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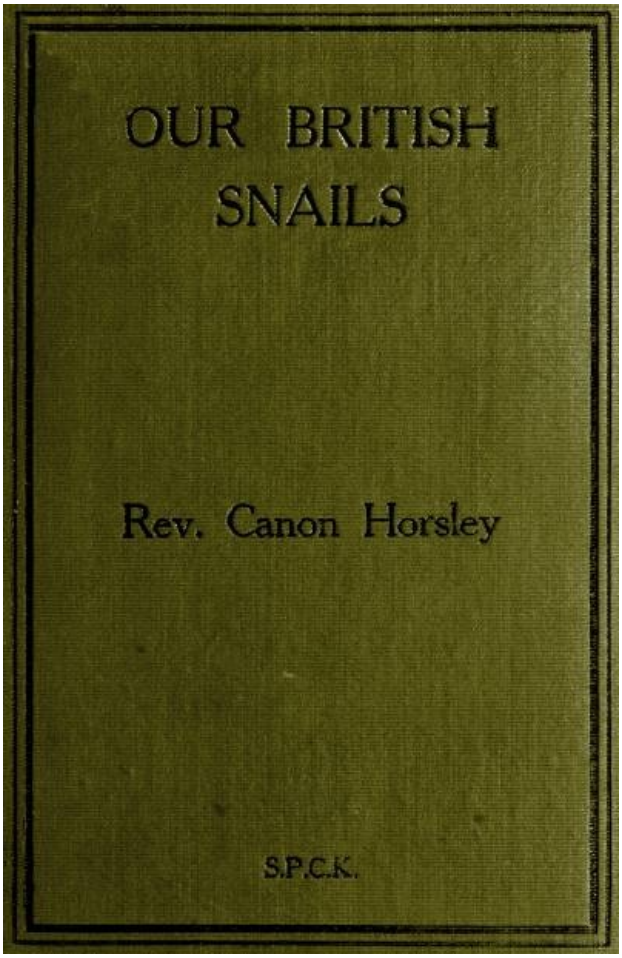
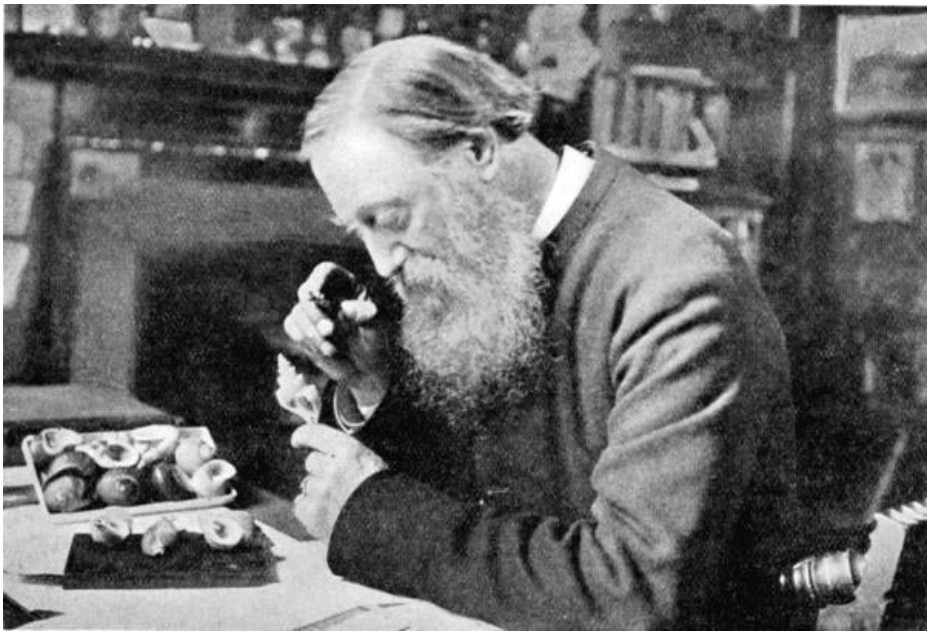


OUR BRITISH SNAILS
Rev. Canon Horsley
S.P.C.K



[Frontispiece.

Canon Horsley in his study examining a rare variety of whelk (var. *Babylonica*) from a stall in the Walworth Road. It is now in the South Kensington Museum.

OUR BRITISH SNAILS

BY THE
REV. CANON J. W. HORSLEY
AUTHOR OF
"SOME FOLK-LORE AND LEGENDS OF BIRDS," ETC.

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PAGE

OUR BRITISH SNAILS

It has been said that a child's education should begin thirty years before its birth, since what he is, or becomes, or does, depends largely upon what his parents were, and not solely on what he learns at home or in school, or from his companions and surroundings.

But the principle of what is called "atavism" shows us that the appearance, tastes, and character of a child's grandparents may reappear, even more than those of his parents; and that, therefore, his education begins sixty years before his birth.

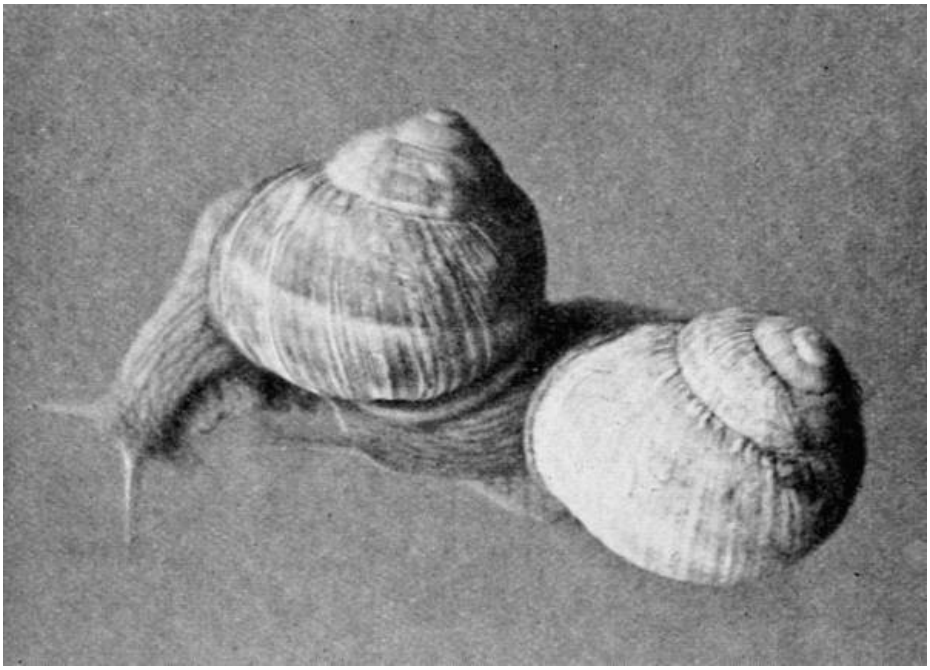
My education, viewing me as a naturalist, began even earlier than that, for nearly all my ancestors of whom I know anything more than their names and abiding place were botanists or horticulturists, and I cannot recollect the time when I was not an observer of nature and a collector of the common objects of the field, the ditch, the seashore, the wood, and the cliff. My father died before I was four, and I have never had any remembrance of his words or looks, yet I remember his cutting down a tree in the shrubbery of his Kentish vicarage garden which forked curiously from the ground, and also of finding that handsome fungus which is scarlet flecked with white. This shows that the observation of the marvels and beauties of God's Green Bible, or Book of Nature, began early in me. The habits of observation, of comparison, and of method, are those which all naturalists and collectors must have; habits which are of great value in other ways as well. Firstly, one must have the seeing eye, and train it to notice what many people do not. (Get and read the old book, much read when I was young, called "Eyes and no Eyes.") Secondly, one must learn to observe the difference (sometimes very small, although important) between one object and others of the same family. Every one knows a wild rose by sight; but nearly every one would be surprised to hear that botanists make out twenty kinds of English wild roses, to say nothing of varieties and hybrids. In all departments of natural history a magnifying glass, for the dissection of inward parts, is necessary in many cases to separate two kinds which look alike. And, thirdly, if you want to make a collection, whether of dried plants, of insects, of shells, or of anything else, you must cultivate ways of order and method and neatness in the arrangement of your collection. And then your increased powers of observation, of comparison, and of method will stand you, and others, in good stead in higher matters of thought and action, and the virtues of Prudence, Justice, Temperance, and Fortitude will all increase in you as you learn more about what is in man, what man should be, and how men should be treated. Let us take Fortitude for example. I have known boys who collected one kind of thing eagerly for a while, but soon got tired of it, and generally had little power of "sticking" to anything. On the other hand, I was once admiring the magnificent collection of shells owned by a middle-aged doctor, and asked him, "When did you begin to collect?" "When I was seven," was his answer. I should expect to find more Fortitude in that doctor's character than in that of a boy who collected "all things in turn and nothing long."

Yet I myself was middle-aged before I felt disgusted with myself, when gazing on a lad's collection of British land shells, that I should so long have been groping in hedges and ditches, and yet never have noticed the variety and the beauty of members of the snail family. (That lad, by the bye, is now a Professor in an American University, and a great authority on shells and other matters.) Since then I have gathered a complete collection of the British land and fresh-water shells, and a very large and valuable one of the *Helicidæ—i.e.* the family to which the common or garden snail belongs—of every country in the world; and have been President of the Conchological Society of Great Britain and Ireland.

I am now, therefore, writing about our British land shells, "slugs and snails" in common speech, with the hope that it may add a new interest to the country walks of lads and lasses.

I could show you a wall-case I made for a school. It contains specimens of all the British land shells with the exception of the slugs, which (with the exception of one of which I shall speak in its place) have no external or

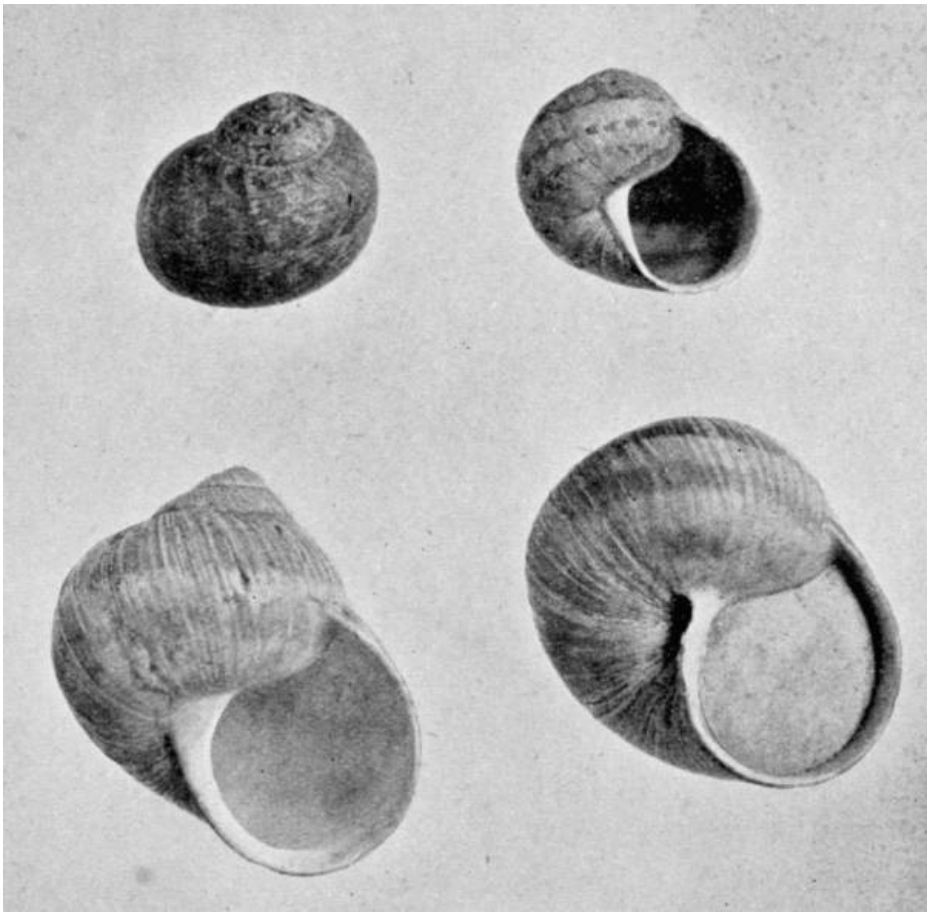
covering shell, although a small sort of shell, or at any rate some chalky grains, is found inside most of them. You would see that some are as small as a pin's head although full grown, and they would require a magnifying glass to distinguish one from the other. The largest is *Helix pomatia* (figured on pp. 11 and 12), which often goes by the name of "the edible snail." All snails are edible and nutritious; but this is the one cultivated in snail farms and sold as food abroad. Sometimes it is called "the Roman snail," from an idea, probably wrong, that it was introduced by Cæsar's soldiers, although as a matter of fact it is unknown in South Italy. Sometimes also it is called "the apple snail," partly because it is as large as a middle-sized apple, and partly because people thought the name *pomatia* came from the Latin *pomum*, "an apple," whereas it really comes from the Greek πῶμα. This word means a lid, or closing arrangement, and this mollusc makes a hard front door for itself when it hibernates, *i.e.* suspends active life and buries itself in the winter.



***H. pomatia*, half natural size.**

It is much to be regretted that in most cases scientific names fail to give much information to the young student, and in some cases they give none at all. The first or generic name is supposed to be formed from Greek, the second, or specific, from the Latin, but there are some hybrids and many mere "nonsense names" to puzzle beginners. Thus the slug Limax gets its name from *limus*, "mud"; but a scientist, who ought to have known better, when wanting a name for another kind of slug, transposed the initial letters and made Milax! Vitrina is a sensible and descriptive name, the Latin for glassy, given to a shell like thin glass; but the Greek Arion recalls either a certain musician or a certain swift steed, neither of whom naturally suggests a slug. For Balea at least four derivations have been suggested—none of them probable. Two facts concerning the life or appearance of a mollusc we should learn from its two names, but this is not the case with *Agriolimax agrestis*, which is by interpretation "the field slug inhabiting fields." Nor are we helped by the specific name *virgata* or striped when so many land shells are striped or banded, and still less by *terrestris* for one land shell when all land shells are terrestrial.

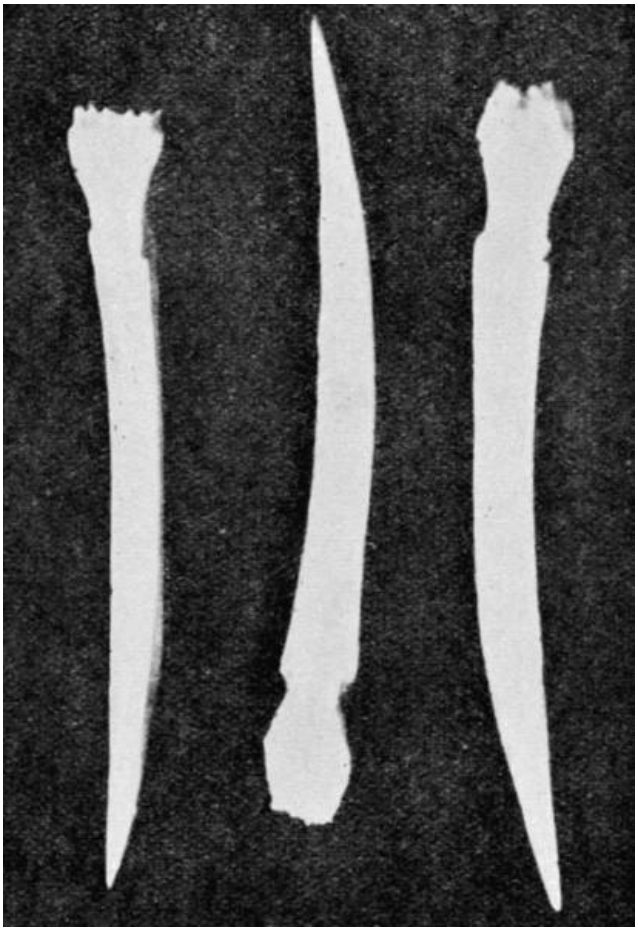
You would note, however, in this wall-case that the species are not many (a good many of the specimens are varieties, not separate species), and that, therefore, one can collect with the hope of speedily forming a complete collection without that inevitable absence of finality found when one collects postage stamps, or, still more, picture postcards, of which one might secure thousands, only to find that fresh thousands were brought out next year. Here, however, is no impossible ideal of perfection. There are but eighty-two land and forty-five freshwater shells in Britain.



Dextral *H. aspersa* and *H. pomatia*. The right-hand shell at the bottom shows the winter epiphragm of *H. pomatia*.

Let us imagine we are starting for an afternoon snailing near London. Which way? To Oxshott? To Caterham? To the latter for choice, since it is on the chalk, whereas the former is on the sand. Snails require lime to make shells, and only on chalk or limestone will you find an abundance. Here, too, as at Box Hill, we shall find the big *Helix pomatia*, only found in a few English counties, and very local there. If we were very fortunate, we might find a sinistral, or "left-handed" specimen. In the case of the *pomatia* on the right hand there is shown the thick epiphragm which the mantle secretes before the mollusc hibernates. It hardens on exposure to the air like plaster-of-paris; but is not a true operculum, for that is a constant possession of the shells which have it. Opercula are mainly found in marine or fluviatile shells, and may be either horny (like the winkle) or stony. Amongst our British land shells *Cyclostoma elegans* and *Acicula lineata* alone have true opercula, though others form some thin epiphragm for the exclusion of cold air and enemies when they hibernate.

Most shells grow to the right, and a freak which does the contrary is so rare that of the millions of the common *H. virgata* that I have seen and handled, only one delighted me with its left-handedness. If it is early summer (nearly all snails hide, burrow, and sleep during the winter), look about on the grass for some half-chalky, half-stony shields, which are the winter front doors of *H. pomatia*, now discarded; while sharper eyes might even descry the flinty little darts with which they have been love-making. The illustration on p. 15 shows three of these darts, much magnified. Only the most highly developed Helices possess these courting weapons, not unlike bayonets in form, sometimes rounded and smooth, and sometimes with two or even four lateral blades, so that the section of the dart of *H. pomatia* is in the form of a Greek cross. Not many British shells have these darts, but in one case their study is useful, since *H. nemoralis* and *H. hortensis*, though so closely allied that early conchologists considered them to be of the same species, have darts remarkably distinct one from the other, so that they become a court of final appeal if from outward appearance it is difficult to distinguish, say, a white-mouthed *nemoralis* from a dark-mouthed *hortensis*.

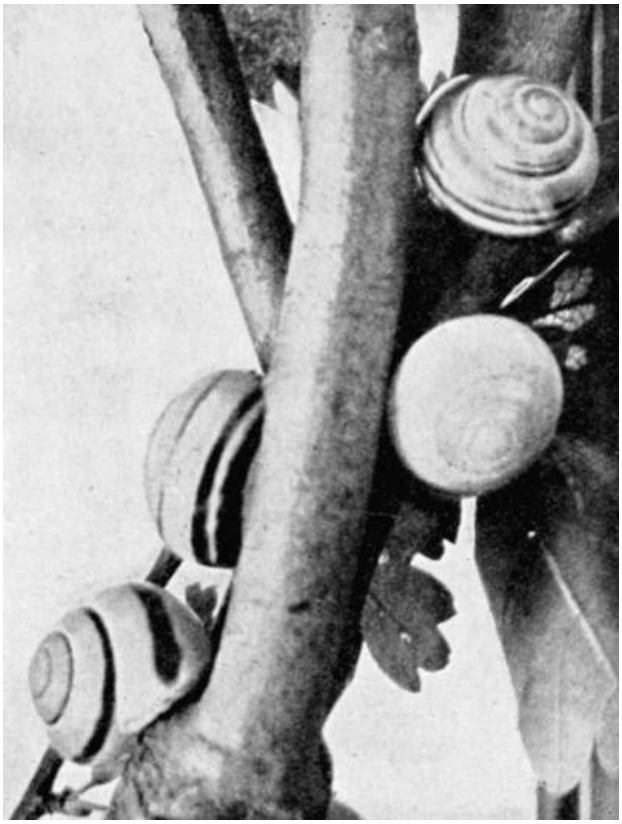


Love-darts of *H. pomatia*, much magnified.

Whenever you see a stone, a brick, a branch of dead wood, or even an old boot or a piece of newspaper in the hedge or on the grass, turn it over, for many of the smaller shells are thus found, and “leave no stone unturned” is eminently a motto for the conchologist. Some of the shells will be tiny, and must be studied under a magnifying glass—which all naturalists should always have in their pockets—or even under a microscope at home, in order to discover, not only their beauty of marking or sculpture, but even to what species they belong.

When you see a man sweeping herbage with a net, or beating hedges and shrubs over an inverted umbrella, he is probably an entomologist in search of caterpillars or beetles; but the same methods will often reward the snail-hunter.

Especially in the hedges will you find the two allied species *Helix* (*Cepea*) *nemoralis* and *hortensis*, to which the attention of beginners should first be directed, inasmuch as they are so common, so beautiful, and so varying both in colour and the number of the chocolate bands they usually bear. See the illustration of some of these at rest on hawthorn, p. 17. Canary-yellow, flesh-colour, chocolate, and almost white, are the prevailing ground-colours. Five is the normal number of bands on the largest or body-whorl, although sometimes all run into one, and often one, some, or all are wanting. Where only one band is found—throughout the Helicidæ—it is usually that on the periphery or middle of the whorl, and a shell in which this band is wanting, while others are found, is a rarity. People are usually astonished, on seeing a good series of the colour and variations of these two shells, how they vie with those of warmer regions.



***H. nemoralis* at rest on hawthorn.**

Next search trunks of trees, and especially the smooth boles of the beeches. The rough bark of the elm or oak is not congenial to slugs or snails. Where trees are moss-covered at their foot, or walls at their top, many of the smaller shells may be expected; while handfuls of dead leaves may be shaken over something white, or taken home in a large bag to be treated there. Hurdles leaning against a hedge are often found to bear a good crop of snails. Damp places must be sought in dry weather; but a rainy day, that troubles some kinds of naturalists, sends the conchologist forth rejoicing, especially if a warm evening follows a wet day. A night search with a lantern will often be profitable. Where they will be undisturbed, traps may be set, such as flat pieces of wood (the older the better), or cardboard, lying on the grass; while most of those species that belong to the group which seems to prefer the sun, *e.g. H. itala*, *virgata*, etc., are fond of a newspaper for food rather than for shelter.

During the hibernating season, which extends from November to April, we turn rather to ditches than to hedges, and, armed with a perforated scoop at the end of a long stick, we dredge among the water-weeds, or sift, like gold-washers, the sand or mud in ditches, ponds, and backwaters of rivers. Here we are introduced to the great bivalve family which is unknown on land, and our trophies range from the freshwater mussels, as large as our hand, to others hardly larger than a pin’s head. These must be sought at the bottom; but on the weeds, or on the bottom, will be found not a few species of gasteropods or univalves, some of which we may have noticed in a freshwater aquarium. These, of course, are closely connected with the land shells, which the bivalves are not. They can be brought home alive in a tin box with a little moss, whereas for the land shells a calico bag with a little foliage therein is best. In both cases some small glass tubes with corks should be brought in a tin box in order to keep safely and separately the tinier kinds. You can often discover what small shells inhabit a particular ditch or pond by noticing the cases of caddis-worms, some of which are formed almost entirely of shells instead of vegetable fragments.

Using the precious gift of observation, we have found our shells; at home we exercise the other gifts of comparison and order, in the preparation and arrangement of our collection. A dash of quite boiling water kills instantaneously any molluscs whose shells we want to preserve, and then the body is extracted after the fashion observed with regard to winkles at tea. Be careful to get out all the body of the animal, and then it is well to wash out any slime or particles by directing a fine but strong jet of cold water into the shell. This can be done by holding your thumb nearly over the mouth of a watertap, while the shell is held in the left hand. Only adult shells should usually be taken, and those which are weather-worn or bleached should be neglected. In most the lip, or opening, of the shell will be hard if adult, and membranous if young; but experience alone will enable you to discriminate, especially where the young of one species is like the adult of another.

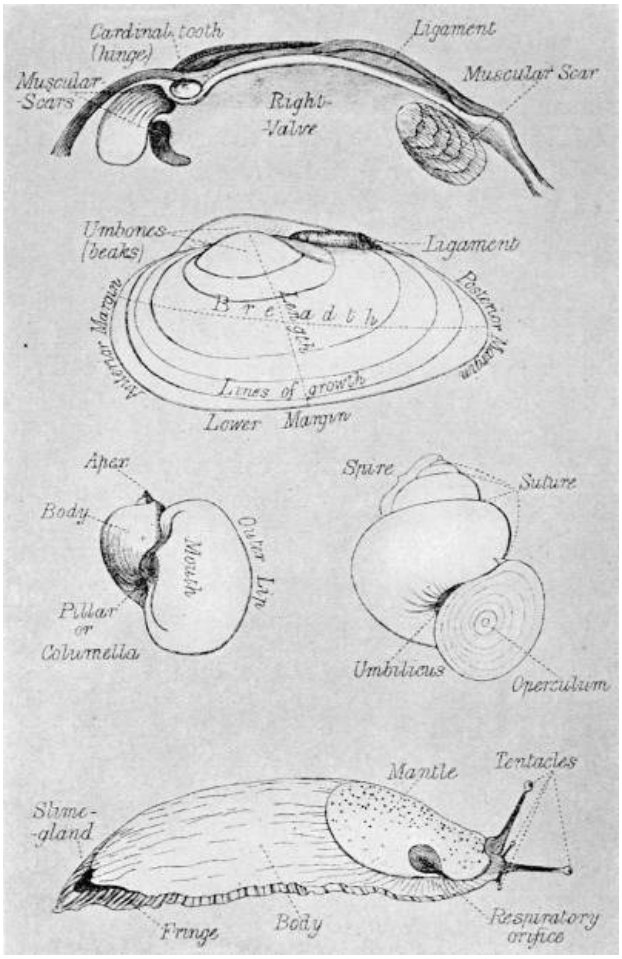
Get into the way of carrying a note-book with you to record not only what shells, or varieties of a species, are found in any particular spot, but also anything you observe as to the habits or peculiarities of the objects of your search. Notes as to protective colouring or mimicry; the influences of a wet or a dry season on the relative thickness of shells; the difference in size caused by abundance or scarcity of diet; what plants are preferred and what avoided as food by particular helices,—are some of the points of interest, apart from the earliest and latest dates at which certain species are abroad and active.

If you possess, or borrow, a microscope, many new wonders and fresh lines of inquiry will open out. I know one professor who devotes himself to the study of the teeth of molluscs. A snail may possess over twenty

thousand tiny flinty teeth set on a ribbon so as to make a mowing-machine for the vegetable matter on which it feeds. With its aid also you might study the life-history of a mollusc from the egg onwards, and be able to determine by minute anatomical points whether two molluscs were of the same species or not—a matter in which the shape or appearance of the shell is not always a safe guide.

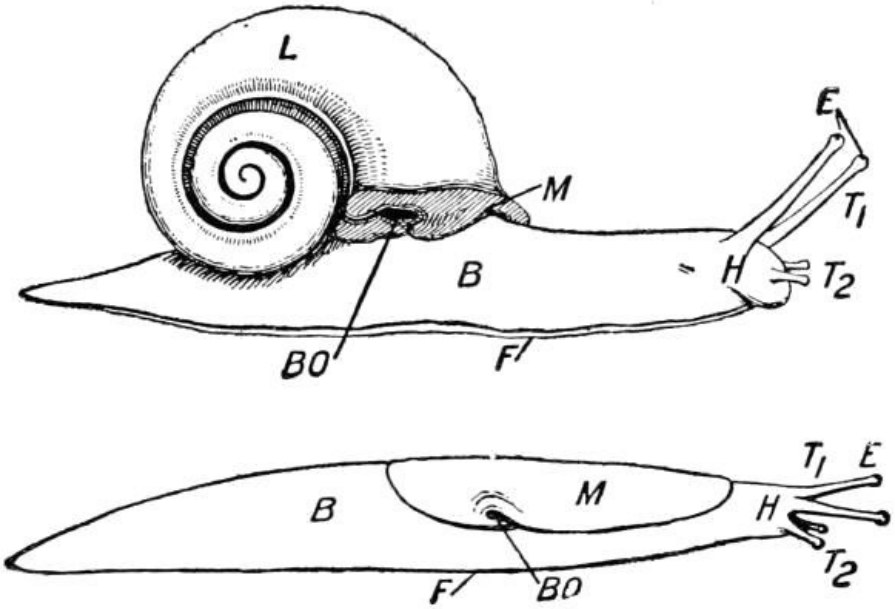
Here, then, is a new hobby for some of my readers, or, at any rate, a fresh source of interest when they are in the country. If any collector lives near you, I am sure he or she would be delighted to have your company during an expedition, and you would learn more by sight and hearing than by reading. If, however, you must fall back upon a book, get *The Collector's Manual* by L. E. Adams, published by Taylor Bros., Leeds. This is invaluable both to the beginner and to the owner of a good collection.

From this I borrow by leave the plate on p. 22, which will enable the beginner to understand from the first certain names of parts of the shell or the body of the bivalve, univalve, or slug which otherwise might not be clear. The "muscular scars" are indents in the shell which mark where the muscles were fixed whose function was to bring close together the two valves of the shell when it has need to exclude air or enemies.



Names of parts of shell and of body. *Unio*, *Limnæa*, *Vivipara*, and *Arion*.

The figures of the snail and the slug below are introduced to give further knowledge of the soft parts. B is the body, soft and with a surface generally wrinkled or covered with small tubercles. F is the foot or muscular pad which forms the foot by the wavelike contractions of which it moves. H is the head, bearing the tentacles T_1 and T_2, of which the upper pair have the eyes, E. The mantle, M, makes the shell by secreting lime, etc. In it is the breathing orifice, BO, obvious in the slug, but in the snail nearly hidden by the shell. L in the snail is the spiral part, the liver, and it occupies a large part of the shell.



Body of snail and of slug.

Without going into details of classification and anatomy, which would only deter or puzzle a beginner, let me take two typical molluscs of those which we shall find in England, the common garden snail *Helix aspersa*, and a freshwater mussel, *Unio margaritifer*, and see where they come in the scale of creation and what are their powers and peculiarities.

Molluscs (*mollis esca*, soft food—boneless creatures) are below the aristocracy of the vertebrates or backboned creatures, and so they come just below the Fishes, but above the Insects. They are divided into those possessing a head and those possessing no head (although with some sort of a brain or organ of sense), the snail being of the former class and the mussel of the latter. The former are univalves and the latter bivalves having two shells for protection. The latter also are restricted to life in water, whereas the former are found both on land and in water, *e.g.* the snail and the whelk, although for ages probably no molluscs were air-breathing land dwellers. In the class of Cephala, to which our snail belongs, there is the sub-class of Gasteropoda, or stomach-footed, because on the ventral side of the body a sole-like disc or foot exists, by the wave-like expansions and contractions of which the animal progresses.

In this sub-class there is a division according to their having or not having an operculum, or means of closing and protecting the orifice of the shell. Most gasteropods which live in water have this; most which live on land (only two exceptions in British molluscs) have not. Here again we must trace our snail down to the sub-order of Pulmonata, or lung or air-sac breathers as distinct from its sisters which inhabit water and breathe by gills. This sub-order is again divided into various families, Arion, Limax, Testacella, Vitrina, Zonites, Helix, etc., and Helix again is divided into various genera, of which Helix is one, and even this is subdivided into sub-genera, Patula, Punctum, Acanthinula, Vallonia, Chilotrema, Gonostoma, Pomatia, Tachea, etc., and to the sub-genus Pomatia our garden snail as well as the “Roman snail” belongs. Looking backwards we, therefore, place our friend as the species *aspersa*, of the sub-genus *Pomatia*, of the genus *Helix*, of the family *Helicidæ*, of the sub-order *Pulmonata*, of the order *Inoperculata*, of the sub-class *Gasteropoda*, of the class *Cephala*, of the sub-kingdom of *Mollusca*, of the kingdom *Invertebrata* or backboneless animals.

It belongs by origin not to the earliest form of snail, but to the most highly organized group in the world, especially characteristic of the European region, and possessing in their superiority the power to colonize and dispossess the original native snails of other lands. The shell is globular in form with five whorls (the Greek word “helix” means a coil), each usually marked with five bands of pigment. It is mainly a vegetarian, and by habit a lover of the twilight and of moisture. With the exception of *H. pomatia* it is the largest of our native shells, and is too common to satisfy gardeners. A powerful animal of its kind, it can travel a yard in twelve minutes, or at the rate of a mile in a fortnight, can bear or draw on level ground a weight fifty times its own. It breathes about four times a minute, and its heart-beat varies from sixty to eighty per minute according to temperature, or its activity. It takes its winter rest in clusters, closing its mouth with a membranous film, while if the cold increases it shrinks farther into its shell and makes more epiphragms or film curtains to keep out the cold. Not only on the Continent, but in several parts of England, notably about Bath and Bristol, it is sought, sold, and used for food, and in Belgium it is said to be preferred to the larger and more firm-fleshed *H. pomatia*. The eggs, from forty to a hundred, are laid in the earth and hatched in from a fortnight to a month, according to the weather. I had observed them as a boy, and used to call tapioca pudding “snail’s egg pudding.” In the year of their hatching they attain but half their proper size, but after hibernation they eat voraciously and grow rapidly, so as to attain full size in a little more than a year. Most die in their second hibernation (if not destroyed by their many enemies, gardeners, collectors, rats, rabbits, ducks, thrushes, and beetles); but when kept and protected for observation they have achieved the great age of even ten years.

They have a great power of “homing” like pigeons, however far (for them) is their journey after favourite food. The slime-marked journeys or feeding tracks of this species (and still more of slugs) afford matter of great interest. As to sight the two eyes are the dark specks on the tip of the upper pair of “horns,” but the range of vision is very short indeed, and the difference between light and approaching darkness is all that some seem able to perceive. The organs of hearing are two small sacs filled with fluid in which are some

calcareous grains. They hear little which is audible to human ears, and if not altogether deaf they are dumb as far as we can hear. The power of taste they possess, as is shown by the preference of some foods to others. The sense of touch is acute and resides in all parts of the soft and moist external skin, and especially in the upper tentacles or horns in the *Helicidæ*. Jaws they have with which to seize and to bite off food, and in *H. aspersa* and others these bear teeth, but the chief work is done by a sort of toothed tongue, the radula, which rasps off particles of food with a side to side motion of the head as the animal advances. Our *aspersa* has 12,615 teeth on this ribbon, contained in 145 transverse rows. The organs of digestion are complex and practically much the same as our own. Little vegetation would be left in nature had not, on the one hand, snails been kept down by many enemies as well as by their need of hibernation and their short life; while on the other by numerous devices in the course of ages many plants have protected themselves against the moving machine of a snail's mouth. Cultivated plants, which generally lose their natural protections, have to be guarded by human guards or gardeners. Some plants defend themselves by prickles or hairs, some by hardening themselves with lime or flint, some by bitter or acrid juices. A heart of two chambers, veins, arteries, and blood our snail possesses, and, like man, the old snail has a slower pulse than the young one, and in both exercise increases the pulse rate and also warmth. Breathing is accomplished by a single chamber or air-cell, but also through the skin. As in the case of plants, some kinds are male and female separately, and as some have both powers and products in the same plant, so also is it with mollusca. *H. aspersa* and most Gasteropoda are of the latter kind.

Having now taken *H. aspersa* as the representative of our univalves, let us take the "Pearl Mussel"—*Unio margaritifer*—as that of our bivalves, all of which live in the water, whereas of univalves some are "land snails" and some "water snails." It would say of itself, "I am a species of the genus Unio (*unio*, a pearl), which belongs to the family Unionidæ, which belongs to the sub-order Isomya (*i.e.* having muscles of equal power to close the two valves of the shell), which belongs to the order Lamellibranchiata (*i.e.* having gills arranged in leaf-like fashion), which belongs to the sub-class Pelecypoda (*i.e.* having a foot somewhat of an axe-shape), which belongs to the class Acephala (headless), which is the second of the two chief classes into which Mollusca are divided.

"I differ from the Gasteropoda (whether they be terrestrial or aquatic) in that I and my near relations are exclusively aquatic and of a sedentary life, which makes the protection of two encompassing shells necessary. These shells are secreted by my mantle lobes, and are united by a ligament which tends to make the valves 'gape' for water and food and by two contracting muscles which close them in danger. I have a degenerate brain and no eyes. My mouth has neither jaw nor teeth, but possesses nervous lips covered with cilia, the vibration of which carries food-laden water to my mouth. My foot, when protruded, is seen as a large muscular appendage, and, by alternately expanding and contracting, it enables me to burrow or plough through mud or even sand, and so disturb the minute organisms on which I feed. I can thus travel fifteen feet a day, or about a mile in a year.

"I have no eyes, but distinguish well between light and shade by means of the surface of my body when exposed. I breathe, that is, get oxygen from the water, by means of gill-plates. As regards other internal organs, I differ not much from *H. aspersa*, but I am either male or female. Outside I am black and uncomely; but within I am pearly-white, and but for my power of forming pearls round an irritating grain of sand the civilization of England would have come to pass later than it did, for it was the report of my pearls which brought Cæsar to Britain."

Now let us enumerate the species of land and freshwater shells to be found, (all but two) in England, and most of them in Ireland or Scotland.

Arion ater is a large (3 to 5 inches) and common slug, usually black (whence its name *ater*), but also red, brown, or white. In some varieties the foot-fringe is orange. When irritated it contracts into a hemispherical lump. A few chalky granules under the mantle are the representatives of a shell. See the illustration of three specimens on p. 31. That hole in the mantle is the breathing orifice, and its forward position is a characteristic of the group *Arion*. The body of slugs is kept moist by a constant exuding of slime from a gland in the tail.

Three specimens of *Arion ater*, showing tentacles, breathing orifice, and slime gland.

Arion subfuscus (*i.e.* somewhat tawny). Smaller (2 to 3 inches) than *A. ater*, grey or yellowish, with usually a dark stripe on each side. Foot-sole white, and its fringe white with dark cross streaks. Never very abundant.

Arion minimus.—The smallest Arion: not an inch long. Grey or yellowish. Feeds on fungi. Body wrinkled with microscopic spikes. Common. The *young* of *A. ater* might be mistaken for it.

Arion hortensis.—Grey with purple side bands. Foot-sole yellow. 1 to 1-1/2 inch in length. Generally found in gardens, as its name indicates.

Arion circumscriptus.—Very common in fields. A dark band down the back, foot-sole white. Very “sluggish.”

Geomalacus maculosus (*i.e.* the spotted earth-mollusc).—Only found in south-west Ireland. Probably a relic of the prehistoric time when Ireland was joined to Portugal and Spain. Has a solid chalky shell beneath the shield. Blackish with oval yellow spots. Feeds on lichens.

Amalia gagates (*gagates* is Greek for “jet”).—Dark lead colour. Foot-sole white. Length 2-1/2 inches. Local, and mainly near sea.

Amalia Sowerbyi.—Brown, speckled with black. Foot-sole yellowish. Length 2-1/2 inches. Local. Shell often very thick.

Limax maximus.—Length 4 to 6 inches. Grey with two dark lateral bands. Often found in cellars.

Limax cinereo-niger.—Ashy-black. Very like *L. maximus*, but with a sharp keel, and the sole paler in the middle than at the sides. Less nocturnal and less fond of houses; chiefly found in forests on hills. Local, and not common.

Limax flavus.—Yellow, with a faint dark network of markings. Tentacles blue. Sole cream. Length 4 inches. Only found in cellars and near houses.

Limax marginatus.—Semi-transparent. Grey, with two dark bands on each side. Foot-sole with a dark line down the middle. Shell solid, often a cube. Length 3 inches. Fond of tree climbing.

Limax tenellus.—Yellow. Tentacles black. Mucus yellow. Found in woods. Lives on fungi. Rare.

Agriolimax agrestis.—The common field slug. Swarms everywhere. Its milk-white slime is characteristic. Very variable in colour and markings.

Agriolimax lævis.—Slender. All chocolate brown. Length 3/4 inch. Shell may be seen through the mantle. Active. Our smallest slug. Usually found near ditches.

It may be useful here to give the chief differences between the genera Arion, Amalia, Limax, and Agriolimax. The shield in the first two is granulated, in the other concentrically striated. The breathing orifice in Arion is in front of the centre of the mantle margin; in the others behind. The shell is distinctly formed in all but Arion, in which it is absent or represented by a few granules. Arion has no dorsal keel. Amalia has one all down the back. In Limax and Agriolimax it is confined to the caudal part. Other differences are only discovered by dissection.

One may also here note that to preserve slugs is difficult, and the best plan is to have a coloured drawing made of them when extended. Otherwise they may be drowned in cold water, cleaned of slime with a soft brush, and then preserved in glass tubes with diluted formalin or alcohol. Or, after drowning, they may be skinned and the skins dried on a card and varnished. Note also that most slugs have many variations in colour and markings.

Testacella haliotidea.—This genus of slugs forms a link between the naked slugs with rudimentary shells within, and the snails which live within their shells. The name *Testacella*, or little shell, was given by Cuvier in 1800, because this slug has a small shell at the end of the tail. Haliotidea means having a shell in the form of the marine shell *Haliotis*, the meaning of which again is the ear-shaped seashell, often called “Venus’ Ear.” It is subterranean in habit, and lives on worms. It should be looked for on the surface on damp nights, or is found when digging. Its length is 3 inches at most. Pale yellow in colour. See the illustration on page 35.

Testacella scutulum (a little shield).—Not so common as the former species, and differing chiefly in anatomy.

Testacella Maugei.—First found at Tenerife by M. Mauge. Reaches 4 inches in length. Deep brown in colour. Shell larger. Rarer and more western in habitat than the other species.

Testacella haliotidea.

Vitrina pellucida.—The Vitrinas in several ways afford a connecting link between the slugs and snails, having the same tooth-formation and mantle as the former, while the shell cannot contain the whole body. As the name indicates, the shell is like a bubble of clear greenish glass and very delicate. It is small, and found in damp places, coming out mostly at night. Omnivorous, it is often found feeding on dead worms, and, unlike nearly all our earth molluscs, can be found abroad in winter.

Vitrea (Polita) lucida.—This is the largest of our British Hyaliniæ, which are difficult to distinguish. The body of this species is cobalt blue, the apex of the shell is flat, its colour opaque, and the last whorl more expanded than in others. All belong to the sub-genus *Polita*, and have polished or glossy shells. All love shade and moisture, and should be sought under stones or wood or in moss. They only come out by day when it is wet, a habit they may have acquired from their being a favourite food of birds, 416 having been found in the crop of one nestling Stockdove; while various flies are very destructive to them. This species prefers animal food, and is more gregarious than others. Not common.

Vitrea (Polita) cellaria.—The next largest species is the most common of all. It is fond of cellars (whence its name), and I found it under the stone lid of a manhole in the drain of S. Peter’s Rectory, Walworth—the only shell left in that part of London. It resembles the previous species, but is smaller and has a broader and deeper suture between the whorls, while the foot-sole is paler than the body.

Vitrea (Polita) Rogersi.—Local. Found in dense woods. It is much like both *H. cellaria* and *H. alliaria*, and all three smell of garlic, but the last is much smaller than the others. The tentacles in the first are long, and in the third short; while in *Rogersi* the upper pair are long and the lower very short. It is also the most glossy of all. If put in a box with other small shells it will clean them by cannibalism.

Vitrea (Polita) alliaria, *i.e.* smelling of garlic.—Often confused by quite good conchologists with the preceding species, but the body is much darker, and the shell smaller and less white below than either *cellaria* or *helvetica*. The always present smell is said to protect it from ants. Common, but local, and often a pest in

greenhouses and ferneries.

Vitrea (Polita) nitidula.—Common. Less glossy. Marked expansion of the last whorl as it nears the mouth.

Vitrea (Polita) pura.—Like *nitidula* but smaller, and edge of mantle white instead of dark. More common in the north. Shell thin and dull white.

Vitrea (Polita) radiatula.—Never abundant. Striations on shell give it a radiated appearance when magnified. Animal nearly black.

Vitrea crystallina.—The smallest of the genus. Shell transparent, pearly white. Umbilicus (*i.e.* the opening in the centre of the underside showing the whorls) very narrow. Subterranean in habit. Whorls, four; whereas *H. pura* has five; also more compressed.

Euconulus fulvus.—Distinctively pyramidal in shape. Small. Brown. Common under rotten branches and moss in woods. Hardly hibernates.

Zonitoides nitidus.—Chocolate-brown, with no white round the umbilicus (as has *H. nitudula*). Larger than, but not unlike, *H. radiatula*. Gregarious. Chiefly found by water; also in damp hothouses. Amphibious.

Zonitoides excavatus.—Its broad and deep umbilicus is quite distinctive. Mainly British. Dislikes lime, and is most plentiful on the coal measures.

We come now to the Helicidæ family and its genus Helix, in which there are various sub-genera of which the name is given in brackets. The shell in this genus can wholly contain the body; the tentacles are always four; the shell conical, and rarely with a depressed spire. The word “helix” is Greek, and means a coil.

Helix (Gonyodiscus) rotundata.—Very common under stones, moss, etc. Circular, flat, with a large open umbilicus. Horn colour with brown markings.

H. (Pyramidula) rupestris, i.e. inhabiting rocks.—Small. Gregarious. Dark brown. Mainly on exposed dry walls and cliffs.

H. (Punctum) pygmæum.—Very small. Yellowish brown and glossy shell. Mainly on moist dead leaves. Not unlike *H. rupestris* except as to habitat.

H. (Acanthinula) lamellata.—Small. Horn-colour. Epidermis raised into lamellæ or ridges in the line of growth. Mainly northern. Frequents dead leaves, especially beech and holly.

H. (Acanthinula) aculeata.—More common than the former; which it resembles in habitat. Differs chiefly by the ridges being produced into spines.

H. (Vallonia) pulchella.—Tiny. White. Mouth trumpet-shaped. Umbilicus wide. Under stones and at the roots of grass. Its variety *costata* (which some make a separate species) is strongly ribbed.

H. (Helicigona) lapicida.—Circular, flattened, dark brown, strong white reflected rim to mouth. Large umbilicus. Marked keel, which distinguishes it from all other British land shells. Chiefly on chalk soils. Often on beech tree trunks.

H. (Gonostoma) obvoluta.—Common abroad, but confined in England to a few spots in Sussex and Hants. Circular, flat above, mouth triangular, with a strong pinkish-white rim with three denticles.

H. (Pomatia) pomatia.—Described earlier. Found in Hants, Sussex, Kent, Surrey, Oxford, Gloucester, and Bedfordshire; but very local. Elsewhere it may well be an escape from captivity, or the remains of an attempt (always unsuccessful) to establish a colony. Box Hill and Caterham are two good localities for Londoners. In Kent it has two centres, Charing and Shoreham with their contiguous parishes, but there is a great gap between them, and it is absent from places on the same chalk ridge which are identical in soil and vegetation.

H. (Cryptomphalus) aspersa.—The sub-generic name means that the umbilicus is hidden in adult shells by a fold of the pillar lip; the specific name means sprinkled (with brown blotches); but it may be a slip of the pen, for *aspera*, or rough, from the rough shagreening of its surface. Five banded, like so many of the Helicidæ, but usually the second and third band unite. No umbilicus. The variety *exalbida* (chiefly found in Kent and the West) is straw colour and somewhat transparent. Commonly sold for food on the Continent as well as *pomatia*, which is cultivated in “snail-farms,” but not native in Germany or Switzerland, and in France chiefly found in the coast departments. Insipid; but as nourishing as calf’s-foot jelly. Fond of gardens (whence its common name), but not of gardeners. As most animals are marvellously gifted with a knowledge of what food to eat and what to avoid, it is curious that *aspersa* will eat voraciously the leaves of the spindle-tree, though this soon poisons them. It is said also that they share with cows and horses the ignorance that the leaves of the yew should be avoided on pain of sickness or even of death.

H. (Cepæa) nemoralis.—As already stated, this is the most brilliantly and variously coloured and diversely banded of all our English land shells with the exception of its very close connection *H. (Tachea) hortensis*. It is happily very common, and so the attention of beginners should first be directed to this. Thrushes and mice are its great enemies, the former smashing it on some stone which may be found surrounded by the broken shells. The “mouth” or peristome is normally black, the shell larger and stouter than *hortensis*, in which the mouth is white. When a white-mouthed *nemoralis* or dark-mouthed *hortensis* (both rare) is found, the shape of the internal flinty dart at once distinguishes them. In some places both live together: in most one is found and not the other. *Nemoralis* is fond of sand-hills by the coast, but is chiefly a hedge-snail, and the edges of main roads are preferred because of the greater variety of food, because the traffic scares away their bird enemies, and because the dust gives them abundance of already prepared material for their shells. When, however, the collector comes to a wayside cottage where fowls are kept he need not waste his time in looking for snails in the neighbouring hedge. The more the chicken industry extends and the more the Bird Protection

Acts operates, the worse it is for collectors of snails. The banding is probably protective, as in the case of the tiger and the zebra, and renders the shell less visible.

Helix (Cepæa) hortensis.—Rarely found in gardens in spite of its specific name. A hedge-snail. White forms not uncommon, though almost unknown in *nemoralis*. Though the weaker form, the coalescence of the five bands into one broad one is more common here than in *nemoralis*. Also the variety with only one band, and that on the periphery, is very common in *nemoralis* and rare in *hortensis*. It is more dependent on shade and moisture than its congener. Smells of garlic when immersed in boiling water to be killed. *Hortensis* is a more northern, and *nemoralis* a more southern, shell by origin and distribution. There are 89 possible band variations in any normally five-banded shell, and all have been noted in the case of *nemoralis*, but in *hortensis* only 61. They are distinguished, for purposes of record and exchange, by numbers. Thus the type is 12345, the usual one-banded variety 00300, the common coalescence of the second and third band is 1(23)45, and when all bands unite (12345). The unicolourous or bandless variations would be 00000.

H. (Arianta) arbustorum.—Local. Usually found in hedges and by ditches on chalk and limestone. Shell globose, brown or yellow, with a check or willow leaf pattern, and a single dark band on the periphery. Lip strong and white. Animal usually nearly black. Very fond of moisture. Anatomically related to *A. lapicida*, but no external resemblance.

Helix (Theba) cantiana.—First observed in Kent (where it is especially fine and abundant), whence its specific name, but generally dispersed in South and East England. A dull, creamy white shell with a pink tinge, sometimes becoming partially or wholly reddish.

Helix (Theba) cartusiana (first noticed near a Carthusian monastery). Much resembles *cantiana*, but is much smaller and more smooth. Chiefly found on the downs of Kent and Sussex. Used to be common on Deal sand-hills—now devastated by golf! The tint in this is brown, in the former red.

H. (Hygromia) rufescens.—A flattish, dark brown shell, abundant in the south of England, and not rare elsewhere. Has a semi-lunar mouth with a white internal rib. In gardens seems to prefer violet beds.

H. (Hygromia) hispida, *i.e.* hairy.—These hairs are deciduous, and the hairless variety used to be considered a separate species under the name of *concinna* (*i.e.* neat), but would now be the variety *depilata*, or bald. Broad and deep umbilicus. Common, except in Ireland. Usually associates with *H. rufescens* in moist places.

H. (Hygromia) granulata is also hairy with white silky bristles. Yellowish in colour. Shell thin. Local, but abundant where found. Its umbilicus is very small. It falls from its food plants at the least shake.

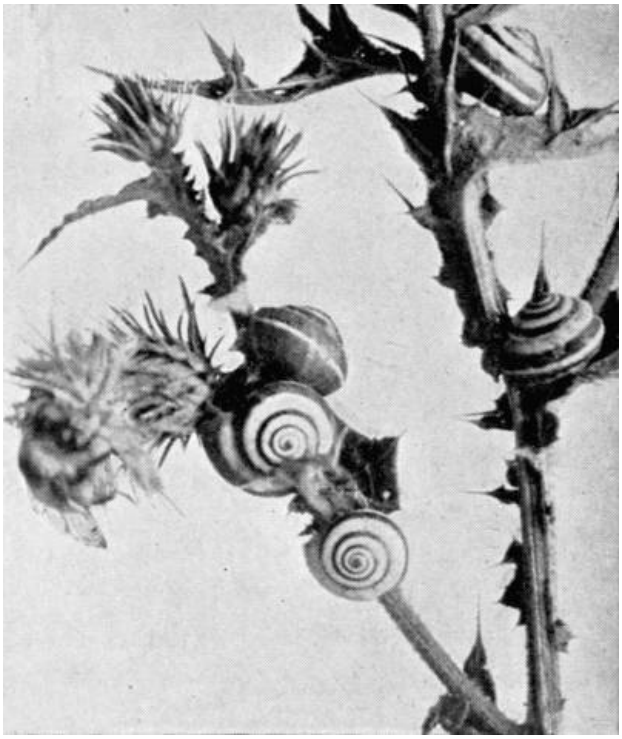
H. (Hygromia) revelata.—Scantily haired. Globular thin shell. Pale green. Mainly found in Cornwall and South Devon. In cold or dry weather it buries itself rather deeply.

H. (Hygromia) fusca.—Very thin, glossy, brown shell. Local. Hardy, and even active in frost. Chiefly found on nettles, which many shells like as food, though avoiding the commonly associated horehound.

H. (Euparypha) pisana.—First noticed at Pisa. Somewhat like *Helicella virgata*, but larger, sub-globular, and solid shell, yellowish-white with dark lines or bands. Aperture or mouth yellowish or rosy. Most common in Portugal and Morocco, and all round the Mediterranean, dry places, especially near the sea. In England chiefly confined to Tenby and other parts of Pembrokeshire; also in the Channel Islands. Varies much in tint and markings. Swarms where found; it loves sun and heat. Seems to lend itself better to colonization than most species.

H. (Helicella) itala.—So named by Linnæus, who probably received it first from Italy. Shell almost circular, flat. Umbilicus very large and open. Common on heaths and downs, especially near the sea.

H. (Candidula) caperata.—(The specific name means wrinkled, like a goat’s horn.) Careless of heat or cold. Distinguished from the young of *H. virgata* by being more depressed, having a larger umbilicus, regular and strong striation, and round mouth with white internal rib. Found under stones and on grass. Common.



***Helicella virgata* at rest on thistle, natural size.**

H. (Heliomanes) virgata (*i.e.* striped).—A very variable shell. See the illustration above of some at rest on thistles. Local, but very abundant where found. Whitish shell with dark bands, but a yellowish and a white variety usually is found with the type. The most beautiful variety, *radiata*, is chiefly found in Romney Marsh, and from Hythe to Rye.

H. (Turricola) terrestris.—A Mediterranean species, well established since 1890, in one spot near Dover. A pyramidal shell, greyish, with one dark band on each whorl.

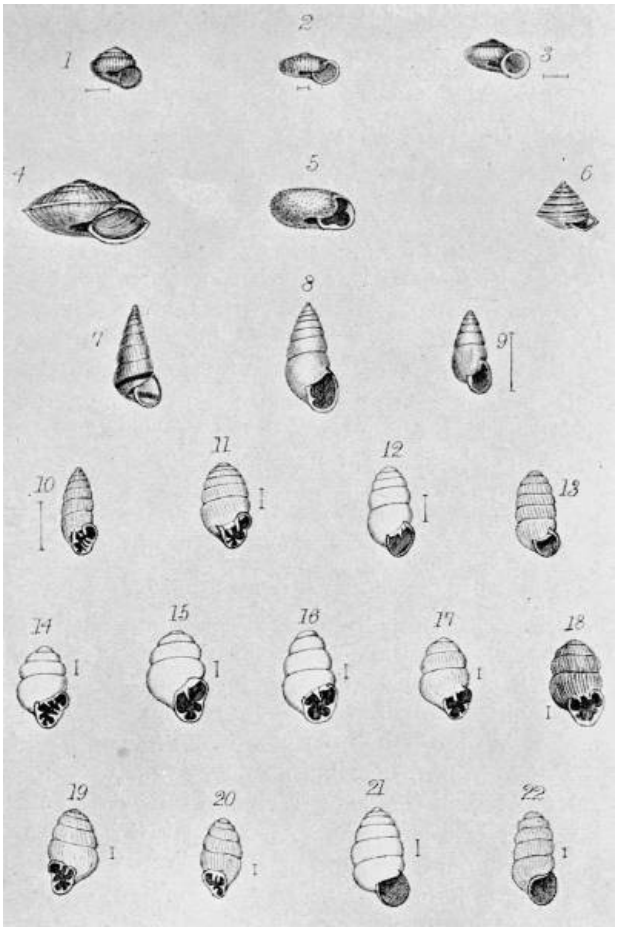
H. (Cochlicella) barbara (*i.e.* foreign).—Long, conical, whitish, with one dark band. By the sea-coast. In shape somewhat like a Buliminus.

We come now to the Pupa family and its genus Buliminus and its sub-genus Ena. It is represented by:—

Ena montana.—A local and southern shell, conical, slightly glossy, brown. Lip white and deflected. Commonly found on the holes of smooth-barked trees, and it closely resembles the small knobs on beech trunks.

Ena obscura.—Like the former, but much smaller, and found nearly everywhere in England and Wales. Found in hedgebanks, or on beech trunks. Its specific name is derived from its habit of covering itself with a coating of earth, and so becoming inconspicuous.

The plate on p. 47, gives figures of some of our smaller shells, enlarged in most cases so that their distinguishing marks can be seen. The upright line by the side of each figure gives its actual height. The shells as numbered are *Helix rupestris*, *H. pygmæa*, *H. pulchella*, *H. lapicida*, *H. obvoluta*, *H. terrestris*, *H. barbara*, *Ena montana*, *Ena obscura*, *Pupa secale*, *P. anglica*, *P. cylindracea*, *P. muscorum*, *Vertigo antivertigo*, *V. moulinsiana*, *V. pygmæa*, *V. alpestris*, *V. substriata*, *V. pusilla*, *V. angustior*, *V. edentula*, and *V. minutissima*. Without a magnifying glass it will be seen that it would be very hard to distinguish some of the minute shells, but this enlargement enables us to see the characteristic denticles in the mouth, and the presence or absence of striations on the shell.



Some of our smaller shells. Actual size indicated by the upright line.

Pupa (Abida) secale is named from the Latin for rye, a grain of which the shell more or less resembles. Conical, brown, mouth horseshoe-shaped with eight white denticles. Our largest Pupa. Local, but abundant where found. Prefers calcareous rocks or woods.

Pupa (Lauria) anglica.—Small, ovate, purplish in colour; mouth like that of *secale*. Lives in moss, mainly in the north of Britain.

Pupa (Lauria) cylindracea.—Small, cylindrical, paler than the last; thick and reflected white lip with one denticle. Abundant. On stones, in moss, under leaves and bark.

Pupa (Jaminia) muscorum.—Common, especially on sandy soils near the sea. Mouth nearly circular, whereas in the two former species it is horseshoe-shaped. The lip is thin and not reflected.

The genus Vertigo (*i.e.* twisted, the Latin equivalent of the Greek Helix) contains shells even smaller than the Pupæ, about the size of a pin’s head.

Vertigo (Alæa) antivertigo (*i.e.* not reversed or sinistral, as are *V. pusilla* and *V. angustior*). Semi-transparent, glossy, horn-colour, with denticles (as have all except *V. edentula* and *V. minutissima*). Found in nearly all counties in moist places.

Vertigo (Alæa) moulinsiana.—Our largest species, though only 2-1/3 millimetres in height. Mainly in marshy places. Not common.

Vertigo (Alæa) alpestris.—Rare and local, chiefly northern. Nearly transparent shell.

Vertigo (Alæa) pygmæa.—Common, and often in colonies at roots of grass and under stones and logs. Not confined to moist places.

Vertigo (Alæa) substriata.—Local. Strongly striated.

Vertigo (Vertilla) pusilla.—Sinistral, as is also

Vertigo (Vertilla) angustior.—Both species rare and local. The former is the larger and broader. In the former the last whorl is broadest, in the latter the penultimate. In the former the mouth is semi-oval, in the latter triangular. In the former the outer lip is very slightly, in the latter very deeply contracted. The former has 6 to 7 teeth, the latter 4 to 5.

Vertigo (Sphyradium) edentula is dextral and without denticles. Perhaps the most common *Vertigo*. Partial to bracken.

Vertigo (Isthmia) minutissima.—Dextral and without denticles. Smaller, narrower, and more strongly striated than edentula, but rarer. All the Pupæ should be examined with a magnifier.

Balea perversa (*i.e.* sinistral) is a much larger shell belonging to the Clausilia family. Thin, dark horn-colour,

semi-transparent, glossy, 7 to 8 whorls, local, but abundant where found. Chiefly found on trees.

Clausilia (Pirostoma) bidentata.—All our British clausilias are sinistral. The clausilium (little door) is an internal contrivance fastened to the pillar of the shell (whereas an operculum is attached to the body of a mollusc) by an elastic ligament to protect it against insect enemies when the animal withdraws. *Bidentata* has two denticles, fusiform and reddish-brown, as are all. Very common on walls and trees.

Clausilia (Pirostoma) rolphii.—Rare and local. Almost subterranean in habit. More coarsely striated than the last. The upper whorls nearly of the same breadth, forming a short cylinder.

Clausilia (Alinda) biplicata.—Very local. Chiefly on Thames willows. Larger than the two former, and streaked with white.

Clausilia (Marpessa) laminata.—Much like the former, but widely distributed. Usually found on beech and ash trees, and on limestone rocks. Smooth and glossy.

In the family Stenogyra we have three genera, Azeca, Cochlicopa, and Cæcilioides (with also the imported *Stenogyra Goodallii*, found only in pine-houses).

Stenogyra (Azeca) tridens is a small chrysalis-shaped, solid but semi-transparent shell, horn-coloured, with 3 denticles. Not rare in moist places.

Stenogyra (Cochlicopa) lubrica (*i.e.* slippery).—Very common in moss and under stones or logs. Much like the previous species, but no denticles and fewer whorls, and broader mouth.

Stenogyra (Cæcilioides) acicula.—If this word is supposed to be Latin it would mean either “like to a blind worm” or “like to a lettuce”! *Cæcus*, however, being Latin for blind, the allusion is no doubt to the fact that this wholly subterranean species is eyeless. The only British representative of a large family of carnivorous molluscs. I have found it on Saxon bones when unearthed, and in crevices of limestone underground, but it is generally found dead amongst the rejectamenta on the banks of rivers. It is a pretty, glossy white shell, 5 millimetres in height by 1 in breadth.

I may notice here two other land shells, although they scientifically are grouped amongst the fluviatile Gasteropoda.

Cyclostoma (Pomatias) elegans.—Common on calcareous soils, especially chalk. A spiral shell of 4-1/2 whorls, suture very deep. Mouth circular (whence its name) and provided with a thick shelly operculum which closes the orifice when the animal retires by means of an elastic ligament. This and the next species are our only land shells provided with an operculum, and this shows their derivation from the marine Gasteropoda (*e.g.* whelk and winkle). Perhaps all shells were originally marine, but some became first amphibious and then terrestrial. It is quite unlike any other of our land shells.

Acicula lineata is a very small shell, the size of the Pupæ; mainly northern in distribution. Feeds on liverworts and fungi. Very local; 6 or 7 whorls. Mouth pear-shaped, with a horny operculum.

The Family Succinea really ranks with the land shells, as belonging to the sub-order Pulmonata or lung-breathing molluscs. It is, however, amphibious, and hibernates in the mud at the bottom of a ditch.

Succinea putris (it is the mud, not the animal, which is putrid!) is called the Amber Snail from the colour of its shell, which is unlike any other. Common on flags, etc., at the edges of ditches and ponds.

Succinea elegans.—Difficult to distinguish from the former, but the animal is darker and the shell more slender, with a deeper suture and a narrower mouth.

Succinea oblonga is local and rare. Generally found near the sea. Much smaller than the other Succineas, and easily mistaken for the young of other species. Colour dull greenish.

The family Auriculidæ is represented in Britain only by *Carychium minimum*; a very small, semi-transparent, white and glossy shell found under mossy stones and other moist places. Common, but sharp eyes are needed to find it.

We now come to the freshwater shells, which we capture best by means of a perforated scoop, whether they are on the waterweeds or hidden in the sand or mud of the bottom.

It may be noted that all freshwater shells are greenish-brown which is an excellent protective colouring as rendering them less visible among water weeds to the fish, which devour them greedily.

The family of Limnæidæ (or lake dwellers) has the sub-families, Planorbis, Physa, Limnæa, and Ancylus. In the Planorbinæ (*i.e.* flat-coiled) the only representative of the genus Segmentina is *Segmentina nitida*, a small, quoit-shaped, keeled, semi-transparent, light brown shell, with internal divisions like those of a nautilus which are visible from the outside of the shell. Local. Found in stagnant or sluggish water. The genus Planorbis contains the sub-genera Hippeutis, Gyraulus, Gyrorbis, Coretus, and Bathyomphalus.

Planorbis (Hippeutis) fontanus is much like Segmentina but has no septa, and is flatter. Common, especially on watercress. Often encrusted with mud.

Planorbis (Gyraulus) nautileus is very small; quoit-shaped, with the upper side flat. Grey and striated. The variety crista has the ridges of the epidermis drawn into points, and is beautiful when seen by a magnifying glass. Common in ponds and ditches.

Planorbis (Gyraulus) dilatatus is a very small shell imported in cotton bales from America, and naturalized in canals in Lancashire. No other of its kind is so small.

Planorbis (Gyraulus) albus is dull white and striated. Flattish above, with spire depressed. Frequently encrusted and black with mud. Common.

Planorbis (Gyraulus) parvus (but not so small as *dilatatus*).—Convex above with a central depression, concave beneath. Suture deep, and umbilicus large. Smooth and glossy. Local.

Planorbis (Gyrorbis) spirorbis.—Very flat, glossy, brown, whorls 5 to 6. Common in ponds and ditches.

Planorbis (Gyrorbis) vertex.—Very like the last, but flatter and thinner, and with a prominent keel. More local than *spirorbis*, but sometimes found with it. Whorls 6 to 8.

Planorbis (Gyrorbis) carinatus.—Larger than *spirorbis* and *vertex*. Sharply keeled in the centre of the outer margin. Mouth angulated above and below. Local, mainly in the south and east of England.

Planorbis (Gyrorbis) umbilicatus.—Like the last, but the keel is below and not on the centre. Mouth rhomboidal. More common than *carinatus*.

Planorbis (Coretus) corneus.—Far the largest species. Dark brown, lighter below. Mouth nearly circular. Spire sunk. In boiling water often exudes a crimson fluid. Common.

Planorbis (Bathyomphalus) contortus.—Small, 8-whorled, flat above, very convex below. Fairly common in still water. Very compact in appearance.

The sub-family Physa has two genera, Aplecta and Physa.

Physa (Aplecta) hypnorum is a spindle-shaped, very glossy, semi-transparent, dark reddish brown, shell, with 6 to 7 whorls. Not common. Found in still water.

Physa (Physa) fontinalis.—More common, and found in running as well as in still water. Shorter and more rounded than the last. Shell very thin, greenish horn-colour. Lobes of the mantle expand over the shell. Seen in an aquarium are its perpendicular threads of mucus, up and down which the animals climb.

Limnæa (Amphipeplea) glutinosa.—Very local. Somewhat like *Ph. fontinalis*, but larger and more thin. In young specimens the mantle covers the shell, and in adults the animal is not wholly contained in the shell.

Limnæa (sub-genus Radix) involuta.—Only found in one Irish tarn. Whorls envelop the spire. Very thin, pale amber.

Limnæa (Radix) peregra.—The most common and variable of all our freshwater shells. Spire pointed. Somewhat amphibious. Found practically over the whole of the Eastern Hemisphere.

Limnæa (Radix) auricularia.—Mouth very large, with outer lip widely reflected. Very common and fine in the Thames. Spire very short, apex sharp.

Limnæa (sub-genus Limnophysa) stagnalis.—The largest of the genus. Common, except in Wales. Shell greyish, spire long and tapering to a point; 12210 teeth on its lingual ribbon. See the illustration on p. 57, which also shows above two specimens of *Paludina contecta*, one being covered (as freshwater shells often are) by a vegetable growth, which obscures the marking.

Limnæa (Limnophysa) palustris.—Shell tapering, somewhat solid, brown, much smaller than stagnalis. Common in slow or stagnant water. Some varieties much darker than the type.

Limnæa (Limnophysa) truncatula.—Like the last in shape, but much smaller, and with a deeper suture. Common, and fond of being out of the water. A parasite of this mollusc causes “fluke” in sheep which have taken it in by drinking or by eating grass by the side of ponds and ditches.

***Paludina contecta* (two) and *Limnæa stagnalis* on water-weeds.**

Limnæa (Omphiscola) glabra.—Also amphibious. About the same size as *truncatula*. Local. Inner lip rather thick and reflected on the base of the penultimate whorl.

Limnæa (Ancylus) fluviatilis.—"Freshwater limpet." Shell, rather limpet-like, with a hooked apex (whence its generic name), adheres to stones or piles in running water. Common. I once dredged a large water-beetle with three of these shells adhering to its wing-cases; thus it would be transported to fresh habitats.

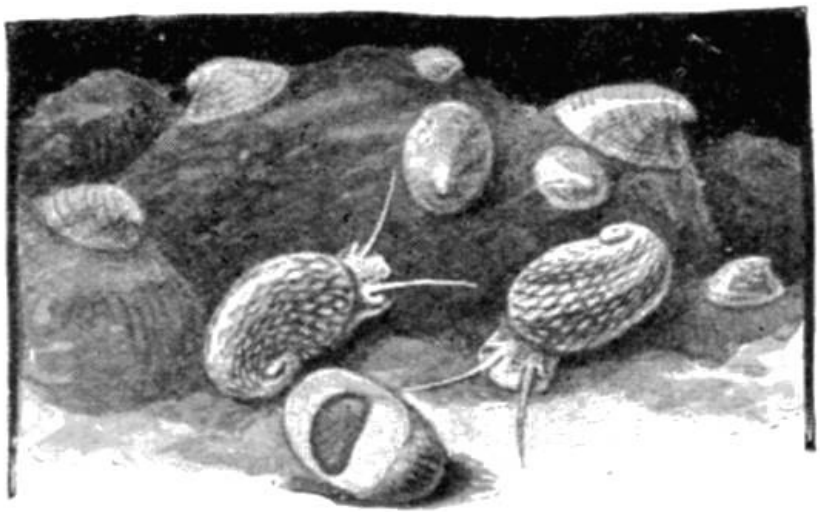
Limnæa (Acroloxus) lacustris.—Like the former but more local, and preferring sluggish or still waters. Shell more oblong, thinner, and apex twisted to the left instead of to the right as in *fluviatilis*.

The sub-order Pectinibranchiata (comb-like gill) contains the genera Neritina, Paludina, and Valvata, in all of which there are two tentacles with eye at the base, and an operculum to the shell.

Neritina fluviatilis.—Solid, glossy, chequered brown, white, and purple (but also a lemon-coloured variety). Operculum semi-lunar, orange, with a projection which serves as a lock to keep the operculum in position. Not rare in England; on stones in running water. See illustration below, which also shows above *L. (Ancylus) fluviatilis*.

Paludina (Vivipara) contecta.—Shell dark green with darker bands. Conical. Suture very deep. Operculum horny. Viviparous. Local.

Paludina (Vivipara) vivipara.—More common than contecta. Shell more oval, not so glossy, light greenish yellow, suture not so deep, no umbilicus, apex blunt.



***Neritina* and *Ancylus*.**

Paludina (Bythinia) tentaculata.—(The eyes in this genus are not on foot-stalks; the operculum is shelly instead of horny). Common in slow water and ditches. Shell semi-transparent, yellowish, mouth oval, angulated above. Operculum made of plates rising one above another formed at different stages of growth.

Paludina (Bythinia) leachii.—Much smaller and less common than the last. Distinct umbilicus; mouth almost circular.

Paludina (Paludestrina) ventrosa.—A brackish-water shell, swarming where found, *e.g.* from Erith to Gravesend, and in East Anglia. Shell small, thin, semi-transparent.

Paludina (Paludestrina) jenkinsi.—A larger shell, not confined to brackish water and spreading very rapidly. Swarms where found. A variety has a marked keel which sometimes bears bunches of spines at equal distances.

Paludina (Paludestrina) stagnalis.—Larger and with more whorls. Not so common.

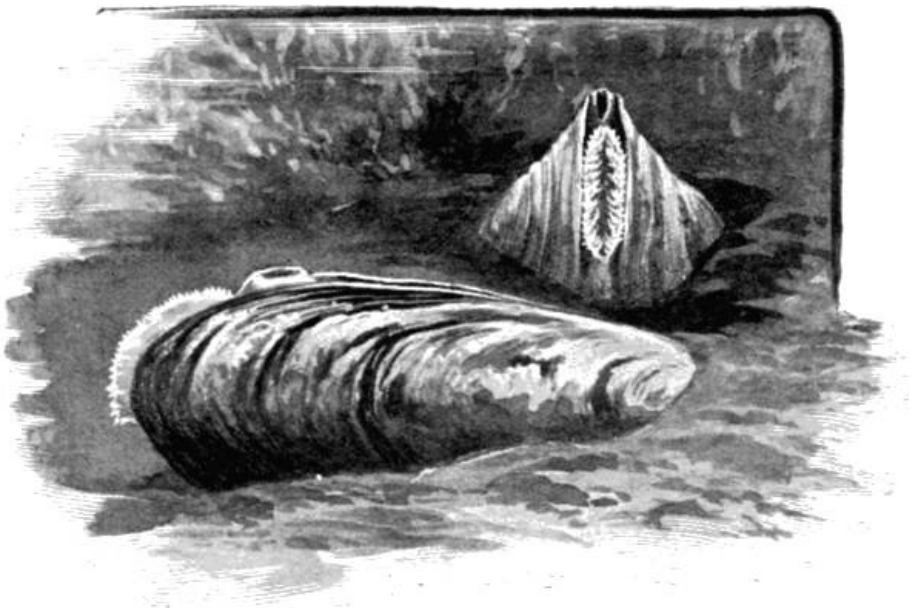
Paludina (Pseudamnicola) anatina.—Small, sub-conical, deep suture. Found in brackish water, and apparently identical with *Hydrobia* or *Paludestrina similis*, which I used to find by the Thames, where it is now apparently extinct.

Valvata piscinalis.—Globular, suture very deep, circular mouth, operculum concentrically spiral. In ponds and slow water. Shell yellowish, but commonly covered with conferva.

Valvata cristata.—Much smaller; shell disk-shaped. Frequents the roots of flags. Shell striated and more or less ridged, but the name *cristata* refers to the plume-like appearance of its breathing apparatus.

We now come to the bivalve shells with leaf-like gills. The Unionidæ contain two genera, Unio and Anodonta, commonly called freshwater mussels.

Unio tumidus.—Shell ovate, very solid, dark brown; common. See accompanying illustration, which shows the fringed branchial siphon which draws in food-bearing water, and the smaller anal siphon by which it gets rid of undigested matter.



Freshwater mussel breathing and eating.

Unio pictorum.—More oblong and thinner shell, yellowish, girdled with brown in the lines of growth. Common. The specific name recalls that gold and silver paint used to be sold in these shells (or marine mussels) for illuminating work. It is said to produce 220,000 eggs in the three summer months.

Unio (margaritana) margaritifer.—Shell solid and black, beaks always eroded. Mainly found in mountain streams. Its pearls are few and poor compared with those of marine shells; but they attracted the notice of Cæsar and so hastened the conquest (and development) of Britain.

Anodonta cygnea.—(In this genus the hinge is toothless, whence its generic name. The specific names *cygnea* and *anatina* mean "swan" and "duck," in reference to their comparative size). This is the largest of our freshwater shells, reaching even 9 inches in breadth by 4-1/2 in length. Common in ponds and slow water. Sometimes the shells are yellowish green with rays of the same colour.

Anodonta anatina.—Doubtful if this is a separate species or only a smaller form. The hinge line is raised instead of being straight, and the posterior side slopes abruptly instead of gradually.

In the next family are two genera, Sphærium and Pisidium.

Sphærium corneum.—Very common. Shell somewhat globular, glossy, opaque, horn-coloured, marked with lighter bands in the line of growth. Usually on the bottom, but can suspend itself by threads of mucus.

Sphærium rivicola.—Much larger. Also flatter and more striated. Yellowish brown or greenish. A whole series of young of different sizes will be found in the animal.

Sphærium pallidum.—Local in canals and ponds. Oblong. Distinguished also from the previous species by the body being milk-white, and the shell is ashy-grey.

Sphærium lacustre.—Local. On the beaks is a calcareous nucleus which distinguishes it. It is thinner than *corneum*, and rounder than *pallidum*.

Pisidium amnicum.—(Our five *pisidia* resemble *Sphærium*, but are much smaller, all but *amnicus* being minute. Very abundant where found. *P. amnicum* and *fortinale* are triangular in shape, *P. pusillum* oval, *P. nitidum* round, and *P. roseum* or *milium* oblong; but they are difficult to distinguish on account of their similarity and variation). *P. amnicum* is nearly twice the size of the others, and this and *fontinale* may be found in slow rivers, whereas the others prefer stagnant waters.

Pisidium fontinale.—Smaller and thinner, and with more prominent beaks than *P. amnicum*.

Pisidium pusillum.—The most common species. Distinguished from the last by being oval and by its beaks being blunter and more central.

Pisidium nitidum.—Rare. Very glossy and striated.

Pisidium roseum (from the colour of part of its body).—Like *nitidum*, but oblong, with a straight lower margin, and with beaks placed away from the centre.

The last shell to be mentioned could not be mistaken for any other. It belongs to the sub-order *Heteromya* (*i.e.* with adductor or closing muscles not equal); to the family of *Mytilidæ* (or mussels) and the genus *Dreissensia* (named after a Dutch conchologist).

Dreissensia polymorpha is a triangular, boat-shaped, bivalve, supposed to have been introduced with Russian timber (as was also probably *Hydrobia Jenkinsi*). It is gregarious, and attaches itself to objects by a byssus like our marine mussels. Shell yellowish-brown with wavy purplish lines, wrinkled in the line of growth. Common in the New River, and has been found in iron water-pipes in Oxford Street.

All our shells have varieties (many an albino or white form), and the collection and distinguishing of these varieties, which in some species are numerous, adds much to the interest of the collector. In addition there are also the variations in size or markings which can hardly rank as varieties. Inasmuch as none of our shells are peculiar to our country (which is from the natural history and the geological point of view only a detached portion of the Continent), it may be well to warn young collectors that if they receive shells from the Continent, mere varieties are there often named as separate species and variations considered as definite varieties. This is especially the case with *Helicella virgata*.

As to the arrangement of shells in a collection before a regular cabinet is obtained, the tinier shells may be kept in small glass tubes with corks (such as used for homœopathic medicines), and the medium sized ones in the trays of common matchboxes, these being arranged in large shallow glass-covered trays which can be obtained from any cardboard boxmaker at a small cost, and several of these, stored one above the other, form an excellent substitute for a more costly cabinet. In all cases the name, and the place where the shells were found, should be written on a small slip of card placed in the tube or tray. It is not well in most cases to fasten the shells on card, but if this is done gum tragacanth is best. The collection should be kept free from damp and from dust.

Hints for Collecting and Preserving Shells of Molluscs.

The following notes supply a few general rules as to finding and preserving shells:—

Of Shell-bearing Molluscs there are three classes—Marine, Freshwater, and Land. The first two include Univalves and Bivalves, the last only Univalves.

1. Marine Shells may be obtained, 1st, by searching on and under rocks at low water, or on coral reefs, among seaweed attached to them, or floating on the sea, or on a sandy beach. Bivalves may be found by digging in the sand, or mud, on a beach, or at the mouth of a river: their presence is generally indicated by a circular breathing hole in the sand. 2nd. By dredging, by which means only deep-sea shells can be obtained; but after a storm these may often be found upon the shore, before they have lost their lustre.

Limpets, etc., should be detached with a thin blade passed quickly under the shell, taking care not to break the edges. Small shells on and in seaweed, and limpets, etc., adhering to stones will drop off and sink to the bottom in a vessel of cold fresh water.

2. Fresh-water Shells may be obtained in any river, lake, pond, marsh or reservoir. Univalves, chiefly on the banks, on reeds and plants growing near the hedges, and on the under surface, leaves, and stems of aquatic plants. Bivalves generally at the bottom, among stones, or buried in the sand, or among the roots of aquatic plants.

3. Land Shells.—These resemble, more or less, in their habits the garden snail, though varying greatly in character, size, and colour. They mostly abound in a chalk or limestone district, and in moist and wooded situations. Some species inhabit low and damp spots, roots of trees, hollows and crevices of rocks and walls; some lie under stones or pieces of wood, or in the earth; others climb shrubs, and in tropical climates even lofty trees. Their haunts vary according to the weather and the season. They come out early in the morning, and after rain. Some bury themselves in moist places during the dry season, or burrow under leaves, grass, or stones, often closing the mouths of their shells with a white secretion to prevent evaporation during the period of hibernation.

The smallest shells, especially of land species, and young imperfect shells should be collected.

In all cases “live shells,” *i.e.* shells in which the animal is alive, are to be chosen; but, when these cannot be procured, “dead shells,” which have not lost their lustre, or their colour, especially those of rare species, should be preserved.

With regard to the mode of Preserving Shells.

1. No attempt should be made to clean them, or to remove the furry skin, more or less thick, with which they are often covered, beyond removing with a soft brush any mud or sand adhering to them.

2. The animals of Land and Freshwater shells may be killed by immersing them for a few minutes in *boiling* water, after which the bodies may be easily extracted whole with any suitable instrument, *e.g.*, a fork or a pin, according to size. Hot water should not be used with marine shells: it often destroys their lustre. They should be buried, if time permits, in sand, or other dry material, until the animal dries up (in small shells) or rots (in large specimens); or they may be drowned in cold fresh water, and hung up in the air to dry or rot away. In the former case, if an operculum (with which some species, both marine and land, close their mouths, more or less partially) exists, it will, generally in the case of land shells, remain in its place, adhering to the shell. In the latter, the decayed matter should be washed out, and the operculum, if any, replaced and fixed, say, on cotton filling the shell. This applies equally to land shells.

3. Care should be taken not to injure the edge or lip of the mouth of univalves, or the ligament of the hinge of bivalves. When bivalves gape on dying in water, or if the ligament be broken, the valves should be closed and tied together. If the ligament of a gaping bivalve should become dry and stiff, it can be softened by putting it in water.

4. The localities in which each species is found should be noted, and, in the case of dredging, the depth of water.

With regard to the mode of packing Shells for Transport.

All solid shells may be wrapped in one or two folds of paper of any kind. Fragile and minute shells should be put, generally separately, into a box or bottle—with or without cotton, as required. Such packets may be heaped up in any box, heavy shells at the bottom, without pressure, and any blank filled at the top with paper or other elastic material. Sawdust injures the lustre of many species.

Two books on shells should be procured at an early stage of the collector's career, which will give not only minute descriptions of all our land and freshwater shells and their varieties, but also plates of illustrations. These are the *Collector's Manual*, by L. E. Adams, 2nd ed., published by Taylor Brothers of Leeds; and Rimmers' *Land and Fresh Water Shells*, published by George Grant of Edinburgh.

THE END.

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