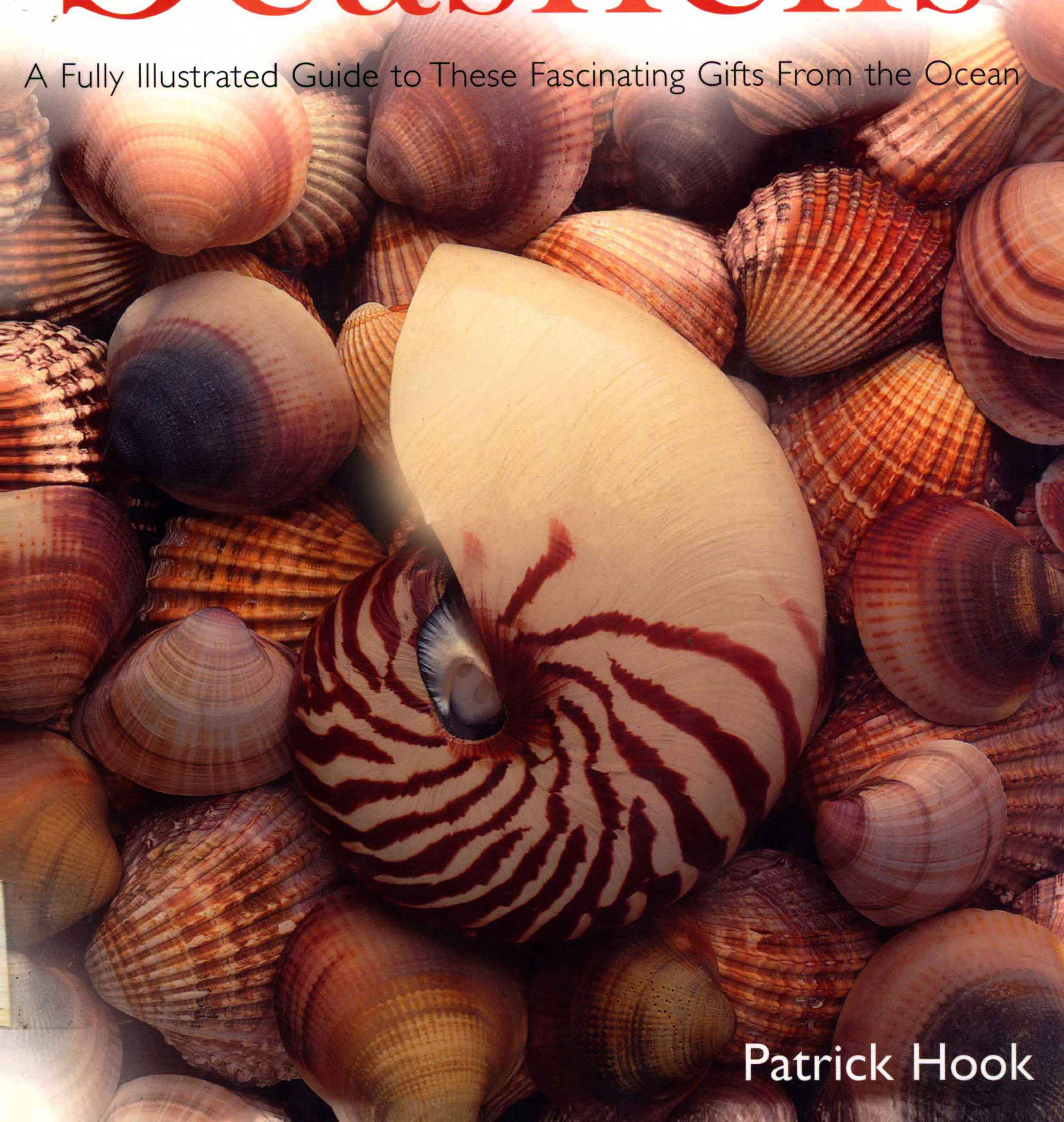
The World of Seashells

A Fully Illustrated Guide to These Fascinating Gifts From the Ocean



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Glossary

Aberrant: When an individual is markedly different from others of its species.

Adductor muscles: Found in bivalves — they are The muscles which close the two valves tightly.

Biota: Expression used to describe the flora and fauna of a habitat.

Byssus: The threads bivalves use to attach themselves to the substrate (rocks, jetties, etc.).

Callosity or Callus: A localized area of thickening of the shell.

Cardinal: The central hinge tooth found in bivalves.

Conchology: The study of shells; today it means the study of the shell only, that is, not the living organism inside.

Descriptor: Person who first described the species for science, and the date when published.

Endemic: When a species is native to or confined to a certain area.

Exhalent siphon: The tubular extension of bivalves through which they circulate water from the mantle cavity.

Inhalant siphon: The more ventral tubular extension of bivalves through which water is sucked into the mantle cavity — from this the mollusk filters out its nutritional supply. Some gastropods also have an inhalant siphon.

Ligament: The "spring" which opens the two halves of bivalves. The adductor muscles work against it when the mollusk pulls the halves shut. This why dead bivalves always have their valves open.

Mollusk (UK: Mollusc): derives from the Latin ***mollis***, which means "soft". It encompasses any invertebrate of the phylum Mollusca; often these mollusks have shells — but not always.

Niche: The position that an organism takes up within an particular ecosystem, e.g. limpets on rocks.

Operculum: The trapdoor that gastropods use to seal themselves against the outside world, usually a horny or calcareous disc attached to the foot.

Polymorphism: This means that a species has several different forms.

Population: The number of individuals of a given species in a certain habitat or geographical area.

Radula: The "rasping tongue" of most mollusks. When seen under a microscope, it is a bit like a conveyor belt with cutting teeth inserted into it.

Siphonal/anterior canal: The groove through which the inhalant siphon passes.

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Introduction

Shells have fascinated mankind ever since civilization began. They have been represented in art through paintings and sculptures, in finance as currency, and in battle as heraldic symbols. In fact, my own family coat of arms has four "escallopes invert" — that is, upside-down scallop shells, as the major elements of its design.

One of the attractions of shell collecting is that it is within the reach of everyone — it is true that the rarer specimens can fetch vast sums of money, but at the other end of the spectrum, they are free for the taking. Very often the fascination with shells starts at an early age with slow walks along the beach under the patient supervision of family members. If these early forays were anything like mine, the wonderful fruits of this collection would soon end up on the flower-bed — my father would use them as extra calcium for his beloved plants!

Over the years, there have been a few people who have made themselves famous by collecting and/or writing about shells — some of the collections put together were spectacular, and some of the books on the subject have been works of art in their own right.

Every single species of shell also has its place in nature, along with all the complex interactions that this implies. Some are predators, and all are prey. Some are abundant, while others are on the edge of extinction. Many are edible, but others are highly poisonous. While most are entirely harmless to man, there are others that are capable of inflicting fatal wounds if handled carelessly, or trodden on by the unwary.

Some people will find their almost endless variety of shapes and colors to be enough to sustain a life-long fascination, but for many others, the driving rationale is to study their biology — that is, how shells coexist with their environment.

Much of the scientific research into shell species is focused on those with commercial significance, such as abalones, mussels and oysters. Sometimes the financial return is from turning the meat of the mollusk into food, while in others it is for the production of pearls, or the production of "artifacts", such as jewelry, or tourist gifts.

We have found and scientifically described over 100,000 different species of shells — but this is estimated to be only half of them. This isn't surprising: our planet's surface is four-fifths water, and it we know more about the surface of the moon than we do about the bottom of our seas and oceans!

This book can only scratch the surface of the subject, but I hope that it will serve as a starting point for those newly arrived at the subject, and thought-provoking for the existing enthusiast.

Patrick Hook

Shells: what they are and how they are constructed

Right: This is an excellent illustration of how a nautilus shell is constructed. The living mollusc controls its buoyancy by pumping water in and out of these chambers.

Below: Sand dollars are often found washed up on beaches and are commonly mistaken for seashells by newcomers to the shoreline. They are, in fact, sea urchins, which are members of the *echinodermata* and therefore far removed from the *mollusca*.

What constitutes a "shell"? Today there are clear guidelines: if it's not in the phylum mollusca, it's not a shell! It wasn't this straightforward in the past. In the 18th century, shells were considered to include any animal that had a rigid exterior covering, for example crabs, lobsters, and sea urchins, all of which are in different categories today (crabs and lobsters are crustaceans; sea urchins are echinoderms). The modern classification was initiated by Baron Georges Cuvier who grouped mollusks (the word "mollusk" derives from the Latin *mollis*, meaning soft) together in much the way they are now, except that he included the barnacles and brachiopods — these are now placed in the crustacea and brachiopoda.

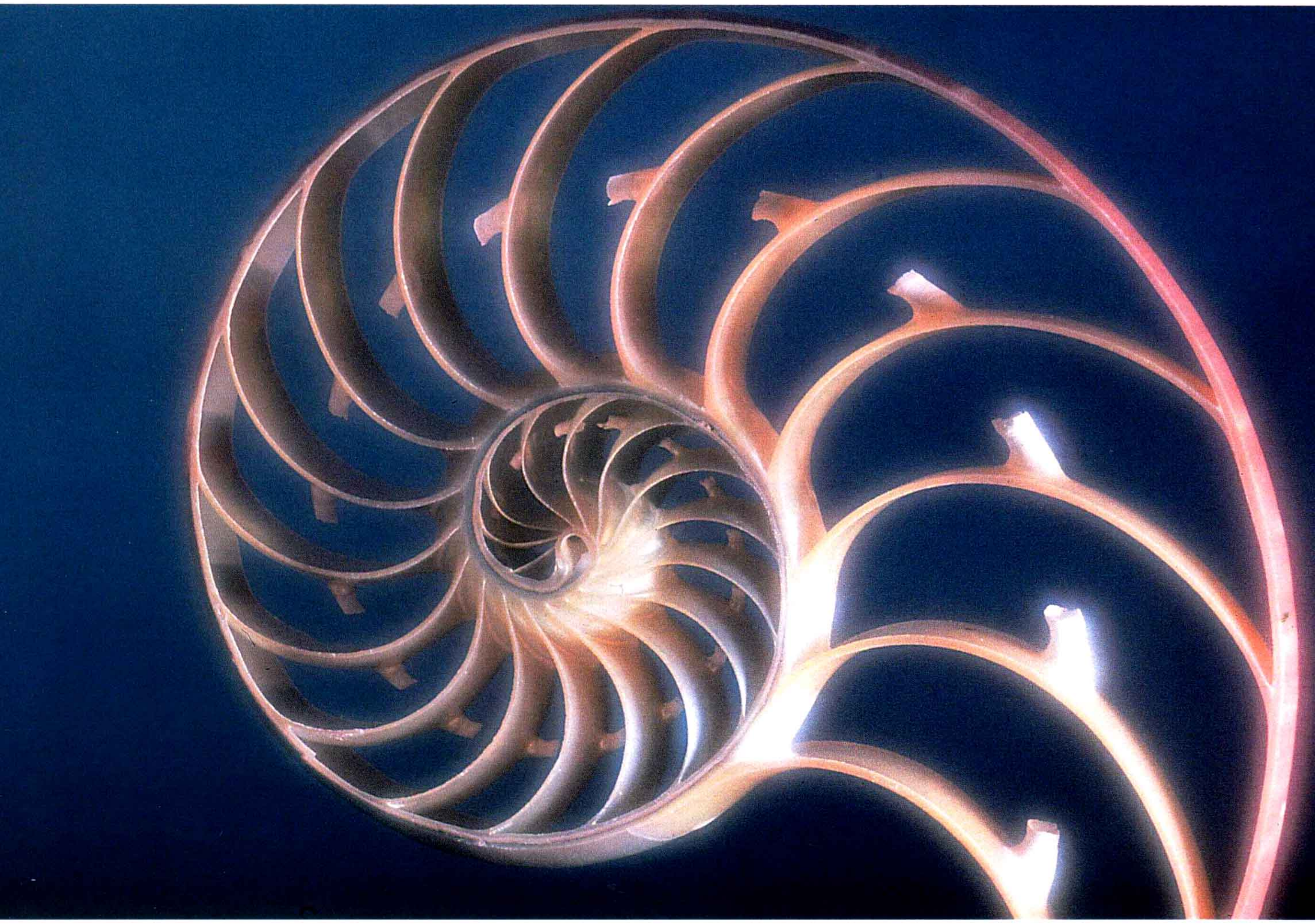
Not all mollusk species possess a shell: take the slug — a mollusk, and yet quite obviously shell-less. The slug highlights another distinction: not all mollusks come from the sea. Many live on land or in fresh water. "Shellfish" is also a misnomer: it's not a scientific word, but one used to cover seafood that has some form of hard outer covering, and hence covers not only mollusks but also shrimps, prawns, crabs, lobsters, etc.

Why do some mollusks grow shells in the first place? Mostly for protection against predators. The shell protects the mollusk for long enough for it to be able to breed, but at a metabolic construction cost low enough not to reduce its breeding success. There's a trade-off: the shell must be strong enough to protect the tasty morsel inside from predators and still be practical to build — and the fact that shells have been around for so many millions of years tells us that this has been achieved with a great deal of success. They are bio-engineered with a very clever blend of design and materials, and — as with so much in nature — there are many superb optimizations of form and function in shell structures.

In the marine environment most predators attack their prey using force — for example the trigger fish uses powerful jaws to crunch its way through coral or crustacea. Shells consist of calcium carbonate crystals embedded in a matrix of protein. The crystals are of aragonite — a mineral which is also found naturally in rock. The inner surfaces of most shells is made of "nacre", but in some species it is used to create the entire thickness of the shell — including the Pearly Nautilus and the Pearl Oyster. Each crystal of aragonite is in the shape of a small platelet, measuring 5 x 5 x 0.5 microns; these are laid down in layers, glued together with special proteins. The clever part is that the shell allows very small cracks to occur when it is attacked, but it dissipates them so effectively that they don't combine to produce an actual breakage. It is, therefore, extremely difficult for a predator to form a crack without exerting far more force than would be reasonable.

The limiting factor of nacre strength is the protein that glues the platelets together: they fail when pulled apart, not by snapping. Nacre produces a slow and steady failure, requiring a lot of energy to get through, instead of a sudden collapse. Few predators expend enough energy to make the shell give way, allowing the mollusk to live for another day, and repair the damage. The fact that nacre is built up of crystals and protein makes it a composite material — just as carbon fibre, kevlar and glass fibre are combined with resins to produce tough, durable structures, such as boats, aircraft and racing cars.

Shells are also constructed so that their maximum strength is in the direction of expected attack from a predator — in other words, from outside. The energy required to produce a crack from outside is ten times that required to produce one along the length of the shell, thus saving the mollusk from expending its resources constructing needless material strength, and yet another example of the way that human engineers can learn lessons from nature!



Shell classification: how they are named

Far Right: **Some seashells have common names that don't make any obvious sense. Others, such as this blood tooth, need no explanation.**

Right: The Black-Spotted Triton was described for science by Linnaeus in 1758, so these details are added to the end of its scientific name thus: *Cymatium lotorium*, Linnaeus 1758. (See page 123.)

One of the problems with the classification of any plant or animal order is that it doesn't stay the same for very long — the taxonomists are forever arguing about the relevance of certain morphological features, whether a particular tubercle is more significant than a given bristle, and so on. There is no single system that everyone agrees will be universal. The truth is that every system is an entirely artificial ordering — one that we, as humans, have decided to impose on the natural world for our own convenience. In other words, whatever I say here, some people will disagree with it, and the odds are it will be out of date before I get to the end of the paragraph anyway!

A lot of shells have an English, or common, name, and all those that we have found have one in Latin — the scientific name; this latter is derived from the "binomial" system which was first used by Carl Linnaeus (properly written Carl Von Linné) in 1753, in his book *Species Plantarum*. This was the starting point for scientific nomenclature for botanists, and the same happened for zoologists when Linnaeus published his tenth edition of *Systema Naturae* in 1758. What made him unique amongst scientists of his time was that he was a very systematic worker. Can you imagine the mess we'd be in today if Linnaeus had tried to impose a naming system on over a million different animal species without it being rigorous and methodical?

The Latin name has at least two parts, and may well have "extra" names tacked on the end. Sometimes they translate into meaningful phrases, especially those named back in Linnaeus's time. For instance, the "Elongate Tusk," named in 1842, is known scientifically as *Dentalium longitrorsum*, which translates as "Long Tooth" — rather unsurprisingly as it looks just like one!

When the species in question has various subspecies, an addition is

made to the name; for instance, when the "Rock Shell," Latin name *Thais haemostoma*, is considered, the subspecies from Florida has the word *floridana* added, so it becomes *Thais haemostoma floridana*. Notice also, that the first letter of the Latin name is spelt with a capital (this is the "generic" name), whereas the first letter of the second (this is the "specific" name) and any others are in lower case.

You will often also see a name and, possibly, a date at the end of the Latin name, such as "Conrad, 1837." This identifies who first described the species for science, and the date when the description was published. However, if this name and date are placed in parentheses, it means that the species has been moved from the genus where it was first put into another one. This may sound a bit much, but it's scientific convention — it also helps to clarify the situation if someone else uses the same Latin name for a different species.

One of the other confusing aspects of naming any plant or animal is that, as we discover more and more about which species are related to which, we have to re-classify them — that is, we have to take them out of the place where we formerly thought they belonged in the family tree of life, and put them in what we hope is the right place. This means that we have to change their Latin name. To make matters even more confusing, a single species may have many different common names, even in the same country. For instance the shell known as the "Lance Auger" in some countries is known as the "Marlinspike" in others.

The classes of the phylum mollusca

The phylum mollusca contains some real surprises if we expect it to contain "just" shells, for it also includes the cephalopods — so the octopus and the squid are in this varied group. It also covers several more familiar classes, including the bivalves (scallops and clams), the gastropods (slugs and snails), scaphopods (tusk shells), and the polyplacophorans (chitons). There are two others which are much less well known; these are the aplacophorans (solenogasters), and the monoplacophorans.

Class Aplacophora

The aplacophorans are worm-like creatures that don't have shells in much the same way that slugs don't, so they are less well known to shell-collectors than more conventional classes. They are marine animals that vary tremendously in size: some are only 0.04in long (1mm), whereas others grow up to a foot in length (300mm). The 250 or so species divide into two types — those that are predators, and those that feed on detritus.

The nautilus shell has buoyancy chambers and can float a long way even after the mollusk which created it has died. Because of this, when you find a nautilus it is impossible to know where it came from.

Class Monoplacophora

Until the 1950s, when the first living species was found, it was thought that the monoplacophorans had been extinct for between 50 and 370 million years, as they were only known from the fossil record. Since then more recent discoveries have brought the current total to about 12 known species. Rarely seen by shell-collectors as they live in deep water — sometimes very deep water indeed, ranging from between 600ft (183m) and 20,000ft (6,100m) in depth — they vary in size from about 0.1in (2.5mm) up to about 1.5in (38mm); they are very simple mollusks with limpet-like shells that feed on things like algae.

Class Polyplacophora — Chitons

The polyplacophorans are sometimes called the "coat-of-mail" shells, as they usually have eight plates that overlap like medieval armor. These are attached to each other with strong fibres, producing a tough and durable defence against most predators. The 800 or so members of the class are entirely marine; most are shallow water species, but some extend into the abyssal depths. They are grazers on various marine growths, in much the same manner as the limpets with which they often share their habitat.

Class Scaphopoda — Tusk shells

The Tusk shells are uncommon marine animals that have tubular shells which bear more than a passing resemblance to the tusks of, for example, an elephant. The most obvious difference (apart from size!) is that the shells are open at both ends. There are about 350 species, ranging in size from 6in (150mm) down to about a 0.1in (2.5mm). Their preferred habitats tend to be where there is soft sand or mud to bury themselves.