side is composed of an oval, sucker-like disc, which, exactly like the leather "sucker" of the boys, has served to keep the creature in its place.

Varying very much in their natures, habits, and appearance, and having convex but not spiral shells, the examples of still life to which these remarks have introduced the reader will be found to belong to some of the families named at the head of the chapter. We must now study the characters of each as far as we can without the microscope.

CHITONIDÆ.

Chiton.—Among the sucker-footed molluscs stationary on the surfaces of stones and shells, some will be found in which the oval convex surface is composed of a series of arched shelly plates, set in a rough softer border: the two end-plates of the shell are semicircular, and the border is, in some species, studded with star-like branches of bristles; in others, finely shagreened; in others, apparently smooth.

On releasing the *Chiton* from its hold, and looking at the under side, we find the greater part of the oval occupied by the foot; at one end the head is represented by a kind of proboscis, with a dentated mouth, covered by a sort of hood; at the other end we see, between the border and the foot, on each side, a pair of leaflets, which constitute the breathing apparatus of the animal.

Among the foreign species of this genus there are some very large, very beautifully and variously sculptured; some which have the border armed with strong spines; some which have the valves beautifully beaded, or elegantly marbled; some which have the shells nearly, and others entirely, covered by the membrane; and others (called *Chitonellus*) which resemble a long banded slug, with small shelly pieces along the back. The British species are—

C. fascicularis: with bunches of bristles on the border, and coarse granules on the valves; dark-coloured.

C. discrepans or *crinitus:* the same as *C. fascicularis,* but with the valves more angular, and the granules finer and more numerous; mottled.

C. Hanleyi: with spines on the border; middle of the valves beaded, side areas of the valves with few granules; brownish.

C. ruber: with valves smooth, shining, red; border very finely powdered.

C. cinereus: mottled with various colours; valves and border finely and irregularly granulated. The commonest species. It is generally dull, frequently ashy, and the granulations are only seen on close examination.

C. albus: very difficult to distinguish from *C. cinereus;* the scales of the border are coarser in proportion to those of the valves.

C. asellus: broad and depressed, of a dull ash-colour; granules on the middle areas in rows; border narrow.

C. cancellatus: smaller, narrower, and more elevated and rounded than *C. asellus.*

C. lævis: beautifully marked with red, rather flat but angular; valves smooth, border finely reticulated.

C. marmoreus: mottled; valves microscopically granulated, border quite plain.

PATELLIDÆ.

In the *Chitons* we found something like a distinct head and mouth, with toothed tongue, but no tentacula and no eyes. The *Patellidæ* however are not all in the dark; some of them have eyes, and all of them have tentacula. They

have the creeping disc large and powerful; the mouth has a pair of horny jaws, and a long ribbon-shaped tongue, armed with teeth. When the animal is removed from its shell, a muscular impression is seen, which surrounds the inner surface, excepting at the part where the head lies, which is not itself attached, but can be protruded. The shell is conical. The genera are—

I. PATELLA.—The point of the cone is not at all curved, but it is at the shorter end of the shell; and turning it over, we find the space for the head towards the same, which is therefore the front. The animal has two needle-shaped tentacles on a distinct head, with an eye on a swelling near the base of each; the edge of the mantle which lines the shell is hairy.

Supported on a wide base, the strong pyramidal shell is held firmly in its position by the pressure of the air on the vacuum formed by the sucker-foot. The wildest waves may rage, the heaviest stones be hurled against it, without altering its position or destroying the protection it affords to its owner. Yet the creature *can* move, and it is said can even raise his shell and *spring* to a considerable distance!

> "Well, suppose it a *bounce*, sure a poet may try
> By a bounce now and then to get courage to fly."

At any rate, he occasionally moves by crawling, particularly when young, and is so proud of the achievement, as to mark his progress by scraping the rock with the edges of his shell. In advanced life he becomes too idle for the exercise, and often creeps into confined niches, which he outgrows, and where he becomes a fixture for the rest of his life. Specimens are found to have remained so long in one position as to have excavated a slight cavity, or at least have marked a ring underneath them. This sedentary habit accounts for the great irregularity in the shell, which is forced to conform in growing to the irregularities of its position.

Limpets, although sometimes eaten, are not recommended as food; yet have they often afforded a providential supply to the shipwrecked mariner, cast upon their rocky dwellings, or to the poor of a coast at times when better food was scarce. Only three or four summers since, I remember seeing at Hastings numbers of women and boys on the low rocks, with pots and pans, which they were filling with limpets, as they declared, to boil and eat. They were people on tramp, waiting for harvest-work, and in the meantime were glad to get any supplies within reach. The *Patella vulgata* is much used as bait by fishermen; while the *P. athletica*, often thought to be the same species, is distinguished

from it so scientifically by the fish, as to be quite unavailing to lure them to their doom. The British species are—

P. vulgata (or common Limpet) : shell conical, jagged at the edges, with the substance of the shell of a greenish or greyish colour, and the spatula, or central surface, opaque white; the rays vary in brightness and depth; ribs few and broad.

P. athletica : substance of the shell white; the ribs numerous, narrow, and elevated; spatula tinged with orange. Animal much lighter in colour than *P. vulgata*. Not popular with the fishes.

P. pellucida, or Transparent Limpet.

On this species Mr. Hanley remarks : "The two varieties of this elegant limpet differ so remarkably from each other as strikingly to illustrate the effects of habitat and food upon colour and solidity. The most typical *pellucida* feed upon the leaves of fuci; the aberrant *lævis,* upon the roots and stalks, in which, indeed, it is wont to imbed itself. The former is thin, semi-transparent, of a dark olive when adult, of an ochraceous yellow when young, is regular in shape (which ranges from sub-elliptic to rounded ovate), and is adorned with more or less interrupted rays of lustrous mazarine blue." The other is a thicker, less regular, less transparent, 'pinched up' shell.

1. Lepton squamosum. 2. Cyc[illegible]s cornea. 3. Pisidium amnicum
4. Cyprina Islandica. 5 Artemis lineata. 6 Astarte Dammoniensis

II. Acmæa differs in some anatomical points from *Patella*, and comprises

A. testudinaria, the Tortoise-shell Limpet.

A. virginea, a small shell, with pink rays.

III. Pilidium *fulvum* has no eyes on his tentacula, and no fringe on his mantle; his body is white, and his shell is small, orange-tinted, and slightly curved.

IV. Propilidium *Ancyloides* differs from *Pilidium* chiefly in having the apex of the shell bent backwards instead of forwards, so as to resemble *Emarginula* without the slit; it is a very little, conical, white shell, and the animal is as blind as his above-named brother.

DENTALIADÆ.

Of the "tooth shell" we have but one *authentic* example, namely, the

Dentalium *Tarentinum*, or *entalis*.—This well-known shell is a long curved tube, tapering at one end, and open at both. The animal lives buried in sand or mud, under water, and feeds upon *Foraminifera*, and even small bivalves; it has not a very distinct head; the foot is conical and pointed, and the breathing apparatus consists of a feather-like apparatus of great beauty.

CALYPTRÆADÆ.

The *Cap of Liberty, Cup and Saucer,* and *Slipper Limpets.* —Of the former we have one example, the

Pileopsis *Ungarica,* which is found attached to stones and shells on our coasts, and ranges as far as the coast of Norway northward, and to the Mediterranean southward. The shell is shaped like a cap with a coiled apex ; it is covered outside with a soft fringed epidermis, and has a pretty pink tint inside, where the muscular impressions may be seen shaped like a horseshoe; the head is distinct, and has eyes at the swelled base of the tentacles; a tongue with seven teeth, the middle one of which is hooked; the foot is strong and round; the mantle fringed.

Of the latter we have one also—

Calyptræa *Sinensis,* the shell of which has a spiral plate inside—our sole representative of the varied forms of internal laminæ, which characterize genera and species of the tribe in more tropical localities. The *Cup and Saucer Limpet,* for instance, of which there are several beautiful species, has either a flat or a conical shell, with funnel-shaped cup in the under side. The *Horseshoe Limpet* has an internal appendage jutting forward in two points. The *Slipper Limpet*

has a septum across the hollow; and others again, like our species, have the spiral plate.

C. Sinensis lives on rocks or stones; it has eyes on its tentacula, which are short and rather pointed; the spawn is laid on the stones, wrapped up in bundles of fringed membrane. The fry show a regularly spiral shell, and it is only in growing that the sides become expanded so as to form a limpet. "Mr. Alder has observed the *Calyptræa* to carry and hatch its spawn under the neck, in front of the foot."

FISSURELLIDÆ.

The few representatives of this family of "Key-hole Limpets" in British seas will be best described under their respective genera.

I. Fissurella *reticulata* is like an oval cross-barred limpet, with a hole at the top of the shell for the anal tube. On the mantle there is a row of little cirrhi, one corresponding with each rib in the shell. Another row of cirrhi surrounds the foot. The eyes are placed on little knobs at the base of the tentacles.

II. Puncturella *Noachina* has a hole in the shell, not *at*, but behind the apex, through which the anal siphon prominently protrudes; the shell is small, white, very

conical, with the apex curled in front of the opening. The row of cirrhi on the foot does not extend to the hinder part.

III. EMARGINULA.—The fissure for the anal tube in *Emarginula* is in the basal margin of the shell. The cirrhi above the foot form a complete circle. The peduncles of the eyes become more distinct in this genus. The shells of our British species are as follows :—

E. reticulata : white, high, with pits between the cross-bars.

E. rosea : rarely rose-coloured ; very small ; the back very much arched, and apex curved ; deeply cross-barred.

E. crassa : white, large, ribbed.

CHAPTER XX.

TENACIOUS GRASP OF THE 'SEA-EAR,' HOLES IN THE SHELL.—OUTSIDE PAINTING, INSIDE IRIDESCENCE.—ANIMAL GOOD FOR FOOD, BUT TOUGH.

HALIOTIDÆ, OR EAR-SHELLS.

HALIOTIS *tuberculata* belongs to the splendid race of molluscs whose shells bear so strong a resemblance to an ear in their flattened form and inflected border. The animal has a very large, oval, discoid foot, used as a sucker when at rest, and maintaining him clinging with great tenacity to his chosen spot, which is generally on the under surface of the stones. The body is beautifully fringed and lobed, and variously tinted with brown, green, white, and buff; the head ends in a small lobe, and has a fringe between the long slender tentacles; at the end of a pair of short peduncles the *Haliotis* carries blue eyes. In admiring a female specimen we might say—

"Marked you her eye of heavenly blue?"

The shell is the flattest and most spreading of spiral univalves. It has a very small flattened spire and a very large aperture, remarkable for the series of holes formed along the ridge, corresponding with the *canal* of others: only a few of the latest of these are kept open, the preceding ones having been successively filled up from within by the fresh deposits of pearly matter. The outside is handsomely painted with zigzag markings of green, brown, red, and white, and the inside so brilliantly iridescent, that the shell is used in large quantities in the manufacture of *papier máché*.

So little is known of the character of molluscs, that we have sometimes actually been asked, how we *painted* the shells! In general, it is easy enough to see at a glance that Nature has, in every case, given the last finishing touch to her own productions; but in paintings of many of the *Haliotides* there is so much the appearance of the colours being "laid on," that such a question might naturally be asked by persons who had never seen a shell before.

Even this solitary species of *Haliotis* is admitted among the British Fauna without any strict right to the honour. Its only claim arises from its residence among the islands of the British Channel, where it is plentiful. It is there called

"Ormer," and often cooked and eaten; but, being "beaten to make them tender," only present another example of the principle asserted already of three things, that

"The more you beat them, the better they be."

But as we are not abundantly supplied with molluscs of great magnificence, and as specimens of this one have been *reported* British, we are content, in this instance, "to own the *tough* impeachment."

CHAPTER XXI.

STRESS OF WEATHER.—THE FLOAT.—EGG-BAGS.—YOUNG.—PURPLE DYE.—'MERRILY O'ER THE WATERS BLUE.'

IANTHINIDÆ.

THE rough winds blowing in upon us from the Atlantic, particularly during the latter part of summer and autumn, sometimes drive upon our western shores large fleets of floating mollusca, whose natural habitat is upon the broad expanse of the great ocean. Among these the pretty purple *Ianthina* sometimes appears in large numbers, floating in full activity on the surface of the waters, or cast helplessly on the shore, staining the sands or shingle with a band of reddish-blue.

The means by which the *Ianthina* keeps itself suspended at the top of the water, is one of those wonderful contrivances of nature which we are so often called upon to admire. The

foot of the animal secretes a kind of mucus, which is capable of being blown out into a large and compact float of well-connected air-vessels, which, lying on the surface, sustains the slight weight of the animal and shell just underneath. In the breeding season, the float of the female increases greatly in extent; and the eggs, put forth one by one, ascend to the float above, where each is hung up in a little bag. The little bags near the furthest end of the float are generally found empty, the young ones having gone off to make floats of their own; those in the centre have the little creatures with their thin shells formed; and those nearest the animal hold the recently-deposited eggs.

As the young ones, fully formed, are released from their little cells, they slide up to the top of the parent's float, and thus gaining the surface of the water are soon in a state to assert independence, and float about with their own apparatus complete.

The *Ianthinæ* have a large head, with two tentacula and two short peduncles "in the place where the *eyes* ought to grow," but no appearance of eyes; the breathing apparatus consists of two plumes; and the foot (so called) is short, secreting the *cartilaginous spume* which forms the float.

The shell is well known as one of the prettiest of our spe-

cies; it is light, spiral, with a large aperture, sinuated in the centre, of a bright purple tint.

When thrown by stress of weather on the strand, the *Ianthina* seems perfectly helpless, its so-called foot not assisting it to crawl or find its way back to the waters; so there it lies, staining everything with its own hue.

This purple stain is very strong, pervading all parts of the shell and animal, and, when numbers of them are cruising "merrily o'er the waters blue," making the said waters blue indeed. The stain remains long on the hands, the handkerchief, paper, or anything else tinted with it. It appears to be used for the same purpose as the ink-fluid of the cuttle-fish; for, when menaced by an enemy, the *Ianthina* suddenly throws out a quantity of the fluid, and thus hides himself from sight in a cloud of his own making.

Three species of *Ianthina* frequent our coasts, distinguished by their shells; that of

I. communis (or *fragilis*) is broader than long, with rather flattened whorls; it is pale on the upper side, and of a more or less dark tint on the lower.

I. pallida is of a globular form and smooth.

I. exigua is also globular and wrinkled, with a higher spire than *I. pallida*.

CHAPTER XXII.

BRITISH TOP-SHELLS NOT THE HANDSOMEST.—DESCRIPTION OF THE TRIBE.—TROCHUS.—PHASIANELLA.—ADEORBIS.—SCISSURELLA.

TROCHIDÆ.

In those tribes of showy mollusca whose fine shells, "decked in the gorgeous livery of nature," excite so much admiration by their wonderful sculpture and tasteful arrangement of colours, we of these bleak Northern Isles are by no means rich. Though we find our few species of *Trochidæ* described, in books of British Conchology, one as 'this handsome shell,' another 'this fine shell,' another as 'this beautiful species,' and so forth, these epithets can only be applied in a limited, comparative sense; for our shells of the *Trochus* tribe, although pretty compared to those of other tribes, and not altogether without a beauty of their own, must on the whole be considered as rather poor representatives of their tribe.

The *Top-shells*, so named from their form, which is conical, are almost all brilliantly iridescent within the aperture, the same kind of pearl lining their inner surface as adorns the *Uniones* and the Pearl Oysters. The whorls are generally more or less beautifully sculptured; some with coronated edges, some with spiral beadings, others with symmetrical undulations, and others with these adornments combined. The colours are generally bright and clear, but have their glories veiled, as well as preserved, by the brown epidermis which covers them.

The foot of the *Trochidæ* is generally expanded and lobed at the sides, and presents the first instance we have met with in our course, of carrying near its hinder part a little plate, called the operculum. It is so arranged that when, from a desire to rest or to escape from sudden danger, the animal finds occasion to retire within his stronghold, he first throws back his head, with its eyes and tentacula, withdrawing them under the mantle which lines the aperture; then, gathering up and drawing in the lobes and cilia of his body, he brings the front part of his foot over them; and last of all comes the hinder part of the foot, enclosing the rest, and bringing with it the operculum, which, fitting neatly to the aperture, shuts all in safe, bidding defiance to external foes.

The genera of British *Trochidæ* are—

I. TROCHUS.—The animal has a large head, ending in a rather truncated proboscis: it has two rather long tentacles, with a short eye-bearing peduncle at the base of each; a pair of lappets between the tentacles, and another scalloped lappet on each side, behind them, on the body, which has three cirrhi on each side. Shell pyramidal; operculum horny. The species are—

T. zizyphinus, or *conulus:* the sides of the shell, unless white, are coloured with brownish flames; the spiral lines are sometimes mounted into ridges, sometimes some of them slightly beaded; the figure is very conical, and the inner side of the aperture has no hollow behind it. Animal mottled with bright reddish-brown.

T. conulus: shell more strictly conical, with the whorls straight and *smooth;* colour arranged in rows of lines and spots.

T. alabastrum: shell white, with three spiral ridges on each whorl of the spire, the top of them beaded.

T. granulatus: the shell is rather rounded and swelled, and has spiral rows of beads on the whorls. The animal is very large in proportion to the shell, the foot being

much expanded, and the neck-lappet wide; it is whitish, mottled and speckled with brown.

T. umbilicatus: shell flat at the base; outline of spire rather swelled; surface spirally ribbed, grained, and spotted with dark brown; a hollow behind the columella. Animal of a dusky greenish tint.

T. exiguus: shell narrow, small, conical, sometimes tawny, sometimes crimson; the whorls are edged with a belt, and surrounded with three spiral crenated ribs. Animal tinged with red.

T. striatus: shell resembling *T. exiguus,* but closely grained; coloured with broad brown flames.

T. Montagui: a small, speckled, long, conical shell, with plain ribs, and crenated interstices. Animal white, with black markings.

T. tumidus: small, with a hollow behind the columella; speckled, with plain, spiral ribs; whorls swelled, and with shoulders, so that the spire ascends by steps.

T. cinerarius: shell with a central hollow, spirally striated, marked with close grey lines.

T. magus, or *tuberculatus:* a broad shell, having a belt round the lower, and a row of knobs on the upper part of the whorls; umbilicus large; colouring variegated.

T. lineatus: shell broad, not perforated, smooth, marked with zigzag lines.

T. millegranus: shell with spiral serrated ribs on the whorls, and a prominent marginal belt.

T. undulatus: shell very small, broad, undulated near the suture of the whorls, pinkish, spirally ribbed, with a large umbilicus.

T. helicinus: small, transparent, smooth. Animal orange mixed with grey, with five cirrhi on each side of the body.

T. pusillus: smooth, microscopically minute.

II. PHASIANELLA.

P. pullus is the only specimen we have of this genus. It is very small, smooth, not so oval as the well-known elegantly-painted type, and has a rounded shelly operculum. In its way, however, it is quite a gem. It is variously ornamented with markings of purplish, crimson, or brown. These markings are sometimes in rows of spots, sometimes in clouded mottling, sometimes in wavy lines, but always exquisitely arranged. The animal partakes of the bright hues of its testaceous covering. It has very long hairy tentacula, with eye-peduncles at the base, fringed neck-lobes, and a pointed foot. In walking, our little *Phasianella* gives a

see-saw movement to its shell, and vibrates its tentacles, which, like the snail, it uses as feelers.

III. Adeorbis *subcarinata* takes its name from a pretty, minute, white, spreading shell, with several angular ridges or keels.

IV. Scissurella *crispata* is named from a very minute, microscopic, white shell, which has a slit in the outer lip of the aperture. Continuous with this slit, and running round all the whorls, is a groove, partitioned off by cross-bars.

A fossil genus of large shells, named *Pleurotomaria*, presents a similar structure, which I am much inclined to think analogous to successively-closed holes of the *Haliotis;* the slit in the *Scissurella* answering to the last open hole of the *Haliotis*, and the pits in the spiral groove of the former agreeing with the blocked-up apertures of the latter. This cannot, however, be known with certainty until the animal of our *Scissurella* can be examined, and then we may perhaps have a new light thrown on the habits of the extinct group of mollusca to which we have referred.

Cardium edule 2 Cardium lævigatum 3 . 4 . Isocardia cor.

CHAPTER XXIII.

NERITINA OF THE STREAMS.—PALUDINA AND HER YOUNG.—CHARACTERS AND SPECIES.—BITHINIA.—HABITS.—VALVATA.

NERITIDÆ AND PALUDINIDÆ.

NERITINA *fluviatilis*.—Adhering to stones by the sides of running streams of fresh water, may be seen the little mollusc whose specific name tells the story of its life. The rivers which flow out into the sea on the eastern and western sides of England are its favourite haunts; it is found in the Thames, the Trent, the Severn, and the Avon. The shell is oval, with a very small flat spire, and a large half-moon-shaped aperture; the outer surface is susceptible of great variation in painting, of which a kind of network of purplish-red is the most common. The animal is rather white, with the head and proboscis black, and a black line running along each tentacle; the eyes, fixed upon pedestals, are also

black; the foot is broad in front and rather tapering at the back; the operculum is half-moon-shaped, shelly, with a little spire and a key-like process, which fits under the straight columella of the shell. This is the shell which is often picked up by the children from sand-heaps in a half-fossil condition.

PALUDINIDÆ.

I. Paludina.—In dried specimens of *Paludina* frequently met with in cabinets, we sometimes find several glassy, round shells, adhering by the dried mucus to the inner surface. This results from the habit of the female, which gives one of the species its name of *vivipara*. The eggs are not only kept in safety *until* they are hatched, but the young fry is also preserved within the shell for some time after they leave the egg, and their testaceous transparent bubble is fully formed. When very minute, they are covered with bands of hairs, which disappear in the course of a couple of months, when they are sent adrift to seek the means of future existence for themselves. It has been ascertained that, during the reproductive season, which commences in autumn, only two, three, or four young *Paludinæ* are sent forth from the parental roof in the course of twenty-four hours; so that

it would appear that the anxious mother is by no means in haste to rid herself of the care and responsibility of her infant offspring.

The *Paludinæ* inhabit fresh-water streams. They have a rather square, lengthened proboscis, with hairy-ended tentacles, which are thickened at the bases by the union with them of the eye-pedestals; they have a triangular foot, on the end of which is placed a horny operculum; this operculum is oval, and formed of successive layers round a central nucleus (*concentric operculum*); the tongue is short, armed with denticles. The shell is rather top-shaped, with a high spire, composed of rounded, gradually-increasing whorls; the aperture oval, having an uninterrupted edge; a smooth, thin epidermis covers the exterior.

P. Listeri (commonly known as *P. viripara*) has the shell rather short, with a large perforation behind the mouth; whorls darkly three-banded, very full and rounded; the mouth has a rather thickened ledge. The animal is brightly speckled with greyish, yellow, and brown, with a large mantle; on the whole, of a *golden* hue.

P. vivipara (known as *P. fasciata*) has a rather more oval shell, with the whorls not so rounded and separate, a smaller perforation, and no doubling of the edge of the aperture. Animal on the whole of a *coppery* hue.

II. Bithinia.—We have two species of this genus, which differs from the last in two respects:—first, the operculum is testaceous; second, the animal is not *viviparous*, but *oviparous*. Not having an opportunity of consulting the work of M. Bouchard-Chantereaux, for his account of the reproducing habits of the *Bithinia*, I must be content to give an outline taken second-hand from the work of Messrs. Forbes and Hanley; so that, if it be considered in the light of a robbery to avail ourselves of the labours of others, I shall only incur the pains and penalties of a "receiver."

"The *Bithinia tentaculata* lays from May to August. There are usually from thirty to seventy globular, yellowish, hyaline eggs, which are united together in a band, and attached to stones or the stems of aquatic plants. When the animal desires to lay, it seeks some smooth place, and begins to clean the surface with its mouth before commencing. That being done, it contracts its foot, so as to render itself a third shorter than its usual dimensions when creeping, but also a third broader. Then, ceasing to use its mouth, it raises the centre of the anterior extremity of its foot, so as to form a little canal, intended to receive the egg. It next withdraws its head a little within the shell, and directs its muzzle towards the branchial orifice, where an egg appears,

which it seizes and guides into the little canal to fix it in its destined locality. Then the animal cleans the body to which it adheres anew, and deposits a second egg, repeating the operation till all the eggs are expelled, and arranged in ribband-fashion, each band, when laid by an adult, consisting of three rows. The whole process proceeds slowly, time being left between each effort sufficient for the agglutination of the egg. The young ones emerge at the end of from twenty to twenty-five days, and do not attain full growth until the end of their second year."

The shells of *Bithiniæ* are smaller and more hyaline than those of *Paludinæ*. The animal is purplish-black, speckled with bright yellow, with long tentacles, thickened at the base by the eye-swelling; a rather long, rounded proboscis; and the foot somewhat bell-shaped. Of

B. tentaculata, the shell is thin, smooth, horny, oval, without any hollow behind the mouth;

B. Leachii, the shell has the whorls more rounded and separate, and a hollow behind the mouth.

The *Bithiniæ* frequent ditches, canals, and slow rivers in almost every part of England.

III. Valvata *piscinalis* is a little fresh-water mollusc, which has the foot divided in front into two lobes. The

shell is round and horny, much shorter than *Paludina* or *Bithinia*. The animal deposits her eggs in a little leather bag, which she hangs on stones or the stems of water-plants, where they remain till they are hatched and liberated from their bag by the bursting of its rotting sides. They all leave their prison in company, being united in a floating mass of jelly.

The shell of *Valvata cristata*, our only other species, has a flattened spire.

CHAPTER XXIV.

PERIWINKLE OF THE ROCKS.—GREEN PASTURES.—THE DOOR OF HORN.—VARIATIONS.—'PIN-PATCHES.'—LACUNA.—ASIMINEA.—RISSOA, SPECIES AND HABITS.—JEFFREYSIA.—SKENEA.

LITTORINIDÆ.

THE small, rather lively molluscs belonging to this group are doubly interesting to collectors of limited opportunity, seeing that some of them are to be found crawling about in great numbers in almost all the places where the ocean spray washes the rocky shores of Albion. Living, as their name implies, between watermarks on the shore, they can be seen and taken without the dredge. The typical representative of the family, the well-known "Periwinkle," is among the most familiar of our shell-fish.

I. LITTORINA.—The pleasures of a sea-side ramble are much increased by an intelligent observation of the varied forms of animation that we meet with, among which the

periwinkles are often prominent, not only for their numbers but also for their activity. They dot and stud the slimy rocks with their turbinated shells, or creep through the tiny corallines, or slide along the overhanging fuci in search of food.

> "Part single, or with mate,
> Graze the seaweed, their pasture,
> And through groves of coral stray."

Let us examine the nature of these interesting objects by taking an example: here is one at rest. We see a rather solid-looking shell of a dark colour, perhaps distinctly banded; at the base, on which it rests, it is rounded out; but at the apex, which is towards the eye, it is a little pointed; its surface is not quite smooth, but at a glance appears as if it were so: it is *L. littorea*. On cruelly disturbing its repose, by turning the shell over, so as to see the aperture, we find that the latter has a flattish, white columella, or inner edge, and that, instead of seeing at once the soft parts of the animal, we find it is shut in by a horny plate or operculum, which is spiral, but with very few, rapidly increasing whorls; presently this plate begins to be raised, and then, peeping cautiously between it and the outer lip of the aperture, the tawny animal protrudes his head, which is closely

marked with black waved lines; the muzzle is rather short, broad, and straight in front; the pyramidal tentacles are ringed with the black lines; they are blunt-pointed at the apex, but thick at the base, where they have a very thick swelling, on which the bright little specks of eyes are placed. Throwing back the pointed hinder part of the whitish foot, which carries away the horny door with it, the periwinkle lifts his heavy shell over his back, and crawling away is soon out of sight.

One remarkable circumstance connected with the history of this and several other species is, the great variation of form which it is apt to assume in some positions; for although going to a fishmonger and purchasing a pint of periwinkles from his stock, we do not often find any great deviation from the common well-known type, yet, in some cases, where disturbing influences have introduced an undue influx of fresh water, the most varied forms occur.

The wildest cases of eccentric formation, however, met with on our modern shores, are symmetry itself compared to those of more ancient seas. Among the periwinkles of the crag are some specimens so different from each other, that it would seem impossible to recognize them as belonging to the same genus. Some are quite pyramidal, others have

almost cylindrical whorls; one has a flattened spire, with a keel in the middle of the whorl; one has two broad keels, another three narrow ones; while, in one extreme instance, the last whorl is separated and extended, having an umbilicus behind the mouth. Yet it is not very difficult to a practised eye, to recognize a certain resemblance running through all these varied forms.

Most persons can remember, at one time or other, particularly when children, being busy with a pin in one hand and a "winkle" in the other, sticking the point into the horny plate, and so drawing out the savoury morsel, whose appearance is so unpromising, but whose flavour is by no means to be contemned.

The consumption of boiled periwinkles, called "Pin-patches" in Suffolk, is large in London, as well as in many maritime places, and forms a considerable item of trade. Several of the species are very difficult to distinguish, through their great variability of form. Each form has had a separate name given to it at one time or other, but they glide so much into each other that it is not easy to define where one ends and the other begins. Messrs. Forbes and Hanley suspect that some of the intermediate forms may be hybrids. On the whole, I am inclined to take the boundaries of the

species as given by those authors, in a summary at the end of their more particular descriptions and more numerous divisions.

L. Neritoides assembles in great numbers very high up on the shore; sometimes so very high that the tide can scarcely reach it, and where it can only be occasionally washed by the spray. It is small; it has a black head and snout, and a white band in front of the foot. The shell is smooth, conical, with the mouth rather spread out in front; its colour is very dark, nearly black, occasionally relieved by a white band.

L. littorea: the common Periwinkle as described above. It is oviparous.

L. rudis is viviparous, the ovaria being found in the autumn full of completely-formed young shells. It is of a lighter hue than *L. littorea*, without the linear arrangement of the colours. The shell is smaller, more rugged, with a smaller aperture in proportion, and the whorls more rounded at the sides. This species includes *L. patula*, *L. tenebrosa*, and *L. saxatilis*.

L. littoralis, perhaps more frequently met with than the other sorts, is one with a yellow or yellowish-brown, smooth, oval shell, which has a flattish spire, and a

kind of squareness in the whorls; it sometimes occurs with a beautiful tinge of bright purple in the aperture, under the bright golden edge of the outer lip. The animal is either a yellow or of a dusky tint, with the head and horns black. *L. fabalis* and *L. palliata* of authors are included.

II. Lacuna receives its name from the hollow spiral groove behind the open spreading apertures of the shells which belong to it. The mollusc lives on seaweeds on the shores, like *Littorina;* the foot is rounded at both ends, the front part being partly separated into a lobe; on the upper part of the foot is a lobe, or lappet, terminating in a filament at each hinder corner; and on this lappet is fixed the operculum, which resembles that of *Littorina*. The shells of this group are very pretty, and may be summarily described as follows:—

L. pallidula, (including *L. patula*)*:* broad, smooth, with large wide aperture, very small spire, a dull pale yellow epidermis, and broad, white umbilical groove.

L. puteolus: globular, mouth not quite so large in proportion to spire; clearly banded with dark brown.

L. vincta: pyramidal, oval, with a produced spire; smooth, sometimes banded.

L. crassior also has a produced spire, but is rather angular and thick, and has scarcely any umbilical groove.

III. Assiminea *Grayana* is a small mollusc, with a dull, horny shell; found in great abundance on the marshy borders of rivers where the water is brackish or fresh. It was first noticed by Mr. J. E. Gray at the Greenwich marshes, and described in the fifth volume of the 'Zoological Journal' by the Rev. M. J. Berkeley. The muzzle of the animal is lobed in front; there is a groove running backwards on each side from the base of the tentacula, which are short, and have the eyes placed on their tips; the shell is *Trochus*-shaped, and about the sixth of an inch long.

IV. Rissoa is a genus of rather minute, some of them microscopic molluscs, which have very long tentacles, with eyes at their thickened bases; the foot is pointed at the back, and bears a horny operculum; it is produced in front of the muzzle. The shells are generally rather pyramidal, and greatly varying in sculpture in different species, which are so numerous and minute that we shall only mention a few of the most remarkable characters:—

R. labiosa: a produced tapering spire, with elegantly turned longitudinal ridges; smooth, with an expanded and thickened outer lip.

R. costulata : with the ridges thicker, less oblique, but angulated.

R. rufilabrum.

R. abyssicola : beautifully cancellated.

R. calathus : the same, but with a crenulated outer lip, and more produced spire.

R. rubra : smooth, pyramidal, of a reddish-brown colour.

R. costata : with beautifully-carved oblique ridges, and a slight keel.

R. striata : spirally striated, and puckered at the suture.

R. crenulata : broadly cancellated.

R. lactea : upper part of whorls decussated, lower part spirally ribbed.

R. Beanii : decussated, with a thickened, crenulated outer lip.

R. striatula : with sharp spiral keels, and intermediate sculpture.

R. cingillus : banded with reddish-brown.

R. Zetlandica : cross-barred coarsely.

R. rubra : smooth, with a broad red band.

R. semistriata : striated, prettily coloured with flames.

R. sculpta : finely cross-barred.

R. punctura : striated both ways, coloured with flames.

R. parva : smooth, variously coloured in flames.
R. inconspicua : resembling *R. parva.*
R. vitræa : long, smooth, transparently white, with the last whorl but one large.
R. proxima : very minute, striated.
R. ulvæ : conical, smooth, pale yellowish-brown.
R. fulgida : microscopic, banded with brown, smooth.
R. littorea : smooth, globular.
R. pulcherrima : very minute, coloured with square spots.
R. soluta : less globose than *pulcherrima,* striated.
R. anatina : smooth, short, with shouldered whorls.
R. ventrosa : smooth, white, with rounded whorls.

The habits of these minute animals are not so generally known as those of some other more conspicuous genera ; for, although some of the kinds live in great numbers just under the water's edge, it is only when dead that the shells are thrown on the shore ; so that in proportion to their plentiful distribution, comparatively few opportunities occur of examining the animals, or of watching their movements. A collector may have the tantalizing pleasure of crushing under his feet, in some places, myriads of these tiny shells on the beach, day after day, for weeks, without once meeting with a living specimen. Some of the species seem to have the

capacity for enduring various conditions of existence, and flourishing at various depths of the water, or on the shore in sandy and muddy places.

When walking, they wave their tentacles alternately from side to side; when at rest, the foot is much contracted, and the horns withdrawn into the shell. Their motion on the ground is very rapid; and they are also possessed of a means of floating, foot uppermost, on the surface of the water: to effect this, they have the power of confining bubbles of air sufficient to sustain them.

Some of the species afford nourishment to water-birds, who pick them up greedily from the muddy and sandy bottoms on which they crawl.

V. Jeffreysia.—Although there is nothing to distinguish the shells of this genus from those of *Rissoa*, the animal is very different, for it has four tentacles, two long and two short; and the eyes are placed far back behind the tentacles, so as to come within the shell, which most likely, for that very reason, is in both the species very transparent. The shells of

J. diaphana, which is long; and

J. opalina, which is shorter and globose, are very simply formed, glassy, and light, admirably adapted to the

1. Arca tetragona . 2. Læda caudata . 3 Nucula nucleus. 4. Pectunculus pilosus .
5 Mytilus edulis . 6. Dreissena polymorpha .

animals, which not only carry their houses on their backs, "but have to see through them as they glide on their marshy way."

VI. SKENEA includes another set of minute littoral molluscs, resembling *Rissoa*, excepting that their shells are flattened. The species found on the shores of our islands are—

S. planorbis: smooth, with wide umbilicus, very much like a microscopic Ammonite.

S. nitidissima: polished, with spire concave.

S. rota: wheel-like, having ribs radiating from the centre of the spiral disc, above and below.

S. divisa: like *S. planorbis*, but striated on the under side.

S. Cutleriana: not quite so much depressed; striated above and below.

S. lævis: shaped like *S. Cutleriana*, but smooth, excepting in the umbilicus, where it is spirally striated.

Skenea planorbis congregates in great numbers under stones, at low water.

CHAPTER XXV.

SIMILAR ANIMALS WITH DIFFERENT SHELLS.—TOOTH-LIKE CÆCUM, AND THE SPIRAL TURRITELLA.—CÆCUM SPIRAL IN EMBRYO.—HABITS OF THE TURRITELLA.

TURRITELLIDÆ.

I. Cæcum.—It is curious to find, crawling under a minute tubular shell, resembling a *Dentalium*, or tooth-shell, a mollusc so much like the *Turritella*, that it is placed by the authors of the 'History' in the same family, and might almost have been placed in the same genus, but that the association of two such very different shells would have been too much for the nerves of us poor conchologists. It is a remarkable instance, tending to show how little reliance is to be placed on the mere character of the shell, in any systematic arrangement of Mollusca. So long as the tiny creature can withdraw his head and foot into the shelter of his glassy tent, it seems to matter very little whether the upper

part of his body lies straight up in the tube, or whether it is twisted through a spiral curl to the apex.

The indefatigable Mr. Clark has discovered and lucidly explained the true nature of the *Cæcum*, which has a spiral shell in its extreme youth, and has also the curious habit, in common with the *Turritella*, of partitioning off a chamber in the upper part of the hollow, by building a septum across it. In *Turritella* the deserted part of the spire beyond this septum remains, in *Cæcum* it falls off.

The *Cæcum* carries a horny, round, spiral operculum, with many plain-edged whorls, thus, in another respect, aspiring to an affinity with the more noble *Turritella;* the head is muzzle-shaped, with long slender horns, having the eyes in their base; the foot is short, squarish in front, and rather blunt behind; the mantle has no fringe. Mr. Clark, who watched the movements of living specimens with great perseverance, after minutely describing the characters, says: "The animal is not at all shy; it shows itself in all directions, marches with great vivacity, carrying its shell sometimes with the convexity upwards, resting on the posterior point of one of its sides, frequently changing one for the other, by suddenly withdrawing the head and body, by which action it is thrown on the operculum at an elevation of fifty or sixty degrees; it then turns on the side it wishes."

C. trachea is so named from the rings round the tube of the shell giving it the appearance of a piece of wind-pipe.

C. glabrum is smooth.

II. TURRITELLA *communis*.—This more elegant mollusc, with his spirally-fluted shell, winding down in many an oblique gyration from its pointed apex, would look with scorn on his humble neighbour the *Cæcum*, did he but know that so insignificant a creature was placed beside him, not only in the walks of submarine life, but also in the "order of of Nature," as guessed at by the ablest investigators. Yet our solitary species, although beautifully sculptured and sometimes prettily marked with darker touches on a brownish ground, has not much to boast of in comparison with some of his congeners of foreign parts, whose tapering spires and noble pyramidal columns have been so suggestive of elegance in architectural design.

The shell of *T. communis* attains, when well developed, the length of two inches to two and a half; it has about fourteen whorls with three or four spiral ridges; operculum horny, round, many-spired. The head of the animal is produced into a muzzle-shaped, squarish proboscis, notched in front, with long narrow tentacles having eyes at their base; the foot is short, square in front, blunt behind, and grooved

underneath; the mantle is fringed; in general colour the animal is white, tinted in parts with brownish-grey.

It inhabits various depths of water, but most commonly affects the more shallow parts. The *Turritella* seldom lives in those depths where light but dimly penetrates. Is it because he loves the light for its own sake, or because he would have his *tower-like* shell coloured as brightly as possible? For in those few cases where *Turritellæ* inhabit more gloomy and impenetrable recesses, the shells are found without any adornment from the solar rays.

CHAPTER XXVI.

CLUB-SHELLS.—CERITHIUM.—BRITISH SPECIES.—PELICAN'S FOOT APORRHAIS.—EYES AND EARS OF STROMBIDÆ.

CERITHIADÆ.

I. CERITHIUM.—Our *Club-shells*, as the members of this group are called, from their shape, certainly do not present the idea of very formidable weapons, the largest of British species hardly exceeding half an inch in length. We are now entering the series, the shells of which terminate in a sinus or canal in the aperture of the shell, corresponding either with a fold in the mantle or a distinct siphonal tube.

The eyes of *Cerithium* are placed on prominent bulgings near the bases of two rather stout tentacles, which take their rise at the back of the snout-shaped head; the foot bears a horny, spiral operculum, and the mantle has a fold or sinus at its front edge, which is not however produced

into the distinct siphon characteristic of the *canaliculated* shells. The three following British species are enumerated as characterized by their shells :—

C. reticulatum : of a brown colour, with four granulated ridges on the whorls.

C. adversum (so named from having the whorls turned in a contrary way to that of the majority of shells) : it is reddish-brown, with three granulated ridges on the whorls.

C. metula : white, elegantly tapering, with three sculptured ridges on the whorls : taken in deep water.

II. Aporrhais.—Although this genus is now believed to belong to a different group from the *Strombidæ,* among which I have placed them in the 'Thesaurus,' the shells have so much the character of that family that they have always been associated with it ; and as it so happens that in our British seas we have no representatives of the true *Strombidæ,* we should consequently enjoy no opportunity of introducing one or two remarks about them, unless it were taken in this place.

It has been an inquiry of some interest, what degree of efficiency may be ascribed to the *senses* of mollusca, judging, as far as possible, from the organs supposed to represent them. The so-called eyes in some molluscs, imperfectly de-

veloped as they are, afford but a poor substitute for real powers of vision; while in others even these are wanting. The *Strombidæ* generally have large and handsome shells, with spreading lips to the apertures, of which the pink-mouth conch-shell, so commonly used in ornamental garden-work, and hawked about the streets, is a familiar example. I mention the family, all out of place as it is here, in order to make known to my readers some very interesting observations, and the result of some rather cruel experiments, by the Rev. Lansdowne Guilding with respect to the *eyes* and *ears* of these mollusca. That gentleman remarks that if Mr. Brayley (a writer on the subject in the 'Zoological Journal') "had an opportunity of examining the giant *Strombidæ* which inhabit the Caribbean Sea, he would find the eyes more perfect than those of many vertebrated animals. In these he would see with astonishment a distinct pupil, and a double iris, equalling in beauty and correctness of outline those of birds and reptiles. On dissection he would discover a vitreous and aqueous humour, and the black pigment, which will be sought for in vain in the *Helicidæ*.

"The *Strombidæ* also possess the sense of hearing, or, what seems allied to it, the sense which the perplexed entomologist Lehmann has termed "aeroscepsy." I lately suspended

a number of large *Strombi* by the spire, that the animals when dead might fall from the shell. They had remained in this situation several days, till the body, weak and emaciated, hung down nearly a foot from the aperture, and the eyes had become dim. I found that even before my shadow could pass over them they were aware of my presence, and endeavoured to withdraw into the shell; I then cut off the eyes, with the thick, cartilaginous tentacula in which they were lodged, but the animals still continued to be sensible of my near approach, while hanging in this mutilated and painful condition."

Our two species of *Aporrhais*, however, have been subject to no such barbarous trials, although they have been captured and carefully observed.

The head has a produced, rather tapering muzzle, divided at the end into two lobes; tentacles very long, with eyes on rather distinct knobs at their base; foot, seen underneath, presenting a bell-shaped disc; mantle spread into fingers.

The young shell is turreted, and not very unlike a *Cerithium* in appearance; it has rows of oblique tubercles on the tapering whorls, but when full grown the outer lip thickens and expands into lobes or fingers, which have a groove in the centre of each, so as to present a not inapt re-

semblance to the foot of a bird; the aperture likewise terminates in front by a produced canal, and at the back by a part of the two lips running up a whorl or two of the spire.

The common *A. pes-pelicani* lives on gravelly bottoms, in rather deep water, creeping very slowly, and using his feelers freely. Caution marks his entire character, not making one advance until he has secured the last, and deliberately ascertained what is before him; he makes his way by slow degrees, and when in captivity is always chary of displaying his beauties to the observer; not that he need be ashamed of his personal appearance, for his white body, very prettily speckled on the head and horns with bright scarlet, carries a well-sculptured and curiously-formed shell.

The other species, *Aporrhais pes-carbonis*, has a lighter and smaller shell, with shorter spire and longer and more tapering digitations.

CHAPTER XXVII.

WENTLETRAP.—FORMATION OF THE RINGS, OR VARICES.—BRITISH SPECIES OF SCALARIA.

SCALARIDÆ.

Scalaria.—While the few British species of this genus possess shells far inferior in size and beauty of form to that most elegant of spirals, the *Scalaria pretiosa*, and some other exotic kinds, they make up the deficiency in formal grandeur by a display of extra taste in the colouring of their turreted whorls. Contrary to the general habit of British mollusca, the shells of *Scalariæ* vie, in the brightness of their tints, with any of their foreign brethren. The well-known 'Wentletrap,' *Scalaria pretiosa*, so celebrated for the extravagant prices formerly paid for specimens by collectors, has the beauty of its shell greatly increased by the whorls being separated from each other, each ridge, or varix, forming a distinct ring round the circumference.

This is not exactly the case with the species of our coast, which have the whorls almost as closely connected as the *Turritellæ*, or any other turreted shells. They have a lengthened spire of many whorls, which are girt at regular intervals by circular ribs, indicating regular periods of growth. At these periods, the mantle ceases for a time to deposit its shelly secretion in advancing layers, and accumulates all its stores upon the edge of the circumference, which becomes thickened and rolled up, as it were, so as to form an external varix or ridge; this accomplished, the onward growth is continued, till, arriving at the corresponding ridge of the preceding whorl, the animal is reminded that it is time to make another. Thus, from ridge to ridge, and from whorl to whorl, proceeds the gradual formation of the tapering column. The foot is angular and semicircular in front, slightly sinuous at each side, and terminating in a pointed arch behind; the head has two long, pointed tentacles, with eyes at their base; operculum horny and spiral. Some species, if not all, live by preying on marine creatures smaller than themselves. About the apertures of some dried specimens may be seen a purple stain, indicating that the *Scalariæ* secrete and exude a brilliant purple dye.

The shells of our species may be thus distinguished:—

S. communis has the ridges nearly uniform in size, and those of one whorl lock into and are continuous with those of the other; the colouring is pale fawn or nearly white between the varices, variegated with purple touches; the varices are white, with purple spots in bands.

S. Turtonis has the whorls rounder, the varices not strictly continuous, thin in the upper whorls, irregularly thickened and flattened in the lower; general aspect more brown than in *S. communis*.

S. clathratula: small, white, with sharp varices.

S. Trevelyana: fawn-coloured, not variegated with thin, uniform varices.

S. Grœnlandica, rarely found on our coasts, has rather flattened ribs, *with spiral grooves between them.*

CHAPTER XXVIII.

A LONG LIST OF LITTLE SHELLS, WITH INFINITESIMAL DISTINCTIONS.—SPECIES OF ACLIS, STYLIFER, EULIMA, CHEMNITZIA, ODOSTOMIA, EULIMELLA, TRUNCATELLA, AND OTINA.

PYRAMIDELLIDÆ.

This family contains a swarm of little mollusca, which, however well they might repay a minute examination by those who can obtain an intimate knowledge of them, certainly present no great attractions to the general student. Many of these shells are exquisitely sculptured, but the species are so difficult to distinguish from each other, that the strongest impression remaining on the writer's mind about them, after being engaged in their delineation for the work of Messrs. Forbes and Hanley, was that of relief at having arrived at the end of the tedious list. While, in some instances, the unhappy artist was blamed for not making clear to the eye the difference between one of these

microscopic atoms and another, he often felt that he could have safely challenged their definition by the authors with the shells themselves before them. The following will therefore be found a very summary account of the genera and species:—

I. Aclis has a long retractile proboscis, long thin tentacles, with the eyes at their thickened bases; the foot tongue-shaped; the shells are like the minute *Turritellæ*.

A. ascaris is pyramidal, spirally ridged.

A. supranitida is like it, but with a perforation behind the aperture, and the upper part of the whorls not ridged.

A. unica: very long and narrow, finely decussated.

A. nitidissima: like *A. unica*, but nearly smooth.

II. Stylifer.—The little molluscs to which this generic name was first applied by Mr. Broderip are found living parasitically in the body of star-fish, in which they burrow, and on which they feed. Cunningly boring their hole in a pulpy spot, chosen so as to avoid the vital parts of the tortured *Asterias*, they live and fatten in security upon his substance.

The *Stylifer astericola*, found living on the coast of Borneo, as described by Mr. A. Adams, has two elongate, subulate tentacles, with the eyes sessile near the outer side of

their base, and a small rounded head; the mantle is entirely enclosed and covered by the thin shell; and the foot is narrow, slender, very much produced beyond the head in front, and scarcely extended at all behind.

S. Turtoni, the only species found in Great Britain, has a pretty little globular transparent shell, with a style-like apex. Of this *Stylifer* Mr. Alder says, in his 'Catalogue of the Mollusca of Northumberland:'—"We lately obtained a specimen of this species alive on the spines of an *Echinus* at Cullercoats, but rather injured, and in a very sickly state. We placed it in a glass of fresh sea-water, hoping that it might recover and display itself more distinctly; but in this we were disappointed, as it soon died, and, being left unlooked at for a while, had partially decayed. The animal was white, had a rather large foot, without operculum, and a rounded head, with two cylindrical tentacles and minute eyes at the base. No portion of the shell was covered by the fleshy parts, but we are not prepared to say that, in a state of vigour, the animal has not the power of extending some part of the mantle or foot over it."

The last observation does not agree with Mr. Broderip's account of the foreign species, who describes a sack-like mantle enveloping a large part of the last whorl of the shell.

Lima tenera. 2. Anomia ephippium (shell and button) 3 Pecten niveus.
4 Anodonta cygnea. 5 Terebratula caput-serpentis

III. Eulima.—The animals carrying these shiny, tapering shells possess two long tentacula, with eyes at their thickened bases; the foot is much extended in front, and square, but short at the back, carrying a horny spiral operculum. The shells have very acute apices, which are very apt to be distorted, and oval or pyriform apertures. The British species are—

E. polita: shell white, pyramidal.

E. distorta: shell smaller, white, with a curved spire.

E. subulata: shell narrow, coloured with brown spiral bands.

E. bilineata: rather fuller in form, white, with two spiral lines in the middle of each whorl.

A specimen of *E. distorta,* taken alive at Northumberland, had a yellow body with a variegated band of carmine on each side. They live on sandy bottoms, at various depths, rarely crawling out of their shells so far as to expose their eyes, the transparency of the shell rendering it unnecessary.

IV. Chemnitzia is a genus consisting of small molluscs, which have the head elongated into a bilobed snout; the eyes placed near the base of flattened and produced tentacles; and the foot broad and square in front, pointed

behind, and carrying a horny, pyriform operculum, with a spiral nucleus at one end. The shells are long, many-whorled, longitudinally ribbed. But the chief point of interest about them consists in the fact of the shell, in a very young state, having a globular, spiral form, with the whorls in the opposite direction to what they afterwards assume, when the nucleus becomes turned over, as it were, and the next whorl, twisting round, proceeds in a natural direction. This gives a little twisted knob to the apex of the shell. The shells of the British species may be thus cursorily enumerated :—

C. elegantissima : tall, white, with simple, oblique ribs.

C. rufa : reddish or banded; broader, with the interstices of the ribs spirally striated.

C. formosa : white; the whorls turreted; interstices of the ribs cross-barred.

C. fenestrata: white; whorls angular; ribs crossed by two spiral keels.

C. scalaris: white, short; whorls shouldered; interstices of ribs spirally striated.

C. rufescens: pale reddish or banded; ribs numerous, oblique; interstices finely striated.

C. indistincta: minute, narrow, white; ribs crowded, flexuous.

C. clathrata: pale reddish, short; ribs rather straight, few cross-bars in the intervals.

V. Odostomia.—The shells of these lively little molluscs are smoother and less turreted than those of the preceding genus; they have fewer whorls, and a spiral fold on the inner lip. This last character distinguishes them from the shells of *Rissoæ*. The species are—

O. nitida, O. unidentata, O. Eulimoides, O. glabrata, O. pallida, O. obliqua, O. Warrenii, O. Rissoides, O. insculpta, O. cylindracea, O. alba: the shells of these are smooth, and rather oval.

O. conoidea, O. conspicua, O. acuta, O. clavulus, O. plicata, O. truncatula: smooth, and more or less conical.

O. striolata, O. dolioliformis: spirally striated.

O. interstincta, O. spiralis, O. excavata, O. decussata: sculptured in both directions.

Some of the above species in each group are very difficult to distinguish from each other, and some of the latter are not very different from *Chemnitziæ*. The animals resemble the latter genus in all essential particulars; they are all brisk little creatures, not at all shy in captivity, but moving about, showing all their parts freely. They live in rather deep water, and, like the *Chemnitziæ*, begin their shell in a

sinistral direction, so that, when the full-grown pyramid is formed, its apex consists of a twisted knob.

VI. Eulimella.—In all important characters the animals of this genus resemble those of the two last, but the shells, although, like them, formed with a sinistral spire, are like those of the genus *Eulima*, pyramidal, with numerous whorls, and brightly polished. Of the four British examples,

E. Scillæ is the most regularly pyramidal, with the sides straight, and the aperture angular;

E. acicula, less regular and less angular;

E. affinis, with the whorls a little bulging;

E. clavulus, with the apex very obtuse.

VII. Truncatella *Montagui*.—This minute mollusc, requiring a mixture of fresh-water with the briny element in which he dwells, chooses those places accessible to the purer streams; he has a produced muzzle and triangular tentacles, with eyes at their base. When young the shell is transparent and smooth; after three or four whorls it swells suddenly, is slightly ribbed and puckered at the sutures; and when adult, the thin tapering whorls fall off, leaving a truncated, cylindrical figure of three or four turns to the remainder.

VIII. Otina *otis* has a very small, glossy brown, obliquely-

oval, flattish shell, with small spire and large aperture, like a *Sigaretus*, or "imperforate ear-shell." Its body is thick and large, compared with its shell; its head is rounded and bilobed; its foot is divided by a central groove; and the eyes are set at the bases of very short triangular lappets or flattish tentacles. It lives on the shore accessible to the tides, and hides in the chinks of rocks and the hollows of deserted shells.

CHAPTER XXIX.

NATICA.—SEEMING FORESIGHT IN DEPOSITING EGGS.—PARTLY COVERED SHELL.—SWIMMING.—CRAWLING.—AT REST.—CARNIVOROUS.—SPECIES. —VELUTINA.—LAMELLARIA.

NATICIDÆ AND VELUTINIDÆ.

NATICA.—Loosely coiled on the sandy beach or hanging on some ledge of rock, is sometimes found a thin, half-spiral, gristly substance, lightly coated with loose sand, which adheres to it in consequence of its gelatinous nature: it is transparent, and being carefully examined will be found divided into hexagonal grains: this is the nest of the *Natica*, and each hexagon contains the germ of a mollusc, glued to the sides of six of its future brothers and sisters. The form of the mass is that of a hoop spirally twisted. The female has sagaciously contrived the curve of her gelatinous deposit so as to fit it for rolling on the surface of the sand without

becoming immersed in it, so that her infant progeny may not be prematurely choked.

Another very curious character in this genus is the apparent large size of the animal compared with its shell. To see a *Natica* when in action, one would suppose it much more likely that the soft parts were meant to wrap up the shell and keep it polished, than that the shell should ever afford shelter and protection to the whole animal. Yet the fact is, that all that mass of fleshy substance, and all that broad expanse of mantle and foot, can not only be neatly folded and gathered within the hollow of its shelly covering, but can be firmly and safely enclosed by the hard semicircular door carried on the foot.

As the British species exhibit much the same peculiarities as those of foreign coasts, I shall avail myself of the observations of Mr. Arthur Adams, who enjoyed so many opportunities of seeing, and describes with such felicity what he saw, of the habits of mollusca among the islands of the East. "*N. melanostoma*," that gentleman observes, "is furnished with a strong coriaceous foot, well developed in front, by means of which it perforates the sand, while its tentacles are protected; but when the tide rises and covers the sands, the large side-lobes and dilated hind part of the foot are

expanded, and the *Natica* flaps along above the sand. A great peculiarity in the animal of this family is the existence of an operculigerous lobe, which in the polished species nearly covers the shell, and is seen in our figure mounting up behind and partly covering the sides."

Thus the *Natica* is seen in three very different aspects:—first, when shut up in his shell at rest; secondly, when, deserted by the tide, he wraps up a part of his shell by the lobes of his mantle, and coils up the front flaps of his foot into an instrument for perforating the sand; and thirdly, when under water in full motion, with his broadly expanded foot undulating as he walks or swims. At the latter exercise, to which his fin-like expansions must particularly adapt him, he is by no means inexpert; and in captivity has been observed to prefer it to the more sedate movement of crawling.

Far from adopting or favouring the vegetarian theory, so popular in some circles, the *Natica* is more than suspected of a strong penchant for animal food; nor is he reported to be moderate in his predaceous habits. Like his noble four-footed exemplar, the lion, he has strong teeth on his tongue, which would assist him in tearing and reducing his food. The head is long, with a proboscis which is capable of being withdrawn; it is hidden by a kind of veil in front, bearing

upon its edges the two tentacles; eyes are either wanting or rudimentary behind the veil; the operculum, whether of shell or horn, is half-circular and has a small flat spire. The shells are smooth, rounded, with small spires of few whorls; the aperture is half-circular, with its inner edge nearly straight; behind the columella is a hollow, or umbilicus, which is sometimes wholly or partially concealed by the spreading callus, or swelling of the columella. Our species:

N. monilifera, with the shell very globose, with the whorls arching suddenly from the sutures; it is of a dull greyish or fleshy tint, with a single band of brown, squarish marks; operculum horny. Animal yellowish, tinged with purple; the foot is capable of very great expansion, and the head is furnished with very small eyes.

N. nitida has a smaller shell, sometimes marked all over with bands of spots, and the whorls shelve towards the suture, so as to produce a more tapering spire. The animal is faintly yellowish, spotted with greyish-brown. Its habits are not so much to burrow in the sand as to throw up little hillocks of it, in which to hide until the tide returns.

N. sordida: the shell is not so tapering as *N. nitida*, nor

so globose as *N. monilifera;* in size it is between the two, and it is of a uniform chestnut or leaden hue. The animal is of a dusky brownish tint.

N. Montagui has a small, reddish, globular shell, with a whitish band near the suture.

N. Helicoides: the shell is thin, white, oval, with scarcely any umbilicus or callus on the inner lip.

N. pusilla: shell smaller and more tapering than *N. Montagui;* umbilicus small.

N. Kingii: shell very small, white, with yellow epidermis; spire produced; scarcely any umbilicus.

VELUTINIDÆ.

I. Velutina.—Here we seem to be returning to a more simple form of animal. It has a thick foot, with perpendicular sides; a head produced into a proboscis; a pair of long tentacles, with eyes at their bases; no operculum. Shell with a very small spire, and large, oblique, spread mouth.

V. lævigata has the well-known pinkish shell, with a brown velvety epidermis, and a bright orange-coloured, slightly speckled animal.

V. flexilis has a light-greenish, membranaceous, shell-like protection.

II. LAMELLARIA.—The shell of *L. tentaculata* is flat and open, like a *Haliotis;* that of *L. perspicua* is more globose, like a *Sigaretus.*

Both species are white, being entirely covered by the mantle of the animal. Seen from above, the mantle presents an oval, irregular, convex disc, with a sinus in front; when turned up the foot is seen, which is oblong and rather scalloped at the sides; beyond this foot, but still under the mantle, protrudes the head, with the pair of tentacles, bearing eyes at their base.

CHAPTER XXX.

CANCELLARIA WANTING IN THE BRITISH FAUNA.—TRICHOTROPIS.—CERITHOPSIS, ITS CHARACTER AND HABITS.

CANCELLARIADÆ.

Of the genus *Cancellaria* itself, with its elegantly-formed and well-sculptured shells, our own shores do not present a single example. The nearest approach to it is found in a rather small boreal mollusc, named

I. Trichotropis *borealis*.—It has a neat little fusiform shell, with spiral keels, covered by an epidermis, which, when in good condition and not too aged, is gathered up, at the upper keel, into a coronet of stiffish hairs. The aperture is pointed in front, ending in a slightly-depressed canal. Behind the inner lip is a broad hollow, or umbilicus.

The head of the animal is short and broad, having a retractile proboscis, and two pointed tentacles, with the lower

half thickened, so as to form eye-pedestals, the eyes being placed near the middle of the tentacles; the foot is short and broad, rounded at the back, and squarish in front, a little contracted at the sides. It bears an operculum, which, as to construction, is called *concentric*, although the nucleus of the successive layers is lateral.

II. Cerithiopsis *tuberculoris* is a very curiously-constructed animal, having a shell so much like that of a *Cerithium* as to be, in itself, quite undistinguishable. Its operculum is placed on a lobe, or flap, at the back of the foot, which is grooved underneath, the groove terminating in the centre by a perforation. I should not be at all surprised to hear, when the animal is better known, that this groove had something to do with a byssus, and that this mollusc, like *Rissoa parva* and *Cerithium obtusum*, was in the habit of suspending itself by byssal cords during the hybernating season. This notion however, it must be confessed, is rather loosely hazarded, and is not at all founded upon any actual examination of the structure.

The tentacles are blunt, thickened at their bases, with eyes on the thickened part, near together; and in front of the head, above the fore part of the foot, is a flap, or mentum, resembling that which, in *Natica*, is reflected so as partly

to cover the head. The mantle has a fold, or siphon, lining the canal of the shell.

Perhaps the flap, or "mentum," may be serviceable to the *Cerithopsis* in swimming, as it has been observed to push the front of the foot with its flap far beyond the head when indulging in that exercise, which is not so much the case when the motion is that of walking.

CHAPTER XXXI.

PREDACEOUS TRIBES.—MUREX.—PURPURA.—TYRIAN DYE.—EGGS AND YOUNG.—VORACITY.—IN CAPTIVITY, FEEDING ON A FELLOW PRISONER.—NASSA.—BUCCINUM, OR WHELK.—FUSUS.—EGG-CAPSULES.—TROPHON.

MURICIDÆ.

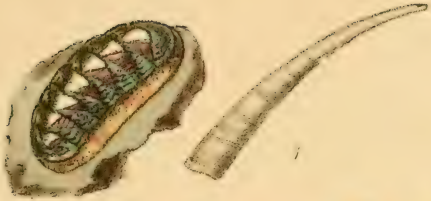
THE name of this family calls up visions of the most exquisite forms and brilliant adornments to be found in the whole range of conchological existence. The genus *Murex* itself presents an assemblage of molluscs, which contain among their number some of the most celebrated species. The far-famed "Rose-bud," with its pink branchings, and the *tripterus*, with its delicate white fringes; the "Ducal Murex," with its crimson bands; the "Venus's Comb," with its graceful spines, and many other celebrities, are the shelly coverings of its members. Then the *Purpura*, with its Tyrian dye, and the Whelk, with its culinary excellence, add their interest to this varied, although well associated group.

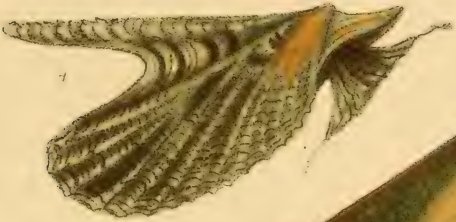
We are among the *Canalifera* now; for all the spiral shells of *Muricidæ* have a more or less produced groove at the end of their apertures, through which passes a siphon, formed of a lengthened and rolled-up portion of the mantle.

The *Muricidæ* are the very eagles, tigers, and constrictors of their class, feeding on living victims, and taking so large a meal at one time as to require a period of rest for digestion. Each small victim, or portion of a larger one, ere it passes into the body of its ferocious devourer, has to run the gauntlet through a long proboscis, lined by a tongue, armed with triple rows of teeth. The following are British representatives of this family:—

I. Murex.—The latest monograph of this genus is that by Mr. Reeve, in his 'Conchologia Iconica,' in which nearly two hundred species are described, and pictorially represented,—a task of no small difficulty; for nearly all the species have, running up the spire, from whorl to whorl obliquely, a varix, or swelling, marking the edge of former apertures; and these varices are often armed with branches, spires, fringes, teeth, and furbelows of the most complicated description.

If we had to choose a characteristic example of the genus as to the shell, we certainly should not fix upon either of





v. del. et lith. Vincent Brooks Imp.

1. Dentalium entalis. 2 Chiton emarginatus. 3. Hyalæa trispinosa.
4. Avicula Tarentina 5 Pinna pectinata 6 Fissurella reticulata.

our British species; for in *M. erinaceus* the varices are rather irregular, and in *M. corallinus* they can scarcely be distinguished from the knobs or tubercular swellings between them.

The head of the animal is half-circular and flat. It has two tentacles, thickened at their bases, where the eyes are placed a little way up. The proboscis is rather long, and can be drawn in at pleasure. The foot is proportionately small, oval or squarish, rounded behind, carrying an operculum composed of horny layers placed within each other, the nucleus being near the pointed end.

M. erinaceus is of a yellowish-white colour, having a light-brown shell. The shell may be described as having its general outline conical at both the spiral and channelled ends, and rather angular in the middle of the sides. The whorls are deeply ridged, having varices at not quite regular intervals, rows of scaly projections in front, and tubercular swellings between them. When adult, the canal is closed in by the spreading forwards of the inner lip.

M. corallinus is small, of a bright scarlet colour, with a brown, ribbed shell; the varices are not fringed or scalloped, or even defined at the edges; they are scarcely

to be distinguished from the tubercular swellings of many fusiform shells.

II. Lachesis *minima*.—A very minute mollusc, with a fusiform shell, which, during the life of the animal, is of a dark-brown colour, but after death becomes reddish.

III. Purpura.—The genus to which this name is now applied does not include the mollusc from which the Tyrian purple of antiquity was procured. That historical honour belongs pre-eminently to the *Murex trunculus*, and, in a secondary degree, to other species of *Murex*. Nevertheless the *Purpuræ*, like their more splendid neighbours, do secrete a fluid quite as capable of imparting the royal tint to any fabrics dipped in it. Behind the head in *Purpura lapillus*, the only species our islands possess, is a receptacle containing a white fluid, which, on exposure to the air and light, reaches a brilliant purple tint through several intervening gradations of yellow, green, and blue. The dye so obtained is made permanent without difficulty; but, although it was formerly used in Irish manufacture, it has long since ceased to be so employed,—perhaps through not being procurable in sufficient quantity to make it worth collecting.

The shell is oval or fusiform, rather stout, with a thick outer lip, and a well-defined canal; the whorls of the spire

are turreted and more or less distinctly ribbed. In early stages, as seen on the upper part of the spire, the ribs are adorned with scalloped leaflets, and sometimes this beautifully-foliated structure is continued in the more adult condition. The animal is of a yellowish tint or white, with conspicuous eyes placed at the end of the bulging parts of the tentacles; the scalloped edges of the mantle correspond with the denticulated edge of the aperture.

The egg-bags of the *Purpura lapillus*, commonly called the 'dog periwinkle,' are deposited on the surface of rocks, or stones, or shells, united in considerable numbers to a common membrane, on which they stand erect like so many oval cups, each cup containing an embryo. Here the young *Purpuræ* remain for some months before the cup opens; and when this happens, they do not all take immediate advantage of the new-born privilege, but some of them prefer remaining in ease and comfort where they are for a time, till they acquire sufficient strength and courage to leave the protection of their cells.

The *Purpuræ*, like the *Littorinæ*, crawl about on the shore between watermarks, and seldom venture under the lower tidemark. Gliding stealthily among the seaweeds and stones, it seeks its prey, and woe to the small winkle,

limpet, or *Trochus* that comes within reach of its terrible proboscis. It will bring the aperture of its own shell opposite to that of its victim, and then introducing his apparatus, never leaves it until all the soft parts are transferred to his capacious stomach. But even where no aperture or door leaves the smaller mollusc open to the attack of his enemy in that way, he is by no means deterred by this little difficulty; for if the object of his attack be a limpet, firmly attached to a stone, or a bivalve, tenaciously holding its shell closed, he will manage to perforate the shell, and through the hole to draw forth the quivering substance. Mr. Spence Bates related to the authors of the 'History of British Mollusca,' that by way of experiment he placed a *Purpura* in a vessel of sea-water in company with a mussel, and observed the result. In a short time the *Purpura*, finding that the mussel was not at all open to his advances, and that the valves of the shell were so firmly drawn together as to leave no chance of effecting an entry between their edges, began to think of attacking him from without. Seeking a portion of the outer surface free from epidermis, he commenced boring. His human observer, repudiating the policy of 'non-interference,' removed him and turned the mussel over, placing that valve uppermost which was most covered

with the horny protection; the creature soon managed to turn over the huge body and shell of the mussel, and resumed his operations at the point where he left off when disturbed; and he did this repeatedly after similar interruptions. At last, quite satisfied that the breach would in time be effected in that way, Mr. Bates resolved to wait no longer for the the process, but at once to give the voracious shell-fish an opportunity of satisfying its appetite, at a smaller demand of exertion from itself and of patience from its observer. To this end he cut the muscles of the bivalve, so as to deprive it of the power of keeping its valves closed: its fate was thus accelerated; it was now at the mercy of its enemy. The latter no sooner perceived the valves open, than, leaving his former work of boring, he seized his advantage by inserting his trunk between the valves, not in this instance acting upon the general rule, that the enjoyment of an acquisition is increased in proportion to the difficulty and trouble of obtaining it.

When not so unexpectedly assisted, however, the hungry *Purpura* exhibits much patience, occupying himself for a couple of days in making his way through a mussel-shell. After gorging himself with a large portion of the contents, he lies for weeks without attempting to procure a fresh supply.

It appears from this account, that the epidermis of the mussel affords a great protection against marine animals of predaceous habits, for a fine specimen with that covering perfect would hardly be attacked. This is Nature's method of preventing the too rapid diminution in the number of a species of acknowledged utility to man.

IV. Nassa.—This genus contains numerous small species of mollusca formerly mixed up with the genus *Buccinum*. The shells are much smaller, but have a similarly ribbed and furrowed spiral character; their spire is generally conical, and the last whorl moderately large, toothed, and terminating in a short but strongly-marked canal; a distinguishing character of *Nassa* is that the inner lip ends in a little knob, with a notch beneath it. The animal has a large foot, with a fork at the hinder end, and a kind of hook at each corner of the truncated front; the operculum is small, pear-shaped, and very pointed; the eyes are on swellings about one-third up the pointed tentacles. These lively little creatures move about freely in rather shallow water, using their retractile proboscis with fatal effect on the victims devoted to their appetites. The mantle is produced in front into a siphonal tube, pushed out far beyond the canal of the shell. The young *Nassæ* are deposited in small membranous capsules. The British species are—

N. reticulata: animal yellowish, speckled with grey, its foot terminating in two filaments, which are turned up vertically in walking. Shell brownish, with dark bands; lips white; longitudinal ribs flexuous, with knobs near the suture.

N. incrassata: with the end of the foot divided into very short, triangular processes. The shell is shorter, and the whorls more rounded, and the colouring brighter, than in *N. reticulata*.

N. pygmæa: the caudal processes of the foot are long and filiform, as in *N. reticulata*. The shell has a long spire and short mouth; it is closely ribbed, and exhibits here and there an irregular varix.

V. Buccinum, or *Whelk*.—The shell of the common British species of our markets is subject to so great a variation of shape, sculpture, and even colouring, that it would not be easy to describe the species from any one variety, but the prevailing form is oval, with a large body-whorl and aperture, and a spire with moderately rounded whorls. The elegant curvature of the wave-like swellings on the whorls gives our species the appropriate name of *B. undatum:* across these undulated swellings run, in a spiral direction, raised lines. The shell is sometimes small and of great

thickness, in other cases large and thin. The animal is of a general yellowish tint or white, blotched with black or grey; it has a large flabby foot, a long retractile proboscis, long siphon, rather short and thick tentacles, with eyes on their swelled bases, and an oblong operculum, composed of layers over-edging a side nucleus. The young of *Buccinum undatum* is deposited in a round patch of gristly cells, each of which contains two, three, or four embryos.

Never having had the good fortune to taste the whelk, I cannot vouch for its excellency; but it is by no means rare to see people standing at the stalls, eating these boiled mollusca with a little pepper and vinegar, and to all appearance much enjoying the *al fresco* repast.

B. Dalei is only known by the shell, which in shape is not unlike the more normal varieties of *B. undatum;* it is smooth and glossy, with a blunt apex and rounded whorls.

B. Humphreysianum is named from a light, thin, pale pinkish or fawn-coloured, faintly-striated shell, with delicate streaks of light brown; the whorls are rounded, and the aperture is pinkish, and occupies about half the length of the figure.

B. fusiforme: a whitish shell, clothed with a greenish-yellow

epidermis; has a long spire with rounded whorls, and numerous longitudinal ribs crossed by raised lines.

B. acuminatum: the beautiful tapering spire with sloping sides, and the regular bead-like granulations of the spiral lines, in the elegant but rare shell to which this name is applied, render me unwilling to admit that it is but a variety of *B. undatum*. In spite of the curious and monstrous forms known to occur in that species, I cannot resist the conclusion that the form of *B. acuminatum* is normal and distinct.

VI. Fusus.—The shells of *Fusi* are more tapering than those of *Buccinum* at the canal end; the operculum has its nucleus at the end, not at the sides. The foot of the animal is not so spreading; the siphonal fold is not so much produced; and the eyes, instead of being placed at the base of the tentacles, are at the end of thickened portions half-way up.

The nest for hatching the fry of *Fusi* is curious in all the species. That of *F. Norvegicus* consists of a lens-shaped bag, of an inch diameter, glued to the inside of shells. Mr. Howse, in a paper in the 'Magazine of Natural History,' gives an account of some which he examined. He says:—"The envelope is coriaceous, of a horny appearance, very

transparent, smooth, glossy, and of a yellowish colour; one of the capsules contained three, the other only two embryos. The last were far advanced, and apparently ready to leave the case. Through the transparent covering, when first dredged, I could see them moving about, and adhering to the inner surface of the capsule by the expanded foot, the sides of which were of a faint lilac colour. The thin operculum, the flattened tentacles, the diminutive spot-like eyes of these beautiful creatures, were also distinctly visible. The young shell is very thin, brittle, pellucid, brilliantly glossy, and of a pale amber colour, nipple-formed, and perfectly resembles the nucleus, or upper whorl, of the adult individual, as will be seen by referring to the accompanying plate. Those most advanced in growth have two whorls, and are half an inch in length by a quarter in width."

The capsules of *F. antiquus* are smaller and placed above each other in a heap. The young are fully formed before they leave the capsule; but the young shell, which forms the nucleus or apex of the spire of the adult, is thin, rounded, and of a totally different character: hence the curious mammillated apex observed in all the species. The British *Fusi* are—

F. Islandicus: animal pale-yellowish, rough. Shell white

or flesh-coloured, with pale brownish sweeps of colour; apex smooth and distorted; spiral raised lines, more or less conspicuous.

F. propinquus has the shell much like the last, but the young shell, and consequently the apex of the adult, is symmetrical.

F. Berniciensis: a very handsome and rare shell, with granulated spiral keels, a very obtuse apex, and well-developed canal. It is covered with a light brown epidermis, under which it is of a delicate pink colour, showing beautifully in the mouth. It is about two inches and a half long, of an elegant fusiform contour.

F. antiquus, the well-known large species, has a solid shell, is of a more oval form, with wider aperture than the other species. It ranges in colour from white to orange-brown, the white variety being sometimes beautifully tinged with orange in the inner part of the mouth. Like *Buccinum,* this species is occasionally met with *reversed:* the apex, unlike that of *Berniciensis,* is smooth and distorted. Laid on the back, with the mouth horizontal and filled with oil, with a lighted wick passing through the canal, this fine shell serves as a lamp to cheer the gloom of the northern

islanders; and in that position, bears some resemblance to the simple lamps of antiquity.

F. Norvegicus has a smooth, delicately pink or flesh-tinted shell, with a very large mammillated apex; in most other respects resembling *F. antiquus*.

F. Turtoni has a large shell, with a long tapering spire, terminated by an apical coil of three whorls; the aperture, from the undulation of the outer lip, resembles that of *Buccinum undatum*.

VIII. TROPHON is a division of *Muricidæ*, greatly resembling the *Fusi*, both in the soft parts and in the shell. The latter, in the distinct varices encircling their whorls, approach the *Murices*. Of the British species—

T. clathratus has rather rounded whorls, with thin, white, smooth, leaf-like varices, between which it is brownish.

T. muricatus has angular whorls, with scalloped and aculeated varices; it is usually of a pinkish or reddish-brown colour.

T. Barvicensis has angular whorls, unarmed varices, crossed by spiral riblets.

CHAPTER XXXII.

NO BRITISH CONES.—CHARACTERS, HABITS, AND SPECIES OF MANGELIA.

CONIDÆ. Genus MANGELIA.

The Cones love warmer climes than ours; not a single specimen crawls on our beaches, or hides among our sea-weeds, or gladdens our eyes with its glowing tints and brilliant markings. The *Mangeliæ* however are a very pretty little race, which claim a certain relationship with the missing genus, and which, with the *Pleurotomæ*, are thought to form a group, having characters in common sufficient to unite them in family bonds with the true Cones.

At first sight, this association would appear forced and inconvenient, for the shells of *Mangelia* are scarcely conical: they are fusiform, all having produced spires, and most of them distinct canals. In common with the *Cones* and the *Pleurotomæ*, they have a sinus at the hinder or upper union

of the outer lip with the body. Some of them have, others have not, opercula. As far as the shells are concerned, we may give some notion of their affinity with the *Cones* by saying, that some *Pleurotomæ* are like some *Cones*, and some *Mangeliæ* are like some *Pleurotomæ*. Mr. Arthur Adams, in his account of the mollusca seen or collected during the voyage of the Samarang, mentions that no fewer than forty-three species of these brisk little molluscs were found among the islands of the East Indian Archipelago. That gentleman informs us that their "favourite locality is coarse, loose sand, either in sand-patches on the reefs, or under stones in deep water outside the reefs, or in still deeper water, where the sand is mixed with mud. . . . The species which live at considerable depths are dark-coloured, and strongly ribbed; those that prefer the loose sands are generally granulated, finely ribbed or cancellated, and of a light brown colour; while light-coloured species, which are seen crawling over mud flats, are often covered with a fuscous epidermis."

The *Mangeliæ* have subulate tentacles, meeting at the base, with eyes placed on the truncated ends of thickenings at various heights. The proboscis is retractile, and the siphon of the mantle is produced beyond the canal of the shell. The foot is more or less truncated in front, some-

times bluntly pointed at the back. Where an operculum exists, it is "unguiculoid," or composed of successively advancing horny layers, the first and smallest of which is at the pointed end. The animal is generally white, sometimes speckled with grey.

M. turricula has the foot partly divided, and spread into auricles in front. Shell white; whorls turreted, with blunt angulated ribs; aperture shorter than spire.

M. Trevelyana: shell white, short, with crowded ribs; aperture as long as the spire.

M. rufa: shell brownish; whorls not distinctly turreted; bluntly ribbed.

M. septangularis: foot short, bell-shaped; shell flesh-coloured, with nearly straight whorls, having flexuous blunt ribs, seven on each; outer lip thickened, strongly sinuous.

M. nana: shell small, white; the whorls round, spirally grooved.

M. teres: foot divided in front into auricles, triangular at the back; tentacles long and thin; shell spotted with chestnut markings, spirally ribbed; outer lip strongly notched at the suture, grooved within; whorls rather turreted.

M. purpurea: shell brownish-purple, speckled with white; spire long; whorls rounded; ribs crossed (in one variety they are notched out into produced points).

M. Leufroyi: shell white or brown, with a light band; ribs few, rounded; whorls rounded, crossed with spiral striæ.

M. linearis: shell rather short, with brown raised lines running over rounded longitudinal ribs.

M. gracilis: animal white, marked with pink spots and lines; foot slender, pointed behind; tentacles short; shell brown, with a narrow white spiral band; whorls rather turreted, their upper part bluntly ribbed; canal rather produced.

M. nebula: yellow-spotted, with the back of the foot notched; shell brown; spire and last whorl conical; aperture very short in proportion to the spire; ribs obtuse.

M. brachystoma: the animal exhibited great activity in confinement, freely exhibiting his body, which is speckled with yellowish flakes; the siphon produced; the foot long, tapering to the back, bilobed in front; eyes placed about the middle of short tentacles; shell very small, pale, with raised spiral lines across blunt angulated ribs; aperture very short indeed in proportion to the spire.

lanthina communis . 2 Haliotis tuberculatus . 3 Phasianella pullus
Trochus cinerarius . 5,6. Patella vulgaris .

M. striolata: shell narrow, turreted, whitish, banded with a brown band close to the suture; whorls angulated, with distant ribs; spire longer than aperture.

M. costata: shell like *M. striolata*, with the ribs less numerous; whorls not angulated; a broad chestnut band between the ribs, reaching half-way down the shell.

M. attenuata: a scarce southern species, having the tentacles remarkably long, with the eye-bulgings very near their bases; the foot has a produced point at each side of its straight front edge; the shell is of the most graceful form, tapering at both ends, with gently undulating ribs, crossed by brown lines.

CHAPTER XXXIII.

EUROPEAN COWRY.—APPEARANCE WHEN CRAWLING.—SUDDEN RETRACTION.—MUCH IN A LITTLE SPACE.—THE FRY OF CYPRÆA.—OVULUM.—MARGINELLA.

CYPRÆADÆ, OR COWRY TRIBE.

I. CYPRÆA *Europæa*.—We cannot here trust ourselves to speak of the rich and varied beauties of the shells belonging to this splendid tribe; nor to enter into the very interesting question as to whether they are periodically cast and renewed, as affirmed by some observers; nor attempt to account for some peculiar traits in their nature. For we have but one species; that species is small and dull-coloured, and it belongs to the ribbed group which has been separated under the name *Trivia;* so that any minute remarks on the structure of the "Porcelain" shells might be inapplicable to our pretty but inobtrusive little Cowry.

Near the edge of low water may be seen crawling on the sandy flats, a narrow creature about an inch and a half long,

of a bright orange colour, duskily banded, or yellow, with orange edge, or mottled green and brown, or all pale pink. In front come three horns which, on examination, we find are not all alike; for the centre one is a tube, the siphonal canal protruding to some length: the other two are the slender tentacles, with sharp little black eyes at their bases. Then you just see the front edge of the flat foot, which is straight, with sharp corners; swelling above this is an oval convex body, with a slit down the middle, through which something hard and flesh-coloured appears, with two rows of knobs. This is the shell, wrapped up in the lobes of the gaily-coloured mantle. Behind all this is the continuation of the flat foot, which ends like the top of a gothic arch. Anxious to become a little more intimate with your new acquaintance, you lean over the boat, dip your hand into the water, and seize the object. Drawing it up, you have in your hand apparently nothing but a flesh-coloured shell, in form like a coffee-berry, with ribs across the back, and an opening down the whole length of the under side. But where are the horns and the siphons, and the mantle and the long flat foot? All gathered in a moment within that narrow toothed hole. And, as in the case of Goldsmith's schoolmaster, where

"More the wonder grew,
That one small head could carry all he knew,"

you are astonished that so small a box can contain so large an animal.

The young shells are very different from the mature ones, being very thin, with a wide aperture, more like a *Bulimus* than what they afterwards become.

The account given by Mr. Adams of the fry of *C. annulus*, although referring to a different shell, may still be true as regards our species, as these, like many other molluscs, differ from each other much less in their young state than when more advanced. No doubt when the fry of *C. Europæa* comes to be well known, we shall find it to correspond with the following account of the Singapore shell. Mr. Adams observes that he had an opportunity "of observing the fry. In the course of growth these fleshy expansions become entirely absorbed, and do not ultimately constitute the lobes of the mantle, which embrace and partly cover the shell in the adult."

II. Ovulum.—In this genus the edges of the aperture of the shell are not toothed as in *Cypræa*, and in the two British species the outer lip is not reflected. As in *Cypræa*, the animal, when walking, covers over a great part of the shell

with the lobes of his mantle; in other respects he resembles *Cypræa*.

O. patula is whitish, having the mantle tinged with yellow and barred with orange stripes, and covering two-thirds of the shell, which is open, with a peak or rostrum at both ends; white, smooth, and without any visible spire.

O. acuminata is named from a very little, white, narrow, bulla like shell, peaked at the back, rounded in front. It is a very rare shell, and uncertain as to its real character and position, for the animal is not known.

III. Marginella *lævis* is the only British representative of a most beautiful race of mollusca, with highly enamelled, polished shells. The siphon, the tentacles, the square-fronted, sharp-cornered foot, the eyes near the base of the tentacles, and the mantle covering the greater part of the shell, are all present, as in the animal of *Cypræa Europæa;* but the foot is shorter, the head much more produced between the tentacles. The mantle is covered with little swellings, and is speckled with black, yellow, and brown. The shells of the *Marginellæ* are polished, and show their spires, although they are small, and the sutures covered by an enamel. *M. lævis* is rather conical, and has the outer lip thickened, inflected, and crenulated.

CHAPTER XXXIV.

VARIOUS FORMS OF BULLIDÆ.—SCAPHANDER, OR BULLA LIGNARIA.—GRINDSTONE GIZZARD.—AKERA.—CYLICHNA.—AMPHISPIRA.—TORNATELLA.—PHILLINE.—BULLA.

BULLIDÆ.

THE very variable manner in which the lobes of the head and foot are spread out, winged, fingered, or eared, as the case may be, in various genera and species of this interesting family, and the different proportions, shape, and positions of the shells, or even in some genera their absence, show how difficult it is for naturalists to select any characters which can be relied upon, with certainty and consistency, in attempting to arrange objects according to their natural affinities.

Before my eyes, while writing this, is a plate representing eighteen of the twenty-one genera into which this family is now divided; and certainly a more seemingly heterogeneous

collection of mollusca could scarcely be thrown together, if picked out from various parts of the system for the purpose. There are the *Aplustrum* and *Hydatina* with banded outside bubble-shells, crawling on their leaf-like discs, and exhibiting no fewer than six ornamental projections on the sides of their heads; while the *Tornatina*, with his little rolled cylinder of a shell and narrow foot, is content with two. The *Akera*, whose shell is represented by an elastic roll of transparent horn, has a long head, unornamented; and the *Scaphander* wraps up his head and body in a leather-like lobe, so as to present no appearance of life under his solid, wood-coloured, pear-shaped test. Some of the species look like rolled-up slugs, and others like tadpoles; and while *Philline* covers its shell and body with what resembles four small mats, the *Lobiger* appears all life and animation with four wings.

"Shell none, external or internal," is all that Mr. Arthur Adams can say as to that part of their character, when, in his monograph, he endeavours to throw together the peculiarities of this dissimilar group.

Still the affinities of these mollusca with each other are traceable through every divergence. The head in every genus is more or less lobed; the gills are placed on the right

side of the back, and covered either by the mantle or shell; and the foot is more or less expanded, at the sides, into swimming lobes. This family is represented in our seas by

I. Scaphander *lignarius*, commonly called *Bulla lignaria* because of the wood-like appearance of its shell.—This shell is rather pear-shaped, narrowed at the top, with the aperture wide near the bottom and as long as the shell, which is *convolute*—that is, the last whorl quite covers all the rest, so as to hide the spire. The animal, when at rest, presents the appearance of a pinkish-white leather roll, formed by the coiled-up lobes of the foot and head covering the head itself and the body, but no part of the shell: it has no eyes. The gizzard, or stomach, is very remarkable, consisting of two circular, shelly plates, acting on each other in a manner similar to a pair of millstones, and well adapted to grind, by the action of powerful muscles, the somewhat undigestible animal substances which form the food of the *Scaphander*. My readers will be pleased with the very lively account of this mollusc, which lives under rather deep water on sandy bottoms, from the pen of the Rev. D. Landsborough:—

"Who can be on the shore without admiring the sea-shells? God teaches their inhabitants to form and fashion, and paint in a way which man, with all his boasted taste and

skill, would in vain attempt to imitate. Let us touch a little on one of them—*Bulla lignaria*, found at Whiting Bay, by digging in the sand at ebb-tide. It is not easy to give a description of this elegant univalve. It is oval, convex, and slightly spiral, like a thin plate, pretty closely rolled up at one end, and only half rolled up at the other. Inside it is china-looking, and outside it is like wainscot. It is nearly two inches in length, and at the broadest about an inch and a quarter across. Never did lady recline on a more tasteful couch. The internal structure of this well-lodged mollusc is deserving of our regard. As the inhabitant of the *Bulla* is as soft as a slug, one would think that it would feed on something as soft as jelly: instead of that, it swallows entire the fry of another creature with a shell as hard as its own. This shell-fish is *Mactra subtruncata*, called in the Lowlands *Aikens*, and in the Highlands *Murech baan; baan* denoting the colour, which is white, and *murech*, it is probable, being the Celtic origin of the Latin *Murex*, the shell-fish which yielded the Tyrian dye, or imperial purple. But how can this soft *Bulla* feed on this hard food? Though it has no teeth, it has an equivalent—a gizzard formed of shell as hard as bone, and composed of two valves, or rather millstones. These millstones are bound together with

a very strong ligament, leaving only an opening to receive the food. As soon as the young shells are swallowed, they come under the power of the two millstones, which crush, and grind, and reduce them and their living contents to a paste, in which state they enter the stomach. This stomach is capacious, in the form of a sack of meal bound at the mouth; and in this deep sack the paste remains till it yields its substance for the nourishment of the voracious *Bulla*. Various are the methods by which the Lord enables his creatures to supply their wants. He has given sharp teeth to fishes and quadrupeds, and hard bills to birds; but though the *Bulla* has neither tusks nor beak, he has furnished it with a gizzard, which still better answers its purpose."

II. Akera *bullata* has a very thin, horny, transparent shell, which is *not*, strictly speaking, convolute, for although the last whorl covers the body of the others, it leaves their edges exposed at the top; the upper edge of the aperture is separated from the last whorl so far back that the lip is quite free and elastic, so that it can be bent inwards to touch the opposite lip; the lobes of the foot are so wide that, when at rest, they coil over and invest a part of the shell. This eyeless animal is tinged and mottled with pur-

ple and brown. It is littoral in its habits, and in some places the mud is lined with thousands of *Akera* at high-water mark.

III. CYLICHNA.—This genus comprises little short-footed *Bullidæ*, with eyes at the base of their flattened tentacles, and small, generally white, cylindrical shells. The British species are—

C. cylindracea: shell long, narrow; apex umbilicated; spire concealed.

C. obtusa: shell short and thick, with a slightly produced spire.

C. umbilicata: shell rather oval; apex umbilicated; spire concealed.

C. strigella: shell shaped like *C. umbilicata;* spirally striated.

C. conulus: shell narrow at the top, with an umbilicated apex.

C. truncata: shell with straight sides and flat top, showing the whorls of the spire.

C. mammillata: shell smoother than *C. truncata*, with the apex a little produced.

C. nitidula: shell rather oval, but tapering towards the apex; spire hidden.

IV. AMPHISPIRA *hyalina:* a very minute, white mollusc,

found dead in shelly sand and living in pools between tide-marks, which has the power of entirely withdrawing into its thin, glossy, white, transparent shell; the eyes are always kept under the edge of the shell, which protects them without interfering with the vision; in short, the animal, while progressing, can look out of window all the way.

V. Tornatella *fasciata* is a mollusc not usually associated with the *Bullidæ*, and perhaps there are hardly sufficient grounds for the union. The shell is oval, with a produced spire, and a fold on the columella; and it has an operculum, which is not the case with any of the other *Bullidæ*. The animal does not cover the shell; its head is a squarish disc, divided in front, with two lobed tentacles with eyes at their base.

When this little milky-white animal is under observation in captivity, it exhibits no timidity, and will not even withdraw its body when approached, but sometimes gives out an opaque whitish fluid tinged with purple.

VI. Philline, commonly known as Bullæa. The typical and best-known species bears the light, transparent, ear-shaped, open shell, known as *B. aperta*, which is quite covered by the mantle of the animal. This is thick, white, and slimy: looking down upon it, all that we see is four

flattish discs: one, a lobe turned back over the head; another, the mantle enveloping the shell; and the two side lobes of the foot, capable of great use in swimming. The plates of the stomach, resembling those of *Scaphander*, seem to indicate similar habits in the animal, although the shells are so different, and one internal and the other external. The shell of

P. quadrata is small, white, spirally striated, with a series of minute holes. It is broad and rather square.

P. scabra: minute, white, punctured in spiral lines, with the outer lip toothed: shaped like *Scaphander lignaria*.

P. catena: very minute, white, with chain-like spiral sculpture.

P. punctata: nearly oval, minute, punctured in squares.

P. pruinosa: slightly coloured with brown, frosted or shagreened; rather globose.

These creatures, although so minute, have been carefully examined by Mr. Clark in a living state. That gentleman, in detailing his interesting observations in the 'Zoological Journal,' remarks, with regard to *P. pruinosa*, that the foot is very large when not turned over the back of the animal; that the digitations at the end of the body are used in assisting locomotion; that the animal flaps the sides of its foot

upwards and downwards, as if beating the water, with considerable quickness; and that, although he could not discover in this species the shelly plates which compose the gizzard in most of the species of the *Bullæa*, yet the gizzard must exist in every case, whether shelly or horny in its texture.

VII. Bulla.—The true *Bullæ* of the authors of the 'History of British Mollusca' belong to the genus *Haminea* of Arthur Adams, as described in my 'Thesaurus.' If the views of the latter author should be adopted, we must arrive at the conclusion that no representatives of the true *Bullæ* honour our coasts with their presence.

Our plan being however in this work to adopt implicitly the arrangements of the 'History,' we describe the remaining British species of the family as *Bulla Hydatis* and *Bulla Cranchii*.

B. Hydatis has a general aspect not unlike that of *Philline*, the animal covering the shell in the fold of its mantle, and the side lobes, when folded, meeting over the back. It is thick and slug-like, of a greenish-yellow tint, speckled minutely with brown, black, and yellow. The head-lobe is large, with eyes slightly projecting towards the middle of the disc; the foot is rather square, and

extends beyond the body behind. The shell is rather globular, very thin, and nearly transparent, covered by a thin yellowish or brownish skin, and is partly covered by the lobes and mantle of the animal. Slug-like as this mollusc appears, it is capable of moving with facility, aided in swimming by the broad flaps into which its sides are expanded, and in crawling, by the great extent of its foot.

B. Cranchii shows no eyes on its front disc; it is white, like the oval shell, through which the gizzard of the animal can be distinctly seen.

CHAPTER XXXV.

'CAN IMAGINATION TRACE?'—'SEA-HARE,' OR APLYSIA.—ANIMAL DESCRIBED.—PURPLE JUICE.—SUPERSTITION.—PLEUROBRANCHUS.

APLYSIADÆ AND PLEUROBRANCHIDÆ.

THESE two families, each containing one genus, seem to be naturally placed between the *Bullidæ* and the Nudibranchiate mollusca. Some of them are very beautiful when seen living in their native element, with their flowing lobes expanded and in motion. Having distinct heads, with ear-shaped appendages, they look more like crouching quadrupeds than the generality of molluscs; although, to complete the fancied resemblance, and satisfy the imagination, we must, like Dickens's Duchess, "make believe very much."

I. APLYSIA, forming in itself the family which takes its name, is represented by one species in the British seas, the *A. hybrida.*

2. Littorina littorea. 3. Operculum of the same. 4. Lacuna vincta.
5. Paludina vivipara. 6. Eulima nitida. 7. Scalaria Trevelyana.

The *Aplysiæ* are commonly known as "Sea-hares," the two "ears," or head lobes, and the arched back, accounting for the notion of a likeness which, after all, is rather remote. From the appearance of a dead specimen, it is astonishing to find how poor an idea is obtained of the beauty of the living mollusc, as it may now be seen in the Zoological vivarium. In an interesting communication to the 'Zoological Journal' by Dr. Bancroft, that gentleman, in giving an account of a package of specimens of marine animals collected by himself at Jamaica, thus speaks of his disappointment, at the same time graphically describing the object: —"Another molluscum is also sent in the cask, an *Aplysia:* but, *quantum mutatus ab illo,* as I saw it for a very short time before it died! Death produces a woful alteration in the appearance of this tribe of animals; for the body and members are all so shrunk up, especially when preserved in spirits, that no one can form any just notion of the real structure or habits of the individual from the mere inspection of a specimen in this state. Every little seeming wart or papilla now on its surface, was in life a tentaculum more or less branched, semitransparent, agreeably coloured, varying from half to one inch in length, each arm of which used to stretch itself out in all directions; the different stems on

the head, neck, and body alternately contracting and expanding; while the dorsal sack was constantly opening and shutting its edges, and the singular apparatus within showing a perpetual and curiously varying activity. These animals die shortly after being taken out of the sea; and, although some of them have been brought up to me without delay in sea-water, I have never had the time, even if I possessed the ability, to draw their figure. Nor is there any artist here that I know of who is at all capable of doing justice to subjects of this description, of which there are here many hundreds, probably of the most interesting kind. I must not omit to mention that this *Aplysia*, though apparently dead, afforded a liquor which, applied to linen, soon changed it to a good purple hue."

The head of the *Aplysia* is distinct, and variously shaped, and furnished with four ear-shaped tentacles; the body is oval, convex above. When there is a shell, it is placed over the breathing apparatus on the back of the animal, and covered by a lobe; the mantle is spread out into a large flap on each side, which can be folded over the back so as to cover it, or be used as very efficient paddles in swimming. The projecting mouth is armed with horny jaws, and the foot is large, flat, and oval. Such is the mollusc, to which

has been attributed the most deleterious qualities and the most ferocious habits, and which has always been an object of superstitious fear.

Although, like many other very innocent and harmless molluscs, the *Aplysiæ* exude a purplish liquor when irritated and alarmed, it is difficult to account for the special dread which they have always inspired. Why should the purple juice of the *Purpura* be sought as a precious object, and honoured in the adornment of royal garments, while the poor Sea-hare, for seeking to hide himself in a cloud of similar liquid, should be denounced as a fountain of poison which it is death to touch? Or why should the latter be deemed a monster of ferocity for feeding only partially on animal matter, while the former, which, as we have seen, will greedily gnaw the substance of a *living* mollusc, or swallow a bivalve whole, is considered a very innocent creature? Yet such is the caprice of popular opinion: it depends upon purely accidental circumstances, whether an action or habit shall be regarded with favour or looked upon with abhorrence and disgust.

Our *Aplysia hybrida*, or *Laplysia depilans*, is of moderate size, specimens being sometimes about two inches long when crouching or at rest, and twice the length when

creeping. It is of an olive or yellowish-grey tint, speckled with brown, varied with spots of white. The two front tentacles are long and half-tubular, the two hinder ones short and pointed; the small black eyes are placed at the base of the tentacles.

The shield, or shell, is transparent, thin, brown, horny; the outside is convex, and the apex shows scarcely the rudiment of a spire.

The British sea-hare lives and lays its slimy nests of eggs among, and partly feeds upon, seaweeds below low-water mark.

II. Pleurobranchus, the one genus of *Pleurobranchidæ*, has a very delicate, flattish, membranaceous shield, which protects, not, as in *Aplysia*, the breathing apparatus, but the viscera of the body. The breathing apparatus is partly free, and consists of a single plume. The animal on the whole resembles the *Aplysia* in general appearance, but more rounded when at rest. Of the two British species, the shield of

P. membranaceus is broad and squarish, while that of

P. plumula is narrow, more shelly, and small, with a rather more coiled apex: it is a comparatively rare species.

CHAPTER XXXVI.

SEA-SLUGS WITH EXTERNAL LUNGS.—VARIOUS GENERA AND SPECIES.—THE 'GREEN ACTÆON' AND THE CLERGYMAN.

NUDIBRANCHIATA.

DORIDIDÆ, TRITONIADÆ, EOLIDIDÆ.

The *Nudibranchiata* are so called because their gills, or breathing organs, are placed outside their bodies, being protected by neither mantle, nor lobe, nor shell, but constituting every variety of ornament to the body of the slug-like, but in many instances exquisitely beautiful, animals.

As ordinary lovers of nature enjoy but few opportunities of seeing these curiously constituted, and sometimes complicated, marine creatures in any degree of perfection, it is but a poor idea that is generally formed of their varied beauties. Having no shells, they present no mementos of their existence to the cabinets of collectors; and it generally happens that our interest is not so much excited by objects

that we read of in books, even if pictured in true colours on the plates, as by those which we can see and feel.

Graphic as are the descriptions, and exquisitely true as are the pictorial representations, of the Nudibranchiate Mollusca published by Messrs. Alder and Hancock, that work will perhaps be less read, except by thorough naturalists, than very inferior productions, referring perhaps to mere shells. For this reason, we must be content with passing lightly in review before us some of the British representatives of this order. Let, then, a few of these sea-slugs crawl before us in procession.

First comes the Doris tribe, represented in our seas by a long train of seventeen species. We choose for description one of the prettiest, *Doris planata*. Creeping along, with its mantle fully expanded, it presents to the eye an oblong, oval, flattened, fawn-coloured disc, covered with small tubercles, and prettily sprinkled with light spots and brown specks: towards the hinder end of this disc is seen the vent, around which is arranged a branched star—this is the breathing organ; towards the front end there are two holes, through which are thrust two tentacles, thickened in the middle and ornamented with coiled ridges. With the exception of the protruding end of the foot, this is all we see until the animal

is turned over; then we find a long disc, constituting the foot, with the mantle spread far beyond it on both sides, and in front round the head, which is not very distinct, but is furnished with two pointed tentacula. With the rest of his genus and family the *Doris planata* lives among sea-weeds, but is carnivorous in his diet.

The other species do not differ much from the above. In *D. Johnstoni*, which is of a pale yellowish tint and much scalloped at the sides of the mantle, the bunch of gills is expanded into a beautiful flower; *D. coccinea* and *D. flammea* are both of a splendid red, tinted with lighter orange; *D. repanda* and *D. diaphana* are delicately white, with slight tints; *D. pusilla* is brownish-grey, covered with conical, dark tubercles, and has a very beautifully laminated, rather long pair of dorsal tentacles; *D. sparsa* is of a light yellowish tint, sprinkled with spots of bright reddish-brown. The remaining species are—*D. tuberculata, D. ulideana, D. aspera, D. bilamellata, D. oblonga, D. depressa, D. inconspicua, D. pilosa, D. subquadrata*. Some of the species lay their conglomerate masses of spawn in the form of a coiled ribband, and others in that of a thread.

Letting these pass by, we next observe two lengthened slugs, presenting a very different aspect from the preceding,

in consequence of the cloak being so small as to leave the head and foot exposed.

These are the two species of GONIDORUS—the *G. castanea* being of a brown colour, with large, dark brown gills, chestnut-coloured mantle, all minutely speckled with white; and the *G. nodosa*, of a white general substance, with beautiful pale yellow and purple hues.

TRIOPA *clava* comes next: less than an inch long, with brilliant orange-tipped branchiæ and tentacles, and orange fingers or filaments, like polypi, arranged all round the edge of his narrow mantle; and a lively little fellow he looks.

ÆGIRUS *punctilucens* is next in the procession, his body covered with large tubercles, among which are arranged brilliant, lustrous green, eye-like spots.

THECACERA *pennigera* and *T. virescens*, from their small size, creep by almost unobserved, with their smooth bodies—the former covered with bright orange spots, the latter patched with green.

IDALIA, still small, passes by in a group of three species, remarkable for the circle of filaments surrounding the region of the gills, and the four long, tentacular appendages carried in front of the horn-shaped tentacles. The species are—*I. aspera*, *I. inæqualis*, and *I. quadricornis*.

Polycera *quadrilineata*, *P. Lessoni*, and *P. ocellata* are very pretty little Nudibranchs, having a veil, or border, passing from the front of the head to the region of the gills, which are large and branched. The *P. ocellata* is beautifully marked with circular eye-like spots on its dark green body.

Ancula *cristata* presents a very lively appearance: he has no veil, but his branchiæ are surrounded by filaments, and his long, spirally-laminated tentacles have projecting filaments at their base.

The family of Tritonidæ have the gills arranged in two rows along the back.

In Tritonia the gills are star-like and feathery, and, with the fringed double veil in front of the head and fringed tentacles, give altogether a very complicated appearance to this animal, which exhibits prismatic colours. The species are—*T. Hombergii*, *T. plebeja*, *T. lineata*.

Scyllæa *pelagica*, which lives on floating seaweeds, and scarcely attains, in the British seas, half an inch in length, has tentacles which can be drawn in and out through sheaths, and a pair of wing-like borders along the back, with lobes, on the inner surface of which project very small, branching gills.

A group now moves slowly on, of thirty-seven small species, of surpassing beauty, composing the genus

Eolis.—In this genus the head is nearly as distinct as in the land-slug; it has four tentacles, with eyes placed between the hinder pair near the base; the gills, which are simple papillæ in form, are arranged in rows, or bunches, along the sides, and by their exquisite tints and symmetrical arrangement, impart great and varied elegance to the body. Among the most splendid may be reckoned *E. tricolor,* whose papillæ are white, tipped with bright orange, then with a soft pencilling of purple, passing into brown; the *E. picta,* richly marbled with brown; the *E. Northumbrica,* with the papillæ placed in erect bunches of four on each side, pencilled in the centre of each with brilliant dark green; *E. cingulata* and *E. olivacea,* with ringed papillæ; *E. nana, E. pellucida,* and *E. rufibranchialis,* in which they are centred with deep red, as in *E. Landsburgii,* in which their edges partake of the purple colour of the whole body. Perhaps the greatest beauty of all is the *E. coronata,* in which the papillæ are tipped with white, centred with red, and touched with bright blue, are numerous and gracefully formed, and placed in oblique fasciculi along the tapering body. The most curious of the species is *E. despecta,* in

which the gills are thickened and few, arranged along the back in a single zigzag line. The remaining species are—*Æ. papillosa, Peachii, glauca, longicornis, Drummondii, punctata, lineata, elegans, smaragdina, gracilis, purpurascens, alba, inornata, angulata, concinna, aurantiaca, vittata, glottensis, amœna, arenicola, viridis, cærulea, amethystina, Farrani, despecta, exigua.*

The gills of the next genus,

Lomonotus, are short papillæ, placed on the fringed edge of the mantle. *L. marmoratus* is, as its name implies, marbled with several tints; *L. flavidus* is palely ringed or striped with yellow.

Dendronotus *arborescens* is well named, having its tentacula armed with branches, and the gills arranged down the back in a double row of many-branching processes; it looks like a little submarine forest creeping in and out among the seaweeds.

Doto *coronata* and *D. fragilis* are prismatic, and have, on each side of their backs, a row of branchiæ, shaped like miniature pine-apples. They feed on zoophytes.

Oithona *nobilis* has teat-like gills, arranged on the edges of a very narrow mantle border.

The microscopic *Embletonia pulchra* and *E. minuta* are

followed by *Proctonotus mucroniferus*, with its pyriform, tubercular gills, arranged in twelve rows of three each; and *Antiopa splendidula*, with a crest between the hinder tentacula.

The green *Hermia dendritica* does not differ much in appearance from *Eolis*, but has the vent on the anterior part of the back; *H. bifida* is the name of the other species.

Coming now to the few remaining genera which, in appearance at least, bear a great resemblance to the land-slugs, we find the external manifestation of breathing apparatus gradually lessening, till it assumes a totally different character. Thus, in *Alderia modesta* the gills consist of a single row, on each side, of simple papillæ; in *Rumina Hancocki* they are three small plumes near the vent; while in the species composing the family of *Elysiadæ*, namely *Limatopontia nigra*, *Elysia viridis*, *Actæonia corrugata*, and *Cœnia Cocksii*, the breathing operation is performed over the whole surface of the body, by means of minute, vibrating cilia.

With the interesting account of one of these, the *Elysia viridis*, or, as it is more generally called, the Green Actæon, from the pen of the author of the 'Natural History of Arran,' we must conclude our notice of this order.

"In a little rocky pool of sea-water, near the base of Maddon, betwixt Brodick and Corrie, I discovered, in July, 1844, an *alga* which seemed new to me. . . . On taking it out of the water, I observed a greenish gelatinous animal on it, which, without examination, I cast into the pool again, that it might continue to enjoy life. I afterwards saw on the *Codium* two more of the same species, but considerably smaller; and observing that they were beautifully mottled with azure spots, I deposited them in my vasculum, among the branches of the *Codium*. When, on reaching home, I put them into a tumbler of sea-water, I saw that I had got a rare and beautiful mollusc, discovered by Colonel Montagu on the Devonshire coast. . . . As I kept the *Actæon* for nearly a week in the tumbler, where it seemed to browse with great satisfaction on the woolly beard of the *Codium*, I had good opportunities of observing it, and I found it even more beautiful than I could have supposed. . . . Its colour is green—betwixt grass-green and bottle-green; but in certain lights it has a considerable shade of rich puce colour on the finest velvet. It is beautifully dotted with azure and with gold. The azure spots are small and numerous on all parts of the body and of the fins, and are precisely of the same brilliant azure as the lines on *Patella*

pellucida. The golden spots were confined to the upper parts of the body. They were few in number, but considerably larger and less regular in form than the azure dots. Two of them, for instance, were oblong, and extended from the ear-like tentacula down to the eyes, which were placed on the back of the neck, as if to keep watch against the enemies from behind, while it was busy feeding on the rich pasture afforded by the green *Codium*. . . . The membrane that acts as fins is of the same colour and substance as the body. . . . At the base of each fin, and pretty close to the back, there could be seen, when the light was favourable, all along the inside, a line like the midrib of a leaf; and from this double midrib there proceeded at intervals, veins in a slanting direction to the upper margin of each fin; so that when the two fins were expanded, it was like a green-veined leaf. To this appearance it may at times owe its safety, by deceiving the eye of prowlers. The description of the mouth, given in the quotation, suited my specimens, except that in them the margin of the *upper* lip was black. The lower lip and part of the throat were quite white, and were the only parts that had none of the azure dots. Could I transfer to the printed page a coloured drawing of it by my daughter, a single glance would give a better idea of

it than all my words; though still we should be constrained to say, 'Who can paint like Nature?' This brief quotation from the Poet of the Seasons suggests to us an answer to those who may be ready to say, 'What trifling! why such a fuss about a sea-slug?' If God painted it, should not we admire it, and adore him by whom it was arrayed in so much beauty? He made all things for his own glory; and if this tiny mollusc, like a floating emerald, has not before attracted the gaze of any eye in Scotland, this is a reason why we should admire it the more when seen, and give glory to Him who deigned to adorn it. Millions of them have lived and died unnoticed by man; but as they enjoyed all the happiness of which they were susceptible, they were not created in vain."

CHAPTER XXXVII.

KNOWN TOO WELL.—ONCHIDIUM.—ARION.—GEOMALACUS.—LIMAX.—DEPREDATIONS.—THE TREE SLUG.—TESTACELLA.

SLUGS.

ONCHIDIADÆ, LIMACIDÆ, TESTACELLIDÆ.

Our comparatively limited knowledge of the first of these families is amply and painfully compensated by an experimental acquaintance with the second. While the former consists of air-breathing slugs, which nevertheless must live in a position accessible to sea-water, the latter everywhere pervade our gardens, cellars, trees, and fields.

The *Onchidiadæ* are represented in the British Fauna by one genus and species only, the

Onchidium *Celticum*, which lives in company, on the perpendicular sides of rocks, ascending or descending with the tide, so as to keep a distance of about a foot above the surface of the water, thus avoiding immersion, while the

1. Aporrhais pes-Pelecani. 2. Turritella communis. 3. Cæcum trachæa.
4. Buccinum undatum.

waves dash over it. It is found in Lantivet Bay, measures about half an inch, and has a thick tuberculated coat covering its body. The breathing-hole is placed at the hinder part of the animal.

The *Limacidæ*, or true land or air-breathing slugs, consist of the genera *Limax*, *Arion*, and *Geomalacus*. They are long, fleshy animals, which have a short mantle, or shield, covering the front part of their bodies, and sometimes concealing a rudimentary shell. They have a head capable of being drawn back or shrunk into the body, and having four horns or tentacles, two of which have eyes at their tips. The shield, or mantle, covers the respiratory cavity, the outer opening of which is seen at one side of it. Few creatures have so great a power of contraction, and assuming a different form when at rest to what it bears when crawling at full length. In the former state it forms a short arched body, resting on a flat disc, and guarded in front by the shield. In the latter, it stretches out to a long, serpent-like form, three or four times as long, and glides over the ground, leaving a slimy trail behind it.

The large black fellow, sometimes called the Horse-leach, so often seen in the open fields, has been named Arion *ater*. A variety of the same species occurs in the woods, of a

scarcely tinted white, and claims the name of *A. albus*. Another variety has been called *A. succineus*, for its amber tint. De Férussac, unable to find differences of a specific value in these variations of colour, unites them under the name of *Arion empiricorum*. The border of the foot is lined with yellow or orange, the shield is marbled, and the back generally streaked. Although the *Arion* has no shell, properly so called, yet calcareous rudiments may be often found under the shield. Their rather large, thick-skinned, yellowish, oval eggs are deposited under stones and wood in the autumn. The young are of a light speckled colour. The disc and body of *Arion flavus* are longer and narrower than in *A. empiricorum*. A rather pretty little slug, with dark stripes down the back, which is said to lay phosphorescent eggs, not very uncommon in gardens, is called *Arion hortensis*.

Geomalacus *maculosus*, found in the west of Ireland, is described as "an exceedingly beautiful animal, measuring, when creeping, about two inches in length; the colour of the shield and upper part of the body is black, elegantly spotted with yellow; the under surface of the foot light yellow, and divided into three nearly equal bands; the edge of the foot is brown, with transverse sulci." There are

several differences between this genus and *Arion*, but that which most easily catches the eye is the forward position of the opening in the breathing cavity.

The genus LIMAX is distinguished from the two preceding by several important characters, among which may be mentioned, the anterior instead of the posterior position of the spiracle on the shield, as compared with *Arion*. It is really a most mischievous foe to agricultural and horticultural pleasures. Armed, like his relations, with sharp, horny teeth, the little *Limax agrestis* pervades with his baneful presence every nook and corner of the field and the garden. Coiling himself up into an arched lump of flesh, he lodges in the recesses of the tenderest plants, and crawls out to munch the young sprouting leaves, often before the plant has acquired strength to survive the treatment. Often, when watching the progress of some cherished bed of vegetables, the gardener observes the young sprout stunted, ragged, and languishing: "an enemy hath done this!"—here is the enemy—a pale or mottled grey slug, about two inches long when stretched to the utmost, leaving a milky mucus in its train; but its name is Legion. While the most voracious, it is also the most prolific of all slugs, laying its round transparent eggs by the hundred. This species of *Limax*

bears a small, flat, oval, more or less rudimentary shell under its shield.

Limax *cinereus* is a larger and finer species, sometimes growing to the length of six inches. Its head is pinkish-grey, and the body and shield striped, and mottled with ash-colour; the back of the tail is keeled, and the shell under the shield rather large, and of an oblong square.

Limax *arborum* lives on trees, eating the wood, particularly in the decayed parts. It mounts the branches, and has the power of letting himself down by means of a thread of mucus, like that of a spider.

Limax *flavus* is the large fleshy slug which leaves its slimy trail on the walls of cellars and damp places under ground.

The remaining species are *L. gagates* and *L. Sowerbii*, which have keeled backs; the small *L. brunneus* and the rare *L. tenellus*.

Family TESTACELLIDÆ.

Testacella *Haliotoidea* may well be placed in a separate family from the *Limacinæ*, although very slug-like in its form and appearance. It is intermediate between the slugs and the snails, carrying a small ear-shaped subspiral shell

externally on the hinder part of the back, with the opening of the pulmonary cavity under its edge. Should any one fond of gardening be fortunate enough to find, within the enclosure, this slug with a shell on its tail, let him not destroy it, but let it live, and it will multiply: it is an enemy to his enemies; it is carnivorous, and its favourite food is the vegetable-devouring slug. Burrowing deep in the ground in winter, it only comes to the surface to devour such noxious creatures as may come in its way. The *Testacellæ* however do not multiply very fast, and the contents of the stomach sometimes show that they have not scrupled to devour smaller specimens of their own species.

CHAPTER XXXVIII.

A LINK IN THE CHAIN.—VITRINA.—COMMON SNAIL.—THE PRIZE.—WINTER COVERING.—MEDICINE AND FOOD.—SPECIES.—THE PET SNAIL.—ZONITES.

HELICIDÆ.

VITRINA, HELIX, ZONARIA.

Before speaking of those garden pests, commonly known as Snails, we must introduce a pretty little animal, which seems to come very naturally between them and the *Testacella* slug. While the true snails can withdraw their whole bodies within the "house" which they carry on their backs, and the *Testacella* carries only a single *tile* on the back of his foot, our little

Vitrina *pellucida* has a very simple, transparent, shining, glassy, greenish shell, capable of sheltering part of the body, when contracted, but not the whole. It has a flattened spire, of few whorls, and a large aperture, stretched in front so as to make the general shape rather oval. The animal is long

and slender, with two long and two short eye-bearing horns; it is of a bluish-grey tint, with two purplish lines running down the horns to the back of the neck. The shell is carried rather far back on the end of the foot, which, instead of gradually tapering, terminates suddenly in an oblique declivity.

HELIX.

The common Garden Snail, with a rather rounded, dull-coloured, banded shell, and with a greenish-grey, granulated body, which is generally, when taken, angrily thrown over the garden-wall, and which is so often deaf to the poetical invitations of the children "to come out of his hole," is called *Helix aspersa*, because its shell is aspersed, or sprinkled, with spots of white and black. Although the usual specimens of the shell have a very dull appearance, yet it sometimes occurs very pretty and bright; and the bands in the aperture, when the animal is removed, are often found to be of a very beautiful purple tint. The horns of the animal, too, when closely observed, are found to be exquisitely delicate, with a stream of colour seen through the transparency, and reaching the little spot which we call the eye. The author well remembers collecting specimens

of most remarkable beauty, when a boy, roving about the chalk hollows of Greenhithe. The ground-colour of the shells was light yellow, and the spots and bands clear and brilliant. But the great prize was a single specimen, with the whorls *reversed,* or turned in the opposite direction to the usual form. Although this happens not unfrequently with some other species, and even with *H. aspersa* in France, it is extremely rare in England. In fact, I believe this was the first authenticated instance of a British *reversed aspersa*. The first collector to whom it was shown was glad to give a high price for it, and many a long day was the same locality searched, and the same bushes beaten, but without success.

Those gardens which are enclosed by old walls and thick hedges are most liable to the mischief arising from the voracious habits of these molluscs. In these retreats, where they can find holes and crevices for retirement, they greatly abound. As soon as they feel the cold, they withdraw into winter-quarters, creeping into cracks and under stones, and clustering together, and sometimes clinging to each other. When a shell is taken out of one of these corners, the aperture is often found with a hard white covering, cemented to the edge and completely enclosing the animal. This

epiphragm differs from the operculum of other mollusca inasmuch as it is only temporary; it is secreted, when required, for the purpose of enabling the animal to pass the winter in his state of torpid security; and when the genial warmth of summer is felt, a mucus is put forth which dissolves the epiphragm at its edges, it falls off, and leaves the destroyer at liberty to walk forth in quest of green food.

It is well known that these snails are an article of commerce for food; that there are "snail gardens" on the Continent for their propagation; that they can be cooked so as to become great delicacies, and are particularly recommended as strengthening and nourishing food for persons suffering under pulmonary complaints. The eggs, which are buried underground, are round and transparent.

Helix pomatia has a much larger and more globose shell, much less oblique, than *H. aspersa*. It is of a pale fawn-colour, with light bands; it is wrinkled lengthwise, and particularly at the sutures. The shell is really a good handful, and the animal a good mouthful, to those who can get over the seeming unpleasantness and enjoy the luxury. It is pre-eminently called "the edible snail."

H. aperta has a greenish-brown shell, rather smaller than

H. aspersa, with a large open aperture, and small spire; it is wrinkled lengthwise; the animal is large and dusky.

H. arbustorum has the shell rather flattened, brown and marbled, with light oblique lines across the marbling; the lip is white and turned back. This species lives chiefly in woods, and in other damp and shady places.

H. Cantiana has a still more depressed shell, which is pale above, darker fawn below. It has a hollow, or umbilicus, behind the lip. When young it is hairy.

H. Carthusiana has the shell about half an inch wide, flat, whitish, with a pure white rib round the mouth.

H. nemoralis has the very pretty variously-banded shell so common in hedges, among the stinging nettles. It is thin and light, rather round, with the mouth oblique, the outer lip reflected and callous; frequently dark-brown, while the body of the shell is sometimes white or yellow, with or without clear brown or white bands. Some varieties are named *H. hortensis*, and a variety between this and the typical *nemoralis* has been called *hybrida*; the animal is of a greenish-yellow colour, banded on the head with brown.

The following account of a pet snail is from the 'Zoolo-

gical Journal,' and sorry I am to be obliged to record a tragical sequel to the story, for the poor little thing was killed by being accidentally thrown on the fire.

"In October or November, 1823, a full-grown individual of *Helix nemoralis* was found in a garden in Lambeth, closed up for the winter. In this state it was thrown about by children in a warm room for a month. Happening to be placed in a garden-pot, it felt the moisture, and soon walked about; but, finding no food, it attached itself to the plant, and returned to its torpid state. When disturbed and moistened, it was generally revived; but although lettuces, primrose leaves, and at least twenty other plants of various textures, were presented to it, it refused to eat, but after drinking, would return to its winter-quarters upon the edge of the pot or leaves of the plant. Each time it closed its aperture it was observed to form a weaker membrane. Fearing it would starve, a fresh supply of vegetables was presented to it, and whilst it was drinking it was closely watched, in the hope of seeing it eat also, when it was observed to lick up the minute portions of wool that had been deposited with the dust in a much-frequented room; this led to the idea of its being a carnivorous animal, and a wounded worm was offered to it, the dead portion of which

it immediately nibbled, but did not eat much; a portion of roast mutton appeared to be most palatable, for, after eating a small part, it retired and closed its shell as usual. In a week this now partly domesticated snail was again aroused from its torpor by water, and it fed heartily upon a portion of the mutton that had been allowed to dry, and was sodden with the water. This operation has been repeated at intervals of about a week, and the animal has evidently gained strength; if roused at shorter intervals it refused to eat.

"Should the carnivorous appetite of this species of *Helix* be verified by observations in the summer and open air, it will lead to important considerations respecting the food of the inhabitants, not only of recent but also of fossil shells; for we know of no difference between the structure of this animal and that of *H. aspersa* or *pomatia*, which undoubtedly feed upon leaves. It will also show the necessity of our becoming well acquainted with the habits of what are considered noxious animals, before we destroy them."

H. pisana has a flattish shell, with serrated linear bands of brown or grey. That of *H. virgata* is still flatter, and has the whorls narrower and an umbilicus behind them. This shell is banded generally with a row of little streaks in the middle, a large band at the upper, and several

smaller bands at the lower part of the whorls. It is found in great numbers in chalky districts, especially near the sea. That of *H. caperata* is flat and pale, wrinkled on the upper part of the whorls, which are slightly angular; it is interruptedly banded. *H. ericetorum* is wider than the preceding, with a wide umbilicus, and in shape almost like a *Planorbis*: this species is banded with brown.

H. obvoluta has a small brown shell, with a depressed, or even slightly hollow, spire; it has a deep umbilicus, and a tortuous, squarish lip. The animal is of a dusky colour. Not a very common species in Great Britain.

H. lapicida, fancifully named the "rock-cutting snail" by Linnæus.—Found in fissures of rocks and in woods. A peculiarly-shaped brown shell: it is like a lens, orbicular, convex on both sides, and sharp at the edge.

H. rufescens has the shell also lenticular and of a reddish colour, but not so angular as *H. lapicida*.

H. hispida, *H. revelata*, and *H. sericea* are small species, having hairy shells. The first is depressed and of a horny colour; the second is greenish, rounded; and the third is pale, with a squarish aperture.

H. aculeata, *H. lamellata*, and *H. fulva* are the names

given to three very minute *Helices*. The shell of the first is turreted, and has a keel of horny points round the whorls; that of the second is regularly ribbed; and that of the third is smooth, with a conical spire.

H. fusca has the shell transparent, brown, depressed, very slightly wrinkled, small; *H. rotundata* is very depressed, wrinkled, and with a large umbilicus; *H. pulchella* is a minute white snail, with a very white, umbilicated shell, with a nearly circular mouth, living under stones or in crevices in dampish places.

Two more minute species complete the list of this genus, namely, *H. umbilicata*, with the shell small, white, depressed, with a large umbilicus; and *H. pygmæa*, microscopic. It is of the *H. umbilicata* that Montagu observes:—"This shell always affects such lofty places as the tops of houses, without once being found near the base; and in that situation its inhabitant braves equally the scorching beams of the sun in summer and the frigid wind of winter, without attempting to descend."

ZONITES.

This genus consists of small snails, which differ from those of *Helix* proper in having thin, glassy, flattened shells,

with the edge of their aperture sharp and not reflected. The character of the teeth in the animal is also found to resemble that in *Vitrina* more than *Helix*.

The species are—*Z. cellarius:* white, with the head and neck violet; the shell about half an inch wide; pale amber; flat, with smooth, rounded whorls. *Z. alliarius*, with the shell much smaller and more convex. *Z. nitidulus:* larger, pale yellow above, opaque-white beneath, with large umbilicus. *Z. purus:* animal white, with two black lines; shell very small, depressed, white, smooth, and transparent. *Z. nitidus:* dark, with a transparent, glossy, minute shell. *Z. radiatulus:* black, with a depressed, shining, transparent shell, regularly ribbed. *Z. excavatus* is like it, but the shell not so much depressed; and *Z. crystallina* is very minute, white, with a flat, shining, smooth, transparent, greenish-white shell.

The most minute, and at first sight insignificant, of these various creeping things are endowed with beauties of detail which well repay attentive examination; and, while a thoughtless person would pass by a whole drawerful of their tiny shells, as containing a "parcel of snails, all alike," a more attentive observer would find something peculiar and interesting in each.

CHAPTER XXXIX.

OVAL SNAILS: BULIMUS.—PUPA.—BALEA.—CLAUSILIA, ITS SPRING DOOR.—ZUA.—AZECA.—ACHATINA.—AMPHIBIOUS SUCCINEA.

HELICIDÆ, OR SNAILS (CONTINUED).

BULIMUS.—The snails which are reckoned under this denomination resemble the *Helices* in every respect, excepting that their shells, instead of being rounded or orbicular, with short spire, have their spires produced, and consequently a long or oval form. Large and splendid as are some of the foreign shells of the genus, our English *Bulimi* are but three in number, and small in size. The shell of *B. acutus* is decidedly the prettiest; it is pyramidal, with very neatly-arranged dark markings. That of *B. Lackhanensis* is plain brown, rather tapering towards the apex, which is blunt. These two are about three-quarters of an inch in length, while *B. obscurus*, resembling the latter, is only half the size, with the mouth the smaller in proportion.

1 Mangelia septangularis. 2 Mangelia turricula. 3 Trichotropis borealis.
4 Murex erinaceus 5 Natica monilifera. 6 Purpura lapillus 7 Natica Alderi.

Pupa.—As is the case with most of the genera and species of mollusca, the name has reference to the shell, which is very much like the chrysalis of a butterfly, being cylindrical and pointed at the top. The shell is formed of many whorls, and the aperture has teeth or folds on its edge. The animals are shorter in proportion than those of snails, and their lower tentacles are very little, sometimes hardly at all developed. All our British species are small, and their distinctions minute; the number and form of the teeth in the aperture being important. Some of them are reversed or sinistral shells. The species are—*P. umbilicata*, the commonest species, found under stones, among lichens, near the sea, or inland, on high and low grounds, in every position; *P. muscorum*, *P. Anglica*, *P. secale*, *P. edentula*, without any teeth in the aperture; *P. minutissima* and *P. pygmæa*, both very minute; *P. substriata*, having six teeth; *P. antivertigo*, with quite a labyrinth of them; *P. pusilla*, reversed, with six to eight teeth; and *P. Venetzii*, also reversed.

Balea *fragilis* has a small, dull-coloured, many-whorled, pyramidal shell, and in the character of the soft parts resembles *Bulimus*.

Clausilia.—The shells of *Clausiliæ* are long and narrow,

with very short apertures, and very long many-whorled spires; they are something like lengthened *Bulimi,* but reversed. Some land-snails, as *Cyclostoma,* have an operculum; others, as *Helix,* make an epiphragm: the former being constant and carried on the back of the foot outside, when the animal is exserted; the latter being made when wanted, and then thrown away. Far more elegant and finished is the contrivance with which the little *Clausilia* is furnished, to protect itself when at rest, from the intrusion, through its narrow and contracted aperture, of outward foes. The outer entrance of the shell being contracted and complicated by folds round the aperture, an operculum would not conveniently accommodate itself to the opening; so the *Clausilia,* retiring far within its shell, secures its retreat by a little door, which lies within a groove till the animal has passed it, when it springs back on its hinge and covers him. This door, or *clausium,* is a delicate little twisted plate, attached to the inner wall, or columella, of the shell by means of an elastic pedicle, or hinge. When the animal wishes to move out, it pushes the clausium back into a groove, where it remains until again freed by the re-entrance of the animal. It is, in fact, a spring-door, most exquisitely made and beautifully finished, with the elastic spring always in good repair.

This admirable contrivance may be observed by procuring a living specimen; killing the animal when exserted, which may be done by drowning it; removing it, and then breaking off the outer part of the aperture. The clausium may then be seen, and the elasticity of the spring may be renewed by moisture. The British species are *C. laminata, C. biplicata, C. plicatula, C. nigricans, C. bidens,* and *C. labiata.*

Zua *lubrica* is like a small *Bulimus,* with a rather short, lead-coloured body, with a very polished shell. It lives among moss, in woody districts.

Azeka *tridens.*—The teeth or folds in the aperture of the shell distinguish this little species generically from *Zua.*

Achatina *acicula* is a little white *Bulimus*-like animal, with a simple white shell; the latter differs from those of *Bulimi* in having a little notch abruptly terminating the inner lip.

Succinea *putris* and *oblonga.*—The first of these is commonly known as *S. amphibia,* from its habit of frequenting river-sides and other damp places. The upper pair of tentacles is thick and swollen; the foot very large; the shell is oval, with an oblique, large aperture, and of that transpa-

rent *amber* colour which gives to the genus its name. The common size is little more than half an inch. *S. oblonga* lives near the sea-side, as well as inland, burying itself in sand in winter. Its shell is smaller than that of *S. putris*, and has the spire more produced, and the whorls more rounded.

CHAPTER XL.

AIR AND WATER.—LIMNÆUS, SPIRAL.—PLANORBIS, DISCOIDAL.—ANCYLUS, PATELLIFORM.

LIMNÆIDÆ, OR FRESH-WATER SNAILS.

ALTHOUGH the mollusca of this family live chiefly in the water, they belong to the order of Pulmoniferous Gasteropods; because, like the land-snails, they breathe air, and are furnished with a pulmonary cavity instead of gills. They swarm in ditches, ponds, and lakes; sometimes in running water, sometimes in stagnant pools. They may be seen crawling among the mud and stones at the bottom of the water, or clinging to the weeds growing at the sides, creeping on the under surface of water-lily leaves, or, with the shell hanging downwards and the flat of the foot upwards, gliding along the surface of the water. They have short muzzles, and two large, sometimes triangular, tentacles, with eyes at their bases. They lay their eggs in gelatinous

masses, attached to water-plants. Although so much like each other in general character and habits, the *Limnæidæ* differ extremely in the form of their shells. These are all of a light horny substance, but present three distinct characters: *Physa* and *Limnæus* have spiral, oval shells, more or less like *Bulimus; Planorbis* has the spire compressed so as to form a flat disc; and *Ancylus* has a non-spiral, open shell, like a limpet.

Limnæus.—The shells are light, inflated, with a wide aperture and small spire; a twisted columella, and no operculum. The animals have broad heads, with a pair of triangular tentacles.

The *Limnæus* is often found with the epidermis removed near the spire and the shell corroded. Among the various means of accounting for this, one has actually been resorted to of accusing these animals of eating each other, commencing by nibbling through the spire! It has also been observed, that if the water-snails are accidentally left dry they will assume the habit of land-snails, thicken the outer lip of the shell, and make an epiphragm. Of the British species, the shell of

L. palustris is dark-coloured and rather oval, although pointed; that of

L. stagnalis is light, has the last whorl and the aperture much inflated, and the spire elegantly tapering. These are rather large shells, but the shell of

L. glaber is small, light-coloured, and cylindrical; the aperture only about half as long as the spire, thus differing from *L. truncatulus*, which is oval, with the aperture and spire about equal.

L. pereger has an oval shell, averaging half an inch in length, having a small spire, with the body-whorl suddenly inflated, and the aperture oval and large, but the different varieties of this species are very puzzling.

L. Auricularia has a rather larger shell with pointed spire, and the last whorl so inflated as to make the breadth almost equal to the length; the columellar lip is much twisted.

L. Burnettii has the spire of its oval shell almost sunk, while that of *L. involutus* is depressed lower than the outer edge of the last whorl.

L. glutinosus has a light and thin shell, shaped like *L. Burnettii*, but with an exserted spire.

Physa *hypnorum* and *fontinalis*.—The horns of these water-snails are long, not triangular, as in *Limnæus*, and the shells are reversed; they are shaped like those of *Lim-*

næus. That of *P. hypnorum* is oblong and conical; while that of *P. fontinalis* is oval, with a large aperture.

Planorbis.—The tentacula of this genus are subulate; the head stout and broad; the foot short and truncated. The shells are coiled up, so as to form flattened discs; they have been likened to Ammonites, commonly called "petrified snakes."

P. corneus: the shell, which, like the greater part of the species, is horny in texture and colour, is the thickest species, having the whorls few, deep, and squarish; it sometimes occurs nearly an inch in diameter and half an inch in the depth of the whorls. The animal is black, and gives out a purple fluid when irritated.

P. albus has a very small white shell, the spire of which, although flat, is not sunk; the aperture is wide and oblique; surface microscopically striated. *P. glaber* has the shell somewhat similarly shaped and smooth.

P. nautileus has sharp, oblique ridges on the whorls of its very minute, white shell.

P. carinatus and *P. marginatus* have very flat shells, with a keel round the circumference of the disc, which is about two-thirds of an inch in diameter. The former is more polished and more depressed than the latter species.

The upper disc in the many-whorled shell of *P. vortex* is deeply concave; while in *P. spirorbis*, a very similar species, both discs are concave. The whorls of *P. contortus* are very closely coiled, and the aperture is semilunar.

P. nitidus and *P. lacustris* have small, highly-polished shells, with angular whorls nearly overwrapping each other. The latter species has internal laminæ, represented externally by dark lines.

ANCYLUS, or *Fresh-water Limpet*.—This little animal, like the *Limnæus*, has triangular tentacles. The shell is like a limpet, having no spire, but the apex a little turned on one side: in *A. fluviatilis* it is turned to the right, and in *A. oblongus*, which is long and narrow, it turns in the opposite direction.

It is truly wonderful to observe the opulence of nature, and to notice in the different shells of these very similar animals, *Planorbis*, *Limnæus*, and *Ancylus*, in what different ways the same end may be answered.

CHAPTER XLI.

CONOVULUS.—CARYCHIUM.—CYCLOSTOMA.—ACME.

AURICULIDÆ AND CYCLOSTOMIDÆ.

THE *Auriculidæ* are air-breathing molluscs, with volute-shaped shells, which frequent marshy places or sea-beaches, within reach of the salt spray.

CONOVULUS has an oval or rather conical shell, with small spire, and the aperture toothed. It has triangular tentacula, with eyes at their bases.

C. bidentatus is white, with the crawling disc of the foot divided across the middle. This makes the method of crawling very peculiar. The front part, with the head and neck, moves forwards, and, taking its hold, waits in a fixed position until the other part comes up to it with the shell; then another advance of the front, and so on; making the march tedious. The shell is white, and has two folds on the pillar.

C. denticulatus is yellowish, with a yellowish-brown shell.

CARYCHIUM *minimum* is a very minute animal, with a white, thick-lipped shell.

The *Cyclostomidæ* are land-snails, with an operculum.

CYCLOSTOMA *elegans* has a pretty, spirally-striated, oval shell, with rounded whorls, and a flat, shelly, few-whorled operculum. The animal has a thick and long snout, at the back of which are placed rather stout, subulate tentacles, with eyes at their bases. The foot is oblong, with a central division lengthwise, the sides being alternately contracted when walking.

ACME *lineata:* animal with long thin horns, with eyes at their bases, and a turreted pupæform shell, with blunt apex and a horny operculum.

Although the British species of these two families are few and small, they are the representatives of a numerous, fine, and interesting series of mollusca in other parts of the world.

CHAPTER XLII.

LAST, NOT LEAST.—ARMS ROUND THE HEAD.—ANCIENT AMMONITES.—OCTOPUS IN AMBUSH.—ELEDONE.—CHANGING TINTS.—SEPIOLA.—HABITS IN CONFINEMENT.—ROGIA.—LOLIGO AND ITS PEN.—OMASTREPHES.—SEPIA.—CONCLUSION.

CEPHALOPODA, OR CUTTLE FISH.

FROM the superior organization of these mollusca, they are considered as standing at the head of the class. Their bodies are sack-shaped; the head is developed at the end of the sack: it is furnished with large eyes, and surrounded at the top by arms, with which the creatures seize their prey and convey it to their mouths. The mouth is situated in the centre of the circle of arms, and is furnished with a pair of horny jaws, not unlike the beak of a parrot. The name of *Cephalopoda*, or *limb-headed*, is not inappropriate, for these limbs round the head are locomotive as well as prehensile organs.

Those ancient cuttle-fish, the *Ammonites*, were provided

with beautiful flat-spired shells, but that race of magnificent molluscs is now extinct.

All the cuttle-fish inhabit the sea, but comparatively few are found near our coasts. Those few are arranged in the following order:—

Family OCTOPODIDÆ.

Octopus.—The *O. vulgaris* lives among rocks, hidden in crevices, watching for prey. When it observes a little animal approaching, it puts forth its long arms to seize it. The arms are eight in number, and are provided with prehensile suckers, which make it extremely difficult for any unfortunate creature, once encircled in the Octopodian embrace, to escape. It will sometimes, when not provided with a natural hiding-place, heap around itself a pyramid of pebbles, from which it can make its observations without being seen. The eyes are supplied with eyelids. This species is without any shell or pen.

Eledone *cirrhosus* has an oval body, is smaller than *Octopus vulgaris*, not exceeding four or five inches in length. Like most of the species of the order, this animal changes its colour and appearance according to the sensations of the moment.

Family TEUTHIDÆ.

These have *ten* arms round their head, two of them longer than the other, with pediculated suckers. They have movable eyes, an internal bone or pen, and fin-like flaps on their bodies.

Sepiola *Atlantica* and *Rondeletii*.—These beautiful, active little animals are thus described:—"The *Sepiola*, the minutest of the naked *Cephalopoda*, possess a structure as complex and elaborate as that of the largest *Octopus* or *Loligo*. By the length of its cephalic arms, and their numerous large pedunculated suckers, it compensates for the want of developed suckers on its long tentacula. By the great development of its *ink*-gland, and the magnitude of its organs of vision, it compensates for the want of more solid means of protection. The rounded form of its body required the dorsal lamina to be shortened, which would have impeded the motions of the mantle, had it extended, as in the *Loligo*, to its extremity. The great muscular strength of its dorsal fins, and the mobility of their scapulæ, give rapid and varied motion to this delicate and defenceless animal; and they constitute the most perfectly developed arms of this class."

Mr. Alder says of *S. Atlantica* :—"This is an odd fish, crouching generally at the bottom (of the tumbler of water) like a toad, with its great goggle-eyes half closed, and sometimes crawling along by means of its suckers, puffing the water through the funnel all the time. When it does take to swimming, it darts very quickly through the water, and is difficult to catch. When taken out of the water and placed on the hand, it had recourse to an odd mode of progression, turning two or three summersets in regular tumbler fashion; first laying hold with its arms, turning over and laying hold again, until it managed to get back into the water."

Rossia *macrosoma* and *Owenii*.—An interesting account is given of the manner in which cuttle-fish of this genus change their colour, by Dr. Ball. Speaking of a specimen which he had alive, he says : "It was very active and watchful; on passing the hand between it and the light, the changes of colour were as quick as thought. When lying quietly at the bottom of the basin it was sometimes almost white; but on passing my hand over it, it instantly became of a bright liver-red. . . . It displayed various degrees of this colour, occasionally varied with blotches of white. Its variations of colour were rapid beyond comparison with the chamæleons."

Loligo, or the *Quid Cuttle-fish,* has broad fins at the end of a cylinder-shaped body; it has a long internal pen, and produces a jet-black liquid, commonly called ink.

L. vulgaris is about a foot and a half in length. It has eight short thick arms, and two long tentacular arms, which are spread at the end, and lined with suckers; its fins are long.

L. media and *L. marmoræ* have a narrow spotted body, with short fins, tapering off before reaching the pointed extremity of the body. The animals are about three inches long.

Omastrephes *sagittatus, O. Todarus,* and *O. Eblanæ* very much resemble species of the genus *Loligo,* but the fins make a semicircular termination to the body. They are called *Flying Squids* by fishermen.

Family SEPIADÆ.

Sepia.—As only the internal bone of *Sepia biserialis* has yet been found, *S. officinalis* is the only remaining cuttle-fish of the British seas which we shall have to speak of. And it is one with which we are familiar, not indeed from any general knowledge of the animals of this class, but simply from the internal skeleton of soft bone, so often sold in our

Europæa Cypræa . 2 Fusus Bermiciensis 3 Fry of Fusus Tortoni 4 Egg-bag of the same.
5. Bulla Lignaria .

shops and placed between the bars of our bird-cages. Although the animal is common, and the bone often thrown upon our shores, it is not very often seen alive.

When it can be seen however, it is well worth looking at. The body is wide and flat, with narrow fins bordering its whole length; it is marked with beautiful, zebra-like cross stripes of white on a bright ground, arranged in a beautiful pattern; the tentacular arms are of great length, measuring a foot and a half, while the whole length of the animal without them does not exceed nine inches. The internal bone is too well known to need description: it is oval, thick, and white, with a dorsal beak at one end; the centre is sulcated by the edges of successive layers. From its peculiar substance it has been made useful as pounce, and it is considered good for cage-birds to peck at.

Restlessly active and voracious are all the Cuttle-fish, great and small, beautiful or hideous, naked or covered; whether the *Nautilus* with a true shell, or the *Argonaut* with a shelly ovarium; the *Sepia* with an internal bone, or the *Octopus* without one. Their means of aggressive warfare are truly formidable; and the black fluid, which they have the power of discharging, serves as an admirable defence, by hiding them from pursuit in a watery cloud.

Having thus together contemplated this interesting class of animals, as developed in and around our own beloved island, and observed their characters and habits as far as we could, without making a very abstruse study of what may well be regarded as an intellectual recreation, we must here pause and reflect on the effect produced on our minds by so many proofs of Divine wisdom, and ask each other,

> "Which of us
> So superficially surveys these things
> As not to mind from whence they grow?"

CHAPTER XLIII.

[This Chapter, accidentally omitted in the printing, should appear between Chapters V. and VI.]

TUBE-MAKERS.—THEIR CHARACTERS AND HABITS.—THE 'WATERING-POT.' —GASTROCHÆNA.—SAXICAVA.—PETRICOLA.—VENERUPIS.

GASTROCHÆNIDÆ.

The British mollusca included by Professor Forbes under this appellation are all, like the *Pholades*, borers: they all make their dwellings in the rocks. In their case, however, there is no probability of the shell being used as a rasp, for its outer surface is smooth in every species. In the general oblong form of animal and shell the *Gastrochænidæ* resemble the *Pholades*, and, like the latter, have a double siphon at the upper or hinder end; the tongue is not round and sucker-like, but sharp, curved, and pointed, and it is protruded through a small hole in the mantle, which is otherwise entire. In all the shells of this family the valves are

united by a true ligament, and most of them gape widely in front. Some of the genera of this family, as now constituted by Professor Forbes, enclose their bodies and shells in a supplementary, tubular, shelly cavity, and compose the Lamarckian genus *Tubicolæ;* and it certainly seems to me more reasonable, with Lamarck, to separate the genera *Saxicava, Petricola,* and *Venerupis,* from the tube-forming *Gastrochæna, Fistulana, Aspergillum,* and *Clavagella,* than to unite them as the English professor has done.

GASTROCHÆNA.

This is interesting as the only British representative of the Lamarckian *Tubicolæ,* and as presenting an instance of the desire exhibited by so many species of boring molluscs to protect themselves by *lining their holes.* We have already seen this in the case of the *Teredo* and some of the *Pholades;* and now we come to the *tube-makers,* we find an extension of the same principle. In the well-known *Aspergillum,* in which the tube forms the principal object, we have an instance of the valves of the shell taking a rudimentary character and forming a part of the tube. This tube is formed by the edges of the valves expanding and spreading laterally and perpendicularly until they become a

circular pipe, terminating at one end in a fringe and at the other in a perforated disc, nearly resembling the rose of a watering-pot. In the *Clavagella* one valve is loose in the tube, and the other forms part of it; while in *Fistulana*, as well as in our British genus, both valves are loose within the tube.

M. Deshayes has entered into a very interesting inquiry as to how the tube becomes enlarged, so as to correspond with the increasing size of the animal; and how the valves, in the case of *Clavagella* and *Aspergillum*, become a part of the wall-lining. That accurate naturalist endeavours to explain this, by supposing the animal to dissolve and reconstruct successively the parts of the tube, to meet its altered requirements. He believes the animal to secrete an acid for the purpose of dissolving parts of the tube at pleasure, and thus accounts for the disappearance of that part of it which is now occupied by the fixed valves. With the latter part of the supposition, our only genus of *Tubicolæ* has nothing to do; but as to the enlargement of the tube, I may venture to remark, that the same principle appears to be carried out with regard to the *Tubicolæ* as with regard to the *Teredo* and the tube-making *Pholades*. In a young state, and during the period of growth and the labour of ex-

cavation, the animal is content with the two simple, open, and in some cases rudimentary, valves of the shell; and that the tube, whether formed independently or from the expanded edges of the valves, is not formed until maturity and completed labour call for repose. Then, like a retired man of business, the mollusc walls in his enclosures, to keep out the agitating currents, and make himself secure and comfortable for the rest of his days. The British genera included in Professor Forbes' family of *Gastrochænidæ* are—

I. Gastrochæna.—The body is of an oblong square, rather broadest in the lower end or front, and at the hinder or upper end extended into a long double tube. The canals forming this double tube are one for drawing in, and the other for throwing out, the alimentary matter. The openings are both surrounded by hairs, which no doubt serve by their motion to bring nutritious substances within reach. In the front part of the animal there is a small slit in the mantle, through which passes a small, curved, sharp foot, or tongue, very unlike the broad sucker-like foot of the *Pholas*. The valves of the shell are oblique, white, with a large pear-shaped opening. They are united at the back by a true *ligament*. The animal, with its valves, is enclosed in a bottle-shaped case, the small end of which generally

protrudes, and the bulb-like part generally forms the inner lining of a cavity, but is sometimes free. In the latter case the *Gastrochæna* is found among madrepores and broken shells, and the tubes are partially composed of the same, cemented together. "The inside," says Mr. Jukes in the 'Magazine of Natural History,' "is smooth, and consists of thin layers of the calcareous secretion applied by the animal in the formation of its chamber, which somewhat resembles a powder-flask; the lengthened neck through which the animal passes the double tube, is formed of concentric layers of the same substance, preserving to a certain depth the same figure as at the summit." The only British species is *G. Modiolina*.

Torbay on the English coast, and Birterbuy Bay in Connemara, are stated to be among the most populous of its habitats. "From the former," say the authors of 'British Mollusca,' "we have taken masses of limestone well honeycombed by its excavations." It is also found at Exmouth and Weymouth. The other genera associated with the above are—

II. Saxicava, the animal of which greatly resembles that of *Gastrochæna*, but which never forms any supplementary tube; and does not always excavate, being some-

times free. It is however generally fond of retirement; if it can find a rock soft enough to be easily pierced, it does so; and if it can find a crevice or hole in harder rock, it creeps into it, and adapts its growth to the shape of the cell. The British species are *S. arctica*, the shell of which is generally spinose; and *S. rugosa*, which is rough and irregular, but without the spines.

From the very variable forms assumed by both the above species, they have received many generic and specific names. But these variations may be considered as the result of a very enviable power possessed by the animal, namely, that of adapting itself to its position and circumstances.

III. Petricola is a rather similar mollusc to the last, but has the siphons much more divided, and the shell has teeth on the hinge. The genus is represented in Great Britain by *P. lithophaga*.

IV. Venerupis.—Shell more *Venus*-like, and animal very similar. Represented among British molluscs by *V. Irus* (Plate IV. fig. 2).

These two last appear to be much more nearly allied to the *Venus* tribe than to *Gastrochæna*.

CHAPTER XLIV.

WORDS! WORDS! NOTHING BUT WORDS!

Supposing the reader to have received from the preceding chapters some general idea of British Mollusca,—their nature and habits, how they live and where they wander,—and to have had awakened within him an interest in the subject, he will naturally desire to know by what means a further acquaintance may be made with them. He may perhaps be disposed to obtain a more particular knowledge of their natural characters and of their artificial classification. For this purpose, it will be necessary to consult books of more extensive information and of higher scientific pretension than this. In such books however the inquirer will meet with difficulties for which he was not prepared. In the present work, thus far, the writer has endeavoured to convey an impression of the subjects, by means of language such as would be used in describing familiar things in every-day

conversation. But in scientific works it is usually judged more correct to use terms of strictly technical application.

The purpose of this chapter is to enable the uninitiated to understand some of the technicalities referred to. Thus, it will be seen, a different plan is here pursued from that which generally obtains. For, in most books of an elementary character, it is usual to *begin* with the A, B, C, or with such phrases as "Grammar is the art of," etc., or "The science of Conchology teaches," etc. But in this work it has been my endeavour to avoid all these technicalities in the outset as much as possible, so as not to weary the reader before he is sufficiently interested in the subject to wish for their acquaintance.

The details to which the reader is now to be introduced however will apply particularly to the conchological part of the science. We have been speaking of mollusca as animals, each one as to its habits, its shape, its appendages, testaceous or otherwise; we are now to consider the shell alone, and to inquire, "How is the shell of any particular mollusc described and distinguished from that of any other?"

THE SHELL OF A TRUE MOLLUSC

Must be distinguished from three other kinds of *tests* pos-

sessed by marine animals. The first of these belong to the class *Crustacea*, consisting of crabs, lobsters, etc. These differ from true molluscs, not only in the composition and structure of their tests, but also in having jointed limbs; each limb being invested by a portion of the test as by a sheath. The second belong to the class containing the *Echinus*, or Sea-urchin, of which genera and species abound in many seas. The testaceous covering of *Echini* is composed of a number of small pieces, placed edge to edge, composing an outer covering to the fleshy part of the animal, which is supported within by a pyramidal arrangement of bones. This test is fibrous in texture, and guarded on the outside with movable spines, which turn on ball-and-socket joints. The third class of tests to be distinguished from true molluscan shells is that of the *Cirripedes*. The shelly pieces belonging to those interesting marine animals resemble true shells in many respects, but bear a different relation to the other parts of the animals, which, in their true characters, are so nearly connected with the *Crustacea*, that they do not enter into the science of Molluscology.

A true molluscan shell is composed of one or more pieces; each piece being formed by a series of layers lying obliquely upon each other, in such a manner that each new layer

begins within, and terminates a little in advance of, the one before it.

A shell consisting of one piece is called a *Univalve;* as a snail or a periwinkle.

A shell composed of two pieces opposed to each other, is called a *Bivalve;* as a mussel or an oyster.

A shell made up of several pieces in a series is called a *Multivalve.* Now that the *Cirripedes* are no longer included in the class of mollusca, the only *Multivalve* is the *Chiton.*

These definitions must not however be understood in their strictest sense, or without qualification. For, while a *Univalve* is said to consist of a single piece, it must be remembered that, in many cases, the opening of the hollow in that piece is enclosed by a movable door, which, fixed on the foot of the animal, is brought in upon it when a condition of rest is assumed. This is the *operculum,* which is quite accessory to the principal shell, and does not, like the opposite valve of a bivalve, turn upon it by a hinge. Similar observations may be made respecting some bivalves.

The *Pholas,* for instance, besides the pair of valves composing the main shell, has, in many instances, one or more separate smaller pieces named *accessory plates,* which are

shown in the illustrations. They are fixed, by means of cartilages, on the back of the hinge.

The class of shells named *Tubicolæ*, by De Blainville, are bivalves attached to, or lying within, a shelly tube or pipe; and in the case of the *Aspergillum*, or watering-pot, the nuclei of the two valves are soldered into the tube so as to form a part of it. This last however is not a British example. The *Anomia* has a bony button, which, fixed to the external object of attachment, passes through an opening in the lowest of the true valves; and many bivalves have little bony appendages placed within, upon their hinges.

STRUCTURE AND GROWTH.

Let us take a Univalve shell, or one valve of a Bivalve, and examine the manner in which the growth proceeds from the nucleus. The *nucleus*, or pair of nuclei, as the case may be, is the first formed part, and is generally present with the young animal in the egg, or within the body of the parent. It is of a more horny and transparent substance than the after-growth, and generally so different in shape as to give very little idea of what it is afterwards to become. It may be considered as the top, or *apex*, of a sometimes straight or curved, but generally *spiral*, cone.

In measurement and description it is called the *apex*. When the animal is hatched, or leaves the egg or body of the parent, it begins to enlarge its shell so as to correspond with the increasing size of the body. This is done by a mucous substance secreted within the mantle of the animal, and deposited obliquely on the edge of the opening. This is lined within by another secretion, the two forming a new layer: one layer follows another till the whole is complete. The last-formed layer forms the edge of the opening into the hollow, and in the case of univalve shells this opening is called the *aperture*.

On the outside, the edges of the successive layers will nearly always remain visible, being indicated by concentric lines, or striæ, called *lines of growth*. In some species the layers are irregularly terminated, their edges overlapping each other in such a manner that they may be easily separated, and give a leafy appearance to the surface. This *foliated* structure is seen in the common oyster.

THE EPIDERMIS

Is an outer covering, formed by a series of horny layers on the edges of the shelly ones. The French name is "drap marin," and it is sometimes more learnedly spoken of as the

periostraca. It is sometimes very thin and smooth, and sometimes thick and rough, but in every case it affords an admirable protection to the shell.

CHARACTERS OF SHELLS.

Regarding each piece or valve of a shell as a *cone*, thus for technical purposes adopting the word in its utmost latitude of signification, as applied to any structure commencing at a point and increasing downwards, or even almost in a plane outwards, we shall see that the main character of the shell will depend upon the direction and rate of increase in which the growth takes place.

In the great majority of univalve shells the increase takes place obliquely; that is, each layer is wider, or more advanced, on one side than on the other, and the result is that the cone becomes spiral, and the shell comes under the denomination of

SPIRAL UNIVALVES.

These, in which the cone in its course from the apex becomes twisted round an imaginary axis, are susceptible of great variations in the closeness, the obliquity, and the rate of increase in the different coils into which the spiral part is twisted. These coils are called *whorls*. The inner side,

where the whorls meet and sometimes form a pillar, is named the *columella,* or *columellar* lip. The *aperture* is the opening or entrance to the hollow part of the cone, into which the animal retreats. Its edge, as a whole, is called the *peritreme.* The outer side, or that which is furthest from the axis, is called the *outer lip:* the inner, or the one which either forms or is contiguous to the axis, is called the *inner,* or columellar lip.

THE SPIRE,

Composed of the volutions above the aperture, is described, as a whole, as being long or short, in proportion to the aperture; as consisting of few or numerous volutions; as *tapering, conical,* or *ventricose.* Its *apex,* or nucleus, is *obtuse* or blunt, *acute* or sharp. In some species of land-shells it falls off after the shell is fully formed; it is then said to be *deciduous.* In *Planorbis* and some other shells, instead of being produced into a pyramid or dome, it is depressed and even concave: when shaped like a teat or nipple it is *papillary,* and when more rounded it is *mamillated.*

THE WHORLS

Of the spire are described as more or less rapidly enlarged;

7a

Jewett, del. et lith. Vincent Brooks Imp.

1.Doris planata 2 Achatina acicula . 3.Testacella haliotidea .
4 Helix pomatia 5 Cyclostoma elegans .6 Succinea putris .
7.Aplysia hybrida .

more or less oblique; and flattened, or rounded, or angular, at the sides. When rounded out, they are said to be *inflated* or *ventricose*.

THE SUTURE,

Or seam, which, in the spire, distinguishes one whorl from another, is described as more or less distinct; sometimes marked by a groove, or *canaliculated*, and sometimes hidden by an after-deposit of enamel. It is even in some cases, instead of being marked by a depressed line, raised by the enamel into a swelling or ridge.

VARICES.

In the course of the shell's growth, it sometimes happens that a check takes place; the increase onwards is for a time suspended; and the secretion, accumulating round the last-formed layer, becomes a raised ridge, the edge of what is then the aperture. After this is formed, the growth proceeds in a regular way, till another stoppage occurs, another ridge is formed, and so on till the shell is fully formed; and the last ridge is the peritreme of the permanent aperture. These successive ridges remain prominent outside the whorls of the spire, and are named *varices*. They occur

at various intervals: in some species regular, in others irregular. In *Triton* they are rather irregular, occurring at various parts of the whorls; in *Murex* they are so regular as to form uninterrupted ridges up the spire, by occurring in the same position in each successive whorl: they are then described as *continuous*. In *Harpa* and *Scalaria* they are beautifully regular and smooth; in *Murex* they are sometimes variously and beautifully fringed, or branched, or spinous.

RIDGES AND STRIÆ.

All striæ, or ridges, or furrows, or wrinkles, in the same direction as the lines of growth or the varices, are described as *longitudinal* or *concentric:* all in the other direction, or following the turns of the spire, are *spiral*.

THE APERTURE,

Or opening of the spiral hollow, is sometimes named the mouth; but this is hardly suitable, because there would then be the mouth of the shell and the mouth of the animal, and, in describing the mollusc, great confusion might arise between the two. The aperture is described as a whole, including the columella, the outer lip, and any canals into

which it may be formed at the upper or lower parts. As to its general shape, it is sometimes, as in *Cyclostoma* and *Scalaria*, circular or nearly so; sometimes, as in *Neritina*, where the inner edge is nearly straight, it is *semilunar*, the outer edge taking the form of a half-circle. In many instances, being narrowed towards the upper and widened at the lower extremity, it becomes *pyriform*. In *Cypræa* it is *linear*, making a groove or line along the shell: this is owing to the thickening and inflection of the edges when fully developed. In *Trochus* it is *trigonal*, or three-sided; and in some instances it is obliquely, *longitudinally*, or *transversely* oval,—longitudinal being in the direction of the axis, and transverse the opposite.

The *edge*, or *peritreme*, of the aperture is *entire* when it is continuous without interruption all round; but in the greater number of cases it is interrupted on the inner side by the last whorl, and in some cases by notches in the outer lip, and in others by lower or upper canals.

The *canals* of the aperture are formed by the contraction of the upper part of the outer lip against the last whorl, in such a manner as to leave a groove between; or by the prolongation of the hollow tube at the lower end. The lower canal is sometimes described as the "caudal canal." It is

sometimes *recurved,* or turned back over the body of the shell; and sometimes it is *varicose,* forming a spiral ridge or tumidity. In some of the *Murices* it is *closed* by the meeting of the edges, excepting at the very extremity; in other cases it is simple and open.

The *inner* or *columellar lip* of the aperture commences when it joins the last or body-whorl, and is generally separated at the lower end from the outer lip by the notch or canal found in most species. The outer lip is measured from where it joins the body-whorl above, to where it joins the inner lip below.

It may be remarked, that I am now using the words *above* and *below, upper* and *lower,* because the shells are being considered mathematically rather than naturally. For in crawling, the head of the mollusc is projected from near the lower part of the aperture, and the point or apex of the shell would lie backwards; so that some writers describe the part of the aperture nearest the spire as *posterior,* and that nearest where the head of the animal protrudes as *anterior.* It is thus indeed that I have represented some of the mollusca in the former part of this work. The outer lip, sometimes named the right lip, or *labrum,* by continental writers, is sometimes *reflected,* or turned outwards, and sometimes

inflected, or turned inwards. Some outer lips are *denticulated*, or studded with small teeth; some *dentated*, when the teeth are larger. Some are expanded into flattened lobes, or *alated;* others drawn out into long lobes, when they are said to be *digitated*.

The *columella*, or *columellar lip*, in some instances lies upon, and is lost, as it were, in the last whorl; in other instances it is free and independent, standing out in a complete ridge separate from the body of the shell. The lower part of it is perhaps more properly named the *columella* when it forms a solid axis on which the shell turns. Many of the columellæ are ornamented by oblique or transverse folds: these are remarkably elegant in the species of *Melo* and *Cymba:* in *Turbinella* they are more horizontal.

There are cases in which there is a hollow, or *umbilicus*, behind the inner lip; and some where this hollow is continued up to the very apex of the shell. The usual means of expressing this is to say, "axis perforated."

THE OPERCULUM,

As before observed, is a kind of accessory valve, or door, used by the animal in closing the aperture of his shell, after snugly ensconcing himself in his quarters. It is formed of

successive layers in the same manner as the shell, and must not be confounded with the *epiphragm*, which is secreted by snails as a winter covering. Opercula differ from each other: first, in their composition, some being *testaceous*, or formed of shelly matter; others being *corneous*, or of a horny substance: secondly, in their growth: some are *spiral*, being formed of many flat whorls, others of few whorls; some are *concentric*, having the lines of growth in successive rings round the central nucleus; in others the nucleus is lateral, and again in others terminal.

SYMMETRICAL UNIVALVES.

In *Patella*, *Dentalium*, and some similar univalves, the cone is quite simple, not spiral, but only slightly curved from front to back, not from side to side. They are therefore *conical*, simple and symmetrical. The *Dentalium*, we may observe in passing, will help to illustrate the formation of an ordinary spiral univalve. For, if we suppose the slightly-curved tube soft and pliable in our hands, we could begin at the smaller end, and coil it round in whorls like a corkscrew, till it became a spiral shell or twisted cone. Nor does it appear to be very essential with respect to the nature of the mollusc, whether his shell be straight or

twisted. The very young *Dentalia* and some limpets are spirally twisted. The *Vermetus* commences with a spiral shell resembling *Turritella*, which after few whorls grows out into an irregular *Serpula*-like tube.

SYMMETRICAL CONVOLUTE UNIVALVES.

No shell is perfectly symmetrical, but some have their successive volutions coiled up so nearly on one plane as to appear so. In this manner the *Nautilus*, and the *Spirula*, and the ancient *Ammonites*, have every appearance of being symmetrical.

All of these are *chambered* shells; but among the *Testacea* of Great Britain there are few examples of this peculiarity. The *Cæcum*, when the mature shell is formed, builds a wall in the cavity behind its body, leaving the hollow of the spiral nucleus empty, so that it falls off. On cutting through a *Turritella*, septa may be seen across the cavity of the upper whorls, dividing it into several chambers. The tube of one species of *Teredo* is also chambered.

BIVALVE SHELLS,

Consisting of two principal pieces united to and turning upon each other by means of a hinge. In describing, the

two valves are spoken of as the shell, and each of the pieces is named a *valve*. The formation of each valve is the same as that of the one piece of which a univalve consists. From the nucleus the growth is effected by concentric rings, which, being placed very obliquely and inequilaterally, produce only a single curve instead of a spire, and the whole width of the valve constitutes its aperture. This is the manner in which we should describe it if comparing it to a univalve. But in order to view the bivalve correctly, as in itself, we must suppose it in the position of creeping away before us. The part of the shell at the greatest distance would be the anterior side; that nearest to us, the posterior; the valve on our right hand would be the *right valve;* and that on our left, the *left valve*. The edge on which the hinge is placed is the *dorsal margin;* and the opposite edge from which the foot protrudes is the *ventral margin*.

MEASUREMENTS.

In measuring the proportions of the shell, the *length* will be reckoned from the anterior to the posterior ends; the *breadth* from the thickest part of the right valve to that of the left; and the *height* from the dorsal to the ventral margin. The point in each valve, from which the growth

proceeds, is generally a curved, swelled portion on the dorsal margin, and is named the *umbo*, or beak. All the lines, ribs, and streaks of colour, which commence and diverge from these points towards the ventral margin, are described as *radiating;* all those which are formed in rings round the nucleus,—that is, in the direction of the lines of growth, —are named *concentric*.

The *anterior* of the shell may be known from the *posterior* by the *umboes* turning towards it; or, if there is a *ligament* visible externally, it is on the *posterior* side.

Formerly a different system of measurement and description was used; and, lest it should mislead those who find it in Lamarckian works, it will be desirable to explain it here. By that system, what is now known to be the posterior was described as anterior, and *vice versâ*. The ventral margin was turned upwards, and the margin with the hinge was named as the base. The length was measured from apex to base, and the width from anterior to posterior. The lines, etc. which we now speak of as *radiating*, were *longitudinal;* and those which we describe as *concentric*, were *transverse*.

THE UMBOES OF BIVALVES

Are sometimes *central*, or placed near the middle of the

dorsal margin, and the shell is then described as nearly *equilateral;* sometimes they are near one end, and then the shell is very inequilateral. In the Mussel (*Mytilus*) they are terminal, no part of the anterior end of the shell projecting beyond them. They vary much in the degree in which they are curved, generally only *leaning* towards one side; in *Pectunculus* showing no perceptible bias; in *Chama,* coiled round in a kind of flattened spire on the back of the valve; in the beautiful *Isocardia,* regularly and freely spiral; and in the fossil *Diceras,* irregularly twisted, large, and distant from each other.

THE LUNULE AND DORSAL AREA.

On the dorsal margin of bivalves is sometimes seen a portion, or area, separated from the rest, either by a line or by a difference of texture, or by being hollow or depressed. When this is on the posterior side of the umboes, it is termed the *dorsal area;* when on the anterior side, it is the *lunule.* When looking upon the dorsal edge, with the front towards the spectator and the valves closed, the lunule appears heart-shaped or round; and sometimes it forms a kind of button, encircled by a deep groove; in other cases it is flat, and not distinctly circumscribed.

THE HINGE OF BIVALVE SHELLS.

Under this term is included all the apparatus by which the two valves are joined together, and act upon each other, so as to keep their relative positions. It is placed on the dorsal margin, and includes the lateral and cardinal teeth, the cartilage and ligament, and the pit and the fulcrum, and, in some cases, other processes and appendages.

THE LIGAMENT,

Using the word comprehensively, includes two distinct substances, which are sometimes so united as to appear but one; and sometimes they are quite separated, and their functions are very different. The *ligament*, properly so called, is the outer horny substance, which serves to bind the valves together by a portion of their dorsal margin. The other portion, now commonly distinguished as the *cartilage*, is a very elastic material, which, unless pressed, would occupy more space than that allotted to it, and therefore tends to press outwards so as to open the valves. It thus presents a force opposed to the adductor muscles of the animal, which tend to bring the valves together. In some cases the cartilage lies close within the ligament, on the outer edge of

the shell. The phrase used then is *ligament external;* in other cases there is scarcely a vestige of outer ligament, but the cartilage is contained in a pit, or series of pits, within the edge of the shell; and then it is said that the ligament is *internal*. In some shells there is not only a very strong external ligament, but also, quite separate from it, and placed in an oblique pit within the shell, is the cartilage.

A good specimen of internal ligament, or cartilage, is found in the *Pecten*, which moves about rapidly, by using its valves as fins, alternately opening them widely and shutting them. This is effected by the adductor muscles and the cartilage acting alternately upon the valves. The latter, contained in a triangular pit, and of great thickness, is pressed into a small space by the contraction of the muscle; and then, the pressure being removed, it throws back the valve with a spring. For this reason, shells whose animals have died are found with their valves open; the muscles no longer having power to contract. In *Arca* and some other species the *ligament* is spread over an outer area, and the *cartilage* is confined to grooves in the same area under it.

THE HINGE LAMINA,

Or thickened inner edge of the shell, on which the teeth

are placed, is generally half-circular in form, and makes a ledge under the dorsal margin. Upon this ledge are the *fulcrum* of the *ligament* and the teeth. The *fulcrum* is a thickening of part of this ledge on which the ligament is placed. The *teeth*, so called, are projections on the ledge of one valve entering into corresponding depressions of the other. Those which are placed centrally, or under the umboes, generally diverging from each other, are called the *cardinal* teeth. Those which are more or less remote from these, towards the ends of the shell, are called *lateral* teeth. Some bivalves have no teeth on their hinges, and others have rows of teeth. *Pectunculus*, for instance, has the hinge lamina semicircular, with a curved row of small, angular teeth on each side: these are *serial* teeth. Sometimes the teeth are *bifid*, or having double terminations.

MUSCULAR IMPRESSIONS OF BIVALVES.

On the inner, concave surface of the valve will be observed one or two slightly depressed areas or impressions, slightly differing in texture from the rest of the surface. These are made by the attachment of the large adductor muscles, used in drawing the valves of the shell together. In the oyster a familiar example is seen. Here there is one central

muscle, which has to be separated from the attachment. It forms the gristle, a portion of which often adheres to the shell after the rest of the animal has been removed. Bivalve mollusca have been divided into two orders, namely, *Dimyaria*, having two of these adductor muscles, and, consequently, two impressions in each valve; and *Monomyaria*, having only one. The *Venus* tribe present familiar examples of the former; while the Oysters and *Pectens* are specimens of the latter. In the *Dimyaria* the two impressions are seen opposite each other, near the anterior and posterior ends of the shell; and there is generally to be traced a line or impression leading from one to the other. This is termed the *pallial impression*, or impression of the mantle. In some cases this impression is *entire*, leading in one uninterrupted curve from end to end, parallel with the ventral margin; but in others it has a *sinus*, or winding, at the posterior end, before it joins the posterior muscular impression. The existence, depth, and shape of this sinus is deemed an important character in determining the bounds of genera and species.

Many words remain, the applications of which are too obvious to need special explanation; and others, which

apply generally to shells, whether bivalve or univalve. A few of these latter must terminate the present chapter.

Aculeated, having spines. *Acuminated,* terminating in a point. *Adnate* is a word applied to the edges of some of the *Unionidæ,* which are united and grow together; this is not the case with any British species. Many species of *Naiades,* when young, have their dorsal margins *adnate,* and, when fully grown, have them separate. A shell, or part of one, is *canaliculated* when it has grooves or canals in one direction; it is *cancellated* when it has ridges crossing each other in both directions; it is *carinated* when it has sharp keel-like edges; and *coronated* when it is surrounded, on an upper edge or angle, by a series of lobes or spines. Any portion of the edge of a shell which is not continuous, but interrupted by a notch or sinuosity, is said to be *emarginated.* The words *fasciated,* or banded; *fasciculated,* or having little bunches of hair (as the margin of *Chiton fasciculatus*); *fimbriated,* or fringed; *flexuous,* or winding; *foliated,* or leaf-like, will scarcely present any difficulty of application, wherever they may occur.

The same may be said of the words *ligulate,* or tongue-shaped; *maculated,* or spotted; *elliptical,* or oval; *palmated,* or flattened, as the fronds of some *Spondyli* and

Murices; patelliform, shaped like a dish, or limpet. The *penultimate whorl* is the last whorl of the spire previous to that which forms the body of the shell. The words *plicated,* or folded; *polygonal,* or many-sided; *inequivalve,* or with one valve exceeding the other; *pyriform,* or pear-shaped; *pyramidal,* or spine-like; *tessellated,* or coloured in pattern like a tessellated pavement; *tuberculated,* or knobbed; *turgid* and *ventricose,* or swelled and bulky; *turreted,* or rising by angular gradations like turrets; *umbilicated,* or having a hollow or circular depression; and *auriculated,* having prominent flattened processes,—are easily applied, as well as many others which are not used exclusively in conchology.

The remaining terms apply to the habits and structure of the mollusca and their shells.

When the mollusc is locomotive, and the shell consequently not fixed to any spot, it is said to be *free.* When, on the contrary, the shell is fixed, it is described as *attached.* The attachment takes place either by means of a portion of the shell (in bivalves, one valve) growing to the surface of rocks or other shells; or by means of a *byssus,* or bunch of fibres. The oysters are often attached in the former manner; while mussels and *Pinnæ* ride at anchor by the latter method.

1 Physa hypnorum. 2 Lymnæa palustris. 3 Planorbis cortex.
4 Ancylus fluviatilis. 5 Rossia macrosoma. 6 Bone of Sepia officinalis.

Mollusca inhabiting fresh-water rivers are termed *fluviatile;* those of the sea are said to be *marine.* An *internal* shell is one which is covered by some part of the animal, as in *Aplysia,* the shell of which is not seen excepting by dissection. An *external* shell is one which covers the animal, or, at least, is not covered by it. Shells are *regular* or *irregular* in their growth, according to the situations in which they live, or their habit as to being attached or free.

Mollusca are *littoral* if they live on the shore, between tides; *terrestrial,* if their dwelling is on land; *oceanic,* if they inhabit the deeper waters.

Shells are *margaritaceous* if pearly in texture; *margaritiferous,* if they produce pearls.

With regard to many of these terms, it is difficult to say why they should be used in English descriptions. Why should we increase the difficulty of a study, by using forms of expression which require a glossary to explain them? Why say that a shell is *bicarinated,* instead of saying that it has two keels, or that it is *fimbriated,* when it is adorned with a lace-like fringe? Would it not be a great improvement, if writers on scientific subjects would adopt the habit of using plain English in their descriptions, and only call in the help of a dead language when the living one failed

to define the object and its characters? If, with the Irish schoolmaster mentioned in 'Household Words,' we had to write a petition in favour of Nelly Rean, we should think it much better at once to own that the poor woman killed a goat, than to admit she had "deprived of existence a small *cornuted* animal." In the case alluded to, perhaps a purpose was served; for as none of the Relief Committee but the clergyman knew what the word 'cornuted' meant, the petitioner made good the celebrated definition of language, as 'a means of concealing our ideas.'

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