

Invertebrate Macrofossils

Lecture 7

Gastropods – Class Gastropoda



What are gastropods?

- The distinguishing feature of the gastropods is the twisting of the visceral mass
- Body is asymmetrical
- There is a head at the anterior, and a muscular creeping foot ventrally
- In most forms the body is protected by a single univalve shell (there are forms lacking a shell, e.g. slugs)
- The typical shell is a tapering tube, coiled in a right-handed spiral



Gastropods

- The most varied and abundant mollusc class
- There are more gastropods now than ever
- 30000 existing species, at least 15000 fossil forms
- Extensive adaptive radiation: mostly shallow water marine, although there are some planktonic forms (pteropods), fresh water and terrestrial forms
- Earliest forms appeared in Early Cambrian



- Changes that occurred from the primitive ancestral hypothetical archimollusc:
 1. Development of head (cephalization)
 2. Dorsoventral body elongation
 3. Coiled shell forming deep retreat
 4. Torsion



Soft part morphology

- The shell is a refuge where the entire body can be retracted
- The body consists of:
 1. the head (true head), with tentacles, eyes and other sense organs
 2. the foot, an elongated structure with a flat sole-like surface (upon which the animal creeps); muscle contractions move animal on layer of slime (produced by mucus glands)
 3. the visceral mass, which contains the internal organs and the mantle cavity, is usually helically coiled and resides inside the shell



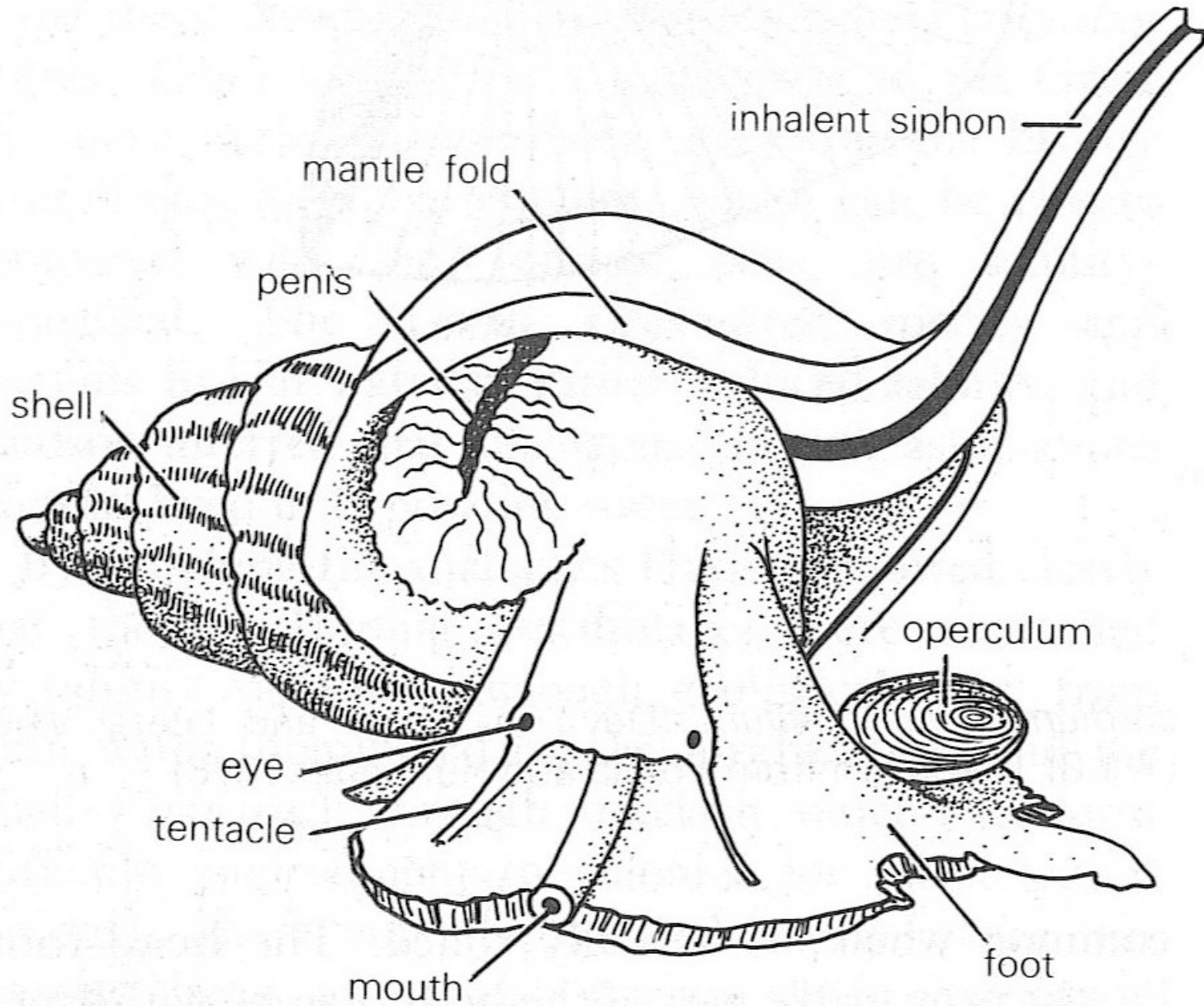
Soft part morphology

- The head and foot consist the retractable part of the body
- Can be withdrawn inside the shell by **retractor muscles**
- Below the head, the mouth is located, which contains a food-rasping tool the **radula** in its lower part
- The radula is a flexible horny ribbon bearing rows of tiny teeth, which scrape against a horny plate at the upper part of the mouth
- Advanced gastropods possess a tubular extension to their mouth the proboscis

Soft part morphology

- Unlike other molluscs the mantle cavity lies anteriorly towards the head
- In aquatic forms the mantle cavity contains feathery gills, in terrestrial lung-like organs
- It communicates with the external environment by means of an **inhalant siphon**, a tubular organ formed by a fold in the mantle
- However many gastropods do not have such a siphon and inhale water along the edge of the shell
- In mantle cavity also anus, mucous glands and osphradia (specialised organs)
- Notable the anterior position of the anus, caused by the torsion (twisting) of the mantle and the viscera during the early larval stages (more details in next lecture)

(a)



Problem

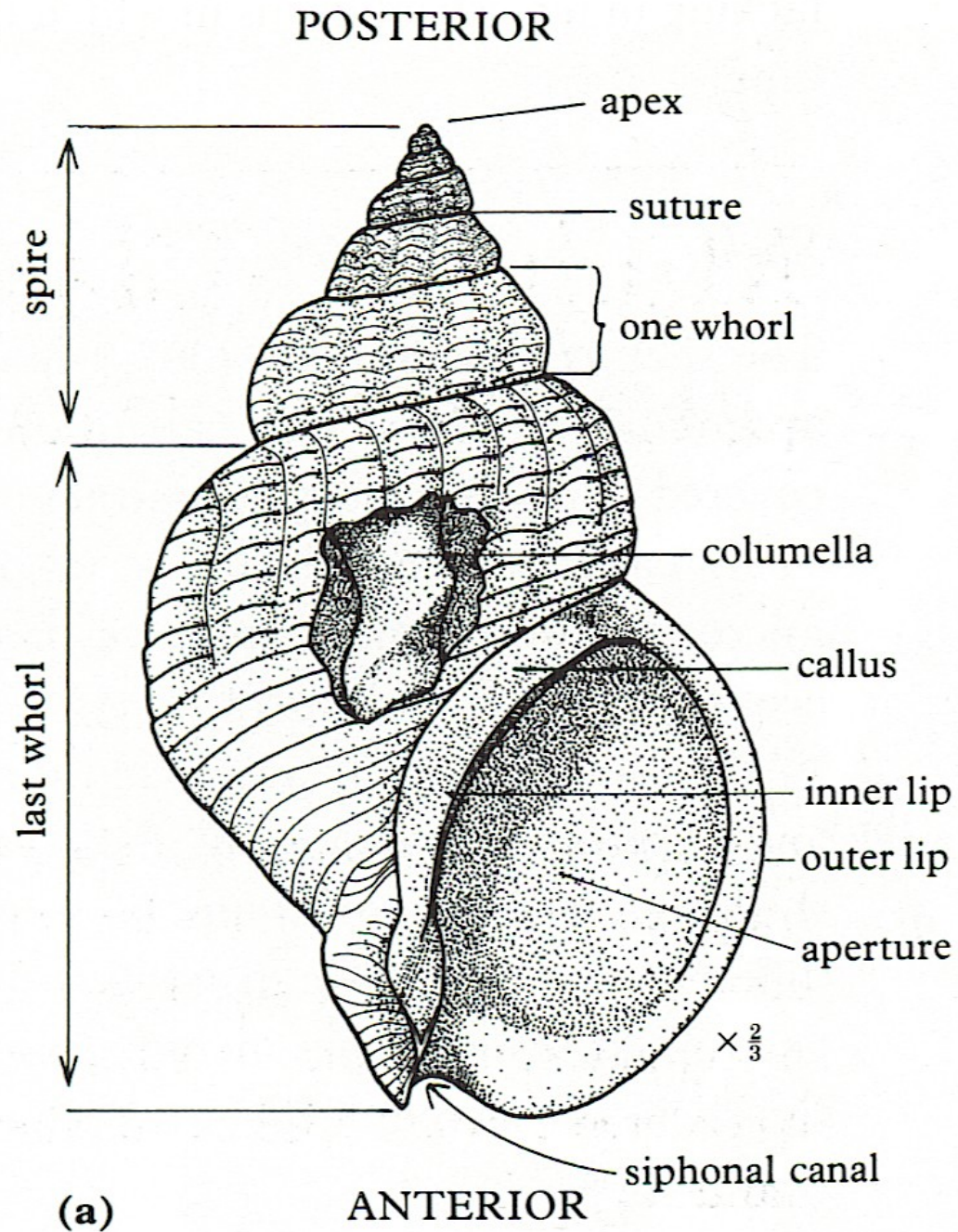
- Mouth and anus at the same area, thus, waste products expelled over the mouth
- Devices that separate inhalant – exhalant water
- Some gastropods possess exhalant siphons
- Others possess an dorsal indentation (**exhalant slit**) in the shell



The shell

- Basically an elongated, usually conical tube, rarely septated, coiled in a number of ways
- The closed pointed end is called the **apex** (posterior of the shell)
- The opening at the wide end is called the **aperture** (anterior of the shell)
- Architecture of shell controlled by coiling, rate of increase in shell diameter, cross-section shape, form of aperture and ornament





Coiling

- Two overall types of coiling:
 1. **Planispiral**, coiled in one plane
 2. **Conispiral**, coiled helically descending from the apex to the aperture (most gastropods)
- In some gastropods coiling is confined to the embryonic shell (protoconch) at the apex, with a conical cap shaped adult shell (e.g. *Patella*)



Coiling

- **Whorl**: each complete coil of a shell
- **Last whorl**: the ultimate whorl
- **Spire**: all the earlier whorls except the last whorl
- **Suture line**: the spiral line along which successive whorls meet



Coiling

- In conispiral shells that are tightly coiled about its axis, a central column is formed, the **columella**
- In planispiral and loosely coiled shells the last or some of the later whorls do not meet centrally and form the **umbilicus**
- Slow increase of shell diameter, last whorl little larger than previous. Rapid increase produces a last whorl larger than even the spire
- Spire may be high and pointed with many whorls, short with few whorls, depressed or concealed by the last whorl

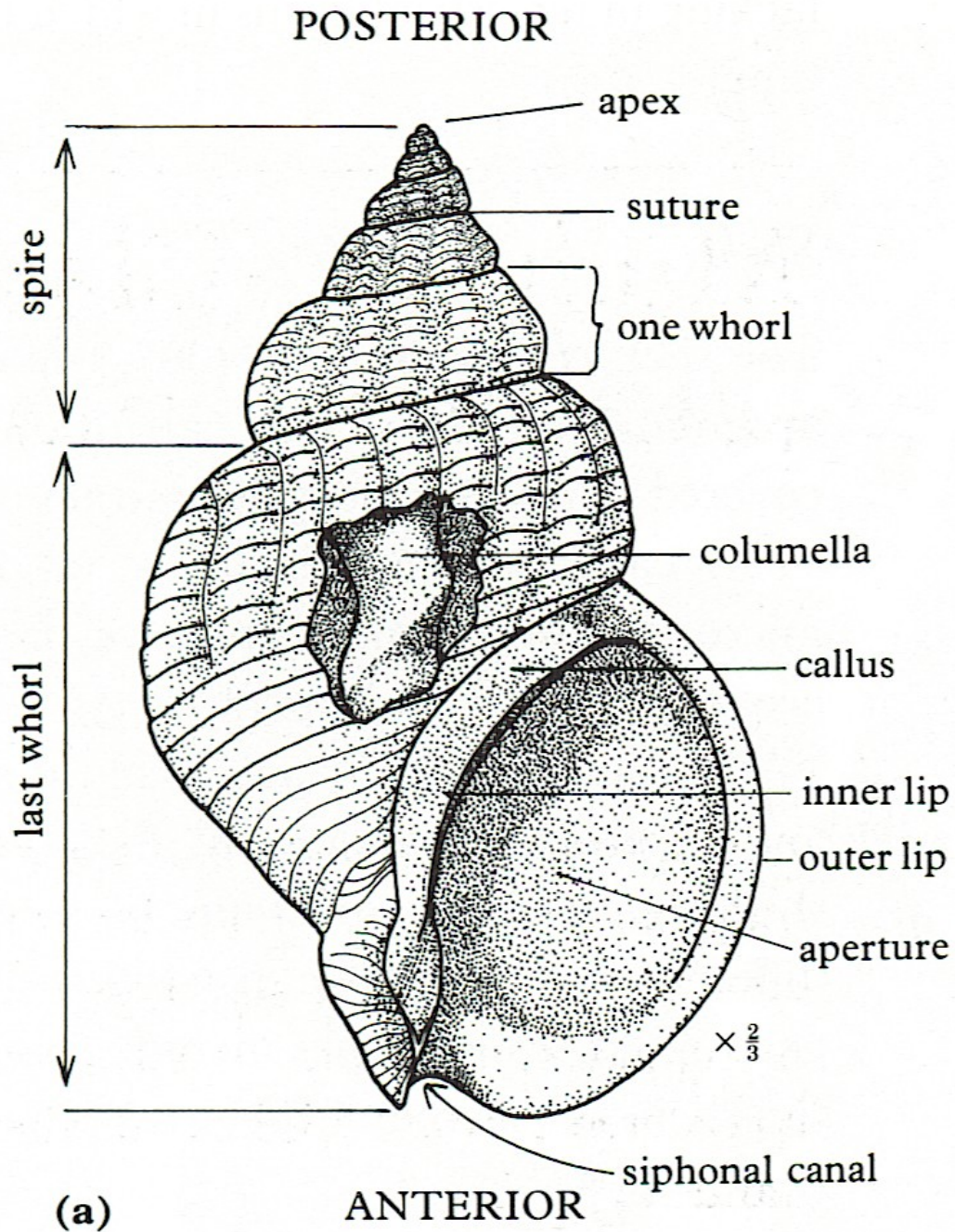


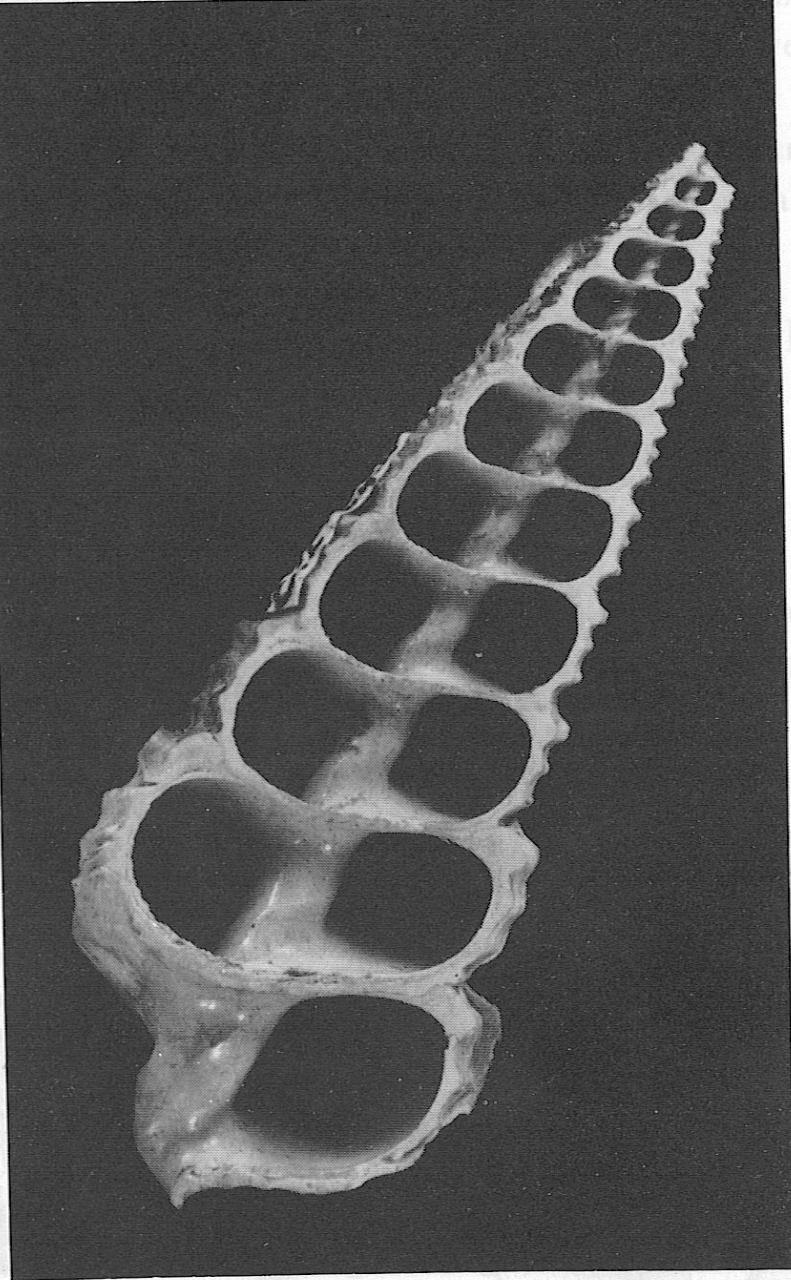
The aperture

- The shape ranges from oval to long and narrow
- The margin nearest to the apex is the posterior margin of the aperture; the opposite side is the anterior margin
- The margin in contact with the previous whorl, is the **inner lip**; the free margin is the **outer lip**
- Many gastropods possess a horny lid, the **operculum**, which closes the aperture when the body is withdrawn into the shell. Borne on the posterior of the foot, and rarely preserved as fossil

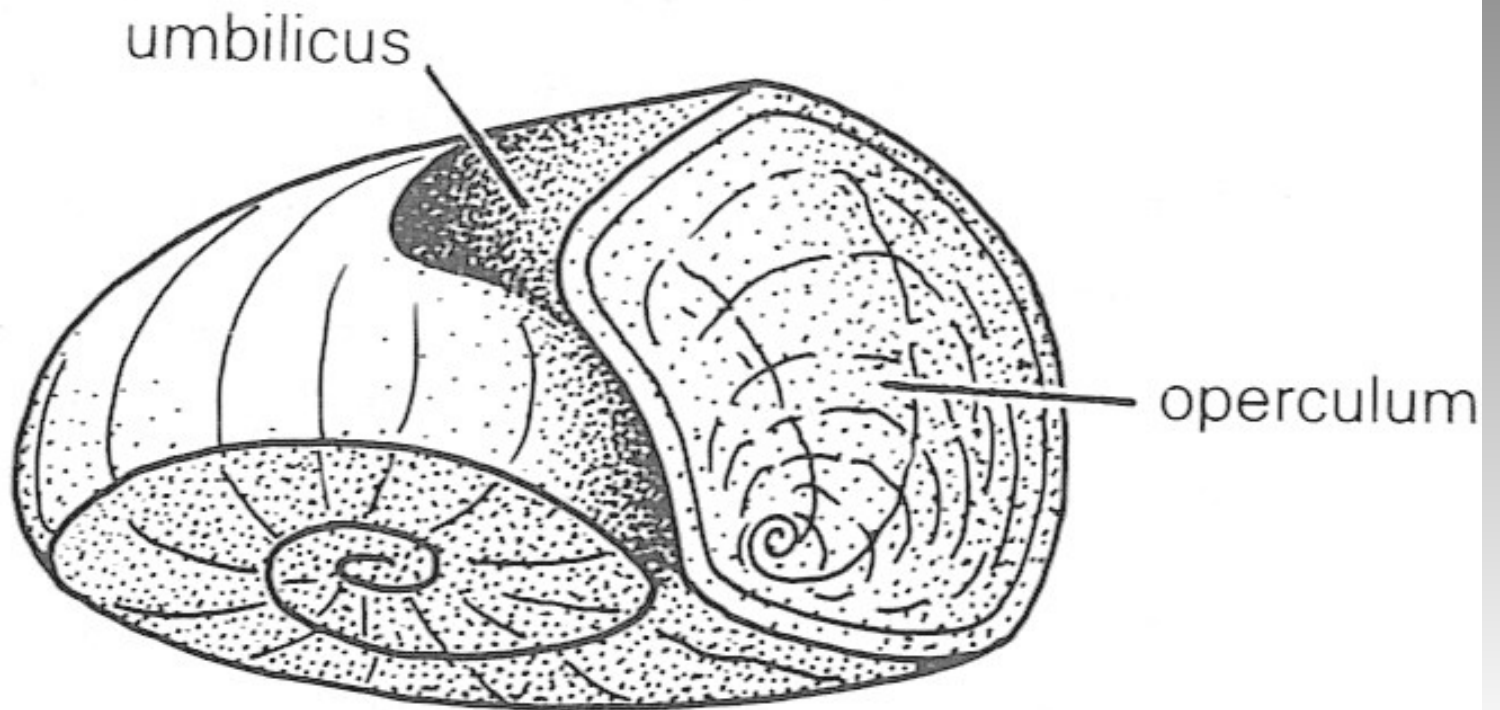
The aperture

- In some gastropods the anterior margin of the aperture is notched or extended, surrounding the inhalant siphon, which is called **siphonal canal**
- Some gastropods are also equipped with a long narrow groove in the outer lip at right angles to the edge, which is the outlet for the exhalant siphon, the **exhalant slit**
- The calcified strip of the exhalant slit trace on the shell is called a **selenizone**
- Gastropods possessing siphonal features are called siphonostomatous; conversely those with unmarked apertures are called holostomatous
- In some gastropods a subsequent layer of shell, the **callus**, is deposited by the mantle on the inner lip and adjacent part of the whorl



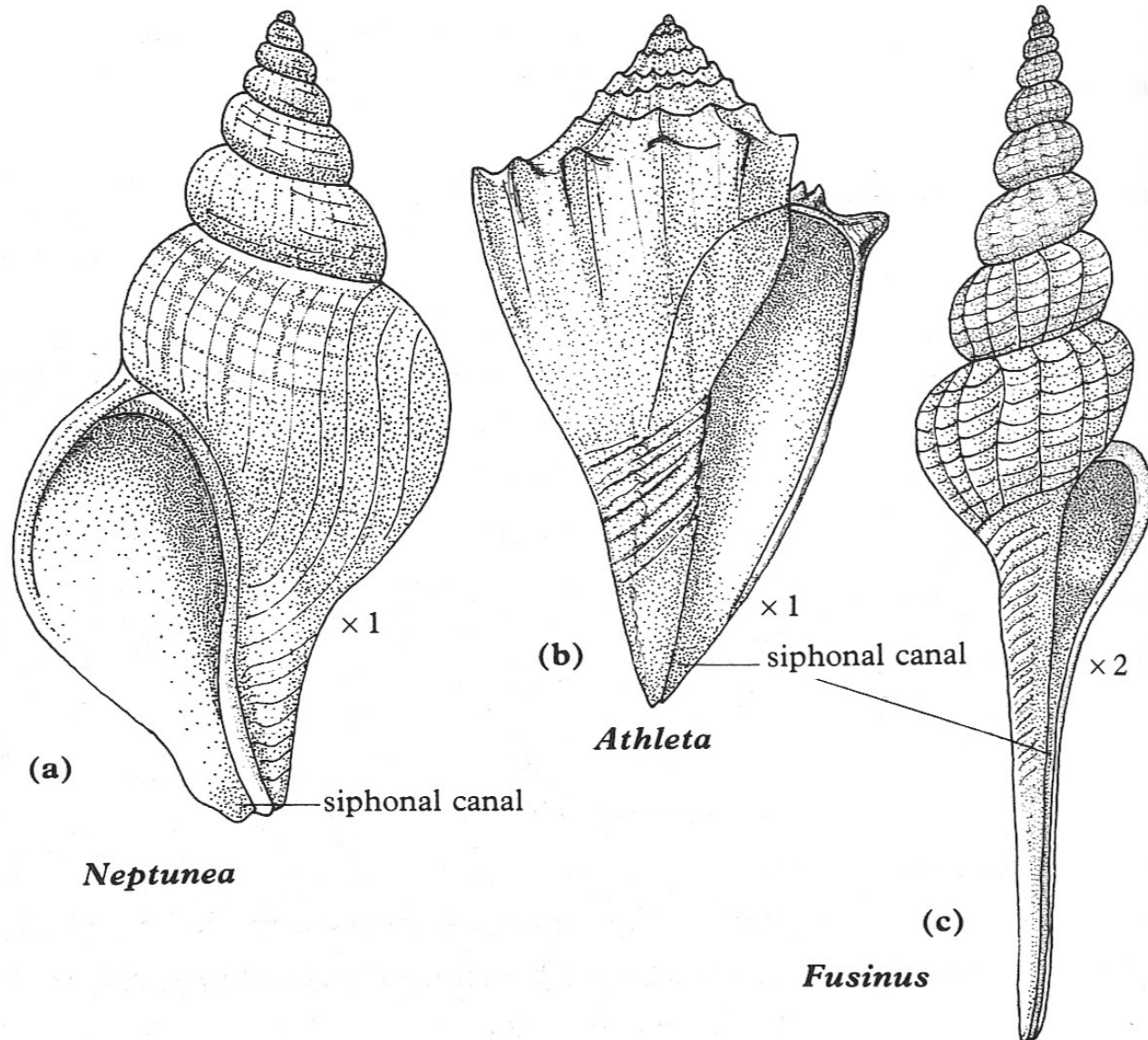


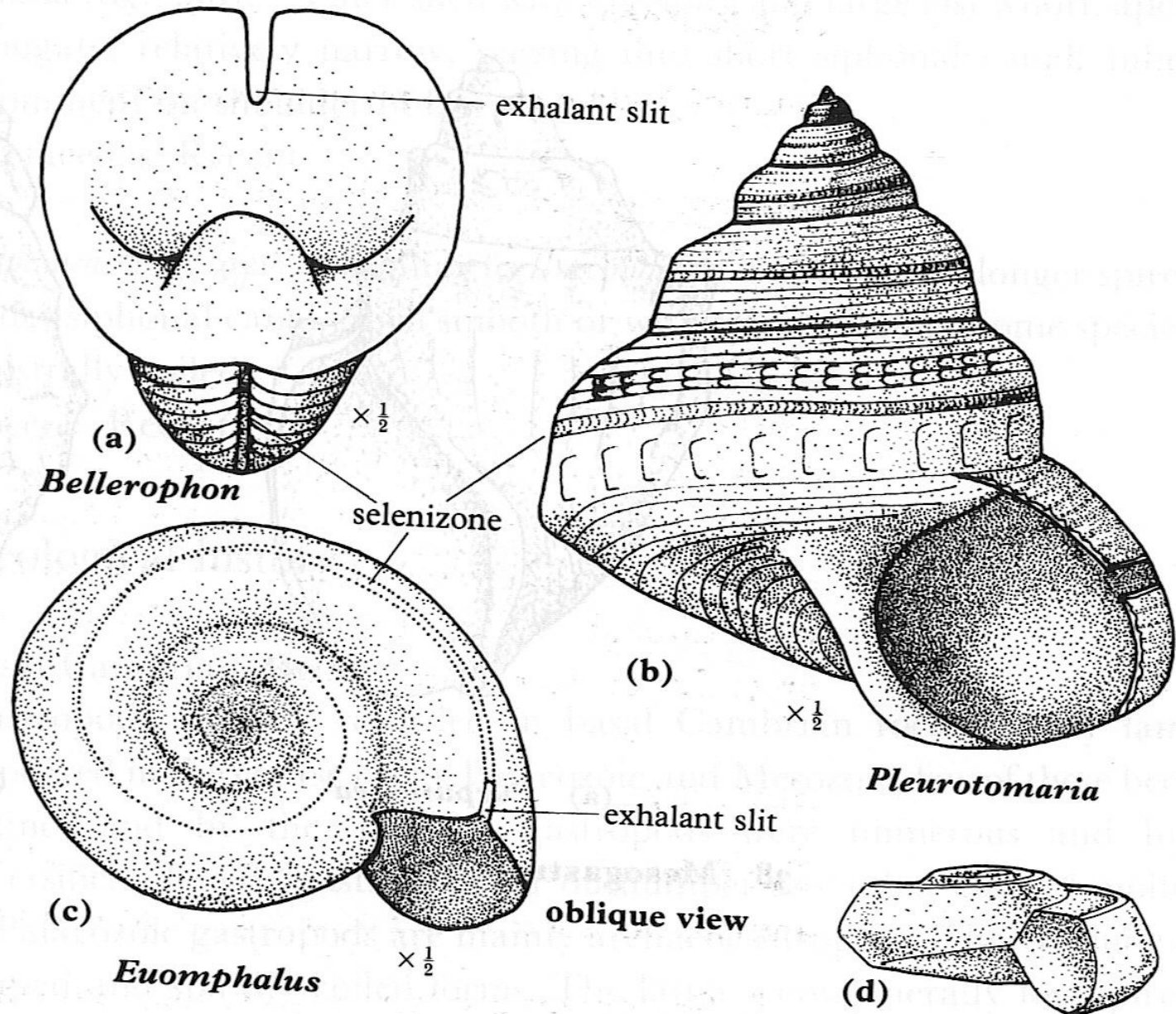
33 Longitudinal section of a gastropod showing the columella ($\times 2$).



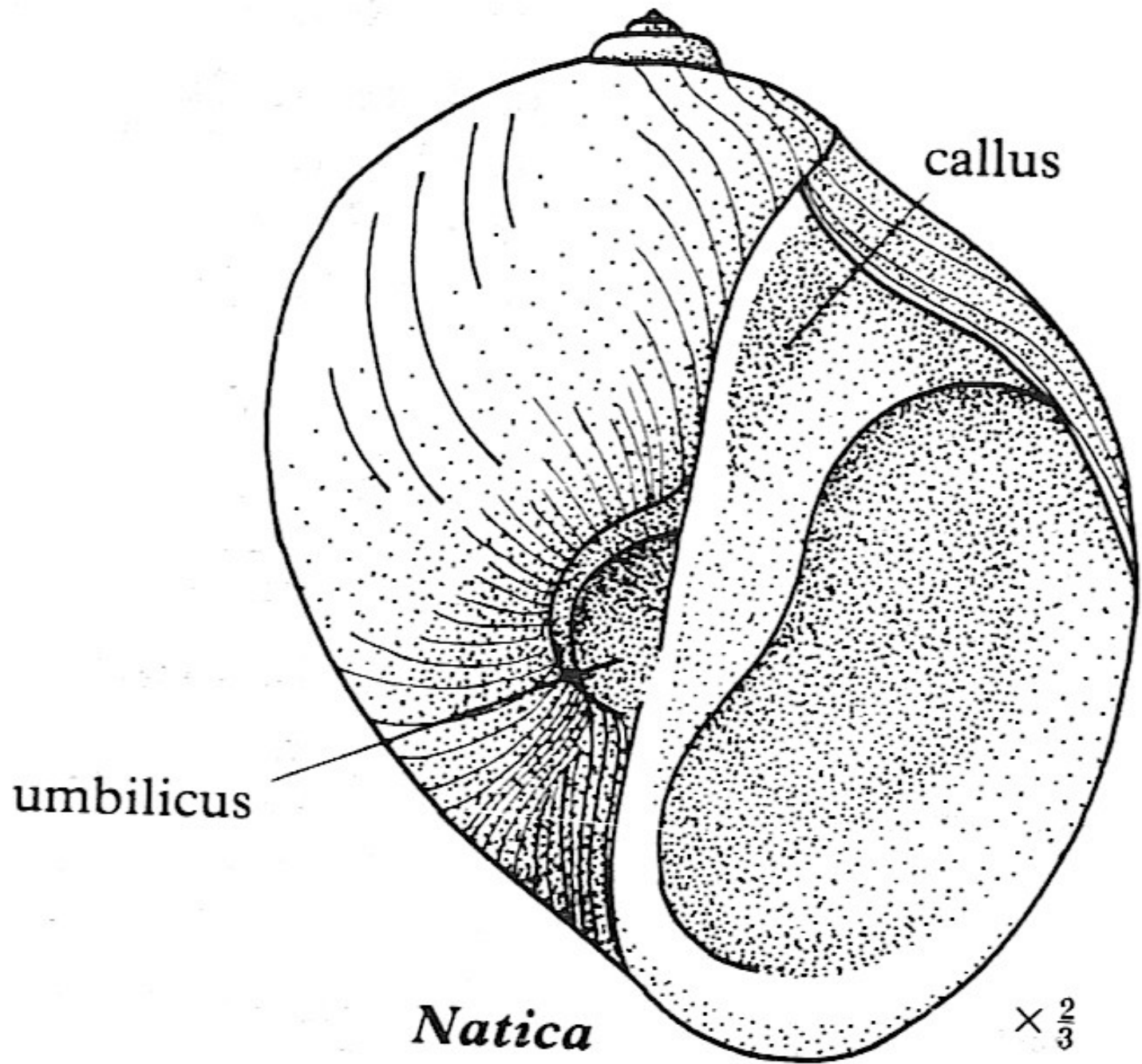
(r) *Maclurites*

39 **Gastropods with a siphonal canal.**





37 Gastropods with an exhalant slit.



umbilicus

callus

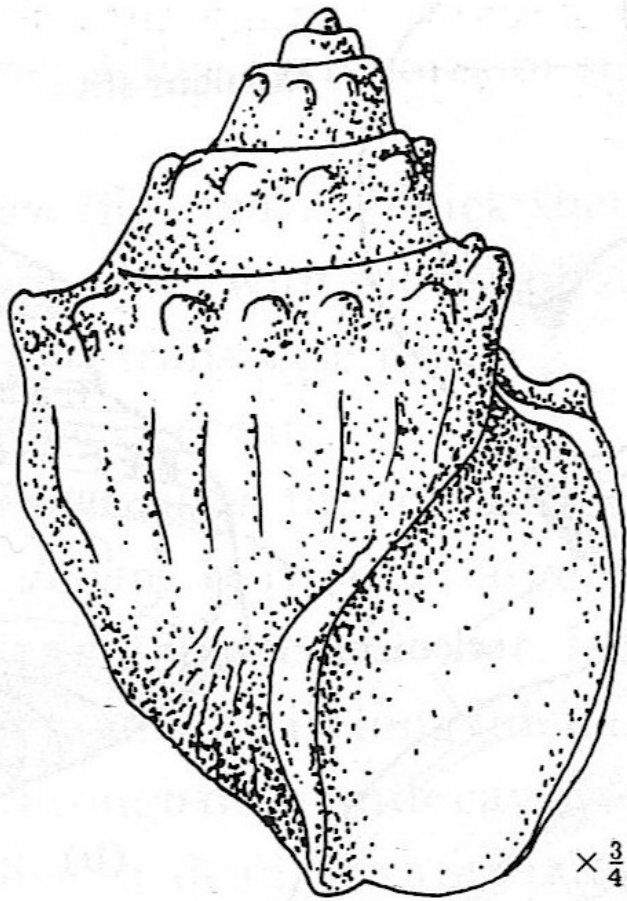
Natica

x 3/10

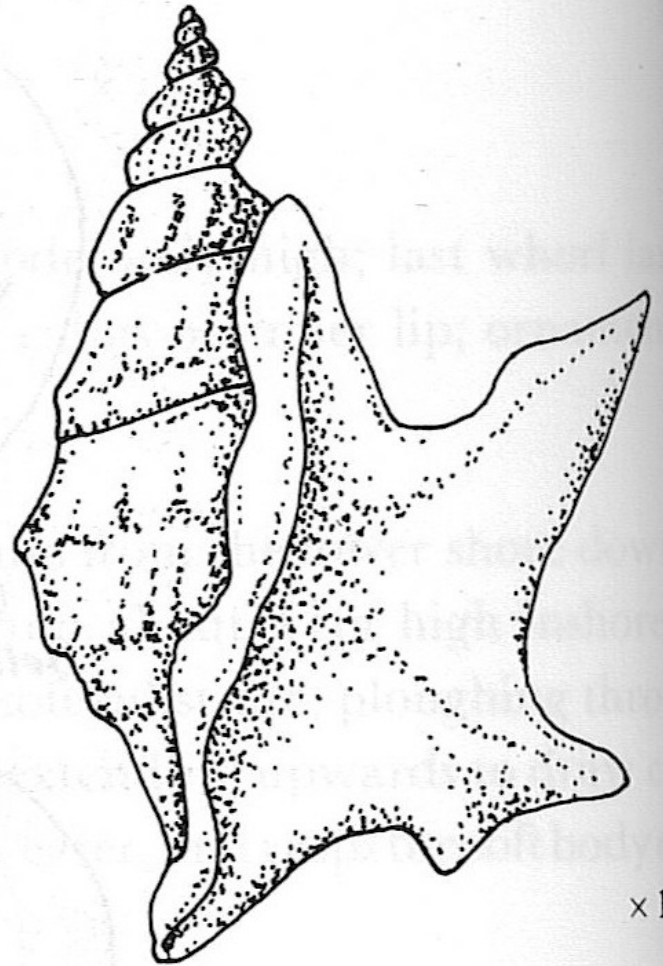
Ornament

- External surface: may be smooth, bear fine or coarse markings arranged transversely or spirally, bear tubercles or spinose projections
- Internal surface: scars left by muscle attachments to the shell. Usually seen in cap-shaped shells, in coiled shells they occur on the columella

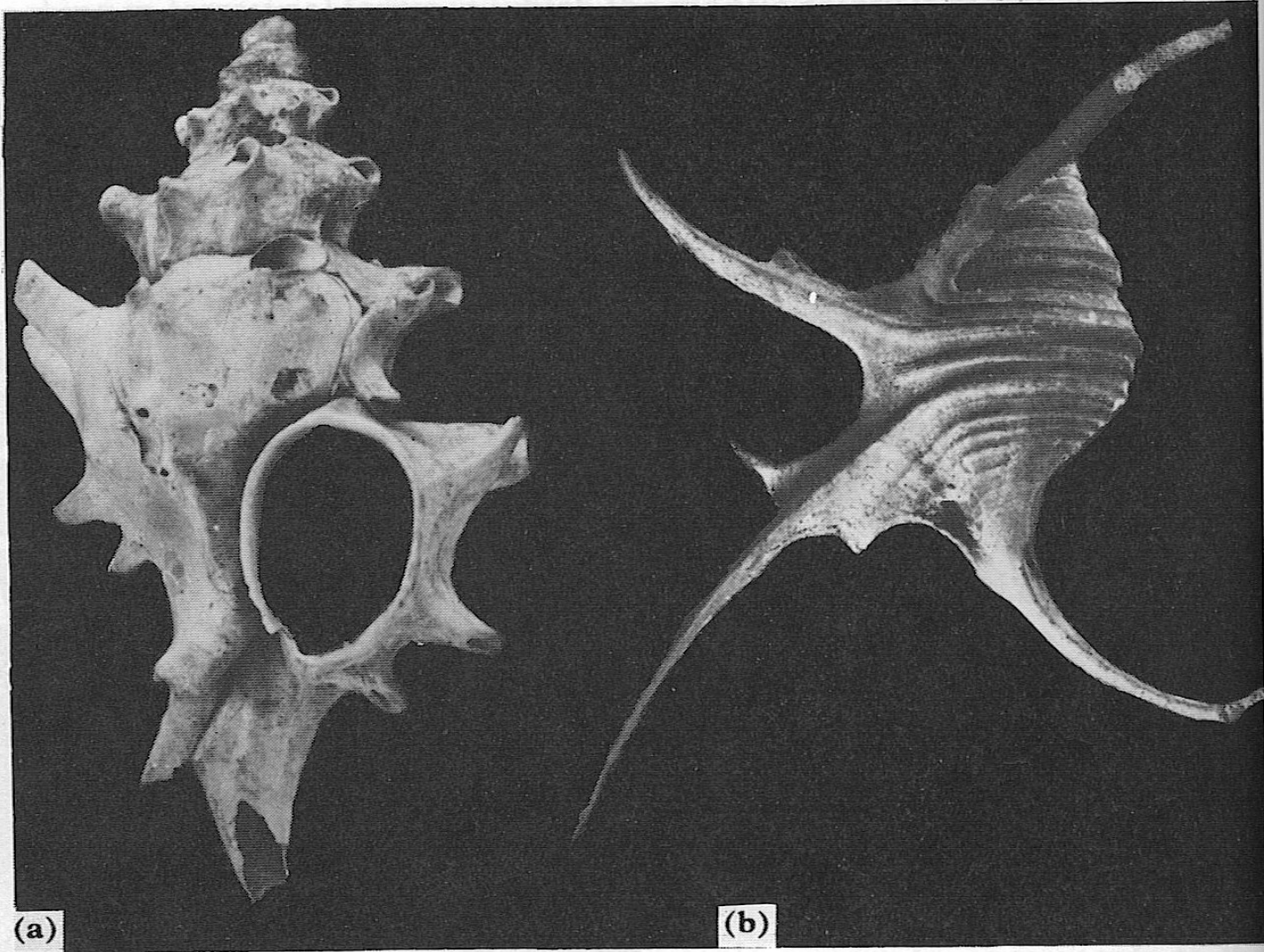




(a) *Purpuroidea*



(b) *Aporrhais*



34 Gastropods with spinose processes.

a, *Typhis*, Barton Beds, Eocene ($\times 4$), the spines are hollow tubes some of which are former siphonal canals. b, *Tessarolax*, L Cretaceous ($\times 1.5$), the spines are extensions of the outer lip which were resorbed during shell growth so that only the last-formed remain.

Orientation

- Most gastropods are asymmetric
- Most gastropods are coiled in a clockwise direction (right-handed)
- Some prefer though a left-handed coiling
- The conventional drawing view for gastropods is with the aperture facing towards you, and the apex pointing upwards



Shell structure

a. The periostracum
external, thin horny layer,

b. The ostracum

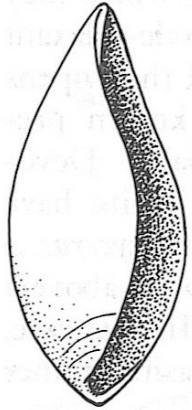
normally composed of layers of aragonite
(sometimes calcite) + organic matter

- Usually structure like in bivalves with two layers, an inner nacreous layer and an outer crossed lamellar layer with thin lamellae
- In fossil shells the aragonite either recrystallizes to calcite or gets dissolved

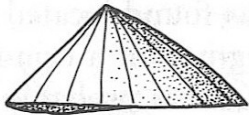


Shell shapes

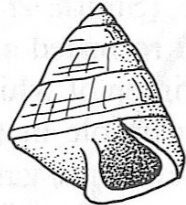
- Convolute
- Patellate
- Trochiform
- Pupiform
- Turreted
- Discoidal
- Turbinate
- Biconical
- Isostrophic
- Irregular
- Digitate



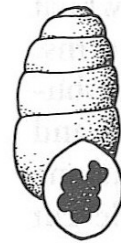
(a) *Acteonella*



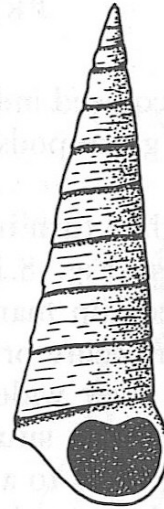
(b) *Patella*



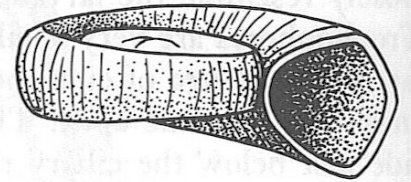
(c) *Calliostoma*



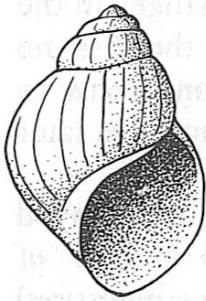
(d) *Gastrocopta*



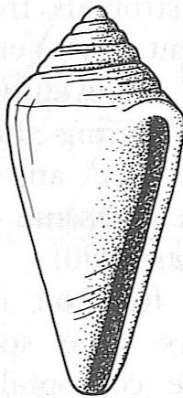
(e) *Turritella*



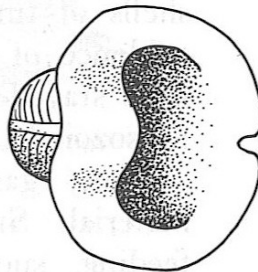
(f) *Schizostoma*



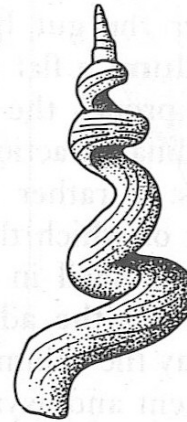
(g) *Ampulella*



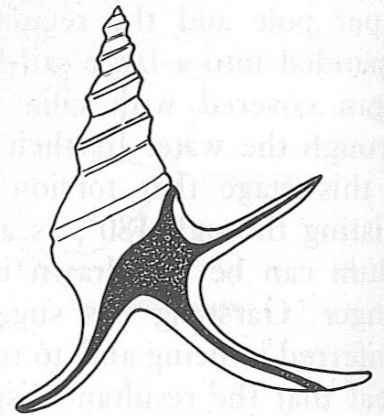
(h) *Conus*



(j) *Bellerophon*



(k) *Vermetus*



(m) *Aporrhais*

Ecology of gastropods

- Typically benthic, though pelagic forms do occur (pteropods); fresh water and terrestrial forms as well
- Those living in littoral zone have a thick shell
- They can feed in a variety of ways
- There are herbivorous forms, carnivorous forms, coprophilic forms and suspension feeders
- Carnivorous gastropods two strategies: either they rasp away the shell of bivalves or other gastropods to reach the flesh, or drill a round hole (may take 14-20 hours) and inject muscle-relaxant substance through, the shell opens and then are able to have their feast





36 A hole drilled by a carnivorous gastropod, probably *Natica*, in a bivalve shell (*Dosinia*) from the Red Crag, Pleistocene, East Anglia ($\times 2$).

Ecology of gastropods

- Most gastropods are hermaphrodite, however they copulate with a complex mating pattern involving more one individuals
- Gastropods with an entire aperture are often herbivorous and usually live on hard substrate
- Forms with a siphonal canal are often found on soft sediment and are carnivorous
- Fresh-water gastropods have thin shells and a thick periostracum

